

DOWSING: A REVIEW OF EXPERIMENTAL RESEARCH

by GEORGE P. HANSEN*

ABSTRACT

Although considerable research has been done on dowsing, its status remains uncertain. This research is reviewed in an attempt to clarify this problem. Late nineteenth and early twentieth century work is summarized to provide historical background. The parapsychological work and the experimental investigations concerning human sensitivity to magnetic fields are reviewed; the results have not been consistent. In both areas the level of experimental control has varied enormously, and positive, although not conclusive results have been found with reasonably good controls by investigators from both standpoints. The work on the physiology of dowsing is also reviewed. The controversy regarding the cause of movement of the rod, the Soviet research, and sociological studies of water witching are also discussed.

Published in the *Journal of the Society for Psychical Research*, Vol. 51, No. 792, October, 1982, pp. 343-367.

Dowsing is a term commonly used to denote the practice of locating underground water with a forked stick; however, in practice its use is really not so restricted. Dowsing is also used to determine answers to other questions such as the sex of an unborn child, and the location of pipes, or for foretelling the future. Numerous exotic instruments have been used by dowsers including scissors, pliers, crowbars, and even German sausages. Probably the three most common instruments are the forked stick or Y-rod, the pendulum, and the L-rod, usually made of a piece of wire or rod bent in the shape of the letter 'L'. The terms water witching, rhabdomancy, radiesthesia, and water divining have also been used as synonyms for dowsing.

In this paper we shall consider dowsing to be a problem-solving technique which apparently utilizes a motor automatism in conjunction with a mechanical instrument to obtain information otherwise unknown to the dowser. Classically, dowsing has been used to solve location problems with the dowser standing or walking over the area of interest. Some dowsers do not use instruments but experience bodily sensations (such as a feeling of heat in the palm of the hand, or a sharp pain in the back). A few examples of this will be considered. Animals also seem to have abilities to find hidden objects (e.g. Rhine, 1971), but this topic will not be discussed here.

The historical origin of dowsing is unknown. Numerous references to water finders and similar terms have led some to think that it is thousands of years old. The first published description of the dowsing rod is probably Georgius Agricola's *De re Metallica* dated 1556 (translated in 1912 by the then future president of the United States Herbert Hoover). From an extensive survey of the literature, Barrett and Besterman (1926/1968) found the first unmistakable reference to the dowsing rod was in 1430; although many earlier works have been construed as referring to dowsing. Two major works on the history of dowsing are by Barrett and Besterman (1926/1968) and by Bird (1979).

The dowsing rod has always been steeped in controversy. Martin Luther thought it the work of the devil. On the other hand, many medieval dowsers

* I wish to thank Dr. Robert Morris and Mark Shafer for suggestions of improvements of earlier drafts of this paper.

baptised their rods along with a child so that they might address the rods by a Christian name. Today the U.S. Geological Survey asserts that dowsing does not deserve further study (*Water Dowsing*, 1977): it claims to have reviewed scientifically controlled tests; but gives no indication of what these tests were. Ellis (1917) wrote the only comprehensive report on water dowsing to be published by this body. Although a 28 page bibliography was included, no data were presented to evaluate dowser's claims; it was largely a historical review. In contrast, the U.S. Army Corps of Engineers has hired dowsers, and the Corps' chief has said with qualifications that he would hire a dowser under some circumstances (*Dowsing Can't Work . . . And Bumblebees, of Course, Can't Fly*, 1968). *The New York Times* reported that the U.S. Marine Corps used dowsing in Vietnam (Baldwin, 1967).

Various sources describe anecdotal cases (e.g. Barrett, 1900; Besterman, 1938; Bird, 1975, 1977, 1979; Dykshoorn, 1974; Haines, 1926; Katz and Paulson, 1948, 1949; McMahan, 1947; Pease, 1884; and Wyman, 1977). In *Water Witching U.S.A.*, Vogt and Hyman (1959) argue at some length that anecdotal evidence does not constitute rigorous scientific proof of the effectiveness of dowsing.

Today two major controversies remain unresolved concerning dowsing (apart from whether it works). The one most discussed is how the dowser obtained the information he is seeking. The second question concerns the cause of the rod's movement; very little work has been done on this. Some work however has been devoted to studying the physiological correlates of dowsing reactions.

Several explanations have been put forward as to how the dowser gets results. Debunkers claim that dowsers are little more than good practical geologists (e.g. Riddick, 1951, 1952). Rawcliffe (1952/1959) suggests that a dowser may occasionally exercise the maximum powers of human observation (e.g. he may note the colour of soil and vegetation, slight differences in growth of plants such as direction of root structure, etc.), and that he processes all this information and moves the dowsing instrument accordingly; at the unconscious level. This is a 'normal inference' explanation. A second explanation is that dowsers react to some known type of radiation (e.g. electro-magnetic) in a little understood way—this is often called the physical theory. A third explanation is that the dowser uses some form of ESP. This has been called the psychical explanation; although to some extent this may be said to explain the unknown by the unknown.

Normal inference explanations may account for some of the anecdotal cases, but they are of little intrinsic interest. It is worth noting that experiments have demonstrated the helpful effect of dowsing in the presence of a person who knows where the hidden object is (e.g. Stratton, 1921; Foster, 1923). The dowser in fact may be able to 'read' subtle behaviour cues as to location. Such possibilities should of course be eliminated in experimental work.

This paper examines the scientific literature on dowsing in the light of these controversies. A brief review of the late nineteenth and early twentieth century studies gives some historical background. Experimental work assuming a biophysical basis for dowsing is considered; a section has also been included on experimental work concerning the physiological concomitants of dowsing. The parapsychological investigations are reviewed with special attention to adequacy of experimental controls. The controversy regarding the movement of the rod is

discussed. Although most authorities believe that it is due to unconscious muscular action, some evidence indicates that PK may sometimes be involved. The scant information available from the Soviet bloc countries is reviewed; and there is a section on sociological studies of 'water witching'.

EARLY RESEARCH

From the earliest days of the Society for Psychical Research, and perhaps before, there was a controversy as to whether dowsing was a physical or psychical phenomenon. Sir William F. Barrett, professor of physics, at the Royal College of Science in Dublin and a principle founder of the SPR, led research on the phenomenon and published two lengthy articles in the Society's *Proceedings* (Barrett, 1897–98, 1900–01). He favoured the psychical explanation; although he also conducted experiments which indicated that some individuals were sensitive to magnetic fields (Barrett, 1884). Continental investigators largely supported the physical hypothesis. Carl von Klinckowstroem, a German research scientist, argued that dowsing could be explained in purely physical terms although the actual physical stimulus (or stimuli) has yet to be defined (Klinckowstroem, 1912, 1925, 1959; Besterman, France, and Klinckowstroem, 1931). Charles Richet, Nobel prize winner and former President of the SPR, suggested that dowsers respond to some type of radiation emanating from various materials (the prevailing view of French dowsers of his day, e.g. Mager, 1931), but claimed that it resembled cryptaesthesia, his term for ESP (Richet, 1923).

One of the experiments conducted by Barrett to test the physical theory was to determine if dowsers could detect the presence of radium salts (Barrett, 1910). Radium salts were placed in a lead case behind the dowsers with the lid sometimes open and sometimes closed. The dowsers involved registered reactions (sometimes quite violent ones) with the lid both open and closed. It was concluded that radioactivity was not the dowsers' source of information. It is not clear whether Barrett's rather strongly stated conclusions were completely warranted. No indication was given whether or not the dowsers had more hits than chance would predict. The experiment was apparently not conducted double blind; thus misleading sensory cues could have biased the results.

Barrett also conducted a number of experiments which supported the psychical theory. Here is a description of one:

A coin was to be hidden in some part of the room in the absence of the dowsers and while all those present in the room looked out of the window, the person hiding the coin was then to leave the room, and one of the dowsers called in to try and find the coin. This was done five times; first the coin was hidden by Sir William Barrett beneath an article lying on a chair in the large Council Room, 45 other chairs being similarly covered. The odds against finding the coin at the first venture were thus 45 to 1, but when Mr. Young was called in he immediately indicated the correct chair. Mr. Young again left the room, accompanied by a guardian, and the coin was hidden under another chair, which was again correctly indicated by Mr. Young. The odds against two such consecutive successes being due to chance coincidence are 2,025 to 1. (Barrett and Besterman, 1926/1968, p. 258).

At the end of five trials, Barrett concluded that the odds against chance occurrence were 80,000,000 to 1. Although these results are impressive and some precautions were taken, not all normal influences were ruled out. There is no indication that the chair selection process was random. The hiding of the coin may have slightly disturbed the original positions of the chairs thus giving a clue. Overall, the methodology of Barrett's experiments (at the same level as other investigators of his time) is inadequate by today's standards.

The work done by investigators over 50 years ago can be considered only exploratory. The procedures and results are difficult to evaluate because often few details are given and afford no firm basis for conclusions. Nevertheless the anecdotal material collected and the experimental results obtained have suggested further areas of investigation.

BIOPHYSICAL INVESTIGATIONS

To the orthodox scientific community, probably the most acceptable method of studying dowsing is through biophysics. This approach assumes that some humans may be able to detect low levels of known types of radiation in a little understood manner. The most widely cited investigators using this approach who have published in English include Maby and Franklin, Tromp, Rocard, Harvalik, and Chadwick and Jensen.

A book published in 1939, *The Physics of the Divining Rod* (currently available from University Microfilms), described the experimental investigations of J. C. Maby and T. B. Franklin, who concluded that ordinary dowsing sprang from a special physiological faculty which could be explained along classical scientific lines (Maby, 1941). Although this work is often cited, the published reviews have frequently been unfavourable. The reviewers for the Society's Journal and for *Nature* assert that the experiments are not well enough described to evaluate (C. C. L. Gregory, 1940, 1941; Ellison, 1969; and *The Physics of the Divining Rod*, 1940).

