DOWSING IN EAST AFRICA

BY A. C. WILLIAMSON

Underground water may be derived from several sources, such as *plutonic* water which originates from deep-seated sources within the earth's crust, and *connate* water contained in some sedimentary rocks, and included in them at the time of their formation. But by far the largest proportion of subterranean water is derived from rain—*meteoric* water—falling on the earth's surface.

In East Africa the geologist or dowser is mainly concerned in locating this latter source of water which, after percolating through the top soil, may be held up by impervious rocks at varying depths from the earth's surface. The water tables of these aquifers* have a fluctuating surface depending on rainfall, natural channels of exit (flow-aquifers), and the amount extracted from boreholes or wells.

It is the flow-aquifer which the competent dowser is able to locate and trace by means of his rod. These aquifers are movements of water along well-defined lines, probably old river beds of sand and gravel which have been covered up by deposits derived from the weathering of surrounding hills, or, as is common in many parts of East Africa, by debris from Recent-Tertiary volcanic eruptions. Fissures in certain formations and geological fault structures may also create conditions permitting relatively free movement of underground water.

In some geological formations flow-aquifers may be many miles apart, but this does not necessarily mean that there may not be vast quantities of water lying below ground at an economical drilling depth. Indeed, the great majority of wells and boreholes selected by geologists and geophysicists are dug or drilled in such aquifers which may, for the purpose of comparison, be described as percolation aquifers.

To determine whether an aquifer is present or not the geologist has to rely mainly on the presence of adjacent rocky outgrops, and, from a study of their *strike* and *dip*, as well as a knowledge of their water-yielding properties, he may be able to make a fair estimate of the depth to the aquifer and to give a prediction of how much water it is likely to yield.

Where such geological evidence is not available, and this applies to large tracts of land of volcanic origin in East Africa, the geolo-

* In order to avoid confusion in terminology the word "aquifer" is used throughout. It should be remembered, however, that an aquifer is a geological structure and need not necessarily be water-bearing, only capable of bearing water. The term "underground stream" is permitted by most geologists as an alternative to the more correct "flow-aquifer," but the use of the term "vein," which has a specific geological meaning and has nothing to do with water, should not be used.

gist is pretty well "foxed" and has then to rely on expensive "wild-cat" drilling to get his information.

Even then, due to the complex and heterogeneous nature of some volcanic formations, a borehole may yield ample water at one place and another bore only a short distance away from it may be completely dry, although both may be drilled to the same depth. The geologist's lot as a water-finder under these conditions is not a happy one, and, what is more important, when the boring result is negative, even more unhappy for the unfortunate client who has paid for the drilling!

I have said it is the flow-aquifer which the dowser normally searches for, but in the absence of these, and this is quite often the case, a well-trained diviner can also locate and predict the depth to, and the thickness of, the water-bearing beds of a percolation or stationary aquifer. Unless, however, he has a very good knowledge of the geology of the country over which he is operating his predictions of quantity must, of necessity, be largely guesswork.

The dowser may be quite correct in his forecast that water is present at a certain depth in a percolation aquifer, but not all the water in a zone of saturation (sometimes very little of it) is available for recovery through boreholes and wells.

That which is recoverable is known as *gravity groundwater*, but unless the dowser has a very detailed knowledge of the water-retaining and water-yielding capacity of the rocks in the water bearing strata he would be wise not to select sites over percolation aquifers.

The quantity of water in a flow-aquifer is comparatively easy to predict with a considerable degree of accuracy. Further, its line and direction of flow can be traced with accuracy, and any point may be chosen for a drilling site to suit the requirements of the client. Another important advantage of being able to select a site on a "flow" is that water in motion is less likely to be as heavily mineralised as that in the adjoining percolation aquifer. This is an important point in many parts of East Africa, as underground water frequently contains large quantities of chlorides, sulphates and fluorides, among other chemical compounds, which may render the water unfit for human or animal consumption.

If, so far, the impression has been given that dowsing for water is a comparatively simple matter to those gifted with the necessary extra-sensory perception then it would be a wrong impression. There are many snags and pitfalls.

