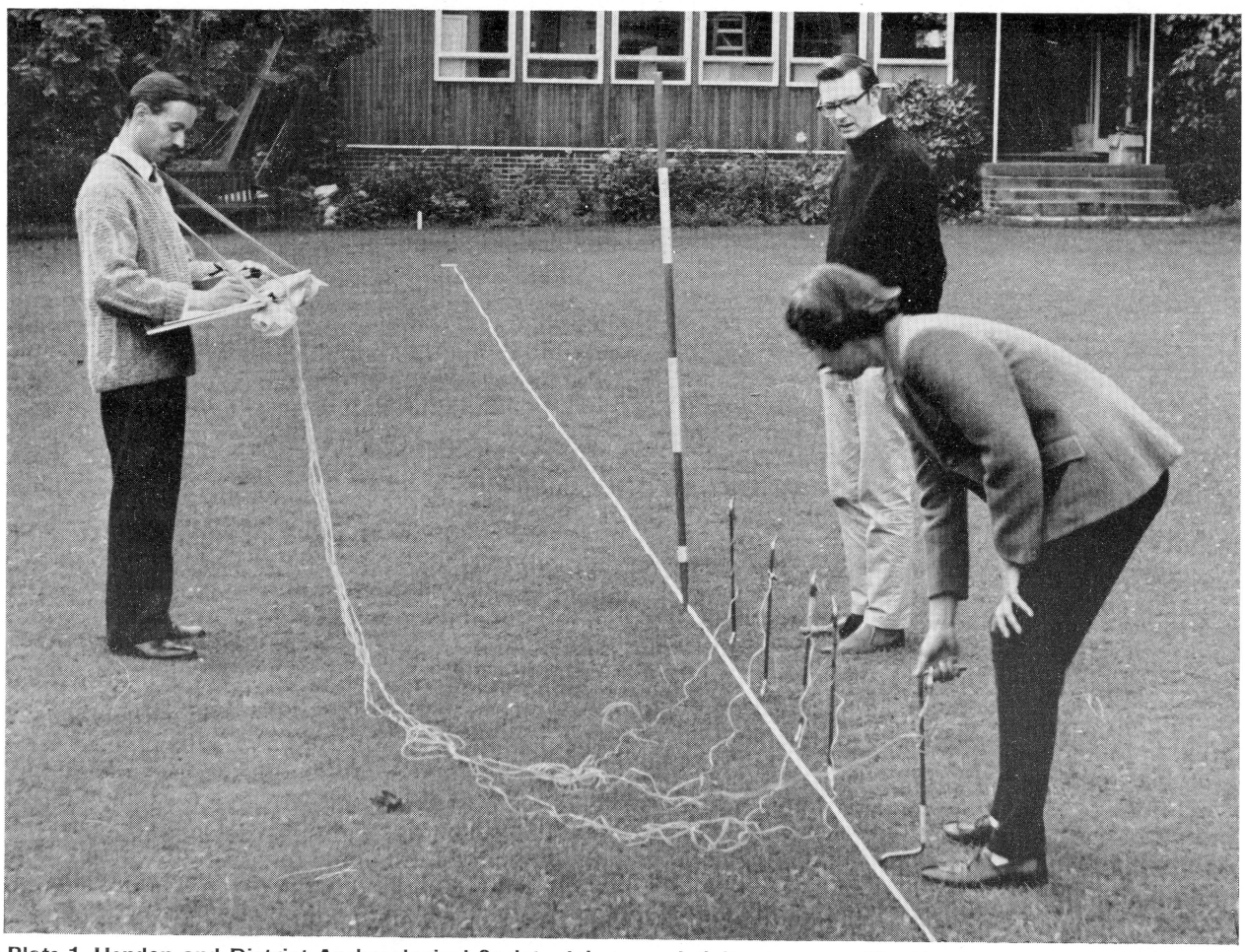


Plate 1. Hendon and District Archaeological Society doing a resistivity survey at Finchley. (Photo: Paul Carter)

BEGINNING ARCHAEOLOGY IN LONDON — 5

RESTITIVITY SURVEYING

Based on a Highgate site

BRIAN ROBERTSON

THE AIM OF this article is to form an introduction to the subject of resistivity surveying by means of a report on an actual site survey.[1] The article will be in two parts, the first one of which will deal with the methods of surveying and an introduction to the site. The second part, which will appear in the next issue, will deal with the survey itself and the analysis and possible interpretation of the results.

