was hoped that two 21in. bore-holes to 135ft. in the selected field would provide an effective supplement to the town supply, which in 1921 averaged 120,000 gallons per day. Owing to the unexpected and very large volumes of artesian water obtained, the rates of flow could not be measured with complete accuracy; so the claim of "over 11 million gallons per day" made by the sinkers, Messrs. Stow and Co., may not fully represent the yield.

At Bourne, where the geological structure is very similar, an artesian flow of "over five million gallons per day" was got from the Lincolnshire Limestone with a 13in. borehole in 1893. A 13¾in. boring near Constantine in Algeria discharges just over six millions. The "greatest yield in the United Kingdom" is claimed by the sinkers for two large boreholes for the Gravesend Corporation, both of which have been tested to seven millions per day, but these do not overflow. Conditions there are exceptionally favourable. South of the town some eight miles of Upper Chalk, dipping gently north with little cover, form an admirable gathering ground.

DOWSING

By Major A. J. EDNEY, R.E.

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Much has been written in the daily Press during the past few years on the subject of water divining. Since this art covers more than the search for water only, the term now generally accepted to cover the whole field is "dowsing." Until recent times methods of dowsing have been a jealously-guarded secret, mainly because most of the possessors of knowledge on the subject have made their living thereby. Nowadays, however, there are a number of books available on dowsing and many societies exist to probe into its possibilities.

History.

The Biblical account of Moses striking the rock in order to produce water for the Israelites has been explained by some as due to the fact that Moses must have been a dowser. The use of a dowsing rod in his hands would undoubtedly have given the appearance of striking the rock. This, however, can only be a matter of conjecture. It is known that the monks in England in early times were well acquainted with methods of dowsing. Many old monasteries still standing in remote country districts draw their water supplies from a good underground flow and often the wells are sited where two underground springs meet. Dowsers were brought over from the Continent in mediæval times to locate tin lodes in the Cornish mines.

Naturally, dowsing in those times was regarded as a form of witchcraft, and as such was roundly denounced by Luther. There is no record, however, of a dowser having been burnt at the stake. In America, the land of apt phraseology, the term " water witch " is still in common use. An old print shows a representation of the devil dancing over a stream with a dowsing rod in his hands.

In 1578, in France, the Baron de Beausoleil attracted notice by dowsing for metals and, after a somewhat chequered career, was appointed by the King to be Commissary-General for Mines in Hungary.

On 5th July, 1692, an incident happened in the south of France which was carefully recorded. A man and his wife were murdered at Lyons. Jacques Aymar, a peasant, claimed that he could discover the murderer by means of his dowsing rod. He first got his rod to react over the dead bodies and then set forth on his search. After a short distance, he entered a garden and his rod turned over a child who was playing there. She told him that three villainous-looking men had called at the house for wine. Thereupon the City Fathers of Lyons took heart and provided Aymar with an escort of five archers. The chase began. The rod reacted over glasses at various inns. Finally Aymar arrived at Beaucaire and went straight to the prison. Here his rod turned over a prisoner who had recently been arrested for theft. The latter swore he was innocent of the murder, but the archers took him back to Lyons the way they had come. Their prisoner was recognized at all the inns *en route*, and finally confessed. He was tried and executed.

An Englishman, Linden, wrote a book on dowsing for minerals, in 1750. It is interesting to note that he advocated holding a piece of zinc in the hand together with the mineral being sought, thereby setting up a very small electrical field. This was before the days of Galvani and Volta, who developed the theory of the electric cell.

Gerboin, in 1798, discovered that more exact results could be obtained by observing the behaviour of a pendulum oscillating over given samples. The time-honoured instrument until then had been the rod.

About 1850, various dowsing machines appeared on the market, and their inventors claimed that the presence of underground water and other substances would be detected by their use. Machines are still available, but the experiences of the users of many of them have not been very satisfactory.

