

EXPERIMENTS
WITH THE
WATER - FINDER

Department of Agriculture, Bombay.

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EXPERIMENTS

WITH THE

WATER-FINDER
OF MESSRS. MANSFIELD & Co.

IN THE

TRAP AREA OF WESTERN INDIA.

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PREFACE.

THE attached paper by Mr. H. K. Mehta, M.A., B.Sc., gives an account of experiments which he has undertaken during the first five months of 1910, to ascertain whether the Water-finder manufactured by Messrs. Mansfield & Co. of Liverpool, and which seemed to be based on sound principles, was likely to be of value in the Deccan and other trap areas. The importance of the matter is obvious. Wells are the principal source of irrigation water over all this area. They are very expensive to make, costing at least Rs. 800 to Rs. 1,000 each. And there are very many failures,—one estimate made to me indicating forty to fifty per cent. of wells dug never reaching water.

The results so far obtained, though not absolutely conclusive, indicate an almost certain success. Where wells have failed, no indication has ever been found: where successful wells exist, indications are always found: where continuous underground streams are for other reasons supposed to exist, the instrument confirms their presence: and where a stream passes near a well so that percolation may be presumed to take place, that percolation is actually found. This would seem to justify the statement, with all but certainty, that the instrument will detect underground streams of water. For *complete* proof we must await the next dry season, when in two at least of the places, where tests have been made, digging on the lines indicated is to be carried out.

The instrument has several disadvantages. It is expensive,—that used by us costing Rs. 750. It requires very careful use, as if exposed partially to the sun, for instance, during the observations, it will not give correct indications,—and it would be necessary for anyone who wished to use it to have special training with Mr. Mehta or his assistants. Then it is slow. To completely survey even a small field so as to arrive at the best point may take a week. One observation will often take half an hour, and this allows (at six hours a day working) only about seventy observations in a week. So that testing for a well with this instrument is a laborious job.

The instrument, in fact, seems rather one for local boards and authorities, or large landowners to purchase, who can have a man

trained to the job to do the actual survey. Such a man must be very intelligent, as the selection of the best site depends on careful plotting of a series of observations, and not on any particular observation.

If these precautions and conditions be taken into account, the instrument seems likely to be of very considerable service.

HAROLD H. MANN,

Principal,

Agricultural College, Poona.

POONA, August 10, 1910.

Experiments with the WATER-FINDER of Messrs. Mansfield and Co., in the Trap Area of Western India.

I. INTRODUCTION.

BY far the largest amount of irrigation in Western India is carried out from wells which are sunk in the trap which forms the prevailing rock over very large areas of the country. The trap area in respect to water-supply is characterised by certain special features. In the first place, the water is relatively near the surface. In almost all the wells where water occurs at all, it is found at a distance varying from ten to seventy feet from the surface, though in the majority of cases the water level varies from twenty to forty feet deep. In the second place, the water occurs in fissures or joints. The trap rock above almost all others is characterised by the presence of enormous numbers of fissures traversing the rock in every direction. Although these fissures may be of microscopic thickness, yet they constitute a weak point in the rocks, for, in course of time, they are likely to be opened out by mechanical and chemical agencies that are day and night at work; and, in fact, the larger fissures that are found in rocky beds have actually been opened out since their original formation by either of these two agencies.

It is these fissures existing in rocky beds along which the rain-water, penetrating into the soil, flows: they thus constitute underground streams or springs which mainly supply water to the wells in parts like the Deccan, and other trap areas where the soil is hard and rocky. But though these streams traverse the country in various directions, it by no means follows that they can be found at each and every spot. It is, therefore, of the utmost importance to anyone intending to construct a new well to know the exact course of the underground stream. This, however, is not quite an easy problem, for, no scientific method has hitherto been known, by which surveys of sub-soil water could be prepared with accuracy. In this matter, people in India, as in other countries, have, from the earliest times, relied upon a class of persons known as *panadias* in the Deccan. These persons profess that they can find out water by methods known to them and which, as they say, are handed down to them from their forefathers. It is needless to mention that most of these

methods are meaningless and absurd, and hardly deserve reference. There are three, however, which, though not of much value and practical utility, deserve some mention :

- (1) Some of these persons fix the position of underground streams from the bending of the branches of trees in the vicinity. According to them, the branches have generally a tendency to droop towards any underground water.

Even if we were to grant the above principle, which, however, is very doubtful, the method cannot be expected to give correct results, as the bending of branches would depend upon many factors, particularly the wind. The method, therefore, is of little or no practical utility.

- (2) Some locate the springs from the natural slope of the country, the nature of the soil, and the wells in the vicinity.

