



UNKNOWN FORCES?

Problems of Geomancy, Animal Navigation,
and Dowsing.

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1

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PLAN OF CONFERENCE.

Earth's Magnetic Forces.

Ley lines - Do they represent the lines of energy of an 'earth force' perhaps known to the ancients and lost by subsequent generations?

How much do we know about the way gravity works? Can we create an artificial gravity, or stop or deflect gravity?

Earth's magnetic fields - can people detect magnetic fields?

If these forces are at work where are they demonstrated?

Theories re UFO's and geomagnetic and seismic fields.

Are they at work in places such as the Bermuda Triangle, and other areas where strange disappearances are supposed to happen?

Animal Navigation.

The homing instincts of birds, animals, and insects.

What is known about the methods by which various creatures find their way across continents and oceans?

Do human beings have a 'homing' ability?

Dowsing.

Dowsing for oil, water, minerals, objects. How it works, and how reliable the methods are.

Various methods of dowsing, rods, pendulums, map dowsing, etc.

Archaeological dowsing.

Psychometry. Is it a force or a psychic experience?

Could the psychokinetic force (P.K.) be an earth force that some people are able to tune in to -- or is it a different force that emanates from the person him/herself?

Final discussion of day's conclusions.

LEY LINES.

Although the effective founder of the study of ley lines was undoubtedly Alfred Watkins (1855-1935), the concept of a ley line occurred independently to several writers of an antiquarian bent. W.H. Black prior to his death in 1872 noticed that ancient churches tended to be linearly aligned. In 1904 F.J. Bennett published Kentish Megaliths and Alignments, in which he noted that old churches and many prehistoric sites appeared to be situated on lines of surprising straightness -- these he called "meridional lines" -- a phrase that by pure coincidence reproduces the terminology of Chinese acupuncture, a subject at that time unknown to the West. Previously in 1894 Sir Norman Lockyer, an extremely eminent astronomer and solar physicist, had published a superb book The Dawn of Astronomy based on the stellar and solar alignments of the temples of ancient Egypt, which he was the first to discuss. The book was, of course, totally ignored by Egyptologists and archaeologists as an intrusion by an unqualified amateur into their own "mystery" (to use the terminology of a medieval craft or guild). Sir Norman's next book Stonehenge and other British Monuments Astronomically Considered (1906), which suggested that one of the uses of the Stonehenge monument was calendric, and which appears in part to have encouraged the later work of Thorn and of Hawkins, met with equal neglect (or perhaps one should say scorn -- c.f. the contempt expressed by R.F.C. Atkinson for Lockyer's ideas in his book Stonehenge, published in 1956). However it was in this book Stonehenge that Lockyer noted two leys. These were (a) an alignment of Stonehenge with three Iron Age hillforts, (b) the alignment of Stonehenge, Old Sarum, Salisbury Cathedral, and the Iron Age fort, Clearburg Ring. He went on to say that "such relationships... but on a smaller scale are often to be noticed." Although contemporary with Watkins it seems that the work of a German antiquarian, Willhelm Teudt (who produced the book Germanische Heiligtümer (Jena, 1929)) and was (like Lockyer) a pioneer of astro-archaeology) led in respect of alignments to conclusions identical to those of Watkins.

It is possible that Alfred Watkins may have heard a lecture by Bennett, but if this is so, what Bennett says may merely have lodged in his subconscious. According to his own recollection in 1922, already 65 years old, he was riding across the hills near Bewardine in Herefordshire, England, and pulled up his horse to look over the landscape. He became aware of a network of straight lines intersecting at the sites of churches, old stones, hilltops, etc. From this insight, he claimed, it was that he developed the idea that prehistoric men in Britain liked to walk in straight lines and therefore tended both to put up markers at selected points between two prominent structures

whether natural (e.g. a hilltop) or seminatural (e.g. a hill fort) or quite artificial (such as a dolmen or market cross). In addition one could suppose that new objects (cromlechs, churches, etc.) might be erected on pre-established straight lines. Often Watkin's presumed lines passed through farms or villages that had ly, leigh, or ley, in their names. Watkins therefore called the lines leys, pronounced lay as when we speak of the lay of the land. Watkins, of an attractive and commanding presence, a tall man of dignified appearance, already highly respected in his locality, within a short time had inspired the hobby of "ley-hunting". Enthusiasm was created by his books Early British Trackways (1922), The Old Straight Track (1925), The Ley Hunter's Manual (1927), and Archaic Tracks Around Cambridge (1932). As a result the "Straight Track Club" was founded in 1926 and remained active until the outbreak of the Second World War in 1939, after which the ladies and gentlemen who had walked the English countryside on Sunday afternoons became preoccupied with a variety of patriotic services, and leys were forgotten in fact until the 1960's.

In 1961 Tony Wedd wrote a book, Skyways and Landmarks, which drew a parallel between ley lines and "orthotemies". The latter concept had been elaborated by a French UFO student or "ufologist" Aimé Michel. Michel claimed that sightings of U.F.O.s (unidentified flying objects) tended to occur at places arranged in straight lines. Wedd therefore suggested that UFO's employed ley lines for navigation. As a result ley hunting was revived by a group of UFO buffs. The Ley Hunters Club was founded in 1962; a magazine The Ley Hunter was published in 1965 and 1966 and revived in 1969. By that time the subject had received a great fillip from the publication of Alexander Thom's work (by the prestigious Clarendon Press, Oxford, no less!) in two epoch-making books -- Megalithic Sites in Britain (1967) and Megalithic Lunar Observatories (1971). Thom is a (now retired) professor of Engineering. His reports were based on some thirty years surveying of ancient stone circles, etc. in Britain, and cannot be faulted as superficial. From his research he derived the thesis that a large number of megalithic circles and other arrangements of stones had been set up to include the purpose of being astronomical observatories for calendar regulation, crop planting and forecasting dire and ominous events -- the eclipses of the sun and moon. Not long before, Gerald S. Hawkins, a U.S. historian, using computers, but working independently of Thom, argued persuasively in his book Stonehenge Decoded (1965) that Stonehenge had been set up as a (rather complex) observatory. Without seeking here to assess the validity of all of Thom's or Hawkins's conclusions, it is sufficient to say that, as far as our own mathematical and statistical knowledge goes, Thom's conclusions as to the mathematical and geometric ability of our ancestors seem

quite incontrovertible. Even without the ascription of astronomical purpose, the shapes of the stone "circles" as elucidated by Thom seem to prove that our forebears not only formulated mathematical ideas but were, in some fields of activity, actually guided by such ideas.

Thom's results were not immediately accepted by archaeologists. Indeed Dr. Glyn Daniel*, the editor of Antiquity -- an "establishment" journal (roughly the equivalent of Nature (U.K.) and Science (U.S.A.) in respect of archaeology) -- delegated Jacquetta Hawkes to review Thom's book in Antiquity. This lady poured scorn from a great height on Professor Thom and his works. To put the matter in perspective it is worth saying that in all countries the sciences tended to be separated into the "hard" ones .. mathematics, physics, engineering, physical chemistry, inorganic and organic chemistry -- and the "soft" ones, biology, psychology, sociology, anthropology, and archaeology. Often the recruitment to the "soft" sciences was by negative selection -- either the schools had insufficient teachers and laboratories for "hard" sciences, or the students were self selected by mathematical incapacity, actual or believed. Things have changed -- every science has now its mathematical sectors and mathematical professors -- archaeology also. In addition, many able people incapable of truly mathematical thought can creatively exploit computers. However, even a decade or so of years ago, there was hostility not only to mathematicians but to the idea of mathematics per se. This accounts, in some degree, for the rejection of Thom and the indifference to the idea of ley lines. Professor Thom, happily, had to spend less time in limbo than Galileo and a public statement was made within a few years (not centuries) by the dean of British archaeologists, Professor Stuart Piggott of the University of Edinburgh, that Thom had proved his case!

Another development had a liberating influence on modern ideas regarding ancient European cultures. This was the revision of radio-carbon dating, which showed that many of the megalithic monuments in Britain and Western Europe were older than the Pyramids and massive buildings in the Near East. This indicated that the prehistoric peoples of Britain and France had a much higher technological ability than had been supposed. It was no longer frivolous to credit them with interest in geometrical concepts such as straight lines. Since 1970 therefore we have seen a considerable revival in ley line studies, mainly on the part of educated laymen who have adopted leymanship as a hobby.

Research on leys of course tends to ramify in all directions. Thus there is the purely archaeological one. Are the objects or "marks" forming a ley, truly ancient or relatively modern? If the latter, is it relevant -- because its location

* Known, on account, of his own popularisations of archaeology, as "glib Daniel"!

on a line still, one might say, testifies to an inherent tendency to tidiness which may operate in all ages? Also what kind of objects is it fair to count as "marks"? E.g. is it fair to include field boundaries, individual trees, or clumps, or smallish boulders, or worked stones? In addition there are statistical questions -- how many alignments can be expected to occur in any area by chance? It will be seen that it is quite possible to be critical as to the validity of the very concept of a ley. Thus Tom Williamson and Liz Bellamy in their book Ley Lines in Question (1983) give a very detailed and fair discussion which certainly encourages an active scepticism as to the existence of leys. On the other hand if one should read The Ley Hunter's Companion (1979) by Paul Devereux and Ian Thomson one may be impressed, as we are, by the maps and detailed descriptions of no less than 41 leys in England alone. Of these leys eight have five marks, eleven have six marks, twenty-one have six to nine marks each, and one comprises ten marks. Also, most of the marks seem really ancient. The subject of leys seems to justify further attention. If the hypothesis that our prehistoric forebears did deliberately lay out their leys is true, we still require to infer their precise motivation. Discussion of the philosophy of ley lines is best done in conjunction with a parallel and possibly related subject -- "geomancy."