One of the most extensive works describing experimental research on dowsing from a biophysical viewpoint was written by Dr. Solco W. Tromp. Tromp, a Dutch professor of geology, has produced numerous articles on geology and two books on medical subjects and served as the director of the Bioclimatological Centre in Leiden. His most widely cited book in psychical research is probably *Psychical Physics* (reviewed by Robertson, 1950; R. Wilson, 1951). Much of this reviews literature concerning the effects of electric, magnetic, and electromagnetic radiation on biological organisms. It also surveys the literature on geophysical fields and meteorological fields such as radioactivity and air ions, and—more briefly—some tests conducted in both laboratory and field conditions to determine levels of sensitivity in dowsers, and the physiological changes they experienced during dowsing. The volume covers many areas; the bibliography cites 1496 items the majority not in English. Tromp (1955, 1968, 1972) has also published brief articles dealing with additional research findings and summarizing some of the material in his book.

Tromp conducted tests to determine dowsers' sensitivity to magnetic fields in the laboratory. A tangent galvanometer with a wooden ring of 1.0 meter diameter and one coil of wire was used to create a magnetic field. The galvanometer was equipped with a reportedly noiseless switch and noiseless

swivel. For many of the tests, dowsers used a U-shaped rod. Tromp found that dowsers could detect *changes* in the strength of an electromagnetic field (for instance, by walking through an area with a varying field strength, by switching current on or off, or by changing the direction of the field) but could not detect the field strength itself. His experiments showed that sensitive dowsers could detect gradients of less than 0.1 gauss per meter (the strength of the earth's field is roughly 0.5 gauss, a child's magnet is of the order of 1,000 gauss). After 20 trials the dowsers became fatigued and could not respond accurately, but for the first twenty trials, those he found sensitive responded correctly 80 per cent of the time. The tests with the tangent galvanometer were conducted with the dowsers blindfolded and with cotton-wool placed in their ears. The person recording the responses was not aware the current was on or off; however, the experimenter controlling the switch was in the same room as the dowser. Tromp noted that some dowsers took up to eleven seconds to respond to the change in the electromagnetic field; but did not mention how the length of each trials was established or the actual number of subjects, trials, or successes.

In other tests conducted with the artificial magnetic fields, dowsers used pendulums. Tromp found that persons not sensitive to the artificial fields when using the loop shaped rod, were sensitive when using the pendulum; and also that, in contrast to findings with the rod, persons using a pendulum could detect differences in field strength. The numbers of subjects, trials, and successes were again omitted.

Tromp reported moreover that dowsers could detect electrostatic fields. The experiments are described briefly and the level of experimental control undertaken is not clear.

Tromp also tested dowsers under field conditions. Dowsers were led along a path in a house, and locations where dowsing reactions occurred were noted. For most of the experiments, dowsers used pendulums as dowsing instruments because Tromp found that they produced the quickest reactions. A magnetic survey was made afterward along the same path. Definite correlations were found between the 'dowsing zones' and the magnetic disturbances. Dowsers were also tested out of doors to determine if they could locate subsurface discontinuities which could not be predicted by even very experienced geologists or botanists. They traversed a pre-assigned path and their reactions were recorded. A soil resistivity survey was made after the dowsing tests (resistivity surveys indicate underground discontinuities). In nearly all the surveys statistically significant correlations were reported between low soil resistivity and dowsing reactions. It was not clear whether the soil resistivity survey was conducted by a person blind to the dowsers' responses.

Although Tromp found strong correlations between changes in magnetic field strength and dowsing zones, he did not conclude that there was a causal relationship between the two where field conditions were concerned. He suggested that dowsers might be sensitive to very low level infra-red radiation, since they could detect changes in soil resistivity although the accompanying magnetic field fluctuations were very small (producing gradients far smaller than those detected by dowsers in his laboratory). Unfortunately he did not present any experimental data to support this hypothesis.

Tromp ruled out a psychic explanation since his dowsers could not predict

zones of disturbance (e.g. low soil resistivity) at a distance. Map dowsing tests he conducted with people claiming such ability were unsuccessful (Tromp, 1968). As no details were given, an evaluation of the methods and results is not possible.

Yves Rocard, professor of physics at the *Ecole Normale* in Paris, also studied the relation between dowsing and electromagnetic radiation. Much of his research on dowsing is discussed in his book *Le Signal du Sourcier* (reviewed by Montgomery, 1964; Parsons, 1963; and Thouless, 1964). Only two very brief summaries seem to have appeared in English (Rocard in Barnothy, 1964; L'Huilier, 1968). In his experiments Rocard set up a wooden frame (50 cm by 100 cm) wrapped with 100 turns of fine wire. The frame was placed in a location with reportedly no stray magnetic gradients. The subjects were given a brief training period on how to hold the Y-rod and allowed to practise when they knew the current was on or off. Rocard reports that during the testing, every precaution was taken to prevent the dowser from knowing whether the experimenter turned the current on or off but gave few details. He concluded that a dowser could detect a changing artificial magnetic field of the order of 0.3 to 0.5 mO/m (approximately equivalent to 0.0003 to 0.0005 gauss per metre in air) at the level of the subject's chest if the dowser were walking at a normal speed. Rocard claimed that a good dowser is never wrong when attempting to detect this signal as long as he is not overworked. He noted that smaller gradients could be detected if the dowser were walking faster or travelling in a vehicle as long as the change was at least 0.3 to 0.5 mO/sec (0.0003 to 0.0005 gauss per second). It was also found that the reaction of the dowser was more pronounced if two coils of wire were used in series. This gave the dowser a longer exposure to the field. Rocard noted that below 0.1 mO/sec (0.0001 gauss per second) detection was inaccurate. It was also found that gradients in excess of some uncertain amount produced 'saturation'; presumably this means that the dowsers were not sensitive to gradients above this level. Rocard also noted that if magnets were attached to the forearms of the dowsers, no reaction was obtained, but if a similar non-magnetic object were used, the dowsers were still able to respond. Presumably no indication was given to the dowsers as to which were and were not magnetic. It was also observed that dowsers' responses were much less clear with a pendulum than with a rod (although this contrasts with Tromp's comments, it should be noted that Rocard's subjects used a type of rod unlike those used by Tromp's subjects). No indication is given as to the number of subjects Rocard tested; thus it is difficult to know whether the indicated range applies to most or only a few dowsers.

Rocard noted that water filtering through porous media in permeable layers next to clay layers might be expected to produce a magnetic gradient on the order of 0.1 mOe/m (0.0001 gauss per metre).

One of the most prolific American investigators of dowsing is Dr. Zabo J. V. Harvalik, a retired professor of physics formerly at the University of Arkansas and a former adviser to U.S. Army's Advanced Concepts Materials Agency. He is now a vice-president of The American Society of Dowsers (ASD). Nearly all his work has been published in *The American Dowsing*, the quarterly publication of ASD (and has appeared in nearly every issue since 1970). The present writer does not know whether independent investigators have tried to replicate it.

Much of this work was done with electromagnetic fields. He, too, has found

that dowsers are sensitive to changes in magnetic field strength though not to absolute magnitude, but believes them to be much more sensitive than other investigators have indicated and that a fairly sensitive dowser can respond to a change of 1×10^{-6} gauss per second (Harvalik, 1970). Later in this report he claimed that an average dowser could detect a change of 3×10^{-7} gauss, a skilled dowser 3×10^{-8} gauss, and an exceptional dowser 7×10^{-9} gauss (the actual gradient involved is not completely clear) and that he tested one subject, Mr. De Boer, who could detect changes of 2×10^{-10} gauss. He mentioned that he found the L-rods gave better results than the forked stick and were easier and more sensitive for inexperienced dowsers. Only final results are presented in many of his reports, and methods of statistical evaluation are not discussed. It is unknown whether double blind conditions were strictly observed and whether all normal sensory cues were eliminated. One of his reports (Harvalik, 1978) is notable for the amount of detail it contains; it is discussed further in the Physiological Studies section of this paper.

Harvalik also found that dowsers could detect and discern different radio frequencies and radioactive substances even with considerable shielding (Harvalik, 1973a; Harvalik and De Boer, 1976). As with many of his experiments, the level of control is uncertain, and replication by others is needed before conclusions can be drawn.

Duane Chadwick and Larry Jensen, electrical engineers from Utah State University, produced one of the most detailed reports of a preliminary investigation concerning magnetic fields and dowsing. In a series of experiments (Chadwick and Jensen, 1971), a number of subjects, most without previous dowsing experience, separately walked along several pre-assigned paths with dowsing rods (mainly L-rods). They were given a set of wooden blocks and asked to place a block at each location where they obtained a dowsing reaction. After the dowsers had traversed the path, a magnetic survey was carried out.

A statistical analysis was made to determine whether there was any patterning of the dowsers' responses. Chadwick and Jensen found that on certain portions of the path, dowsers were much more likely to experience dowsing reactions. The probabilities of this patterning (more reactions in some areas than others) occurring by chance ranged from $p = 0.06$ to $p < 0.0005$. If this were a parapsychological experiment, one might conclude that a very strong stacking effect was observed.

Chadwick and Jensen gave a graphical representation of the relation between the dowsers' responses and the magnetic field but did not present a full statistical evaluation of these data; so it is not clear whether the correlation would be statistically significant (though it well may be). In areas with a gradient of 0.5 gamma per foot (0.000016 gauss per metre), more reactions were obtained than when the gradient was less.

In some experiments an iron bar was buried along the test path and there was reportedly no visual indication of its presence. The iron bar produced a distinct magnetic anomaly. From the graphical data presented it seems unlikely that the number of dowsing reactions near the bar was due to chance.

