A note about this electronic version--

Readers should be aware that this electronic version of *Archaeus* is not quite identical to the print copy. The journal was scanned, and then a PDF file was created. The original courier-style font was replaced by a different font. This resulted in line breaks that did not match the original. The page breaks remained the same. The software sometimes inserted hyphens in odd places, hyphens that were not in the original. There are other slight formatting differences due to the software used in preparing the PDF files.

ARCHAEUS

Volume 4 1986

ARCHAEUS

ARCHAEUS

Editor: Dennis Stillings
Managing Editor: Gail Duke

Editorial Policy. The editorial policy of Archaeus Project publications is directed toward the exploration of past and current ideas of potential value in understanding and broadening the preventive, diagnostic, and therapeutic armamentarium for the management of disease and health. In pursuing this program, Archaeus Project does not exclude from consideration a priori the claims made by serious investigators of phenomena lying outside the traditional bounds of mainstream science and medicine. The Archaeus Project publications *ARCHAEUS* and *Artifex* attempt to present claims of some substance. The content of these publications is designed for readers of a broad humanistic background with special interests in the borderline areas of current and historical science and medicine. Papers to appear in *ARCHAEUS* that either report on facts of a specialized nature or contain theoretical material beyond the scope of the editorial staff are sent out to appropriate referees for comment and correction. These referees are recognized authorities in the fields of physics, medicine, and the investigation of anomalous phenomena. Papers have included material on the psychological effects of electromagnetic radiation and on biofeedback, technical studies of anomalous phenomena, and speculative, metaphysical models of "reality." Reprints of important and hard-to-find articles also appear from time to time.

Manuscript Preparation and Submission. Manuscripts of any length and of subject matter relating to the concerns of Archaeus Project may be submitted. Typed, double-spaced manuscripts should be submitted to Gail Duke, Managing Editor, *ARCHAEUS*, 629 Twelfth Avenue S.E., Minneapolis, MN 55414.

Subscription and Membership Information. Subscribers receive both the journal *ARCHAEUS*, which appears annually, and the newsletter *Artifex*, published bimonthly. Membership in Archaeus Project includes a variety of useful programs and services, in addition to the publications.

EDITORIAL BOARD

CONTENTS

EDITORIAL

Images of the Invisible

Invisible Life

NINETEEN EIGHTY-SIX was a very good year for Archaeus Project. It began with the great success of the First Archaeus Congress (FAC), and ended with some firm ideas on our future direction and the initiation of a number of important projects. Chief among these was the funding of the Special Projects section of Minneapolis Children's Medical Center for the purpose of investigating pediatric cyberphysiology. The reader will be introduced to this term in **Karen Olness'** paper in this issue.

The terms *cyberphysiology* and *cyberbiology* were introduced by **Earl Bakken** during the small group discussions at the FAC. The more general term, *cyberbiology*, is intended to refer to those self-regulatory processes that are mediated by consciousness in living organisms. No arbitrary limits are set on the field of action of these processes. They may or may not be confined to the limits of the body and the individual psyche. They may include not only other living things, but inanimate objects as well. They may not even occur within our traditional notions of time and space. In this sense, Rupert Sheldrake's concepts would be prime examples of cyberbiology. Other examples might be found among some of the alternative healing modalities. It is in this latter category that one can begin to look at the more specific area of *cyberphysiology*. Cyberphysiology would subsume those techniques and phenomena associated with biofeedback, psychoneuroimmunology, autogenics, hypnotherapy, multiple personality disorder, yoga, and similar disciplines and conditions in which states of consciousness appear to be able to affect a variety of "autonomous" functions in profound and specific ways. Again, no assumptions are made about the field of action in either time or space.

The use of the terms *cyberphysiology* and *cyberbiology* are intended to bypass the constricting figures of thought that arise from the use of such words as *autonomous*, *voluntary*, *brain/body v. mind*, and *normal v. paranormal*. To draw an analogy from physics, we feel that research in many "fringe" areas suffers from a mode of thought that keeps asking questions like whether red balls fall faster that green balls, when the answer only becomes possible when the primary fascination with the colors ceases. So it is with the traditional problems involving the psyche and consciousness. We are fascinated with the supposed primacy of the material world when, as a matter of fact, it is our psychic world that is primary—everything else is inferred. We try to connect the phenomena of consciousness with wholly inappropriate material factors—like trying to relate color to gravitational acceleration. The concepts denoted by *cyberbiology* and *cyberphysiology* may serve to rearrange our thinking on these matters. For instance—I would like to see comparisons made among the phenomena of healing, biofeedback control, subliminal perception, psychoneuroimmunology, and psychic phenomena.

Upon close examination there appear to be several things these have in common, a couple of which include solution of extremely complex problems and a positive response to "letting go." There are also indications that some of the more dramatic and persistent anomalous phenomena such as UFOs, poltergeists, the so-called "cattle mutilations", Bigfoot, are cyberbiological as well. Recent authors have speculated that UFOs may be the collective version of poltergeistery, and that they exhibit features that point to self-regulatory mechanisms on a cultural level. This seems to me to be highly probable, since these "strange" anomalies, when treated in a comparative way, reveal features that indicate they are but reworkings in modern dress of the folklore and mythologies of the past.

Invisible Landscapes

> Bid your soul travel to any land you choose, and sooner than you can bid it go, it will be there. Bid it pass on from land to ocean, and it will be there too no less quickly; it has not moved as one moves from place to place, but it is there. Bid it fly up to heaven, and it will have no need of wings; nothing can bar its way, neither the fiery heat of the sun, nor the swirl of the planet-spheres; cleaving its way through all, it will fly up till it reaches the outermost of all corporeal things. And should you wish to break forth from the universe itself, even that is permitted to you.
>
> —CORPUS HERMETICUM,
> *Libellus* XI (ii).

CONTINUING OUR DISQUISITION on matters invisible, let us turn to the subject matter of **Jack Houck's** paper on associative remote viewing. Some time ago, Jack told me a very interesting and instructive story about a case of remote viewing a Russian airbase. The remote viewer was instructed to "go to" the base and describe what he saw. Instead of "arriving" at the prescibed destination, the subject found himself at a hydroelectric plant. The subject was then requested to "go up in the air" and look around. The correct target was then spotted at about five miles distance from the hydroelectric plant. Jack regarded this as a spatial error, of the sort that occurs when one misses the bull's-eye in a game of darts. Although several researchers share Jack's view of the nature of such displacement errors, I do not think that something quite so simple as a spatial error is involved. The subject was asked to go to a location, the Russian airbase, that has the immediate associations of 1) loud noise, 2) power production, 3) movement of that power along straight lines, 4) turbines, and 5) complex technology directed by humans by means of control panels. These sets of conditions are fulfilled both by jet aircraft and by the hydroelectric installation. It thus appears to me that it is not a displacement in three-dimensional space that is involved, but a displacement in a sort of emotion-space.

To give a good, concrete notion of the topology of such a space, the reader is asked to recall the famous *New Yorker* illustration of "the United States as seen by a New Yorker." In this illustration, the famous Manhattan skyline almost totally dominates the picture and is represented in considerable detail. The rest of the country is shown in as extremely empty and contracted, with small indistinct clusters representing the other major cities such as Los Angeles and Chicago. The picture shows, in caricatured terms, the perception of the native New Yorker of the rest of the country in terms of his psychic investment. Distorted (from the perspective of consciousness) *mana** landscapes of this sort are typical of the topology of the unconscious, and since intuitive (i.e., psychic) perception occurs via the unconscious, the images resulting from psychic operations will be ordered accordingly.

Jack Houck's work has drawn attention to some of the characteristics of emotional space-time, and he has developed methods to alter emotion-space topology by creating peak emotional experiences in association with specific objects and outcomes. This has increased, but has not assured, success in remote viewing. In my opinion, further developments in the techniques of associative remote viewing may come from studies of the modes of unconscious symbol formation and of the modes of consciousness observed in primitive thinking.

**mana*: "General term among the Melanesian (and Polynesian) peoples of the Pacific for the mysterious spiritual power which pervades the universe and is indwelling in men, animals, trees, and inanimate objects. *Mana* transcends human power, has various physical manifestations, but operates through human medium or that of supernatural beings ... Max Müller defined the concept of *mana* as the 'sense of the infinite'." (*Funk & Wagnall's Standard Dictionary of Folklore, Mythology, and Legend,* Volume Two: J-Z, New York, 1950, p. 670.)

Such ordering according to psychic energy equations is a well known feature of primitive thinking. Primitives will typically equate objects, not on anything like the rational bases we are used to, but according to the relative *mana* of the two objects. It is also of interest that primitive notions concerning numbers and letters is of a sort that might lead to results comparable to those observed in experimentation with ARV. Qualitative equations of a most confusing nature occur—considered from our point of view. Subtracting three sticks from five sticks might be seen, by a member of a primitive society, as subtracting "three 'five' sticks from five 'five' sticks, leaving two 'five' sticks—everything retaining the quality of 'fiveness'." In addition, certain tribes only use the numbers one, two, and three. Everything above that is simply "many."

The foregoing considerations of "*mana*-equivalence" lead us to consider that a primitive might well see the hydroelectric plant and the airbase as *being the same thing*. Such equivalencies occur regularly in the emotion-space of the unconscious, and result in what we perceive as "displacements." These displacement effects in emotion-space generate more or less *symbolic* representations that require interpretation. However, if no signature exists whereby we can tell whether a displacement has occurred, we are in trouble—how can we then tell, from our conscious point of view, what kind of error has occurred? This is where I have to leave the problem. I believe that a thorough study of *misses* in remote viewing and in ganzfeld studies may reveal characteristic signatures that indicate that the displacement "error" is, in effect, substitution of one person, place, or thing for the target on the basis of an equivalence of associated psychic energy. These substitutions for the target may have a more symbolic quality than a hit. What *more symbolic* means remains to be determined. Why do such substitutions occur? My guess is that they are due to several possible causes: associative complexes in the subject's mind, ambiguities in the instructions, and even the mental states of other persons in the immediate—and perhaps not-so-immediate—environment.

Invisible Menace/Invisible Medicine

IT HAS BEEN pointed out that we in the "Modern Age" have rediscovered the ancient fear of God in the fear of nuclear weaponry. We have also rediscovered the old "superstitious" fear of the invisible. (And **Oliver Nichelson's** contribution indicates that the old concept of the "invisible" ether may not have been all that superstitious.) The immediate stimulus for this renewed fear was the unexpected byproduct of the atom bomb: persistent high levels of ionizing radiation. This invisible menace provoked, and still provokes, anxiety of an almost numinous quality. Hard on the heels of this curse came consciousness of the invisible dangers of environmental pollution and now, most recently, fascination with the invisible dangers of "psychic warfare" and the effects of ELF and microwaves. Interestingly enough, it is the putative psychoactive aspects of these invisible forces that have attracted the most feverish attention. One need not spend a great deal of time discussing these matters with ELF buffs before one discovers the almost mythological attributes assigned to certain frequencies. Ghosts, devils, and demons of the centuries now surf on waves of 16.66 Hertz and, like the great gods of yore, they are all-pervasive energies requiring techno-talismans (Teslar watches, etc.) to ward off their effects.

Invisible forces—imagined or real—provide a superb screen on which to project one's own unconscious neuroses. To the extent that one's unconscious psyche tries to correct a one-sided conscious point-of-view, to that extent this internal, invisible threat is projected into the realms of invisible particles, waves, and chemical pollutants. Consequently, almost everyone seriously pursuing such areas of investigation suffers paranoia as an occupational hazard. But just because you are paranoid doesn't mean you don't have enemies. And, of course, the evidence for the existence of innumerable invisible chemical, radiating, and psychic "enemies" is quite good. **Bob Beck** introduces us

to our updated twentieth century "evil spirits" with his article on ELF mood modification and, in case you think he might be guilty of the "invisible forces syndrome," he, and Eldon Byrd, provide us with an extensive bibliography to support their case.

But like the alchemical Spirit Mercurius, these invisible forces are not only poisons, but medicines. There is evidence that both psyche and soma can be stimulated in positive ways by other frequencies applied in the appropriate manner. There has always been a sort of "Invisible Medicine" (the title of a book I once planned to write) derived from psychic and electrical sources. One of the early documents dealing with the latter is **J. B. Sarlandiere's** work on electroacupuncture which, as some of you will here learn for the first time, goes back a lot farther than the work of the Chinese in the 1950s.

The final paper dealing with "Images of the Invisible" is your editor's effort, in "Meditations on the Atom and Time ...", designed to flush out some of the spookery that lies within the imagery of the atomic bomb and the threat of nuclear war. As Jacques Vallee once observed, our era equals or surpasses the time of the Greeks in its propensity for mythmaking. But our myths are not assigned to gods and demons beyond the clouds and below the earth; instead, they are imbedded in the very fabric of technological "progress." What once ruled us in spirit now rules us in matter, and as we gaze longingly to the heavens for redemption and meaning, we trip over the very thing we are looking for, because—as tradition states over and over—the *desideratum,* while being "the commonest thing" to be "found everywhere" is known only to the wise.

ARCHAEUS

The term ARCHAEUS *(ar-KAY-us) was first used by the great sixteenth-century physician Paracelsus (who, incidentally, founded magnetotherapy) to designate "an invisible spirit ... universal in all things, ... the healer, ... the dispenser and composer of all things." The* Archaeus *is "the hidden virtue of nature" and the "invisible sun"; in another reference, the* Archaeus *is "he who disposes everything according to a definite order, so that each comes to its ultimate matter"; further, "The anatomy of the* Archaeus *is the anatomy of life."*

The Economics of Holistic Health: A Technological Perspective

Earl E. Bakken

THE ROLE OF TECHNOLOGY in health care delivery has increased enormously in recent years. The capacities of this technology to save and preserve lives has become very impressive. But the cost that accompanies these achievements, in terms of their use in the treatment of patients, has stretched the limits of the national health care budget and has had comparable effects on individual and group health insurance. The level of medical cost in the United States now is about one-tenth of the total U.S. budget, and up until this last year it has been growing at the rate of about 15 percent per year. This rate of increase is greater than that of inflation. Businesses in the United States that are paying for health insurance have decided that they can no longer meet the high cost of this insurance. These cost increases have become so great that society—the government—has decided that the cost of health care delivery must somehow be controlled.

All of this has led to the sudden limitation that is being placed on the amount of money that is to be available for health care. In setting these new limits, the government has instituted a cost containment control system, through Medicare, to try to contain the rate of growth in the cost of health care delivery. The companies that have been paying for health insurance have formed coalitions and they are asking their employees to pay for a greater portion of their health care insurance.

This cost containment control system has brought about a change in the way health care is delivered. The progress in research has almost come to a halt, and the quality of health care is dropping at an alarming rate. It is my purpose here to raise the following questions: Are there ways in which what we know of the mind-body relationship and what we know of alternative and holistic approaches to medicine can be implemented to mitigate these problems? Can these areas of investigation and knowledge be used to supplement current health care practices in such a way that the quality of health care can be maintained—or even increased—while at the same time keeping the costs within reasonable bounds? And how can we put these supplemental approaches to work within the health care delivery system?

Let us review a little of the history of the health care system and try to get a picture of how we arrived at the problematic situation we are in today. When we look at the medical approaches used by practitioners in earlier, nontechnological times, and their results, we can see that these practitioners were often capable of diagnosing a patient's problem with an accuracy achieved today by physicians using more technological approaches. Even 50 years ago, doctors had very little reliable technology to work with. The health care that was provided then involved much more direct and intimate contact with the patient. The patient was consulted, with the physician using a hands-on, bedside approach. Intuition played a greater role, at least in diagnosing the standard illnesses. Successful diagnoses were arrived at by some very direct methods: diabetes would be determined by the actual tasting of the patient's urine, for example. Good physicians had good success. Of course, they were not able to help many of the organic problems that are treatable today. But the medicine of 50 years ago was a genuine art. Not much later, when technology began to enter the picture, some of the older, herbal remedies were forgotten, and diagnostic instrumen-

---

From a talk presented at the First Archaeus Congress, Pecos River Conference Center, Santa Fe, N.M., January 1986.

tation entered into standard office practice. The experiences of two world wars led to the development of new sophisticated and reliable surgical techniques, and with these developments came the demand for additional technologies to further the success of those techniques. The beginnings of the medical technology industry—including such companies as Medtronic—occurred about 40 years ago, and the production of medical devices to meet the increased demand became an established and ever-increasing part of the overall medical scene.

Today the balance between art and technology has shifted almost totally over to the side of technology. The sick human being is now approached more as a broken or malfunctioning machine than as an individual experiencing illness. Nowadays one applies instruments to take measurements on this "machine" in order to find the defective part and then proceeds to correct that defective part.

THIS CHANGE in medicine from being an art to being a science has produced many good results. Life expectancy is longer than it was 50 years ago. The quality of life of people who receive the benefits of modern, technology-oriented health care is certainly better than could reasonably be expected without it. Progress being made in such biotechnologies as genetic engineering holds great promise. However, these advances also produce a much larger population of the elderly—a population that is continually more susceptible to costly diseases.

The growth of these new technologies has also contributed to the crisis in health care delivery. It has been calculated that we spend about $400 billion a year in the United States on health care. That includes over-the-counter drugs, health and wellness programs, and other personal health- and wellness-related expenditures. Of that total, about $100 billion is paid by Medicare. Another $100 billion is spent for the private insurance programs paid for by companies. In those cases in which people are not covered by one of the insurance programs, but are paying for their own health care, the cost is, of course, immense. Therefore, the poor person, who has no insurance, is not getting any health care to speak of. Now $400 billion is about 11 percent of the Gross National Product, and $100 billion is about 10 percent of the national budget. The government has stated that the main reason for this intolerable level of cost is technology. If we make the assumption that technology is the culprit chiefly responsible for these high levels of expenditure, then it follows that, if we wish to limit these costs, we must limit the increase in the use of technology that is already in place. It must be concluded that, in some way, the medical profession is overusing technology. But the problem here is that, in the last 50 years, medical care has become virtually synonymous with technology; therefore, if we limit the use of technology in medicine, by definition we are cutting medical care itself. That is part of the crisis that we are facing.

The government does not take into consideration some of the real costs, including the decrease in the number of people working in the health care delivery system. (Of course, one could reply that many of these people are those who are operating the overabundant technological devices.) Defensive medicine—the extra tests and other often superfluous precautions taken by physicians in order to avoid lawsuits—also increases the costs of medicine to a great extent. These costs are further inflated by the heroic efforts taken to keep terminal elderly patients alive. Tied to this additional high expense are the complex legal and ethical questions of when to "pull the plug." This was not so much of a problem when there was plenty of money to keep these patients going, but it is a problem now, and the increase in the population of the elderly makes these issues even more pressing. A fairly common practice now is for physicians to try to convince a patient's relatives that, if the patient suffers a cardiac or respiratory arrest while hospitalized, no attempt should be made to resuscitate—that the attempt to do so simply will not be worth it in the long run. There are people who say that the elderly have a duty to die, that they should get out of the way so as not to burden society with the high costs of maintaining them in their declining years.

As I noted, if today's quality of medicine is to be maintained, we

will have to allow an increase in cost of about 15 percent per year. Such a rate of increase is completely in-consistent with the attempt by Congress to control the budget. Of course, there is some question about what portions of the national budget need controlling most: for instance, should the defense budget be reduced in favor of allocating more money for health care? However, the government has decided in favor of stopping the growth in the health care budget and it will probably start to reduce the size of that budget. This is a ma-jor cause of the current serious situation in health care delivery.

How does the cost containment program work? The major portion of the health care in the United States, paid for through Medicare, has come under the "diagnostic-related group" (DRG) system. This system has been devised in such a way that the disease conditions afflicting patients who enter hospitals are classified into one or more of 467 specific groups, or DRGs. Each DRG is assigned a value—the amount of money that the government will pay for that particular disease over the course of treatment for that disease in the hospital. Before 1983, when the DRG system was introduced, the hospital would treat the patient's original problem; then, if additional nonrelated medical difficulties arose during the patient's stay, these were treated also, as a matter of course. When the condition of the patient indicated that he was ready to be discharged from the hospital, he would be sent away, and Medicare would be charged for the total cost of making the patient's condition suitable for returning to normal life. That was a retrospective payment system. Now, under the prospective system, the precise amount of money that the hospital is going to end up getting is set when the patient enters the hospital. Now that it knows that only a fixed amount will be received no matter what course of treatment the patient might eventually require—regardless of the severity of the disease—there is a very different emphasis on the role of the hospital. No account is taken of whether additional health problems may manifest during that patient's hospital stay; the hospital receives just that amount of money assigned to the preestablished relevant DRG. This amount is set nationally, with slight variations based on cost of living in different areas of the country and on whether it is a city or a rural hospital. Each hospital has its own rate schedule to which it tries to adhere, but by 1987 that is supposed to become evened out so that all hospitals will receive the same amount of money for a given disease.

IT IS FAIRLY obvious what problems can develop within such a system. If a patient comes in with a particular disease, it will be of great economic advantage to take care of that disease as quickly as possible so that the costs fall within the amount assigned to that disorder. The sooner the patient leaves the hospital, the more profit can be made. Along with this there has developed the peer review system, which assumes that the individual doctor examining the case cannot be fully trusted to make a good decision; others must look over the case before the government will pay for it. This leads to a real dehumanization of both the patient and the hospital staff. A patient is no longer Mr. Jones; he is the gall bladder in Room 304. Now that cost is such an issue, hospital administrators take a very strong interest in what course of treatment is suited to a particular patient and they are playing a bigger and bigger role in the decision-making process as it relates to medical treatment. These methods of operation also have an effect on the way the medical technology industry does business; companies now join together in groups and approach those hospitals that give them the best prices.

The role of the hospitals is changing rapidly now and will change even more in the next few years. Hospitals today are restructuring themselves, changing from private, not-for-profit institutions into parts of major, for-profit hospital chains. They are integrating vertically—buying supply companies and insurance companies. All sorts of new ways of delivering health care are coming into being—HMOs (Health Maintenance Organizations), PPOs (Preferred Provider Organizations), and other new delivery systems—all aimed at cutting costs while still providing adequate health care.

The role of the physician in private practice is changing as well. Physicians are increasingly losing their authority over many aspects of the medical situation. Soon it will all be handled by group practices, university practices, or forms of the prepaid systems that I have already mentioned. Due to this and other factors, many physicians want to get out of the system and are applying for jobs in sales, research, or other areas related to their training, because they no longer feel that they can practice medicine the way they really want to.

Another aspect of the health care delivery crisis is the explosive growth in the cost of malpractice and product liability insurance, which is another major factor in changing the way in which medicine is being practiced. The current cost of malpractice insurance for physicians in some specialties—most notably obstetrics, orthopedics, and neurosurgery—is in the range of $100,000 annually, a cost that reflects the proliferation of lawsuits and the correspondingly high settlements being handed out. With insurance premiums at this level, most physicians are finding it very difficult to continue practicing. Either they must go without insurance, or the insurance costs leave them unable to go on practicing. The same situation prevails in the medical technology industry: it is difficult to get product liability insurance, and then only at tremendous cost. This makes it very difficult to remain competitive with foreign companies, which, as a rule, do not labor under the same disadvantages. Many companies producing medical technologies are being forced into bankruptcy.

THE PROJECTED costs of addressing the AIDS program will put additional, substantial pressure on the whole health care delivery system. The growth of the regulatory environment is yet another impingement on the system. By 1990, we may expect a total of only about 20 major health care systems that will be providing health care delivery to fully 90 percent of the population. The government will work into this through a voucher system rather than through the DRGs. When this state of affairs has been instituted, over half the hospital beds will have become surplus, because these systems will all work toward keeping people out of the hospital. Furthermore, probably over half the physicians will not have direct employment in the health care delivery systems, because such systems will be much more efficient than they are now and will tend to handle people on a production-line basis, thus shrinking the time spent between doctor and patient.

The growth of the regulatory environment is yet another impingement on health care delivery cost. The movement of the FDA into technology has certainly added to the financial burdens of coming forward with new products and techniques. The result of all this—the pressure to reduce doctor-patient time and the pressure to limit costly procedures not clearly and directly called for—is to create a head-in-the-sand policy in which the medical powers-that-be do not want to discover anything additionally wrong with a patient than what he came in with. It is like being served dinner in a restaurant where, after the price has been established, and the food has been served, the waiter becomes functionally blind and deaf to any additional needs the diner might have. In sum, we are facing a significant drop in the quality of health care to be delivered to large segments of our population—most certainly to the elderly, those working for companies under their health insurance companies, and the poor who have no insurance. This is very discouraging to physicians. Employees also become discouraged and, when they must pay such a large portion of their medical costs themselves, they stay out of the hospitals in droves. This state of affairs indicates that we will be moving rapidly toward a health care rationing system. Only a few people will qualify to be taken care of. The question is: Who will these people be?

Most of these changes started in 1983, which has been called "the year the music stopped." They are an attempt to hold the cost increase in health care delivery to 1 or 2 percent per year as against the 15 percent increase necessary to continue to use the system in its present form. The Gramm-Rudman bill, going into effect, which is designed to bring the national budget into balance by 1990, is going to cause a decrease in the amount of money allocated to health care. Accordingly,

it is my prediction that the DRG system will collapse within the near future. By 1990, the system will probably have to be replaced. How this will be done is a subject in itself.

I BELIEVE THAT we will soon have systems like these in many other countries. In Britain, for example, if you are over 55, it is unlikely that you will ever be able to obtain dialysis, and getting admitted for a surgical procedure may well take as long as two years. Such rationing systems have to come into being if we are to stay within the required budget limitations. Of course, with malpractice insurance as costly as it is, physicians will soon have to stop even doing certain procedures. Many specialists will leave their specialties. Care—except for the very sick patient who has no place to go—is moving out of the hospitals and into outpatient units or into the homes. In a way, this is a trend to return to ways in which medicine was practiced half a century ago. People are now being pushed out of hospitals long before they are ready, and this has given rise to all sorts of horror stories about people who have been discharged and who then go home and die as a result of complications that could easily have been managed during their stay in the hospital. For this reason, I believe that the DRG system will not long continue.

What are the solutions? Is there anything that we as a group have to offer to ameliorate this rather dismal picture? I do not claim to have the answers; I only hope that we can move toward them. For one thing, such solutions will probably involve the prevention of illness. Putting more money into preventive medicine will reduce the number of people who end up with severe illnesses requiring expensive treatment. Programs of prevention will mean spending more money on training in self-discipline and in a concern for our own state of health and what affects it. If we could persuade people to stop smoking, for example, we would save huge amounts of money. Nationally, smoking costs us several hundred billion dollars a year, not just in health care but also in the cost to business and industry. Private companies are contributing their own resources to reducing these problems. In addition, private "wellness" centers are springing up around the country, offering programs for changing life styles in ways that benefit health. One of the major policy debates now developing concerns the amount of money that we should put into changing people's life styles as against treating illness technologically. Furthermore, we have to be sure that we are using the right sort of prevention, not leading people into attempting to prevent one disease while creating another in the process. Jogging for health problems may lead to orthopedic difficulties down the road, for example; eating foods high in calcium may result in the development of kidney stones later in life. These potential problems have not yet been clarified.

Paradoxically, the solution to the high cost of technological medicine might be to use better and more appropriately applied technologies. Home computer diagnosis may be of importance, for example. Through the medium of the computer, the patient may be able to do his own "hands-on" medicine, to integrate within himself the art of healing. He may be able to access that "inner physician" spoken of in ancient tradition and to develop, through direct experience, a working relationship with that center of his own being out of which both his illness and its healing emanate.

CYBERPHYSIOLOGY IN PEDIATRICS

Karen N. Olness, M.D.

Introduction

THE PREFIX *cyber* is derived from the Greek word *cybernet*, which means "helmsman" or "steersman." *Cyberphysiology* refers to human steering or self-regulatory abilities, including those related to choice of life-style, voluntary performance, and/or self-regulation of autonomic responses. This new area of study contributes to prevention, diagnosis, and treatment. Greater understanding of cyberphysiology with respect to children has major implications for health, including treatment of acute and chronic disease, public health programs, and health care costs. Of particular interest to those who work with children is how early training in self-regulatory abilities may affect adult life, particularly with respect to health.

Childhood Themes

The word *theme* is derived from the Greek word meaning "to place, set, or lay down." In the following paragraphs, "childhood themes" refer to concepts set in childhood. Gerald Holton, Professor of Physics at Harvard, has noted that "themata," or elements in past and present concepts, methods, and hypotheses that constrain or motivate individuals, are usually not acknowledged by adults. Most adults like to believe that their ideas derive from logical cognitive activity, when in fact adult behaviors and discoveries are closely related to childhood themes. Holton has written:

> Elementary particle physics is shot through and through with themes that may well have their origins in a part of the imagination that was formed prior to the conscious decision of the researcher to become a scientist. … My belief is that much, perhaps most, of a scientist's thematic imagination is fashioned in the period before he becomes a professional. Some of the most fiercely held themata are evident in childhood.[1]

Children often play with their thought processes, using imagined pictures, imagined sounds and smells, imagined feelings. These may not involve words at all; nonetheless they may become iconographs that form a basis for adult themes. Einstein noted that words did not play a part in his mental conceptualization of relativity. June Goodfield, in writing about a famous female scientist, describes the delight she took in pure abstract thought at the age of six.[2] Bronowski described the childhood themes of artists, teachers, and scientists.[3]

Reprinted with minor changes from *Topics in Pediatrics* (Summer 1986), published by the Minneapolis Children's Medical Center, by permission of the Center.

EACH OF US had childhood figures of thought that led to themes. The figures of thought that we developed may have been based on genetics, culture, nutrition, education, physical environments, playmates, and a host of other factors. These important brain activities are poorly understood, yet they lead not only to themes that govern the discoveries of scientists but also to themes that affect all of us, including our health. These include themes relating to choice of diet, concepts of body function, or physiologic responses to stress.

To use a computer analogy, these themes govern access codes to the considerable number of programs that must exist in the juvenile brain. Developmental studies in preschoolers suggest that there are times when learning is most appropriate and/or efficient. Access codes for directing legs to walk, perceiving dimensions, and speaking are practiced and remembered. Possibly some access codes are closed or unavailable after a certain stage of maturity. What about access codes for language? Preschoolers who are bilingual do not know for some time that they speak two languages. They have merely learned access codes appropriate to the various adults in their lives. A four-year-old ethnic Chinese girl living in Bemidji, Minn., suddenly realized that she spoke differently to her grandparents than she did with her friends in nursery school.

"Grandma," she said excitedly, "I have two mouths. One is Chinese, and the other is English."

Otto Schmitt, Professor of Biophysics at the University of Minnesota, has proposed that access codes important to adult health are acquired early and that child health professionals, parents, and teachers should pay more attention to these codes and their governing themes. The average child cannot anticipate adult outcomes resulting from health-related activities (such as toothbrushing or eating properly) or training. It will be up to parents, teachers, and child health professionals to reinforce options and possibilities with respect to cyberphysiologic controls.

Methods

CLINICAL RESEARCH

For generations, reports of cyberphysiologic controls were clinical or anecdotal, and many came from reports concerning unique individuals who seemed to have unusual skills at self-regulation. The work of Schwarz in the 1960s first documented that adults could regulate certain autonomic processes through a method popularly known as biofeedback.[4] Clinical applications with respect to children began in the early 1970s. It soon became apparent that children seemed far more capable than adults in learning skills such as self-regulation of peripheral temperature, cardiac rate, galvanic skin resistance, etc. From 1975 to 1985, more than 25 English-language articles appeared in pediatric journals, documenting clinical applications of cyberphysiologic controls in children.[5-15] Training in such controls was mediated through self-hypnosis training, relaxation-imagery training, or biofeedback training with relaxation components.

One such system is computer game feedback for children. Games are won as relaxation increases. They reflect measurements of galvanic skin resistance, electromyography, respiratory rate, cardiac rate, and peripheral temperature. Electroencephalographic feedback programs are demonstrating promise in the adjunct management of seizures and attention deficit disorders. While provision of feedback from cyberphysiologic monitoring is not essential to acquisition of voluntary control over certain autonomic processes, such feedback does raise the interest level of children and increases the speed at which they learn.

LABORATORY RESEARCH

THE GOAL OF LABORATORY RESEARCH in this area has been to contribute to our understanding of the extent to which children can modulate autonomic responses and the mechanisms whereby they effect these controls; developmental factors relating to such controls; biochemical

changes that occur in connection with such controls; environmental factors (including medications) that play a part; and physiologic and psychometric measurements that may serve as predictors of these controls.

Investigative approaches have included controlled studies of a single autonomic response, such as peripheral temperature control, brainstem auditory evoked potentials, galvanic skin resistance, or electromyographic responses. They have also included assessment of pain responses with and without cyberphysiologic intervention, assessment of nausea, and assessment of respiratory function. Advanced technology now has permitted controlled studies that involve concurrent monitoring of physiologic responses and biochemical changes.