Resistivity surveying is a method of geophysical prospecting long used by geologists but only comparatively recently has its archaeological potential been realised. The method is based on the fact that different soil types will resist the passage of an electric current to differing extents. This is due to the presence of retained water in the substance concerned. Therefore a hard rock with little retained water will give a high resistance reading whereas a sandy or clay soil will give a low reading. It is also clear that the weather conditions will affect the resistance values and this point will be discussed later. This is not the place for a discussion of the theory of resistivity surveying as a knowledge of

1. Carried out by Hendon and District Archaeological Society between the 22nd July and 2nd August, 1969.

the complex theory is not essential to the good and efficient operation of a meter.[2]

It is possible for a variety of buried features to be distinguished by their differing resistivity configurations, but these may vary considerably from site to site, depending on soil conditions and types. A buried feature is by definition considered to be made of different material from the surrounding soil, and it would therefore influence the resistance values accordingly. It can, however, do this in one of two ways, and under different circumstances the same feature could do both. If the nature of the buried feature is such that it is more solid than the surrounding soil, its resistance will be higher than that of the soil. Similarly if the feature is less dense or looser packed than the surroundings, the resistance will go down.

It must be remembered that a resistivity meter will not distinguish between a natural feature that is different from its surroundings, and an archaeological feature buried in otherwise natural soil. It is, therefore, of prime importance to bear in mind, when analysing the results of a resistivity survey, that there could be a natural explanation of the resistance values obtained. A second principle of resistivity surveying is that an interpretation of resistance values alone will never be archaeological evidence for a site. The function of such a survey is to narrow down the area in which excavations should be carried out in order to find that evidence.

Plate 2. The Martin-Clark Resistivity Meter
(Photo: John Earp)

Features need not only be indicated by raised resistance values. Certain types of features can be and frequently are indicated by lowered readings, although lowering trends are more difficult to detect. The classical example of a feature that gives lowered readings is a silted-up ditch. In this case the contents of the ditch have a lower resistance than the surrounding soil and will thus show up as a trough on a traverse graph. Ditches can show as peaks, as for example, foundation or semi-robbed trenches which contain rubble of a higher resistance than the surrounding soil.

The Resistivity Meter

The technical literature describes several resistivity meters and different methods of surveying. The instrument that was designed with the archaeologist in mind is the small battery-powered Martin-Clark Resistivity Meter (plate 2). It is this type of meter that has been used for the survey reported in this article.[3] It has also been used successfully by the author in the location of a Roman Road in Mill Hill.[4] This instrument with its five electrodes is very easy to operate and all that is involved once the electrodes are in the ground is to switch on, adjust the ammeter needle to zero using the 'ohms' and 'ohms x 100' knobs and then to read off the resistance. Alternatively it is possible to find the null point using a pair of headphones and adjusting the resistance until the lowest intensity sound is heard.

The Method of Surveying

The most important principle in the method of surveying with any type of meter is the accurate marking out and recording of the lines along which one intends to traverse. These lines should be laid out in string and not with a metal tape measure which could make contact with the electrodes. There are several methods of arranging the electrodes, but the most widely used configuration in archaeology is the Wenner system. This system is based on equidistant electrode spacing, the actual separation of which is chosen by consideration of the depth at which the feature one wishes to detect is likely to be. From the theory of resistivity surveying, it can be shown that using the Wenner system, the electrode separation is approximately equal to the depth at which the instrument is reading[5] (Fig. 1).