When making a survey in search of underground water the dowser, if he has already located the presence of a flow-aquifer, is not so limited in the choice of a site for drilling as the geologist who depends largely on local topographical features, the extent of catchment areas in relation to local rainfall and the study of adjacent rocks.

The position of a flow-aquifer may appear to have no correlation with the immediate surrounding topography and geology, for such aquifers may, and generally do, originate many miles away. It is for this reason that the geologist is often surprised when the dowser strikes a good supply of water in an area where he considers it highly improbable, if not impossible, to find any water at all.

But let us accompany the dowser on a water-finding survey.

Firstly, after being shown the general direction where water is required, the dowser holds the divining rod in both hands and in line with the eyes. He then pivots round in a circle scanning the horizon as he does so. Should there be a flow-aquifer in the vicinity the rod will give a gentle pull downwards in that direction. This is known as *distant detection.* Some dowsers can by this method locate the presence of a strong underground movement of water several miles away. If the dowser has this particular sensitivity much tiresome and unnecessary survey work is avoided.

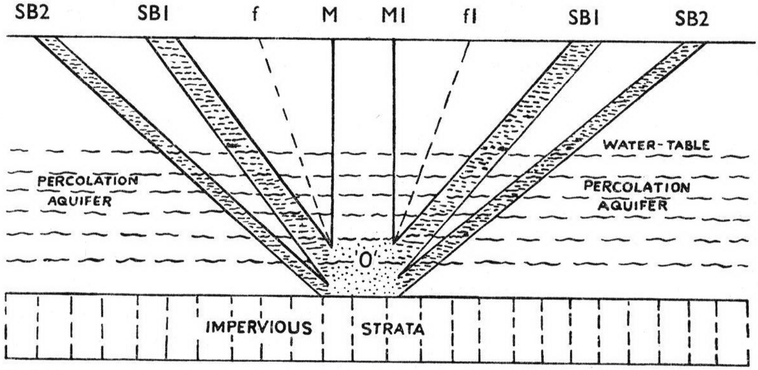
He then walks, or is driven in a car, in the direction of the rod's pull, holding the rod in the normal manner. When he is some distance away from his objective he feels the rod becoming " alive " in his hands ; he is in fact now detecting ripples of force reflected from the flow-aquifer. This is an important moment for the dowser as he has now entered the *flow-pattern* wherein his rod will react over many dowsing zones and it is his skill in the interpretation of these that success or failure depends.

Every flow-pattern has five strong dowsing zones of varying widths, in addition to many weaker and narrower ones, but it is only under one of these that the flow-aquifer lies. This does not necessarily mean, as some dowsers seem to think, that water will be found only under one of these reaction zones. On the contrary, a flow-aquifer is normally associated with a percolation or " stationary " aquifer, the water-table of which would be struck at the same depth anywhere in the surrounding country or where the rest level of the water-table is interrupted by a change in the underlying rock formation or some geological discontinuity.

In some formations, however, such as dolomitic limestones, lava rocks, etc., if the structural and topographical conditions are suitable, much subterranean water may flow through closely confined limits in fissured channels and it is only by drilling directly over one of these, of course, that water would be struck.

Most diviners have no trouble in locating the flow-pattern, but many fail to interpret correctly the dowsing zones therein. A common mistake is to choose the point which gives the strongest reaction on the rod, but this need not necessarily be over the

" flow " ; indeed, very often the strongest reaction is felt over one of four reflected *side-bands.* These are shown in the following diagram of a typical flow-pattern in homogeneous formations, but, for simplification, only a few of the more important dowsing zones are illustrated:—



" O " *represents the flow-aquifer, probably in sand, gravel, or other loose material;* MM1 *are the edges of the flow;* f f1 *the flow-band reactions;* SB1 *and* SB2 *the main reflected side-bands or parallels.*

Interpretation of the Flow-Aquifer Pattern

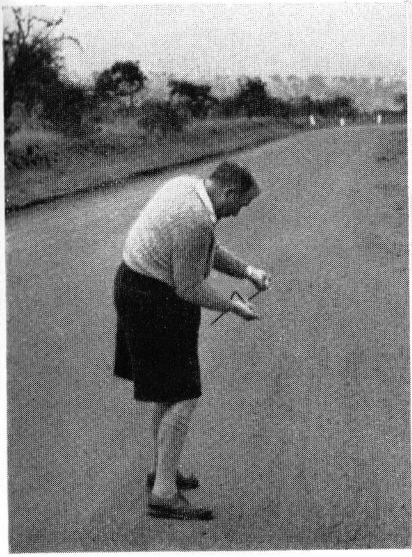
Before pegging out the flow pattern it is important that the dowser should find the direction and line of flow of the aquifer.