The method is too general, and cannot be depended upon to give satisfactory results. It may be that one, after examining the above conditions, sometimes hits upon the right place, but that is largely accidental, and not because of this method.

- (3) The position of subterranean springs is sometimes determined by some persons from the existence in the vicinity of such trees as Banyan (*Ficus bengalensis*), Pipal (*Ficus religiosa*), and Umbar (*Ficus glomarata*). These trees, as they assert, send their roots deep down into the soil and derive the water they require for their subsistence from the underground streams.

The principle appears quite sound, for it is very likely that those trees, which send their roots very deep into the soil, derive the water required for their subsistence from underground streams, if there be any. It is, however, very doubtful that they thrive only where there are such springs. Even if it be so, this method is of very limited application, for it is not always that one meets with such trees.

From the above, it appears that the methods, employed by *panadias* in determining the position of underground streams, are either meaningless or of little practical utility; still people for so many years, for want of any better course, have relied upon them, and have spent large sums of money in digging wells, very often

to find them wasted. It is not that the people have much faith in these persons, for they have, as a matter of fact, very little; but rather than dig a well at any place without guidance, they think it more advisable to sink it at the spot pointed out to them by *panadias*. The want of any strictly scientific method has been very keenly felt not only in India, but all over the world. Any instrument, therefore, which is based on scientific principles, and which can exactly determine the course of subterranean springs, would be particularly welcome, and more so in Western India than anywhere else, where, as pointed out above, well irrigation has played such an important part in the past and is likely to do so in future.

An instrument, which seems to have some claims to this position, and which is known as "Water-finder" or "Spring-finder," has been recently brought out by Messrs. Mansfield & Co., Liverpool. This instrument was ordered out by the Agricultural Department last year; and several tests have been made at good many places, the results of which, as can be seen from the detailed account given further on, seem to indicate that the instrument is likely to be of practical utility.

II. THE WATER-FINDER.

Construction.—The instrument consists of a wooden case divided into two chambers. In the lower of the two, there is a coil of wire wound on a bobbin; in the upper, at the centre is a pivot on which rests a light magnetic needle, which by its movements detects underground streams. There is also a graduated scale, on which the magnet moves, and by means of which the deflections of the needle are measured. On one side of the upper chamber, there is a door which enables the magnet to be removed from the pivot at pleasure. With the instrument, are provided a tripod stand and a table on which the instrument is to be placed while taking an observation. On the table there is a white line which is always to be directed towards the magnetic North, while using the instrument.

Principle.—The principle of the instrument seems very simple and may be explained by the following two illustrations: If a copper wire be held near a magnetic needle, and its two ends be connected to the two terminals of an electric battery, so that an electrical current flows in the wire, it will be found, that the needle is deflected from its normal position, and it will remain deflected so long as a current is traversing the copper wire. If, however,

instead of directly holding the wire near the magnet, a closed metallic circuit be held near it, and a copper wire be placed near the circuit, it will be again found, on suddenly connecting the ends of the wire to the terminals of a battery, that the needle is deflected; the deflection is, however, only transient and not permanent as in the last case. Here, when the ends of the copper wire are suddenly connected to the terminals of the battery, the current flowing in the wire induces a transient current in the metallic circuit, which causes the deflections of the magnet; and as the current induced in the metallic circuit is only transient, the deflection of the needle is temporary. If again the intensity of the current flowing in the wire be suddenly varied, a transient current will be induced in the circuit, which will once more produce a temporary deflection of the magnetic needle. This principle is known in physics as the principle of electro-magnetic induction.

The same principle causes the deflections of the magnetic needle in the water-finder, when it is fixed at a place below which a stream is flowing, with this difference that here the inducing currents do not flow along a copper wire but are generated in the underlying strata. These currents, which are known to be generated by a variety of causes, generally follow the course of a stream, that being the path of least resistance. They then induce currents in the water-finder much in the way, in which the current flowing in the copper wire, in the above illustration, induces in the metallic circuit; and it is these induced currents that affect the magnetic needle, in the upper part of the chamber, which consequently is deflected from its position of rest. The greater the strength of the subterranean springs, the more rapidly and violently does the magnet oscillate. The whole efficiency of the instrument would seem to depend, in fact, on the preference of earth currents to follow the path of an underground stream.

Method of using the instrument.—The tripod stand is first firmly fixed in the ground, with the table perfectly horizontal as shown by the spirit level, and with the white line pointing to the magnetic North as indicated by a compass provided with the instrument. The instrument is now placed on the table with the zero of the scale directed towards the North.

After the instrument is thus firmly set up, the magnetic needle is placed on the pivot and the door of the case is closed, so that the movements of the needle may not be affected by the wind. When the needle has come to rest, its movements are to be watched very carefully.