In another experiment the subjects were given 30 wooden blocks and were asked to drop them wherever they felt like it while on an assigned path. The patterning of responses among the subjects was more consistent than would be

expected by chance at the 10 per cent level. When compared with the magnetic survey, on the average there were as many reactions in areas with the gradient greater than 0.5 gamma per foot (0.00016 gauss per metre) as in cases with a smaller gradient. It appears that this method which requires some conscious involvement to achieve a dowsing response was not effective. The apparently unconscious movement of the dowsing rods seems to make for greater accuracy.

Chadwick and Jensen did present calculations to show that the expected change in the magnetic field due to an aquifer (an underground formation containing water) could be as high as 0.0043 gauss. From previous data it seems that a dowser might be able to detect this. However, Chadwick and Jensen did not conclude that dowsing was necessarily an efficacious method of locating underground water. They noted that no wells had been dug in their study, that the type of information actually used by the dowsers was undefined, and that the patterning of the dowsers' responses was not necessarily due to magnetic anomalies. Although they did *not* conclude that dowsers were sensitive to magnetic anomalies, they did conclude that further research was warranted and recommended that extraterrestrial radiation be monitored during testing, or that tests be conducted in an environment shielded from all extraneous magnetic influences. They also noted that it is not clear which (if any) magnetic field the dowser might be detecting (e.g. field at ground level, at head level, gradients in vertical or horizontal plane, etc.).

W. H. Jack, a parapsychology instructor at Franklin Pierce College in New Hampshire, experimented to determine whether subjects could use dowsing to detect a current flowing through a wire (Jack, 1978). The twelve subjects, members of an experimental parapsychology class, used L-rods to determine whether or not a current of 0.1 amp was flowing through an extension cord (no data were given as to the resulting magnetic field strength or gradient). The subjects were asked to report whether the current was on or off. Of 240 trials, there were 141 hits ($p < 0.01$). Jack indicated that the subjects were in familiar surroundings, in good rapport, and involved in the experimental design, but admitted that the study was not conducted double blind. The person recording whether power was on or off also recorded the dowsers' responses—allowing the possibility of biased recording errors. From the report, one might be given the impression that the subjects were using psi to obtain the correct results; even if there were no recording errors or other sensory leakage, there could have been an effect due to electro-magnetic radiation. The report does not show whether the intent was to investigate a psi phenomenon or a biophysical one.

Jack (1977) also conducted an experiment in which six rather inexperienced dowsers (college students) attempted to locate a vein of water previously dowsed by several more experienced ones. Twenty-six two-metre long intervals were marked with stakes along a road, and the subjects were asked to use L-rods to determine the previously selected interval. A majority vote was taken, and the group did pick the correct interval, $p = 0.038$. A definite effort was made to establish a realistic dowsing situation and psi conducive environment. The subjects were told that the experimenter planned to build a house and needed a well and were encouraged to visit the site when the well was to be dug. A picnic was held after the dowsing test. It appears that the test was not conducted double blind; the experimenter apparently knew the location of the pre-selected interval

and was present during the test. It is also uncertain whether the dowsers were using psi, or reacting to some electromagnetic radiation, or some other stimulus. Overall, the result basically confirms the patterning of responses noted by Chadwick and Jensen.

Several experimental failures to support the electromagnetic hypothesis have been reported.

Foulkes (1971) attempted to replicate Rocard's work with artificial magnetic fields. Coils of wire similar to his were set up. The dowser (who claimed such ability) was given a short series of learning trials in which he knew whether the current was on or off. Three runs of 25 trials were held with no indication given to the dowser whether the current was on or off. Only chance results were obtained. Unfortunately only one dowser was used in this study. No mention was made whether there were possible magnetic anomalies in the area of the testing.

Whitton and Cook (1978) also conducted two experiments attempting to determine whether subjects could detect the presence of weak magnetic fields. In the first, twenty-seven subjects, two believing themselves to be dowsers, were asked to determine whether current was flowing through a coil similar to that of Rocard's (here alternating current was used). Each was allowed a preliminary learning trial conducted without the use of dowsing instruments, although the subjects were allowed to move around. They simply stated verbally whether the current was on or off. Only chance results were obtained. In the second experiment, eleven subjects, none of them professional dowsers, were asked to determine whether current was flowing through the coil of wire when it was placed in a known horizontal position beneath the floor of the room. In this case direct current was used. The subjects were given L-rods to use. Again they gave verbal reports. Here also only chance results were obtained. No mention was made as to whether there were possible magnetic anomalies at the test site.

Balanovski and Taylor (1978) claim to have tested dowsers' sensitivities to magnetic fields. They found that those tested were insensitive to fields of 100 gauss. Taylor (1980) reported that one dowser tested with 500 gauss was also not sensitive. No gradients were indicated in the reports, and no details were given as to testing procedure. Taylor and Balanovski (1979b) also tested a number of persons, including dowsers, for sensitivity to high-frequency low power level electromagnetic fields. The subjects sat close to an antenna while the power was randomly switched on or off. Between 10 and 60 trials per subject were conducted but they were apparently unable to tell whether the power was on or off. Taylor and Balanovski (1979a, c) conclude that dowsing is not possible because the level of sensitivity required is far greater than that they claim for human capability.

Much work has been done concerning the effects of electromagnetic radiation on living organisms; Barnothy (1964), Presman (1970), Persinger (1974), and Dubrov (1978) have summarized the findings. Except for work on dowsing, very little has been done to determine the effects on humans of very slight changes in magnetic fields. Some work in biophysics indicates that at times a small field has a greater effect on a living organism than a stronger field (Presman, 1970). There have been anecdotal reports of persons receiving radio broadcasts from the fillings in teeth; presumably the radiation involved is relatively low intensity. Wieske (1963) reported two cases of amazing auditory sensitivity to electric

fields. One woman could even hear telephone conversations by listening to the wires!

Because of the wide range of findings reported as to the sensitivity of dowzers, it is difficult to draw conclusions. Although there is positive evidence that humans do have some ability to detect weak electromagnetic fields, the results of Whitton and Cook, and Balanovski and Taylor challenge the conclusions of other investigators. It is far too early to conclude that this sensitivity can be used to detect underground water.

Further experiments appear justified and could have wide ranging implications. Work could be done to determine human thresholds of sensitivity to horizontal and vertical magnetic fields (ideally in a shielded environment to eliminate extraneous magnetic fields). The psychological state of the subjects might usefully be varied; perhaps relaxation would facilitate greater sensitivity. Any further work must use extremely tight controls to rule out alternative information sources. The results of such experiments might indicate unsuspected communication systems; if so, such knowledge would have useful applications.

PHYSIOLOGICAL STUDIES

In contrast to the biophysical investigations just discussed, there is considerable agreement among studies of the physiology of dowsing. Various anecdotal reports indicate that some good dowzers experience profound physiological changes while dowsing. Barrett and Besterman (1926/1968) reported instances of dowzers becoming dizzy or sick while standing over underground water. Bill Cox, a prominent American dowser, reported that an extremely sensitive dowser he trained would vomit while standing over a good water well location. Tromp and Rocard have reported on European work, and Harvalik has described more recent American work.

Tromp (1949) conducted a number of experiments measuring the skin potential between wrists of dowzers. Tests were used to monitor skin potential while dowzers were exposed to artificial magnetic fields, while walking through 'dowsing zones' (a rather vague term; in some instances they were definitely associated with magnetic anomalies), and while walking next to human beings. An Einthoven string galvanometer was used to record skin potential. The loop-shaped dowsing rod was placed in insulated grips, and a special circuit was established which included part of the dowsing rod (Tromp conducted several experiments to ensure that the circuit did not change skin potential).

In dowzers exposed to an artificial magnetic field from a tangent galvanometer, changes in skin potential were registered almost immediately after the field was developed. The report does not show whether the dowzers knew whether or not the current was on. Tromp cited evidence to support the argument that changes in the electrocardiograms recorded by the Einthoven string galvanometer during these experiments were not due to psycho-galvanic reflexes (a psycho-galvanic reflex is a sudden decrease in skin resistance accompanying a mental reaction such as that caused by calling a person's name (frightening him, etc.)). Tromp tested the monitoring equipment to ensure that the change was not caused by induction potentials. In other experiments, he had dowzers walk over dowsing zones while their skin potential was being monitored. Very distinct changes were found while the dowzers were in the dowsing zones,

changes which did not occur if the dowzers were outside a dowsing zone and intentionally moved the dowsing rod. He also found that the same changes occurred when the dowzers walked through the dowsing zone but did not carry the rod and that persons not especially sensitive exhibited similar changes except the changes were slower and less pronounced.

Tromp noted that persons sensitive to dowsing had much lower skin resistance than those not sensitive, and claimed that non-sensitive persons can be made sensitive for a short time by washing their hands. In other experiments, the skin potential was monitored while a dowser moved the rod over the body of another human. Tromp found differences when the rod was held over the head and when over the feet. There were different changes for men and women. Few details are given of these experiments; the results would be strengthened if influences such as psycho-galvanic action could be convincingly ruled out.

A number of American studies have been done with Henry Gross, a dowser made famous by the works of historical novelist Kenneth Roberts (1951, 1953, 1957).

Gallay (in Roberts, 1953) reported on a short study conducted with Henry Gross by a group of electrical engineers familiar with Tromp's work. They attempted to verify and extend it. For the first part of the experiments, the skin potential was monitored while working indoors doing 'long range' dowsing rather than walking back and forth over known underground water. On some of the trials a noticeable change occurred; however, subsequent trials did not obtain significant results. In the latter part of the experiments, the tests were conducted near a known vein of water. When Gross walked over the vein of water, a change of 100 millivolts was noted, which returned to approximately normal after he crossed it. For the nondowzers tested, changes of less than 10 millivolts were generally recorded. In a later set of experiments, Gallay tested a Canadian dowser, Desrosiers. Desrosiers used no dowsing instrument but experienced his dowsing reactions as painful sensations on the soles of his feet and in the small of his back. Changes in skin potential were from 100 to 200 millivolts when he walked over the known water vein. The maximum change noted with a number of non-dowzers was 30 millivolts. The location of the water vein was apparently known to the dowzers; again the results would be strengthened if psycho-galvanic action could be ruled out.