GEOMANCY

In 1939 Dr. J. Heinsch, a regional planner in Germany, wrote a paper Principles of Prehistoric Sacred (or Cult) Geography, in which he claimed that ancient peoples in Europe and the Orient laid out landscapes and important buildings according to a "magical" view of nature. This geomantic planning or geomancy -- the sacred layout of the landscape -- involved all sites with religious or community significance, e.g. temples, sacrificial places and boundaries. Heinsch reached his conclusions quite independently of other researchers such as Lockyer, Watkins, or Teudt. His work remained quite unknown until the 1970's.

It was in 1969 that John Michell in his book The View Over Atlantis effectively rediscovered geomancy and "put it on the map". His starting point was from the concept of ley lines. Michell resurrected an idea put forward in 1939 by an English ley enthusiast, Arthur Lawton, in a book Mysteries of Ancient Man. Unlike Watkins, who believed that leys were essentially only paths, Lawton suggested that they marked the course of a mysterious form of energy. The ley lines followed "terrestrial currents" (sometimes called "telluric currents"). John Michell associated this idea with an ancient Chinese notion, that of "dragon lines" or "paths of the dragon". He was led to make this connection

by a discovery he made concerning a very long English ley which links several sites which folklore relates to dragons or dragon slaying such as St. Michael's Mount in Cornwall and Stoke St. Michaels in Wiltshire. This finding reminded Michell of the Chinese lung mei, lines connecting mounds and hilltops. In Chinese tradition a network of such lines extends all over the world. To some extent this parallels beliefs held by Australian Aborigines as well as Celtic peoples in Wales, France, and Ireland as to the existence of "fairy paths". In China, where landscape and civic planning had been important from early times, there was in fact a profession devoted to the art called feng-shui. Feng-shui aimed at mapping the "dragon currents". The optimal places for human use were the points where two of the lung-mei lines met. The Feng-shui masters, interestingly enough, explicitly associated the dragon lines with magnetism, and used as detecting instruments when mapping the lines, actual magnets in special jade settings.

Another line of thought taken up by Michell and students of geomancy was started by Guy Underwood, who was a student both of archaeology and "dowsing" (i.e. "well witching" or "water divining"). In his book The Pattern of the Past published posthumously in 1969, he claimed that many prehistoric barrows and standing stones were located over points where underground streams of water crossed or joined. Underwood also said this was true of every pre-Reformation church. He also said that certain lines of two sorts, aquastats and track lines, followed ancient banks, boundaries and trackways. In this connection John Michell and other geomancers cite much folklore to the effect that each important building had its site chosen by divination of some kind.

The reader will, of course, discern that there is a considerable problem in equating ley lines with underground streams or Chinese lung-mei, which are not straight, yet straightness is the very essence of a ley. Possibly there is more hope in equating leys with the local directions of magnetic lines of force, but not much, as leys run in all directions with no apparent relation to either geographical or magnet north or south. However it is fair to say that the whole complex of ideas, leys, water dowsing, lung-mei and magnetism is certainly stimulative of thought as to the true range of human senses.

INVISIBLE FORCES AND FIELDS.

When speaking of the great majority of humankind we have to admit that the number and range of their abilities for sensory perception are somewhat limited. We can claim a fairly "direct" perception of light, heat and sound, and the senses of pressure, touch and smell convey also a "direct"

perception of the action of material substances and objects (even those as physically "light as air"). We have written direct in quotes because we are not at present wishing to write as philosophers. Psychologists and epistemologists since the time of Bishop Berkeley have rightly pointed out that, in a manner of speaking, the "direct" impact of the five senses is not as direct as we might think. Be that as it may, we intend in the present discussion to accept the "directness" of perception in the case of the five senses as a characteristic validly distinguishing them in their immediacy and imperativeness from more indirect and inductive perceptions such as that of gravity. It is true, of course, of the five senses that we perceive their objects or external referents as a result of their effects as communicated to our consciousness through a sequence of neuro-chemical receptors, neuronc transmission, and some kind of processing by the brain. However even if the experiences are, in an ultimate analysis, only subjective, those of touch, smell, hearing, heat and vision are to a very high degree far more imperative and therefore more "direct" perceptions than those we have of other forces such as gravity.

Our "belief" in gravity, i.e. our reliance that there exists a force between material objects is, even at the most elementary level, a matter of deduction. Empirically, from an early age, we learn that things (including ourselves) fall to the ground when unsupported, that even our own arms and legs feel heavy if extended, also that it is very uncomfortable or even lethal to be suspended upside down. However it requires a very difficult and lengthy chain of reasoning --- induction and deduction --- to the inference that there is an all pervasive field of force which we call "gravitation". Indeed the human perception of gravity was so indirect that it was only late in the eighteenth century that gravity ceased to be regarded as an "occult force", i.e. an assumption introduced gratuitously into science by (unfortunately) "mystical" mathematicians, such as Sir Isaac Newton.

Although we have, in the sense permitted in the present context, a "direct" perception of sound, we have to concede that this perception is severely limited in range. Bats, moths, and sheepdogs -- to name but a few -- are among the creatures that can hear ultra-sound at frequencies considerably higher than the limits of human perception. The case of the electro-magnetic spectrum is entirely similar. Only in the late nineteenth century was it realized that radiant heat is only a more sluggish form of light. We see the sun, the moon and the stars, but even today not everyone knows that should they sit out in the sunlight what reddens their skin is not the sunlight but its ultraviolet radiation. We know its effects, but only retrospectively and

8

without direct perception. Similarly the human race and its ancestors have been bathed for millions of years in electromagnetic radiation from opposite ends of the spectrum. These include extremely long waves (i.e. of low frequency) and very short waves (i.e. ultra high frequency -- gamma radiation). Radioactive substances can injure or kill victims, totally unaware of their presence. Yet all these and other radiations, gamma rays, X-rays, ultra-violet, infrared (including radiant heat), microwaves, radiowaves, and E.L.F. waves (extremely low frequency, or equally, extremely long waves) are variant expressions of the same phenomenon, -- the electromagnetic field.

It follows that human beings have a somewhat limited perception of the world, narrower even than do some animals of other species. For example, bees, it is known, can take their bearings from the sun's position. This is so even when the whole sky is overcast with clouds. Many years ago Karl von Frisch had made experiments with light filters and concluded that bees could see the sun's ultra-violet light through the clouds. Physicists however said this was impossible as they proved, using ultra-violet photography, that a bank of clouds completely absorbs ultra-violet light! But this was not the end of the story! In 1959 new highly sensitive photographic plates became available and enabled the sun to be photographed through the clouds! Even visible light has features hidden from human perception but revealed to the honey bees. Light, according to the substances it has passed through en route to the eye, has a property called polarization which the human eye cannot detect. The bee's eye is constructed differently so that the bee has a direct perception of the direction of polarization. Polarization is different at different points of the sky so that the bee sees the sky with a typical pattern of lightness and darkness. The sky is therefore structured in a manner analagous to the patterning of the stars in the night sky as we (and many birds) see it. This pattern is one of the means enabling the bee to navigate out to desirable forage and to guide its homing to the hive. All this should make us feel inferior to Apis mellifera and other animals with ultra-violet vision like the horseshoe crab and the luna moth. However our ability to distinguish colours within the (humanly) visible range seems to exceed greatly that of most other species. For example, the bee cannot see red as a colour -- it is indistinguishable from black! Furthermore the bee only distinguishes twelve pure colours as compared to 250 which the human eye can separate from each other.

Professor Michael Persinger of the Psychophysiology Laboratory at Laurentian University has suggested that without us knowing, we can be affected by a variety of E.L.F. waves,

the "Schumann waves", which have a frequency of about 7.5 Hz. The wave length is simply related to the earth's circumference because the waves are propagated in the region between the earth's surface and the ionosphere. Professor Persinger has discussed possibilities in connection with the Schumann waves in a paper in the book edited by himself ELF and VLF Electromagnetic Field Effects (1974), and in his own book The Paranormal (1974, two volumes). He points out that the frequency 7.5 Hz. and its harmonic 15 Hz. (i.e. 15 cycles per second) are of just the same order of magnitude as the frequency of many brain electrical processes (e.g. the famous alpha, beta, delta, and theta rhythms). Thus the Schumann waves might be the vehicle for telepathic communication or even (conceivably) for clairvoyance experiences. Professor Persinger has also suggested a connection between seismic events in the earth's surface which generate electric fields of which persons in the vicinity have no direct perception and which manifest themselves only by physical results such as luminous appearances in the sky which observers often ascribe to UFOs. When geophysical pressures develop in subterranean quartz (e.g. granite, etc.) then electric potential gradients as large as 100,000 volts per metre can be generated and can locally ignite the air producing luminosities. (Reference: a series of papers by M.A. Persinger entitled "Geophysical Variables and Behaviour" in the journal Perceptual and Motor Skills, especially Vol. 53, pages 115-122, 1981). A convenient summary of Professor Persinger's stimulating proposals is appended. He was kind enough to give an overview of his ideas and research results at a conference on psychokinesis held in 1974 at this Foundation and published in the journal New Horizons (Vol. 1. Number 5, Jan 1975).