The electrodes supplied with the Martin-Clark

2. Full explanation of this theory can be found in M. J. Aitken, *Physics and Archaeology* (1961).
3. Resistivity Meter kindly loaned to Hendon and District Archaeological Society by Mr. M. Rivlin.
4. Report in press.
5. For details of the Wenner and other systems of electrode spacing see: R. J. C. Atkinson "Resistivity Surveying in Archaeology" in *The Scientist and Archaeology* Editor E. Pyddoke (1963).

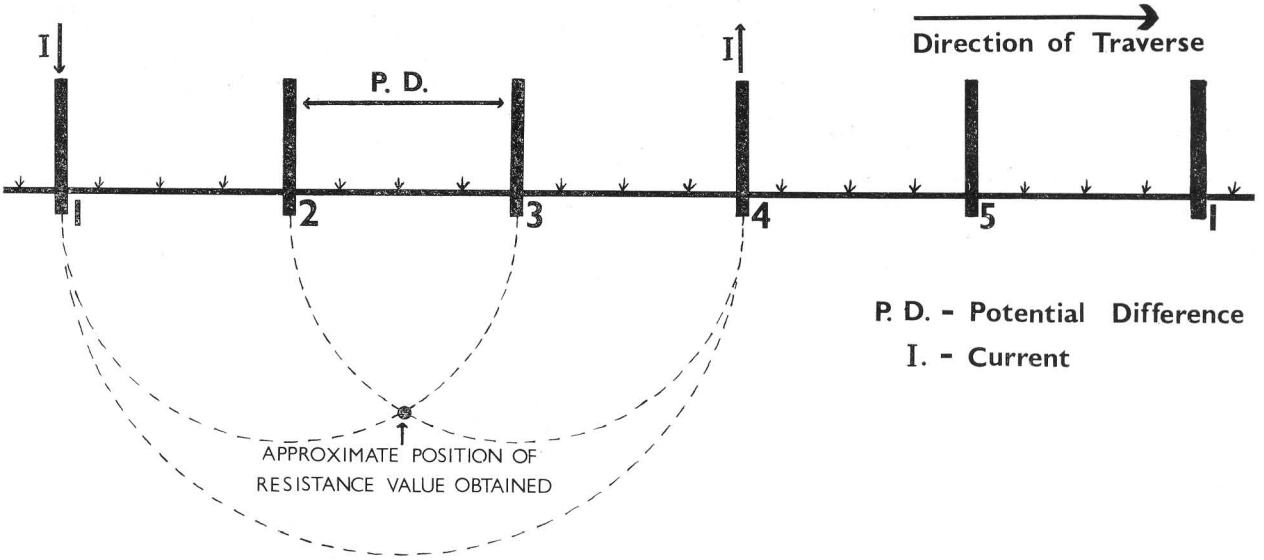


Fig. 1. Electrode layout using the Wenner system of surveying

Resistivity Meter are cranked for ease of insertion and to ensure that the same length of electrode is always pushed into the ground (plate 1). The electrodes, which are colour coded to make them easily distinguishable, are numbered 1 to 5 as shown in Fig. 1. An electric current is passed in at No. 1 and out at No. 4 with the potential difference being read across Nos. 2 and 3. No. 5 is neutral to allow rapid leap-frogging of the electrodes. After the reading between Nos. 2 and 3, No. 1 is passed over and the rotary switch on the instrument changed to bring the next four electrodes—Nos. 2, 3, 4 and 5 into use. The next reading is then taken between Nos. 3 and 4. No. 2 is then passed over bringing 3, 4, 5 and 1 into use, and so on along the traverse line.