Berthold E. Schwarz, a psychiatrist, also investigated the physiological and psychoanalytical aspects of Henry Gross's dowsing (Schwarz, 1962-63 and 1968). Electroencephalographic studies were made while Gross was dowsing for water veins near the laboratory; map dowsing for water; and dowsing for objects hidden in the laboratory. Schwarz concluded that there were no associated measurable changes on the EEG other than increased eye movement and muscle artefact. The report indicates that all testing was done in the laboratory but none while Gross was crossing an underground vein of water or other dowsing zone. Although these tests were not designed to determine dowsing's effectiveness, Schwarz did report some notable successes for near distance dowsing, map dowsing, and dowsing for hidden objects. These can only be considered anecdotal cases because no statistical evaluation was presented and the tests did not always exclude sensory cues.

Schwarz also conducted experiments monitoring respiration, skin resistance,

pulse pressure, and pulse rate. During the periods in which dowsing was attempted the respiration became irregular, the skin resistance decreased, the pulse pressure increased and the pulse rate slightly increased. While Gross was dowsing, the electrocardiograms showed an increase in heart rate of 23 per cent compared to a rest period. These experiments were conducted both in the laboratory and when dowsing for water in the neighbourhood. Schwarz concluded that polygraphic studies suggested that dowsing is associated with a significant expenditure of energy and is a rather abrupt process. The same conclusion could have been reached by watching Gross while he dowsed.

Rocard (in Barnothy, 1964) made several comments on the physiology of dowsing. He noted that electrical resistance between palms of the hands for a 'good' dowser is $\frac{1}{3}$ to $\frac{1}{4}$ that of a 'poor' dowser. No details were given as to how this was determined. Rocard suggested that nuclear magnetic resonance might explain a dowser's sensitivity to magnetic gradients. He argued that protons of the dowser's body in the weaker portion of the field might move at a different rate than those in a stronger portion. This would cause beats detectable by the dowser. Apparently no experimental work was done to test this hypothesis.

Harvalik reports two experiments attempting to locate dowsing sensors in the body. In the first (Harvalik, 1973b), a dowser walked over several dowsing zones (undefined) while a magnetic shield was placed over various portions of his body. Harvalik concluded that the dowsing sensors seemed to be located between the seventh and twelfth rib somewhere in the body. It is not clear whether the experiment was conducted double blind and whether sensory cues were eliminated. In a well described second experiment, Harvalik (1978) reports a study with dowsers detecting low-power high-frequency electromagnetic fields. Fourteen reputed dowsers participated with 694 trials (661 hits, 33 misses). The high-frequency generator was randomly switched on or off; the trials were conducted double blind. Pieces of aluminium sheet were placed on various portions of the dowser's body to shield the 'dowsing sensors' from the radiation. Harvalik concluded that the sensors exist in the area of the kidneys and in the brain, possibly in the pineal region. Several questions can be raised about this experiment. Were the dowsers responding to the electromagnetic radiation or to some other possible stimulus associated with the high-frequency generator (e.g. slight noise or heat)? Secondly, were the dowsers aware of the experimenter's expectation as to location of the sensors? If the dowsers were always able to sense the field, they may indicate no reaction when the shielding was placed in a position they expected to be effective. Overall, given the high rate of success, this is one of the best experiments supporting the validity of dowsing.

Cope suggests several mechanisms to account for sensitivity to magnetic fields. Thus, biological superconductive Josephson junctions might explain such sensitivity (Cope, 1973). In a series of articles (e.g. Cope, 1978, 1979a, 1979b) he suggests that magnetoelectric dipoles might help to explain dowsing as well as auras and other reported phenomena. His work has been financed in part by the U.S. Office of Naval Research. He has not supported his ideas with direct experimental evidence.

Another concept that may concern physiological effects is the rather obscure idea of 'noxious rays'. Some dowsers believe that at certain locations, the earth gives off rays which damage health. Most investigations of this have been done in

continental Europe, and few references have been translated. Klinckowstroem (1959) briefly presented some of the European findings. He concluded that dowsers may indeed react to stimuli from the soil; although their nature may be unknown. Tromp (1968) also reports experiments done in continental Europe. One study found that mice preferred to sleep outside a dowsing zone rather than in one. Mice treated with a carcinogenic tar were said to develop 30 per cent more carcinoma when placed inside dowsing zones rather than outside them. In another experiment, dowsers located several dowsing zones, across which a hedge was later planted. The hedge grew well except at the dowsing zones. Bird (1979) has compiled an extensive list of references on the subject and has described a number of anecdotal cases and experimental investigations. Because the summaries in English are quite brief, it is not possible to evaluate this work critically.

Two topics seemingly similar to noxious rays are those of ley lines and earth energies (supposed systems of energy patterns related to specific geographical locations and detectable by dowsing). C. Wilson (1978) has described some beliefs about this. There seems to be considerable current interest in this area; *The American Dowser* (Earth Mystery Related Publications, 1980) recently listed nine different publications concerned with it. Nevertheless, the present writer knows of no well controlled experimental work dealing with it. Zorab (1959) mentioned that the Royal Academy of Science of the Netherlands had investigated claims regarding earth rays and found them unconfirmed. Hopwood (1979) claimed to have established an artificial ley with a wire and monitored his own dowsing reactions; but Scorer, Parsons, and Tart (1980) pointed out that as the tests were not double blind no conclusions could be validly drawn from them. Taylor and Balanovski (1979b) reporting a test in which dowser Bill Lewis claimed to detect energy bands around an ancient standingstone, noted that magnetometer readings seemed to validate Lewis's claim but that a more sensitive magnetometer would be required for a definite conclusion.

Various studies of the physiological changes accompanying dowsing reactions seem to agree. Changes in skin potential were noted by a number of investigators. There seems to be no evidence disputing this finding for the cases in which a dowser crosses a 'dowsing zone'. Pisani, Deodato, and Nigro (1969) report that a magnetic field (800 Oe) applied to the palms of the hands reduced electrical skin resistance. Perhaps additional work on acupuncture (as described by Tiller in Mitchell, 1974) or other work involving electrical conductivity between points on the skin would shed further light on this matter. Although considerably less work has been done on physiological effects than in attempting to determine whether humans are able to detect weak magnetic anomalies or other electromagnetic radiation, what has been done strengthens the evidence for human sensitivity to such weak anomalies. Harvalik's work attempting to locate dowsing sensors is especially notable for this.

PARAPSYCHOLOGICAL INVESTIGATIONS

Since early investigations by the SPR, various investigators have approached dowsing from a parapsychological standpoint, notably at the Parapsychology Laboratory at Duke University. As with the biophysical work, various levels of control were used, and results have not been consistent.

J. B. Rhine (1950) tested Henry Gross to determine if he could discern whether or not water was flowing through an underground pipeline. The control valve was some distance from the dowsing site and was out of sight of the dowser. For some of the trials a coin toss was used to determine whether the water was to be turned on or off; for other trials it was determined mentally by the experimenter.

In the first section of the experiment, significant missing was found ($p < 0.001$), and the consistency of the missing was also impressive. A noticeable decline effect was also noted between the first and second halves; however, it was not quite significant. Rhine felt that the results indicated the use of ESP and discussed this later (Rhine, 1952). Several weaknesses of this pilot study should be noted. Possibility of sensory leakage was not completely eliminated. Slight vibrations from water moving in the pipe might have been present, and verbal cues between experimenters might have been possible. Although several impressive statistically significant items were found, it seems they were derived from post-hoc analysis, and as discussed by Nicol (1955), this might be explained by possible nonrandomness of the experimenter's mentally determined trials. Taking all the data presented of the tests with Henry Gross, there was no overall significant hitting or missing; Rhine did not comment on this.

Remi Cadoret, an M.D. on the staff of the Duke Parapsychology Laboratory, also investigated dowsing. He experimented to determine if the results and patterns of responses on one ESP task could be used reliably to predict results on another similar task (Cadoret, 1955).

Several pilot series were first run. A penny was placed under one of 25 tiles arranged in a grid (5 by 5). The subjects were taught to use a pendulum (a button on a string) as a dowsing tool and were asked to pick the row and the column containing the penny. Although the possibility of sensory cues was not completely eliminated, overall results were not significant. However a very significant decline effect was found between the first and second halves ($p = 0.0014$).

In another experiment a map was laid over the 5 by 5 grid. The map showed the squares corresponding to the tiles underneath and also corresponding to a grid established in the back yard of the experimenter. For some of the trials, a penny was placed under a tile beneath the map; for other trials a penny was placed in one of the back yard grid squares (the subjects did not know whether the penny was under the map or in the back yard). For this experiment each subject made 18 responses, six using the pendulum, six using roller bearing dowsing rods (apparently L-rods), and six with the subjects calling his findings aloud. From the results of the tests with the pennies below the titles, Cadoret noted the pattern of response in relation to the target (e.g. some dowsers might consistently miss the target by one row or column). He devised a mathematical procedure to predict the correct target square given the dowser's response, and was able to predict the location of the penny for those trials in which the penny was in the back yard significantly better than chance, $p = 0.018$. This experiment was the most tightly controlled, and sensory cues seem to have been completely ruled out.