To ascertain which way the water is moving the dowser should hold the rod a few inches from the ground directly over the flow, i.e., between MM1, and pivot round in a circle. An upward thrust of the rod indicates the " up-stream " side of the flow and a downward pull the direction in which the water is moving.

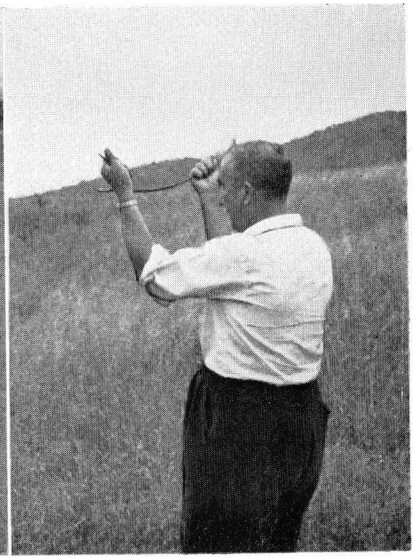
He should then trace the aquifer for some distance as it is very important that the parallel reflected dowsing zones should be pegged out at right-angles to the line of flow.

I have said that many dowsers are unable to sort out MM1 from the other dowsing reactions such as SB1 and SB2. To the trained dowser, however, this is not difficult. One method is to employ the distant detection technique already referred to. If, for example, the dowser is standing between SB1 and SB2 his rod will give a pull in the direction of SB1. He now crosses SB1 and makes another distant detection and this time the rod's movement will be towards MM1. He then repeats the performance on the other side of the pattern.

Another method is to measure carefully the widths of the various dowsing zones. To do this it is necessary to side-step



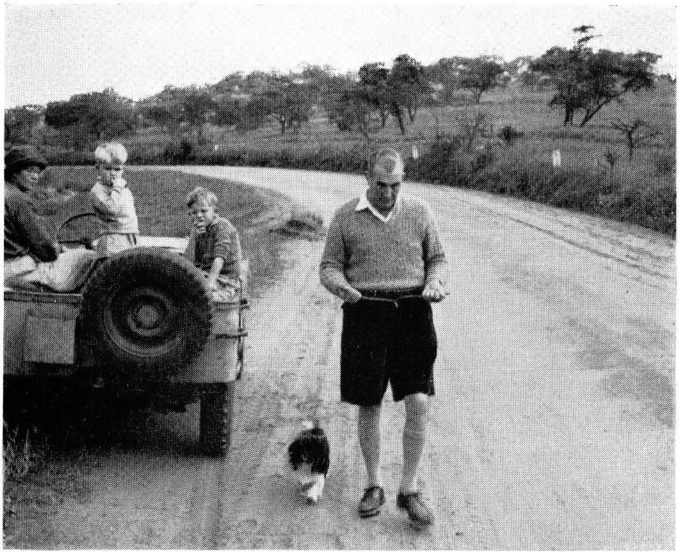
The reaction over a dowsing zone; strong upward pressure is being applied to the rod



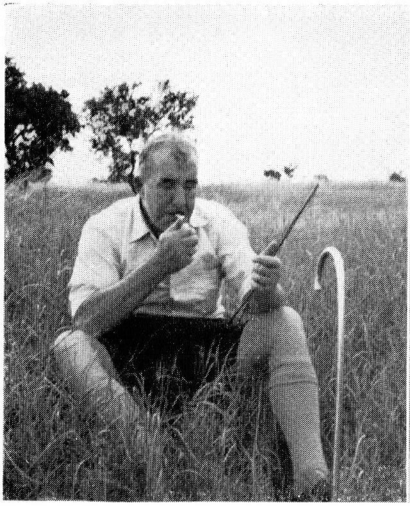
Distant detection; a strong flow-aquifer can be felt several miles away