The Survey Site

Centred on TQ 28298897 in Highgate Wood is an early Roman pottery factory that is considered to have been in production between A.D. 60 and 120.[6] Approximately one-third of a mile south of this factory area, there is considered to be a second Roman site.[7] This site was first defined by a surface pottery scatter (centred on TQ 28398845) but there were no indications as to its nature. It was thought, however, that this might well have been a further industrial area. Despite the wooded nature of the area it was felt that this site would lend itself to resistivity surveying prior to any excavation, in order to try to define its limits more accurately than the pottery scatter had done.

It was planned to survey 40,000 sq. ft., approximately centred on the known pottery scatter. To achieve this a 200 ft. square was laid out. The zero point of the survey was taken as the north-west corner of this square and located in the centre of the public footpath at TQ 28388849 (Fig. 2). From this point the base-line for the survey, which was also the line for traverse No. 1, was laid out along a bearing of 115° Magnetic (107° Grid) from the zero point. The survey itself would consist of traverses each of 200 ft. parallel to this base-line. The zero points of all the traverses would be at fixed intervals along the line 205° Magnetic (197° Grid) for 200 ft., thus completing the square.

By consideration of the depths at which features were found on the factory site, and of some trial traverses run over a small part of the area in 1968, it was decided to use a 2 ft. electrode separation throughout the survey. An electrode separation of 2 ft. gives 100 readings per traverse, making each traverse 201 ft. long. It is important to remember, with a 2 ft. electrode separation and the first electrode at the zero point, that the first reading is between the second and third electrodes, that is at 3 ft. (see Fig. 1). The traverses were also spaced at 2 ft. intervals, therefore the whole survey consisted of 100 traverses making a total of 10,000 readings.

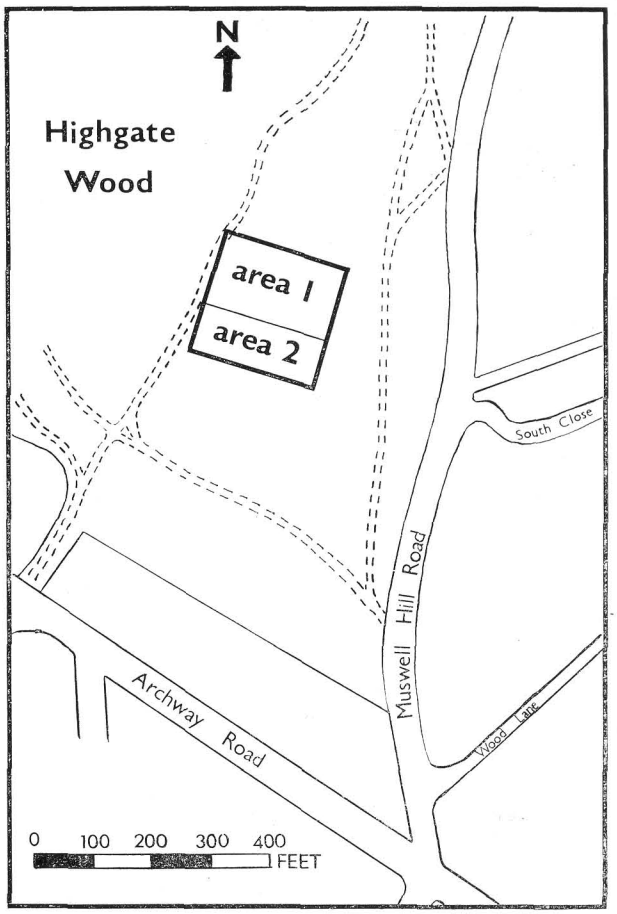
Aitken states that trained operators can carry out a resistivity survey at a rate of 300 readings per hour.[8] If this rate could be sustained, a survey of 10,000 readings could be carried out in approximately four working days. Bearing in mind the tedious nature of resistivity surveying and the difficulties of accurate marking out in woodland, it was doubtful that this rate could be achieved. Not counting the time lost by rain and other technical problems the present survey took 11 days to complete, during which time the rate of 300 readings per hour

6. A. E. Brown and H. L. Sheldon, "Early Roman Pottery Factory in North London," *London Archaeologist* **1** (1969) 39.

7. A. E. Brown and H. L. Sheldon, *op.cit.* 44, note 5.

8. M. J. Aitken, *op.cit.* 69, note 2.

Fig. 2. The survey location plan. (Based upon the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office. Crown copyright reserved).



was achieved on several occasions. The time to do each traverse ranged from 15 to 50 minutes with an average traverse time of 28 minutes.