Results

CLINICAL RESULTS

Multiple studies in children report that they have been successfully trained to cope with pain, needle phobias, bowel and bladder incontinence, undesirable habits, and performance anxieties. Controlled prospective studies recently completed at Minneapolis Children's Medical Center have documented the superiority of self-regulated pain control over prophylactic medications for juvenile migraine, as well as a reduction in morbidity among asthmatic children who learn relaxation-imagery exercises as adjunct management along with their usual medications.[16-17] With respect to pain problems, studies demonstrate that the longer the problem has existed, the longer the training required to reverse it. Anticipatory training provides the child with a sense of competency and coping and may begin at age two or three years. Now under development at MCMC are home training units, allowing parents to reinforce training in bowel control for children who have fecal incontinence secondary to spina bifida or anal atresia.

LABORATORY RESULTS

Controlled studies at MCMC have documented the ability of children to self-regulate peripheral temperature, brainstem auditory evoked potentials, transcutaneous oxygen, electromyographic responses, and anorectal reflexes.[18-20] Studies at the University of Texas, the University of Washington, and the University of Iowa have confirmed these findings. Pilot studies suggest that self-regulation of certain immune functions should be further studied. There is ongoing work at Michigan State University and at Penn State University in this important area.

We have found that children demonstrate individual patterns with respect to autonomic ability and the ability to self-regulate certain autonomic processes. For example, one child may have an elevated galvanic skin resistance and normal peripheral temperature during waking hours, while another child may have the opposite. Such individual characteristics may be genetic or acquired as a result of focusing on certain figures of thought or of particular conditioning experiences. Regardless of the origin of these variations, there now is ample evidence that children can learn to control their responses and to maintain those more apt to be associated with long-term good health and comfort.

We have several pilot programs in grade schools, on request of educators, to teach children self-regulation of body processes as a means of stress reduction. Children and faculty learn how forcing tachycardia or tachypnea will cause them, within minutes, to perceive negative images and feelings, while raising peripheral temperature or reducing the respiratory rate will trigger comfortable feelings. Deliberate focusing on pleasant images results in stabilization of autonomic responses, while deliberate focusing on frightening images is associated with rapid heart rates and reduced peripheral temperatures. Children and faculty in local grade schools have been pleased with such training.

Discussion

Cyberphysiologic monitoring in children has become increasingly sophisticated as well as noninvasive. Available technology provides for

concurrent monitoring of multiple physiologic responses in both sleep and waking states. Such monitoring can provide information to pediatric health professionals concerning responsiveness of specific autonomous processes to mental and/or physical activities or to medications; feedback to children regarding how their thinking affects body responses; and evidence of specific stressors that produce inappropriate or undesirable physiologic responses in certain individuals—labile blood pressures, for example.

RESEARCH HAS PROVIDED EVIDENCE that neurally mediated autonomic responses, usually viewed as reactive reflexes, can be modified by learning that is significantly dependent on image design or figures of thought. Children demonstrate creativity and variability in images that they select to facilitate a specific outcome: for example, "I thought of sitting on the sun to warm my hands."

An important quality of learning and knowledge is that it is state-specific. What each of us can know depends on the state of consciousness we are in, in relation to the state we were in when we first learned the information. What we learn and how we retain and remember it is often related to concurrent sensory stimuli, which we may not have consciously recognized when we sat in the classroom, watched television, or ran on the playing field. Those stimuli may be kinesthetic, auditory, or olfactory. If such stimuli are strong conditioners, their subsequent appearance may elicit a memory or a physiologic response. It will be important to consider states of learning and concurrent sensory stimuli as variables in further studies in the area of cyberphysiology.

Prospective studies are needed to compare training methods, duration of training, and appropriate developmental stages for certain kinds of training. Swedish elementary schools now provide self-regulation training in physical education classes. Such training is now part of many athletic programs throughout the world. For example, athletes who participated in the Winter Olympics biathlon in 1983 were trained to con-trol their heart rates in order to improve marksmanship. Astronauts are routinely trained in these methods. Our data suggest that training begun in the preschool period carries forward into adolescence and adulthood with modest reinforcing practice. It will be important to follow the Swedish children over the next 20 or 30 years.

Experiments undertaken over the past decade have confirmed that, in animals, immune responses can be conditioned. A few studies in adults demonstrate that certain immune responses can also be conditioned in humans. The animal studies reveal that such conditioning may be inadvertent. It will be important to understand whether or not such inadvertent conditioning may occur in children and how it might be anticipated, modified, or reduced.

Summary

Cyberphysiology in pediatrics is a new area, which will no doubt affect preventative, diagnostic, and treatment considerations. Incorporation of this knowledge into anticipatory guidance for children and families may become an important task for for child health professionals. Detailed research in collaboration with basic sciences is essential to further understanding. In the meantime, some clinical applications already exist.

References

1. C. Holton, *The Scientific Imagination* (New York: Cambridge University Press, 1978).
2. J. Goodfield, *An Imagined World: A Story of Scientific Discovery* (New York: Harper and Row, 1981).
3. J. Bronowski, *The Ascent of Man* (Boston: Little, Brown, 1974).

4. G.E. Schwarz, "Cardiac responses to self-induced thoughts," *Psychophysiology* 8 (1971): 462–467.
5. K. Olness and G.G. Gardner, "Hypnotherapy in pediatrics," *Pediatrics* 62 (1978): 288.
6. K. Olness, "Imagery (self-hypnosis) as adjunct therapy in childhood cancer, clinical experience with 25 patients," *American Journal of Pediatric Hematology/Oncology* 3 (1981): 313.
7. ————, "Hypnosis in pediatric practice," *Current Problems in Pediatrics* 12 (1981): 1.
8. D.P. Kohen, K. Olness, S. Coiwell, and A. Heimel, "The use of relaxation-mental imagery (self-hypnosis) in the management of 505 pediatric behavioral encounters," *Journal of Developmental and Behavioral Pediatrics* 1 (1984): 25.
9. D.T. Williams and M. Singh, "Hypnosis as a facilitating therapeutic adjunct in child psychiatry," *Journal of the American Academy of Child Psychiatry* 15 (1976): 326.
10. L. Zeltzer and S. LeBaron, "Hypnosis and nonhypnotic techniques for reduction of pain and anxiety during painful procedures in children and adolescents with cancer," *Journal of Pediatrics* 101 (1982): 1032.
11. D.T. Williams, H. Spiegel, and D.I. Mostofsky, "Neurogenic and hysterical seizures in children and adolescents," *American Journal of Psychiatry* 135 (1978): 82.
12. L.N. Lewenstein, "Hypnosis as an anesthetic in pediatric ophthalmology," *Anesthesiology* 49 (1978): 144.
13. S. LeBaron and L. Zeltzer, "Behavioral incentive for reducing chemotherapy-related nausea and vomiting in adolescents with cancer," *Journal of Adolescent Health Care* (1986); in press.
14. J.W. Varni, E.R. Katz, and J. Dash, "Behavioral and neurochemical aspects of pediatric pain." In D.C. Russo and J.W. Varni, *Behavioral Pediatrics: Research and Practice* (New York: Plenum Press, 1982).
15. M.M. Omizo and R.E. Williams, "Biofeedback-induced relaxation training as an alternative for the elementary school learning-disabled child," *Biofeedback and Self Regulation* 7 (1982): 139.
16. K. Olness, J. MacDonald, and D. Uden, "Comparison of propranolol, placebo, and self-hypnosis in management of juvenile classic migraine," *Pediatrics* (1986); in press.
17. D.P. Kohen, "Applications of relaxation/mental imagery (self-hypnosis) to the management of childhood asthma: Pulmonary function and behavioral outcomes of a two-year controlled study," *Pediatrics* (1986); in press.
18. W. Dikel and K. Olness, "Self-hypnosis, biofeedback, and voluntary peripheral temperature control in children," *Pediatrics* 66 (1980): 335.
19. M. Hogan, K. Olness, and J. MacDonald, "The effect of hypnosis on brainstem auditory responses in children," *American Journal of Clinical Hypnosis* 27 (1985): 91–94.
20. K. Olness, F.A. McParland, and J. Piper, "Biofeedback: A new modality in the management of children with fecal soiling," *Journal of Pediatrics* 96 (1980): 505.

MEDITATIONS ON THE ATOM AND TIME: AN ATTEMPT TO DEFINE THE IMAGERY OF WAR AND DEATH IN THE LATE TWENTIETH CENTURY

Dennis Stillings

Then the Heart of Heaven
Blew mist into their eyes,
Which clouded their sight
As when a mirror is breathed upon.
Their eyes were covered and they could see only
What was close, only
That was clear to them.
—Popul Vuh

IN A RECENT editorial in *Artifex*,[1] I questioned whether it is possible to have an image of world peace. I answered in the negative. The present paper tries to take the more positive view that the appropriate imagery may well exist, but that some work may be necessary to arrive at it. The image of the atomic bomb and its social and political effects is replete with traditional religious symbolism. By linking up the symbolism of the Bomb with the timeless imagery of the Self and of God, we may be able to develop a workable relationship with a fact of modern life that appears absolutely refractory to our best rational purposes. This paper is an attempt to give the Bomb a face, and also, perhaps, a voice.

According to John Hersey, author of the classic work *Hiroshima*,[2] Peter H. Wyden's new book, *Day One*,[3] a thick volume treating the people and events leading up to the development and use of the atomic bomb, is "quite simply ... what every literate person on earth should know about the start of the atomic age." I certainly agree with this, especially since Wyden has emphasized, not the technological details of the Bomb's creation nor the titillating details of its weird destructive effects, but the peculiar psychological environment which produced this Faustian weapon.

In Wyden's account, the Bomb seems to have a life of its own. It is a kind of invisible Frankensteinian jinn that tricks the scientists into pulling out the cork in its bottle. Robert Wilson, one of the early scientist recruits to Los Alamos, recalled that: "Our life was directed to do one thing, it was as though we had been programmed to do that" (pp. 148–149). This "programming" apparently contained a hypnotic suggestion not to inquire too closely about just those aspects of the Bomb that were the nastiest. Little was known about the radiation effects or, for that matter, the probable yield; however, the radiation effects of the Bomb were expected to be negligible compared with the blast effects (pp. 16,19). Consistent with the pervasive modern contempt for all things Invisible, the gross effects of the atomic blast were emphasized, while the deadlier invisible aspects of the Bomb were regarded with a "lack of respect" (p. 210).

It was possible, according to calculations, that the explosion of the Bomb (always referred to at Los Alamos as "The Gadget") could ignite the nitrogen in the earth's atmosphere, thereby burning up the world (p. 50). The chances of this occurring were calculated at three in a million. "It seemed a reasonable risk to go ahead" (p. 51).

Special thanks to Managing Editor Gail Duke for digging up many of the strange and suggestive facts and images used in this paper.

WHO WERE THE PEOPLE through whom the Bomb brought itself into being?

> Playfulness, not aggressive urges, led [Dr. Leo Szilard] to visualize an atomic chain reaction. ... "I [Szilard] assume that I became a scientist because in some ways I remained a child." Like an uncontrollable youngster, he enjoyed playing with fire, and a small one would not do. Szilard loved to be unpredictable and rarely gave advance notice of his appearance. Until 1951, when he married his long-time Berlin friend Gertrud Weiss ... Szilard lived out of suitcases and never kept an apartment or a car. He owned almost nothing but his clothes" (pp. 21ff.).

Szilard appears as the true *genius* of the Bomb. His personality is typical of the *puer aeternus*, the "eternal youth" who has, among other interesting traits, a strong resistance to being burdened with worldly considerations. The classic *puer* plays with the world, but is not of the world.[5] Such persons are close to the playful inner core of nature and to those operations in life referred to by the alchemists as a *ludus puerorum*—child's play. That the puer personality may have a direct connection to atomic conflagration and the end of the world may be found in imagery presented by Jung:

> The *Puer Aeternus* is simply the personification of the infantile side of our character. ... [This] little boy ought to be brought up, educated, perhaps spanked. ... In mythology, the figure of the [*Puer Aeternus*] has an almost divine creative character. ... In *Faust* he has three forms: Boy-guide, Homunculus, Euphorion. They were all destroyed by fire. … Fire puts an end to everything, even an end to the world.[6]

It is of interest that the name of the first atomic bomb was "Little Boy" (p. 194) and that the Japanese, unaware of this designation, referred to the Hiroshima weapon as the "original child bomb."[7] Edward C. Whitmont has pointed out the relationship between violence and birth imagery and how this imagery relates to the Nuclear Age in his book *Return of the Goddess*.[8] In addition to drawing our attention to the birth-child-violence imagery of the Bomb, Whitmont notes that the pilot of the *Enola Gay*, the B-29 that delivered the weapon to Hiroshima, named the aircraft after his mother.[9]

Edward Teller was injured in a streetcar accident in Budapest, and had an artificial left foot as a result (p. 25). This fact may well have inspired the handicap of Dr. Strangelove in Stanley Kubrick's 1964 movie.[10] A widespread notion is that the Devil has one cloven hoof and limps, earning him the designation "Old Halt-foot." Teller has, for many, certainly played the Devil in the history of nuclear weapons, being the major promoter and developer of the hydrogen bomb. Both Teller and Szilard were the subjects of a "prayer" occasionally recited by colleagues: "Lord, deliver us from our enemies without and our Hungarians within." Both men were "convivial, childishly impulsive, disdainful of detail, and sugar-holics. Teller was a chocolate fiend" (p. 101).

Oppenheimer, lionized by nearly everyone, is portrayed by Wyden as an archetypal intellectual parlor-pinko and "bodyguard" to the Bomb. He shows Oppenheimer's almost instinctive ability to divert the Los Alamos group away from any concerns about the construction or use of the Bomb.[11] It is of interest that Jean Tatlock, his former mistress, swallowed sleeping pills and plunged her head into a full bathtub. Oppie's daughter committed suicide in 1977 (pp. 114–115). Teller seemed to be the most conscious of what development of the Bomb meant, as well as the implications. In a letter to Szilard he made the following statement:

> "I have no hope of clearing my conscience," Teller professed. "The things we are working on are so terrible that no amount of protesting or fiddling with politics will save our souls. ... Our only hope is getting the facts of our results before the people. This might help to convince everybody that the next war would be fatal. For this purpose actual combat use might even be the best thing. ... The accident that worked out this dreadful thing should not give us a responsibility of having a voice

in how it is used. ... I should like to have the advice of all of you whether you think it is a crime to continue to work. But I feel that I should do the wrong thing if I tried to say how to tie the little toe of the ghost to the bottle from which we just helped it escape" (p. 178f.).

In a somewhat tardy reflection on similar matters, Oppenheimer put it thus: "In some sort of crude sense which no vulgarity, no humor, no overstatement can quite extinguish, the physicists have known sin, and this is a knowledge which they cannot lose."[12]

The Bomb as God

MODERN MAN, with his secular world view and estrangement from any real relationship with spiritual factors, is a phenomenon scarcely 300 years old. For perhaps tens of thousands—if not hundreds of thousands—of years before our wonderful "enlightenment," human beings took cognizance of such factors in almost every aspect of their daily lives. Our arrogant, sophistry-laden "explainologies" have ruthlessly severed any connection we once had with spiritual matters. There is nothing that science cannot explain. One wonders how God would get *any* message across today, much less proof of His existence. God might now have to confront us in the manner in which Moses confronted Pharaoh; only with the plague involving death of the first-born among the Egyptians did Pharaoh begin to listen. We are even more hard-hearted than Pharaoh. The great wars of the twentieth century have already exacted a heavy toll of the first-born, and we have done very little to change things. The problem of missing children is already a plague that reaches to the second- and third-born, and social warfare rages over the not-yet-born. Christ's saying "Suffer the little children to come unto me, for of such is the kingdom of heaven" (Matthew 19:14) takes on hair-raising implications. The Slaughter of the Innocents is an image associated with periods of historical change. One thinks of Herod's efforts in this regard, the Children's Crusade, the killing and abandonment of children in the eighteenth century, the brutalizing of children in the nineteenth century and the thousands of missing children today. Who is the Piper whom we have failed to pay for ridding the town of rats? And what exactly *are* these "rats"? Rats and vermin frequently symbolize such things as "gnawing" doubts and troublesome noises from the dark corners of the psyche. In revenge the Piper leads all the children off to an inaccessible cave in a mountain. We do not really know whether there are relatively more missing children today than in times past. Symbolically speaking, it doesn't really matter. The recent concerns about the problem of missing children may be a symbol for the creative potential of society that is vanishing "into the mountain," i.e., into the collective unconscious. What these "children" will develop into is a wide open question; however, the large number of movies about sinister groups of children (*The Man Who Fell from Grace with the Sea, Children of the Corn, Lord of the Flies,* to name but three good examples) indicate that the return of these "missing children" will not be an event congenial to our notions of civilization and progress."

TRY THIS as an intellectual exercise and thought experiment: How would God prove His existence or deliver a message of incontestable authority in the face of modern scientific skepticism? What could the extraordinary proof be for such an extraordinary event? We have built scientistic walls a mile high and a hundred feet thick to keep out, a priori, any contact with matters of the spirit. Signs in the physical world are called "anomalous phenomena," and (if their actual occurrence isn't denied) it is assumed that a "natural" explanation for such things will be found—which is merely begging the question. If God were to prove His existence, or even give us a short message, what means would He have for doing it? *How could he get our attention?* Let me suggest some possibilities.

GOD GAVE US the atomic tinker-toy set, we built "the gadget," and lo! the "gadget" took on a life of its own. God manifested His will in the only way that impresses us any more: in the operations of matter as expressed in physics and technology. Wyden's book gives us the kind of information that makes it possible to take a look at the religious dimensions of thermonuclear symbolism: Secretary of War Stimson did not regard the Bomb as a new weapon "but as a revolutionary change in the relations of man to the universe." It would be "a final arbiter of force." He added that the Bomb must not become "a Frankenstein [monster] which would eat us up" (p. 158). Those working on the Bomb apparently could not do so without making religious references to nearly every aspect of the weapon's development and use. Trinity,[14] the code name used for the initial test at Alamogordo, N.M., was derived, by Oppenheimer, from a John Donne sonnet (p. 203n)—Number XIV of the Holy Sonnets:

> Batter my heart, three person'd God; for, you
> As yet but knocke, breathe, shine, and seek to mend,
> That I may rise, and stand, o'erthrow mee, and bend
> Your force, to breake, blowe, burn and make me new.
> I, like an usurpt towne, to another due,
> Labour to admit you, but Oh, to no end,
> Reason your viceroy in mee, mee should defend,
> But is captiv'd, and proves weake or untrue.
> Yet dearely' I love you, 'and would be loved fame,
> But am betroth'd unto your enemie:
> Divorce mee,'untie, or breake that knot againe,
> Take mee to you, imprison mee, for I
> Except you 'enthrall mee, never shall be free,
> Nor ever chast, except you ravish mee.

The allusion to *this* poem in the Trinity code name is most significant. Donne asks God to tear him from the clutches of the Devil. The themes of Ahab[15] and Faust—the latter wanting to know what "held the world together at its core"—are transferred from the realm of mere literature to concrete manifestation in the material world through Oppenheimer. The entire poem is directly relevant to the moral background of the Bomb's development.

The Trinity test was scheduled for 4:00 a.m. Monday, July 16, 1945, near Alamogordo, N.M., on the bleak desert plain known as the Jornado del Muerta—the Journey of Death. On Sunday the 15th, toward mid-afternoon, thunder was heard. Wind and rain collapsed tents in the base camp, ten miles from ground zero. Mist enveloped the test tower, and storms were reported heading for it. Rumors were circulating about the possibility of the Bomb setting the atmosphere on fire. At 2:30 a.m. the storm reached ground zero and knocked out the principal searchlight, leaving the test area in pitch darkness. The exteriorized, psychokinetic symbolism of all this is hard to miss. An ancient reader of signs and portents would have cancelled the whole operation on the basis of such transparently foreboding events. These discouraging phenomena that immediately preceded the first nuclear test make plain, in symbolic and synchronistic fashion, that a manifestation of forces outside the control of the ruling principles of consciousness (the principal searchlight) is taking place. (It is of interest that Jahweh, or Yah, a god of mountains and deserts, was early identified by Aramaic and Hebrew sources with the Sumerian Adad, the rain and thunder god.[16]) It also appears as though a conflict within the godhead were manifesting. On the one hand, the Bomb and its uncanny success indicate the support of the god, while on the other hand it is as though another aspect of the divine nature were sabotaging its own goals. The admittedly zombie-like activity of those involved in producing the Bomb betokens the domination of unconscious forces, with a consequent *abaissement du niveau mental* (lowering or weakening of consciousness) on the part of the human participants. Oppenheimer himself evinced this state quite clearly. The test was rescheduled for 5:30 a.m. Oppenheimer waited for the hour of the Trinity test, his face "white and lifeless," thinking, "I must remain conscious" (pp. 211–212).

At the time of the explosion, 5:29:45 a.m., July 16, 1945, William L. Laurence of *The New York Times*, prone on his belly, thought of the Lord's command, "Let there be light!"; Isidor Rabi feared that the intense light would burn "forever." With clear perception of the case, General Farrell exclaimed, "The long-hairs have let it get away from them!" (p. 212). Miles away, a blind woman saw the nuclear light (p. 214). Kistiakowsky, another of the Los Alamos self-admitted "science-slaves," remarked, "I am sure that at the end of the world, in the last millisecond of the earth's existence, the last human will see what we saw" (p. 216). Thus the Bomb imagery encompasses the light of the beginning and the fire of the end of the world. This "Death Light"[17] represented one aspect of the Bomb phenomena "where theoretical calculations had been off by a big factor. Much more light was produced than had been anticipated."[18]

THE BOMB is Alpha and Omega. It is, as Winston Churchill remarked, "the second coming in wrath" (p. 224). More than mere human agency seemed to infuse the technology of the Bomb: it was considered miraculous that something with the extraordinary technical complexity of the first nuclear device should have worked exactly right on the very first try. Oppenheimer, whose very soul was tuned to the essential meaning of this godlike weapon, came forth with a line from the *Bhagavad Gita*: "I am become death, the shatterer of worlds!" Even this line, occurring in the thirty-second quatrain of Chapter 12 of the *Bhagavad Gita*, occurs among a series of poetic images that could well be applied to describing a nuclear detonation. Vishnu, the Hindu characterization of the "Higher Self" and the manner in which the Supreme Being manifests to the human race, especially in times of emergency, is addressed.

Of a thousand suns in the sky
If suddenly should burst forth
The light, it would be like
Unto the light of that exalted one.

With diadem, club, and disc,[19]
A mass of radiance, glowing on all sides,
I see Thee, hard to look at, on every side
With the glory of flaming fire and sun, immeasurable.

Without beginning, middle, or end of infinite power,
Of infinite arms, whose eyes are the moon and sun,
I see Thee, whose face is flaming fire,
Burning this whole universe with Thy radiance.

Devouring them Thou lickest up voraciously on all sides
All the worlds with Thy flaming jaws;
Filling with radiance the whole universe,
Thy terrible splendors burn, O Vishnu!

Vishnu: I an [Death], cause of destruction of the worlds, matured
And set out to gather in the worlds here."[20]

On hearing of the success of the Trinity test, Truman remarked, "It may be the fire destruction prophesied in the Euphrates Valley Era after Noah and his fabulous Ark" (p. 224).

The code name for Tinian, the island from which the nuclear strike against Japan would be launched, was "Papacy."[21] At the first Tinian briefing, the projector went haywire and shredded the film of the Trinity test (p. 240).

The Bomb as Jahweh

The Bomb as "the second coming in wrath," i.e., the return of Christ to judge the world as told in Revelations, points to a return of Jahweh as well. It is characteristic of Jahweh to be wrathful. Since God the Father (Jahweh) and Christ are one theologically, symbolic manifestations incorporating aspects of both divine figures may be expected.

CARTHAGE WAS NOTORIOUS for its "Molochs"—mass incinerations of children—a practice derived, so it seems, from the Hebrews. Moloch is a corruption of the name Melech, a king of the Hebrews and one of the gods of the Ammonites. They sacrificed their children to him to obtain good harvests.

"The most acceptable Sacrifice to their God, they esteemed *Murtherers, Thieves*, and *Robbers*, and also other Criminals, but for want of these Innocents often suffered. In some places this Custome was observ'd, which, I suppose, was common to the *Druids* of *Britain and Gaul; They made a Statue or Image of a MAN in a vast proportion, whose Limbs consisted of Twigs, weav'd together in the nature of Basket-ware: These they fill'd with live Men, and after that, set it on fire, and so destroy'd the poor Creatures in the smoak and flames;* the strangeness of which Custome, I have here thought not amiss to represent the view. [p. 104]

"The Ceremony observed in sacrificing of *men* to their Idols, in a *Wicker* Image, as it was strange, so, without any question to be made, it was not begun by chance, but upon some great occasion, and something extraordinary may be sought for in the Magnitude of the Statue it self, whence it proceeded." [p. 105]

—Aylett Sammes. *Britannia Antiqua Illustrata: or, the Antiquities of Ancient Britain, derived from the Phoenicians* ... 1st vol. London: Printed by Tho. Roycroft, for the Author, 1676. Folio.

Jahweh manifests as a cloud and a pillar of fire (Exodus 13:21–22, 14:24; Numbers 14:14; Nehemiah 9:12).[22] The references to divine fires that burn "forever," that burn cities, that are "unquenchable" are too numerous to cite. Yah, the god of wind and lightning, rides in a chariot drawn by two dragons.[23] (It is of interest to note that one little game that was played by the scientists in the early days of nuclear fiddling involved bringing two subcritical masses of plutonium into close proximity by using a device called the "Dragon." This device and procedure was used to determine the "point of criticality" for various reacting masses. The term for this game was "tickling (or twisting) the dragon's tail."[24])

From a description in *Day One* of the condition of some of the Bomb's victims:

> Their faces were wholly burned, their eyesockets were hollow, the fluid from their melted eyes had run down their cheeks.

From Zechariah 14:12:

> And this shall be the plague wherewith the Lord will smite all the people that have fought against Jerusalem; Their flesh shall consume away while they stand upon their feet, and their eyes shall consume away in their holes, and their tongue shall consume away in their mouth.

Students of pop culture will recognize the imagery of *Raiders of the Lost Ark*.

This notion of a future Judgment Day with the horrible features described above was elaborated in the eighteenth century by the theologian Friedrich Christoph Oetinger.[25] According to his conception, this plague will be the result of the withdrawal of electricity from living matter. (In Oetinger, for the first time, electrical forces come into association with Judgment Day; one suspects that Oetinger would have developed some very interesting imagery about nuclear radiation.) According to Oetinger, this withdrawal of the "primordial light" from the damned will give rise to the picture described in Isaiah 66:24:

> And they shall go forth, and look upon the carcases of the men that have transgressed against me: for their worm shall not die, neither shall their fire be quenched; and they shall be an abhorring unto all flesh.

And in Ezekiel 29:9, 11–12:

> … I will make the land of Egypt utterly waste and desolate. ... No foot of man shall pass through it, nor foot of beast shall pass through it, neither shall it be inhabited forty years . ... And I will make the land of Egypt desolate in the midst of the countries *that are* desolate, and her cities among the cities *that are* laid waste shall be desolate forty years. ...

SIMILAR IMAGERY appeared in the aftermath of Hiroshima. The bombed-out area was not expected to be inhabitable for many years. This turned out not to be true. Furthermore, the ground and the seeds in it were stimulated in such a way by the Bomb that an uncannily lush growth of every sort of plant occurred there within a few weeks.[26] If Jahweh/God/Jesus has returned to judge and punish, why is it that so many innocent people have perished in the horrors of the twentieth century? I contend that this is an extension of the notion of *holocaust*, which, let us not forget, means mass *sacrifice*.[27] That such an event should be focused on "God's chosen people" in Hitler's Germany needs theological and symbological study. What might it *mean* to have the singular "privilege" of being one of the Chosen? The Christian myth—the terrors of which we are experiencing now in the concrete realms of politics and technology—includes sacrifice of the lamb, and we now are all the Lamb, the flock of sheep. According to Jung:

> The god of our time is Christ, and his symbol is the lamb, he was the sacrificed lamb. So if people were to be sacrificed in his honor, they should be sacrificed as sheep. Now that sheep are exceedingly gregarious is even

> proverbial, so that great crowds should be slaughtered, like herds of sheep, [this] would be the appropriate sacrifice. In what easy way could such sheep sacrifices be performed in reality? By war. We have excellent machinery for that purpose, in a few seconds several thousand people could be killed. So the collective slaughter, the slaughter of the sheep, can be done technically quite easily by war. War is the sacrificial knife by which that can be accomplished. Now the sacrificial knife [read: Bomb] does nothing by itself, a hand guides the knife, so if war is the sacrificial knife, who then is the priest? You can say Wotan, or ... a god of war. The state is merely the modern pretense, a shield, a make-belief, a concept. In reality the ancient war-god holds the sacrificial knife, for it is in war that the sheep are sacrificed. [During the Nazi period, German youths regularly sacrificed sheep at the time of the solstice.] The Christian herd of sheep is now without a shepherd. ... So instead of a personal divine being, we now have the dark gods of the state; in other words, the dark gods of the collective unconscious. It is the old assembly of the gods [the Old Ones[28]] that begins to operate again because no other principle is on top. ... [T]he old instincts begin to rage again. That is not only the problem of Germany. … The essential truth comes back to us; whatever has been in a metaphysical heaven is now falling upon us, and so it comes about that the mystery of Christ's sacrificial death, which has been celebrated untold millions of times by the masses, is now coming as a psychological experience to everybody. Then the lamb sacrifice is assimilated in us, we are becoming the lambs, and the lambs that are meant for sacrifice. We become gregarious as if we were sheep, and there will surely be a sacrifice.[29]

We bunch up in systems-dependent cities where the single blow of the bomb can be most closely analogous to the traditional quick, accurate cut of the sacrificial knife.[30] The movement from the country to the city in this century has been no accident. According to Zola, the big cities are *holocaustes de l'humanité*.

Heinrich Heine, confining his remarks to the German people, put it this way:

> Christianity has occasionally calmed the brutal German lust for battle, but it cannot destroy that savage ecstasy. ... When once that restraining talisman, the Cross, is broken ... the old stone gods will leap to life among forgotten ruins, and Thor will crash down his mighty hammer on the Gothic cathedrals.[31]

BEN G. PRICE, in his article, "The Nuclear Threat Comedy,"[32] draws additional parallels between the Nuclear Age and the ideological subjugation of a scientific/political control group which feeds on fear of nuclear weapons. Like an ancient priesthood, the minions of this control group cite the great universal destruction [read: Wrath of God] by nuclear attack [read: Hellfire] unless we contribute huge sums [read: tithes] to support their expert program to protect us from such an eventuality [read: priestly intercession]. I believe there is a great deal to be said for this analogy. Since we are currently under the rule of the God of War, it is only reasonable that a priesthood should exist and that it should take on precisely those aspects characteristic of such a group. Remember that Tinian, the island from which the Bomb left for Japan, was code-named "Papacy." Price's remedy is insufficiently perspicacious, in my opinion. He suggests we laugh in the face of this "control group" and deny the reality of the fear. This is just another rationalistic repetition of what got us into this predicament in the first place. The possibility of nuclear war is, after all, real enough, as was the ancient and healthy fear of God.[33] It is the interposing of an organized priesthood between the individual and the living reality that is highly questionable these days. One may laugh at those politicians and scientists that have an interest in promoting fear of nuclear weapons, but the imagery behind these merely human manifestations is truly cosmic, and is no joke. If one is to ridicule the priests, one must then still institute a personal religious relationship to those factors that lie beneath the outward trappings.

RESURRECTION OF GNOSTICISM: THE RETURN OF THE UFOS

IN 1946, Winston Churchill gives his "Iron Curtain" speech. The pilotless rocket missile is constructed by Fairley Aviation Co. Atomic bomb tests begin at Bikini. In 1947, the sound barrier is broken by the Bell X-15 rocket-plane. The modern age of Flying Saucers begins. In 1949 the U.S.S.R. tests its first atomic bomb. Between 1946 and 1949, the full basic technology of nuclear weapons and the technical means of delivering them become established, if not yet fully developed. The world is divided between the two super-powers, and the rule of the war gods is firmly established. We have returned to a world in which the pre-Christian blood-drawing gods rule. But, as I have indicated in this paper, we are replaying the Judeo-Christian myth in a "fast-forward' mode. What has been done once can be done again much faster. Having conquered the pagan gods once, Jehovah returns to conquer them again. With this return come sets of imagery in the political and technological realms that are parallel to the biblical process. The heralds of Jehovah are the UFOs, with their own intense light, heat, and radiation.[34] The literature on the relation-ship of Jehovah and biblical stories to UFOs is vast and quite cranky. Most such writings suffer from concretization, i.e., it is put forward that definite "entities" and their "spacecraft" are involved. What this body of literature says is not often very important from a rational, scientific point of view. *That it exists is important, for that in itself is symbolic*, and these often apocalyptic writings frequently contain valuable imagery.