Working of the instrument.—From the tests that were made at various places to be described later on in detail, the following conclusions are drawn as to the working of the instrument :—

- (1) If an underground stream is present under where the instrument is fixed, the needle will, after a certain time, commence to move.
- (2) The movements of the needle depend upon where the instrument is fixed (whether exactly above the stream line or on one side or the other), and upon its strength and depth.
 - (a) If the instrument is fixed at a place below which a stream is flowing, the movements of the needle are generally of an oscillatory character.

The rapidity of the swing, that is, the period of oscillation, depends upon the strength and depth of the stream ; it may be as much as half an hour or even one hour, if the stream be very feeble and at a great depth ; if, on the other hand, it is very powerful or very near the surface, as was the case at Kelwa Máhim where the instrument was taken for testing, the movements of the needle are very rapid and of large amplitude, the needle moving from one end of the scale to the other.

- (b) If the instrument is fixed on one side or the other of the stream line, the movements of the needle are slow ; the oscillatory character generally becomes less and less marked as the instrument is taken further and further from the stream line, until when it is removed far from it, the needle does not move at all.
- (c) The limit, within which the instrument can detect the existence of a stream, depends upon its strength and depth. It may be as great as thirty feet sideways from the stream as was observed at Kelwa Máhim where it was known to be very powerful and very near the surface ; or it may be as small as seven or eight feet as was the case in Dr. Sahasrabudhe's gardens in Poona, where the stream was very feeble.

Precautions to be taken while using the instrument.

(1) No direct sunlight should be allowed to fall on the instrument while taking an observation, as the heating of the coil would slightly deflect the needle.

(2) The instrument should not be tried near a building or any iron structure; nor should it be tried under trees, as these are likely to affect the instrument.

(3) The instrument cannot be used in the rains, when the soil is nearly saturated with water.

III. TESTS WITH THE WATER-FINDER.

Realising how useful the water-finder, if successful, could be to the cultivators, the Agricultural Department ordered it out last year, and it was exhibited at the time of the Poona Agricultural Conference last September. As was expected, many people were attracted to it; applications were soon received by the Department from various quarters for an advice in the matter of well digging. But such advice could not be given simply on the authority of the instrument maker, and it was thought advisable to test how far the instrument would be a success. A number of places were therefore selected for the testing of the instrument.

Kelwa Máhim.—The first place that was selected was Kelwa Máhim, a small village in the Thána District. This village is particularly fortunate in the supply of underground springs; for, they traverse the country in various directions and are very near the surface. At every five or six hundred feet, one meets with a well with an abundant supply of water. But recently the village has become notorious for its bad climate and its bad water. Almost the whole year round, the people suffer from malarial fever due to bad water. The water, in the existing wells, has been rendered undrinkable on account of the vicinity of plantain gardens. It was, therefore, proposed by the Municipality in consultation with the Sanitary Engineer to dig new wells outside the town and far away from the influence of plantain gardens, and to supply water to the town by means of pipes.

It was in connection with this water-supply scheme that the water-finder was taken to Kelwa Máhim. The work, there, lasted for about a month during which time about three hundred and fifty observations were taken at various places. The principal object

was to try the instrument by taking observations near existing wells and to trace the springs, flowing into them, outside the town for the construction of new wells.

The instrument was, therefore, set up near one of the wells in which a powerful stream about twenty feet below the surface was flowing; at this place it gave a good indication as could be determined from the movements of the needle. The stream was then followed up by successively taking observations at points near one another, and in that way a continuous stream was traced for a distance of about a mile and a half, and a suitable site was selected far away from the influence of plantain gardens, for the digging of new wells for the water-supply project referred to above. The same stream was found to supply water to nine existing wells near each of which an observation was taken. In every case the results were quite satisfactory. While tracing the stream, the following points were noted with regard to the working of the instrument :—

- (1) At some points, the movements of the needle were very rapid and of an oscillatory character; at others they were slow and small in amplitude, while at others again no indication could be obtained. The first series of points were probably those exactly above the stream, while the second were perhaps at a small distance from the stream line, and the points where no indication could be obtained were at such a distance from the stream that the instrument could no longer be affected by it.
- (2) Whenever the movements of the needle were rapid and of an oscillatory character, it was found that there was a certain similarity in them, specially as regards extent, and rapidity of the swing, in most cases the needle swinging from one end of the scale to the other.
- (3) At points where the movements were rapid, the needle usually commenced to move a minute or two after the instrument was set up.
- (4) When the instrument was shifted to either side of the points of greatest activity, it was found that the movements of the needle were gradual and on one side or the other of its position of rest. The needle also took a greater time to commence moving, sometimes as many as fifteen minutes were required. It was, therefore, inferred

that the points of greatest activity were actually on the stream line and it was by joining such points that the stream, as mentioned above, was traced.

