# EARTH ELECTRICAL RESISTANCE MEASUREMENTS NEAR THE BATH SWALLET, MENDIP HILLS, SOMERSET

By L. S. Palmer, D.Sc., PH.D.

## I. INTRODUCTION

For some time it has been suspected that water runs underground in a north-easterly direction from the neighbourhood of the Bath Swallet, near the University of Bristol Spelaeological Society's Headquarters, south of Mendip Lodge Hill. There is no direct evidence for this suspicion, but the occurrence of running water under the camp site is a deeply rooted belief with local inhabitants, and with at least one who professes to be a water diviner. It may be significant that a very large quantity of rock and debris has disappeared into Bath Swallet during the past thirty years. Furthermore, the evidence of much water action on the sides of the deep Triassic valley running roughly eastwards from the Society's Hut suggests that the valley may have resulted from the collapse of an old cave system, the upper end of which may still exist as an accessible cave leading from the Bath Swallet.

It was with the object of detecting such a cave that a series of earth electrical resistance measurements was made in the early part of July 1949 and continued in July 1950.

## II. THE SITE

The first measurements were made practically due north of the Bath Swallet. They disclosed the presence of what appeared to be a cave at a depth of about 150 feet from the surface. Reference to a recent survey of Rod's Pot revealed the fact that the geophysical survey had been carried out directly above this cave, and the electrical measurements merely confirmed the presence of a cave that was already well known. Consequently, a second site was located further to the east, because the general trend of both Rod's Pot and the Bath Swallet suggested that any continuation of the latter was more likely to be in a north-easterly direction.

*Figure* 40 is a plan of the locality of the Bath Swallet. The positions finally selected for three traverses in 1949 and for one (No. 4) in 1950 are indicated by the continuous lines running roughly S.W. to N.E. and numbered 1 to 4 respectively. $O_1$, $O_2$, $O_3$, $O_4$ are the four stations at which measurements were first made on each traverse. Twenty-one stations were sited and are marked by dots on the several traverses.