DETECTION OF MAGNETIC FIELDS.

The electromagnetic field has two extreme aspects -- the static electric field and the magnetic electric field. Direct perception of the former is, it seems, restricted to relatively few species. These appear to comprise only a group of fishes endowed with poor sight and hearing and deficient in pressure-wave reception. They possess a sense we entirely lack -- the ability to respond to static electric fields. For example the fish Gymnarchus niloticus will respond, as our erstwhile colleague, Dr. Hans W. Lissman of Trinity College, Cambridge, England, showed, to the movements above the water of a rubber comb electrified by combing his hair! This fish also responded to the movements of a strong magnet held just above the water level. In this case the response was probably to the electric field generated by the varying magnetic flux to which the Gymnarchus were subjected, rather than the magnetic field itself.

Nonetheless, the perception, conscious or unconscious, of static magnetic fields, is most interesting; it is a topic that appears time and time again in many fields of research. A magnetic sense has been proved for termites, June bugs, pond snails, weevils, crickets, locusts and flies. For example, Professor Gunther Beker of the Federal Institute for Testing of Materials (in Berlin) found that, irrespective of their initial orientation, termite queens -- species Macrotermes and Odontotermes -- always turned ~~some~~ to sleep so that they pointed in the direction of one of the four points of the compass. This ability failed if the termites were shielded from the earth's field by containment in a steel box. If, however, a bar magnet was put in with them, then within fifteen minutes they were all lying directly at right angles to the magnet. Dr. F. Schneider at the Swiss Federal Experimental Institute (near Zurich) found that the resting orientation of June bugs was significantly influenced by imposed magnetic fields. Dr. Frank Brown and his coworkers at Northwestern University, Evanston, Illinois, found that the pond snail (Nassarius obsoleta) when allowed to emerge from a corral showed a preference to go out in a particular direction. In the morning they tended to turn to the right, but later in the day there was a preponderance of leftward turning. This result is of statistical significance because it was based on observation of no less than 33,000 snails! Because certain components of the earth's magnetic field change diurnally the investigators suspected that this might be the cause of the animals' variant behaviour in the course of each day and put powerful magnets in proximity to the snails, which altered their behaviour. Brown's team obtained similar results with flatworms (Planaria). Another research scientist, J.D. Palmer, of the University of Illinois, observed the exits of no less than 7000 small animals from their enclosure. Their direction was not random but had a preferred orientation. In Germany, Becker has shown that certain flies do not land in random directions but align their trajectories along lines of the terrestrial magnetic field.

Can humans detect magnetic fields? In September 1978 this Foundation published a report of some experimental work done by it and its associates addressed to this question. The paper is contained in the copy of the New Horizons journal (Vol.2. part 4) which is appended. In the experiments a solenoid about three feet in diameter and about one inch in length was excited according to a random schedule of which the subjects were ignorant, as were also those experimenters with whom they were in contact, a standard "double blind" procedure being rigorously followed. The 27 subjects were asked at each trial to assess whether or not the solenoid's current was on or off. In one experiment the solenoid was activated by a weak A.C. current producing an alternating magnetic field of 0.43 millioersted amplitude

at its centre. (This field is the order of a thousandth of that of the earth's static magnetic field). In another experiment the current was D.C. and produced a steady field of 0.6 oersted (or gauss -- in this context an oersted is also a gauss). Participants in the experiment included a respected senior electrical engineer with a long experience in designing and setting up power supplies for various important installations belonging to the Federal Government of Canada. His participation was of especial interest because he had on many occasions in the field been able to ascertain by an intuition whether or not various subterranean power lines had been "on" or "off". In these experiments he did not score decisively, but was among those of the subjects who reported sensations of "tingling" "prickling", etc. These experiments were not significant in respect of human susceptibility to magnetic fields, but were admittedly restricted to a very narrowly defined situation both behaviourly and in regard to the range of magnetic parameters.

Some experiments have been done in the way of magnetic exploration of the notorious oceanic area called "The Bermuda Triangle". Some twenty years ago this region, whose vertices are Miami, Bermuda, Jamaica, became written up as a purlieu in which ships and aircraft tended to disappear without explanation. Explanations put forward though in a dramatic accent tended to be vague. UFOs have been evoked, also undersea residents. Otherwise mysterious forces have been postulated. One of the more useful surveys was done by the late Ivan Sanderson. In an article Vile Vortices he listed some ten or so similar disaster areas, including one in the North Pacific near Japan. In our present state of knowledge it would seem that the most likely explanation for the fatalities in these areas is just sudden bad weather in acute forms, but a final resolution must await further evidence.

With regard to migrating and/or homing birds the evidence concerning the assistance given to them by the earth's magnetic field is complex and even confusing. We shall talk later about the various mechanisms involved in migration and homing. Migratory animals usually become restless at the appropriate time of the year, even if in captivity. This is ascribed, probably correctly, to hormonal changes initiated by environmental factors, such as temperature, rainfall, wind, etc., rather than assessment of nutritional factors such as food supply, etc. In birds day length seems to be the most influential determinant. In captivity migratory birds become thoroughly restless at the time that their wild cousins migrate. They fly in their aviaries or shuffle in their pens.

If they can see a cloudless sky by day or by night then their shufflings assume a particular direction. This is always the same as that of the initial flight of the wild birds. Thus, confined Baltic starlings shuffle towards the southeast just like their fellow starlings who aim for France, southern England and Ireland. To fly southwest in the fall is therefore an innate behaviour pattern in Baltic starlings. However, the shuffling and direction of departure are only southwest if the birds can see the sky. If the sky is invisible to captive birds, they become confused and do not take up the correct orientation. However there are remarkable exceptions. Professor F.W. Merkel and Dr. H.G. Fromme of the Zoological Institute, Frankfurt University in Germany had robins in an aviary which excluded sight of the day or night sky (either of which in the case of migratory birds are sufficient to permit of initial orientation). In the autumn the robins, as to be expected, became restless, but instead of being disoriented or confused, they all tried to fly, as if to Spain, in the right south-westerly direction. Thus they had some non-visual clue to orientation! To ascertain the nature of this clue the Frankfurth zoologists put the robins in a steel chamber; the birds were now restless and confused. When the door of the box was opened the robins' flutterings again tended southwest. This, together with many auxiliary experiments, was taken to indicate that the earth's magnetic field was a significant factor in, at least, the initial orientation of some migratory bird species.

Actually, experiments tending to show that migratory birds use magnetism in navigation have produced rather contradictory results. For example, Wiltschko was able to alter the orientation of robins in a predictable way by exposing them to a magnetic field produced by solenoids. Also they showed that the robin's response is based not on the horizontal component of the earth's magnetic field but on the magnetic declination (!) the angle of inclination of the earth's magnetic field to the vertical (or zenith) -- a result so surprizing that it must be true -- for who could have thought of it a priori?

The case of homing pigeons is most complex. Pigeons are not migratory birds and are usually trained to "home" by repeated flights over increasing distances. It appears that their final approach to their own lofts is by visual means, because when they are temporarily semi-blinded by putting eyeglasses with frost lenses on them, although they get home in the end, the

final approach is very muddled and roundabout as compared to the fly in of the normally sighted bird. (In this respect pigeons are like almost all the migrant birds; they arrive within a few feet of their destination, sometimes to the nest left a year before). Experiments in which magnets have been attached to the pigeons to investigate the possibility that they navigate to an important degree by reference to the earth's field have, as with other birds, yielded negative results, in the sense that when the sun is visible presence of the magnet does not detract from the homing performance. However, although an overcast sky does greatly detract from homing ability, it does not always totally spoil the performance. It appears from fairly recent experiments however that if the sky is overcast then the presence of a magnet tends to impair the residual homing ability. Thus it is permissible to suppose that sensing of the earth's magnetic field is an auxiliary or reserve mechanism in the pigeon's battery of methods of navigation, which includes visual sighting of land marks as well as observation of the sun's bearing.

Students of animal navigation have only recently been converted to the view that magnetism may play a role. This is for two reasons. G.V.T. Matthews of Cambridge University, a distinguished researcher and author of the important monograph Bird Navigation (Second edition 1968) was so strongly an advocate of navigation by the sun that he was perhaps overly intolerant of alternative hypotheses. Secondly, H.C. Yeagley in 1947 had put forward an hypothesis of his own in a paper in the Journal of Applied Physics. Yeagley supposes that birds steered themselves by reference to a navigational grid rather like the LORAN system for aircraft which came in during the 1939-1945 War. Yeagley postulated that the bird had two senses -- a magnetic sense and also an ability to sense the Coriolis force. This force is technically a "fictitious" force. But, having said this, it is sufficient to say that it is just like "centrifugal force" which tends to push us to one side when rounding a bend in a subway car or on a roundabout. In the simplest case a bird flying North is acted on by a tiny force tending to push it eastwards. The effect, which derives from the rotation of the earth and which depends on the bird's latitude, although minute, is quite real. In practical life, even in these days of aircraft, the Coriolis force (named for G.G. de Coriolis, who in 1835 drew attention to its existence) is important because it profoundly influences the pattern of trade winds and ocean currents. Yeagley's hypothesis finally fell into disrepute. This was in part due to the negative

experiment with magnets and partly because no mechanism by which creatures could discern the minute Coriolis force could be reasonably postulated. Lastly, certain experiments which we will not detail told against Yeagley's theory. With the death of his theory, interest in the magnetic side of it expired also pro tem.