- (5) When the instrument was removed to about 30 feet to the side from the points of greatest activity, it ceased to give any indication. The limit within which the instrument could detect the existence of the stream of the particular strength and depth was, therefore, about thirty feet.
- (6) The instrument always gave good indications at places where there was absolutely no uncertainty as to the existence of springs, for example, near each of the wells that came across while tracing the stream.

Poona.—The results obtained at Kelwa Máhim were very promising. The very fact that a stream could be continuously traced by means of the instrument for a distance of a mile and a half is in itself a strong evidence in its favour. But this is not the only point to be said in its favour. There are other points as well which will be discussed at length later on. Be it noted, however, that the movements of the needle, at some places very rapid and oscillatory, at others slow and at others again absolutely nil, seem highly significant.

The instrument was yet to be tested under different conditions. The next place that was, therefore, selected was the garden of Dr. G. S. Sahasrabudhe, L.M. & S., in Poona. Dr. Sahasrabudhe, some years ago, dug a well but did not succeed in getting any water. In the sketch given at the end is shown the position of this well as well as of other wells in the neighbourhood. It may be seen from the sketch, that in the immediate vicinity of Dr. Sahasrabudhe's well (well No. 2), and at a distance of about three hundred feet from it, there is another well (well No. 1). This well contains some water, though the supply is scanty. The water, in the month of April when the instrument was taken there, stood about sixty feet below the ground level, and the *mhot* could work only two hours in the morning. Besides this, there are two other wells (well No. 4 and well No. 5) at some distance from well No. 2. They also do not contain any water. The problem, therefore, was first to ascertain by means of the instrument whether water would be found in Dr. Sahasrabudhe's well by digging still further, and, secondly, to select the best place in his gardens for the construction of a new well, in case there was no chance of getting water in the old.

Observations were commenced from well No. 1, where there was no uncertainty as to the existence of a stream. The instrument also pointed to the same thing, for when it was set up near the well on the side from which the stream was flowing into the well, an indication, though feeble, was obtained. Observations were then successively taken at other points near one another, and the stream flowing into the well was traced.

But the task of tracing the stream was not so easy as at Kelwa Máhim, for wherever the instrument was fixed, the movements of the needle were exceedingly slow and feeble; the instrument had again to be kept at every place for a long time, as the needle sometimes took fifteen or twenty minutes to commence moving. The second difficulty that was experienced was that the stream would often be missed; it often happened that the instrument would give an indication, though of course feeble, at some points, but would not give any at points nine or ten feet on either side of it. In order to avoid this difficulty, points for observations had to be taken very near one another.

From the movements of the needle and the small limit within which the instrument could detect the stream, it was inferred that the stream running into well No. 1 must be very feeble which was confirmed by the scanty supply of water in it.

The movements of the needle, however, gradually improved as the instrument was taken further and further from well No. 1 until ultimately they were quite rapid and oscillatory at No. 34. (See the plan.) Henceforth, between No. 34 and No. 70, the needle could be seen swinging quite distinctly, though not of course with the same rapidity as at Kelwa Máhim. The greater activity of the needle beyond No. 34 seemed to indicate that the strength of the stream between 34 and 70 was much greater than that between 34 and 1. This means either of two things: for, it may mean that a stream flowing from the west divides at No. 34 into two branches, one proceeding towards well No. 1 and the other taking some other direction, or it may mean that the principal stream is flowing from the south and that it divides at No. 34 into two branches. In any case, we should expect another stream near No. 34, and this was found to be the case, for when the instrument was set up, on the side where it was expected, the needle did indicate its existence. The stream, however, was found to be weaker than the stream *A*, but nearly equal in strength to the one flowing into well No. 1.

Observations were also taken on all sides of well No. 2, but no stream could be found near it. In the sketch are shown the positions of all the streams, from which it may be seen that the two feeble streams *B* and *C* which are derived from *A* pass at a distance of about one hundred feet on either side of the well, and that no stream runs through it. A suitable place was, therefore, pointed out to Dr. Sahasrabudhe on the stream line *A* for the construction of a new well.

Depth of the stream A.—The depth of the stream *A* may be roughly estimated thus. As the depth of the stream *B* near well No. 2 is equal to sixty feet, and as it is derived from *A*, the depth of the latter must be somewhat less than sixty feet, possibly about fifty feet.