One of the ancient Gnostic doctrines[35] takes the position that the creator-god of the Old Testament was really a sort of demon. The high, all-good God could not have created the world or there would be no evil in it. Since there is evil, a demiurge, a lower "god" did the actual creating. Seeing that evil was already in the world, the high God sent his Son to correct the situation. Since the Jews worshipped the demiurge (Jehovah), they would naturally be under marching orders from their god to destroy the Son of Man, who was about to interfere with the world as the demiurge created it. These images are reappearing in the modern UFO theologies. In these "theologies," one sect represents the belief that "saucers" from the Pleiades are messengers from the "higher ET god," other messengers are from "Hoovah"[36] (Jehovah, the demiurge), and make their appeal to those poor souls as yet unacquainted with the superiority of the Good Pleiadean ET. A neo-Gnostic UFO anti-Semitic movement based on these ancient notions exists right now, and I have talked to people who express such beliefs.

Jehovah has been connected with the UFOs and cattle mutilations of the 1970s.[37] Whether the mutilations of cattle and even household pets are a paranormal phenomenon or not is really beside the point. The fact that this idea is bruited about and has its followers is of great significance, however. Jehovah is emerging in pop-symbology and, in harmony with his nature, he is perceived as taking his due in animal sacrifices. If these mutilations and killings are being done by human agents, this certainly does not affect the symbolic meaning and the resultant mythopoeia. This grotesque imagery, however, may actually be something of a positive sign. God is substituting a ram for Isaac. The time of mass sacrifice of humans by world wars and nuclear wars may now be past. Santuria[38] is spreading, and the number of other cult rituals involving animal sacrifice also seems to be increasing. Such practices were also part of the pagan revival among Nazi youth, so this behavior could as well be considered ominous. In this historico-religious rerun, ancient Jehovah is moving to confront the even more ancient gods of war. The "God of Love" is hard to uncover in this imagery. The time for such sentimentalities is either over or will only be suitable at some future date. Right now such notions are difficult to maintain, if not actually harmful. Perhaps one may think of a God of "Tough love." The intertwining, overlapping, persistently confusing images of God, the gods, Jehovah, and Christ in this essay point to the meaning of the ancient saying, "No one against God, but God." Human consciousness may well be the one factor in the universe that can go far toward resolving this seemingly eternal round of conflict in the Godhead.

"The War in Heaven," by Albrecht Dürer. From Dürer's *Apocalypse*, Nuremberg, 1498.)

matter what is written *there* in spirit.

IN PERIODS OF great historical transition, when one ruling principle strives to supplant another, the image of the War in Heaven emerges. A battle is waged above the earth in which the contending forces within the divine essence battle it out for dominion over the time-bound world. The War in Heaven is commemorated on earth by our unruly behavior at the New Year.[39] In earlier times, a period of ritual chaos reigned after which a new order was established. We are now in the interregnum between the ages of Pisces and Aquarius, and a new ruling principle is trying to establish itself.[40] Until this is done, we may expect a great deal of chaos, both political and social. The new gods must destroy or subjugate the old before they can take over.

Since we are in an age when these very myths are manifesting in matter, it follows that we will develop a technological analogue to this cosmic strife—Star Wars technology. As this technology is realized, the corresponding battle of cosmic principles will reach its climax and a new order will emerge. It is this archetypal background that gives such certainty to the U.S. President that this technology will bring peace; it will not, but it is our own "sign in the heavens" relating to the Second Coming. Having declared that there are no gods, we have become the gods ourselves and have correspondingly merged our thoughts and energies with the dynamisms of the Beyond. What they do in realms of spirit, we do in realms of matter, like the distal pens of a pantograph writing *here* in

THE APOCATASTASIS

WE ARE LIVING during the time of a great *apocatastasis*, the Greek term for the return of everything that has been lost.[42] The number of extraordinary "accidental" archaeological discoveries in recent years attests to this.[43] It is as if the earth itself "groaneth and travaileth"[44] to bring forth the buried and forgotten past. The successes of psychic archaeology reflect the harnessing of the human psyche to the task of unfolding the *apocatastasis*. Our mad emphasis on development and distribution of image- and sound-recording devices, our nostalgic collecting of things from the past, our concerns with revisionist history are all part of this time-phenomenon. Our extraordinary accomplishments in technology have enabled us to generate special effects (in movies) and technical configurations that are closer and closer to direct representations of psychic processes. With our extraordinary

ability to manipulate matter, we are nearly in technological lock-step with movements of the spirit. What previous centuries recorded in literature and art, we model in both form and action in the very substance of the world, and withal, not stopping at the boundary between the organic and the inorganic, the psychic and the hylic. The tightening spiral dance that is thus created is rapidly leading to a mystical marriage of spirit and matter, the outcome of which may well be the transformation of physical reality and a direct confrontation with the Divine. The apocatastasis includes the reiteration of earlier states of the psyche and the images that accompanied those states. Everything returns for a cosmic inventory, the census is being taken, and the whole world awaits the New Birth. In this high-speed replay of past states, the last images of Christianity remain to be manifest. At the current rate at which these ancient images are being replayed, the manifestation of these images cannot be far off and will involve, one may expect, a supreme collective sacrifice, the collective equivalent of the sacrifice of "God's own son." What could this be? Nietzsche, who embodied and suffered precisely those images of which we are speaking, suggested the following:

> perhaps the day will come when a people, distinguished by wars and victories and by the highest development of a military order and intelligence, and accustomed to make the heaviest sacrifices for those things, will exclaim of its own free will, "we break the sword," and will smash its entire military establishment down to the lowest foundations. Rendering oneself unarmed when one had been the best-armed, out of a height of feeling—that is the means to real peace, which must always rest on a peace of mind.[46]

FOR THIS REASON, it should not be supposed that the range of effects characteristic of thermonuclear war is limited only to thermonuclear war proper. What we are focused on today is merely the *technological* representations—the *hardware* of nuclear weapons and their delivery systems and the mechanics of nuclear destruction. We do not see the essence of the Nuclear Age as an *all-pervading condition of existence*. If, as I believe, nuclear weapons are merely a concrete expression in metal of a condition that permeates the entire spectrum of human experience, one may expect events and situations to manifest that are symbolically equivalent to nuclear war—whether or not the actual physical event occurs. And it certainly looks like this is what is going on; we have massive destruction of the land surface worldwide, both occurring naturally and devised by man, we have widely distributed natural and manmade explosions and fires, and we are witnessing the emergence and dominance of diseases not dissimilar in symptomatology to the secondary effects of radiation exposure—including the epidemic rate of cancer and the newly emerging AIDS. This latter has already been connected with the psychological states associated with nuclear war.[47]

Further analogies might be made in the area of social behavior and in the individual psyche. From such events as Three Mile Island, Chernobyl, innumerable chemical accidents, and world-wide terrorism, one wonders if the bottom line on it all is not the equivalent of what would have been considered a major war, perhaps even a world war, a few decades ago. Whether we use nuclear weapons or not, does the image be-hind the Bomb create a kind of dispersed nuclear war equivalent?[48] Is there some special meaning in this new situation? Is a lesson being broken up into its component parts so that a step-by-step understanding of the operations of violence and evil may become possible, even for pacifists? Or is nature, by manipulation of the human psyche, and by its own mechanisms, realizing the imagery of nuclear destruction in the world while avoiding the precipitation of nuclear war itself, which would destroy both man *and* nature in an irrevocable way. There is already evidence that nature is subtly altering the direction in which we relieve ourselves of our aggressive instincts. Current researches are being directed toward "psychic warfare," using psychoactive radiofrequencies, advanced psychological mind-control techniques, and even parapsychology as weapons. The battlefield may thus become the mind, and not the planet.

There is no question that a remarkable set of symbols is emerging in our time—a set of symbols that has taken some 2,000 years to become energized.

The Bomb as Symbol of the Self

THE SELF, as defined by Jung, is a borderline concept expressing the totality of the conscious and unconscious psyche." The Self is also a transcendental, metaphysical concept to which a great deal of Eastern philosophical speculation is devoted. Vishnu, for instance, is the Higher Self relating to the person of Arjuna in the conflict occurring in the *Bhagavad Gita*. The Self is the center of the personality from which the fate of the ego is organized. The Self is often represented as a circle, "wheel," or mandala. This mandala imagery and the dynamics of the Self are represented in the technical construction of the Bomb itself. The plutonium in the Bomb is formed into a highly polished sphere surrounded by explosives. Detonation of these explosives causes the plutonium sphere to "implode" into its own center, generating a critical mass. This is followed by the colossal fireball of the nuclear explosion. The Self is "smaller than small, greater than great"— as is the atom—and contains the idea of God as the *coincidentia oppositorum*, the union of opposites.[50] It is the "child" and the "senex" (the "Old One"), the "child bomb" and "Jahweh." It is the heat and light of the sun and the cold and darkness of nuclear winter. It is sterile death, and springlike life.

> With the greening of springtime [in Hiroshimal came hope for the end of hunger. Food seemed to sprout from every inch of open space. Wheat was growing across the street from City Hall. Around the ruin of the A-bomb dome—the former Industrial Promotion Hall—tomatoes, cabbages, and potatoes were thriving (Wyden, p. 331).

Imagery of the Self as Vishnu arises in Wyden's account:

> The "hypocenter" was in the courtyard of [the Shima] hospital. It was ground zero, the hub of the nuclear death wheel ... the focus of Hiroshima's new universe. ... [E]veryone could learn at least one new English word: "hypocenter," the place from which all life and death was measured (p. 254).

Pax Atomica

At the close of this remarkable book, Peter Wyden notes that friends of his remarked, "We've had forty years of nuclear peace. We must have been doing something right all this time." To this, Wyden replies, "Wrong. Anyone able to bring a measure of objectivity to the realities laid out in these pages can surely agree that we're here today less by design than by the grace of luck. Sheer dumb luck" (p. 367).

"Sheer dumb luck" explains nothing, of course. We have not had nuclear war simply because it is so terrifying a prospect that we avoid almost any kind of major confrontation at all costs. Since World War II there have been a dozen—perhaps three dozen—incidents that 50 or 75 years ago would have been considered to be more than serious enough to justify launching full-scale reprisals. Even our more recent major hostile actions, Korea and Vietnam, were carried out in a state of collective doubt amounting to general semiparalysis. No, our "sheer dumb luck" would have run out long ago, if that were all there was to it. Like Zeus in Aesop's fable of the stork and the frogs, the universe has answered our prayers for a "king," a "charismatic leader" who will prevent any more world wars. The King is the Bomb. It provides a world-wide order centering around itself and it exacts a vast tribute in gold. Is it even possible that our attempts to rid ourselves of this harsh "King" mask an underlying motivation to return to the days of exuberant and free conventional warfare? That we chafe under the strictures of the nuclear threat? A conundrum for pacifists. …

Time and again in Eastern literature, in certain "New Age" writings, and in the analysis of dreams, one is admonished to accept what is attacking or threatening. If a tiger charges you, it is to be seen as

a threatening aspect of some neglected part of your own personality. Acceptance of that part will transform it into a harmless, if not helpful, new thing, and a profound change in the personality will take place. I am not talking about acceptance of the particular example of deadly and monstrously expensive nuclear technology, encased in steel, and mounted in missile warheads, but rather about the meaning expressed by such things and the feelings that are evoked.

PERHAPS THE SYMBOLISM I have discussed can lead toward developing the kind of imagery and visualization that can take us toward a meaningful image of world peace, not some "positive visualization conception of future frolicking in golden meadows. We need to create imagery with the same kind of technical detail and expertise that produce complex devices. Vague notions of an undefined, unanalyzed "image" of world peace are worse than useless, they are dangerous.[51] Such vagueness arises from an historical and deep-seated contempt for the reality and complexity of matters psychological. Everyone thinks he knows all about the psyche; he does not realize that psychological work calls for the same sort of careful and detailed approach we use in scientific and technological investigations.

In the closing years of this century we are being given the opportunity, under the aegis of the pax atomica, to examine in some detail our naive notions of good and evil, of peace and violence, and of life and death. Sentimental notions of peace and love simply will not do. Man is, and forever will be, a microcosmic zoo containing snakes and eagles, lions and lambs, fish and frogs. It may be all right for lambs to eat grass, but for a lion to do so, as a rule, means he is no longer a proper lion. Human consciousness is now being presented with new symbols and new meanings. We have not come to terms with the inner animal; there-fore, its countenance has become quite fearful, like a charging tiger. This time around we are confronted not with a "babe wrapped in swaddling clothes," which is easy enough to accept, but with a "rough beast, its hour come 'round at last," that slouched to Alamogordo to be born.

References

1. Dennis Stillings, Can We Image World Peace?" *Artifex* 4, 3 (Summer 1985).
2. John Hersey, *Hiroshima* (New York: Alfred A. Knopf, 1985). "A new edition with a final chapter written forty years after the explosion.
3. Peter H. Wyden, *Day One: Before Hiroshima and After* (New York: Warner Books, 1985).
4. In more recent times the effects of the equally invisible EMP (electromagnetic pulse) generated by nuclear detonations have been noted and appreciated.
5. For a study of the *puer aeternus* and a discussion of its role in certain aspects of twentieth-century political and social events, see Marie-Louise von Franz, *The Problem of the Puer Aeternus* (New York: Spring Publications, 1970), passim.
6. C. G. Jung, *Dream Analysis: Notes of the Seminars in Analytical Psychology Given by Dr. C. G. Jung, ... November 1928–June 1929,* 3rd ed. (Zurich, 1958), vol. 1, p. 129.
7. Hersey, *Hiroshima*, p. 82.
8. New York: Crossroad, 1982: especially chap. 2, "Desire, Violence and Aggression."
9. Part of this material was presented at a Minneapolis lecture (1983) sponsored by the Twin Cities Jung Society and Archaeus Project.
10. Oppenheimer's mother was born without a right hand and always wore gloves (Dan Kurzman, *Day of the Bomb: Countdown to Hiroshima* [New York:

McGraw-Hill, 1986], P. 151). The motif of "handlessness," or cutting off of the hands of the mother or father, occurs in folklore and in alchemy where it signifies the torment of both the alchemist himself and of the *prima materia* (the original matter = *mater* = mother). This torment is also depicted as the splitting of an egg, which also represents the *prima materia*. (See Jung, *Alchemical Studies, Collected Works* [*CW*] 13 [Princeton: Princeton University Press, 1967], "The Motif of Torture," and pp. 82ff.) See also "The Handless Maiden" (*Grimm's Fairy Tales*) in which the pure maiden loses her hands to the machinations of the Devil. This idea occurs in *Moby Dick* where Ahab loses his leg to the whale (Moby Dick is symbolic of the demonic in the world, the *deus absconditus*, the dark and hidden God).

11. Wyden's account of Oppenheimer's turning aside of any questions regarding the project is more than a little suggestive of Captain Ahab's control of the crew of the *Pequod*. Considering this aspect as well as some of the other more cosmic images of *Moby Dick*, one might wonder if Melville's work—considered by Jung to be "the great American novel"—is not prefigurative of the American fate to pursue and "capture" this great natural force of destruction. One might well expect such a mighty horror as the Bomb to create anticipatory images in fiction and mythology long before its complete physical manifestation. Robert Jungk, in *Brighter than a Thousand Suns* (New York: Harcourt Brace Jovanovich, 1958), reports the following:

> In connection with the choice of this locality [Eniwetok] for the first test of the hydrogen bomb the American author and painter Gilbert Wilson noted a strange coincidence. While he was reading *Moby Dick* it struck him that "only a century after Herman Melville wrote his great book our own American atomic engineers unwittingly selected almost the very spot in the broad pacific, some few thousand miles southeast off the coast of Japan, where the fictional *Pequod*—this was the American whaler commanded by the vengeful and fanatical Captain Ahab—was rammed and sunk by the White Whale. ... Melville had Ahab describe the Whale with an image remarkably similar to the conventional symbol of the atom used by artists, "O trebly hooped and welded hip of power!"

Both Teller, "Father of the H-bomb," and Ahab had lower extremity amputations.

See also Wyden's chapter "Dealing with the Doubts" and the reference to "The Quantum Whale" (n. 24).

12. "Physics in the Contemporary World," lecture, Massachusetts Institute of Technology, Nov. 25, 1947.

13. See Alice E. Buck, "The Child and the Child Archetype in a Nuclear Age," *The Journal of Religion and Psychical Research* 9, 2 (April 1986): 65–74.

    Jung, commenting on the significance of the story of the Pied Piper of Hamelin, sees the disappearance of the children as related to stories of certain heroes "in whose death the populace cannot or will not believe, and whose return is expected, with fear or hope, in the distant future. For the psychologist this is an apt way of saying that though the forces represented by the ... vanished children have momentarily disappeared from consciousness, they are still very much alive in the unconscious." The connection of children and the Pied Piper with rats (We use the term "rug-rats" for very young children, and it is the belief among certain Hindus that rats become reborn as children.) in the story connects the Piper with Wotan, banished by Christianity to the role of the Devil, and the Devil is the Lord of rats and flies (*Jung, Letters, 2: 1951–1961* [Princeton: Princeton University Press, 1975], pp. 330–332). See the movie or read the book *Lord of the Flies* for a graphic depiction of such mythology in modern terms.

14. Tritium, an important component of the first thermonuclear device exploded at Eniwetok in 1952, is a radioactive isotope of hydrogen with a mass three times that of ordinary hydrogen—an apt representation of three-in-oneness.

    Jung relates the Divine Trinity to the microphysics of the creation and destruction of matter in his essay, "A Psychological Approach to the Trinity" (*Psychology and Religion: West and East, CW* 11 [Princeton: Princeton University Press, 1958], p. 187).

15. Here Oppenheimer plays Ahab, hunting the Bomb in the remote white sands of New Mexico.

16. Louis Herbert Gray, ed. *Mythology of All Races*, vol. V, *Semitic* (Boston: Marshall Jones Co., 1931), p. 43.

17. See Mike Perlman's study of the symbolism of the nuclear light in his paper, "Phaethon's Vision of Enlightenment: The 'Success' of the Nuclear Bomb" (Evelyn McConeghey and James McConnell, eds., *Nuclear Reactions* [Albuquerque, N.M.: Image Seminars, 1984]).

18. LASL. *Los Alamos 1943-1945: The Beginning of an Era*. LASL-79-78 Reprint (May 1984).

19. It is of interest that the objects here mentioned are of the same shape as UFOs, which are also characterized by heat, intolerably bright light, fire, and radiation effects.

20. *The Bhagavad Gita*, trans. and interp. Franklin Edgerton (New York: Harper Torchbooks, 1964).

21. The tradition of religious, alchemical/transformative associations for nuclear test sites is carried on for the first test of a thermonuclear device (Eniwetok, 1952). This device was installed on the tiny islet of Elugelab (the lowly birthplace typical of new gods) in a protective shed whose shape was very reminiscent to those present of the Kaaba, the building which houses the sacred stone of the Moslems at Mecca (Robert Jungk, *Brighter than a Thousand Suns*, p. 303).

22. "Army searchlights were laid on to follow by simple triangulation the ball of fire by night and the mushroom cloud by day with an optical finder" (Leona Marshall Libby, *The Uranium People* [New York: Charles Scribner's Sons, 19791, p. 220). Compare the above naively written statement with Exodus 13:21: "And all the time the Lord went before them, by day a pillar of cloud to guide them on their journey, by night a pillar of fire to give them light, so they could travel night and day."

23. *Mythology of All Races*, vol. V, p. 43.

24. In their article "The Strange Death of Louis Slotin" (*Saturday Evening*

Post, March 6, 1954, P. 25), Stewart Alsop and Ralph Lapp are fascinated by this image of "tickling the dragon's tail," and repeat it several times. Slotin died trying the experiment. No one knows exactly what went wrong. For a description of the "Dragon" and "twisting the dragon's tail" see Libby, *Uranium People*, pp. 201ff. The mythology of a cosmic dragon that is aroused by nuclear forces is the theme of the various Godzilla movies. This mythology is also developed in Thomas E. Bearden's book *Excalibur Briefing* (San Francisco: Strawberry Hill, 1980) which discusses the giant sleeping dragon "Zarg." More recently, we find John A. Wheeler referring to the subatomic particle as like a "great smoky dragon" that cannot be localized in space or time (*Science Digest* 94, 7 [July 1986]: p. 11). It was said of Moby Dick (whale = dragon in mythological tradition) that he "was ubiquitous; ... he had actually been encountered in opposite latitudes at one and the same time" (see "The Quantum Whale: Quotations from Herman Melville's *Moby Dick*" [*Artifex* 5, 3 (June 1986): 12]).

25. Ernst Benz, *Theologie der Elektrizität* (Mainz: Verlag der Akademie der Wissenschaft und der Literatur, 1970).

26. Hersey, *Hiroshima*, pp. 91-92.

27. "*holocaust*: a burnt sacrifice; a sacrificial offering the whole of which is consumed by fire. 2. Hence, a complete or thorough sacrifice or destruction, esp. by fire, as of large numbers of human beings."
"*sacrifice*: 1, (2) *A whole offering*, entirely devoted to the god, the holocaust, or whole burnt offering being the ordinary form." (*Webster's New International Dictionary of the English Language*, 2nd ed. [1954])

28. In the horror fiction of H.P. Lovecraft, the Old Ones are extraterrestrial creatures that invaded earth tens of thousands of years ago. In subsequent horror fiction, these "Old Ones" have been portrayed as ultradimensional beings striving to re-enter the earth plane to enslave and destroy humans.

29. C.G. Jung, *Psychological Analysis of Nietzsche's Zarathustra: Notes on the Seminar Given by Prof. Dr. C.G. Jung, ... Autumn 1938–Winter 1939* (Zurich, n.d.), Vol. 10, pp. 164–167.

30. The city is also the base of operations of guru con men who are expert at "fleecing." Other sheep flock about, pursuing this fad or that. The feeling of helplessness is characteristic of city dwellers and, without the systems supporting them, they mostly are.

31. Quoted in Albert H.Z. Carr, *Juggernaut: The Path of Dictatorship* (New York: Viking Press, 1939), p. 463.

32. *Critique: A Journal of Conspiracies and Metaphysics* 17/18 (Spring/Summer 1985): 60–63.

33. See Gerhard Adler, *Psychology and the Atom Bomb*, Guild Lecture No. 43, The Guild of Pastoral Psychology Lectures (London: H.H. Greaves Ltd. Delivered April 1946; repr. November 1964.) Repr. in *Psychological Perspectives* 16, 1 (Spring 1985): 13–28.

34. For a superb example, complete with appropriate religious symbolism, see the account of the so-called Cash-Landrum close encounter in Brenda Butler, Dot Street, and Jenny Randles' *Sky Crash: A Cosmic Conspiracy* (Suffolk: Neville Spearman, 1984), pp. 217–222.

35. Francis Legge, *Forerunners and Rivals of Christianity* (New York: University Books, 1964), pp. 89, 210–212.

36. For an account of the "Hoovah" entities, see Andrija Puharich, *Uri: A Journal of the Mystery of Uri Geller* (Garden City, N.Y.: Doubleday/Anchor Books, 1974), and Greta Woodrew, *On a Slide of Light: A Glimpse of Tomorrow* (New York: MacMillan, 1981). For information on the Pleiadean E.T.s, see W.C. Stevens, *UFO Contact from the Pleiades: A Preliminary Investigation Report* (1983).

37. Reports of the mysterious mutilation of cattle still come in. The

total number of cases has been estimated at over 10,000. A newsletter with the remarkable title *Stigmata* continues to monitor these putatively anomalous events. Whatever the cause of these "mutilations," it is irrelevant to the argument put forward here.

38. The Santuria cult, of Caribbean and South American origin, has come into conflict with the SPCA in this country because of their ritual sacrifice of chickens.

39. Paul Jordan-Smith, "War in Heaven," *Parabola* 7, 4 (October 1982): 69.

40. Interregnum—the period of time between two periods of rule. In some cultures, no laws are in effect during such periods.

41. The War in Heaven archetype has recently revealed itself in fantastic astronomical speculations. For these bizarre theories on the cosmological effects of E.T. wars, see the *National Enquirer UFO Report* (New York: Pocket Books, 1985), pp. 96–100.

42. Originally a doctrine of the Ophite sect of the Gnostics. The idea of the *apocatastasis*, the return of everything to God, was developed by Origen (c. 185–254 A.D.).

43. One thinks immediately of the discoveries of the Qumran scrolls, Philip of Macedon's tomb, and the Shaanxi find, to name but a few. The movie *Raiders of the Lost Ark* gains no small amount of appeal from its essentially apocatastatic theme.

44. To see the immediate association between these archetypal ideas, the reader is referred to the two works of Jeffrey Goodman, *Psychic Archaeology: Time Machine to the Past* (New York: Berkley Books, 1980), and *We are the Earthquake Generation* (New York: Berkley Books, 1979), "the controversial best-seller that predicts a 20-year 'Season of Catastrophes' beginning with Mount St. Helens." The recent fascination with catastrophic earthquake scenarios (California sliding into the ocean, etc.) arises from the palingenesis of the ideas we are discussing.

45. According to our general argument, psychic archaeology is not a process we have "decided" to use. It is a connivance on the part of the *Spiritus Mundi* to enlist our unconscious assistance in realizing the *apocatastasis*. Psychic archaeology will be successful because the time supports it and insinuates its program into our psyches.

46. *The Complete Works of Friedrich Nietzsche: The First Complete and Authorized English Translation*, ed. Dr. Oscar Levy, vol. 7, *Human, All-too-human*, pt. 2 (Edinburgh/London: T.N. Foulis, 1911), pp. 336–338.

47. The connection between AIDS and nuclear war is made by David S. Greer, M.D., and Lawrence S. Rifkin of Brown University in their unpublished paper "The Immunological Impact of Nuclear Warfare." This paper takes a causal view, however, while I believe it is essentially synchronistic. In his essay, "The Start of a Plague Mentality" (*Time*, Sept. 23, 1985), Lance Morrow calls AIDS the "young friend" of the Bomb. AIDS has been compared to the *Waldsterben*, the mysterious dying of forests in Europe. In Greek mythology (the tales of the "old gods"), Zeus (who is identified in Semitic literature with both Jahweh and Adad) had a boyfriend named Ganymede; upon Ganymede's death, Zeus put him into the sky as the constellation Aquarius. Homosexuality was culturally acceptable in the time of the Greeks. Christianity suppressed it. Homosexuals may, in consequence, be symbolic (and real!) "civilian" casualties of the "War in Heaven."

    Nuclear physics is apocatastatic in its essence. Victor White, O.D. (*God and the Unconscious* [New York: Meridian Books, 1961], p. 33) uses apocatastatic terms when he says of the Bomb and man that "Human *hubris* had reversed the creation-story of Genesis not merely on paper but in fact; man's own ingenuity had begun to reduce matter back to force, cosmos to chaos."

    Jung, in "A Psychological Approach to the Trinity," p. 187, sees the Holy Ghost and its manifestations of fire and light as "an

apocatastasis of the Father. To use an analogy from physics, the Holy Ghost could be likened to the stream of photons arising out of the destruction of matter, while the 'Father' would be the primordial energy that promotes the formation of protons and electrons with their positive and negative charges." Victor White's and Jung's statements are equivalent, and both illustrate the pervasive archetypal situation of which the Bomb is merely the outward expression. The archetype produces a wide range of synchronistic phenomena permeating the full range of human experience. The exteriorized manifestations of this consciously unrealized archetypal situation include nuclear weapon-analogous destruction throughout the natural world—including human physiology. J.G. Ballard, in his fictional work *The Crystal World*, tells of a "crystal plague" that threatens to turn the entire world into crystal—a kind of heaven-sent divine apocatastatic leprosy of light.

Another aspect of the apocatastatic constellation is the apocalyptic "revelation of all things at the end of time." Just as other religious notions, such as the War in Heaven, are imbedded in technology represented by the exploratory devices LandSat and the deep-sea "Alvin" bring the ancient prophecies toward imminent fulfillment.

48. See Bird Krueger on D.E.A.D. (Distributed Equivalent Atomic Destruction), "Bird's Corner" (letter to the editor), *Artifex* 4, 6 (December 1985): 13. A recent editorial in the *Wall Street Journal* reports the fact that twentieth-century totalitarian governments have killed more people than all twentieth-century wars combined. "This number already approximates the number that might be killed in a nuclear war" (*Wall Street Journal*, July 7, 1986).

49. For an introduction to some of the newer aspects of psychic warfare, see Eldon A. Byrd, "Implications of Nonlinear Interactions in Biological Systems," *ARCHAEUS* 1, 1 (Winter 1983): 1–6; *OMNI* 7, 5 (February 1985): 40; Martin Ebon, *Psychic Warfare: Threat or Illusion?* (New York: McGraw-Hill, 1983), and Ron McRae, *Mind Wars: The True Story of Secret Government Research into the Military Potential of Psychic Weapons* (New York: St. Martin's Press, 1984).

50. Adler, *Psychology and the Atom Bomb.*

51. Stillings, "Can We Image World Peace?"

ASSOCIATIVE REMOTE VIEWING

Jack Houck

REMOTE VIEWING is a term coined by Harold Puthoff and Russell Targ to describe a form of psychic functioning historically known as clairvoyance.[1] Dr. Puthoff and Mr. Targ, both formerly with Stanford Research Institute (SRI) International, have researched this phenomenon since the early 1970s, and their results are published in several books.[2] Their research was concentrated on training selected individuals to "see" or "view" a scene or event that was occurring at a distant location. In addition, the ability to "view" the scene at different times— past, present, and future—was established.

One particularly significant outcome of this research was the discovery that viewers could reliably access remote information when they were asked to describe a scene, but that they were not as reliable when the target was a number or a letter. This discovery led to the development of *associative remote viewing* (*ARV*), in which a scene is associated with a particular message. A group of scenes is chosen, each scene having a different message associated with it. When the viewer's perception corresponds to one of the scenes, then the message corresponding to that scene is accepted.

A natural extension of this idea is to use ARV to determine information that will be known only in the future. Scenes can be associated with possible outcomes of future events (such as stock market advances or declines or contracts won or lost). A remote viewer is asked to look forward in time to the moment when the outcome of the future event is revealed and to describe the scene he is viewing precognitively. The description given by the viewer is compared with a set of possible scenes; then the outcome associated with the scene that most closely corresponds to the viewer's description is chosen as the predicted outcome for that future event. An example of this process is shown in Fig. 1, in which remote viewing is used to predict whether the stock market will go up or down in some selected period of time. The details of Fig. 1 will be discussed later in this paper.

IN 1983, Russell Targ and Keith Harary decided to apply the ARV technique to predicting the prices of silver futures. The idea was to generate capital for their research on paranormal phenomena. Since funding for this sort of research is very hard to obtain, they reasoned, why not generate their own? They also felt that, if this technique could be shown to work, then others would apply it, and more understanding would result. Their first attempt was very successful.[3] Their second attempt, however, was not.[4]

At least two other teams of researchers decided to apply the ARV technique to fund-raising after the initial success of the Targ/Harary team. Harold Puthoff ran a very successful experiment to raise money for a children's school.[5] Stephen Schwartz and Rand De Mattei of the Mobius Society also ran an experiment with the intention of raising money for their research on paranormal phenomena.[6] Their efforts were not financially successful.

These pioneers have found, through trial and error, what does and does not work when one is conducting an ARV experiment. I have had the privilege of studying these experiments as well as participating directly in the Schwartz/De Mattei experiment. My conceptual model of paranormal phenomena[7] provided me with some ideas about how to improve the ARV process, and, in January 1985, I decided to implement these improvements in the form of a computer program and an ARV protocol and to run my own ARV experiment. This paper documents those ideas and the ARV protocol and gives the results of the ARV experiment to date.

In my conceptual model of how the human brain/mind functions, the brain is constantly transmitting information into and receiving information from a central storage system, which I have called the STU (Space-Time Unit). The STU may be thought of as being a multidimensional information repository completely encompassing our normal three-dimensional world. The "mind" provides channels for all sensory information to be transferred between the human brain and the STU. All information on events that have occurred is stored in the STU. It is constantly receiving information from the present. It also contains the information about possible future events. Associated with the stored data is information related to the emotion surrounding the event. The greater the emotion related to the event, the more likely it is that the mind will lock onto the time of the event, either a past, a present, or a future event. The original idea behind the PK party was to create a peak emotional event at the current time so as to achieve a paranormal result: metal-bending.[8] For an ARV experiment, the greater the emotion generated at the time of the "feedback" (when the correct target scene associated with the outcome of the event is shown to the remote viewer), the more likely it is that the viewer's mind will go *forward* in time, from the time when he does the viewing, and lock onto the time of the feedback event. The viewer will then be able to "see" the target scene being displayed at that time—the scene associated with the actual outcome of the event for which the outcome is to be predicted. (Two target scenes are always chosen; the one associated with the wrong outcome is never shown.)