Right—Measuring a flow-aquifer pattern

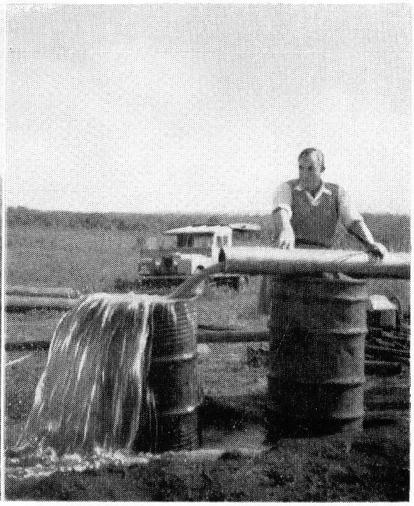
Left—Determining the direction of a flow: the dowser is standing directly over the flow-aquifer between the sticks which mark the width of the flow MM1



The divining rod should be held comfortably but firmly



Dowsing can be very exhausting. The walking stick is a mumetal rod



A successful hole located by dowsing; pump test at 8,000 gallons per hour slowly over them. At the zones' edges the rod will flick upwards and then pull downwards. Normally it will be found that the widths of SB1 and SB2 are one-half and one-quarter, respectively, the width of MM1.

Still another method of identification is to insert a metal conductor in the ground between what is believed to be MM1. If the dowsing reaction completely disappears then the dowser is truly over MM1. If not he is standing over one of the reflected side-bands.

The diagram also shows two very thin reaction bands at f and f1 on either side of MM1. These are rather difficult to locate as they are relatively weak in strength, but they are of considerable importance as they give an indication of the quantity of water in the aquifer.

The diviner having now correctly interpreted the dowsing zones of the flow-pattern his next dowsing problem is to determine the depth to the aquifer and the quantity of water therein.

Depthing is the bugbear of all dowsers as there are so many factors which can cause his calculations to go wrong.

Assessment of Depth

There are several ways of finding the depth to the flow-aquifer. One of the oldest is known as the rule of the isosceles triangle or the 45-degree parallel. The distance measured at right-angles from the centre of the flow zone to the first parallel is sometimes approximately equal to the depth to the aquifer in homogeneous formation, but where there is diversity of strata, and particularly where there are thick beds of clay, this method is of little value in estimating depth.

A more accurate means of predicting depth is known as the point depth method invented by the late Major R. Creyke, who had a considerable reputation as a geologist and dowser. This method consists in the placing of a vertical metal rod within the flow zone. The conductor used may be of any kind of metal but an alloy known as "mumetal," supplied by the Telegraph Construction and Maintenance Company in England, gives the writer particularly good results, although some dowsers seem to doubt its special efficacy over other metals.*

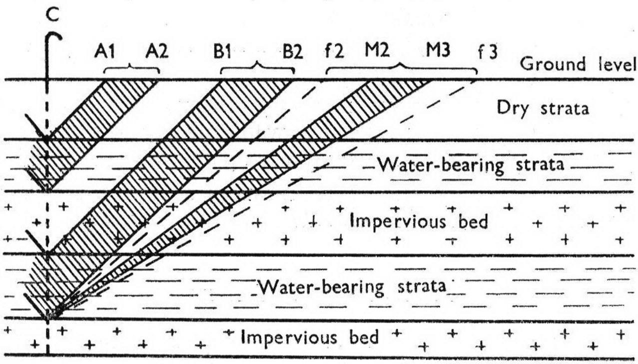
The effect of the metal conductor according to Maby is to set up a local field . . . "an earthed dipole that creates a radiographic interference pattern of concentric rings of reaction. And the radial spacing of the latter is again equal or proportional to the

* See *B.S.D.J.*, II, 9, p. 86 and 16, p. 353, by Elvan (Major R. Creyke).—Editor.

depth of the first subjacent conductor or main reflecting layer. This spacing should be measured along three or four radii, and averaged, in case uneven or tilted strata cause irregular or elliptical form."