Quantity of water.—The quantity of water, carried by the stream *A*, can be also ascertained from similar considerations. As pointed out above, the streams *B* and *C* are nearly equal in strength and are derived from *A*; it may, therefore, be inferred that the latter should at least be twice as powerful as either of the other two. The amount of water discharged by *B* into well No. 1 is, as mentioned above, such that a single *mhot* can work two hours per day in summer and about six hours per day in winter. The quantity of water that would be discharged by *A*, if a well be constructed anywhere on that stream line, should, therefore, be sufficient for a single *mhot* for at least four hours in summer and about twelve hours in winter.

Stream line D.—Sketch No. 2 also shows another stream *D* traced near wells No. 4 and No. 5. This stream, as may be seen, passes near these wells, but does not run through them. It may, however, be mentioned, that well No. 4 contains some water, but no stream as such flows into it. The water is simply due to percolation, being probably derived from the stream *D* which passes at a distance of about twenty feet from its side. This is important, as it serves to verify the indications of the instrument, and also to fix the depth of the stream. The water in well No. 4, in the month of April, was about thirty-five feet below the ground level, which may, therefore, be taken as the probable depth of the stream *D*.

The movements of the needle on this line, were neither very rapid, nor very slow; they were more rapid than on the lines *B* and *C*, but less than on the stream line *A*; the limit within which the instrument could be affected (ascertained in the usual

way, by shifting the instrument on either side of the points of greatest activity) was certainly greater than near the streams *B* and *C*, and nearly equal to that near *A*. From this, a rough idea can be had of the amount of water conveyed by the stream *D*.

Ráo Sáheb V. N. Dandekar's gardens.—The instrument was also taken in Ráo Sáheb V. N. Dandekar's gardens in Poona in the month of May. Last year (1909), he dug a well in his gardens but could not get any water. A number of observations were, therefore, taken round about this well, but no stream could be detected near it; neither could any stream be detected anywhere in his gardens, for, when the instrument was set up on all the four sides to see whether a stream was flowing from any of the sides, it did not give any indication at all.

Tembhurni.—The water-finder was next taken to Tembhorni (Sholápur District) in the fields of Mr. Damodar Maruti Bhoi. This gentleman had applied to the Agricultural Department for an advice with regard to two wells which he had dug but which were quite failures. The problem was to ascertain, by means of the water-finder, whether to dig still further in the hope of getting water, or to abandon the wells altogether and construct a new one at a suitable place. The sketch, given at the end, shows the position of these two wells, as also of other two at some distance from them in the adjoining fields.

Observations were, first of all, taken in the immediate vicinity of well No. 1. Two streams (*A* and *B*) were found to pass near it, at a distance of about fifteen feet from its edge; they were then followed up, towards well No. 2, in the usual manner by taking a number of observations at points near one another. It was, in this way, ascertained that the stream *A* was also passing near well No. 2. A second stream (*C*) could also be detected near it, about ten feet from its edge, which, on being traced, was found to unite with stream *A* at No. 96 as shown in the sketch. The needle, as should have been expected, showed a much greater activity at this point than anywhere else.

Depth.—It is to be noted that the sides of well No. 1 are always wet, and particularly so near points *g* and *f* on the stream lines *A* and *B* respectively, where the instrument had given very good indications. This fact is very important, as it at once serves to verify, in an indirect way, the indications of the instrument, and also to fix the depths of the streams. For, the wet surfaces are about fifteen feet below the ground level, which may, therefore, be

taken as the probable depths of the streams *A* and *B*. Knowing the depth of *A*, we can determine that of *C*; for, as pointed out above, these two streams unite together, and consequently there cannot be much difference in their depths. Of course, it is quite possible that they may not unite to form one stream, and that one may be below the other; but in that case, we should expect them to have two different directions beyond No. 96; for it is most unlikely that they should have the same course, if one is below the other. It is, therefore, highly probable that the three streams *A*, *B* and *C* have nearly the same depth and that this depth is between fifteen and eighteen feet below the ground level.

Quantity of water.—The method that was employed, in the garden of Dr. G. B. Sahasrabudhe at Poona, in determining the quantity of water, was to compare the movements of the needle above the unknown stream with those at points above a stream of known strength and depth; and the same method was followed here. The instrument was, therefore, set up near well No. 3 which had a very good supply of water (the *mhot* working nine hours every day); and the stream flowing into it was traced in the usual way. The movements of the needle on this line were very similar to those on the lines *A*, *B* and *C*; they were neither very rapid, nor very slow; the needle did not take much time to begin moving after the instrument was set up; and the limit within which the instrument could be affected was nearly the same for all the stream lines *A*, *B*, *C* and *D*. Besides, the depth of *D* was nearly the same as the calculated depths of *A*, *B* and *C*; it was, therefore, inferred that all the streams were nearly of the same strength, so that each would discharge a quantity of water sufficient for a single *mhot* for nine hours.