According to my model, memory is stored in the STU and it forms a complete record of the space-time history of the individual, his "world line." Most people easily access information along their own world lines; they do it all the time. It is easier for a person to "see" events along his own world line than to access information along someone else's world line. Events in a person's future can also be observed, especially if the person makes a deliberate attempt to have them occur. In the ARV procedure, one or more remote viewers agree on the specific place where they will meet to be shown the correct scene, and all agree to create a peak emotional event at that feedback place and time. The only thing that is not known about that feedback event is which target scene will be displayed. This procedure makes it relatively easy for the viewers to visualize the feedback event and, once "tuned into" (observing) that event, to look at the target scene being shown. The feedback event is never held at the same place; this precludes the possibility of some future feedback event having greater emotional impact and thereby causing the viewers' minds to be diverted to the wrong time and to view the wrong target scene.

In applying the ARV technique to predicting the behavior of the stock market, it is very important that no one at the feedback event know what target scene has been associated with the possible outcome (e.g., the market could go up or it could go down). It is speculated that, if anyone is at the feedback event who has seen both possible targets, a remote viewer's mind can go to the feedback event and travel back along the world line of that individual, accessing information about both target scenes, then reporting on the wrong one. For the same reason, someone whose world line has crossed or come in contact with that of anyone who has seen both targets should not be at the feedback event. (A husband who has selected the targets should not have his wife orchestrate the feedback event.)

IT IS IMPORTANT that all the participants in an ARV experiment limit their emotional experiences during the period between viewing the feedback event and taking part in it, so that their minds do not become diverted to the wrong time and event. (Since it is unlikely that a bedroom scene is one of the possible target scenes, having a sexual peak experience is permissible.) On one occasion, some researchers in one of the early ARV experiments were judging the data provided by the viewers and they saw that it all pointed clearly toward one of the target scenes. The judges all became very excited, because they were sure that they would be suc-cessful in their investment, based on this information. When the report came back from the market the next day,

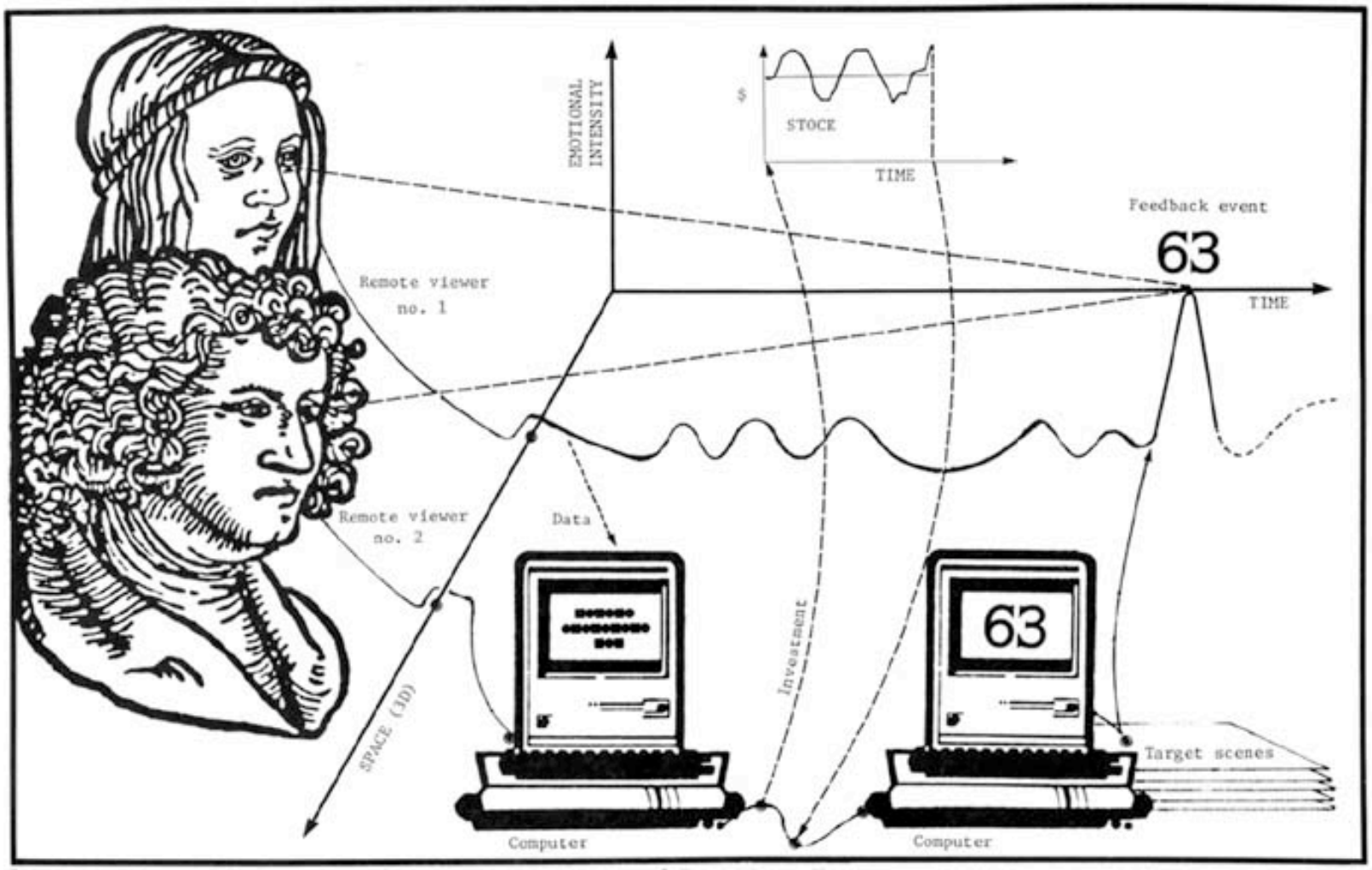


Fig. 1. Associative remote viewing. (Wavy lines indicate viewers' "world lines.")

however, they found that they were wrong. This phenomenon has been called "displacement." It was probably caused by the diversion of the viewers' minds to the time of judging rather than the time of the feedback event. The excitement at the time of judging was probably much greater than the emotion felt at the time of the event. This problem was compounded by the fact that the judging occurred at the same place as the feedback location and that one of the judges provided the feedback to the remote viewers. When a computer is used to perform the target selection and to carry out the judging functions, and it provides information only about the correct target scene, many of the potential problems in ARV experiments that could lead to displacement are eliminated.

The targets to be viewed can be real objects (as used by Targ and Puthoff), real physical places (as origin-ally proposed by Houck), or pictures of real places (slides and photographs of scenes, as used by Schwartz). The difficulty of generating a target pool of real places and the logistical problems of getting the remote viewers to those places at the time of the feedback event, in all weather conditions, made the use of real places impractical. The Mobius Society had been using 72 pictures of scenes as targets for a number of experiments, and they agreed to sell sets of these pictures to participants in my ARV experiment. They also helped encode the answers to their 31-question questionnaire for each of the 72 target scenes. (After a remote viewer looks at the feedback event and describes the target scene, he fills out this questionnaire, answering all 31 questions, yes or no, about the target scene he has viewed. These include questions like: "Are agricultural features prominent in the scene, e.g., farmlands?" "Is any *significant* part of the scene notably complex, chaotic, hectic, or cluttered?" "Does any *significant* part of the scene involve perception of height or depth, e.g., looking up at a tall structure, mountain, unusually tall trees, etc., or looking down from any elevated position?")

THIS DATA is typed into a computer; the computer randomly selects a target pair (two target scenes out of the pool of 72 scenes, which are guaranteed to be quite different from one another).[9] The computer then compares the answers to the questions provided by the viewers with the target encodings provided as the masters for both the target scenes. It also randomly assigns one of the selected targets to an up market outcome and one to a down market outcome. It then uses some discrimi-

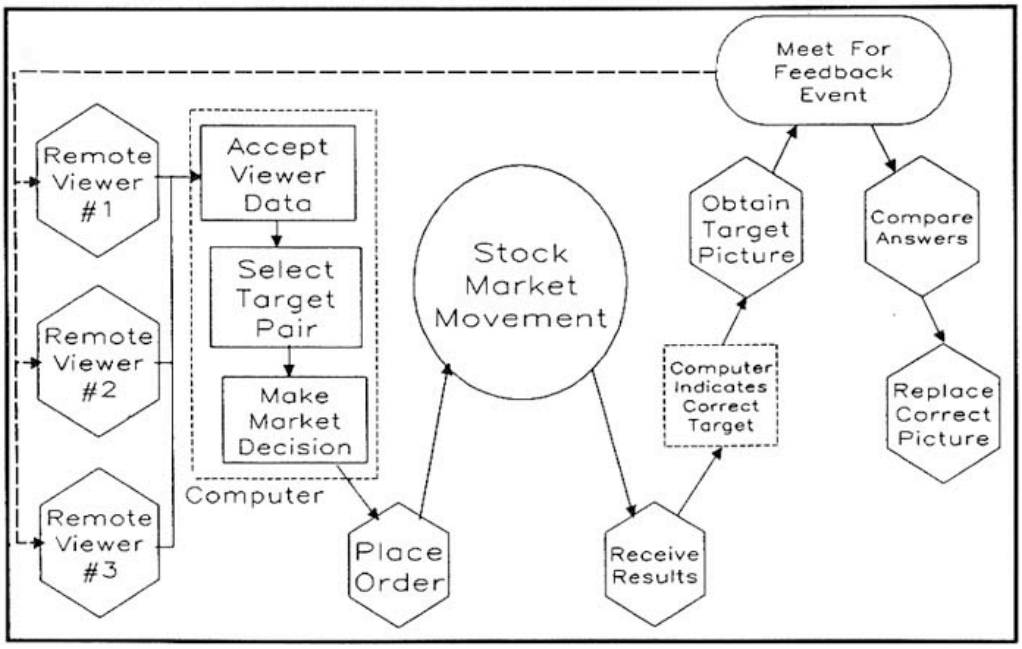


Fig. 2. Associative remote viewing procedure.

nation logic to select which predicted outcome it recommends. The details of the computer program, the logic rationale, and the questionnaire are given in the program documentation.[10]

Once the predicted market outcome is known, someone involved in the ARV experiment calls his (emotionally detached) stockbroker and invests in whatever market this group was planning to use for their investment. The choice of market depends on many factors, such as volatility, volume, simplicity of transaction, duration of investment, and insensitivity to a single investor. In my ARV experiment, we have used both the Standard & Poore (S&P) 100 Index and the S&P 500 Index.

No "conventional" knowledge about the stock market was used in these investments. For my experiment, I wanted to be able to get in and out of the market in a single day and to have the market be very volatile without much volume, so that it would appear to the small investor to behave randomly. The invest-ment would go in at the beginning of the day, the market would go either up or down, and at the end of the day the money would be taken out of the market. Money would have been either won or lost, depending on whether or not the prediction of the he day's market movement was correct. At the end of the day, the stockbroker would call and indicate the results. In such an experiment, once the results are known, the in-formation about the market transaction is put into the computer, which then indicates the number of the correct target scene. It does not divulge the incorrect target scene number, so that no one at the feedback event will know what scene was associated with the other target, which one of the remote viewers' minds might pick up. The computer displays only the number of the correct target scene, not the name of the place in the scene. This is to keep the person using the computer from having an emotional experience when at the computer terminal. That person then retrieves the correct picture from the stack of 72 pictures and takes it to the place designated for the feedback event, without looking at the picture. When all participating view-ers arrive at the feedback place, they all look at the correct picture and attempt to create a peak emotional event. This can be difficult if money has been lost. In any event, the group, which is presumably celebrating, should display the picture prominently so that they could "see" it better when they were viewing it and mentally send the information about the target scene back in time to themselves when they were doing the remote viewing.

FIGS. 1 and 2 attempt to illustrate and summarize the ARV process. Fig. 1 emphasizes thinking in emotional space-time, using the peak emotional event at the feedback time to help lock the viewers' minds onto that time. Along the emotional intensity axis there can be many different emotions (joy, anger, love, fear). From my experience with the PK parties, I have learned that it does not seem to matter which type of emotion a person calls up, as long as it is intense. The ARV experiment has shown me that when the feedback events have been very exciting, they are associated with a successful outcome.

The ARV procedure is summarized in Fig. 2, which shows three viewers submitting their questionnaires to the computer, which then makes the market decision, the order being placed and the result received, the correct target being indicated, and viewers meeting for feedback.

One of the benefits of having the computer "manage" each of the ARV experimental trials is that a permanent record is kept on the computer disk. All the ARV groups participating in my experiment have agreed to send their data files back to me for analysis. This has provided a large data base for analysis of this process, which will lead to additional improvements.

There are 15 groups of people doing the AV experiment according to my protocol and using my computer program, with a total of 72 different remote viewers participating. Because the experiment is ongoing and the analysis of the results to date is incomplete, only general comments will be made at this time. Each group consists of from one to twelve viewers. It was learned very early in the experiment that the groups with large numbers of viewers were having trouble get-

* The computer program is available for Apple II, Macintosh, and IBM personal computers.

ting everyone to the feedback event (because of scheduling conflicts, sickness, or other imponderables). Originally I had suggested that a group should have six viewers, thinking that the probability of group success would be improved if one could treat the success of individual viewers as an independent statistic. It now appears that this is not true, and—what with the problem of getting these large groups together at the feedback event—it was decided to reduce the group size to about three viewers per group. The groups with only one viewer, with no one else around to make the feedback event exciting, simply could not generate enough excitement to cause the necessary tuning-in of the mind to the feedback event. Groups with two and three viewers seem to have the best success to date. Overall, the groups have a 53 percent success rate out of 567 ARV trials (as of March 1986). Some of their ARV trials have been done without an actual investment (for example, when they were waiting for their account to open). It is noteworthy that there has not been any difference in their success rate when money was being invested during that trial. There did seem to be a pattern developing in that most groups were successful in their early attempts and that this success rate fell off as they continued. This is a familiar phenomenon noted in parapsychology laboratories. In my experiment, however, most of the groups began in November and December 1985. I have not yet correlated the individual group "slump" with an overall "slump," shared by all the groups, that occurred during December 1985 and January 1986. The good news is that, for those groups that are continuing the experiment, they are no longer in a slump. In summary, the success rate of this ARV experiment has not been as high as I would have liked it to be. I am convinced that the ARV process works, however, and that the computer program plays an important role in the process.

THE MOST IMMEDIATE AREAS for improvement are the questionnaire and the target scenes. People simply do not answer the questions about the same scene in the same way. Either we will have to tailor the questionnaire to the type of individual doing the perceiving or we will have to make the questionnaire/target scene combination less sensitive to individual interpretation. Furthermore, many people are getting a good remote perception of the form or shape of objects in the target scene, but their interpretation may ascribe incorrect meanings or images to the forms, thus incorrectly describing a scene. Someday the computer equipment to do pattern recognition from the remote viewer's drawings may become available to the home personal computer user. That technology will probably make a dramatic improvement in successful ARV applications. Much is being learned and can be learned in the future by continued experimentation and application of the ARV process. The future of these experiments is very promising. Having the data computerized will allow us to analyze it very thoroughly. The learning that results from that analysis, in addition to the ideas already being formulated, will provide the direction for future improvements. ARV is more difficult than it may seem, and those groups continuing to participate in this experiment are very dedicated. It is unlikely that everyone will begin to apply the ARV technique to the stock market, even if it is vastly improved, so those using conventional techniques for investing need not worry. However, I will continue to improve the ARV experimental process and to find remote viewers who enjoy participating.

References

1. Harold E. Puthoff and Russell Targ, "A perceptual channel for information transfer over kilometer distances: Historical perspective and recent research," *Proceedings of IEEE* 64 (March 1976).

2. Targ and Puthoff, *Mind-Reach: Scientists Look at Psychic Ability* (New York: Delacorte Press, 1977); Puthoff and Targ, *Mind at Large*, ed. Charles T. Tart (New York: Praeger, 1979); and Targ and Keith Harary, *The Mind Race: Understanding and Using Psychic Abilities* (New York: Villard Books, 1984).

3. Erik Arson, "Did psychic powers give firm a killing in the silver market?" *The Wall Street Journal*, Oct. 22, 1984.

4. From personal communication with Targ and Harary.

5. Puthoff, "Associative remote viewing experiment," *Proceedings, 1984 Parapsychology Association Conference*, Dallas, Texas.

6. Stephan Schwartz, "Associative remote viewing experiment," loc. cit.

7. Jack Houck, "Conceptual model of paranormal phenomena," *ARCHAEUS* 1, 1 (Winter 1983).

8. See Houck, "PK Party history," *Psi Research* 3, 1 (March 1984).

9. Technique developed by James Spottiswoode and Rand De Mattei and documented in n. 10.

10. Houck, "Use of the associative remote viewing computer program" (December 1985). To obtain a copy of this paper, write Jack Houck, 16892 Canyon Lane, Huntington Beach, CA 92649.

TESLA'S SELF-SUSTAINING ELECTRICAL GENERATOR AND THE ETHER

Oliver Nichelson

The Historical Ether

BEFORE THE DISCOVERY of the electron, the principal theory used to describe electrical activity was the theory of the ether. At the turn of this century, the ether theory in use by science was the remnant of a concept common in Western thought for several centuries. Although science always aims at giving accurate descriptions of the workings of nature, these descriptions change from period to historical period. In the same way that an object in one country is called by a different name in an adjoining country, so do the descriptions of nature change during different periods of man's history.[1]

In nineteenth-century Western science, the broadest view of the physical world was that all objects were somehow connected with one another through a prematerial ether. Solid bodies were believed to be made from a condensation of this ether. In this world view atoms and electrons did not exist as scientific realities.

Toward the end of the last century, the atomic picture of the world began to emerge, step by step. Solid bodies were explained as being the result of minute vortices in the ether—small whirlpools—forming lumps of matter. William Thompson, Lord Kelvin, the virtual spokesman of Victorian science, developed an ether vortex model of the electron in an effort to explain some of the properties of electricity.[2] The electron as a discrete particle did not become a fact of science until J.J. Thompson discovered it in 1897.

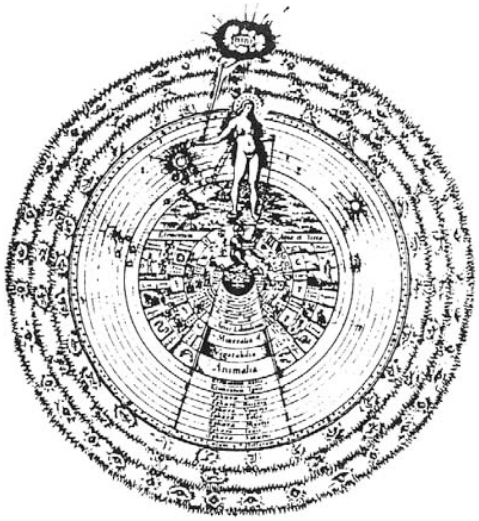
In 1905, the view of nature as a single entity formed out of the ether was supplanted by the modern one, that matter is made of collections of particles. In that year, Albert Einstein presented his famous paper on Brownian motion, explaining the movement of particles of pollen on the surface of water in terms of discrete units of matter. From then until today, the atomic view has prevailed.

This difference between the nineteenth- and twentieth-century descriptions of nature makes it difficult to form a complete picture of the work of the early electrical researchers. Michael Faraday, James Clerk Maxwell, and Nikola Tesla are recognized today as valued contributors to the understanding of electricity, but their work was carried out before the electron—the fundamental carrier of electrical charge—was discovered. All these scientists held a belief in a physical ether. Though Faraday's laws of induction are still accepted, and Maxwell's equations for electromagnetism are used routinely, and Tesla's generators still power our lights, the etheric physics that they learned, and out of which their discoveries came, has been judged scientifically wrong.

This curious situation, in which Faraday, Maxwell, and Tesla can be seen to be both right in their results but wrong in their beliefs about physics, comes from an inability to translate the concepts of their historical period into the language of our period. This faulty chronological translation, like the difficulty of translating between languages of adjacent countries, is also an obstacle to understanding the physics of self-sustaining electrical ("free energy") generators, which is based on that earlier view.

In the last half of the nineteenth century, when researchers had to deal with the ether in practical engineering terms in order to build their electrical devices, the concept of the ether, then several centuries old, had been considerably watered down: it was believed to be something like a thin gas that could be found everywhere. However, that view of the ether was not historically correct.

With thanks to Marshall Nechtow for his last-minute advice. —ED.



"The mirror of the Whole of Nature and the Image of Art."
—ROBERT FLUDD

THE ETHER had been pictured traditionally as a nonmaterial substance capable of condensing into ponderable matter. Gas, no matter how thin, is still ponderable matter and, because of that, could not qualify as being the ether.

To find out what was meant historically by the concept, an early writer can be cited. Robert Fludd in 1659 described the "Ethericall influences" as being of a "far subtiler condition, than is the vehicle of visible light: ... they are so thin, so mobile, so penetrating, and so lively, that they are able, and also do continually penetrate, and that without any manifest obstacle or resistance, even unto the center or inward bosom of the earth, where they generate mettals of sundry kinds." Fludd cites an even older source on the nature of the ether, the writings of Plotinus (third century A.D.), where the ether is described as being so fine "that it doth penetrate all bodies of the world, as well above in heaven, as below on earth; and ... maketh them not a jot the bigger for all that, because this inward spirit doth nourish and preserve all bodies. …"[4]

From these older descriptions of the ether, the following attributes may be seen that are missing from the late-nineteenth-century concept. First, the ether was held to be truly nonmaterial: it did not make bodies "a jot bigger." If the ether were a gas, its addition to anything would be measurable. Second, the ether was a substance less material than "the vehicle of visible light," that is, something less material than what today is known as a photon. Third, the ether was credited with generating metals and nourishing all bodies, clearly a distinct property not belonging to gases.

Whether or not the reality of the ether as put forth by these writers is accepted, it is historical fact that the ether that A.A. Michelson and E.W. Morely did not find in their experiments (1887), and that the modern atomists ridiculed so strongly when they came to scientific power in the early twentieth century, was never claimed to exist by the people who first used the term. Taking a longer view of science, modern theorists fought a battle against an issue that never existed.

If, on the other hand, the ether is looked at from the point of view of the earlier description of its properties, something can be learned about the operation of at least one type of self-sustaining electrical generator. To do this, the ether concept has to be translated into an artifact of contemporary science.

The Modern Ether

THE PROPERTIES of having less mass than a massless photon, being able to interpenetrate a body but not add to it, and generating material bodies are encompassed in the modern view of the quantum wave nature of matter. In quantum theory, an object can be viewed as consisting of either particles or waves. It is not an idea that everyone is comfortable with even today, but it is widely accepted and known to be verifiable by experiment. Transistors, tunnel diodes, and even digital watches are a few of the real-world objects operating on physical principles that are best explained by citing the quantum wave nature of matter.

If an object can be both a quantum wave and a particle, then in its wave state it may be said to interpenetrate an object without making it "a jot bigger." Also if this wave is equivalent to a particle, the wave will not have the mass of a particle: it will have amplitude instead. The quantum wave is also responsible for the generation of solid bodies. Present theory has it that a particle exists in its quantum wave state until a measurement is made; the wave is then said to collapse to form an object. The collapse of the quantum wave defines the state of the object; that is, it generates the particle.

As we can see, the quantum wave state of nature very much resembles the seventeenth-century picture of the ether. With this conceptual parallel in mind, it is possible to understand better the work of Nikola Tesla, who held the ether theory as a scientific concept; who built working electrical machines on the basis of this theory; and who is associated with the idea of an electrical generator that could maintain a current without an external prime mover.

As he was schooled during the 1860s, Tesla's understanding of physics was pre-atomic. In his biographical articles Tesla does not comment on the theoretical aspects of his education, but in his technical writings he uses the term the ether in a positive sense and only in his later writings are there found grudging references to atomic particles and electrons.

TESLA'S MAGNIFYING TRANSFORMER

Tesla's most famous device was what he called a Magnifying Transformer, the principal tests on which were carried out in Colorado during 1899. The device is described in his patent as an "Apparatus for Transmitting Electrical Energy."[5] It claims some unusual characteristics, among which are the propagation of waves faster than the speed of light, the transmission of signals not around the earth but through the earth, and doing this by eliminating electromagnetic waves as much as possible—the only electrically related waves known today as being capable of transmitting signals.

TESLA DID THIS using a coil with 10,000–11,000 ft of cable,[6] which he claimed had little or no resistance. This last fact gave rise to the belief that, in addition to its other unusual characteristics, the device had the property of maintaining its current for a measurable period of time after its disconnection from an outside power source.

Let us go out on a limb and speculate that the ether is similar to quantum energy. Tesla held a belief in a physical ether and that he had built a device capable of maintaining an electrical current without an external prime mover: a conclusion can then be reached that the quantum wave theory may be used to understand the dynamics of Tesla's magnifying transformer. This follows from the work of Dr. Andrija Puharich, who, in a 1976 paper, put forth the idea that the magnifying transformer could not be explained by the laws of classical electrodynamics, but was explainable in terms of high-energy particle transformations.

The wave theory of matter gained its present popularity in 1923, through the efforts of Louis de Broglie. When experiments showed that light could be considered to be both a particle and a wave, he reasoned that an electron, clearly a particle, could behave like a wave as well.

P-360

N. TESLA.

APPARATUS FOR TRANSMITTING ELECTRICAL ENERGY.

APPLICATION FILED JAN. 18, 1902. RENEWED MAY 4, 1907.

1,119,732. Patented Dec. 1, 1914

WITNESSES:
B. Lawson Dyer
Benjamin Miller

INVENTOR,
Nikola Tesla.
BY Kerr, Page & Cooper
his ATTORNEYS.

He deduced the wavelength of the electron from the equation E = hν, which equates the energy of a particle with the product of Planck's constant h and the frequency ν.

In analysing the Tesla magnifying transformer, this mathematical relationship can be used to determine the quantum energy of a wave in the transformer's operating frequency range. Tesla recommended that the transformer be operated at under 20 kHz. Taking the frequency at 15 kHz and putting that value into the equation gives:

$$E = h\nu = (6.63 \times 10^{-34}\ \text{Js})\ (1.5 \times 10^{-4}\ \text{Hz}) \qquad (1)$$
$$= 9.9 \times 10^{-30}\ \text{J}$$

where J = joules
s = seconds
kHz = kilohertz

which would be the emitted energy per accelerated charge carrier in the conductor.

If the magnifying transformer were operating at 100 A, the total charge would be written as follows.

if by definition $i = q/s$ (2)
and therefore $q = i\,s$
then if $s = 6.7 \times 10^{-5}$ s
$i = 100$ C/s
$q = 6.7 \times 10^{-3}$ C

where A = amperes (coulombs per second)
i = current (A)
q = charge on the electron = 1.6×10^{-19} C
C = coulombs

This relationship can be used to determine the number of charge carriers per second in the accelerator.

$$N_e = \frac{6.7 \times 10^{-3}\ \text{C}}{1.6 \times 10^{-19}\ \text{C/ electron}} \qquad (3)$$

$$= 4.2 \times 10^{16}\ \text{electrons}$$

where N_e = number of electrons

The total number of charge carriers times the emitted energy per charge carrier would equal the quantum energy of a wave at a given frequency:

$$E_t = (4.2 \times 10^{16})\ (9.9 \times 10^{-30}\ \text{J}) \qquad (4)$$
$$= 4.17 \times 10^{-13}\ \text{J}$$

where E_t = total emitted energy

If the highest reported current that Tesla used, 1000 A, is put into the calculation, the quantum energy range would be 4.17×10^{-13} J to 4.17×10^{-12} J. If we convert to a more commonly used system of measures, the energy range of a quantum wave at 15 kHz would be:

$$E_t = (6.2 \times 10^{12}\ \text{MeV/J})\ (\text{quantum energy}) \qquad (5)$$
$$= 2.6\ \text{MeV to } 26\ \text{MeV}$$

where Mev = million volts

In order to generate a wave of this energy, an electron would have to undergo a potential difference in the range of 2.6 MeV to 26 Mev. Tesla's magnifying transformer was reported to operate in the range of tens of millions of volts. At 10 MeV there would be more than sufficient electrical force to create a quantum wave for the amount of charge in motion at 15 kHz. At 30 MeV there would be enough force to produce such a wave for a current of 1000 A at that frequency.

THE GENERATION of a quantum wave by the magnifying transformer goes a long way toward explaining some of the properties that Tesla claimed for the device. For one, he said that electromagnetic waves were reduced to a minimum, and, indeed, it would seem hard to propagate any electromagnetic radiation with the blunt-topped tower he used in his transmission experiments. If the waves that were being emitted were quantum waves, or waves of the ether, however, his claims about radiating energy from one point to another without the use of electromagnetism become clear.

In addition, Tesla's statement that electromagnetic radiations were similar to the waves transmitted by an ordinary whistle through the air[8] makes sense. According to his view, electromagnetic waves were nothing but undulations in the atmospheric gases, while his transmissions were taking place in a wholly different medium, that of the ether.

Tesla's claim of the instantaneous transmission of energy also has a basis in modern theory, since a quantum wave is nonlocal in nature. That is, its effect is not limited to one particular point but, through a physical process still not completely understood, the effect can be measured at great distances from the point of origin at the moment of origin.

THE SUPERCONDUCTING STATE

As to maintaining a current in the transformer without an external power source, the only condition known today for achieving this is the state of superconduction. This seemed to be ruled out in the case of Tesla's device, which operated far above the near-zero temperatures needed for superconduction. However, what is understood as the superconducting state in today's science is in fact a description of the conductor. If a material has a certain type of atomic configuration and is cooled to a certain temperature, a superconducting condition exists in which a perpetual current can be maintained. The superconducting state, how-ever, can exist without there being a current in the conductor. The state is a characteristic of the conductor.

Tesla may have discovered that superconductivity can be a property not of the conductor but of the current itself.

To examine how this might be the case, a specific model of electrical activity will be used. Instead of picturing an electric current composed of billiard-ball particles, little satellites of nuclear suns or as an electron gas or an electron plasma, we can imagine it as an electron liquid. At this point, the makeup of the liquid is not as important as is its fluid nature and the fact that the fluid is electrical.

The model of a liquid is useful because it provides an easy example of how a substance can remain the same and still become radically different under certain conditions. In the case of water, when heat is removed from it, a phase change takes place that transforms it into solid ice. When thermal energy is added to water, it undergoes a different phase change and becomes a gas. The substance remains the same, but it exists in three different states.

One of the extreme states that a fluid can achieve is superfluidity, during which a liquid moves up the walls of its container. This, of course, is a property of the liquid, not of the container. Perhaps the same phase-change phenomenon takes place in the electron liquid. Under certain conditions—high voltage and/ or high current—the electron liquid will remain the same substance, but will take on radically different properties, similar to the state of superfluidity. This condition results from a state change in the current, not in whatever material is serving as the conductor.

A state of superfluidity in an electron liquid would explain how Tesla was able to send a current through the earth. In its commonly known state a current does not travel far through the earth's resistance, but if the current has undergone the proper phase change, it could easily travel with no resistance. Likewise, a phase-changed current would travel through a generator coil with no resistance. Having undergone that change, it would become a supercurrent in a nonsuperconducting conductor. Such a condition would allow a generator to maintain a current without an external power source.

This particular explanation, which, of course, has to be tested, of Tesla's self-sustaining generator is not an explanation of all the other similar devices, such as the Figueras, Hubbard, and Hendershot devices.[9] There are probably as many engineering explanations for such devices as there are inventors of them.

One common characteristic shared by all the other devices may be contrasted with Tesla's magnifying transformer in that they did not require the high voltages and currents that Tesla used. However, they do not represent an engineering advance over Tesla's methods.

Tesla put his main efforts into high-energy devices virtually as a matter of practicality in marketing a product. In 1900, a year after his Colorado Springs experiments, he wrote an article for Century Magazine in which he stated that he had spent a great deal of time on a smaller generator, but realized that negative mar-ket pressures would not allow such a machine to see the commercial light of day." And he was right—it is not possible yet to buy a Hubbard or Hendershot generator to light our homes.