In 1913, a conference on dowsing was held in France by M. Mager. That, together with the work of the late Sir William

Barrett and Theodore Besterman, represented the first co-ordinated attempt to put the investigation of the phenomenon on a proper scientific footing. At the present time, societies for the study of dowsing exist in all European countries. In England the work is carried out by the British Society of Dowsers. In Paris recently the degree of Doctor of Veterinary Medicine was conferred on a veterinary surgeon in recognition of a thesis on diagnosis of animal disease by dowsing. He also carried out a practical demonstration by successfully pointing out cows in a herd that was infected by tuberculosis. In 1933 the first Congress was held in England under the auspices of the British Society of Dowsers.

The Action of the Rod and Pendulum.

Firstly, it must be stated that a very large proportion of the population could be made to feel some reaction when holding a dowsing rod over running water. Subjects must be prepared to believe that they are able to dowse and must carry out an honest test. Having obtained a reaction, it is possible for a person, by practice and training, to develop the power.

The Rod.

The rod of history is the fork-shaped piece of hazel, the wood being about the thickness of the little finger and the branches of the fork about 12 inches long.

A more convenient rod may be made by taking two pieces of black whalebone, each 14 inches long and 7 mm. x 2 mm. cross-section. These should be bound together at one end by a piece of black adhesive tape. To try this instrument, hold it over running water—for instance, a garden hose with the tap turned on. The rod will then lift or dip, the movement varying for different persons. The rod should be held firmly in each hand but the muscles of the forearm must be allowed to relax. Whalebone rods already cut to size may be obtained from Devine and Co., Ltd., St. Stephens Road, Old Ford, London, for 1s. 6d. per pair. If no reaction can be obtained over running water, then ask someone who is known to be a dowser to hold your wrists, and try again. Reaction is increased if an open safety-pin, points outwards, is held between the thumb and first finger while holding the rod.

A single rod about three feet long and $\frac{1}{4}$in. diameter is used by some dowsers. Hold the rod in the right hand and approach running water, at the same time giving the far end of the rod an up-and-down movement. On passing over the water, the movement of the end of the rod passes from oscillation to rotation.

A further method is to use the hands only. Extend the arms in front of the body with the fists closed and the backs of the hands uppermost. Approach running water, quickly moving

the fists together and six inches apart again continuously. In this case, on passing over the water, one hand will be drawn slightly in front of the other.

An indicator which seems to act readily with people who are only slightly sensitive consists of a straight rod with one end bent at right angles. The rods can be of 10 gauge iron or copper wire, the long arm being about 18in. in length and the short arm 6in. To use these rods, hold them out to the front and parallel. On traversing underground water both rods will swing inwards and cross.

The Pendulum.

First procure a black solid rubber ball about 1½in. diameter, a yard of black thread, a small stick, 4in. long and ¼in. diameter, and a match. Bore a hole ½in. deep in the ball and, using a piece of the match as a plug, fix one end of the thread into the ball. Tie the other end of the thread to the centre of the small stick and wind the thread thereon. Now stand over water running in a hose pipe, hold the thread of the pendulum between the thumb and forefinger of the right hand, stretching out the remaining fingers. Give the pendulum an oscillating movement, at the same time slowly allow the thread to unwind. When the pendulum is a certain length the movement will change from oscillation to gyration. Carry out this test several times and the length of pendulum required for the detection of water is then known. This length is not necessarily the same for everybody. The main difficulty in working with a pendulum is to prevent movement by auto-suggestion.

Dowsing for Water.

When searching for underground water, it is desirable that, having located a supply, the depth, quantity and quality should be known.

Location.

It may here be pointed out that a knowledge of geology is invaluable to the dowser since in many cases it narrows the field of search. Again, there are many facts of everyday life which give clues as to the existence of underground water. A large solitary tree standing in the middle of a seemingly waterless plain will be found to have its roots in hidden water. Ancient buildings away from villages and towns usually depend on some local underground water supply. Moles must drink once a day or they die. Fields with molehills should therefore attract the attention of the dowser. A cursory glance at the ground's configuration, on the other hand, may often lead one astray.