It will be seen then that not only does this method give an estimate of depth to the flow-aquifer but it also may be used to find the depth to, and the thickness of, intervening water-bearing strata.

Fig. 2 roughly illustrates the dowsing zones where more than one aquifer is present:



Where C *is the metal conductor ;* A *and* B, *reflected zones of water-bearing strata ;* f2, M2M3, f3, *reflections in miniature of flow zone pattern. The flow aquifer is vertically below* C, *just above the impervious bed.*

When the rod is stuck in the ground directly over the flow zone, i.e., between M and M1 the dowsing reactions shown in Figure 1 are cancelled out.

When measuring the distances to the reaction zones the dowser need not in this case step out at right-angles to the line of flow, but it is very important that he make good contact with the metal conductor before doing so. He should hold the divining rod in the normal manner and encircle the handle of the conductor with one of his hands, taking care that both hand and rod come in close contact with the metal. On no account should the rod become disconnected from either hand.

On reaching the edge of the first dowsing zone at A1 the rod will bend down and continue to do so until A2 is reached. The manner of holding the rod is important. As soon as the downward pull at A1 is felt strong upward pressure should be applied to the rod, thus creating a kind of " trigger " effect which releases the rod violently upwards when it reaches the edge of the dowsing zone A2.

The distance from C to A1 is the depth to the first aquifer and from A1 to A2 the thickness of the water-bearing strata. This performance is repeated for the second aquifer B.

The depth to the flow-aquifer is the distance from C to mid-way between M2 and M3. This reflected flow zone pattern is a duplicate in miniature, complete in every detail including the weak and narrow flow-bands, of the original flow pattern represented in the first diagram as f, MM1, f1. As far as the writer has been able to discover there does not appear to be any definite proportional relationship between the measurements of the two patterns, but it does seem to be the case that the greater the depth to the flow-aquifer the smaller the reflection is in relation to the size of the original pattern. Another unexplained phenomenon here is the absence, in every case, of dowsing reactions between the percolation aquifer zone and the miniature flow pattern.

The diviner having now pegged out and measured the dowsing zones along a radius from C should then do the same over three more radii. A good plan is to take measurements along the four cardinal points of the compass. This is particularly necessary to offset *diurnal* effect on the reflected dowsing zones. It will be found that measurements taken in the early morning from MM1 or C to, say, SB1 or A are quite different from those measured at another time of the day. What has happened is that these reflections have moved either nearer to, or further away from, MM1 or C according to the position of the sun in the heavens. *The position, however, of MM1, which lies directly over the flow-aquifer, remains constant irrespective of the time of day.*

These changes in the position of the reflected zones may give rise to grave errors in estimating depths to water-bearing aquifers, but by taking the mean of measurements along several radii such errors can be greatly reduced.

Probably the most common error in depthing is due to refraction of the reflected dowsing zones caused by changes in the underlying rock formation. Clay is notoriously bad in this respect. In this case the dowsing " ray " may be deflected vertically in its passage through the clay bed, instead of at an angle of 45 degrees (after diurnal corrections have been made) as is normally the case in a homogeneous stratum, thus giving false depth measurements at ground level. It is for this reason that most dowsers insist that the thickness of any clay beds encountered during drilling is added to the predicted depths to the water-bearing aquifers.

The Creyke depthing technique appears to minimise to some extent the effect of rock refraction. In some formations, however, particularly where there are great thicknesses of clay beds, the whole Creyke depthing pattern may be duplicated a considerable distance away from the first reflected pattern. In this case it is the second pattern which gives the true depth readings.

Assessment of Quantity

A reasonably accurate method of determining the amount of water in the flow-aquifer is to measure the distance from the centre of the flow zone (MM1) to one of the flow-bands (ff1) on either side of it (see diagram below), and to compare this measurement with those over known flows in similar geological formations. The further away the ffs are from MM1 the greater the amount of water in the flow-aquifer.