TESLA BELIEVED that he had a greater chance for introducing a new electrical technology if it made use of the generators then being sold, but used their output in novel ways. This is why he concentrated on the wireless power transmission project, though even that idea proved to be too ambitious for his time. A careful study of his later writings shows that many of his more advanced concepts were based on earlier work with lower-voltage versions of generators capable of maintaining a supercurrent. These designs appear to be based on intricate configurations of coil geometries. The peak of this line of research may have been just before the fire in his New York City laboratory in which many of his prototypes and papers were lost. The task of uncovering the precise nature of these designs becomes very complex, because after the fire Tesla spoke of his more advanced work only obliquely and never in detail. It is possible that recovering these earlier designs would bring about the second stage of electrical technology—one that Nikola Tesla initiated in the United States 85 years ago.

References

1. There have been several such paradigm changes in Western ideas about nature. Theories alternate between that of a one-substance universe out of which everything is made and that of a many-substance universe in which the constituent particles are separated by a vacuum.
2. For more on the ether, see also E.T. Whittaker, *A History of the Theories of the Ether and Electricity* (London: Longmans, Green, 1910).
3. Robert Fludd, *Mosaicall Philosophy: Grounded upon the Essentiall Truth or Eternal Sapience* (London: Printed for Humphrey Moseley, 1659), p. 221.
4. Ibid.
5. U.S. Patent No. 1,119,732, of Dec. 1, 1914; application filed Jan. 18, 1902.
6. Nikola Tesla, *Colorado Springs Notes. 1899-1899* (Belgrade: Nolit, 1978), p. 43.
7. Andrija Puharich, "The physics of the Tesla magnifying transmitter, and the transmission of electrical power without wires." Planetary Association for Clean Energy, Ottawa, Ontario, 1976.

8. Tesla, quoted in *New York Herald Tribune*, Sept. 22, 1929, p. 21.

9. Christopher Bird and Oliver Nichelson, in "Nikola Tesla: Great scientist, forgotten genius" (*New Age* [February 1977]: 41–42), note that Clemente Figueras, an engineer in Las Palmas (capital of the Canary Islands) claimed to have invented a device for generating electricity without burning fuel (*New York Herald*, June 9, 1902). The article prompted Tesla to claim priority for having first developed a similar device and for revealing the physical laws underlying it. On July 29, 1920, the *Seattle Post-Intelligencer* ran an article on the Hubbard coil, the invention of a 19-year-old gadgeteer, Alfred N. Hubbard. This device,

   > no larger than a small wastebasket, measured only 11 inches in diameter and 14 inches in length. Its output of current totaled 35,000 watts (260 amperes at 125 volts), or enough power to light 350 100-watt bulbs. … The inventor maintained that his power unit could operate for years, and that it could drive a large touring car at normal speed, illuminate a medium-sized office building, ... and allow an airplane to fly all the way around the world without stopping. (p. 41)
   >
   > [In July 1928,] the Detroit Free Press ran a story ... [on a new fuelless motor"] designed by one Lester Jennings Hendershot ... and successfully tested ... in a demonstration witnessed by the world-famous aviator Charles Lindbergh, who testified that the motor worked. (p. 42)

10. Tesla, "On the problem of increasing human energy," in Nikola Tesla, *Lectures, Patents, Articles* (Belgrade: Nikola Tesla Museum, 1956), p. A-143; repr. by Health Research (Mokelumne Hill, Calif.),1973.

MOOD MODIFICATION WITH ELF MAGNETIC FIELDS: A PRELIMINARY EXPLORATION

Robert C. Beck

RECENT well-documented research suggests that between 25% and 75% of human and animal subjects exhibit psychophysiological sensitivity to magnetic and electrical fields in the extreme low frequency (ELF) ranges corresponding to brain-wave spectra.

Neuronal synchronization/desynchronization and brainwave entrainment can be demonstrated clinically in cats, monkeys., and human sensitives in the presence of ELF oscillations of both natural and man-made signals, including pulse-modulated radio frequency carriers.

There is additional evidence that the naturally occurring earth-ionosphere cavity oscillations (known since 1952 as the "Schumann resonance") can affect moods, states of consciousness, and health cycles of all life forms.

Prior to 1975 or 1976, the Soviets began transmitting pulsed electromagnetic signals over broad frequency ranges (from approximately 4 MHz to beyond 18 MHz) of sufficient power (measured at 40 MW peak) to disrupt lawful radio communications globally.

Fundamental frequencies of the higher harmonics as well as the pulse repetition rates (of 5 to 15 Hz) of the Soviet EM transmissions fall precisely within the "window" of neuronal psychoactivity, and have been observed to alter human EEC traces.

Speculation arises as to whether this potentially devastating problem is intentional or an unfortunate side effect of the Soviets' highly advanced global radar holographic imaging technology and undersea magnetic communications pulses.

This personal communication is an overview of my investigation and discoveries in this area since 1970, a discussion of my instrumentation approaches, and projections for possible future research.

An extensive bibliography of pertinent references in the open literature, prepared by the author and Eldon Byrd of the Office of Surface Weaponry, follows the article.

I welcome feedback and communication from other interested researchers.

—R.C.B.

CLINICAL RESEARCH indicates that somewhere between 25% and 75% of human and animal subjects may exhibit marked psychophysiological sensitivity to extremely low frequency (ELF) magnetic and electric fields. Brain-wave entrainment can be demonstrated electroencephalographically when subjects are in the vicinity of oscillations in the frequency range of approximately 3–20 Hz at intensities below 100 nT (nanoteslas). (1 T = 10^4 G.)

ELF fields of 6.67 Hz, 6.26 Hz and lower tend to produce symptoms of confusion, anxiety, depression, tension, fear, mild nausea and headaches, cholinergia, arthritis-like aches, insomnia, extended reaction times, hemispheric EEC desynchronization, and many other vegetative disturbances.

H and B field (magnetic vector) oscillations of 7.8, 8.0, and 9.0 Hz produce anxiety-relieving and stress-reducing effects that mimic some meditative states. It has been speculated that frequencies in this range may be the universally permeating "clock frequencies" or carriers on which "mind" or "consciousness" states can be impressed and in which they may interact with other life-forms in the nebulous realms of ESP, psychotronics, distant healing, radiesthesia, and related paranormal but anecdotal phenomena.

Coherent ELF energies have the unique and interesting property of almost lossless propagation within the earth-ionosphere cavity waveguide, and attenuation of these signals due to distance from transmitter sites is negligible. Power losses are .8 dB per Mm (million meters). The magnetic vectors, unlike electrical (E-wave) components, permeate any substance and cannot be effectively shielded, even by iron, mu-metal, lead, copper, "Faraday cages," etc.

The established physics of radio propagation therefore suggests that vast geographical areas can be readily mood-manipulated by transmissions of EM energy within the earth-ionosphere cavity waveguide. The "Luxemburg effect," by which a transmitter of relatively low power, fed to an antenna array producing a circularly polarized signal, can "piggy-back" to any preexisting RF energy source and produce disturbances of the ionosphere at any frequency desired (which then "modulates" all other energies within that waveguide), was discovered accidentally in 1938. It is fully described in the literature of 40 years ago, but has probably been forgotten or is overlooked by today's technologists.

History and Background

MY PERSONAL INTEREST in EEC and consciousness dates back to 1969, when I became fascinated with the (re)-discoveries of Joe Kamiya and and the conscious control of brain waves through biofeedback. I developed sensitive and reliable monopolar instrumentation for this purpose under the Alpha-Metrics trademark.

In the course of traveling, lecturing, teaching classes, and demonstrating this EEC equipment, and because one of my personal interests was in parapsychology and consciousness research, I had the unique opportunity (and reliable instrumentation at hand) to make electroencephalographic recordings of the brain-wave patterns of a number of truly exceptional subjects in the United States and Hawaii, who were famous or had established reputations as psychics, healers, shamans, dowsers, etc. Since I had a wealth of personal contacts in both the scientific establishment and the "psychic underground," I was fortunate to be allowed to meet and to wire up and instrument a cross section of "sensitives" from vastly different disciplines, ranging from charismatic Christian faith healers to an authentic Hawaiian kahuna, to practitioners of wicca, Santeria, radiesthesia and radionics, to seers, ESP "readers," and psychics.

A striking number of these authentic "sensitives" exhibited a nearly identical EEC signature when reporting that they were in their "working" state of consciousness, a state persisting from one to several seconds intermittently during the "altered state of consciousness" phase of the paranormal activity. The signal appeared to be an almost pure sine wave of up to 25 μV (read monopolar, frontal to occipital, midline) and 7.8–8.0 Hz in frequency (on the "alpha-theta" borderline).

This serendipitous discovery was unexpected, in that—although the subjects were practising opposing disciplines, and came from totally disparate teachings and held opposing viewpoints, and would barely acknowledge the existence or authenticity of practitioners outside their belief systems—they all appeared to be marching to the sound of the same "cosmic drummer" when in an altered state of consciousness.

After replicating this observation a number of times at sites thousands of miles apart, the obvious question arose that if these exceptional people, unknown to one another, were falling into the same "cosmic consciousness" mode, what or where was the signal to which their brain waves became entrained? What was the "drummer"? Was there a "clock" or "synchronizing" signal present?

In 1952, physicist W.O. Schumann postulated mathematically that our earth and ionosphere constituted a cavity waveguide whose physical constants and magnetic field would oscillate at a resonant frequency identical to the range of human brain waves. In 1962, the National Bureau of Standards division of Radio Propagation reported the actual physical detection and instrumental recordings of these signals; and, as predicted, tracings were indistinguishable from encephalographic recordings from human brain waves. This newly discovered phenomenon was dubbed the "earth brain wave."

SINCE THERE IS a pronounced node in these "Schumann resonances" at 7.8–8.0 Hz, the question of possible EEC and ELF interconnectedness appeared to be an irresistible area for investigation.

In 1973, a professional coil fabricator duplicated the "Schumann pickup" (described on p. 313 of the *Journal of Research of the National Bureau of Standards, Division of Radio Propagation,* 66, 3 [May–June 1962]), and I perfected an extremely low-noise, highly filtered amplifier capable of recording and displaying the naturally occurring magnetic oscillations surrounding our biosphere.

My intention was to recontact as many of the "sensitive" subjects from my first study as was feasible and this time to make simultaneous EEC and ELF records and compare the signals for frequency and phase coherency. This was done on a more limited scale than in the original investigation. In a few instances, careful analysis revealed episodes of absolute brain-wave entrainment during the brief seconds when sensitives reported being in their altered states of consciousness. Unexpected variables emerged, such as reliability factors dependent on lunar phases and time of day.

This study was extended to test the theory that if a very small percentage of subjects, by virtue of hereditary factors, religious or metaphysical disciplines, or meditative practices, had sensitized some portion of their minds or brains to act as extremely sensitive "dual-conversion superheterodyne receivers," it might be possible to sense remotely, amplify, and display this real-time "drummer," the Schumann magnetic oscillation, to less sensitive subjects (whose brains were as unresponsive and unselective as a crystal set) so that they too could mimic the highly organized "psychic" abilities of the trained "seer."

Late in 1973, apparatus was built for pulsing a miniature lamp held in an empty eyeglass frame to be a real-time photic stimulus that would cause an evoked potential in step with the ELF "cosmic drummer." This was moderately promising, but only marginally successful because of the individually variable delay-line (of about 100 ms) between the onset of the stimulus and its response.

The next effort at inducing psychic awareness was to place a coil 9 ft in diameter of about 100 turns of #28 magnet wire on the floor of the laboratory and expose subjects to the real-time magnetic replica of the highly amplified "Schumann" signal sensed at a remote location to avoid feedback. Results with individuals and groups experiencing this "magic circle" were dramatically successful. The third-generation investigations were extended to determine if subject's brain waves could be influenced by artificially generated magnetic oscillations of sine waves of low intensity and at specific frequencies within the ranges occurring naturally.

Some subjects exhibited absolute brain-wave entrainment over the range of approximately 6–14 Hz and at signal strengths of approximately 100 nT. Onset of phase/frequency lock-on averaged from 1–4s from the time of switching on the artificial ELF generator and would sometimes last for the duration of the stimulus, usually a 10s episode.

One subject (Mr. A.P., 54) displayed absolute entrainment when he was placed inside a triple-shielded magnetic (iron) and triple electrostatic (copper) Faraday cage. The artificial ELF stimulus was originating from a pocket-size battery-powered device positioned outside the shielded room and 12 ft removed from the subject. Tuning the device over a wide frequency range caused subject's EEC to follow the stimulus exactly.

After demonstrating the neurological responses of sensitive individuals, and doing preliminary mapping of subjective states as reported for various specific frequencies (defined to .01 Hz on a digital frequency

counter attached to the ELF generator), experiments were undertaken on a broader scale with totally unaware subjects, such as customers at local coffee shops during rush hours. This obviated the variables of "suggestion," "expectancy," or "hypnosis."

Anecdotal data was amassed suggesting that a pocket-size transmitter at power levels of under 100 mW could drastically alter the moods of unsuspecting persons, and that vast geographical areas could be surreptitiously mood-manipulated by invisible and remote transmissions of EM energy. Tests were rapidly abandoned after dramatic proof because of ethical considerations.

IT IS WELL KNOWN that naturally occurring earth-ionosphere magnetic oscillations will vary slightly in frequency diurnally, monthly (full vs. new moon), and in definite cycles related to sunspot activity. This may well explain observable "full moon craziness."

We are aware that tides in the ocean are affected by lunar vectors. Resonant frequencies are also affected by Earth/Venus/Mercury/Moon/Jupiter/Sun gravity vectors. And there is well-documented correlation between these geophysical phenomena and episodes of political unrest, mood alteration, and health cycles, as supported by a vast technical and medical literature. Our "drummer" seems to affect all life-forms. An excellent reference source of widely unrelated phenomena that are dramatically tied to our earth's geomagnetic cycles is Petersen's *Man, Weather, Sun*, cited in the bibliography.

By artificially amplifying or altering these geomagnetic fields or by transmitting specific and coherent frequencies, vast segments of earth's population could be affected. This now becomes an attractive modality for psychological or psionic warfare or for intentional modification of moods, which could reflect in areas ranging from time-specific insomnia to stock market fluctuations. (There have been recent epidemics of "worry insomnia" between 4:00 and 5:30 A.M., coinciding with the "Schumann resonance" signal drop-out, as observed in journals of geomagnetic research.)

On several occasions within the last few years, our laboratory began to detect wave trains in the ELF ranges that could not have been of natural origin. These may or may not be related to recent Soviet transmissions of radio energy spread over broad segments of the frequency spectrum ranging up to 28 MW. Danish monitoring stations report that peak powers of these signals are on the order of 40 MW. Transmitters are presumably located near Riga or Gomel. Transmissions have disrupted lawful radio communications throughout the world and have been protested by several nations. The Soviets have not given an adequate explanation of the purpose of these tests. An early theory assumed Soviet experiments with over-the-horizon radar; perhaps the psychoactive EM components are unexpected side effects of these tests.

Canadian Department of Transport monitoring sources have established that spectrum analysis of these strange signals indicate that they may be higher harmonics of a fundamental frequency of 6.67 Hz (the Tesla frequency). The signals are modulated with pulses with repetition rates of 5-15 prf, usually 10 Hz. Besides modifying the electrical, ionic, and stratospheric jet-stream equilibrium weather-motion factors, the signals fall precisely within the "windows" known to be psychoactive. The Canadians also report alarming mood alterations in certain areas of eastern Canada, such as near Timmins and Kirkland Lake, Ontario, which observers believe are linked to Soviet transmissions.

Since both theory and laboratory tests prove that magnetic (H-wave) shielding is impossible at these psychoactive frequencies, even with highly sophisticated multiple iron or mu-metal shielding, it can be speculated that ELF signals can be a powerful potential weapon with global capabilities in psychophysiological warfare. (The wavelength of an 8 Hz signal is 22,159 mi.)

I feel that tests should be undertaken with a number of remote ELF sensors that can be made directional in order to establish by triangulation the sources of these recently detected man-made disturbances, whether originating from offshore or on land. ELF data should be correlated with data monitored from Soviet transmissions detected on shortwave receivers. These can then be correlated with human or animal EEC recordings. (This was done May 25, 1978, with positive correlations.)

ELF as a modality for mood manipulation is a demonstrated reality. And there is a strong possibility that it has been implemented since 1976 by the Soviets, intentionally or accidentally, as an unpredicted side effect of local standing waves or re-radiation of power lines. This speculation is currently being explored by a network of independent scientists working in the disciplines of psychophysiology, geophysics, radio propagation, pharmacology, physics, electronics, and psychotherapy. A bibliography of pertinent medical and technical articles and books follows this report.

Possible countermeasure proposals embrace psychopharmacology, adaptive desensitization, and the utilization of personal low-powered (milliwatt) magnetic oscillators, which—by the law of inverse square—will override hostile signals, man-made or natural, with beneficial frequencies.

An interesting device of this nature with possible "countermeasure" capabilities is the "Vitasette" instrument, designed by W. Ludwig for limited distribution and testing in West Germany. One model of this device is the size of a cigarette lighter and has a claimed battery life of 2 yr. Frequencies are user-programmable over the range of 1.25–19 Hz by activating specific combinations of switches. This "transmitter" generates spike-wave pulses when a mu-metal core of extremely high permeability is driven to beyond saturation with a single transistor and coil. Effective range is claimed to be about 1 m. This is sufficient to ensure proper synchronization of the wearer's "biological clocks," circadian rhythms, and possible coherence of left and right hemisphere neuronal firings. Ludwig claims cures for a broad spectrum of vegetative disturbances. The brain cells appear to "latch on" to the highest amplitude pulses in their proximity in a manner similar to the characteristics of a frequency-modulation discriminator (Foster-Seeley). Unlike audio modulation detectors, however, they will reject background noise and pulses of lower intensity. The analogy is that a small transistor radio held up to a listener's ear will drown out a nearby rock band with thousands of watts of audio amplification. Similarly, a milliwatt device worn on the body can override a hostile transmission of megawatt power at a distance.

While almost everyone is familiar with electronic heart pacemakers capable of ensuring proper heart rhythms, few are aware of recent research establishing that brain waves and other biological functions can be influenced at great distances by magnetic pulses of critical frequencies.

There is promise that such devices, when tuned to highly specific "beneficial" rates, could be of value in stress modification, tension and anxiety relief, dyslexia, insomnia, "confusion" states if caused by right and left hemisphere desynchronization, headaches, sexual dysfunction, and many other conditions. However, as was the case with the initial application of atomic energy, the first large-scale implementations of ELF discoveries appear to be destructive.

I invite other interested investigators to replicate and verify my observations. A brief disclosure of my procedures follows.

A HUMAN SUBJECT, selected for sensitivity, is wired to a battery-powered, totally isolated EEG amplifier. The output is recorded on one or more channels of chart or (preferably) fed as an FM/VCO to channel(s) of magnetic tape. Monopolar electrodes were frontal to occipital, midline. Simultaneously, but with electrical or optical isolation sufficient to eliminate cross talk, the output of a magnetic signal detector (Schumann coil) is chart-recorded or fed to its separate magnetic tape channel.

The Schumann coils typically consist of 50,000–250,000 turns of #38 magnet wire wound on a ferrite, soft iron, or mu-metal core. Coil axis is oriented to magnetic N-S and connected to a separate amplifier having a band pass of 2–40 Hz, a noise figure capable of seeing .1 mV rms at 10 kW and 100-dB-or-better rejection of frequencies of 60 Hz and higher.

With proper subjects, phase, and frequency, EEG "lock-ons" can easily be observed by inspecting the chart recordings or, if measurements are made in the field, by later observation of the magnetic tape

records after signal recovery on paper charts or dual-trace storage scopes (Tektronix 214).

My initial transmitter of magnetic ELF signals consisted of a phase-shift, modified sine wave oscillator whose output was fed to a 10 Hz soft iron core inductance of 1200 Ω DC resistance. Power level was 9 V at .7 mA, or 6.3 mW. This device could cause EEC modification and mood alteration in subjects at up to 10 ft. A higher power device constructed in 1973 provided greater effective range, as was to be expected. Highly specific modulating and carrier frequencies were obviously withheld for fear of potential misuse, as are "keyhole" and waveform data, as well as details of the multiple-source devices producing "soliton" ELF magnetic stand-ing waves.

My investigations began in 1970. Early research in consciousness modification by external nonchemical stimulus was undertaken in the following areas:

(1) Photic stimulation of the subjects by miniature lamps, both cold cathode (phosphors) and filament and "strobe." These light sources were either driven by oscillators or by the subjects' amplified brain waves in real time and (later) with delayed and phase-modified pulses to "pump" EEGs.
(2) Exposure of subjects to voltage-gradient oscillating fields and electrostatic (modulated) fields.
(3) Exposure of subjects to pulse-modulated negative ion generators, typically (-)20 kV DC sources of corona discharge modulated by mechanically rotating screen shields or by carefully adjusted spark gaps that would arc over and short the output at frequencies centering on the 8 Hz range.
(4) Exposure of subjects to actinic stimulus of nearly monochromatic red-green-blue pulses of light through a fiberoptic display device held close to the left or right eye. Phase and frequency of each channel was selectively varied in efforts to excite red-green-blue rod and cone receptors independently and to evoke "standing wave" potentials in specific sites of the occipital cortex. By selective excitation of both eyes with delayed pulses, evoked "standing waves" occurred.
(5) Exploration of audible "click" stimulus, as well as infrasonics, ultrasonics (28 kHz), and phase-shifted sound fed to left and right ears. AudIo-modulated 100 kHz electrostatic fields were tested.
(6) In two series of tests, the amplified, filtered, and clipped (about 200 mV) real-time Schumann signals were fed directly to the head via surface electrodes. This approach was dramatically psychoactive, and was abandoned in 1974 as dangerous after subjects experienced LSD-type visions.

At this time, we prefer *sinusoidal* waveforms (not pulsed, triangular, square, sawtooth, or other wave-forms). Fundamental frequencies are psychoactive, but can be enhanced by audio-modulating them onto compound carrier frequencies, heterodyning multiple sources, or generating "soliton" waves. We feel that much data has been overlooked by other researchers, not specifying the precise frequencies under investigation to accuracies of .01–.001 Hz. There is evidence that long-chain molecules near liquid crystal boundaries may simulate coherent dipole arrays with very high Qs. Biological signals are, after all, at the opposite end of the electromagnetic spectrum, where communications frequencies in the VHF and UHF bands are specified to .005% and better.

These investigations have been undertaken privately as a personal interest by the author. They have been totally funded by myself, and are in no way connected with any outside interests, either governmental or commercial.

Results have been reported on an informal basis via limited personal communications with other interested parties. Highly specific frequency and advanced waveform data are proprietary.

Precise technical details on low-noise biological and geomagnetic amplifiers, filters, Schumann detector coils (now into our fourth generation devices), practical and inexpensive voltage-controlled os-

cillator and FM discriminator circuits for cassette tape recording of ELF and EEC signals and data, practical and inexpensive modifications to digital frequency counters with extended ranges and accuracies of .005 Hz, suggestions for recording, displaying, and analyzing these signals, etc., can be made available to other serious and informed research workers who have a responsible interest in this subject. We feel it wise to withhold only the data on hemispheric desynchronous frequencies.

The instruments and hardware used in this study may be made available for inspection and evaluation.

BIBLIOGRAPHY ON THE PSYCHOACTIVITY OF ELECTROMAGNETIC FIELDS

Robert C. Beck and Eldon A. Byrd

It is unusual to include a bibliography of this magnitude with a mere position paper; however, we feel that, with a subject as controversial as this one, it is essential to give the reader an insight into the tremendous amount of work that has gone on in the background of this relatively new field. The bibliography accompanying the article originally ran only four pages; then, with the help of Eldon Byrd of the Naval Office of Surface Weaponry, a more extensive one was compiled on this sensitive topic. This important bibliography is included in its entirety.

—ED.

J. Aarons, J. Low frequency electromagnetic radiation 10–900 cycles per second. *J. Geophys. Res.* 61 (1956): 647.

———— . and M. Hinissart. Low frequency noise in the range 0.5–20 cycles per second. *Nature* 172 (1953): 682–683.

Abbas, M., and H. Poeverlein. Propagation of hydromagnetic waves in current-carrying regions of the ionosphere and magnetosphere (parallel propagation). *Radio Sci.* 3 (1968): 1010–1012.

Abeles, M., and M. H. Poeverlein, Jr. Multispike train analysis. *Proc. IEEE* 65 (May 1977).

Adey, W. R. Cerebral structure and information storage. In *Progress in Physiological Psychology*, ed. E. Stellar and J. M. Sprague, 3, 181–200. New York: Academic Press, 1970.

———— . Discrimination among states of consciousness by EEG measurement. *Electroencephalog. Clin. Neurophysiolog.* 22 (1967): 22–29.

———— . Effects of electromagnetic radiation on the nervous system. *Ann. N.Y. Acad. Sci.* 247 (1975): 15.

———— . Evidence for cooperative mechanisms in the susceptibility of cerebral tissue to environmental and intrinsic electric fields. In *The Functional Linkage in Biomolecular Systems*, ed. F. O. Schmitt, D. M. Schneider, and D. Crothers. New York: Raven Press, 1975.

———— . Extracellular microenvironment. In A. K. Katchalsky, V. Rowland, and R. Blumenthal, *Dynamic Patterns of Brain Cell Assemblies,* 80-85. Cambridge, Mass.: MIT Press, 1974.

———— . Frequency and power windowing in tissue interactions with weak electromagnetic fields. *Proc. IEEE* 68 (January 1980).

———— . The influences of impressed electrical fields at EEG frequencies on brain and behavior. In *Behavior and Brain Electrical Activity,* ed. N. Burch and H. I. Altschuler, 363–390. New York: Plenum Press, 1975.

———— . Introduction to the effects of electromagnetic radiation on the nervous system. *Ann. N. Y. Acad. Sci.* 247 (Feb. 28, 1975): 15–20.

———— . Ionic nonequilibrium phenomena in brain cell interactions with EM fields. 179th Annual Meeting, American Chemical Society, Physical Chemistry Section, Houston, Tex., March 1980.

———— . Ionic nonequilibrium phenomena in tissue interactions with electromagnetic fields. In ACS Symposium Series 157, *Biological Effects of Nonionizing Radiation*, ed. K. H. Illinger, 272–297. Washington, D.C.: American Chemical Society, 1981.

Adey, W.R. Long-range electromagnetic field interactions at brain cell surfaces. In *Magnetic Field Effect on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.
———— . Models of membranes of cerebral cells as substrates for information storage. *Bio Systems* 8 (1977): 163–178.
———— . Nonlinear effects of electromagnetic fields on whole organisms, living tissues and tissue preparations. In *Nonlinear Electrodynamics in Biological Systems*, ed. W. R. Adey and A. F. Lawrence, 3–22. New York: Plenum Press, 1983.
———— . Organization of brain tissue: Is the brain a noisy process? *Int. J. Neurosci.* 3 (1972): 271–284.
———— . Tissue interactions with nonionizing electromagnetic fields. *Physiol. Rev*. 1981).
———— , and S. M. Bawin. Brain interactions with weak electric and magnetic fields. *Neurosci. Res. Prog. Bull*. 15 (1977).
———— and ———— . Nonequilibrium processes in binding and release of brain calcium by low-level electromagnetic fields. Advances in Chemistry Series 188, 361–378. Washington, D.C.: American Chemical Society, 1980.
———— , and A. F. Lawrence, ed. *Nonlinear Electrodynamics in Biological Systems*. New York: Plenum Press, 1983.
———— , and D. O. Waiter. Application of phase detection and averaging techniques in computer analysis of EEC records in the cat. *Exp. Neurol*. 7 (1963): 186–209.
———— , et al. Impedance changes in cerebral tissue accompanying a learned discriminative performance in the cat. *Exp. Neurol*. 7 (1963): 259–281.
Adler, R. A study of locking phenomena in oscillators. *Proc. IEEE* 61 (October 1973).
Adrian, D. J. Auditory and visual sensations stimulated by low-frequency electric currents. *Radio Sci*. 12 (November–December 1977): 243–250.
Albanese, R. A., and E. L. Fell. Radiofrequency radiation and chemical reaction systems. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Al'pert, Y. L., and D. S. Fligel. Propagation of ELF and VLF waves near Earth. New York: Consultants Bureau, 1970.
Altmann, G. Die physiologische Wirkung elektrischer Felder auf Organismen. *Arch. Met. Geophys. Biol*. 17 (1969): 269–290.
Alvarez, A. M. Apparent points of contact between the daily course of the magnetic components of the earth together with certain solar elements, and the diastolic pressure of human beings and the total count of their leukocytes. *Puerto Rico J. Publ. Health Trop. Med.* 10 (1935): 374–395.
Anderson, D. J., and M. J. Correia. The detection and analysis of point processes in biological signals. *Proc. IEEE* 65 (May 1977).
Anninos, P. A. Electromagnetic fields generated from neuronal activity. *T.I.T.J. Life Sci*. 3 (1973): 15–18.
Aschoff, J. Internal dissociation and desynchronization of circadian systems. *Proc. XXI Cong. Aviat. Space Med*. (1973): 225.
———— , and U. Gerecke. Desynchronization of human circadian rhythms. *Jap. J. Physiol*. 17 (1967): 450–457.
———— , et al. Interdependent parameters of circadian activity rhythms in birds and man. In *Biochronometry*, ed. M. Menaker, 3–27. Washington, D.C.: National Academy of Sciences, 1971.
Asian, E. Broad-band isotropic electromagnetic radiation monitor. *IEEE Trans. Instr. Meas*. 21 (1972): 421–424.
Axelrod, J. The pineal gland: A neurochemical transducer. *Science* 184 (1974): 1341.
Azarnia, R., and W. R. Loewenstein. Parallel correction of cancerous growth and of a genetic defect of cell-to-cell communication. *Nature* 241 (1973): 455–457.
———— , et al. Intercellular communication and tissued growth. VI. Failure of exchange of endogenous molecules

between cancer cells with defective junctions and noncancerous cells. *J. Membr. Biol.* 10 (1972): 247–258.
Azarnia, R., et al. The membrane junctions in communicating and noncommunicating cells, their hybrids, and segregants. *Proc. Nat. Acad. Sci.* 71 (1974): 800–884.
Baranski, S. Histological and histochemical effects of microwave irradiation on the central nervous system of rabbits and guinea pigs. *Am. J. Phys. Med.* 51 (1972): 182–191.
———— , and Z. Edelwejn. EEG and morphological investigations upon influence of microwaves on central nervous system. *Acta Physiol. Pol.* 18 (1967): 423.
——— , and———— . Experimental and electroencephalographic studies of microwave effects on the nervous system. *Ann. N.Y. Acad. Sci.* 247 (1975): 109–116.
Barlow, J. S. Rhythmic activity induced by photic stimulation in relation to intrinsic alpha activity of the brain in man. *Electroencephalog. Clin. Neurophysiol.* 12 (1960).
Barnothy, M., ed. *Biological Effects of Magnetic Fields.* 2 vols. New York: Plenum Press, 1964, 1969.
Barnwell, F. H. A day-to-day relationship between the oxidative metabolism and world-wide geomagnetic activity. *Biol. Bull.* 119 (1960): 303.
Bass, L., and W. J. Moore. A model of neuron excitation based on the Wien Dissociation Effect. In *Structural Chemistry and Molecular Biology*, ed. A. Rich and N. Davidson, 356–369. San Francisco: W. H. Freeman, 1968.
Bassett, C. A. L. Electrical effects in bone. *Sci. Am.* 18 (1965).
———— . et al. Augmentation of bone repair by inductively coupled electromagnetic fields. *Science* 184 (1974): 575–577.
Bawin, S. M., and W. R. Adey. Interactions between nervous tissues and weak environmental electric fields. *Proceedings of the 1975 Annual Meeting,* U.S. National Committee, International Union of Radio Science, 1976.
———— , and ———— . Sensitivity of calcium binding in cerebral tissue to weak environmental electric fields oscillating at low frequency. *Proc. Nat. Acad. Sci.* 73 (1976): 1999–2003.
———, et al. Effects of modulated very high frequency fields on specific brain rhythms in cats. *Brain Res.* 58 (1973): 365–384.
———— , et al. Effects of modulated VHF fields on the central nervous system. *Ann. N.Y. Acad. Sci.* 247 (1975).
———— , et al. Possible mechanisms of weak electromagnetic field coupling in brain tissue. *Bioelectrochem. Bioenerg.* 5 (1978): 67–76.
——— , et al. Weak, amplitude-modulated radiofrequency fields modify 4,5 Ca 2+ release from cat cerebral cortex in vivo. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Becker, R. O. The effect of magnetic fields upon the central nervous system. In *Biological Effects of Magnetic Fields*, vol. 2, ed. M. F. Barnothy, 207–214. New York: Plenum Press, 1969.
———— . The neural semiconduction control system and its interaction with applied electrical current and magnetic fields. *Proc. XI Int. Cong. Radiol.* 11 (1965): 1753–1759.
Beischer, D. E., and J. D. Grissett. Extremely low frequency radiation and man. *Proceedings, Department of Defense Electromagnetic Research Workshop*, ed. P. Taylor, Commander, USN. 1971. (Limited distribution.)
———— , and V. R. Reno. Magnetic fields and man: Where do we stand today? *AGARD Conference Proceedings No. 95, Pt. III: Special Biophysical Problems in Aerospace Medicine,* ed. A. M. Pfister, C12, 1-9. Paris: Necker-Enfants Malades , 1971.
———— , and ———— . Microwave energy distribution measurements in proximity to man and their practical application. *Ann. N.Y. Acad. Sci.* 247 (1975): 473–479.
———— , et al. Exposure of man to low intensity magnetic fields in a coil system. NAMI-1018 NASA R-39. Pensacola, Fla.: Naval Aerospace Medical Institute, Oct. 3, 1967.