Personally, I once discovered that, while a 60ft. bore in a likely looking valley yielded nothing, water was disclosed by the rod at the top of a neighbouring hill at a depth of six feet.

It would be well to consider here the manner in which water flows underground. One hears much loose talk of underground streams and rivers. Such things do undoubtedly exist, but it is unusual to come across a rushing underground torrent. Normally, the source of supply consists of a stratum of saturated soil through which the water slowly moves. Through a fissure in chalk or rock the movement may be rapid; through gravel, noticeable; but through fine sand, almost imperceptible. In the latter case, extraction calls for special strainers and some skill on the part of the well-borer.

To survey completely an area for subterranean water by dowsing is tiring and usually unnecessary.

Assuming that water is required in a certain area, then one should proceed as follows: Go to the centre of the area and hold the rod in the position of readiness. Slowly turn the body clockwise. If the operator is reasonably sensitive and water exists the rod will lift or dip when it is pointing towards a supply and at right angles to the direction of flow. Move off in this direction, grasping the rod firmly. Sooner or later, the rod will react smartly. Mark this place with the heel and continue in the same direction for about 50 yards. Now turn about and go back towards your heel mark still holding the rod. Another reaction will be registered. Mark this place. Halfway between the two marks is usually above the centre of the water. The line of flow is at right angles to the line between the two marks. Test your self by repeating the operation several times. The pendulum can be used to confirm the direction of water given by the rod. Set the pendulum to the required length for detecting water. Hold it in the right hand and cause it to oscillate. Point with the left arm. When pointing in the direction of water, the pendulum passes from oscillation to gyration.

Depth.

I have found that a light hold on the rod will give a reaction over water which is near the surface. The deeper the water the more strongly must one grasp the rod to obtain a reaction. By operating over water of known depth, it is possible to standardise one's grip. This appears to be a clumsy and inaccurate method, but it works—with practice.

Another system is to lay out a 100ft. metallic tape at right angles to the direction of flow, with one end of the tape above the centre of the stream. Stand at the end of the tape which is over the water and face the other end of the tape. Hold the rod in the normal manner and walk in the direction you are facing. After proceeding two or three yards a reaction is felt on the rod. Ignore this, and continue walking. When a second reaction is felt, stop and note the distance on the tape. This

measurement is equal to the depth of the water. This should be checked two or three times on both sides of the flow.

A third means for gauging depth is as follows. Stand over the place where you have located water. Raise the rod to the level of the top of the head. If a reaction is obtained with the rod in this position the water is very near the surface. The deeper the water the more the rod must be lowered to obtain a reaction. I have found that when the rod has been brought down to waist level then the water is about 300 feet deep.

It must be pointed out that results vary with different people, and therefore some form of personal calibration is necessary.

Several methods exist for the determination of quantity and quality of water, but successful results can only be obtained after much practice. The methods employed can be read in many of the standard books on dowsing.

Personal Experiences.

My first experiences in dowsing happened purely by coincidence. With another officer in the Corps I went down to Dorset some years ago to prepare a water-supply scheme for manœuvre camps. A calculation of supplies available from the local river showed us that sufficient water was unobtainable from that source. It so happened that an article on dowsing appeared in *The Daily Telegraph* on that day and that a supply of rods was to hand in a near hazel hedge. We each tried our luck at dowsing, and my rod reacted very strongly after going a few yards. The War Office called in a professional dowser, who confirmed the result of my experiment.

The next phase began in India. A well-boring engineer happened to tell me in the club that he had sunk a number of bores in a tea estate and obtained no water. He was working on the "No water, no pay" principle, and was losing money. I mentioned that I had been able to dowse for water in England, with the result that I obtained leave to accompany him to the tea gardens. In all, five sites were selected where I considered water would be found. The first bore was made, but only yielded 1,500 gallons an hour. The company were sufficiently encouraged to try a second site. This yielded 30,000 gallons an hour, and no further bores were required.