On these observations, Mr. Damodar was advised to make small holes at Nos. 75, *f*, and 90 and to divert the streams *A* and *B* into well No. 1 and the stream *C* into well No. 2.

IV. CONCLUSIONS.

Comparing the observations taken at different places as above described, we note the following points:—

- (1) The instrument has given good indication near wells that contained some water and where consequently there could not be any uncertainty as to the existence of a stream. In all, observations were taken near sixteen

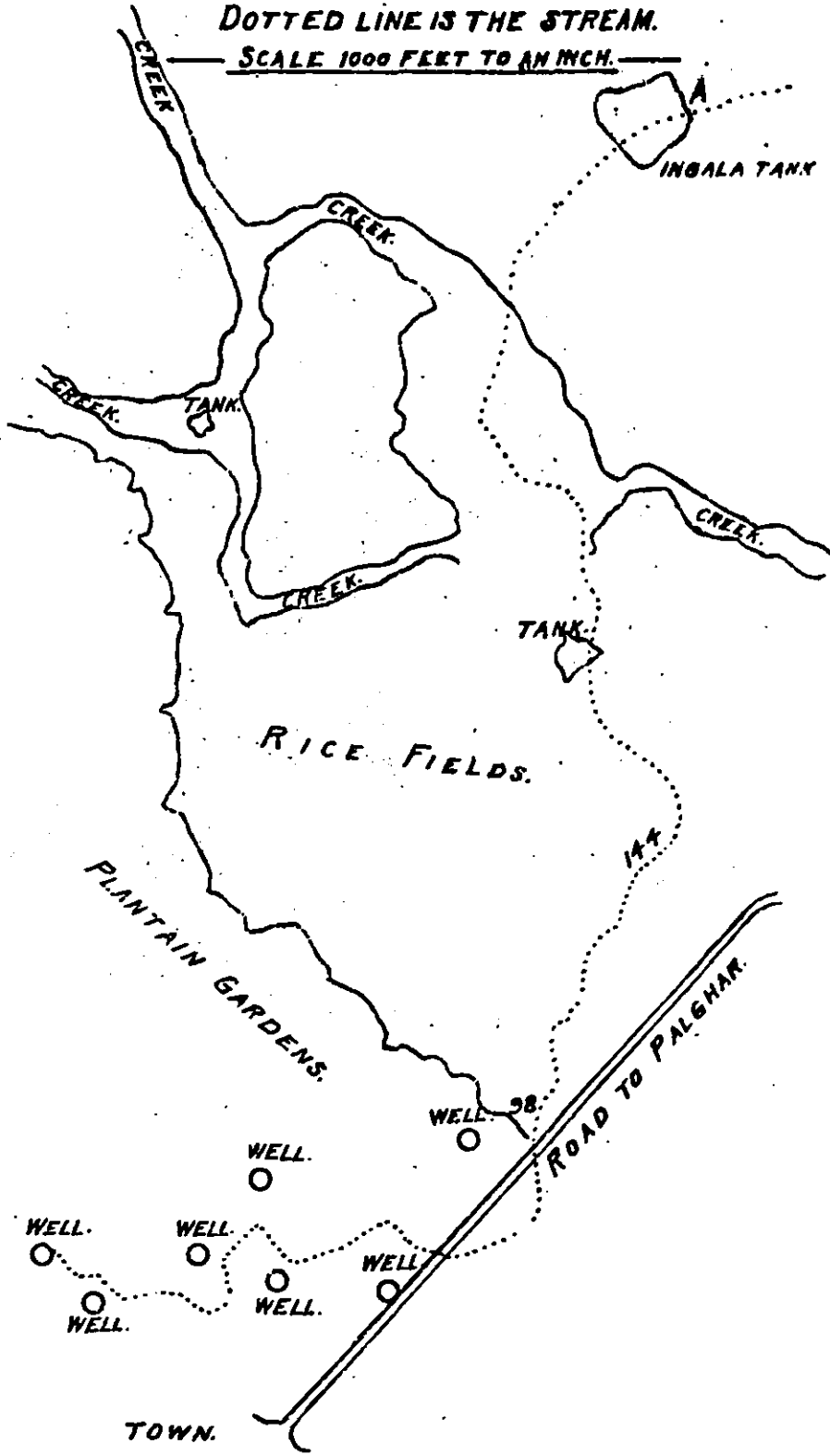
such wells, and in each case a good indication was obtained; and always only on the side from which the stream appeared to flow.