However theories have a tendency to be resurrected. Under the pressure of the more recent results relating to magnets and pigeons three researchers at Princeton, N.J. and Stonybrook, N.Y., namely, C. Walcott, J.C. Gould, and J. Kirschvink, carried out an investigation reported in Science, Vol. 205, Page 1027-28, 1979, under the title "Pigeons have Magnets". They dissected dead pigeons and using a SQUID low temperature magnetometer they discovered a small volume of tissue of the order of a millimetre across in each dimension between the skull and the dura mater (i.e. the brain integument) consisting of permanently magnetic substance. On careful physical and chemical analysis the substance was identified as magnetite.

As we have seen some dowzers claim an association between their skill and an ability to perceive magnetic fields. Before we leave the subject we should advert to an interesting but long neglected area of research -- the alleged human ability to "see" (in some sense or other of this verb) the fields emanating from strong magnets. Here we are in a somewhat different realm from that of the birds and the dowzers. The earth's magnetic field is weak compared to that of permanent magnets, which may exceed it by a factor of hundreds or thousands. In the later years of the nineteenth century a European scientist, Reichenbach, worked with many "psychic" subjects, i.e. persons known for their putatively "psychic" sensitivities, i.e. telepathy or thought reading, clairvoyance, perception of auras, etc. Amongst other abilities he examined whether such subjects could ascertain in the dark the presence of a powerful magnet, and also determine the polarity North or South of its ends. We do not have all the material before us. However a useful reference is a paper by Lord Rayleigh, Sc.D, LL.D, F.R.S., in the Proceedings of the Society for Psychical Research, (Vol. XLV, Feb. 1938), entitled "The Question of Lights " Supposed to have been Observed near the Poles of a Magnet. (In parenthesis it could be said, for the sake of those interested, that this Lord Rayleigh, John William Strutt, 4th Baron Rayleigh, President of the Society in 1938, was a distinguished physicist and the son of a previous President, Robert John Strutt, 3rd Baron Rayleigh, O..M. P.C. F.R.S.

Nobel Laureate. Both were fellows of Trinity College, Cambridge, an institution long noted for its mathematicians, physicists and psychic research workers.) In the paper cited the younger Lord Rayleigh, besides referring to Reichenbach's work (which he described as "quite & uncritical"), also mentioned ideas of Sir William Barrett, a founder of the Society for Psychical Research and a President, another distinguished physicist, who, amongst other things, had worked on vision. In his experiments Barrett had been led to the conviction that "certain sensitives after long immersion in complete darkness perceive a luminosity emanating from the poles of a magnet....." Rayleigh is somewhat critical of the way in which Barrett's "perceive" is to be understood. He says "the earlier workers (i.e. Reichenbach and Barrett) do not appear to have quite fairly faced the question of whether they supposed the perception to be sensory or extra-sensory" His own experiments were completely negative. Generally speaking one could say about this topic as a whole that experimental results are, frankly, not very extensive and correspondingly no conclusions are very firm.

HOMING AND MIGRATION.

It is hard to separate migration and homing because all animal migration appears to imply problems very similar to that of homing. Many many animals go out daily from their habitat to forage and go to places well out of sight of their homes. Numerous species, including totally blind ones, contrive to return entirely by scent. Others like the "bee-wolf" Philanthus triangulum, which lives on sandy heaths have been shown to manage entirely by use of visual landmarks, just as humans do when going to and fro home and supermarket. Other quite humble species such as sand hoppers (Talitrus saltator) have been shown to navigate by the sun. Other cases are more difficult. Thus the female of the slender-billed shearwater (Puffinus tenuirostris) during the period 19 November to mid-January each year fishes on the high seas more than a thousand miles from the breeding grounds on islands between Australia and Tasmania where the male is incubating the eggs. But she returns to the nest without difficulty.

An Antarctic creature with extraordinary ability is the Weddell seal. This seal lives in water at a temperature as low as -70 degrees F, and the surface of the sea is frozen to a depth of several feet for many months of the year. Yet this seal can not only swim under water without coming up for air for more than an hour, but it will

find its own breathing hole each time, even during the long Antarctic night. Swimming in complete darkness under the ice at night, it still finds its 'home' even from distances as much as twelve miles away.

There is an enormous literature on what parapsychologists call "Psi-trailing" -- pet animals, mainly dogs and cats, that find their way back to their homes, if removed, across tens of miles, through large and crowded cities, and across whole continents. Conversely, when the family moves the pets find their way to them. This latter is, it would seem, a feat even one degree more marvellous than that of ordinary homing to a particular geographical spot. According to the canon of strict scientific practice all non-experimental reports of these kinds should be regarded as purely "anecdotal". True as this is, we have to give a fair measure of weight to these stories, many of which have a great deal of corroborative detail. Some "experiments" in these fields are essentially observations which have occasioned themselves accidentally without premeditation. Such is the case reported by the late eminent parapsychologist J. Gaither Pratt in his book Parapsychology (1964). A parapsychologist at Duke University took a cat from its home fifteen miles away to be used in some laboratory tests of ESP (i.e. extra-sensory perception). As soon as the box was opened at the end of the journey the cat jumped out and disappeared in the direction of its home, where it arrived next day!

Just recently, in an English newspaper, there was an account of a cow which found its way, persistently, to the new home of its former owners. It belonged on a farm, and when the farm was sold the cow's owner (and family, who had 'petted' the cow) moved three or four miles away. The cow subsequently broke from its pasture and found its way to the new home of its previous owners. When returned to the farm, it broke out again, several times, until the previous owner finally bought it back and installed it in his new home. The distance the cow went was not all that great, but cows are essentially a "non-roaming" type of animal; they usually stay in the one field for most of their lives.

As we have said some of these cases may have a flavour of the anecdotal; none-the-less a fair number of formal experiments have been done on animal homing. Dogs, cats, and horses, taken from home and transported into hitherto unknown country, but allowed to observe the route from the vehicle during the journey, were able to return accurately and promptly on their own, presumably because they remembered visually the physical features of the way they had come. Homing experiments with horses have proved that these animals, which have a poor sense of smell, but keen eyesight,

have a very accurate visual memory, and even if ridden many miles into unfamiliar country they are able to return, unguided by man, with accuracy and speed. However if horses are taken in closed boxes they are unable to return over unfamiliar country; instead, on release, they wander aimlessly in any direction.

Most experiments with dogs and cats taken in closed containers and released about ten miles away in totally strange terrain have been failures in the sense that the animals rarely find their way home. However there are exceptions. These are sometimes explained as having happened by "random search", which to us seems not entirely to be satisfactory and suggests rejection of an unpalatable result by invocation of an arbitrary hypothesis, because, if the animal is not followed en route by radio or other means, how can the randomness of the search be proven? As a matter of fact K.S. Rawson and P.H. Hartline of Swarthmore College inserted tiny transistor radios under the skin of mice and found that a proportion (too great to explain by chance or random search) even of animals not fully grown, whose experience of the world was confined to a few feet around the nest where they were born, have returned from distances up to two miles. Clearly some mechanism for homing was at work. As yet it is not clear whether some form of sky or sun "compass" may not be involved as with so many animals belonging, as we have seen, to so many widely separated phylogenetic groups.

Because of this kind of result and the small but striking number of experimental homings, particularly by dogs, the "kinaesthetic hypothesis" has been entertained by many animal psychologists over the last half century.* This hypothesis says that the animal can, somehow, despite all the jostlings and bumpings which it experiences in its travelling box, retain a sense of its orientation with respect to the earth. In some unimaginably strange way it can record every relevant twist and turn and at journey's end "deduce" its orientation. At first sight this proposition may seem absurd but we should remember that our respected friend Apis mellifera seems to perform a rather similar feat daily with a nonchalant ease. When the honey bee goes out foraging it will seek, search and sample so that it follows a course that is anything but straight. However as soon as it decides to head for home it makes a "beeline" for the hive, even though the hive may be out of sight. It is as if through all the twistings of the outward bound path it has contrived, as if aided by some internal computer, to summate all the turnings to left or right so that at any time it "knows" its exact bearing relative to the hive, and correspondingly the hive's bearing relative to itself. It would seem therefore to the intelligent layman that the kinaesthetic hypothesis cannot reasonably be rejected until the somewhat parallel case of the honey bee has been elucidated.