Soon after this trouble was being experienced on a Government Experimental Farm in an Indian Province. Much money had been spent in sinking a tube well for irrigation purposes, but no water had been obtained. I selected a site for a fresh bore within fifty yards of the original bore and gave the probable depth of the water as 120 feet. The water-bearing stratum was struck at 119 feet! I would have felt quite satisfied if the water had been anywhere between 90 and 160 feet.

The yield here was 8,000 gallons an hour. I later received a letter saying that the supply had seriously diminished, but there was a bad crack in the pump casing and that might have something to do with it! Some leave was sacrificed for this task and a benevolent Government allowed the bare fare for travelling and deducted eight annas because Civil Allowance rules only allowed taxi fares from the station to Government House and not to one's quarters.

On a new railway alignment in East Bengal, boring operations had been carried out without success over the previous twenty years at a site selected for engine-sheds. A point to drill was indicated by dowsing where 4,000 gallons an hour were obtained within 20 yards of a previous bore.

An interesting experience was gained in Ganjam District, where a reconnaissance was made to discover water for a camp site. The point selected was a short distance from the sea shore in sandy soil. Good drinking water was obtained by sinking a Norton tube well to a depth of 12 feet. This was below high-water mark.

Similarly, a copious supply of water was obtained in the Andaman Islands from a bore sunk to a depth of 60 feet on the sea shore below high-water mark. This water was free from sea salt, but contained a fair supply of other salts which gave it the flavour of Vichy water.

In response to a request from one of the Provincial Governments in India, I agreed to devote sixty days' leave to making a dowsing survey in part of the province.

The formulated task, when it reached me, consisted in travelling 900 miles across country and visiting 66 towns and villages! Needless to say, only a small portion of this work was carried out in the time available.

Altogether bores were made on about fifty different sites that were indicated by dowsing.

As far as I know, none of them failed completely to produce water. In a few cases the supply was rather meagre but better than nothing.

In England the problem is rather different from India, as one is often operating where many underground supplies exist. Dowsing for water is often made difficult by the fact that the area being prospected is in a town, where personal reactions are upset by the proximity of steel-framed buildings, piped water supplies, drains and electric power lines.

In 1934 my first real failure happened. This was at Porton, where the existing supplies were drying up. As far as I know, a bore sunk on a new site indicated yielded little result. I suspect

the near proximity of existing piped water supplies had something to do with the lack of success.

The only other practical work undertaken in that year was selection of two places to bore near London, one at a nursery ground near Staines and the other near Watford, where 120,000 gallons per hour were obtained.

The work on both these occasions was commented on by an independent observer in the *Journal of the British Society of Dowsers* (No. 7). As his remarks are of interest I quote his words :—

" One diviner I met with claimed that he could approximately tell the depth by the height he held the twig above the ground. Thus, if he obtained the greatest pull when holding the rod (a whalebone one, by the way) above his head, then the stream was near the surface, the lower he held the twig the greater the depth to the stream. There certainly appears to be something in this, for he was correct in the three cases in which I tested him out.

" In one case a bore-hole had been drilled in a nursery ground to the West of London. This bore had been carried to 600 feet, and was practically bone dry. This particular diviner selected another spot some 250 yards away, claiming that some 4,000-5,000 gallons an hour could be obtained at a depth of about 250 feet.

" A second bore-hole was subsequently drilled at the spot selected, to a depth of 600 feet, and water was met with in a thick bed of sand which was penetrated between 243 feet and 287 feet below the surface.

" This particular bore-hole has not yet been fully tested; it is quite certain that a yield of over 1,000 gallons an hour will be obtained.

" It is worth while noting that this site was also selected by another diviner, who also claimed that water would be met with at the same depth.

" It has always been a mystery to me how a diviner can compute the depth merely by the way he grips the rod, but judging from results obtained, one diviner I know certainly gets good results on the whole, so far as indicating the depth is concerned.