Karlis Osis also carried out several dowsing experiments while working at the Duke Parapsychology Laboratory (Osis, 1960). One of his special subjects was a Mr. Gwaltney, a superintendent with a local gas company. For one of the tests,

ten small trenches were dug and covered with boards. Eighteen inch long pipes were randomly placed in the trenches. The subject then walked over the trenches while holding a pair of dowsing rods. In the first part of the experiment, the experimenter was present with the dowser, knew the location of the pipes, and recorded the subject's responses, but for the rest of the time the location of the pipes was unknown to the experimenter who recorded the responses. In the experiment with the targets unknown to the experimenter the results were marginally significant ($p = 0.03$). For the entire experiment, the results were quite significant ($p = 0.003$). Normal sensory cues could possibly have played a part; each time the targets were placed, there may have been some slight tell-tale disturbance of the surrounding area. The type of material of the pipe is not mentioned; perhaps the results could be explained by sensitivity to magnetic anomalies rather than psi.

Osis also conducted tests in the laboratory with two selected subjects; one had had spontaneous psi experiences, the other had previous dowsing experience. Either money or photographs were randomly placed under one of 25 tiles arranged in a 5 by 5 grid. Subjects were asked to indicate the row and column in which the target object was placed by using a button on a thread as a pendulum. Based on direct hits, the results were marginally significant ($p = 0.02$). Details given in the report are rather sketchy, and it is difficult to trace whether sensory cueing could have been involved. Osis also tested Cadoret's hypothesis that the patterns of hits and misses on one task could be used to predict hits for a similar task; his data did not support the hypothesis.

Map dowsing tests were conducted at the Parapsychology Laboratory with subjects as far away as Germany. No significant results were obtained. Osis did find one subject with whom there were indications of a consistent missing pattern which might have confirmed Cadoret's hypothesis, but not enough data were collected to draw final conclusions.

Two short studies were reported by Pope (1950) in *Parapsychology Bulletin*. Miss Kirby, Lecturer in Biology at Harrogate Training College in England, conducted a series of tests in which a special subject attempted to locate a coin placed under one of several possible pieces of thick cardboard. Although the experiment was rather short (63 trials), the results were very significant ($p < 10^{-6}$), but though precautions were taken, sensory cues might have been available. In tests conducted by the Physiology Department at Guy's Hospital London, dowsers were asked to determine whether or not water was flowing in a concealed pipe beneath them and to locate the courses of underground drains. Details are sketchy, and sensory cues were apparently not eliminated; they found quite positive results. Unfortunately few details are available, and no number of trials or successes was given.

Moss and Sands (1970) report an experiment in which an experienced dowser was pitted against a novice and a person using a 'scientific method' to predict winners of horse races. The dowser held a pencil over the racing form until a pull was felt to the name of a horse. The novice attempted a similar method. In the first experiment the dowser 'won' more money than the other two when imaginary bets were placed but no statistical comparison was made in the report to determine whether the results were significantly different from chance.

Recently, Anselmo (1978) reported a successful dowsing test. Subjects were

asked to locate coins underneath posterboards. The overall results were considerably above chance ($p < 0.001$). It is not clear whether sensory cues were entirely eliminated, and the experimenter recorded both the dowser's guess and the actual location which allowed possible biased recording errors.

Francis Hitching (1978), author of the book *Dowsing The Psi Connection* (reviewed by Cox, 1978; and Hyman, 1979), conducted a map dowsing experiment testing Bill Lewis, a retired electrical engineer in South Wales, to see if he could use dowsing to locate ancient megalithic sites (standing stones, burial chambers, etc.) in North America. Lewis was given maps of several areas and asked to locate such sites. He held a pencil in one hand and a pendulum in the other; and he moved the pencil over the map until the pendulum indicated a good site. Lewis then asked himself a number of questions which could be answered yes or no. From the information so derived, he gave a description of the site. These predictions and locations were shown to John Stiles, chairman of the ESP committee of the SPR; he formulated a series of similar predictions for locations near the sites of those of Lewis. Stiles made his predictions by guesses based on those of Lewis. Hitching then visited most of the sites and compared the two sets of descriptions with the sites. He found much greater correspondence with the predictions of Lewis than those of Stiles. The major weakness of this procedure is the difficulty of making an unbiased evaluation. The descriptions given by Hitching did indicate that unusual results may have been obtained (his claims were far stronger). More rigorous controls could produce a more convincing demonstration.

A number of unsuccessful experiments have been reported.

Mr. P. A. Ongley, a New Zealand research chemist, tested the claims of 75 dowsers. These ranged from medical diagnosis to tracking people, etc. He concluded that all were unwarranted. Although many tests were conducted, and a large amount of numerical data was presented in his article (Ongley, 1948); few details were given. Many of the claims appear to have been tested with only one or two trials. He seemed to make the tests fair to the dowsers, but the tone of his report suggests that he probably had a rather strong, preconceived opinion against dowsing.

Another series of unsuccessful experiments was reported in *Nature* by R. A. Foulkes (1971). Experiments were organized by the British Army and Ministry of Defence to determine if buried mines could be located by either map or field dowsing; dowsing for water was also tested. For the map dowsing tests, 20 inert mines were buried along several military roads. Seven dowsers were given maps of the roads and asked to locate the mines. Only chance results were obtained. For the field dowsing, a 20 by 20 grid was established with each square being 20 feet (6.1 metres) on a side. Five different types of objects (80 of each type) were buried randomly. Tests were conducted with 22 dowsers to determine whether they could identify the objects. Again only chance results were obtained. An experienced dowser was asked to determine whether water was flowing in a plastic pipe. The water was randomly turned on or off for 50 trials. No significant results were obtained. From the report, the tests seem to have been well organized and well conducted.

Another unsuccessful experiment was conducted by several members of The American Society for Psychical Research including Laura Dale, Gardner

Murphy, and Montague Ullman (Dale, Greene, Miles, Murphy, Trefethen, and Ullman, 1951). Twenty-seven dowsers were taken separately to a small field near Liberty, Maine and asked to locate the best spot for a well, estimate the depth, and the flow rate. Pipes were later driven, water level measured, and the wells were pumped to determine the capacity. A water engineer and a geologist were asked to estimate depth and flow rate at several locations (the engineer and geologist knew of a nearby well, the dowsers did not). The soil was relatively soft, and the water table was nearly level and close to the surface. The geologist's and engineer's predictions were quite good; the dowsers' predictions were quite far from the mark. Because the water table was nearly level over the site, perhaps there were no distinct subsurface anomalies.

Barrington and Stiles (1973) conducted an investigation of a commercial divining instrument called the 'Revealer'. The Revealer was to be used for locating underground services and was basically a pair of L-rods. A number of public utilities, engineering companies, and local authorities had purchased Revealers, and Barrington and Stiles sent them a questionnaire regarding their use and satisfaction with the instrument. Most assessments were favourable. Five representatives of organizations giving favourable replies were selected for field tests. Several different testing procedures were used, but usually objects were buried in a sand pit, marked in a fashion to indicate a grid, and dowsers were asked to select the squares in which target objects (two-foot long sections of pipe of various materials) were buried. Subjects were usually given only 5 to 10 trials. Only one of the five persons tested showed promise. He was subsequently tested again (under admittedly poor conditions) but did not repeat his performance.

James Randi (1979), professional magician and member of the Committee for the Scientific Investigation of Claims of the Paranormal, conducted a test with four dowsers in Italy. Procedures were spelled out in detail prior to the test and agreed upon by the dowsers. The dowsers were asked to locate three buried pipes with running water and to place pegs over the route of the pipes. As stated by Chamberlin (1980), the test had several deficiencies. No meaningful statistical evaluation was possible. Even if the dowsers had been quite close, they were unlikely to fulfil the requirements for a successful test (they were required to place the pegs in a strip eight inches wide). None of them was able to claim Randi's \$10,000 reward. The test contributed little knowledge to the scientific community.

Bryant (1931), Carpenter (1877), Christopher (1970), MacFayden (1946), Parsons (1959), and West (1948) report unsuccessful tests. Unfortunately evaluations cannot be made since few details were given or few trials were conducted. J. W. Gregory (1928) and Sollas (1884) reviewed a number of tests conducted in the late nineteenth and early twentieth century; most produced negative results.

Overall, dowsers have performed reasonably well on dowsing tests purporting to require psi ability. Unfortunately reports are rather sketchy and some seem to indicate possible sensory cues.

Of the tests reviewed, only three stand out as well conducted—the map dowsing tests of Cadoret, Osis, and Foulkes. Of these, only one produced significant results, and that barely significant. It is unknown how many other

well conducted studies have been unsuccessful. Overall, the parapsychological investigations into dowsing remain inconclusive.

If any additional work is done, it would be advisable to use map dowsing so that sensory cues could be eliminated (experimenters should be aware that some maps, topographical ones for instance, might give relevant sensory information, depending upon the dowsing task). Experimenters may get better results if definite steps are taken to create a positive environment and a realistic test situation as suggested by W. H. Jack.

MOVEMENT OF THE ROD

Most dowsing research has been geared to determine how (and if) the dowser obtains the information he seeks; this has been discussed. The cause of the dowsing rod's movement has also been a source of controversy for some time, but has not received much experimental investigation.

Overall, the prevailing view is that movement of the dowsing rod is caused by unconscious muscular action. Even the debunkers such as Gardner (1952/1957), Rawcliffe (1952/1959), and Vogt and Hyman (1959) attribute it to this, and the last two discuss a number of motor automatisms in their book. The idea is by no means new; a Jesuit Priest, Father Athanasius Kircher, suggested this explanation in 1641 (Barrett and Besterman, 1926/1968). William F. Barrett too was a strong proponent of the theory (cf. Barrett and Besterman, 1926/1968; Bennett and Barrett, 1897), and his writings seem to have influenced nearly all other investigators.