As the basis of resistivity surveying is comparative and one traverse is analysed in relation to those adjacent to it, it is desirable to carry out any survey in as stable weather conditions as possible. It is fairly obvious that rain will tend to lower resistance values, so ideally the whole survey should be carried out in dry weather. The survey was drastically affected by rain on the 29th July and for this reason it is divided into Area 1, containing traverses 1 to 62 inclusive, and Area 2 containing traverses 63 to 100 inclusive.

The traverses of Area 1 involving approximately 6,200 readings were all carried out under similar weather conditions between the 22nd and 28th July 1969. During this period there was no rainfall. The remainder of the survey (Area 2 approximately 3,800 readings), was carried out between the 30th July and the 2nd August. The weather conditions during this period were somewhat unsettled, with 1.42 ins. of rain falling during the 29th and 30th July. Further trace amounts of rain fell during the last two days of the survey. Although the site will be analysed as a whole, it is important to bear in mind the possible ways in which the rain may have affected the result. The problem of rain affecting the resistance values will be discussed in the second part of this article with the results of the survey.

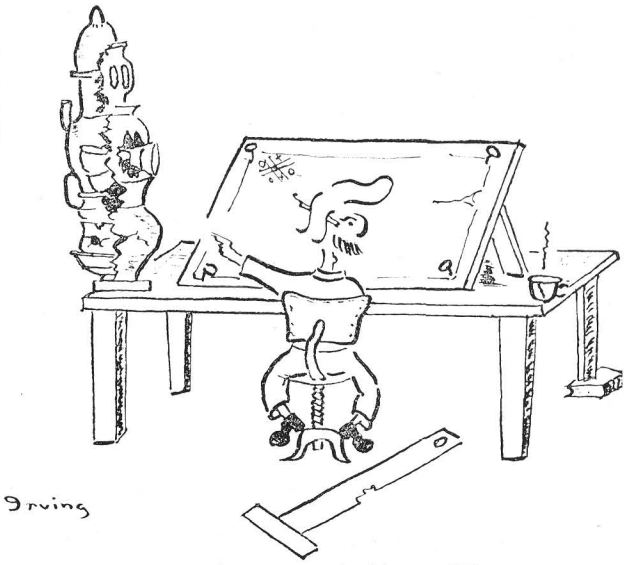
Current Excavations

FULHAM, by Fulham & Hammersmith Archaeological Group. Excavations on the site of the Fulham Pottery, 210 New King's Road, directed by V. R. Christophers. Enquiries to Keith Whitehouse, 56 Tamworth Street, S.W.6. (Tel. 385-6038).

NORTHOLT, by Northolt Archaeological and Historical Research Group. The excavation first undertaken to explore the 14th century Manor House within the moat, has recently assumed great importance as the remains of the original Saxon village at Northolt, are coming to light. Stone buildings within the moat were probably abandoned in the early 15th century although rebuilding took place outside the moat from the 16th century. Work continues on Saturday afternoons throughout the year. Inquiries to C. H. Keene, 21 Islip Gardens, Northolt, Middlesex.

SOUTHWARK, by Southwark Archaeological Excavation Committee. On the site of Hay's Wharf, Tooley Street, near London Bridge, a rescue excavation is producing evidence of medieval structures—Roman material is also appearing. The excavation which takes place every day except Mondays under the direction of Harvey Sheldon, is expected to last until Christmas. Inquiries to Graham Dawson, Cuming Museum, Walworth Road, S.E.17. (Tel: 703 3324).

IN A HOLE



"Who restored this one?"