" I am inclined to think that the velocity of the flow of the underground water may have a considerable effect upon the strength of the pull on the rod and that it is quite possible that a small quantity of water travelling at a comparatively high velocity may have an effect out of all proportion to the quantity.

"This theory seems to have been borne out in a case of water-divining not long ago. A shallow underground stream was located in a gravel bed. The quantity of water was computed by a water diviner and given as being about 25,000 gallons per hour. When the necessary excavations had been made and the pumps inserted, a prodigious quantity of water was met with. In fact, it was nothing less than a broad, slowly moving underground stream, not a fissure. The yield obtained was no less than 120,000 gallons per hour, and this quantity was pumped continuously day and night for three months. Had this water been flowing through a fissure I am inclined to think the diviner would have estimated a much larger yield."

The Causes of the Reactions of Dowsing.

Many theories have been advanced from time to time as to the explanation of the reactions of dowsing. The question was taken up by the R.E. Board some time ago and the following is an extract from the correspondence which ensued:

"Mr. ——, M.A., of the Cambridge Physiological Department, who has conducted extensive research work into the Magnetism and Electricity of the human body, states that he sees no difficulty in testing such mediums to ascertain what, if any, connection the divining power has with the physical property of the individual's body. For complete tests, however, the medium would have to be prepared to be punctured with needles."

A willing medium for a "complete" test was not found.

The main argument as to the phenomena of dowsing centres mainly round the discussion as to whether it is psychic, physiological or physical.

Sir William Barrett, who spent many years studying the question, came to the conclusion that dowsing is a physical reaction, pure and simple.

An eminent German scientist thinks that the process of dowsing is the physical stimulus of the nervous system of the operator.

Again, the proved results obtained by some dowsers, such as prospection off a map, can only be grouped as what is at present termed psychic. With the present rapid advance of science, however, the "psychic" of to-day may be the "physical" of to-morrow.

The human nervous system is divided into the cerebro-spinal and involuntary (sympathetic) systems. The cerebro-spinal system supplies the muscles with nerves which convey only voluntary impulses. Since dowsing is involuntary in its action,

it is not superimposed on the cerebro-spinal system. It is, therefore, the involuntary nervous system, represented by the sympathetic nerves, that must be examined with reference to the phenomena of dowsing.

The best and most comprehensible explanation I have heard so far is that given by Dr. D. D'A. Wright in an article on the cause of the "Phenomena of Dowsing," published in the first number of the *Journal of the British Society of Dowsers*, and is as follows :—

"It is a physiological fact that every voluntary muscle of the body has a double nerve supply ; one from the cerebro-spinal system which conveys voluntary impulses, and another from the sympathetic nerves through which the tone of the muscle is regulated, and it is to this varying tone or tension of the muscle that the movement of the dowser's rod may be attributed.

"It would be here well to quote other evidence connecting the sympathetic nervous system with processes associated with dowsing. It has been found that particularly sensitive persons sometimes experience faintness or show a marked pallor of the face on passing into the zone of radiation from water, minerals or other substances. This pallor is due to the contraction of the small blood vessels of the skin, which are controlled by the sympathetic system. Again, a sensitive person can be placed in a position facing the west and a bright light made to shine into the eye so as to contract the pupil. A phial containing a drug to which the person has previously been shown to be sensitive is now brought close up to the back of the neck, without the subject's knowledge. A brief but very discernible dilation of the pupil will then occur, and at the same time a slight acceleration of the pulse will often take place. These are reflex actions brought about through the sympathetic nervous system. These reactions are definitely physico-physiological and can partly be explained on the assumption that certain parts of the nervous system are concerned in their production.

"Evidence exists to show that the human body contains apparatus capable of receiving emanations from substances and transmitting the results to the muscles.