Beischer, D, E., et al. Exposure of man to magnetic fields alternating at extremely low frequency. NAMRL* Report no. 1180, July 1973.

Bender, H. A. A study of the effect of ELF electromagnetic fields upon Drosophila melanogaster. Final report, University of Notre Dame, November 1976.

Bennett, M. V. L. Electroreception. In *Fish Physiology*, ed. W. S. Hoar and D. J. Randall, vol. 5, *Sensory Systems and Electric Organs*, 493–574. New York: Academic Press, 1971.

Berry, M., and A. C. Riches. An immunological approach to regeneration in the central nervous system. *Brit. Med. Bull.* 30 (1974): 135–140.

Bhaumik, D., et al. On the possibility of Bose condensation in the excitation of coherent modes in biological systems. *Phys. Lett*. 56A (1976): 145–148.

Biggs, M. W. Studies on biomagnetic effect in mice. In *Magnetic Field Effect on Biological Systems*. New York: Plenum Press, 1978.

Bise, W. Low power radio-frequency and microwave effects on human electroencephalogram and behavior. *Physiol. Chem. Phys*. 10 (1978).

Blumenthal, R., et al. Membrane excitability and dissipative instabilities. *J. Membr. Biol*. 2 (1970): 351–374.

Bodenstein, G., and H. M. Praetorius. Feature extraction from the electroencephalogram by adaptive segmentation. *Proc. IEEE* 65 (May 1977).

Boenko, I. D., and F. G. Shakhgel 'Dyan. On the role of reflexogenic vascular zones in changes of blood coagulation during the effect of sound frequency electromagnetic field. *Fiziol. Zb. SSSR Imeni I.M. Sechen*. 54 (1968): 937–941.

Bowart, W. H. *Operation Mind Control*. New York: Dell, 1978.

Bowman, R. R. Some recent developments in the characterization and measurement of hazardous electromagnetic fields. In *Biologic Effects and Health Hazards of Microwave Radiation (Proceedings of an International Symposium, Warsaw, 15–18, Oct. 1973),* ed. P. Czerski et al., 217–227. Warsaw: Polish Medical Publ., 1974.

Branover, C. G., et al. A study of the behavior of the eel in natural and artificial magnetic fields and an analysis of its reception mechanism. *J. Ichthyol*. 11 (1971): 608–614.

Brezowsky, H. and W. R. Ranscht-Froemsdorff. Herzinfarkt und Atmospherics. *Z. angew. Bader. u. Klimaheilk*. 13 (1966): 679–686.

Brodeur, P. *The Zapping of America: Microwaves, Their Deadly Risk and the Coverup*. New York: W. W. Norton, 1977.

Brown, F. Response to pervasive geophysical factors and the biological clock problems. Cold Spring Harbor Symposia on Quantitative Biology, 1960.

Brown, F. A.. Jr. Responses of the planarian, Dugesia, and the protozoan, Paramecium, to very weak horizontal magnetic fields. *Biol. Bull*. 123 (1962): 264–281.

——— . Responses of the planarian, Dugesia, to very weak horizontal electrostatic fields. *Biol. Bull.* 123 (1962): 282–294.

——— . Some orientational influences of nonvisual, terrestrial electromagnetic fields. *Ann. N.Y. Acad. Sci*. 188 (1971): 224–241.

——— , and C. S. Chow. Interorganismic and environmental influences through extremely weak electromagnetic fields. *Biol. Bull.* 144 (1973): 437–461.

Bullock, T. H. Alternation of frequency of pacemaker nerve cells by imposed direct current. *Anat. Rec*. 84 (1942): 18–19.

——— . Conduction and transmission of nerve impulses. *Ann. Rev. Physiol*. 13 (1950): 261–280.

——— . An essay on the discovery of sensory receptors and the assignment of their functions together with an introduction to electroreceptors. In *Handbook of Sensory Physiology*, ed. A. Fessard, III/3. *Electroreceptors and Other Specialized Receptors in Lower Vertebrates,* 1–12. New York: Springer-Verlag, 1974.

*NAMRL = Naval Aerospace Medical Research Laboratory (Pensacola, Fla.).

Bullock, T. H. Initiation of nerve impulses in receptor and central neurons. *Rev. Mod. Phys*. 31 (1959): 504–514.
———— . Neuronal integrative mechanisms. In *Recent Advances in Invertebrate Physiology*, ed. B. T. Scheer, 1–20. Eugene, Ore.: University of Oregon Press, 1957.
———— . Problems in the comparative study of brain waves. *Yale J. Biol. Med*. 17 (1945): 657–679.
———— , et al. Electrical polarization of pacemaker neurons. *J. Neurophysiol*. 6 (1943): 85–98.
Burch, N., and H. I. Altschuler, eds. *Behavior and Brain Electrical Activity*. New York: Plenum Press, 1975.
Callaway, E., and P. R. Harris. Coupling between cortical potentials from different areas. *Science* 183 (1974): 873–875.
Campbell, D. J., and J. A. Kiernan. Mast cells in the central nervous system. *Nature* 210 (1966): 756–757.
Campbell, P. A., ed. *Medical and Biological Aspects of the Energies of Space*. New York: Columbia University Press, 1961.
Campbell, W. H. Geomagnetic pulsations. In *Physics of Geomagnetic Pulsations*, ed. S. Matsushita and W. H. Campbell, 821–909. New York: Academic Press, 1967.
Carr, E. F. Anomalous alignment in the smectric phase of a liquid crystal owing to an electric field. *Phys. Rev. Lett*. 24 (1970): 807–809.
Corson, R. W. Anti-fatigue device works by creating electric field. *Product Eng*. (Feb. 13, 1967)
Cetas, T. C. A birefringent crystal optical thermometer for measurements of electromagnetically induced heating. USNC/URSI-IEEE Meeting, University of Colorado, Boulder, Colo., October 1975.
Changeux, J. P., et al. On the cooperativity of biological membranes. *Proc. Nat. Acad. Sci*. 57 (1967): 335–341.
Chapman, F. W., and D. L. Jones. Observations of earth-ionosphere cavity resonances and their interpretation in terms of a two-layer ionosphere model. *U.S. Nat. Bur. Stand. J. Res. Radio Sci*. 68D (November 1964)
Chapman, S. W., and W. D. Mathews. Audiofrequency spectrum of atmospherics. *Nature* 172 (1953): 495.
Chatterjee, I., et al. Electromagnetic energy deposition in man for near-field exposure conditions. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Childers, D. G. Evoked responses: electrogenesis, models, methodology and wavefront reconstruction and tracking analysis. *Proc. IEEE* 65 (May 1977).
Cleary, S. F., ed. *Proceedings of the Symposium on the Biological Effects and Health Implications of Microwave Radiation*. Richmond, Va., Sept. 17–19, 1969. U.S. Dept. HEW, BRH/DBE 70-2, June 1970.
Coate, W. B., et al. Project Sanguine Biological Effects Test Program pilot studies. Final report, Hazleton Laboratories, November 1970.
Cohen, D. Magnetic fields of the human body. *Phys. Today* (August 1975): 35–43.
———— . Magnetoencephalography: Detection of the brain's electrical activity with a superconducting magnetometer. *Science* 175 (1972): 664–666.
———— . Magnetoencephalography: Evidence of magnetic fields produced by alpha-rhythm currents. *Science* 161(1968): 784–786.
———— . and E. Givler. Magnetomyography: Magnetic fields around the human body produced by skeletal muscles. *Appl. Phys. Lett*. 21 (1972): 114–116.
——— , et al. Magnetocardiograms taken inside a shielded room with a superconducting point-contact. *Appl. Phys. Lett.* 16 (1970): 278–280.
Cohn, T. E. Receiver operating characteristic analysis of sensitivity in neural systems. *Proc. IEEE* 65 (May 1977).
[———— .] *Compilation of Navy Sponsored ELF Biomedical and Ecological Research Reports*, vols. I, II (February 1975), vol. III (January 1977). Bethesda, Md.: Naval Medical Research and Development Command, February 1975.

Committee on Biosphere Effects of Extremely Low-Frequency Radiation. Biologic effects of electric and magnetic fields associated with proposed Project Seafarer. Report of the Committee, Division of Medical Sciences, Assembly of Life Sciences, National Academy of Science, 1977.

Cone, R. A. Transductive coupling in the visual system. In *Functional Linkage in Biomolecular Systems*, ed. F. O. Schmitt, D. M. Schneider, and D. M. Crothers, 234–246. New York: Raven Press, 1975.

Cooke, J., and E. C. Zeeman. A clock and wavefront model for control of the number of repeated structures during animal morphogenesis. *J. Theor. Biol.* 58 (1976): 455–476.

Cope, F. W. Biological sensitivity to weak magnetic fields due to biological superconductive Josephson junctions? *Physiol. Chem. Phys*. 5 (1973): 173–176.

———— . Evidence from activation energies for superconductive tunneling in biological systems at physiological temperatures. *Physiol. Chem. Phys*. 3 (1971): 403–410.

———— . Magnetoelectric charge states of matter-energy, a second approximation. Part II: Magnetoelectrets as possible evidence of magnetoelectric dipoles in solids, and as a possible mechanism for biological effects of magnetic fields. *Physiol. Chem. Phys.* 11 (1973): 461–463.

———— . Superconductive Josephson junctions—A possible mechanism for detection of weak magnetic fields and of microwaves by living organisms. In *Magnetic Field Effect on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.

Crane, J. S., and H. A. Pohl. Theoretical models of cellular dielectrophoresis. *J. Theor. Biol*. 37 (1972): 15–41.

Creutzfeldt, O. D., et al. Relations between EEC phenomena and potentials of single cortical cells . II Spontaneous and convulsoid active. *Electroencephalog. Clin. Neurophysiolog*. 20 (1966): 19–37.

Crosby, E. C., et al. *Correlative Anatomy of the Nervous System*. New York: Macmillan, 1962.

Csaba, G. *Regulation of mast-cell formation*. Budapest: Akademiai Kiado, 1972.

Czerski, P. Experimental models for the evaluation of microwave biological effects. *Proc. IEEE* 63 (1975): 1540–1544.

———— . Influence of microwaves on the hematopoietic system with particular reference to the lymphocyte. *Ann. N.Y. Acad. Sci.* 247 (1975): 232–242.

———— , et al. Influence of microwave radiation on the hematopoietic system. In *Biologic Effects and Health Hazards of Microwave Radiation (Proceedings of an International Symposium, Warsaw, 15–18 Oct. 1973),* ed. P. Czerski et al., 67–74. Warsaw: Polish Medical Publishers, 1974.

———— , et al. Microwave irradiation and the circadian rhythm of bone marrow cell mitosis. *J. Microwave Power* 9 (1974): 31–37.

Damaschke, V. K., and G. Becker. Korrelation der Atmungsintensität von Termitgen zu Aenderungen der Impulsfolgefrequenz der Atmospherics. *Z. Naturforschg*. 19 (1964): 157–160.

Davidson, R. O. *Methods in Nonlinear Plasma Theory*. New York: Academic Press, 1972.

Davis, A. R., and W. C. Rawls, Jr. *The Magnetic Effect*. Pompano Beach, Fla.: Exposition Press, 1980.

Davydov, A. S. *Biology and quantum mechanics*. Kiev: Nauka, 1979.

———— . Nonlinear vibrational phenomena in biology. Academy of Science, Ukrainian SSR, Institute for Theoretical Physics, Preprint ITP-79-69E, 1979.

———— . Solitons as energy carriers in biological systems. *Studia Biophys*. 62 (1977): 1–8.

———— . Solitons in molecular systems. *Phys. Scripta* 20 (1979): 387–334.

De Felice, L. J., and R. L. De Haan. Membrane noise and intercellular communication. *Proc. IEEE* 65 (May 1977).

de la Warr, G. W. *Biomagnetism*. Oxford: de la Warr Laboratories, 1967.

de Lorge, J. O. Behavior and temperature in rhesus monkeys exposed to extremely low frequency-low intensity magnetic fields. NAMRL, Report no. 1203, May 1974.
———— . Effects of magnetic fields on behavior in nonhuman primates. In *Magnetic Field Effect on Biological Systems,* ed. T. S. Tenforde. New York: Plenum Press, 1978.
———— . Operant behavior of rhesus monkeys in the presence of extremely low frequency-low intensity magnetic and electric fields: Experiment 1. NAMRL, Report no. 1115, 1972.
———— . ————: Experiment 2. NAMRL, Report no. 1179, March 1973.
———— . ————: Experiment 3. NAMRL, Report no. 1179, November 1973.
———— . A psychobiological study of rhesus monkeys exposed to extremely low-frequency-low intensity magnetic fields. NMRL, Report no. 1203, May 1974.
———— . and J. D. Grissett. Behavioral effects in monkeys exposed to extremely low frequency electromagnetic fields. *Int. J. Biometeorol*. 21 (1977): 357–365.
———— . and M. J. Marr. Operant methods assessing the effects of ELF electromagnetic fields. In *ELF and VLF Electromagnetic Field Effects*, ed. M. A. Persinger, 145–175. New York: Plenum Press, 1974.
Dern, H., and J. B. Walsh. Analysis of complex waveforms. In *Physical Techniques in Biological Research*, ed. W. L. Nastuk, vol. VI, chap. 3. New York: Academic Press, 1963.
Devyatkov, N. D. Influence of millimeter-band electromagnetic radiation on biological objects. *Sov. Phys. Usp*. 16 (1974): 568–574. Transl.
Dmitriev, V. G., et al. Nonlinear perception of infrared radiation in the 800–1355 nm range with human eye. *Sov. J. Quantum Electron*. 9 (1979): 475–479. Transl.
Doty, R. W. Electrical stimulation of the brain in behavioral context. *Ann. Rev. Psychol*. 20 (1969): 289–320.
Dowling, J. E., et al. The interplexiform cell: A new type of retinal neuron. *Invest. Ophthalmol*. 15 (1976): 919–926.
Drago, G. P., and S. Ridella. A cell electrical model. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Dropp, M. M. Mast cells in the mammalian brain. *Am. Zoologist* 13 (1973): 514.
———— . Mast cells in the mammalian brain. I: Distribution. *Acta Anat*. 94 (1976):1–21.
Dubrov, A. P. *The Earth's Magnetic Field and Life*. Ed. Yu. A. Kholodov. Leningrad: Gidrometeoizdat, 1974.
Dumanskij, J. D., and M. G. Sandala. The biologic and hygienic significance of electromagnetic fields of superhigh and ultrahigh frequencies in densely populated areas. *Biologic Effects and Health Hazards of Microwave Radiation (Proceedings of an International Symposium, Warsaw, Oct. 15–18, 1974)*. Warsaw: Polish Medical Publishers, 1974.
Durfee, W. A., et al. Extremely low frequency electric and magnetic fields in domestic birds. Technical Report, Phase I (Continuous Wave), University of Rhode Island, March 1975.
Durney, C. H., et al. Qualitative explanations of near-field sar characteristics based on experimental and theoretical observations. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Eccles, J. C. *The Physiology of Synapses*. Berlin: Springer-Verlag, 1964.
Einaudi, F., and J. R. Wait. Analysis of the excitation of the earth-ionosphere waveguide by a satellite-borne antenna. Pts. I and II. *Can. J. Phys*. 49, (1971): 1452–1460.
Einolf, C. W., and E. I. Carstensen. Low frequency dielectric dispersion in suspensions of ion-exchange resins. *J. Phys. Chem*. 75 (1971): 1091–1099.
Eisenberg, D., and W. Kauzmann. *The Structure and Properties of Water*. Oxford: Clarendon Press, 1969.
Elul, R. Dipoles of spontaneous activity in the cerebral cortex. *Exp. Neurol*. 6 (1962): 285–299.

Elul, R. Fixed charge in the cell membrane. *J. Physiol*. 189 (1967): 351–365.
———— . The genesis of the EEG. *Int. Rev. Neurobiol.* 15 (1972): 227–272.
———— . Relation of neuronal waves to EEG. In A. K. Katchalsky, V. Rowland, and R. Blumenthal, *Dynamic Patterns of Brain Cell Assemblies*, 97–101. Cambridge, Mass.: MIT Press, 1974.
Emlen, S. T. Can birds obtain directional information from the earth's magnetic field? *Am. Zoologist* 7 (1967): 806.
Enright, J. T. Heavy water slows biological timing processes. *Z. vergl. Physiol*. 72 (1971): 1–16.
Estes, W. K., and B. F. Skinner. Some quantitative properties of anxiety. *J. Exp. Psychol*. 29 (1941): 390–400.
Faber, D. F., and H. Korn. A neuronal inhibition mediated electrically. *Science* 179 (1973): 577–578.
Fife, P. C. Asymptotic analysis of reaction-diffusion wave fronts. *Rocky Mountain J. Math*. 7 (1977): 389–415.
———— . Stationary patterns for reaction-diffusion equations. In *Nonlinear Diffusion*, ed, W. E. Fitzgibbon and H. F. Walker, 81–121. San Francisco: Pitman, 1977.
Finkelstein, D., and J. Powell. Earthquake lightning. *Nature* 228 (1970): 759–760.
Fischer, W. H., et al. Laboratory studies of fluctuating phenomena. *Int. J. Biometeorol*. 12 (1968): 15–19.
Flanagan, W. F., et al. Non-metallic electrode system for recording EEG and ECC in electromagnetic fields. *Physiol. and Behav*. 8 (1977): 531.
Formanchk, V. C., and A. K. Valentino. An improved ELF electric field probe. Technical Memorandum no. 2, HTR no. E6249, March 1974. HTRI, 1825 K St., N.W., Washington, DC.
Frankenhauser, B., and A. L. Hodgkin. The action of calcium on the electrical properties of squid axons. *J. Physiol.* 137 (1957): 218–244.
Frey, A. H. Auditory system response to radio frequency energy. *Aerospace Med*. 32 (1961): 1140–1142.
———— . Behavioral biophysics. *Psychol. Bull*. 63 (1965): 322–337.
———— . Behavioral effects of electromagnetic energy. In *Symposium on Biological Effects and Measurement of Radio Frequency/Microwaves,* ed. D. Hazzard, 11–22. HEW Publ. (FDA) 77–8026, July 1977.
———— . Brain stem evoked responses associated with low intensity pulses of UHF energy. *J. Appl. Physiol*. 23 (1967): 984–988.
———— . Human auditory system response to modulated electromagnetic energy. *J. Appl. Physiol.* 17 (1962): 689–692.
———— . and S. R. Feld. Avoidance by rats of illumination with low power nonionizing electromagnetic energy. *J. Comp. Physiol. Psychol.* 89 (1975): 183–188.
Frey, K. W., and I. Goeke. Wetter und Radiospeicherung der Schilddruse. *Aertzliche Forschg*. 23 (1969): 373–375.
Friede, R. L. *Topographic Brain Chemistry*. New York: Academic Press, 1966.
Friedman, H., and R. J. Carey. Biomagnetic stresser effects in primates. *Physiol. and Behav*. 9 (1972): 171–173.
———— , and ———— . The effects of magnetic fields upon rabbit brains. *Physiol. and Behav*. 4 (1969): 539–541.
———— , and H. A. Taub. The transcephalic DC potential and reaction time performance. *Psychophysiol.* 5 (1969): 504–509.
———— , et al. Effect of magnetic fields on reaction time performance. *Nature* 213 (1967): 949–956.
———— , et al. Geomagnetic parameters and psychiatric hospital admissions. *Nature* 200 (1963): 626–628.
Friend, A. W., et al. Low frequency electric field induced changes in the shape and motility of amoebas. *Science* 187 (1975): 357–359.

Frohlich, H. Evidence for Bose condensation-like excitation of coherent modes in biological systems. *Phys. Lett.* 51A (1975): 21–22.
———— . The extraordinary dielectric properties of biological materials and the action of enzymes. *Proc. Nat. Acad. Sci.* 72 (1975): 4211–4215.
———— . Long-range coherence and energy storage in biological systems. *Int. J. Quantum Chem*. 2 (1968): 641-649.
———— . Long-range coherence and the action of enzymes. *Nature* 228 (1970): 1093.
———— . Low frequency vibrations of macro molecules. *Phys. Lett*. 44A (1973): 385.
———— . Possibilities of long- and short-range electric interactions of biological systems. In *Brain Interactions with Weak Electric and Magnetic Fields*, M.I.T. Neuroscience Research Program Bulletin, 1976.
———— . Selective long-range dispersion forces between large systems. *Phys. Lett*. 29A (1972): 153–154.
Furchtgott, E. Behavioral effects of ionizing radiations. *Psychol. Bull*. 60 (1963): 157–199.
Furedi, A. A., and I. Ohad. Effects of high-frequency electric fields on the living cell. I. Behaviour of human erythrocyte in high frequency electric fields and its relation to their age. *Biochem. Biophys. Acta* 71 (1964): 1–8.
Galejs, J. ELF and VLF propagation for models of a perturbed ionosphere. *Radio Sci.* 5 (1970): 1041–1044.
———— . Schumann resonances. *U.S. Nat. Bur. Stand. J. Res. Radio Sci.* 69D (August 1965).
———— . Terrestrial extremely low frequency propagation. In *Natural Electromagnetic Phenomena below 30 Kc/s*, ed. D. F. Bleil, 205–260. New York: Plenum Press, 1964.
———— . *Terrestrial Propagation of Long Electromagnetic Waves*. Elmsford, N.Y.: Pergamon Press, 1972. [See pp. 129–138.]
Gardiner-Medwin, A. R. Membrane transport to solute migration affecting the brain cell microenvironment. *Neurosci. Res. Prog. Bull.* 18 (1980): 208–226.
Gauquelin, M., and F. Gauquelin. A possible hereditary effect on time of birth in relation to the diurnal movement of the moon and the nearest planets: It's relationship with geomagnetic activity. *Int. J. Biometeorol*. 11 (1967): 341.
Gavalas-Medici, R. [J.], and S. R. [Day-]Magdaleno. An evaluation of possible effects of 45 Hz, 60 Hz and 75 Hz electric fields on neurophysiology and behavior of monkeys. Phase 1. Continuous wave. ONR Technical Report Control no. N00014-69-A-0200-4037, National Technical Information Service no. AD-A008-404/6GA, Springfield, Va., April 1975.
———— , and S. R. Day-Magdaleno. Extremely low frequency, weak electric fields affect schedule-controlled behaviour of monkeys. *Nature* 261 (1976): 256–258.
Gavalas [-Medici], R. J., et al. Effect of low-level low frequency electric fields on EEG and behavior in Macaca nemestrina. *Brain Res*. 18 (1970): 491–501.
Geacintov, N. E. Orientation of biological membranes and cells in magnetic fields. In *Magnetic Field Effect on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.
Geel, S. E., and P. S. Timiras. Influence of neonatal hypothyroidism and of thyroxine on the acetylcholinesterase and cholinesterase activities in the developing central nervous system of the rat. *J. Endocrinol*. 80 (1967): 1069–1074.
Gibson, R. S., and W. F. Moroney. The effect of extremely low magnetic fields on human performance: A preliminary study. NAMRL, Report no. 1175, August 1974.
Glansdorff, P., and I. Prigogine. *Thermodynamic Theory of Structure, Stability and Fluctuations.* New York: Wiley Interscience, 1971. [See pp. 61–95.]
Gollender, H. Eosinophil and avoidance correlates of stress in anterior cingulate cortex lesioned rats. *J. Comp. Physiol. Psychol.* 64 (1967): 40–48.
Goodman, E. M., et al. Effects of extremely low frequency electromagnetic fields on Physarum polycephalum. *Radiat. Res.* 66 (1976): 531–540.

Graf, E. R., et al. Radiation noise energy and human physiology in deep space. *American Astronautical Society, 1976 National Symposium: Saturn v. Apollo, and Beyond,* (EN-2) (1976): 1–18.

Grant, E. H. The structure of water neighboring proteins, peptides and amino acids as deduced from dielectric measurements. *Ann. N.Y. Acad. Sci.* 125 (1965): 418–427.

Green, D. E. A framework of principles for the unification of bioenergetics. *Ann. N.Y. Acad. Sci.* 227 (1974): 6–45.

Green, J. D., et al. Rabbit EEG "theta" rhythm, its anatomical source and relation to activity in single neurons. *J. Neurophysiol.* 23 (1962): 403–420.

Green, J. P. Histamine. In *Handbook of Neurochemistry*, ed. A. Lajtha, vol. IV, *Control Mechanisms in the Nervous System*, 221–250. New York: Plenum Press, 1970.

Grewal, G. S., et al. Measurements of RF absorption in biological models due to near-field exposure. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.

Grissett, J. D. Biological effects of electric and magnetic fields associated with ELF communications systems. *Proc. IEEE* 68 (January 1980).

———— . Exposure of man to a simulated lunar environment, physiological and nervous system effects. Diss., Virginia Commonwealth University, Richmond, Va., 1970.

———— . Exposure of squirrel monkeys for long periods to extremely low-frequency magnetic fields: Central-nervous-system effects as measured by reaction time. NAMRL, Report no. 1146, October 1971.

———— , and J. de Lorge. Central-nervous-system effects as measured by reaction time in squirrel monkeys exposed for short periods to extremely low-frequency magnetic fields. NAMRL, 1971.

Grodsky, I. T. Neuronal membrane, a physical synthesis. *Math. Biosci.* 28 (1976): 191–219.

———— . Possible physical substrates for the interaction of electromagnetic fields with biological membranes. *Ann. N.Y, Acad. Sci.* 247 (1975): 117–123.

Guy, A. W. Biophysics-energy absorption and distribution. AGARD Lecture Series 78, *Radiation Hazards (Non-ionizing Radiations—Biological Effects and Safety Considerations*, September 1975.

———— . A note on EMP safety standards. *IEEE Trans. Biomed. Eng.* 22 (1975): 464–467.

———— . Quantitation of induced electromagnetic field patterns in tissue and associated biologic effect. In *Biologic Effects and Health Hazards of Microwave Radiation (Proceedings of an International Symposium, Warsaw, 15–18 Oct. 1973)*, ed. P. Czerski et al., 203-316. Warsaw: Polish Medical Publishers, 1974.

———— , et al. Determination of power absorption in man exposed to high frequency electromagnetic fields by thermographic measurements of scale models. *IEEE Trans. Biomed. Eng.* 23 (1976): 361–371.

———— , et al. Electrophysiological effects of electromagnetic fields on animals. In *Fundamental and Applied Aspects on Nonionizing Radiation (Proceedings of the Rochester Intemational Conference on Environmental Toxi-city, Rochester, N.Y., 5–7 June 1974)*, ed. S. M. Michaelson et al., 167–211. New York: Plenum Press, 1975.

Hagiwara, S., et al. Physiological properties of electroreceptors of some gymnotids. *J. Neurophysiol.* 25 (1962): 430-449.

Hallgren, R. Inductive neural stimulator. *IEEE Trans. Biomed. Eng.* 20 (1973): 470–472.

Hamer, J. R. Biological entrainment of the human brain by low-frequency radiation. Northrop Space Laboratories, Report no. NSL 65–199, 1965.

———— . Effects of low level, low frequency electric fields on human reaction time. *Commun. Behav. Biol.* 2 (1968): 217–222.

———— . Effects of low-level, low-frequency electric fields on human time judgment. *Proc. Fifth Biometeorol. Cong.,* ed. S. W. Tromp and W. W. Weihe, 129. Amsterdam: Springer-Verlag, 1969.

Hansen, K, M. Some observations with a view to possible influence of magnetism upon the human organism. *Acta Med. Scand*. 97 (1938): 339-364.
Hansson, H.-A. Effects on nervous tissue of exposure to electromagnetic fields. In *Nonlinear Electrodynamics in Biological Systems*, ed. W. R. Adey and A. F. Lawrence, 65. New York: Plenum Press, 1984.
Hardy, J. D. Posterior hypothalamus and the regulation of body temperature. *Federat. Proc*. 32 (1973): 1564–1571.
Hauf, R., and J. Wiesinger. Biological effects of technical electric and electromagnetic VLF fields. *Int. J. Biometeorol*. 17 (1973): 213–215.
Hazzard, D., ed. *Symposium on Biologic Effects and Measurement of Radio Frequency/Microwaves*. HEW Publ. (FDA), 77–8026, July 1977.
Healey, R., and J. Reed. *The Behaviour of Slow Electrons in Gasses*. Sydney: Amalgamated Wireless, 1941. [On the Luxembourg effect.]
Heinmets, F., and A. Herschman. Considerations on the effects produced by superimposed electric and magnetic fields in biological systems and electrolytes. *Phys. Med. Biol*. 5 (1961): 271–288.
Herin, R. A. Electroanesthesia: A review of the literature (1819–1965). *Activ. Nervosa Superior* 10 (1968): 439–454.
Hines, J. N. Antennas. In *Radio Engineering Handbook*, 5th ed., ed. K. Henney, chap. 20, p. 1. New York: McGraw Hill, 1959.
Hirsch, F. G., D. R. McGiboney, and T. D. Harnish. The physiologic consequences of exposure to high density pulsed electromagnetic energy. *Int. J. Biometeorol*. 12 (1968): 263–270.
Hodgkin, A. L., and A. G. Huxley. A quantitative description of membrane current and its application to conduction and excitation in nerve. *J. Physiol.* (London) 234 (1952): 500–544.
Holubar, J. *The Sense of Time*. Cambridge, Mass.: M.I.T. Press, 1969.
Holzer, R. E., and O. C. Deal. Low audio-frequency electromagnetic signals of natural origin. *Nature* 177 (1956): 536–537.
Hong, F. T. Mechanisms of magnetic field interactions with retinal rods. In *Magnetic Field Effect on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.
Hughes, H. C. On the directional dependency of "slow trail" extremely low-frequency atmospheric wave-forms. *J. Atmos. Terr. Phys*. 29 (1967): 545–552.
Hunt, E. L., et al. Behavioral effects of pulsed microwave radiation. In *Biological Effects of Non-ionizing Radiation*, ed. P. D. Tyler, 440–453. New York: New York Academy of Science, 1975.
Hyden, H. A calcium-dependent mechanism for synapse and nerve cell membrane modulation. *Proc. Nat. Acad. Sci*. 71 (1974): 2965–2968.
———— . Changes in brain protein during learning. In *Macromolecules and Behaviour*, ed. G. B. Ansell and P. B. Bradley, 3–26. London: MacMillan, 1973.
Ibrahim, M. Z. M. The mast cells of the mammalian central nervous system. 1. Morphology, distribution, and histochemistry. *J. Neurol. Sci*. 21 (1974): 431–478.
———— . The mast cells of the mammalian nervous system. 2. The effect of proton irradiation in the monkey. *J. Neurol. Sci*. 21 (1974): 479–499.
Illinger, K. H. Interaction between microwave and millimeter-wave electromagnetic fields and biologic systems: Molecular mechanisms. In *Biological Effects and Health Hazards of Microwave Radiation (Proceedings of an International Symposium, Warsaw, 15–18 Oct. 1973),* ed. P. Czerski, et al., 160–172. Warsaw: Polish Medical Publishers, 1974.
———— . Molecular mechanisms for microwave absorption in biological systems. In *Symposium Proceedings: Biological Effects and Health Implications of Microwave Radiation,* BRH/DBE 70-2, PB 193898, 112–115. Rockville, Md.: 1970.
Jacobs, J. A. *Geomagnetic Micropulsations*. New York: Springer-Verlag, 1970.
Jaggard, D. L., and J. L. Lords. Cellular effects: Millimeter waves and Raman spectra—Report of a panel discussion. *Proc. IEEE* 68 (January 1980).