- (2) Near wells that were failures, the instrument either did not indicate anything or showed a stream or streams to pass by the sides; in the latter case indirect evidence could always be obtained. The wells, sometimes, contained water percolating by the sides which could only have been derived from streams near at hand. This was the case in Dr. G. S. Sahasrabudhe's gardens at Poona. At Tembhurni we saw that the surface of the well was always wet and on the side where the instrument had given good indications.
- (3) Where the stream was known to be powerful, the instrument pointed to the same conclusion. Where, on the other hand, it was known to be feeble, the movements of the needle were slow and feeble. Where, again, the movements of the needle changed abruptly from feeble and slow to rapid, the instrument could always detect another stream close by. This was the case at Tembhurni as well as in Dr. G. S. Sahasrabudhe's gardens at Poona; two streams were found to unite together to form one stream at a certain point where, as should have been expected, the movements of the needle were better than anywhere else.
- (4) A definite limit could in each case be found beyond which the instrument would not be affected by the stream and, in fact, it was this that rendered the tracing of streams for considerable distances possible. This limit was great for powerful streams, while for weaker ones it was comparatively small.
- (5) A rough idea could be obtained of the depth and strength of an unknown stream by comparing the movements of the needle above it with those at points above one of known strength and depth.

SKETCH 1.

DOTTED LINE IS THE STREAM.

SCALE 1000 FEET TO AN INCH.



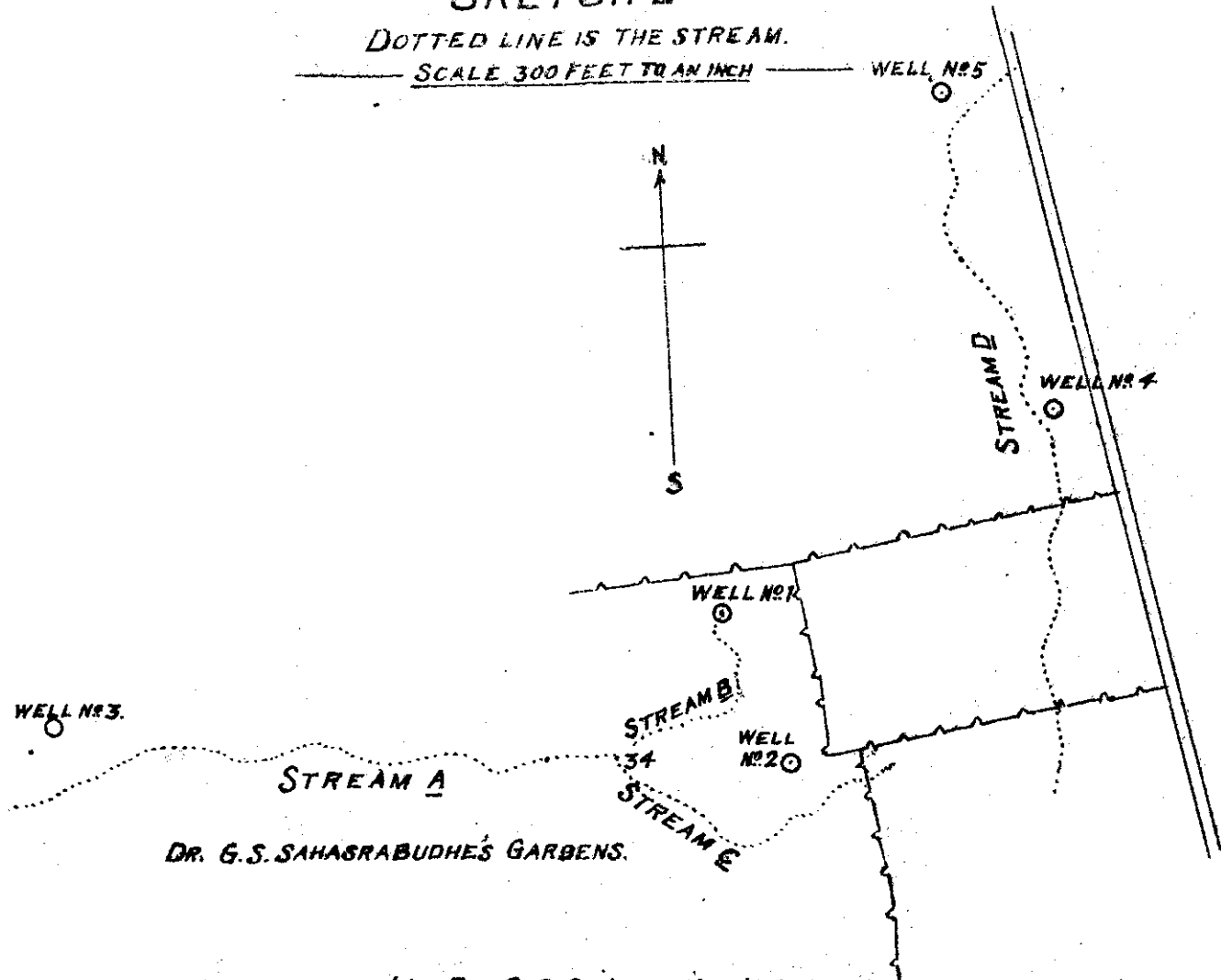
Stream traced at Kelva Mahim (Thana District)

B 768

SKETCH 2

DOTTED LINE IS THE STREAM.