Bennett (in Bennett and Barrett, 1897), Glardon (1898), Hyslop (in Barrett, 1912), and Hyslop (1913) questioned whether unconscious muscular action could account for every case of the sometimes spectacular movement of the dowsing rod. A number of anecdotal cases and the observations of many dowsers tended to throw doubt on this explanation; although apparently at that time no experimental studies were conducted to test it. Glardon (1898) suggested that the traditional twig be replaced by an instrument made so as to preclude the possibility of muscular action interfering with the operation of the instrument. He suggested the use of 'something like a clock or manometer with a steel hand, by means of which the workings of the unknown force could not only be revealed, but measured'.

A recent experiment was conducted by Alvin Kaufman (1971, 1979), an electronics engineer, to test this idea. Kaufman attached one end of a forked stick to a strain gauge bending beam which could measure the force in the rod. He held the strain gauge bending beam in one hand and the other end of the stick with the other. Kaufman found that when the dowser he tested moved over an underground stream, a very much larger force was exerted on the rod than could normally be accounted for; and concluded that dowsing was a promising area in which to study PK. Although the published report is extremely short and gives few details, it appears that PK may indeed play a part in some dowsing phenomena.

SOVIET RESEARCH

The Soviet bloc countries have also pursued research in dowsing for some time. Vasiliev (1965) mentions that such work was done as early as 1916.

Relatively little has been translated into English, and that which has contains few details.

Four brief summaries, Ostrander and Schroeder (1971), Bakirov and Sochevanov (1976), Sochevanov and Matveyev (1976), and Williamson (1979) indicate that the Soviets approach the subject from a biophysical standpoint. In fact much of the Russian literature on dowsing uses the term biophysical effect (BPE). Ostrander and Schroeder present numerous findings and conclusions of Soviet investigators, but virtually no details are given of experimental procedure, which devalues the results given. Bakirov and Sochevanov give a brief history of the recent research and development of dowsing in the Soviet Union and show that it is being used to find ore deposits. No experimental details are given; although a 12 item bibliography (all Russian) is included. Sochevanov and Matveyev record numerous conclusions of various investigators present at a conference on the subject. Williamson discussed several published Russian articles indicating that dowsing is used to supplement geophysical methods: In one region 1,120 wells were said to have been dug on sites located by dowsers. Again, almost no details were given.

The proceedings of the Second International Congress on Psychotronic Research included several papers on dowsing. Apostol and Dumitrescu (1975) presented an abstract on their work. They found that the electric potential between dowsers' palms was correlated with a number of variables such as galvanic skin response, magnetic field, soil temperature, and atmospheric pressure. They found that the 'dowsing area' (an undefined term) was correlated to geophysical anomalies and that its extent showed a diurnal variation. Miklos, Moldovan, Kun-Stoicu, and Levin (1975) presented results of a 'Wedding Ring Test' which used a dowsing procedure to determine the sex of an unborn child. The experimenter held a pendulum (a wedding ring suspended from a folded hair) over the hand of the expectant mother. The pattern of the swing was used to predict the sex. Only 15 cases were run under the experimental conditions; ten successes were obtained, too few for statistical significance.

Boleslav and Boleslav (1970) briefly review the literature of biological effects of electric and magnetic fields. They mention, in passing, their own experiments with a coil of wire; showing that dowsers were sensitive to the field when the coil was vertical but not when it was horizontal. They claim too that their experiments indicate that dowsers are sensitive to electromagnetic frequencies in the broadcasting bands but give no details. They also claim that turbulent or atomized water emits an unknown undulation that is similar to electromagnetic radiation. A discussion of this idea ran to several pages but remained obscure.

Naumov and Vilenskaya (1972) produced a bibliography on parapsychology, including a section on dowsing. The bibliography was quickly translated and published by the U.S. government. The portion covering the biophysical effect includes 25 items of apparently scientific work and 27 items of popular literature. Another section deals with the electric and magnetic fields of living organisms, and a section on foreign work also lists several studies of dowsing.

Wortz, Bauer, Blackwelder, Eerkens, and Saur (1977, 1979), employees of AiResearch Manufacturing Company, reviewed the Soviet work in parapsychology, including dowsing, but concluded that much of that available suggests a poor understanding of physics and a failure to deal with the psychological

processes involved. In fact the presentations of dowsing investigations in the Soviet bloc leave much to be desired. The work translated offers little more than additional anecdotal material. The actual sophistication of experimental methodology is vague because the translated reports are so brief.

SOCIOLOGICAL INVESTIGATIONS

Ray Hyman and Evon Z. Vogt conducted several studies to determine why water witching was such a widespread and persistent practice. A portion of their work at Harvard University was supported by the Hodgson fund. Their findings were presented in their book *Water Witching U.S.A.* (reviewed by Levinson, 1959; Parsons, 1960; and Woodruff, 1959) and in a number of journal articles (e.g. Hyman and Cohen, 1957; Hyman and Vogt, 1958, 1968; Vogt, 1952; and Vogt and Golde, 1958). They assumed that dowsing is not effective in locating underground water, and cited several studies supporting this idea, but ignored studies indicating the efficacy of dowsing.

For the major survey, 500 county agricultural extension agents were questioned about their belief in the effectiveness of dowsing, the number of dowsers they knew, and the educational level, age, religion, ethnic background, etc. of the dowsers. The authors concluded that there were approximately 25,000 dowsers in the United States; that dowsers could not be distinguished from their community on the bases of religion, ethnic group, level of education, or occupation; and that the dowsers were reported to be honest people who made little or no money from practising dowsing.

The highest percentage of dowsers occurred, as expected, in areas with severe groundwater problems. The investigators claim that dowsing is a ritual pattern reducing anxiety about the uncertainty of locating a well.

Barrett and Vogt (1969) report a study of urban dowsers and found some definite differences from their rural counterparts. The study was conducted by surveying and interviewing members of the American Society of Dowsers. The urban dowsers had a higher educational level and most lived in cities of over 50,000 people. They had a strong belief in ESP and thought it related to dowsing, while the rural dowsers usually could give no explanation as to why dowsing worked.

FINAL COMMENTS

In spite of the large number of investigations made into dowsing, its status remains unclear. This is largely a result of sloppy experimental procedure and/or report writing.

For some people, dowsing does appear to be a useful problem solving tool. Dowsers do seem to be goal orientated, and in this reviewer's experience, most do not care how it works: just as well perhaps, since science has no definitive answer. Critics and proponents alike should pay heed to the ideas of a grade school class that studied dowsing (Boone, 1965)—Conclusions should not be drawn on the basis of one experiment.

The biophysical investigations have resulted in a wide range of findings in regard to human sensitivity to magnetic fields. Well described reports are available indicating considerable sensitivity as well as lack of results. If further work is done in this area, rigorous experimental controls must be applied, and

the site of the experiment should be checked for magnetic anomalies. If it is found that humans are much more sensitive than previously expected, parapsychological experiments may require more elaborate shields to rule out ordinary communication channels.

The physiological studies seem to be the most consistent. A number of investigators have reported a change in skin potential when dowsers cross certain 'dowsing zones'. Although much of this work is 30 years old, it seems to be the most promising area for further study.

As indicated previously, to prove that dowsing is a function of psi, more successful, strictly controlled tests will be required. In most of the studies testing this idea, sensory cues were not ruled out. Of the three map dowsing experiments reviewed, one obtained marginally significant results. Further experiments testing the psi hypothesis should utilize map dowsing to rule out sensory information to the subject. It would also be desirable to conduct the testing with a 'real' problem.

In short, the work investigating dowsing from a biophysical and physiological standpoint is promising but not totally compelling. Considerably more experimental work is required to support the case that dowsing is a psi process.

REFERENCES

- Anselmo, E. (1978). Monetary reward and dowsing performance. *New England Journal of Parapsychology*, **1**, No. 2, 23–27.
- Apostol, A., and Dumitrescu, I. F. Radiotelometric measuring of dowsing signal diurnal variation. *Second International Congress on Psychotronic Research*, Monte Carlo, 1975.
- Bakirov, A. G., and Sochevanov, N. N. (1976). [Where the problem of the biophysical effect stands in the USSR and avenues toward its solution.] *Methods and Means in Mineral Ore Prospecting*, Tomsk Polytechnical Institute (reprinted in *The American Dowsing*, **19**, 33–37, 1979).
- Balanovski, E., and Taylor, J. G. (1978). Can electromagnetism account for extra-sensory phenomena? *Nature*, **276**, 64–67.
- Baldwin, H. W. Dowsers detect enemy's tunnels. *The New York Times*, October 13, 1967, p. 17.
- Barnothy, M. F. (Ed.) (1964). *Biological Effects of Magnetic Fields*. New York: Plenum.
- Barrett, L. K., and Vogt, E. Z. (1969). The urban American dowser. *Journal of American Folklore*, **82**, 195–213.
- Barrett, W. F. (1884). On a 'magnetic sense'. *Nature*, **29**, 476–477.
- Barrett, W. F. (1897–98). On the so-called divining rod, or virgula divina. *Proceedings of the Society for Psychical Research*, **13**, 2–282.
- Barrett, W. F. (1900–01). On the so-called divining rod. *Proceedings of the Society for Psychical Research*, **15**, 130–383.
- Barrett, W. F. (1910). On the detection of hidden objects by dowsers. *Journal of the Society for Psychical Research*, **14**, 183–193.
- Barrett, W. F. (1912). Dowsing and unconscious muscular action. *Journal of the Society for Psychical Research*, **15**, 335–337.
- Barrett, W. F. (1913). The psychical versus the physical theory of dowsing. *Journal of the Society for Psychical Research*, **16**, 43–48.
- Barrett, W., and Besterman, T. (1968). *The Divining Rod: An Experimental and Psychological Investigation*. New York: University Books. (Originally published 1926.)
- Barrington, M. R., and Stiles, J. W. (1973). Investigation of a divining instrument called the 'revealer'. *Journal of the Society for Psychical Research*, **47**, 173–191.
- Bennett, E. T., and Barrett, W. F. (1897). The divining rod and unconscious muscular action. *Journal of the Society for Psychical Research*, **8**, 151–158.
- Besterman, T. (1938). *Water Divining*. London: Methuen.
- Besterman, T., France, V. H. de, Klinckowstroem, C. von (1931). Towards a theory of dowsing. *Journal of the Society for Psychical Research*, **27**, 142–160.
- Bird, C. (1975). Finding it by dowsing. *Psychic*, **6**, No. 4, 8–13.