Jasper, H. H., and C. Stefanis. Intracellular oscillatory rhythms in pyramidal tract neurons. *Electroencephalog. Clin. Neurophysiol.* 18 (1965): 541–553.
Johnson, C. C., and A. W. Guy. Nonionizing electromagnetic wave effects in biological materials and systems. *Proc. IEEE* 60 (1972): 692–718.
———— . and M. L. Shore, eds. *Biological Effects of Electromagnetic Waves: Selected Papers of the USNC/USRI Annual Meeting, Boulder, Colo., 20–23 Oct. 1975*, vols. I–II. HEW Publication no. (FDA) 77–8010, 1976.
———— , et al. Fiberoptic liquid crystal probe for absorbed radio-frequency power temperature measurement in tissue during irradiation. *Ann. N.Y. Acad. Sci.* 247 (1975): 527–531.
Jones, R. W. Biological control mechanisms. In *Biological Engineering*, ed. H. P. Schwan, 87-203. New York: McGraw-Hill, 1969.
Justesen, D. R. and A. W. Guy, eds. Biological effects of electromagnetic waves. *Radio Sci.*12, Suppl. 6(s) (1977).
Kaezmarek, L. K. Cation binding models for the interaction of membranes with EM fields. *M.I.T. Neurosci. Res. Prog. Bull.* 15 (1977): 54–60.
———— . Frequency sensitive biochemical reactions. *Biophys. Chem*. 4 (1976): 249–252.
———— . and W. R. Adey. The efflux of 4,5 Ca 2+ and (3H)-aminobutyric acid from cat cerebral cortex. *Brain Res.* 63 (1973): 331–342.
———— , and———— . Factors affecting the release of [14C] taurine from cat brain: The electrical effects of taurine on normal and seizure prone cortex. *Brain Res*. 76 (1974): 83–94.
———— and———— . Some chemical and electrophysiological effects of glutamate in cerebral cortex. *J. Neurobiol* 5 (1974): 231–241.
———— , and———— . Weak electric gradients change ionic and transmitter fluxes in cortex. *Brain Res*. 66 (1974): 537–540.
Kaiser, F. Coherent oscillations in biological systems. II. Limit cycle collapse and the onset of traveling waves in Frohlich's brain wave mode. *Z. Naturforschg*. 33a (1978): 418–431.
Kalmijn, A. J. The detection of electric fields from inanimate and animate sources other than electric organs. In *Handbook of Sensory Physiology*, ed. A. Fessard, III. 3. *Electroreceptors and Other Specialized Receptors in Lower Vertebrates*, 147–200. New York: Springer-Verlag, 1974.
———— . The electric sense of sharks and rays. *J. Exp. Biol*. 55 (1971): 371–383.
———— . Electro-orientation in sharks and rays: Theory and experimental evidence. Scripps Institution of Oceanography Reference Series, Contract no. 73-39, 1-22, 1973.
———— . Electroperception in sharks and rays. *Nature* 212 (1966): 1232–1233.
Kataoka, K., and E. DeRobertis. Histamine in isolated small nerve endings and synaptic vesicles of rat brain cortex. *J. Pharmacol. Exp. Ther*. 156 (1967): 114–125.
Katchalsky, A. Polyelectrolytes and their biological interaction. In *Connective Tissue: Intercellular Macromolecules (Proceedings of a Symposium Sponsored by the New York Heart Association),* 9–42. Boston: Little, Brown, 1964.
Kazhinskiy, B. B. Biological radio communication. USAF, Foreign Technology Division, FTD-TT-62-1923/1+2, 1962.
Keeton, W. T. Magnets interfere with pigeon homing. *Proc. Nat. Acad. Sci*. 68 (1971): 102-106.
———— , et al. Normal fluctuations in the earth's magnetic field influence pigeon orientation. *J. Comp. Physiol*. 95 (1974): 95–103.
Keilmann, F., and W. Grundler Nonthermal resonant action of millimeter microwaves on yeast growth. In *Nonlinear Electrodynamics in Biological Systems*, ed. W. R. Adey and A. F. Lawrence, 59. New York: Plenum Press, 1984.
Kelsall, M. A., and P. Lewis. Mast cells in the brain. *Federat. Proc*. 23 (1964): 1107–1108.

Kendig, J. J. Anesthetics and pressure in nerve cells. In *Molecular Mechanism of Anesthesia*, ed. B. R. Fink, vol. 2. New York: Raven Press, 1981.
Kevanishvili, G. S., and T. G. Zhgenti. Primary mechanism of electromagnetic field effect on living organisms. *Izv. Akad. Nauk. S.S.R.* 62 (1971): 37–40.
Keynes, R. D. Evidence for structural changes during nerve activity and their relation to the conduction mechanism. In *The Neurosciences: Second Study Program*, ed. F. O. Schmitt, 707–714. New York: Rockefeller University Press, 1970.
Kholodov, Y. The effect of electromagnetic and magnetic fields on the central nervous system. NASA TT F 465, 1967. Trans.
———— . Effects on the central nervous system. In *Biological Effects of Magnetic Fields*, ed. M. Barnothy, 196–200. New York: Plenum Press, 1964.
———— . Magnetism in biology. Translation no. JPRS 60737. Washington, DC.: Joint Publication Research Service, Department of Commerce, 1973.
Kiernan, J. A. A comparative survey of the mast cells of the mammalian brain. *J. Anat*. 121 (1976): 303–311.
———— . Degranulation of mast cells following antidromic stimulation of cutaneous nerves. *J. Anat*. 111 (1971): 349–350.
Kimeldorf, D. J., and E. L. Hunt. *Ionizing Radiation: Neural Function and Behaviour*, 261–263. New York: Academic Press, 1965.
King, R. W. P., and T. T. Wu. *The Scattering and Defraction of Waves*. Cambridge, Mass.: Harvard University Press, 1959.
Kirkwood, J. G., and J. B. Shumaker. The influence of dipole moment fluctuations on the dielectric increment of proteins in solution. *Proc, Nat. Acad. Sci*. 38 (1952): 855–862.
Kirschbaum, R. N. Increasing growth rates and livability of mice with an ELF. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
———— , and E. W. Kienholz. Increasing chicken growth rates with niobium and magnetic fields. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Kolin, A., et al. Stimulation of irritable tissues by means of an alternating magnetic field. *Proc. Soc. Exp. Biol. Med*. 102 (1959): 251–252.
König, H. L. Behavioral changes in human subjects associated with ELF electric fields. In *ELF and VLF Electromagnetic Field Effects,* ed. M. A. Persinger. New York: Plenum Press, 1974.
———— . Biological effects of extremely low frequency electrical phenomena in the atmosphere. *Interdiscip. Cycle Res.* 2 (1971): 317–323.
———— . ELF and VLF signal properties: Physical characteristics. In *ELF and VLF Electromagnetic Field Effects*, ed. M. A. Persinger, 9–34. New York: Plenum Press, 1974.
———— . Environmental effects of atmospheric electric processes of very low frequency. USAF, Cambridge Research Laboratory, AF 19(628)-3880 T-G-232, January 1965. Transl.
Kopell, N. Reaction-diffusion equations and pattern formation. In *Studies in Mathematical Biology*, ed. S. A. Levin, 191–205. Washington, D.C.: Mathematics Association of America, 1978.
———— . Waves, shocks, and target patterns in an oscillating chemical reagent. In *Nonlinear Diffusion*, ed. W. E. Fitzgibbon and H. F. Walker, 129–154. San Francisco Pitman, 1977.
Kornberg, H. A., et al. Health effects of occupational exposure to ELF fields. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Kouwenhoven, W. B., et al. Medical evaluation of men working in alternating current electric fields. *IEEE Trans. Power Appar. Systems* PAS-86, 4 (1967): 506.
Kreutzberg, G. W., ed. *Physiology and Pathology of Dendrites*. New York: Raven Press, 1975.

Krippner, S. *Human Possibilities*. New York: Doubleday Anchor Books, 1980.
Kritikos, H. N., and H. P. Schwan. Hot spots generated in conducting spheres by electromagnetic waves: Biological implications. *IEEE Trans. Biomed. Eng*. 19 (1972): 53–58.
———— , et al. Effects of RF fields on nervous activities. *Proceedings, Microwave Power Symposium*, 54–65, Waterloo, Ontario, 1975.
Krumpe, P. E., and M. S. Tockman. Evaluation of the health of personnel working near Project Sanguine beta test facility from 1971 to 1972. USN, Naval Medical Research Unit no. 4, Great Lakes, Ill., December 1972.
Krushausl, J. A. Solitons in physics. In *Solitons and Condensed Matter Physics*, ed. A. R. Bishop and T. Schneider, 22–26. Berlin: Springer-Verlag, 1978.
Labes, M. M. Magnetic field coupling with liquid crystalline structures. In *Magnetic Field Effect on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.
Lagunoff, D. The mechanism of histamine release from mast cells. *Biochem. Pharmacol*. 21 (1972): 1889–1896.
Lakhtakia, A., et al. Near-field absorption in prolate spheroidal models exposed to a small loop antenna of arbitrary orientation. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Large, D. B., and J. R. Wait. Theory of electromagnetic coupling phenomena in the earth-ionosphere cavity. *J. Geophys. Res.* 73 (1968): 4335–4362.
Lawrence, A. F., and W. R, Adey. Non-linear wave mechanisms in tissue-electromagnetic field interactions. DOE, Contract Report no. DE-A101-79 ET, 1979.
Lawrence, G. Electronics and brain control. *Popular Electron*. 4 (July 1973): 65.
Lawrence, J. H., et al., eds. *Advances in Biological and Medical Physics*, vols. 16–17. New York: Academic Press, 1978.
Lefever, R., and J. L. Denaubourg. On the changes in conductance and stability properties of electrically excitable membranes during voltage-clamp experiments. *Adv. Chem. Phys*. 29 (1975): 349–374.
Lehninger, A. L. The neuronal membrane. *Proc. Nat. Acad. Sci*. 60 (1968): 1069–1080.
Lewis, A. J. A report by A. J. Lewis, Ph.D. Document EW-76-011, Supplemental Report Contract no. XG-4208 (54–20) 75S, January 1976. [Report on Soviet parapsychology, the work of Gennady Sergeyev, magnetic field effects (ELF), psychotronics, bioplasma research, etc.]
Lieber, A. L., and C. R. Sherin. Homicides and the lunar cycle: Toward a theory of lunar influences on human emotional disturbances. *Am. J. Psychiat*. 129 (1972): 101–106.
Lin, J. C., et al. Microwave selective brain heating. *J. Microwave Power* 8 (1973): 275–286.
Lindstrom, L. H., and R. I. Magnusson. Interpretation of myoelectric power spectra: A model and its applications. *Proc. IEEE* 65 (May 1977).
Ling, G. N., et al. The physical state of solutes and water in living cells according to the association-induction hypothesis. *Ann. N.Y. Acad. Sci*. 204 (1973): 6–47.
Lin-Liu, S., and W. R. Adey. Effect of ELF modulated 450 MHz field on calcium efflux from rat synaptosomes. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex,, Sept. 14–18, 1980.
Lissmann, H. W. On the function and evolution of electric organs in fish. *J. Exp. Biol*. 35 (1958): 156–191.
Little, W. A. The existence of persistent states in the brain. *Math. Biosci*. 19 (1974): 101–120.
———— , and G. L. Shaw. A statistical theory of short and long term memory. *Behav. Biol*. 14 (1975): 115–133.
Llaurado, J. G., et al. *Biological and Clinical Effects of Low-Frequency Magnetic and Electric Fields*. New York: C C Thomas, 1974.

Loewenstein, W. R. Cell-to-cell connections. In *Cell Interactions (Third Petit Colloquium, London, November 1971),* ed. L. G. Silvestri, 296–298. Amsterdam: North-Holland, 1972.
———— . Cellular communication by permeable junctions. In *Cell Membranes: Biochemistry, Cell Biology and Pathology,* ed. G. Weissman and R. Claiborne, 105–114. New York: Hospital Practice, 1975.
———— . Cellular communication through membrane junctions. *Arch. Intern. Med*. 129 (1972): 299–305.
———— . Intercellular communication. *Sci. Am*. 22 (May 1970): 78–86.
———— . Intercellular communication through membrane junctions and cancer etiology. In *Membrane Transformations in Neoplasias*, ed. J. Schultz and R. E. Block, vol. 8, Miami Winter Symposia, 103–120. New York: Academic Press, 1974.
———— . Membrane junctions in growth and differentiation. *Federat. Proc*. 32 (1973): 60–64.
———— . Permeability of membrane junctions. *Ann. N.Y. Acad. Sci*. 137 (1966): 441–472.
———— . Permeable junctions: Permeability, formation, and genetic aspects. In *The Nervous System: The Basic Neurosciences,* ed. D. B. Tower, vol. 1, 419–426. New York: Raven Press, 1975.
Luben, R. A., and C. D. Cain. Use of bone cell hormone response systems to investigate bioelectromagnetic effects on membranes in vitro. In *Nonlinear Electrodyamics in Biological Systems*, ed. W. R. Adey and A. F. Lawrence, 23. New York: Plenum Press, 1984.
Ludwig, H. W. Electric and magnetic field strengths in the open and in shielded rooms in the ULF- to LF-zone. In *ELF and VLF Electromagnetic Field Effects*, ed. M. A. Persinger, 35–80. New York: Plenum Press, 1974.
———— . A hypothesis concerning the absorption mechanism of atmospherics in the nervous system. *Int. J. Biometeorol.* 12 (1968): 93–98.
———— . Shielding effect of materials in the ULF, ELF and VLF region. *Int. J. Biometeorol.* 17 (1973): 207–211.
———— , et al. Physiological effects of electromagnetic fields in the ELF region. II. A review. *Arch. Met. Geophys. Biol*. B 21 (1973): 110–116.
Lu, S., et al. Neuroendocrine and cardiodynamic response of the dog subjected to cranial exposure to 2450 Mhz (CW) microwave. *Proceedings, Microwave Power Symposium*, Waterloo, Ontario, 1975.
———— , et al. Thermogenic and cardiovascular regulation in dogs cranially exposed to 2450 Mhz (CW) microwave. *Proc. IEEE-S-MTT (Microwave Symposium), Atlanta, Ga., June 12–14, 1974*.
Lux, H. D., and P. Schubert. Some aspects of the electroanatomy of dendrites. In *Physiology and Pathology of Dendrites: Advances in Neurology*, ed. G. W. Kreutzberg, vol. 12, 29–44. New York: Raven Press, 1975.
Maass, J. A., and M. M. Asa. Contactless nerve stimulation and signal detection by inductive transducer. *IEEE Trans. Magn*. 6 (1970): 322–326.
McAffee, R. D. Neurophysiological effect of 3-cm microwave radiation. *Am. J. Physiol*. 200 (1961): 192.
McClain, D. S., and G. M. Edelman. Surface modulation and transmembrane control. In *The Molecular Basis of Cell-Cell Interaction*, ed. R. A. Lerner and D. Bergsma, 1–28. New York: Alan R. Liss, 1978.
McCleave, J. D., et al. Perception and effects on locomotor activity in American eels and Atlantic salmon of extremely low frequency electric and magnetic fields. Final report prepared at University of Maine for ONR, 1974.
McConnell, H. M. Coupling between lateral and perpendicular motion in biological membranes. In *Functional Linkage in Biomolecular Systems*, ed. F. O. Schmitt, D. M. Schneider, and D. Crothers, 123–131. New York: Raven Press, 1975.
MacGregor, R.J. A brief survey of literature relating to the influence of low intensity microwaves on nervous function. Rand Corp, Publication no. P 4397, June 1970.

MacGregor, R. J. A direct mechanism for the influence of microwave radiation on neuroelectric potentials. Rand Corp., Publication no. P 4398, June 1970.
———— . Intrinsic oscillations in neural networks: A linear model for the nth order loop. Rand Corp., Publication no. R 642, February 1971.
———— . A possible mechanism for the influence of electromagnetic radiation of neuroelectric potentials. *IEEE Trans. Microwave Theor. Techn*. 21 (1979): 914–918.
———— . A simulation study of coincidence detection in the dendrites of a single nerve cell. Rand Corp., Publication no. RM-559-RC, December 1969.
McLees, B. D., and E. D. Finch. Analysis of reported physiologic effects of microwave detection. *Adv. Biol. Med. Phys*. 14 (1973): 163–223.
McPherron, R. L., C. T. Russell, and P. J. Coleman. Fluctuating magnetic fields in the magnetosphere. II. ULF waves. *Space Sci. Rev*. 13 (1972): 411–454.
Magnusson, C. E., and H. C. Stevens. Visual sensations caused by changes in the strength of a magnetic field. *Am. J. Physiol.* 29 (1911): 124–136.
Mahlum, D. D. Mechanisms of biomagnetic effects. In *Magnetic Field Effect on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.
Marha, K., et al. *Electromagnetic Fields and the Life Environment*. San Francisco: San Francisco Press, 1971.
Marino, A. A., and R. O. Becker. Biological effects of extremely low frequency electric and magnetic fields: A review. *Physiol. Chem. Phys*. 9 (1977): 131–147.
———— , et al. In vivo bioelectrochemical changes associated with exposure to extremely low frequency electric fields. *Physiol. Chem. Phys*. 9 (1977): 433–441.
Marr, M. J., et al. The effect of low energy ELF electromagnetic radiation on operant behavior in the pigeon and the rat. Final Report, prepared at Georgia Institute of Technology for ONR, Contract no. N00014-67-0159-0009, 1973.
Marton, J. P. Conjectures on superconductivity and cancer. *Physiol. Chem. Phys*. 5 (1973): 259–270.
Mascarenhas, S. Electrets in biophysics. *J. Electrostat.* 1 (1975): 141–146.
Massoudi, H., et al. Long-wavelength analysis of electromagnetic absorption in prolate spheroidal models of man and animals irradiated by a small loop antenna. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Mathewson, N. S., et al. Extremely low frequency (ELF) vertical electric field exposure of rats: A search for growth, food consumption, and blood metabolite alterations. USAF. Armed Forces Radiobiology Research Institute, January 1977.
Maxey, E. S. Critical aspects of human versus terrestrial electromagnetic symbiosis USNC/URSI Meeting, University of Colorado, Boulder, Colo., Oct. 20–23, 1975.
Maxwell, E. L., and D. L. Stone. Natural noise fields from 1 c/s to 100 kc/s. ONR, Report prepared at Deco Electronics for ONR, Report no. 371–590, 1960.
Medici, R. C. Methods of assaying behavioral change as a function of exposure to weak electric fields. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Menzel, D. H., and W. W. Salisbury. Audio-frequency radio waves from the sun. *Nature* 161 (1948): 91.
Meyer, M. E., and D. R. Lamb. Sensitivity of the pigeon to change in the magnetic field. *Psychonom. Sci*. 5 (1966): 349–350.
Michaelson, S. M. Biological effects of microwave exposure. [*Proceedings*,] *Medical College of Virginia Symposium, 1970*.
———— . Human exposure to non-ionizing radiation energy-potential hazards and safety standards. *Proc. IEEE* 60 (1972): 389.
———— , et al. Effects of electromagnetic radiations on physiological responses. *Aerospace Med*. 38 (1967): 293–298.
Michalke, W., and W. R. Loewenstein. Communication between cells of different type. *Nature* 232 (1971): 121–122.
Milroy, W. C., ed. Biomedical aspects of nonionizing radiation. *Proceedings of a Symposium Held at the Naval Weapons Laboratory, Dahlgren, Va., 10 July 1973*.

Milroy, W. C., et al. Electromagnetic pulse radiation: A potential biological hazard? *J. Microwave Power* 9 (1974): 213–218.
Mitchell, D. C., et al. Hyperactivity and disruption of operant behavior in rats after multiple exposures to microwave radiation. *Radio Sci.* 12 (1977): 163–271.
Mittler, S. Low frequency electromagnetic radiation and genetic aberrations. Final Report, Northern Illinois University, September 1972.
Mohler, R., et al. A systems approach to immunology. *Proc. IEEE* 68 (August 1980): 964–977.
Moseley, J. I. et al. Unit activity during focal cortical hypothermia in the normal cortex. *Exp. Neurol.* 37 (1972): 152–163.
Murr, L. The biophysics of plant growth in a reversed electrostatic field. *Int. J. Biometeorol.* 10 (1966): 135–146.
Nahas, G. G. Magnetic field effects on rodents. In *Magnetic Field Effects on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.
Nazarea, A. D. Electric fields and self-coherent patterns and structures in chemical systems: Large-scale effects and biological implications. *J. Chem. Phys.* 9 (1979): 415–449.
Neumann, E., and K. Rosenheck. Permeability changes induced by electric impulses in vesicular membranes. *J. Membr. Biol.* 10 (1972): 279–290.
Nicholson, C. Brain-cell microenvironment as a communication channel. In *The Neurosciences: Fourth Study Program*, ed. F. O. Schmitt and F. C. Woden, 457–476. Cambridge, Mass.: MIT Press, 1977.
———— . Dynamics of the brain cell microenvironment. *Neurosci. Res. Prog. Bull.* 18 (1980): 275–289.
Nicolas, G., and I. Prigogine. *Self-Organization in Nonequilibrium Systems.* New York: John Wiley, 1977.
Nunez, W., and M. Gershon. Species differences in mast cells of the thyroid gland. *Endocrinol.* 92 (1973): 152–159.
Ochs, S. *Elements of Neurophysiology*. New York: John Wiley, 1965.
Ogawa, T., et al. Observations of natural ELF and VLF electromagnetic noises using ball antennas. *J. Geom. Geoelectr*. 18 (1966): 443–454.
O'Konski, C. T. Electric properties of macromolecules. V. Theory of ionic polarization in polyelectrolytes. *J. Phys. Chem*. 64 (1960): 605–619.
O'Neil, J. J. *Prodigal Genius: The Life of Nikola Tesla.* New York: I. Washburn, 1944.
Orgel, A. R., and J. C. Smith. Test of the magnetic theory of homing. *Science* 120 (1954): 891–892.
Orme, J. E. *Time, Experience, and Behavior*. New York: American Elsevier, 1969.
Ormenui, I. Possible effect of ELF range atmospherics of 3-cps range on traffic accidents in a metropolitan area in Hungary. *Int. J. Biometeorol.* 16 (Suppl.) (1972): 93–94.
Ossenkopp, K. P. Maturation and open-field behavior in rats exposed prenatally to an extremely low frequency rotating magnetic field. *Psychol. Report* 30 (1972): 371–374.
———— , and M. D. Ossenkopp. Self-inflicted injuries and the lunar cycle: A report. *J. Interdiscip. Cycle Res*. 4 (1973): 337–348.
———— , and J. Shapiro. Effects of prenatal exposure to a 0.5 Hz low-intensity rotating magnetic field on white Peking ducklings. *Am. Zool.* 12 (1972): 650.
———— , et al. Prenatal exposure to an extremely low-intensity rotating magnetic field and increase in thyroid and testicle weights in rats. *Devel. Psychobiol*. 5 (1972): 275–285.
Oncley, J. L. The electric movements and relaxation times of proteins as measured from their influence upon the dielectric constants of solutions. In *Proteins, Amino Acids and Peptides as Ions and Dipolar Ions*, ed. E. J. Cohn and J. T. Edsall, 543–568. New York: Hafner, 1965.

Ortoleva, P. J., and J. Rosee. Response of unstable chemical systems to external perturbations. *J. Chem. Phys*. 56 (1972): 293–294.
Olsen, R. G. Evidence for microwave-induced acoustic resonances in biological material. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Olsson, Y. Mast cells in the nervous system. *Int. Rev. Cytol*. 24 (1968): 27–70.
Padawer, J. The ins and outs of mast cell function. *Am. J. Anat*. 141 (1974): 399–402.
Parker, J. H., and E. F. Carr. Anomalous alignment and domains in a nematic liquid crystal. *J. Chem. Phys*. 55 (1971): 1846–1850.
Patel, V. L., and L. J. Cahill. Evidence of hydromagnetic waves in the earth's magnetosphere and of their propagation to the earth's surface. *Phys. Rev. Lett*. 12 (1964): 213–215.
Pauly, H., and H. P. Schwan. Dielectric properties and ion mobility in erythrocytes. *Biophys. J*. 6 (1966): 612–639.
Pennock, B. E., and H. P. Schwan. Further observations on the electrical properties of the hemoglobin-bound water. *J. Phys. Chem*. 73 (1969): 2600–2610.
Perkel, D. H., and T. M. Bullock. Neural coding. *Neurosci. Res. Prog. Bull*. 6 (1968): 221–248.
Persinger, M. A. Day time wheel running activity in laboratory rats following geomagnetic event of 5–6 July 1974. *Int. J. Biometeorol.* 20 (1976): 19–22.
———— . Effects of magnetic fields on animal behavior. In *Progress in Biometeorology: Animal Biometeorology*, ed. H. D. Johnson, 177–182. Amsterdam: Swets and Zeitlinger, 1976.
———— . ELF electric and magnetic field effects: The patterns and the problems. In *ELF and VLF Electromagnetic Field Effects*, ed. M. A. Persinger, 275–310. New York: Plenum Press, 1974.
———— . Mast cells in the brain: Possibilities for physiological psychology. *Physiol. Psychol*. 5 (1977): 166–176.
———— . Open field behavior in rats exposed prenatally to a low intensity-low frequency rotating magnetic field. *Devel. Psychobiol*. 2 (1969): 168–171.
———— . Possible cardiac driving by an external rotating magnetic field. *Symposium on Biological Effects of Natural, Electric, Magnetic and Electromagnetic Fields. Sixth Int. Biometeorol. Cong., Noordwijk, the Netherlands, Sept. 3-9, 1972; Int. J. Biometeorol.* 17 (1973) : 263–266. [This issue of *Int. J. Biometeorol*. contains 7 other papers from the symposium.]
———— . Prenatal exposure to an ELF rotating magnetic field, ambulatory behavior, and lunar distance at birth: A correlation. *Psychol. Report* 28 (1971): 435–438.
———— . Studies on the biological effects of low and extremely low frequency electromagnetic fields. Laurentian University, Sudbury, Ontario, 1973–1978. [Monograph available from the author.]
———— . and D. J. Coderre. Thymus mast cell number following perinatal and adult exposure to low intensity 0.5 Hz magnetic fields. *Int. J. Biometeorol*. 22 (1978): 123–128.
———— , and W. S. Foster. ELF rotating magnetic fields: Prenatal exposure and adult behavior. *Arch. Met. Geophys. Biol*. 18 (1970): 363–369.
———— , and K. P. Ossenkopp. Some behavioral effects of pre- and neonatal exposure to an ELF rotating magnetic field. *Int. J. Biometeorol*. 17 (1973): 217–220.
———— , and J. J. Pear. Prenatal exposure to an ELF rotating magnetic field and subsequent increase in conditioned suppression. *Devel. Psychobiol*. 5 (1972): 269–274.
———— , et al. Behavioral changes in adult rats exposed to ELF magnetic fields. *Int. J. Biometeorol*. 16 (1972): 155–162.
———— , et al. Physiological changes in adult rats exposed to ELF rotating magnetic. fields. *Int. J. Biometeorol*. 16 (1972): 163–172.

———— , et al. Psychophysiological effects of extremely low frequency electromagnetic fields: A review. *Percept. Motor Skills* 36 (1973): 1139–1159. [Note: This is perhaps the single most pertinent reference on ELF in this bibliography.—AU.]
———— . Thirty-eight blood tissue and consumptive measures from rats exposed perinatally and as adults to 0.5 Hz magnetic fields. *Int. J. Biometeorol.* 22 (1978): 213–226.
Petersen, W. F. E. *Man, Weather, Sun*. Springfield, Ill.: Charles C. Thomas, 1947.
Petrov, J. R. Influence of microwave radiation on the organism of man and animals. NTIS, Report no. 72-22073, 1972.
Photiades, D. P., et al. Electrosleep in man by a combination of magneto-inductive and transtemporal electric currents. In *The Nervous System and Electric Currents*, ed. N. L. Wulfsohn and A. Sances, 153–158. New York: Plenum Press, 1970.
Piccardi, G. *The Chemical Basis of Medical Climatology*. Springfield, Ill.: C C Thomas, 1952.
Picton, H. D. Some responses of Drosophila to weak magnetic and electrostatic fields. *Nature* 211 (1966): 303–304.
Pierce, E. T. Some ELF phenomena. *J. Res*. 64 (1960): 383–386.
Pinneo, L. K., et al. The neural effects of microwave radiation, USAF, Rome Air Force Development Center, Report no. TRD-62-231, AD 277684, 1962.
Pionsey, R. Action potential sources and their volume conductor fields. *Proc. IEEE* 65 (May 1977).
Pohl, M. A. Natural AC electric fields in and about cells. In *Nonlinear Electrodynamics in Biological Systems*, ed. W. R. Adey and A. F. Lawrence, 87ff. New York: Plenum Press, 1984.
———— and J. S. Crane. Dielectrophoresis of cells. *Biophys. J.* 11 (1971): 711–727.
————, and ———— . Dielectrophoretic force. *J. Theoret. Biol.* 37 (1972): 1–13.
———— and I. Hawk. Separation of living and dead cells by dielectrophoresis. *Science* 152 (1966): 647–649.
Polk, C., and F. Fitchen. Schumann resonances of the earth-ionosphere cavity: Extremely low frequency reception at Kingston. *U.S. Nat. Bur. Stand. J. Res. Radio Propagation* 66D (May–June 1962).
Popa, M. M. Response of guinea pig adrenals to continuous and arrhythmically interrupted low frequency electromagnetic fields. *Proc. 5th Biometeorol. Cong.,* ed. S. W. Tromp and W. H. Weihe, vol. 4, 129. Amsterdam: Springer-Verlag, 1969.
Popp, F.-A., et al. *Electromagnetic Bio-Information*. Munich: Urban and Schwarzenberg, 1979.
Poppel, E., and H. Giedke. Diurnal variation of time perception. *Psychol. Forschg*. 34 (1970): 182–198.
Pressman, A. S. The action of microwaves on living organisms and biological structures. *Sov. Phys. Usp*. 8 (1965): 463–488.
———— . *Electromagnetic Fields and Life*. New York: Plenum Press, 1970.
———— . The role of electromagnetic fields in life processes. *Biofiz*. 9 (1964): 131–134.
[———— .] *Proceedings, Ad Hoc Committee jbr the Review of Biomedical and Ecological Effects of ELF Radiation*. USN, Bureau of Medicine and Surgery, 1973.
Raemer, H. R. On the spectrum of terrestrial radio noise at extremely low frequencies. *U.S. Nat. Bur. Stand. J. Res., Radio Propagation* 65D (November–December 1961).
Ramon, C., et al. Effect of low-frequency weak magnetic fields on *E. Coli* bacteria. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Ravitz, J. L. History, measurements, and applicability of periodic changes in the electromagnetic field in health and disease. *Ann. N.Y. Acad. Sci*. 98 (1962): 1144–1201.

Rein, G., and R. Dixey. Neurotransmitter release stimulated in a clonal nerve cell line by low intensity pulsed magnetic fields. In *Nonlinear Electrodynamics in Biological Systems*, ed. W. R. Adey and A. F. Lawrence, 79–86. New York: Plenum Press, 1984.

Reno, J. L. Microwave reflection, diffraction and transmission studies of man. NAMRL, Report no. 1199, February 1974.

Rentsch, W. Magneto-inductive transmission of stimuli to the brain, in electrotherapeutic sleep and electroanesthesia. *Proceedings, First Annual Symposium (Graz, Austria, 12–17 Sept. 1966),* ed. F. M. Wagenweder and O. St. Schuy, 161–168. Amsterdam: Excerpta Medica, 1967.

Reynolds, D. V., and A. E. Sjoberg, eds. *Neuroelectric Research*. Springfield, Ill.: C C Thomas, 1971. [This book contains papers by 81 contributors.]

Riesen, W. H., et al. A pilot study of the interaction of extremely low-frequency electromagnetic fields with brain organelles. HTRI, Technical Memorandum no. 3, HTRI Project E6185, Contract N00039-71-C-0111, 1971.

Roberts, A. M. Effect of the electric fields on mice. *Nature* 223 (1969): 639.

Romig, M. F., and D. L. Lamar. Anomalous sounds and electromagnetic effects associated with fireball entry. Rand Corp., RM-3724-ARPA, July 1963.

Rosenblum, W. I. A possible role for mast cells in controlling the diameter of arterioles on the surface of the brain. *Brain Res*. 49 (1973): 75–82.

Russo, F., and W. E. Caldwell. Biomagnetic phenomena: Some implications for the behavioral and neurophysiological sciences. *Genet. Psychol. Monogr*. 84 (1971): 177–243.

Saito, M., et al. Response of nonspherical biological particles to alternating electric fields. *Biophys. J*. 6 (1966): 313–327.

Saito, T. Geomagnetic pulsations. *Space Sci. Rev*. 10 (1969): 319–411.

Sampson, H. W., et al. An ultrastructural investigation of calcium-dependent granules in the rat neurophil. *Brain Res*. 22 (1970): 157–162.