SCALE 300 FEET TO AN INCH



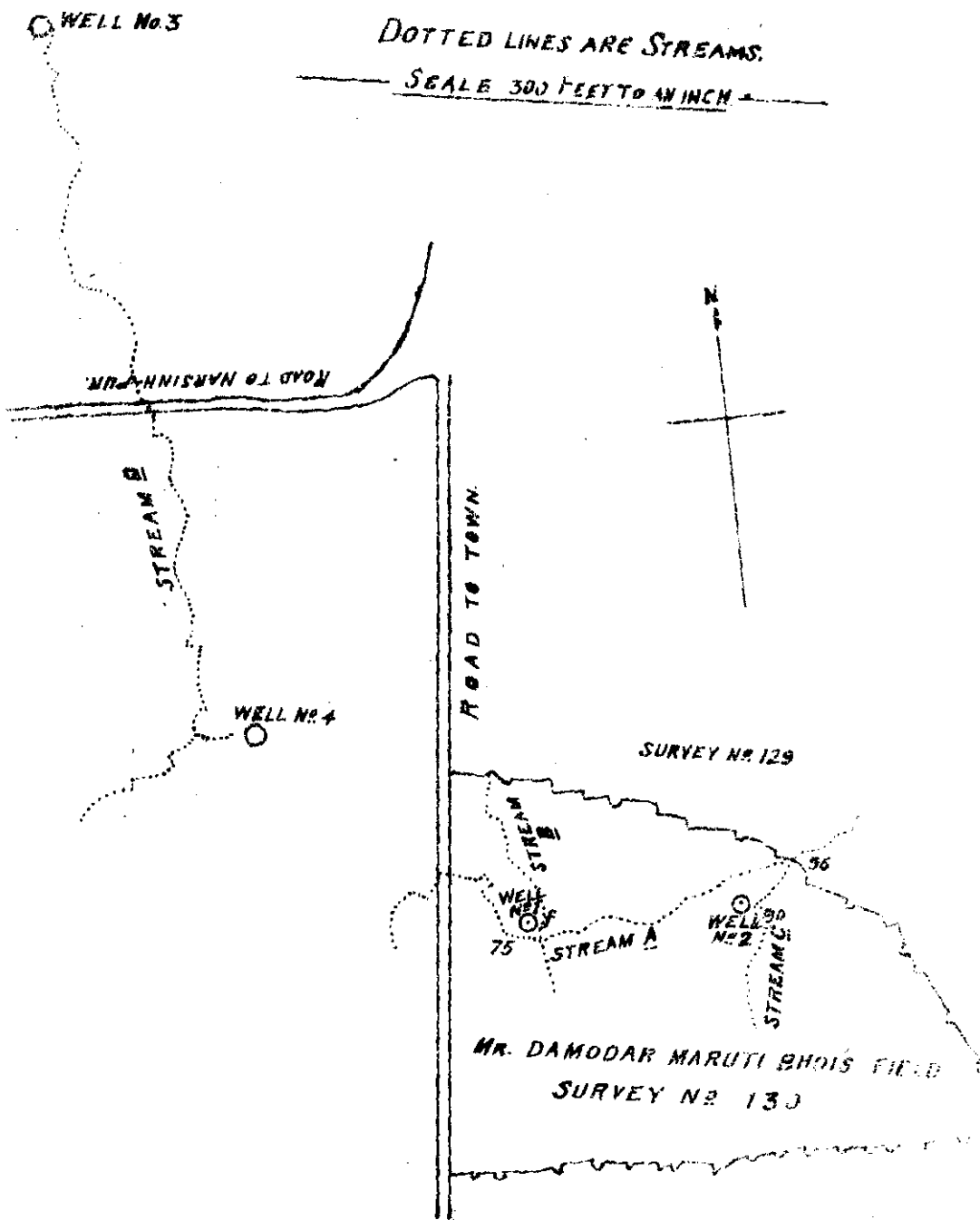
DR. G.S. SAHASRABUDHE'S GARDENS.

Streams traced in Dr. G.S. Sahasrabudhe's Gardens in Poona.

SKETCH 3.

DOTTED LINES ARE STREAMS.

SCALE 300 FEET TO AN INCH



Streams traced at Temburni.
(Sholapur District.)