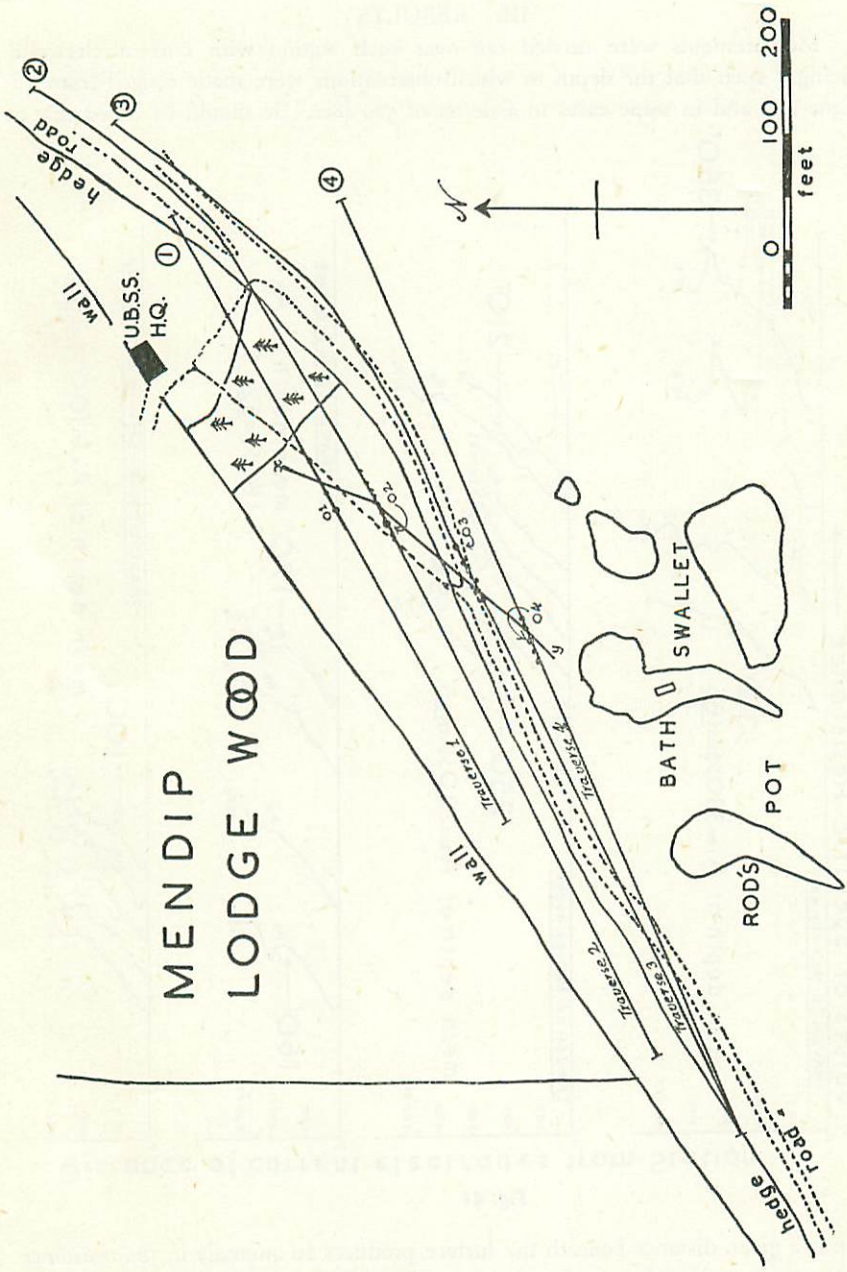


Fig. 40

## III. RESULTS

Measurements were carried out over each station with current electrode spacings* such that the depth to which observations were made ranged from 10 to 300 feet and in some cases to a depth of 500 feet. It should be noted that a

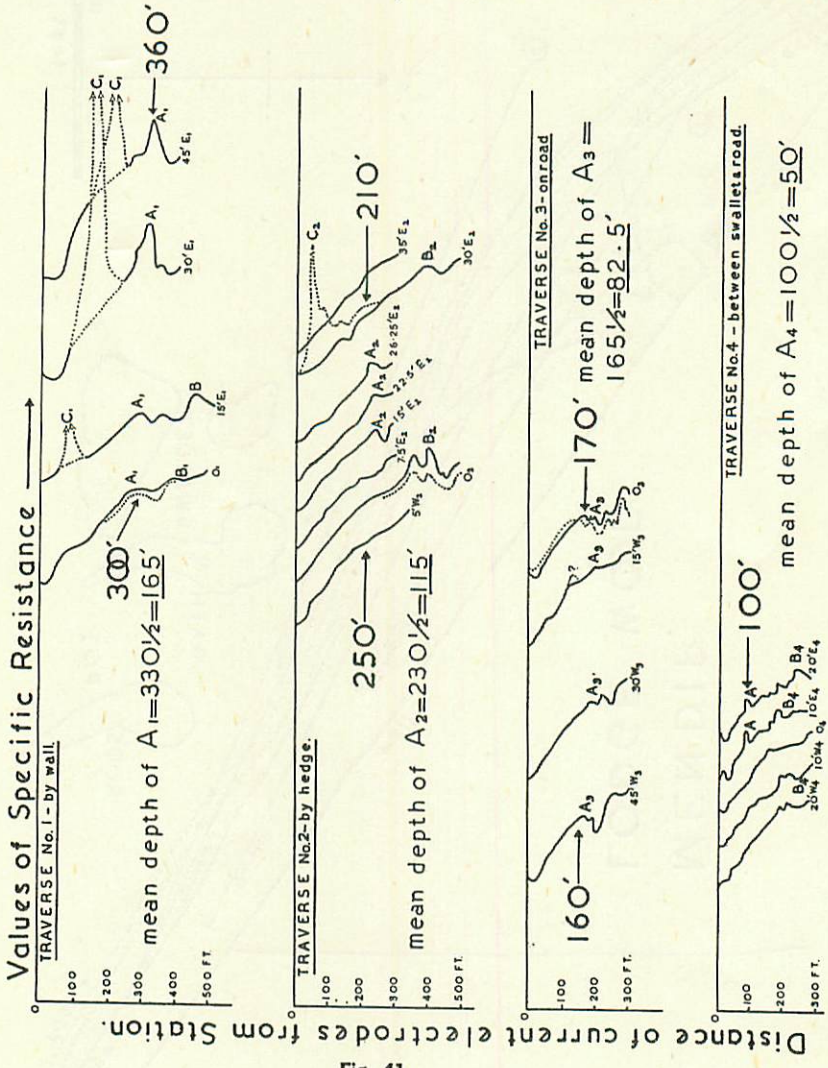


Fig. 41

cave at a given distance beneath the surface produces an anomaly in the resistance measurements when the current electrodes are about 1·4 times this distance from

* A brief outline of the technique employed and the underlying theory was given in Volume 6, No. 1, pp. 27 to 36 of these *Proceedings*.

the station in question. Similarly a horizontal boundary layer between two different strata at a given depth produces an anomaly in the measurements when the distance between the current electrodes and the station is approximately twice the depth of the boundary layer from the surface. This latter factor has been employed when calculating the depths of the points A in *Figure* 42 from the values of electrode spacings shown in *Figure* 41.