* To be distinguished from the "kinaesthetic sense" which tells us how our limbs are disposed. (Sometimes this is called the "muscular sense")

It is worthwhile therefore to note what reasoning has been applied to the kinaesthetic problem. Even without radar or the LORAN radio grid system, or the sun by day or the stars by night, or the magnetic compass, ships at sea can be sure of one thing -- the direction of the geographical north -- provided they have an appropriate inertial device. An inertial device is a mechanical system closely coupled to the same inertial frame as that occupied by the earth. The one used by ships and aircraft is actually a "gyrostat", i.e. a gyroscope or gyroscopic compass. Now it is hardly possible that any animal contains a gyroscope. The alternatives, so far as known physical forces are concerned, have to be equivalent at least to a Schuler pendulum. This is a device whose natural period of oscillation is 84 minutes; i.e. the same as that of a pendulum as long as the earth's radius -- 4,000 miles. Clearly no animal can contain anything equivalent, any more than it can comprise a gyroscope. A different rebuttal of the kinaesthetic hypothesis was effected by G.V.T. Matthews in respect of pigeons, starlings, and herring gulls. He transported them under heavy anaesthetic. To additionally confuse any residual kinaesthetic sensibilities the birds might have the van was given additional rotations and circular drives en route. However the homing ability was unimpaired! Similarly, normal homing was obtained even after surgery on the birds directed to modification of the organs by which we humans as well as mammals and birds relate to the earth's inertial frame. The operations included blocking of the auditory canals, destruction of the tympanic membrane, removal of parts of the inner ear, and removal or cutting of the semi-circular canals. It is fair to say that the kinaesthetic hypothesis has been proved invalid within present day knowledge of physics. This is not to say, however, that a genetically distinct fraction of each of many species may not have an ability to relate to an inertial frame by way of a causal connection at present unknown to us.*

Homing in humans is a comparatively new topic of research. As with animals, there is much anecdotal evidence collected from "Greenland's icy mountains to India's coral strand" and even farther, to comprise Australian Aborigines. Many stories relate to Canadian Indians or trappers lost in featureless snow-covered northlands. Also Lapps and Eskimos and other tundra dwellers appear to have a keen sense of direction. But the evidence, such as it is, tends to suggest that this is not an occult paranormal intuition but is directed by visual clues, especially the sun and the stars, supplemented by a strong time-sense. Other aids to navigation are the prevailing wind, moss on the sunless side of objects, and the general lie of the land, (i.e. up or down in known relation to the compass points -- thus in Toronto it is a good bet that uphill is North, to discriminate East or West without reference to North is a totally different matter). Similarly the flow of streams and creeks

* E.g. the kind of connection between mind and matter exhibited by the "force" or "influence" manifested in P.K. phenomena

and the diurnal movement of birds. Also against the hypothesis of an innate non-deductional directional sense in humans, one can plead various counter examples, such as Harry Witherby's adventure with Norwegian Lapps (see the excellent book Animal Navigation by R.M. Lockley, 1967). Enveloped in dense fog on a lake, the Lapps paddled energetically, but unbeknownst to themselves in circles, and refused to be guided by Withersby's compass. An experiment with a positive result was, however, done in Britain by Dr. R.R. Baker (see Science, Vol. 210, page 555, 1980). Blindfolded students were taken in vans to release sites between 4 and 30 miles from the laboratory. While still blindfolded they were asked to write down the compass bearings of their home relative to their present positions. The results were statistically significant, indicating a tendency to recognize the direction of home. However, as is so often the case in behavioural sciences, the result was not repeated in repetitions at Princeton University. James A. Gould (whom we have already mentioned in connection with the magnetite discovered in the craniums of pigeons) and Kenneth P. Able carried out the same kind of experiment with the guidance of Dr. Baker at Princeton (see Science, Vol. 212, page 1061, 1981) with negative results. This does not, of course, mean the end of the matter. Protem the question is not settled.

Migratory species are extremely varied and numerous -- storks, geese, humming birds, robins, gulls, swallows, starlings, shearwaters, warblers, etc. etc. as well as big mammals, -- caribou, reindeer, elk, and denizens of the sea -- salmon, eels, seals, whales and turtles present endless problems of which only a few have been solved, and those very partially. Many of the issues are highlighted by research with the Adele penguin, which is flightless. Thus biologists in the Antarctic "kidnapped" five male Adele penguins from their site near Wilkes Station and flew them 1200 miles to McMurdo Sound and released them. They were banded, of course. When the penguin population assembled as usual the following Spring three out of the five kidnapped males waddled up the beach to establish their claim at the very nesting sites from which they had been taken. They had been 10 months away, and it was especially interesting because the penguins did not, indeed could not fly, but had walked, tobogganned on their bellies, or swum the whole way!

This was but one of a series of similar experiments with displaced penguins, all of which showed a high rate of return to the birds' birthplaces or nests they had made previously with their mates. The initial overland path taken by each displaced penguin was observed through telescopes. If the sky was clear the bird would immediately set off in a north north east direction. If it was overcast the bird would appear confused and would wander at random until the sky cleared and the sun was visible. The interesting thing is not so much that the penguin

can navigate by the sun and also correct for the sun's position according to time of day because these innate abilities have been demonstrated for a number of birds and other orders of animals, but that there is an innate tendency to set off in a definite direction.

The same is true of many migratory and homing birds. Sometimes the direction chosen is the most obvious and direct route to the destination. In other cases of long migratory flights the direction though not obviously the best, is so in practice, because the migrants take a great circle (i.e. shortest route). In these cases displacement and release can entirely throw out the bird's navigation; they set out in the usual direction and end up in the wrong place. In other cases the birds are unaffected by displacement; either they start off in the customary direction and then mysteriously alter course. Thus a Manx shearwater taken from its nest in Wales to Boston, Massachusetts, returned to its nest after a 3050 miles journey in twelve and a half days, before the letter announcing its release arrived at Cambridge, England. Other birds normally set off in a "wrong" direction in their customary migration and then wheel round. Others initially circle and then mysteriously select the "right" direction for homing or migrating. In the case of the displaced Adele penguins for most of the points of release north northeast was not the "right" way home. However, although it was not possible to track them far, it is clear from the high rate of successful homing that somehow most birds received information causing them to change their course. At present we have no insight as to how this is achieved. It is fair to quote K. Schmidt-Koenig (Migration and Homing in Animals, 1975) who also says "Although a large proportion of all theoretical and experimental attempts to elucidate animal navigation has been devoted to birds, we still lack a satisfactory insight into the problem even with birds and much work remains to be done".

This is equally true of other animal groups. Thus insects migrate, the most spectacular and best known being the monarch butterfly - which lays its larvae on milkweed in Canada and North America, the parents then die, and perhaps several generations of butterflies hatch out during the summer. The last ones to hatch in the fall fly off to the place from which its parents came, Mexico, or California, and have been proved to go to the same trees in the same small mountain area from which their parents came. Here the cycle starts all over again, and their offspring return to Canada and N. America the next Spring. Butterflies in England migrate to the North coast of Africa in the same way.

The salmon going out into the ocean when young, and in later years returning to its birthplace high up on an inland stream is a notoriously difficult case. Some limited progress has been made in recent years. A strong case has been made out for asserting that it has subtle cosmic perceptions by which it recognizes the taste and smell of its home river. But this is likely to be only a small part of the story.

It seems that animals possess a great variety of mechanisms which they use for navigation. Thus it has recently been shown that pigeons may also use smell as well as sight, and perhaps magnetism. However even with pigeons who occasionally perform quite unexpectedly magnificent feats of homing, one gets the impression that some individuals are endowed with an extra sense. It is also worth remarking that there are many migratory species for which we know absolutely nothing of how they navigate!

DOWSING, RADIESTHESIA AND PSYCHOMETRY.

"Dowsing" - also called "water-divining" or "well-witching" is a mysterious art, scoffed at by some, but fully believed by many practically minded persons. The practice of dowsing certainly goes back to very ancient times; a Chinese engraving of 147 A.D. shows the Emperor Yu holding a forked divining rod. In both of the founder nations of Canada the tradition was strong. Even today in the drier parts of England, such as East Anglia, it is common practice to call in a "water diviner" to find a good place to drill if one wants to sink a well. In Old France for centuries the village Abbé's and Curé's had paced their parishioners fields with rods and pendulums, divining for water. The practice of well witching has been widespread in Canada. E.L. Marsh, the historian of Grey County, Ontario, says that in those parts the assistance of a dowser was regarded as the surest way of finding water, and indeed if you talk to the modern "cottager" we find that it is still the most popular and used method of finding the best place to dig a well. The accuracy of the divining rod in finding water has been proved over and over again. Carrying a forked branch of witch hazel, or willow, or in modern times a bent wire coat hanger, the water witch walks slowly over the ground. If water is present the point of the stick turns towards the ground despite all efforts to hold it firmly. In a very high percentage of cases the prediction is completely accurate. To add to the mystery some diviners are not only able to predict the location of the water, but to state at what precise depth the water can be found. This is particularly valuable in dry areas, as it is possible to sink a well at the most shallow point, thus saving costs.

The method of divining is traditional. The dowser cuts a forked twig freshly from a hazel or willow tree - or, as mentioned, in modern times uses a bent wire coat hanger, or two pieces of plastic rod tied together. Usually the dowser pulls the ends apart into a V shape. He clasps the ends in his hands so that the rod is horizontal, and the ends which he is holding are then nearly at right angles to the direction that the V is pointing (straight ahead of the dowser). Thus the two branches of the rod are both very much under tension and the rod is therefore rather unstable. The theory of dowsing is that when he is over water the dowser receives a kind of signal from the rod. Usually he is not consciously aware of this signal, but in some mysterious fashion it is transmitted through his nervous system into the muscles of his arms, and wrists. As a result his wrists make a slight involuntary movement. This is enough to upset the delicate balance of the highly stressed rod which therefore suddenly "flips" either downwards or upwards. This method is the most common way of holding the forked rod, however

individual dowsers may hold it in a different way, and each dowser seems to have not only his own method, but his own theory as to how it works.