- Bird, C. (1977). The dowzers. *New Age*, **3**, No. 2, 26–37 and 76–81.
- Bird, C. (1979). *The Divining Hand*. New York: Dutton 1979.
- Boleslav, F. and Boleslav, J. Perception of electric and magnetic fields in relation to ESP. *Symposium of Psychotronics*, Prague, 1970, Downton, Wiltshire, England: Parapsychical Laboratory.
- Boone, L. (1965). Scientific problem solving and 'water witching'. *Science Education*, **49**, 93–96.
- Bryant, E. C. (1931). The divining rod. *Science*, **73**, 365.
- Cadore, R. J. (1955). The reliable application of ESP. *The Journal of Parapsychology*, **19**, 203–227.
- Carpenter, W. B. (1877). *Mesmerism, Spiritualism, &c.* New York: D. Appleton and Company.
- Chadwick, D. G., and Jensen, L. (1971). *The Detection of Magnetic Fields Caused by Groundwater and the Correlation of Such Fields with Water Dowsing*. Logan, Utah: Utah Water Research Laboratory, College of Engineering, Utah State University, (PRWG 78–1).
- Chamberlin, H. (1980). Dowsing tests deficient?. *The Skeptical Inquirer the Zetetic*, **4**, No. 4, 76–77.
- Christie-Murray, D. (1977). Review of *Pendulum: The Psi Connection* by F. Hitching. *Journal of the Society for Psychical Research*, **49**, 668–670.
- Christopher, M. (1970). *ESP, Seers & Psychics*. New York: Crowell.
- Cope, F. W. (1973). Biological sensitivity to weak magnetic fields due to biological superconductive Josephson junctions?. *Physiological Chemistry and Physics*, **5**, 173–176.
- Cope, F. W. (1978). Man in a gas of tachyon magnetoelectric dipoles—a new hypothesis. Part I: a summary of some real but unexplained biocosmic phenomena. *Physiological Chemistry and Physics*, **10**, 535–540.
- Cope, F. W. (1979a). Delocalized clouds (wavefunctions) of polymerized tachyon magnetoelectric monopoles—a possible cause of large periodic (in space) auras around solids and liquids, detected by sensitive persons (dowzers). *Physiological Chemistry and Physics*, **11**, 175–179.
- Cope, F. W. (1979b). Magnetoelectric charge states of matter-energy a second approximation. Part II. Magnetoelectrets as possible evidence of magnetoelectric dipoles in solids, and as a possible mechanism for biological effects of magnetic fields. *Physiological Chemistry and Physics*, **11**, 461–463.
- Cox, W. E. (1978). Review of *Dowsing The Psi Connection* by F. Hitching. *The Journal of Parapsychology*, **42**, 325–327.
- Dale, L. A., Greene, R. M., Miles, W., Murphy, G., Trefethen, J. M., and Ullman, M. (1951). Dowsing: a field experiment in water divining. *The Journal of the American Society for Psychical Research*, **45**, 3–16.
- Dowsing Can't work . . . And Bumblebees, of Course Can't Fly. *Engineering News-Record*, **180**, No. 18, 56–66, 1968.
- Dubrov, A. P. (1978). [*The Geomagnetic Field and Life Geomagnetobiology*], (Brown, F. A., Ed. and Sinclair, F. L., trans.). New York: Plenum.
- Dykshoorn, M. B. (1974) (as told to Felton, R. H.). *My Passport Says Clairvoyant*, New York: Hawthorn Books.
- Earth Mystery Related Publications (1980). *The American Dowser*, **20**, 40.
- Ellis, A. J. (1917). *The Divining Rod: A History of Water Witching* (United States Geological Survey, Water Supply Paper 416). Washington, D. C.: Government Printing Office.
- Ellison, A. J. (1969). Review of *The Physics of the Divining Rod* by J. C. Maby and T. B. Franklin. *Journal of the Society for Psychical Research*, **45**, 125–138.
- Foster, W. S. (1923). Experiments on rod-divining. *The Journal of Applied Psychology*, **7**, 303–311.
- Foulkes, R. A. (1971). Dowsing experiments. *Nature*, **229**, 163–168.
- Gardner, M. (1957). *Fads and Fallacies in the Name of Science*. New York: Dover. (Originally published under the title *In the Name of Science*, 1952.)
- Gardon, A., and Barrett, W. F. (1898). Correspondence. *Journal of the Society for Psychical Research*, **8**, 177–179.
- Gregory, C. C. L. (1940). Review of *The Physics of the Divining Rod* by J. C. Maby and T. B. Franklin. *Journal of the Society for Psychical Research*, **31**, 215.
- Gregory, C. C. L. (1941). An examination of Mr. J. C. Maby's statement concerning a review in the journal of *The Physics of the Divining Rod*. *Journal of the Society for Psychical Research*, **32**, 38–41.
- Gregory, J. W. (1928). Water divining. *Annual Report of the Smithsonian Institution*, 325–348.
- Haines, C. R. (1926). The dowser or water-diviner. *The Journal of the American Society for Psychical Research*, **20**, 611–617.
- Harvalik, Z. V. (1970). A biophysical magnetometer-gradiometer. *The Virginia Journal of Science*, **21**, No. 2, 59–60.
- Harvalik, Z. V. (1973a). Dowsing reaction to electromagnetic fields in the frequency ranges from 1 hertz to 1 mega hertz. *The American Dowser*, **13**, 90–91.
- Harvalik, Z. V. (1973b). Where are the dowsing sensors?. *The American Dowser*, **13**, 48–49.
- Harvalik, Z. V. (1978). Anatomical localization of human detection of weak electromagnetic radiation: experiments with dowzers. *Physiological Chemistry and Physics*, **10**, 525–534.
- Harvalik, Z. V., and De Boer, W. (1976). Cobalt-60 dowsing experiments. *The American Dowser*, **16**, 167–169.
- Hitching, F. (1978). *Dowsing The Psi Connection*. Garden City, N.Y.: Anchor Press.
- Hopwood, A. (1979). Dowsing, ley lines and the electromagnetic link. *New Scientist*, **84**, 948–949.
- Hyman, R. (1979). Review of *Dowsing The Psi Connection* by F. Hitching. *Zetetic Scholar*, No. 5, 98–103.
- Hyman, R., and Cohen, E. G. (1957). Water-witching in the United States. *American Sociological Review*, **22**, 719–724.
- Hyman, R., and Vogt, E. Z. (1958). Some facts and theories on waterwitching in the United States. *Geotimes*, **2**, No. 9, 6–7 and 15.
- Hyman, R., and Vogt, E. Z. (1968). Psychologists examine the 'secrets' of water witching. *Science Digest*, **63**, No. 1, 39–45.
- Hyslop, J. H. (1913). An experiment in dowsing. *The Journal of the American Society for Psychical Research*, **7**, 126–129.
- Jack, W. H. (1977). Location of dowsed water veins via group decision. *New England Journal of Parapsychology*, **1**, No. 1, 25–31.
- Jack, W. H. (1978). Dowsing for the presence or absence of an electromagnetic field. *New England Journal of Parapsychology*, **1**, No. 2, 16–22.
- Katz, E., and Paulson, P. (1948). A brief history of the divining rod in the United States, I. *The Journal of the American Society for Psychical Research*, **42**, 119–131.
- Katz, E., and Paulson, P. (1949). A brief history of the divining rod in the United States, II. *The Journal of the American Society for Psychical Research*, **43**, 3–18.
- Kaufman, A. B. (1971). Measuring the Phenomenon of dowsing. *Parapsychology Review*, **2**, No. 1, 10–12.
- Kaufman, A. B. (1979). A critical look at the phenomenon of dowsing. *Parapsychology Review*, **10**, No. 6, 20–22.
- Klinckowstroem, C. v. (1912). The divining rod in Germany. *Journal of the Society for Psychical Research*, **15**, 329–334.
- Klinckowstroem, C. v. (1925). The present position of the divining rod question in Germany. *Journal of the Society for Psychical Research*, **22**, 54–60.
- Klinckowstroem, C. von. (1959). Some comments on the controversy regarding dowsing rods. *The Journal of Parapsychology*, **23**, 54–63.
- Levinson, H. C. (1959). Review of *Water Witching U.S.A.* by E. Z. Vogt and R. Hyman. *The Journal of Parapsychology*, **23**, 274–277.
- L'Huillier, J. R. (1968). Report on Professor Rocard's studies on dowsing. In Cavanna and Ullman (Eds.), *Psi and Altered States of Consciousness*. (Proceedings of and International Conference Held at Le Pisol, St. Paul De Vence, France, June 9–12, 1967). Garrett Press.
- Maby, J. C. (1941). The physics and physiology of field dowsing. *Journal of the Society for Psychical Research*, **32**, 14–22.
- Maby, J. C., and Franklin, T. B. (1939). *The Physics of the Divining Rod*. London: George Bell.
- MacFayden, W. A. (1946). Some water divining in Algeria. *Nature*, **157**, 304–305.
- Mager, H. (1931). *Water Diviners and Their Methods*. London: George Bell.
- McMahan, E. A. (1947). A review of the evidence for dowsing. *The Journal of Parapsychology*, **11**, 175–190.
- Miklos, J., Moldovan, I., Kun-Stoicu, G., and Levin, S. (1975). A potentially diagnostic use of the biophysical effect: the wedding ring test (wrt)*. *Second International Conference on Psychotronic Research*, Monte Carlo.
- Mitchell, E. D. (Ed.) (1974). *Psychic Exploration A Challenge for Science*. New York: Putnam.
- Montgomery, D. J. (1964). Review of *Le Signal du Sourcier* by Y. Rocard. *Physics Today*, **17**, No. 7, 54–57.
- Moss, T., and Sands, H. (1970). Why did I flunk the horse test?. In W. G. Roll, R. L. Morris, and J. D. Morris (Eds.), *Proceedings—Parapsychological Association*, No. 7, 25–26.
- Naumaov, E. K., and Vilenskaya, L. V. [*Bibliographies on Parapsychology (Psychoenergetics) and Related Subjects—USSR.*] March, 1972. (NTIS No. JPRS 55557).
- Nicol, J. F. (1955). Randomness: the background, and some new investigations. *Journal of the Society for Psychical Research*, **38**, 71–87.

