NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION NEWSLETTER

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INTRODUCTION TO RESISTIVITY SURVEYING

by F. B. Knox, K. R. Cairns and M. Hitchings.

A number of physical aids to archaeology are at present being experimented with and used in various parts of the world. Examples are aerial photography (and, for that matter, ordinary photography), electromagnetic metal detectors, detectors of magnetism in rocks and soil, and resistivity surveying. It is the last method with which this article deals.

In resistivity surveying an electric current is made to flow between two points at the surface of the ground, (a slowly oscillating (10-100 cycles per second) current is used since a direct current produces, in the soil, effects similar to those which occur in a storage battery and give rise to interfering voltages) and voltage is measured between two other points at the surface (see diagram). Electrical connection with the ground is established by means of four electrodes (conductors of electric current) pushed an inch or so into the ground.

The pattern of current is determined by the pattern of underground electrical resistance near the electrode system, and the resistance pattern should often be closely related to the arrangement of underground structures of archaeological interest. Intimately associated with the current pattern is a pattern of voltage, and the part of this pattern which occurs at the surface can be measured and plotted.

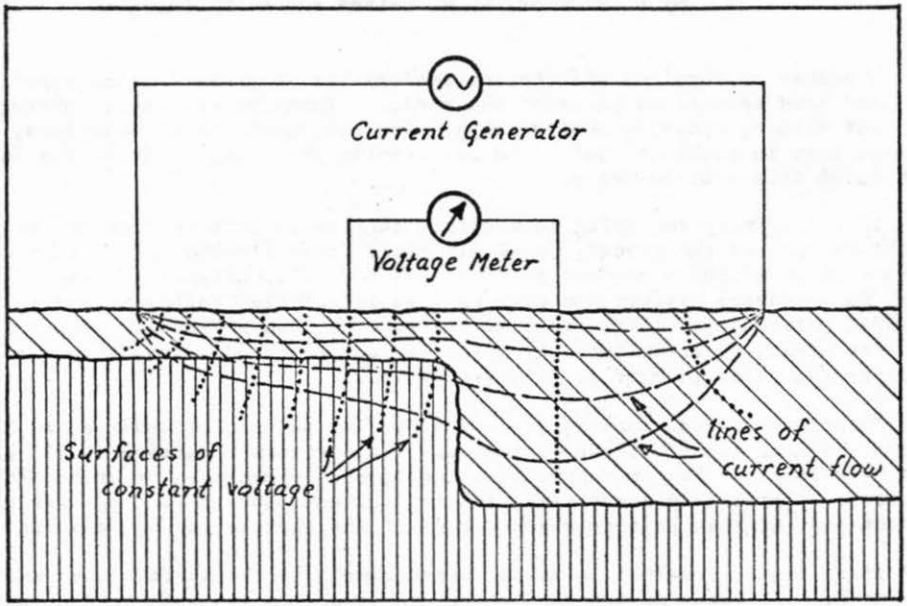
If we limit ourselves to making measurements at the surface the results can be ambiguous; different underground structures can give the same surface pattern of voltage for a given electrode arrangement. The ambiguity can be minimised by moving the electrodes from place to place, and the most suitable way to move them depends very much on local conditions.

An electrode arrangement often used is to have the four electrodes equally spaced in a straight line. For a given current flowing between the two outer electrodes, the voltage between the two inner electrodes is mainly determined by the underground structure within an approximately semi-cylindrical region. An end of the semi-cylinder lies under each of the inner electrodes, and the radius of the cylinder is equal to the distance apart of these electrodes. Measurements of current, voltage and electrode spacing, now allow the average electrical resistivity of the ground within the semi-cylinder region to be calculated. Moving the electrodes around, enables the pattern of resistivity under the surface to be deduced.

If the centre of the conductor system is kept in one place, but the electrode spacing varied, the procedure is called resistivity sounding, and is appropriate when investigating strata. On the other hand, if the electrode spacing is kept constant but the electrode system is moved bodily, the procedure is called resistivity mapping, and is suitable for investigating structures which vary with lateral position - such as the sides of filled-in pits.

A combination of the above procedures should yield much information about the shape of underground structures, with little ambiguity. At this point it should be mentioned that structures of linear dimensions much smaller than the depth at which they lie cannot be detected.

Over the past year we have been developing equipment for use in resistivity surveying, and have made several field trials in the Wairarapa and Wellington districts. So far there has been fairly good agreement between positions of strata boundaries as deduced from resistivity measurements and from soil core samples. Further development of our equipment is required, particularly along lines which will allow measurements to be made more speedily.



Typical current and voltage patterns occurring when "resistivity surveying" a filled-in pit. Fill material is here assumed to have less electrical resistivity than the underlying material.

A number of articles on resistivity surveying are available. General accounts of the subject (but with no particular reference to its use in archaeology) are given in Exploration Geophysics by J. J. Jakosky (Trija Publishing Co., California, 1950) Chapter V; and Geophysical Exploration by C. A. Heiland (Prentice-Hall Inc., New York, 1940) Chapter 10.

An example of its use in New Zealand in connection with a flood control scheme is given in an article by T. Hatherton in the New Zealand Journal of Science and Technology, Vol. 38B, No. 8, (Sept. 1957) p.807.

Accounts of its use in archaeology are given in Archaeology and its Problems by S. J. de Laet (Phoenix House Ltd., London, 1957) Chapter II; and in an article by M. W. Stirling and others in Expedition, Vol. 2, No. 4 (1960) p.19.

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