"There are in the brain, the spinal cord and especially in the sympathetic ganglia, certain large nerve cells which have a peculiar structure in that they possess at one end large branching processes much resembling the roots of trees and at the other end are prolonged into a nerve fibre which passes away into the spinal cord, or into the nerves of the body.

"The branches of one cell approach closely to, but do not actually touch, similar branches of a neighbouring cell. Moreover they are motile and capable of being retracted or extended under certain conditions. For instance, in the case of the brain, when sleep comes on it has been proved that these processes retract from one another so that the gap between them is much increased.

"This it is seen that cells which are good electrical conductors are interlaced with, but not touching, other similar cells. The insulating matter is a poor conductor. This produces something similar to the condenser of a wireless set and it is not unreasonable to assume a similar action in both cases, viz., that of 'tuning in' to different wave-lengths and frequencies through a variation of capacity.

"Further, in the nuclei of the cells of the body are microscopical structures capable of 'inductance.' These are called chromosomes. They consist of coiled tubular threads having an outer coat made of a fat-like insulating substance, containing a fluid with mineral salts in solution forming a liquid of high electrical conductivity. It has been asserted that these structures are electro-magnetic oscillators, and that since they vary in size and curvature they all differ in the length of wave to which they are capable of oscillating.

"In the body, then, are two distinct contrivances which are capable of varying degrees of inductance and capacity, both of which are in direect relationship with the nervous system. In physiological language, the whole is linked up in a reflex arc; which consists of a receiving apparatus—in this case, the skin; a centrally transmitting apparatus—the centripetally directed nerves from the skin; a central receiving station—the large nerve cells which are capable of 'tuning-in' to the various wave-lengths received; from this again the impulse is transmitted through the sympathetic nerves to the muscle fibres of the arm and fingers which hold the divining rod. Through this impulse, variations in the tension of the muscles are produced, and a turning of the detector thereby brought about.

"These activities are all of a subconscious nature. The brain itself takes no conscious part in the action. In certain cases, however, it would appear that the higher faculties of the brain take a share in the transaction, and it is here than a psychic factor appears. Among the expert dowsers on the Continent, it has been found possible, by an effort of concentration and will-power, to tune in the receptive system to the wave-length of particular substances."

Conclusion.

Water supply is a constant worry in military operations in many parts of the world. The detection of underground supplies is then a matter of great importance. It is reasonable, therefore, that officers of the Corps, who are primarily responsible for water supplies, should know something of the practical side of dowsing. Further useful applications would be the detection of land mines and also of sub-soil water in regions where mining operations are proposed.

Much has been done in France in the application of dowsing to the study of medicine. A hospital exists in Nice where all diagnosis is carried out by means of the divining rod.

Machines have been produced containing thermionic valves, on which the emanations of substances in large quantities give deflections of a pointer.

In agriculture, the dowser's art has been used to discover the affinity of seeds for certain soil components.

In Paris I met an enthusiastic master of hounds who carried a hunting whip with a copper and zinc stock whereby he dowsed for his quarry when hounds failed to do their job. *Vive le sport !*

An interesting book has been produced in Germany concerning the detection of "Gamma" rays by dowsing. These rays are apparently produced in planes by faults in the earth's surface. Patients in a hospital, whose beds intersected a plane of "Gamma" rays, took longer to recover than the others.

However fantastic these notions may appear to some, it cannot be denied that men have found water through the ages by dowsing. It is, therefore, reasonable in these days of rapid progress that time should not be lost in reducing the art of dowsing to a science.

The following remarks of the managing director of a widely-known well-sinking firm, in a paper to the British Society of Dowsers, would seem to form an apt conclusion to this article :—

> "To sum up, let us be fair to the diviner. He is up against a big problem. So many things conspire to put him off the track, such as the weather, the time of day, the nature of the soil, the diviner's own state of physical health, even the position of the sun may have more than a little to do with it. After all, we do not condemn the medical profession, merely because on many occasions they fail to diagnose diseases correctly. Let us always apply the same line of reasoning to the water diviner and give him his due."