- Ongley, P. A. (1948). New Zealand diviners. *The New Zealand Journal of Science and Technology*, **30**, Section B, 38–54.
- Osis, K. (1960). Some explorations with dowsing techniques. *The Journal of the American Society for Psychical Research*, **54**, 141–152.
- Ostrander, S. and Schroeder, L. (1971). *Psychic Discoveries Behind the Iron Curtain*. New York: Bantam.
- Parsons, D. (1959). Examination of a dowser. *Journal of the Society for Psychical Research*, **40**, 12–17.
- Parsons, D. (1960). Review of *Water Witching U.S.A.* by E. Z. Vogt and R. Hyman. *Journal of the Society for Psychical Research*, **40**, 260–265.
- Parsons, D. (1963). Review of *Le Signal du Sourcier* by Y. Rocard. *Journal of the Society for Psychical Research*, **42**, 197–200.
- Pease, E. R. (1884). The divining rod. *Proceedings of the Society for Psychical Research*, **2**, 79–107.
- Persinger, M. A. (Ed.). (1974). *ELF and VLF Electromagnetic Field Effects*. New York: Plenum.
- Review of *The Physics of the Divining Rod* by J. C. Maby and T. B. Franklin. *Nature*, **146**, 150, 1940.
- Pisani, D., Deodato, G., and Nigro, A. Action of a static magnetic field on the electrical skin resistance (1969). Abstract in *Biophysics, Bioengineering and Medical Instrumentation* (Excerpta Medica, Section 27), **5**, Abstract No. 65, 1971.
- Pope, D. H. (1950). Two reports on experiments with dowsing. *Parapsychology Bulletin*, No. 20, 1–3.
- Presman, A. S. (1970). [*Electromagnetic Fields and Life.*] (Brown, F. A., Ed. and Sinclair, F. L., trans.) New York: Plenum.
- Randi, J. (1979). A controlled test of dowsing abilities. *The Skeptical Inquirer the Zetetic*, **4**, No. 1, 16–20.
- Rawcliffe, D. H. (1959). *Occult and Supernatural Phenomena*. New York: Dover. (Originally published under the title *Illusions and Delusions of the Supernatural and the Occult*, 1952.)
- Rhine, J. B. (1950). Some exploratory tests in dowsing. *The Journal of Parapsychology*, **14**, 278–286.
- Rhine, J. B. (1952). The challenge of the dowsing rod. *The Journal of Parapsychology*, **16**, 1–10.
- Rhine, J. B. (1971). Location of hidden objects by man–dog team. *The Journal of Parapsychology*, **35**, 18–33.
- Richet, C. (1923). [*Thirty Years of Psychical Research*] (S. De Brath, trans.) New York: MacMillan.
- Riddick, T. M. (1951). Dowsing is nonsense. *Harper's Magazine*, **203**, No. 1214, 62–68, July.
- Riddick, T. M. (1952). Dowsing—an unorthodox method of locating underground water supplies or an interesting facet of the human mind. *Proceedings of the American Philosophical Society*, **96**, 526–534.
- Roberts, K. (1951). *Henry Gross and His Dowsing Rod*. Garden City, N.Y.: Doubleday.
- Roberts, K. (1953). *The Seventh Sense*. Garden City, N.Y.: Doubleday.
- Roberts, K. (1957). *Water Unlimited*. Garden City, N.Y.: Doubleday.
- Robertson, A. J. B. (1950). Review of *Psychical Physics* by S. W. Tromp. *Journal of the Society for Psychical Research*, **35**, 210–215.
- Rocard, Y. (1964). *Le Signal du Sourcier*. Paris: Dunod.
- Schwarz, B. E. (1962–63). Physiological aspects of Henry Gross's dowsing. *Parapsychology* (The Indian Journal of Parapsychological Research), **4**, 71–86.
- Schwarz, B. E. (1968). *A Psychiatrist Looks at ESP*. New York: Signet. (Originally published under the title *Psychic-Dynamics.*)
- Scorer, R. S., Parsons, D., and Tart, C. T. (1980). Letters. *New Scientist*, **85**, 184–185.
- Sochevanov, N. N. and Matveyev, V. S. (1976). Electromagnetic fields as origin of the biophysical effect. *International Journal of Paraphysics*, **10**, 115–122.
- Sollas, W. J. (1884). Report on wells sunk at Locking, Somerset, to test the alleged power of the divining rod. *Proceedings of the Society for Psychical Research*, **2**, 73–78.
- Stratton, G. M. (1921). The control of another person by obscure signs. *Psychological Review*, **28**, 301–314.
- Taylor, J. (1980). *Science and the Supernatural*. New York: Dutton.
- Taylor, J. G., and Balanovski, E. (1979a). A critical review of explanations of the paranormal. *Psychoenergetic Systems*, **3**, 357–373.
- Taylor, J. G., and Balanovski, E. (1979b). A search for the electromagnetic concomitants of ESP. *Psychoenergetic Systems*, **3**, 171–192.
- Taylor, J. G., and Balanovski, E. (1979c). Is there any scientific explanation of the paranormal? *Nature*, **279**, 631–633.
- Thouless, R. H. (1964). Review of *Le Signal du Sourcier* by Y. Rocard. *The Journal of Parapsychology*, **28**, 142–143.
- Tromp, S. W. (1949). *Psychical Physics*. New York: Elsevier.
- Tromp, S. W. (1955). Recent experiments on physical aspects of the muscle-tonus-reflex (dowsing). *Proceedings of the First International Conference of Parapsychological Studies*, New York: Parapsychology Foundation.
- Tromp, S. W. (1968). Review of the possible physiological causes of dowsing. *International Journal of Parapsychology*, **10**, 363–391.
- Tromp, S. W. (1972). Water divining (dowsing). in Fairbridge (Ed.) *The Encyclopedia of Geochemistry and Environmental Sciences*. New York: Van Nostrand Reinhold.
- Vasiliev, L. L. (1965). [*Mysterious Phenomena of the Human Psyche*] (S. Volochova, trans.) New Hyde Park, New York: University Books.
- Vogt, E. Z. (1952). Water witching: an interpretation of a ritual pattern in a rural American community. *Scientific Monthly*, **75**, No. 3, 175–186.
- Vogt, E. Z., and Golde, P. (1958). Some aspects of the folklore of water witching in the United States. *Journal of American Folklore*, **71**, 519–531.
- Vogt, E. Z., and Hyman, R. (1959). *Water Witching U.S.A.* Chicago: University of Chicago Press.
- Water Dowsing* (1977) (U. S. Department of the Interior, Geological Survey). Washington, D.C.: U.S. Government Printing Office.
- West, D. J. (1948). Some experiments in divining. *Journal of the Society for Psychical Research*, **34**, 220–222.
- Whitton, J. L., and Cook, S. A. (1978). Can humans detect weak magnetic fields? *New Horizons*, **2**, Part 4, Issue 9, 2–6.
- Wieske, C. W. (1963). Human sensitivity to electric fields. In Alt (Ed.) *Biomedical Sciences Instrumentation*, **1**, 467–475. (Proceedings of the First National Biomedical Sciences Instrumentation Symposium at Los Angeles, 1963.)
- Williamson, T. (1979). Dowsing achieves new credence. *New Scientist*, **81**, 371–373.
- Wilson, C. (1978). *Mysteries*. New York: Putnam.
- Wilson, R. (1951). Review of *Psychical Physics* by S. W. Tromp. *The Journal of the American Society for Psychical Research*, **45**, 117–120.
- Woodruff, J. L. (1959). Review of *Water Witching U.S.A.* by E. Z. Vogt and R. Hyman. *The Journal of the American Society for Psychical Research*, **53**, 147–155.
- Wortz, E. C., Bauer, A. S., Blackwelder, R. F., Eerkens, J. W., and Saur, A. J. An investigation of Soviet psychical research. *Electro '77*, pp. SS/4–1 to SS/4–15.
- Wortz, E. C., Bauer, A. S., Blackwelder, R. F., Eerkens, J. W., and Saur, A. J. (1979). An investigation of Soviet psychical research. In C. T. Tart, H. E. Puthoff, and R. Targ (Eds.) *Mind at Large*. New York: Praeger.
- Wyman, W. D. (1977). *Witching for Water, Oil, Pipes, and Precious Minerals*. River Falls, Wisc.: University of Wisconsin-River Falls Press.
- Zorab, G. (1959). Comments and letters. *The Journal of Parapsychology*, **23**, 270–272.

1717 Concord Drive,
Fort Collins,
Colorado 80526, U.S.A.