In *Figure* 41 the abscissae are the calculated values of the apparent specific resistances for given distances between the current electrodes and the station. These distances are the ordinates and are given in feet.

The two extreme graphs on Traverse No. 2 (*Figure* 41) are more or less normal and therefore indicate the horizontal limits of the anomalies marked $A_2$ on the remainder of the graphs of this traverse. Anomalies corresponding to $A_2$ and $B_2$ are marked $A_1$ $B_1$, $A_3$ $B_3$ and $A_4$ $B_4$ in Traverses 1, 3 and 4 respectively. It is probable that these high resistance anomalies or kinks in the curves

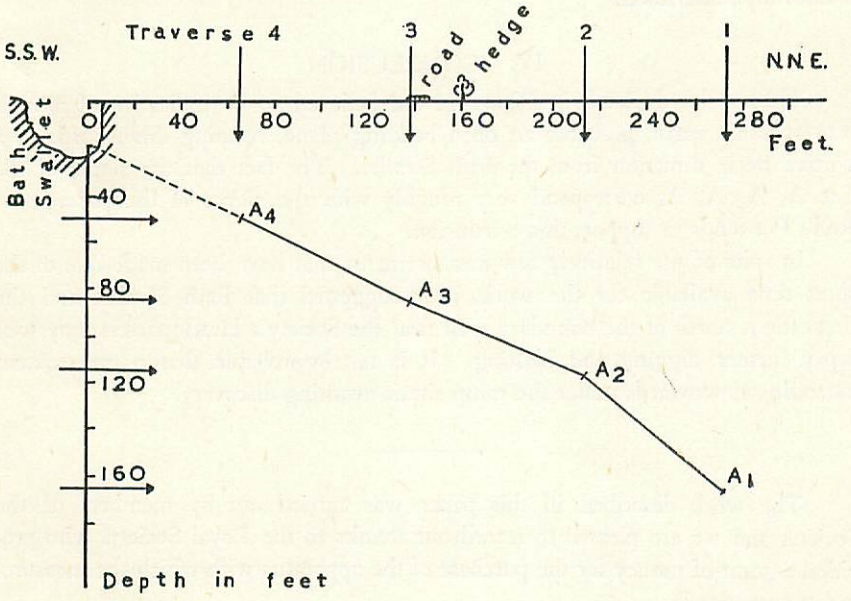


**Fig. 42**

are caused by air spaces such as bedding planes or cavities. The considerable superficial extent of the A kinks suggests that they, at least, are due to a bedding plane. This is supported by the relatively large size of the kinks compared with what might be expected from a cave or tunnel at these depths.

The line *xy* in *Figure* 40 passes through the stations where the A anomalies

are most conspicuous. The general direction of this line conforms to that of the Swallet and is roughly parallel to the direction of Rod's Pot but tends in a slightly more easterly direction.

The current electrode spacings for these effects are written in *Figure* 41, and the corresponding depths are shown on the vertical section in *Figure* 42 by the points $A_1$, $A_2$, $A_3$ and $A_4$ respectively. It is probably significant that the upper portion of the line joining these points projects upwards towards the Bath Swallet, and leads to the obvious suggestion that some cave system might be entered from the bottom of the Swallet.

There is not sufficient data to warrant a similar detailed analysis of the B anomalies.

Anomalies C are not due to air spaces, but probably to abnormally high potential electrode contact resistances at the particular distances indicated by the values of the corresponding ordinates. These anomalies were not always reproducable, and were particularly troublesome along Traverse 1. Their explanation is not fully understood.

## IV. CONCLUSION

The results depicted in *Figure* 42 are believed to be indicative of a high resistance air space, probably an open bedding plane, running downwards in a north-easterly direction from the Bath Swallet. The fact that the slopes of the line $A_1$ $A_2$ $A_3$ $A_4$ correspond very roughly with the slopes of the passages in Rod's Pot tends to support this conclusion.

In spite of the relatively few measurements that have been made due to the short time available for the work, it is suggested that Bath Swallet and the depressions north of the boundary wall near the Society's Headquarters may well repay further digging and blasting. It is not improbable that a cave system extending downwards under the camp site is awaiting discovery.

---

The work described in this paper was carried out by members of the Society, and we are pleased to record our thanks to the Royal Society, who provided a grant of money for the purchase of the apparatus with which the measurements were made.