Whether or not dowsing can be said actually to "work" the theory of dowsing is very interesting. As we have said, it is assumed that the water transmits some kind of signal to the dowser, who is not consciously aware of it. However the signal in some mysterious way induces a muscular reaction. It may be noted that the reception of an unconsciously perceived signal that is translated into a muscular reflex, is closely parallel to some ideas that have been put forward regarding psychic impressions. Psychic impressions, it would seem, are sometimes received unconsciously and fail to register in the mind as a consciously perceived message, but instead force themselves into consciousness in a disguised form, e.g. as a smell. We shall return to this theme later.

Dowsers differ amiably among themselves as to how dowsing works. Some believe there is a physical field emitted by water, especially running water, and it is this field or radiation to which the dowser is sensitive. Many students of dowsing have believed that the field in question is related to magnetism, (i.e. magnetism of the ordinary, everyday kind, not "animal magnetism"). Interestingly enough, some dowsers claim to be sensitive to the earth's magnetism and to be able to map out the earth's magnetic field. Others believe that there is a radiation field given out by water and that dowsers are sensitive to it, but that it is not electricity or magnetism; some writers call it the "radiesthetic field".

Before pursuing this point, however, we should note that successful dowsing is by no means confined to finding water. There are a host of other objects that can be found by using the methods described above. And these are as well documented and proven as is "water witching". Among the more practical uses of dowsing is that of finding lost underground pipes and cables. Under our modern cities lie mazes of underground pipes and cables carrying all the means to provide mankind with lighting, heating, sewage disposal, etc. It is not surprising that locations of some of these pipes get lost from time to time, but what is surprising is that the modern utility companies employ dowsers to find and retrieve their lost cables. To quote specifically, Ontario Hydro keeps a number of diviners on their payroll for this specific purpose. In England the gas companies keep them employed for the purpose of finding and identifying lost and old gas pipes. The American Army authorities not only trained its personnel to use divining rods to locate buried anti-personnel mines in Vietnam, but also employed people to dowse for underground tunnels.

A selected number of dowzers make a comfortable living dowsing for oil, on a commission basis, and again in Canada, many dowzers have successfully sought minerals of many kinds. An "offshoot" of this type of dowsing is what is known as "archaeological" dowsing where some dowzers seem to have the ability to find old burial sites and archaeological objects by use of the forked twig. We have a report of a student who was employed as a grave-digger in Streetsville in 1973 (as a summer job). He was taught by an old grave-digger on the site to test for unmarked burial sites by use of the divining rod. The cemetery was an old one, and many old graves were unmarked. It was embarrassing and wasteful for the grave-digger to dig a new grave and find the site already occupied. So the old grave-digger had found his own method - which worked - of discovering which graves were already occupied. We had a similar experience in Peru in the early 1970's. We had been invited out to the desert area some 40 miles north of Lima, to accompany an archaeologist - and seeker after buried pots and artefacts - on a 'dig'. On the way he called at a local Indian village, and picked up a local 'diviner' known as the 'professor' for his abilities. We went into a vast desert area, literally covered with old bones and skulls. This had been a burial place many hundreds of years previously, and the graves had been systematically robbed ever since. It was all one vast sand tract, the graves were in no way identifiable. The 'professor' walked the area carrying one long thin metal rod, looking for a grave that had not been previously dug. (The habit was to refill graves that had been robbed). Our 'professor' after strolling around with his rod for some time, stuck it in a certain spot and announced that here we would find a grave containing metal, pottery, and jewellery. Our team of diggers got to work, and after several hours (and consuming a few pints of beer) they had dug down to a depth of about 20 feet, where they found the bones of a young girl. Buried with her was a necklace of beads, one or two small pots, and a "toy" - a copper rattle. We kept the rattle, and one pot, our friend kept the necklace and the other pots. The grave did not yield the type of valuable large ornate pot that our archaeological friend had hoped for, but the diviner was entirely accurate in his estimation of the kind of materials that were found.

As we have said the traditional "tool" of the dowser is a 'divining rod' of some kind, made of bent twigs or metal or plastic. But some diviners use another method of detection. They use a pendulum to detect the object of their search. Before starting to work they mentally "tell" themselves that if the pendulum rotates the answer to their question is "yes" or if it swings from side to side, the answer is "No" -- or vice versa -- the decision is their own as to the behaviour of the pendulum. This adds a psychological factor to the exercise.

It implies that the response to the pendulum is somehow conveyed to the brain, and that then in a subconscious or unconscious manner by subliminal movement the brain causes the pendulum to move in the prescribed manner. It is generally believed that the movement of the pendulum, and also that of the rods, is caused by minute subconscious movements of the person performing the operation. Pendulum dowsing is quite popular, and equally effective as rod dowsing -- it is merely a question as to which method the operator feels most comfortable using. Some successful dowzers are capable of even more extraordinary feats - they can 'map dowse' - swinging a pendulum over a map, and asking themselves questions, and using the pendulum they can locate the objects of their search on the map - we have seen it done over a telephone some hundreds of miles away from the place being dowsed. Many of these dowzers believe that there is a strong 'psychic' ability involved, and that they know intuitively where to find the water, oil, minerals, etc. and that the rod or pendulum is merely a 'crutch' to help them focus their attention and subconscious ability.

An extension of this kind of ability is in the practice of radiesthesia, using an apparatus such as the De La Warr machine. (Again, this machine is just a crutch -- in spite of its fancy box full of dials and machinery, it is a fake, with no real working parts). But the dowser uses it to focus the subconscious mind on the task in hand. The De La Warr machine has been extensively used in the diagnosis of illness. A piece of paper containing a blood sample, a hair, or some other such similar artifact is placed on the machine, and the operator turns knobs and dials in order to get a response on the pad, on which his fingers are placed.

So what evidence is there that fields exist of which we as yet know little? What experiments can be done? We have reports of some interesting experiments having been carried out in the area of mechanical dowsing. If the movement of the rods in a dowser's hands are simply due to the pull of a force underground when water, oil, minerals, etc. are present, then is a human being needed to hold the rods? Experiments using the rods in a purely mechanical fashion have been devised and carried out, and some degree of success has been claimed. We ourselves on one occasion attempted this experiment, but with little result. Perhaps the reason was because there are so many pipes (sewage, water, gas, electricity) under a modern city street. As already mentioned we also did experiments to ascertain whether humans can detect weak magnetic fields. Of course if such forces exist, we do not know their nature, we can only guess. Perhaps such a force is neither electric nor magnetic.

Another example of the possible existence of an unknown force is demonstrated in the field of psychometry. This is purely a 'psychic' ability. Some people claim, with some degree of success, that they can hold an object in their hands, and by feeling the force, or rays, emanating from it, they can describe where it came from, something about its owners, and history. Some people seem to have quite remarkable powers in the use of this ability. People who can do this claim that the object gives out some feeling of rays or force, and they can interpret these.

Finally, since we are looking at the possibility of the existence of as yet unknown "force fields" some dowzers and psychometrists claim that they can see a force field around the rod. This reminds us of an occasion when Jan Merta was with us at our 1974 Conference, when this question arose. It was suggested that a dowser should hold a rod, willing it to move in a specific direction, and that another person should stand nearby "willing" it to move in the opposite direction. The experiment was meant to test whether one person could "will" the rod to move when it was being held by someone else. What was interesting, however, was that at the moment of conflict, so to speak, some of the people present saw something happening around the end of the rods. Some claimed that the ends of the rods appeared to throw off sparks, others that there was a shimmering appearance along some three inches at the end of the rods. Was this the appearance of some kind of force?

CONCLUDING REMARKS

It will be clear to the reader that the various topics we have reviewed have in the present state of knowledge only a tenuous and tentative connection with each other. Thus the tendency of men in western Europe to arrange objects in straight lines may result from a purely aesthetic impulse of an austere kind, the precursor of the western genius for geometry as expressed through Pappas, Pascal and Desargues. If so it would have little to do with geomantic notions or with the mode of Chinese landscaping and urban planning that explicitly related to terrestrial magnetism.

Similarly we may claim in the text to have said sufficient to qualify any hasty conclusions as to the range and nature of the dowser's sensitivities, even though we think there is little doubt as to their practical effectiveness. Lastly we might assert with confidence that the evidence of wandering fishes, animals and birds is sufficient to embue us with a proper humility. In spite of a century of quite careful and imaginative research, orthodox biologists are, like parapsychologists after a similar period of devotion to their discipline, the first to admit the presence of impressive and tantalizing mysteries!

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Professor Michael Persinger: ELF waves and ESP.

In the Psychophysiology Laboratory at Laurentian University our primary goal is not only to understand how parapsychological experiences take place, but to predict and control them. Thus we would like specifically in experimental situations to control what (tentatively) has been called telepathic behaviour, and also understand and replicate so-called P.K. events. Today I shall discuss two experimental models which are quite testable and which seem to emphasize the importance of the environment in parapsychological experiences. I myself am trained as a psychologist and physiologist, but in graduate school my outside concentration was geophysics.

When one talks about energy exchanges with Psi phenomena I have to stop and note the fact that, so far as we know, there is *no biogenic* energy that can travel from the body to such unusual distances as occur in telepathic behaviour. Consequently, assuming the phenomena are real, the energy involved with ostensible telepathic events must be coming from somewhere else. Our first investigation indicated that perhaps this energy is coming from the environment.