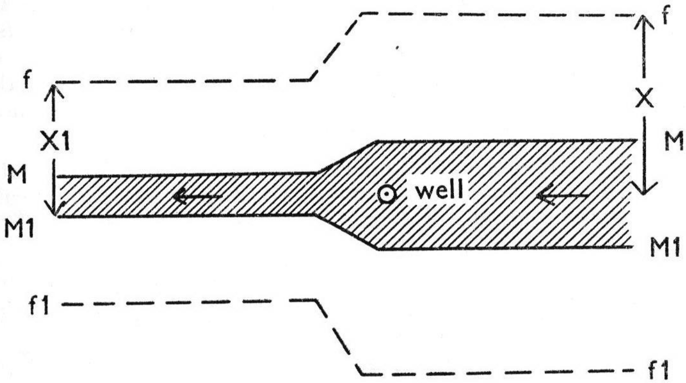
It is of considerable importance then that the dowser should know something of the geology of the country over which he is working, for a flow-band measurement of, say, 20 feet giving 3,000 g.p.h. in loose lava strata may yield only 1,000 g.p.h., on the same flow-band measurement, in granite or gneiss.

When determining " control " yield comparisons for different formations the dowser must select a borehole or well which is known to be situated over a flow-aquifer only. The water released from overlying percolation aquifers or perched bodies of water, if present, would be additional to the true yield of the flow-aquifer.

A quantity chart for any particular formation may thus be graphically recorded. It should be noted here than the quantity chart is not a straight line but in the form of a curve.

There are other methods of estimating the quantity of water in the aquifer, but the one just outlined is the only one known to the writer which can truly confirm whether the flow-aquifer has been struck or not. To know this is of extreme importance since the flow-aquifer is normally associated with other water-bearing strata.

To know whether the flow has been struck or not the dowser should measure carefully the distance from MM1 to one of the flow-bands, f or f1, on both the up-stream and down-stream sides of the well and *before* pumping begins. (As with other reflected dowsing zones there is a diurnal effect causing a difference in measurements between the two ffs, but in the case of flow-band reflections the difference is so slight as to be insignificant). For some time after pumping starts, and where more than one water-bearing aquifer is present, it will be found that there is no immediate contraction of the flow-zone pattern on the down-stream side. This contraction will not become apparent until such time as the " surface " water has been pumped out, and only then, of course, if the flow-aquifer has in fact been struck.



This diagram shows the shrinkage of the flow zone pattern on the down-stream side during a pump test if the flow-aquifer has been entered.

The difference in measurements between X and X1 when related to the quantity chart is a measure of the output of the borehole or well at that point on the curve.

Further, it will be seen that a measurement of X1 can also give an estimate of the amount of water remaining in the flow during a pump test if the full rate of extraction has not been reached.

Quantity forecasts may be considerably upset if dry cavities, fissures and " blow-holes " in Recent-Tertiary volcanics, are encountered during drilling. These voids seem to exaggerate the distance, without a corresponding increase in quantity, of the flow-bands from the flow zone. The same exaggerated effect may be caused when two or more aquifers are superimposed on each other.

Quality

Some dowsers claim they are able to predict the quality of the water in an aquifer, but it is doubtful if this is so. It is, however, a fact that in formations where water in overlying or adjoining aquifers is brackish the water in the flow-aquifer is much less likely to be as heavily mineralised.

Conclusion

It should be emphasised that divining is of a highly individual art and most dowsers have their own particular ways in interpreting the dowsing zones according to their degree and type of extra-sensory perception.

Some dowsers, unfortunately, surround the whole subject in a supernatural atmosphere and will not divulge their methods of divining. Such secrecy may be natural enough, but when this is accompanied by a disinclination or refusal to substantiate their results fully—their failures as well as their successes—they should be treated with a good deal of suspicion.

After all, orthodox water finders—geologists and geophysicists—are obliged to produce an honest record of their work when called upon to do so and any professional dowser worth his salt should be in a position to do the same.

The only real test of a dowser's capabilities is to compare his results with those obtained by geologists and geophysicists working under similar geological conditions and preferably in an area where orthodox means of finding water have been unsuccessful.

The dowsing methods described in these articles have given the writer reasonably good results; certainly better than those obtained by geologists and geophysicists in difficult water-finding formations. And that is the proof of the pudding!