The earth is a charged sphere surrounded by the ionosphere, which is a layer full of ions and charged particles, commencing at about 50 miles above the earth's surface. Essentially the earth-ionosphere construction is similar to a spherical condenser. The region between the ionosphere and the earth's surface thus constitutes a spherical waveguide within which certain electromagnetic frequencies can propagate with small attenuation.

These "Schumann waves" are extremely low frequency (ELF); the fundamental frequency is about $7\frac{1}{2}$ Hz. (i.e. $7\frac{1}{2}$ cycles per second), but significant harmonics (e.g. 14.5 Hz) do exist. A feature of the Schumann resonance is that the frequencies within the spherical wave guide can propagate round the earth at least once without appreciable attenuation. This is an interesting property because we know that telepathic behaviour seems to involve great distances. These Schumann resonance waves also have tremendous penetrability. It is almost impossible to shield them out; the ordinary shielded room, such as is used in most electrophysiological work, is very likely to be inadequate. In Germany, where much of the ELF research has been done, it is found that in order to shield out more than 95% of ELF one needs an underground bunker surrounded by several inches of steel. This constitutes a second parallel with psychic phenomena because we know that many psychic experiences occur inside buildings. A third characteristic of these natural frequencies, perhaps the most important one, is that, although they show diurnal and seasonal variations, none the less they occur all the time. Detailed description of the physical and biological properties of ELF fields can be found in a recent text (Persinger, 1974a).

Another feature of ELF waves is their time variation within biofrequency regions. In other words if we consider the brain as a generator of time varying electrical potentials (i.e. the cortical voltage measured in the EEG) we find that a proper maximum is developed at frequencies near 10 Hz. In fact, most of the electrical processes taking place in the brain, e.g. memory, occur at frequencies in this band. As mentioned, the ELF waves exemplify an energy which can be transmitted over long distances and through substantial material barriers. It should be now clear that they are at the same frequency as the basic electrical processes occurring in the brain. Calculations by my German colleagues show that if indeed the cortical voltage in the brain is oscillating at 8 Hz., and if

is a electro-magnetic in the environment at all vibrating at 8 Hz., then energy interaction can take place.

This model is very testable because a number of things can be predicted from it. For example, a significant number of nocturnal ELF fields propagate more between midnight and 4 a.m. than at other times. Also they have a geographical preference; e.g. it is easier to transmit at ELF field west to east than east to west. Furthermore, propagation of these ELF waves is heavily dependent on the local magnetic field. We can imagine lines of magnetic force coming out of the earth; ELF fields follow these lines. Just as the U.S. missile called the "Sidewinder" could follow a jet heat trail, so do the ELF fields use the magnetic flux lines as guides and transmission ducts. Consequently, if you disturb the static magnetic field of the earth you would modify the propagation of these waves.

Now, we collected accounts of cases of telepathy and clairvoyance from various sources — the Journal of the American Society for Physical Research, as well as from some popular magazines, and plotted their occurrence distribution as a function of the hour and the day. It appears that they have a tendency to peak roughly between midnight and 4 a.m. This is what one would predict from the ELF model. We find also that there is a greater tendency for the putative agent in telepathy cases to be west of the percipient rather than to the east. This is, in fact, statistically significant, but we are aware that this is only a pilot study, and we plan to replicate it. Similarly the number of cases as a function of distance between the putative agent and the putative percipient falls off in the same order of magnitude as you would expect if an ELF field was involved with telepathy. According to the ELF model, if there is an interference with the propagation of ELF waves around the earth, then there should be a decrease in the number of "ESP" reports. This is indeed what we find. There is a significant negative correlation ($r = -0.68$) between the number of telepathy-clairvoyance reports and the U index which is a measure of the amount of geomagnetic disturbance throughout the world. When there is a geomagnetic disturbance the magnetic flux lines all over the earth's surface are shaken about and the propagation of ELF waves is impaired. Thus we have found a number of interesting parallels between telepathy and ELF propagation which suggest that ELF fields produced in nature, vibrating at the same frequency as electrical activity in the brain, may be involved in the production of ESP experiences.

But, what of P.K.? Well, if indeed the environment can be tapped for ELF, then an energy exchange will result. We have made some calculations which indicate that if a person had some peculiarity in his brain so that its power peaked at 7.8 Hz. then he would have the possibility of absorbing ELF energy, and using it in his body. Now there is a great

amount of energy available in earth's spherical waveguide, so that a considerable energy contribution is potentially available from the environment. Another interesting speculation concerns the harmonic frequencies of the ELF. Although the major fundamental frequency of the Schumann resonance is only 7 to 8 Hz., it has a second harmonic which peaks at about 14.5 Hz. According to the present theory individuals who have brain energy output peaking at both 7.8 and 14.5 Hz. should be the ones with exceptional P.K. powers. Interestingly enough, some of the Soviet literature indicates that when the Soviet medium is causing objects to move, then there is an increase in that activity (i.e. 3-7 Hz)*. One could argue that the energy is coming from within the medium. Alternatively, we suggest that there is a resonance taking place between her brain and the ambient ELF fields.

Of course there are various features which are not clear from the model. How is the energy focussed on the object which is moved? Also, why can't we all harness the Schumann ELF waves? Well, for one reason, most people have their alpha power peak around 10-12 Hz. However, certain people with thyroid problems and also certain kinds of psychotic patients have a different distribution of cortical energy output. It may be these individuals who are most liable to have telepathic, clairvoyant, or P.K. experiences.

Now the model is very testable. For example, we can actually put ELF energy into the brain. We have done this at Laurentian University and the data are promising. We take a putative agent and get him to look at an object. Meanwhile we detect his cortical voltage with an EEG apparatus and feed it through an amplifier. The amplified EEG which is now of the order of 10 volts is then applied to large flat metal plates. A "percipient" is seated between the plates and is exposed to an electrical field which is a "replica" of the brain potentials of the agent.

One last similarity between ELF waves and the natural electrical activity of the brain is worth comment. The magnetic component of the brain's field is of the order of a millionth of an oersted, which is very small compared to that of the earth, (about $\frac{1}{2}$ an oersted), but just the same order of magnitude as that of the ELF field. The amount of energy in the ELF field is, of course, very small. However, Professor Frank Brown, at Northwestern University, has shown that living organisms are sensitive to minute differences in the geomagnetic field though apparently the functioning of their nervous systems is unaffected by more powerful electric or magnetic fields. More detailed information on this model can be found in a recent book on this subject (Persinger, 1974b).

*C.f. page 193, this Journal, and Whitton (1974).

7. Luminosities and other Strange Phenomena.

Dr. Owen said, by way of preliminary:

In the present section we are putting together a number of phenomena which are doubtfully related but nevertheless, phenomenologically speaking, have something in common in that they all involve light patterns, luminous appearances etc. Professor Persinger's paper suggests a natural origin for some types of nocturnal light. But, as Professor Hynek shows, there are a number of nocturnal experiences which seem to fall outside the limits of seismic effects. In the UFO experiences, as with the appearances described by Dr. Tanous and by Matthew Manning, we are up against the problem of multiple witnessing which militates against the phenomena being entirely hallucinatory or subjective. Luminous phenomena, curiously enough, do not occur in poltergeist annals — the sole modern exception is the occurrence of flashes of light at Clayton, North Carolina (Roll, 1972). Whether visual experiences having a religious content can be legitimately discussed in parapsychological terms is a problem that has never been legislated for (Owen, 1972c). It may be permissible therefore to remark that the only event that I have heard of which resembles the wall projections described by Dr. Tanous and by Matthew was the vision alleged to occur in 1879 at Knock in County Mayo, Ireland (Delaney, 1961). Our justification for including a discussion of luminosities in a conference on P.K. is, of course, association with P.K. both in Matthew's case and in numerous UFO sightings.

Professor Michael A. Persinger: Thermoelectric and seismic effects.

Perhaps you have heard about allegedly haunted houses in which there are "cold spots", and of UFO sightings where something is seen that looks rather like a luminous object. I would like to put forward a model for predicting why certain kinds of unusual experiences take place in some areas. Part of the model involves the Peltier effect. If an electric current is passed through two conductors separated by a thermo-electric material a temperature change takes place depending upon the current direction. Such a temperature change will result if an initially high potential gradient discharges across the conducting layers through the thermoelectric material. We get what is called "heat reduction" at the interfaces. Preliminary calculations indicate that an initial voltage gradient of roughly 1000 volts per meter will cause the temperature at the junction to fall at least 5°C, this reduction being for approximately 15 minutes. This is the same order of magnitude as is claimed for the so-called cold spots of some "haunted houses".

This model predicts that the closer the junction is to the house the greater the cooling effect will be. Thus the foundation of an old house

would be likely to have more continuity with the conducting layer and the cooling phenomena would take place more effectively. Another event that could take place if the house was on the top of a hill is that any nearby thunderstorm or local electrical change could induce a peak voltage on the hill-top, energize the layer, and produce a cooling effect inside the house.

Now it seems at first sight as if potential gradients of 1000 volts per metre don't occur in nature. However this is not quite true. Such electrical potential can occur specifically in areas under seismic stress. Papers by Finkelstein and Powell at Yeshiva University, New York, indicate that in areas subject to seismic activity, people sometimes report seeing luminous objects. They have found that these areas have a high quartz content; if a very heavy mechanical stress is put on the quartz then potential gradients as large as 100,000 volts per metre are generated. Such voltages can locally ignite the air producing luminous appearances that could be mistaken for UFOs. Dr. Yutaka Yasui from Tokyo has published photographs of such luminosities associated with major earthquakes.

We do not expect these phenomena frequently in areas which have had recent big earthquakes, because a fracture of the geological strata dissipates the energy. Thus areas like some parts of California are not so likely to exhibit these phenomena as often as others. However there are many areas where seismic pressure is building upon the local quartz-like structures. Brown Mountain, whose lights were the subject of a report in *New Horizons* (Bessent, 1972), is such a region. Another area which we predicted is the famous New Madrid region which comprises southwestern Illinois, Missouri, Arkansas, and western Tennessee. Similarly, seismic activity is increasing in an area which includes New England and portions of the St. Lawrence Valley in the U.S.A. and Canada. We also predict that the sites of UFO "landings" would show an increase in manganese silicate and perhaps magnesium and iron because the passage of excessive current tends to destroy the thermoelectric material and associated natural Peltier condition.

Can Humans Detect Weak Magnetic Fields?

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ABSTRACT: Two experiments on detection of weak magnetic fields are described.

1. Introduction

The controversy over whether magnetic fields can physiologically affect or can be detected by *Homo sapiens* historically began with Anton Mesmer over two hundred years ago. There is little doubt that lower animals are influenced by weak magnetic fields. Barnwell and Brown (1964) have shown that snails, flatworms, fruit flies and *Paramecia* have highly differentiated responses to magnetic fields. Snails and flatworms for example distinguish the orientation of an artificial magnetic field and will systematically orientate their body axes to the field. Persinger et al. (1974) have demonstrated consistent alterations in thyroid function of rats exposed prenatally to low frequency weak magnetic fields.

In humans the controversy has been clouded with claims of healing and other anomalous effects of magnetic fields (as for example described by Davis and Rawls, 1974). Charcot and his pupils were among the first to investigate the putative healing effects of magnets (Owen, 1971). The issue can be approached by three questions. Is the normal geomagnetic environment essential for man? Can man behaviourally detect the presence or absence of an artificial magnetic field? Are there central nervous system correlates of magnetic fields?

Beischer (1971) has in part answered the first question with a *No*. By exposing subjects for 10 days to a null field environment he found no significant changes in tests of motor performance, spatial orientation and time estimation from results in the normal geomagnetic environment. He concludes that "a magnetic directional sensing, so convincingly demonstrated in insects, was either lost by man during the evolutionary process or is active in a more subtle way not noticeable in the described experiments".

Regarding the second question, there are claims that a certain group of individuals known as *dowsers*, who claim to be able to detect the presence of subterranean water, are sensitive to local gradients in the earth's magnetic field. In field dowsing, a dowser walks over a terrain and his forked twig or L-shaped rod will rotate or in some manner signal the presence of water, oil, minerals or whatever the dowser is attempting to locate (Tromp, 1968; Lewis, 1974; Owen, 1975). Barrett (1884) reported that in a large survey, three individuals could tell by standing beside an electromagnet if the current was on or off. Rocard (1964) claims to have shown that dowsers can detect magnetic field gradients

as small as a few tenths of a millioersted per metre. (The earth's magnetic field intensity at the poles is about 0.7 oersted). Foulkes (1971) duplicated Rocard's study with results no different from pure chance.

The third question is equally provocative. A very interesting but still not confirmed effect of magnetic fields is the alteration of the electroencephalogram (EEG) in the presence of a magnetic field. Mikhailovsky (1969) reported that a subject's EEG showed delta and theta rhythms in the presence of 0.01 to 5 Hz, 1000 gamma sine waves.* Maxey (1975) found that in two of eleven subjects their EEG had evidence of coupling to a magnetic field of 4.7 to 11.4 Hz, 30 gamma. These two experiments were done with very low intensity fields. High intensity fields also have an effect on the mammalian EEG. Gualtierotti (1963) found alterations in the DC activity. Becker (1963) and Kholodov (1964) noted the occurrence of delta waves, and Kholodov (1962) and Beischer and Knepton (1966) found a decrease in the frequency pattern and an increase in spindles in the EEG. Becker (1969) has reviewed to 1969 the effects of magnetic fields on the central nervous system. The results of experiments with low field intensities are important, as in nature normally only weak fields occur (Conlay, 1969). Interestingly, the human EEG itself produces a very weak magnetic field which may be as high as 0.0025 gamma (Cohen, 1972).

The present study was undertaken to further clarify the second question and to determine if individuals can behaviourally detect weak artificial magnetic fields.

2. Experiment One

A flat coil of 100 turns of 28 gauge magnet wire was wound on a stiff cardboard circular support and suspended in a vertical plane with a wooden frame so that the centre of the coil was one metre from the floor. The coil radius was 0.46 metre, and 5% resistors were placed in series with the coil to give a total resistance of 1600 ohms. A wavetek function generator supplied a 10 Hz alternating current of 0.31 mA through the coil. This system produced a theoretical magnetic field intensity of 0.43 millioersted (mOe) at the center of the coil. The power dissipated was 0.16 mW and the magnetic energy was 4×10^{-10} joule.

Twenty-seven subjects, including two who believed themselves to possess the ability to dowse were studied during five experimental sessions spaced one month apart. Two experimenters were present; one to turn the current to the coil on or off, and the other to record the subjects' responses and whether or not the current was on. A trial consisted of first switching the current on or off to the coil and then a subject walking past within one metre of the coil and verbally stating simply whether or not the current was "on" or "off". The subjects were free to walk past the coil several times, stand in front of the coil or move their arms about or indulge in such motor behaviour as they believed would help obtain the correct response. Each subject was allowed a learning trial at the beginning of the series. At the end of each of the five experimental sessions, the subjects were told their performance score for that session. Not all subjects were present during all the five sessions and thus a variable number of total trials was obtained for each subject.

A chi-square test for non-randomness of responses was calculated for the response when the current to the coil was on, when it was off, and on the total

*One gamma = 10^{-5} gauss.

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responses across all sessions for each subject. A chi-square test on a two by two contingency table to test if the current status was independent of each subject's total responses was done. In all cases P exceeded 0.05 (5%). A One Sample Runs Test was used to confirm randomness of the current states at the 5% significance level.

3. Experiment Two

The method for experiment 1 was used with the following modifications. The coil was suspended horizontally under the wooden floor of the testing room. The subjects were aware of its location. An automotive battery delivered a direct current to the coil such that the computed magnetic field intensity at the center of the coil was 600 mOe, approximately equal to the earth's magnetic field. A magnetic compass placed on the floor above the coil before the experiments deflected about 30° when the current was turned on. Eleven subjects, none professional dowsers, were studied during three experimental sessions. Each subject was equipped with a pair of dowsing rods (i.e. "angle-irons") consisting of coat-hanger wire bent in an "L" shape, with the two legs of the L about 4 inches and 10 inches long respectively. The subjects walked across the floor over the coil loosely holding the short legs of the angle-irons vertically, one iron in each fist. They reported their opinion of whether the current was on or off, based on the amount of rotation of the rods as they walked over the coil. It was confirmed that the off-on current status for each subject within an experimental session was random.

4. Results

In experiment 1 the results for all subjects in their ability to correctly identify whether the current was on or off were not different from chance. Two subjects gave more off-responses and two gave more on-responses than expected by chance, but in each case the results were independent of coil current status. When all subjects were grouped, there was an average per subject of 9.2 (S.D. 7.2) on-current trials with an average of 4.6 (S.D. 3.9) on-responses and 4.5 (S.D. 3.7) off-responses, and an average per subject of 7.7 (S.D. 5.9) off-current trials with 3.6 (S.D. 3.1) on and 4.0 (S.D. 3.8) off-responses.

Within specific experimental sessions there were tendencies for some subjects to have significantly correct responses, but this was not maintained over the five sessions. Interestingly, some subjects reported physiological sensations in the presence of the artificial magnetic field. Some of these sensations were reported as "tingling sensation in back of hands", "sensation in head like change in air pressure as in an elevator", "a prickling feeling", "tingling sensation in stomach", "like walking through a cloud or fog". These sensations were reported in learning trials when the subjects knew the current to the coil was on.

The results for the second experiment were similar to the first. For all subjects, the results of identifying whether the current was on or off were not different from chance. Two kinds of errors are possible, identifying "on" when the current is off, and vice versa. Both kinds of errors occurred equally within both experiments.

5. Discussion

This study did not confirm the results of Rocard (1964). However, Rocard tested known dowsers in experiments using dowsing rods. The two self-proclaimed dowsers in the first part of the present study did not achieve significant results, but they did not use dowsing rods. The results of the present study are

consistent with those of Foulkes (1971), who found that the one experienced dowser tested could not detect weak static fields. It should be noted, however, that the fields used in the first part of the present study (about 0.4 mOe) and those used by Foulkes (about 7 mOe) were about 1500, and 90 times weaker respectively than the earth's magnetic field at Toronto (about 600 mOe). The second part of the present study employed static fields equal to the earth's magnetic field, and negative results were still obtained.

The methods in the present study do not exactly duplicate Rocard's (1964) study, especially as known (or professional) dowsers were not used. However, as regards non-acclaimed individuals — by far the majority — the present evidence suggests that they cannot behaviourally detect very weak magnetic fields.

6. Acknowledgment

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