[———— .] Sanguine Division, Sanguine System Final Environmental Impact Statement, 77-78. USN, Naval Electronics Systems Command (PME 117-21), 1972.

Scheich, H., and T. H. Bullock. The detection of electric fields from electric organs. In *Handbook of Sensory Physiology*, ed. A. Fessard, III. 3. *Electroreceptors in Lower Vertebrates*, 201–256. New York: Springer-Verlag, 1974.

Schiff, J. and W. R. Loewenstein. Development of a receptor on a foreign nerve fiber in a Pacinian corpuscle. *Science* 177 (1972): 712–715.

Schmidt, S., and P. Ortoleva. Multiple chemical waves induced by applied electric field. *Chem. Phys*. 67 (1978): 1010–1015.

————, and ———— . A new chemical wave equation for ionic systems. *J. Chem. Phys*. 67 (1977): 3771–3776.

Schmitt, F. O., and F. E. Sampson. Brain cell microenvironment. In *Neuroscience Research Symposium Summaries*, ed. F. O. Schmitt et al., vol. 4, 191–325. Cambridge, Mass.: MIT Press, 1970.

———— , et al. Electronic processing of information of brain cells. *Science* 193 (1976): 114–120.

Schmitt, O. H., and R. D. Tucker. Human perception of moderate strength low-frequency magnetic fields. IEEE meeting, 1973. Typescript.

Schumann, W. O. Elektrische Eigenschwingungen des Hohlraumes Erde-Luft-Ionosphäre. *Z. angew. u. Phys*. 9 (1957): 373–378.

———— . Über die strahlungslosen Eigenschwingungen einer leitenden Kugel, die von einer Luftschicht und einer Tonosphärenhülle ungeben ist. *Z. Naturforschg*. 7A (1952): 149–154.

Schwan, H. P. Alternating current spectroscopy of biological substances. *Proc. IEEE* 47 (1959): 1841–1855.

———— . Biological impedance determinations. *J. Cell. Comp. Physiol*. 66 (Suppl.) (1965): 512.

———— . Biological hazards from exposure to ELF electrical fields and potentials. NWL, Technical Report no. TR-2713, 1972.

Schwan, H. P. Characteristics of absorption and energy transfer of microwaves and ultrasound in tissues. In *Medical Physics*, ed. O. Blassers, 1–7. Chicago: Yearbook Publishers, 1960.
———— . Determination of biological impedances. In W. L. Nastuk, *Physical Techniques in Biological Research*, vol. 6, 323-406. New York: Academic Press, 1963
———— . Electrical properties of bound water. *Ann. N.Y. Acad. Sci*. 125 (1965): 344–354.
———— . Electrical properties of tissue and cell suspension. *Adv. Bioi. Med. Phys*. 5 (1957):147–209
———— . Interaction of microwave and radio frequency radiation with biological systems. *IEEE Trans. Microwave Theor. Techn*. 19 (1971): 146–152.
———— . Microwave biophysics. In *Microwave Power Engineering*, ed. E. Okress, vol. 2, 213–244. New York: Academic Press, 1968.
———— . Microwave radiation: Biophysical considerations and standards criteria. *IEEE Trans. Biomed. Eng*. 19 (1972): 304–312.
———— . Principles of interaction of microwave fields at the cellular and molecular 1eve1. In *Biologic Effects and Health Hazards of Microwave Radiation (Proceedings of an International Symposium, Warsaw, 15–18 Oct. 1973),* ed. P. Czerski et al., 152–159. Warsaw: Polish Medical Publishers, 1974.
———— . To provide for the protection of the public health from radiation emissions. U.S. Senate, 19th Congress, Hearings Before the Committee on Commerce, May 13, 1968, 699–718.
———— . and K. R. Foster. RF-field interactions with biological systems: Electric properties and biophysical mechanisms. *Proc. IEEE* 68 (January 1980).
———— , and G. M. Piersol. The absorption of electromagnetic energy in body tissues—Review and critical analysis. I. Biophysical aspects. *Am. J. Phys. Med*. 33 (1954): 371–404.
————, and ———— . The absorption of electromagnetic energy in body tissues. II. Physiological and clinical aspects. *Am. J. Phys. Med.* 34 (1955): 425–448.
———— and L. D. Sher. Alternating-current field-induced forces and their biological implications. *J. Electrochem. Soc.* 116 (1969): 22C–26C.
———— , et al. Complex permittivity of water at 250 C. *J. Chem. Phys*. 64 (1976): 2257–2258.
———— , et al. The electrical properties of bilayer membranes. Abstracts, 10th Annual Meeting, Biophysical Society, Boston,1966.
Schwartz, J. Histamine as a transmitter in the brain. *Life Sci.* 17 (1975): 503–518.
———— , et al. Histamine formation in the rat brain in vivo Effects of histidine loads. *J. Neurochem*. 19 (1972): 801–810.
Schwarz, G. A basic approach to a general theory for cooperative [?] intramolecular conformation changes of linear biopolymers. *Biopolymers* 5 (1967): 321–324.
———— . Cooperative binding in linear biopolymers. I. Fundamental static and dynamic properties. *Eur. J. Biochem.* 12 (1970): 442–453.
———— . General equation for the mean electrical energy of a dielectric body in an alternating electrical field. *J. Chem. Phys*. 39 (1963): 2387–2388.
———— , et al. On the orientation of nonspherical particles in an alternating electrical field. *J. Chem. Phys*. 43 (1965): 2562–2569.
Sclabassi, K. J., et al. Complex pattern evoked somatosensory responses in the study of multiple sclerosis. *Proc. IEEE* 65 (May 1977).
Seamon, K. B. Calcium and magnesium-dependent conformational states of calmodulin as determined by nuclear magnetic resonance. *Biochem*. 19 (1980): 207–215.
Sel'kov, E. E. Oscillations in biological and chemical systems. *Eur. J. Biochem.* 4 (1968): 79–86.
Servantie, B., et al. Pharmacologic effects of a pulsed microwave field. In *Biologic Effects and Health Hazards of Microwave Radiation (Proceedings of an International Symposium, Warsaw, 15-18 Oct. 1973),* ed. P. Czerski et al, 36–45. Warsaw: Polish Medical Publishers, 1974.

Servantie, B., et al. Synchronization of cortical neurons by a pulsed microwave field as evidenced by spectral analysis of electrocorticograms from the white rat. *Ann. N.Y. Acad. Sci.* 247 (1975): 82–86.
Sharma, R. C. Mechanism of characteristic behaviour of cells in an alternating electric field. *Nature* 214 (1967): 83-84.
Shatten, V. H., and J. M. Wilcox. Response of the geomagnetic activity index Kp to the interplanetary magnetic field. *J. Geophys. Res.* 72 (November 1967): 5185–5191.
Sheer, D. E. *Electrical Stimulation of the Brain*. Austin: University of Texas Press, 1961.
Sheppard, A. R. High frequency permittivity measurements in the time and frequency domains. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
———— . Magnetic field interactions in man and other mammals: An overview. In *Magnetic Field Effect on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.
———— and M. Eisenbud. *Biological Effects of Electric and Magnetic Fields of Extremely Low Frequency*. New York: New York University Press, 1977.
———— , et al. ELF electric fields alter neuronal excitability in aplysia neurons, Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
———— , et al. Extracellular alternating currents change firing rate in aplysin pacemaker neurons. *Soc. for Neurosci. Abstr.* 6 (November 1980).
———— , et al. Models of long-range order in cerebral macromolecules: Effects of sub-ELF and of modulated VHF and UHF fields. *Radio Sci.* 14 (November–December 1979): 141–145.
Sher, L. D. Mechanical effects of AC fields on particles dispersed in a liquid: Biological implication. Diss., University of Pennsylvania, Philadelphia, Penna., 1963.
———— , et al. On the possibility of nonthermal biological effects of pulsed electromagnetic radiation. *Biophys.* 10 (1970): 970–979.
Sholl, D. A. *The Organization of the Cerebral Cortex*. New York: John Wiley & Sons, 1956.
Silverman, C. Nervous and behavioral effects of microwave radiation in humans. *Am. J. Epidemiol.* 97 (1973): 219.
Soyka, F. *The Ion Effect*. New York: E. P. Dutton, 1976.
Spiegel, R. J., and W. T. Joines. A semiclassical theory for nerve excitation by a low intensity electromagnetic field. *Bull. Math. Biol.* 35 (1973): 591–605.
Spirkin, A. Getting to know psycho-biophysical reality. USAF, Foreign Technology Division, Report no. FTD-ID (RS) T-1175-80.
Stein, M., R. C. Schiavi, and M. Camerion. Influence of brain and behavior on the immune system. *Science* 191 (1976): 435–440.
Stern, S., et al. Detection of 60 Hz electric fields by rats: Preliminary results. Second Annual Meeting, Bioelectromagnetics Society, San Antonio, Tex., Sept. 14–18, 1980.
Stewart, G. T. Change of phase and change of state in biological systems. *Molec. Cryst. Liq. Cryst*. 7 (1969): 75–102.
———— . Liquid crystals of lipid in normal and athcromatous tissue. *Nature* 183 (1959): 873–875.
———— . Some physico-chemical properties of paracrystalline spherulites of biological origin. *Nature* 192 (1961): 624–625.
Stratton, J. A. *Electromagnetic Theory*. New York: McGraw-Hill, 1941.
Sturrock, P. A. Generation of radio noise in the vicinity of the earth. *U.S. Nat. Bur. Stand. J. Res., Radio Propagation* 66D (March–April 1962).
Subbota, A. G. The effects of a pulsed super high frequency field on the higher nervous activity of dogs. *Bull. Exp. Med.* 46 (1958): 1206–1211.

Sugiura, M., and J. P. Heppner. Electric and magnetic fields in the earth's environment. In *American Institute of Physics Handbook,* sec. 5, 265–303. New York: McGraw-Hill, 1972.
Swenberg, C. E. Theoretical remarks on low frequency magnetic field interactions with biological systems. In *Magnetic Field Effect on Biological Systems*, ed. T. S. Tenforde. New York: Plenum Press, 1978.
Swicord, M. L., G. S. Edwards, and C. C. Davis. Strong interactions of radiofrequency fields with nucleic acid. In *Nonlinear Electrodynamics in Biological Systems*, ed. W. R. Adey and A. F. Lawrence, 35–58. New York: Plenum Press, 1984.
Szuts, E. Z,, and R, A. Cone. Rhodopsin: Light activated release of calcium. *Federat. Proc*. 33 (1974): 1471. [Abstract.]
Tabichers, L. Y., et al. Apparatus for the treatment of neuropsychic and somatic diseases with heat, light, sound, and VHF electromagnetic radiation. U.S. Patent no. 3,733,049.
Takashima, S. Membrane capacity of giant squid axon during hyper- and depolarizations. *J. Membr. Biol*. 27 (1976): 21–39.
———— , and A. Minakata. Dielectric behavior of biological macromolecules. In *Digest of Dielectric Literature*, ed. W. Vaughn. Washington, D.C.: National Research Council, National Academy of Sciences, 1976.
———— , and H. P. Schwan. Passive electrical properties of squid axon membrane. *J. Membr. Biol.* 17 (1974): 51–68.
———— , et al. Effects of modulated KF energy on the EEG of mammalian brains, II. Appearance of fast and slow waves after chronic irradiations. *Proceedings of the 1978 Symposium on Electromagnetic Fields in Biological Systems, Ottawa, Ontario, June 28-30, 1978*.
Tasaki, I. Evolution of theories of nerve excitation. In *The Nervous System*, ed. D. B. Tower, vol. III. *The Basic Neurosciences,* 177-195. New York: Raven Press, 1975.
Tenforde, T. S., ed. *Magnetic Field Effect on Biological Systems*. New York: Plenum Press, 1978.
Teng, H. C., and H. E. Howard. The relationship between sudden changes in weather and the occurrence of acute myocardial infarction. *Am. Heart J*. 49 (1955): 9–20.
Tepley, L. R., and K. D. Amundsen. Notes on sub ELF emissions observed during magnetic storms. *J. Geophys. Res*. 69 (1964): 3749-3754.
Toomey, J., and C. Polk. Research on extremely low-frequency propagation with particular emphasis on Schumann resonance and related phenomena. Bedford, England: Air Force Cambridge Research Laboratories, 1970.
Triffet, T., and H. S. Green. Information and energy flow in a simple nervous system. *J. Theor. Biol*. 86 (1980): 3–44.
Tromp, S. W. *Medical Biometeorology*. New York: Elsevier, 1963.
———— . *Psychical Physics*. New York: Elsevier, 1949.
———— . Seasonal and yearly fluctuations in meteorologically induced electromagnetic wave patterns in the atmosphere (period 1956–1968) and their possible biological significance. *Interdiscip. Cycle Res*. 1 (1970): 193–199.
Trullinger, S. E. Where do solitons go from here? In *Solitons and Condensed Matter Physics*, ed. A. R. Bishop and T. Schneider, 338-340. Berlin: Springer-Verlag, 1978.
Tyler, P. E., ed. Biologic effects or nonionizing radiation. *Ann. N.Y. Acad. Sci*. 247 (February 1975).
Uteush, E. V. Research on the psychophysiological peculiarities of the operator. USAF, Foreign Technology Division, Report no. FTD-MT-24-57-1970.
Vaccaro, S. R., and H. S. Green. Ionic processes in excitable membranes. *J. Theor. Biol*. 81 (1979): 771–802.
Valentinuzzi, M. *Magnetobiology*. Downey, Calif.: North American Aviation, 1961.
Von Holst, E. Electrically controlled behavior. *Sci. Am*. 206 (March 1962): 50–59.

Vyalov, A. M., et al. On the problem of the effect of constant and variable magnetic fields on the human organism. In *Occupational Pathology*, ed. A. P. Shisskova, 169–175. Moscow: Ministry of Health, 1964. [Translation available.]
Wachtel, H. et al. Effects of low intensity microwaves on isolated neurons. *Ann. N.Y. Acad. Sci.* 247 (1975): 46–62.
Wade, N. Fischer-Spassky charges: "What did the Russians have in mind?" *Science* 177 1972): 778.
Walcott, C., and R. P. Green. Orientation of homing pigeons altered by a change in the direction of an applied magnetic field. *Science* 184 (1974): 180–182.
Wallach, D. F. H., and P. H. Zahler. Protein conformation in cellular membranes. *Proc. Nat. Acad. Sci.* 56 (1966): 1552–1559.
Waltmann, N. Electrical properties and fine structure of the ampullary canals of Lorenzini. *Acta Physiol. Scand.* 66 (Suppl. 264) (1966): 1–60.
Wang, H. H., and W. R. Adey. Effects of cations and hyaluronidase on cerebral electrical impedance. *Exp. Neurol.* 25 (1969): 70–84.
———— , et al. Calcium, mucopolysaccharides, and cerebral impedance. *Federat. Proc.* 27 (1968): 749. [Abstract.]
Wever, R. Different aspects of the studies of human circadian rhythms under the influence of weak electric fields. In *Chronobiology*, ed. L. E. Scheving, F. Halbert, and J. E. Pauly, 694–699. Tokyo Igako Shoin, 1974.
———— . The effects of electric fields on circadian rhythms in man. *Life Sci. Space Res.* 8 (1970): 177–187.
———— . ELF-effects on human circadian rhythms. In *ELF and VLF Electromagnetic Field Effects*, ed. M. A. Persinger, 101–144. New York: Plenum Press, 1974.
———— . Human circadian rhythms under the influence of weak electric fields and the different aspects of these studies. *Int. J. Biometeorol.* 17 (1973): 227–232.
———— . Influence of electric fields on some parameters of circadian rhythms in man. In *Biochronometry*, ed. M. Menaker, 117–132. Washington, D.C.: National Academy of Sciences, 1971.
———— . Influence of light on human circadian rhythms. Nord. Council Arct. Res. Report 10 (1974): 33–47.
———— . A mathematical model for circadian rhythms. In *Circadian Clocks*, ed. J. Aschoff, 47–63. Amsterdam: North Holland, 1965.
Wieske, C. W. Human sensitivity to electric fields. *Biomedical Sciences Instrumentation: Proceedings of the First National Biomedical Sciences Instrumentation Symposium,* vol. 1, 467–475. Distributed by Plenum Press, New York, 1963.
Williamson, S. J., et al. Evoked neuromagnetic fields of the human brain. *J. Appl. Phys.* 50 (March 1979).
Wortz, E. C., et al. Biophysical aspects of parapsychology. Garrett Airesearch Corp., Document no. 75-11096A, 1975.
———— . Novel biophysical information transfer mechanisms (NBIT). Garrett Airesearch Corp. Document no. 76-13197, Contract no. XG-4208 (54-20) 75S, January 1976.
Zeeman, E. C. Primary and secondary waves in developmental biology. In *Lectures on Mathematics in the Life Sciences,* ed. E. C. Zeeman, 69–101. Providence, RI: American Mathematics Society, 1974.
Zhokov, V. P., and E. I. Indeikin. Relationship between acute attacks of glaucoma and changes in the magnetic field of the earth. *Vestn. Ophthalmol.* 5 (1970): 29–30.

MÉMOIRES

SUR

L'électro-puncture,

CONSIDÉRÉE COMME MOYEN NOUVEAU DE TRAITER EFFICACEMENT

LA GOUTTE, LES RHUMATISMES

ET LES AFFECTIONS NERVEUSES,

ET SUR L'EMPLOI DU

Moxa japonaise en France;

SUIVIS D'UN

Traité de l'Acupuncture et du Moxa,

PRINCIPAUX MOYENS CURATIFS CHEZ LES PEUPLES DE LA CHINE,

DE LA CORÉE ET DU JAPON;

ORNÉS DE FIGURES JAPONAISES.

PAR LE CHEVALIER SARLANDIERE,

DOCTEUR EN MÉDECINE, MEMBRE DE PLUSIEURS ACADÉMIES

ET SOCIÉTÉS SAVANTES.

A PARIS,

CHEZ L'AUTEUR, RUE DE RICHELIEU, N° 60;

ET CHEZ Mlle DELAUNAY, LIBRAIRE,

RUE SAINT-JACQUES, N° 71.

1825.

REPORT ON ELECTRO-PUNCTURE

Jean Baptiste Sarlandière

Translated by Gail Duke

[Acupuncture arrived in Europe with the publication of Willem Ten Rhyne*'s Dissertatio de arthritide mantissa schematica, de acupunctura et orationes tres* (London: Chiswell, 1683) and Engelbert Kaempfer's paper "Curatio colicae per acupunctura japonibus usitata," in *Amoenitatum exoticarum*, Lemgoviae [Lemgo], 1712, pp. 582–589. The Oriental devices and techniques were adapted to the emerging electrical science of the eighteenth century and applied to electrophysiological studies and methods of electrotherapeutical treatment. In fact, an acupuncture fad developed in the early nineteenth century (c. 1810–1830) comparable with the flurry of interest that reoccurred in the West in the early 1970s. Although Europeans did not adopt acupuncture in the form practiced in early China and Japan (putting a needle in the toe to control toothache was simply disregarded as nonsensical), the needles and techniques were used in conjunction with electricity to treat refractory bone breaks, tumors, aortic aneurysm, pain, and a host of other disorders—sometimes with great success. Chief among these successes was the use of electroacupuncture for the amelioration of pain. It is to this medical modality that Sarlandière directs his main attention, laying claim to the method as being of his own invention.

Sarlandière's brief monograph provides a guided tour of the methods and equipment of an early practitioner of medical electricity and the wide range of physical disorders treated by these methods—some of which may merit re-evaluation. —ED.]

ELECTRO–PUNCTURE* or electrical acupuncture differs from acupuncture proper in that the needle does not play the principal role in the operation but rather serves as a conductor of electricity, which, introduced through the skin into the muscle tissue itself, or into fibrous tissue, changes the vitality of these tissues until the very nature of the pain is altered and the irritation ceases. How does this marvel take place? Does it change the mode of irritation, forcing the nerves to feel the pain in a different manner from the one to which they have become accustomed? Does it overcome the sharp and lacerating pain of gout and rheumatism by means of a shock, a convulsion, a stimulus that forces an entire muscle or a whole section of fibrous tissue to contract, so that the irritation is disturbed and finally overcome? I do not wish to stop to discuss these propositions or to offer others that would also have some degree of probability; I shall limit myself to presenting the facts and attempting to examine with care the phenomena I have observed, in order to avoid conjectures and false claims, an infinite source of so many errors in medicine.

So as to enable my readers to judge the importance of electro-puncture, I must briefly consider electricity and acupuncture by themselves, since electro-puncture consists of a combination of these two techniques.

---

*From *electrum*, from which is derived *electricitas*, electricity; and *punctura*, puncture. [The starred footnotes are the author's original notes throughout. Numbered notes are the translator's.]

Mémoires sur 1 électro-puncture, considérée comma moyen nouveau da traiter efficacement la goutte, las rhumatismes et les affections nerveuses, et sur l'emploi du moxa japonais en France ... [by] Le Chevalier [Jean Baptiste] Sarlandière. Paris, chez l'Auteur, 1825.

Simple Electricity

ELECTRICITY, as we know, consists of a fluid that is common to all natural substances. On some of these it can be made to accumulate by means of friction. Glass, resins, and sulphur, for example, when rubbed, have the property of accumulating electricity and transferring it to other bodies that absorb it easily. Through this means, the fluid is transmitted with a speed that we have not yet been able to measure. Thus, pointed metal objects absorb the electrical fluid most easily; it runs through their entire length with the rapidity of lightning and is transmitted to the bodies to which they lead. If these bodies be insulated upon supports made of glass, or by silk cords, or by some other body that does not easily allow electricity to penetrate it, they are apt to receive and retain all the electricity transmitted to them.

Our own bodies may be included among those that easily receive the electrical fluid and readily accumulate it. When they are insulated from the common reservoir (the earth) and are in direct connection with the conductors of an electrical machine, they can become saturated in some way with electricity, to the point where one's hair appears to be on fire and stands on end, which occurrence is referred to as receiving an electrical bath.

If, during this process, the noninsulated operator brings a wooden pointer close to some point on the surface of the insulated person, there is produced between this point and the piece of wood an electrical current, which produces the same sensation as a draft. If, instead of a wooden pointer, a boar's-bristle brush is brought near the body, a great number of these currents are produced, and with them weak sparks, which cause the sensation of pins and needles in that part of the body.

If, instead of these pointed objects of wood or hair, a metal pointer is brought close to that part of the body a distance of 2 centimeters (8 *lignes*[1]) a current will come out of it in the same way; but if it is moved to a distance of 1 centimeter away, a luminous arc (*aigrette*) is produced between this pointer and the skin surface, which gives the sensation of a prick. If a bundle of iron or brass wires is substituted for this pointer, these arcs remain [visible], and the pricking sensations are multiplied.

When, instead of a sharp point of metal, one employs a blunt pointer or a small knob similar to the head of a large pin, a spark leaps from the end and strikes the skin, producing the sensation of having been touched by a glowing ember; but without leaving any mark of a burn: at this point the sensation goes no deeper than the skin surface.

If one uses a metal ball of the same volume as a hazelnut or a walnut in place of a blunt pointer, the sparks emitted are larger and strike the skin with greater force. The shock seems to be transmitted to the underlying muscle fibers. When, instead of placing such balls 2 centimeters away from the part being treated, we place them on a piece of flannel that covers the skin and move them back and forth over a specific area, we have electrification by friction: the patient then notes an uncomfortable heat, a smarting sensation like the one he would feel if he were too close to a large fire; the skin reddens and remains that way for some time.

Finally, if, instead of direct conduction of the electrical fluid collected from the sheet of glass by the points of the conductors to some part of the body, one accumulates this fluid in a Leyden jar, which has been put in contact with a graduator or Lane's electrometer, and then places the insulated person in contact with the internal armature of the jar and also with the external armature, this apparatus, in discharging all the accumulated fluid, causes the two parts of the body upon which [the flow] is directed to feel a jolt or concussion, more or less strong according to the electrometer setting. This shock passes through the skin, acts upon the muscles nearby, and seems to be dissipated in passing along the principal nerve fiber, which sends out branches to these same muscles. The sensation of this shock is most marked as it passes through the joints. When a large number of sparks have been accumulated in the Leyden jar, and it is discharged upon some part of our body, the shock becomes very violent, passes through a greater

distance, is felt in a larger number of muscles, and sometimes seems to shake the spinal marrow and even the brain; tremors lasting several hours, and even several days, have been observed to follow such shocks.

Electrification, by means of the electrical bath, through currents or emanations, by arcs, friction, sparks, and shocks, has been applied to a large number of disorders, sometimes badly administered, sometimes well understood and well directed. It has succeeded principally in relieving painful afflictions of the muscles and fibrous tissues and especially in chronic disorders. It has also been used successfully in treating nervous diseases, whether convulsive, paralytic, or sensitive. It has also been successful in stimulating appetite, in restoring bodily fluids, in reestablishing certain suppressed functions, and in breaking up noninflammatory tumors, such as goiter, scrofula, white tumors, engorgement of the cellular tissue of the glands, etc. It has also been used with good results in treating subinflammatory irritations of the skin, such as eczema (*dartres*) elephantiasis, etc., and even some circumscribed skin inflammations, such as furuncles, etc. Certain of these very long-standing afflictions have yielded to the persistent application of electricity, although they had resisted every other therapeutic technique. However, one must observe that when the cutaneous or cellular tissues are affected, and remain very sensitive to the touch, one must apply the electricity only in the form of a current or at most in the form of arcs. When there is little sensitivity, [as when] the cutaneous affliction is very chronic, one may apply in the form of sparks. Strong sparks and shocks should be reserved for muscu-lar, fibrous, glandular, and nervous disorders. Nervous disorders of the eye and the ear should be treated with great precaution. Nervous diseases of the other senses, and of the muscular system on a small scale, can be treated by sparks graduated according to the chronicity and the morbid tenacity of the disease; in many [other] muscles or in the nerve centers [such diseases] are always treated by means of shocks. Neuralgias, or irritations of the nerve fibers (*tics douloureux*, convulsive tics) should be treated first with sparks and afterwards with shocks.

GENERAL RULE

ONE SHOULD never treat inflammations of a serious nature with electricity, no matter where they are located; but it would be even more dangerous to administer electricity for inflammations of the viscera than for those of the exterior tissues. This is the main reason why electricity has failed (*échoué*) [when used by unskilled practitioners] ignorant of the laws of physiological medicine. This powerful method of stimulation never would have been decried had it not been administered inopportunely. In cases of gout and rheumatism especially, it has had great success when the complications of inflammation have been arrested, and when one is sure that no coincidental irritation of the viscera is present. Paralyses, epilepsy, and the different types of manias have been quite resistant to electricity when these disorders resulted from an organic lesion of the brain or the spinal marrow; when they are merely functional, however, unhoped-for success can be achieved. If this method had not been too often practiced blindly by nonmedical physicists, who equated the vital laws of the body with the behavior of inert objects, and furthermore, if the doctors who used it had been good physiologists, what incontestable benefits would have been derived in order to be convinced of this, it suffices to note that electricity is a powerful stimulant of the nerves and the exterior organs, which may be administered while at the same time one is careful to protect the viscera, by treating them antiphlogistically when one fears they may become over-excited. What a difference between this form of stimulation and that caused by irritants given internally—spirits, diffusibles, tonics—when are efficacious only when they are introduced into the gastric organs! What a difference, I say, in cases where the [viscera] must be protected, while at the same time [it is necessary to] supply energy to the organs that surround them! ...

Simple Acupuncture

ACUPUNCTURE is a technique that has been known and practiced since time immemorial by the Chinese, the inhabitants of Korea, and the Japanese. The marvels that these peoples attribute to this methodology can derive in part, it is true, from the Oriental imagination and from their love for the miraculous, and perhaps it is this which has prevented the nations of Europe from giving it their attention up to now, although this procedure had already been introduced to them by Kaempfer* and Ten Rhyne, and although Dujardin, in France, and Cleyer had been dealing with this subject for a long time. But the persistent attention paid to it by peoples as civilized and learned as the Chinese and the Japanese, [who] used it for many centuries almost to the exclusion of all other therapeutic methods, with the exception of moxa, proves that it must have some significance and that it is worth the attention of practitioners.

The Japanese regard acupuncture and moxa as such superior modalities that they do not hesitate to use them even when all other remedies have failed: nevertheless, they also know how to employ vomitives, purgatives, sudorifics, and blood-lettings—the heroic medicines that we use. … [T]hey so love and exalt acupuncture and moxa that a large number of their physicians neglect any other therapeutic approach, holding only to [those] that they deem positive and essential ... the application of moxa and the practice of acupuncture.

The use of moxa has already been introduced among our European practitioners, and several of them have praised its good effects, although few know the true method of using it.

Acupuncture consists of thrusting a very slender needle through the afflicted parts of the body. These needles are usually made of gold or silver and ordinarily 3 *pouces*[3] in length, not including the handle, itself about 1 *pouce* in length. They are kept in a case which the Japanese call a *santok*.

Formerly, Japanese practitioners of acupuncture used a little mallet to hit the handle of the needle with very light taps until it had reached the desired depth; but they have since given up this practice, which is painful due to the needle's being forced in to some extent, in spite of [any] precautions they may take. Today, when they have determined the site of the operation, they simply place a small tube or pipe against the body surface, holding it perpendicular to the skin, into which they introduce the needle; then with the index finger they lightly tap the protruding end of the handle until [the needle] has gone through the skin. Then they retract the little tube and continue tapping with the tip of the index finger until the needle has reached the desired depth.

Other [acupuncturists] pinch the skin between the index finger and thumb of one hand, while with the other hand they introduce the needle in the manner I have just described; this technique seems preferable to me, for I have noticed that the skin becomes numb when it is compressed, and then, when it is stretched, the instrument enters more easily, and one feels no pain to speak of. Some begin by pushing in the needle while [at the same time] rolling it between index finger and thumb; and this method is still better, in that the instrument enters with only the lightest pressure being required and consequently cannot cause pain. In effect, it penetrates by pushing aside (*écarter*) the fibers rather than by going through them.

One is amazed at the ease with which these needles move; but there is no amazement on the part of surgeons who have been consulted in cases in which these needles have penetrated the flesh and been lost; they know how rapidly these little instruments move. Thousands of needles or pins have been observed as they passed through muscular, cellular, and other tissue. On this subject one can consult the observations reported by M. Silvi (*Mémoires de la Société médicale d'émulation,* 5th year, p. 181)[4] made by M. Villars, professor on the faculty of Strasbourg, who, in 1798, extracted from the skin a large number of needles and pins, which a young woman had swallowed in a fit of delirium; and by Dr. Kérandren,

---

*See Kaempfer, Supplement 3 and 4 of the *Histoire du Japon*.

who saw a woman holding a[n empty?] needle-case in her hand, after having darted the needles forcefully toward her [own] chest, in which they were implanted. Those that could not be pulled out immediately passed under the skin and [moved] in different directions; they were finally perceived in other parts of the skin, after having moved among the soft parts of the body for a time (*Bulletin des sciences médicales*, 1810). General observations of this kind may be found in the *Ephémérides des curieux de la nature*.

The Japanese leave the needle in contact with the afflicted parts for some time; sometimes they thrust it in rapidly and withdraw it in the same way; at other times, having suddenly withdrawn it, they thrust it into the same puncture again and repeat this operation several times, either penetrating to the same depth or thrusting it in a few *lignes* deeper each time . ... When they perform the operation on the abdomen, they follow the movements of [the patient's] respiration by lessening the pressure on the skin at the moment of inspiration and withdrawing the needle slightly at exhalation.

They also direct the needle, either obliquely, laying it flat, in order to go parallel to the teguments to some extent, or perpendicularly, ordinarily preferring the latter method. The depth to which these needles reach is usually from 2 to 20 *lignes*, rarely beyond.

It must not be imagined that the Japanese, who perform this operation with the greatest dexterity, do so without taking ample precautions: they avoid the course of the nerve trunks, arteries, and veins. They never practice acupuncture when the patient has just finished eating, when there is great fatigue, or when the patient has an empty stomach. They also avoid the operation if the patient is perspiring heavily or if he is angry or melancholic.

Physicians in these countries regard acupuncture as an operation requiring the greatest caution, and they believe that the gravest complications can result from this technique when wrongly applied. They bind themselves by oath not to practice themselves until they are experts and until they have received the authorization of those under whose auspices they were trained. This authorization is seldom granted until 5 or 6 years of assiduous application, which is easy to understand in nations having so little anatomical knowledge and in which physiology is enveloped in illusions ceaselessly created by an imagination both superstitious and marvel-loving.

LIKE ELECTRICITY, acupuncture has been used for a wide variety of disorders: the Chinese and Japanese, for example, apply it for everything; but it is well attested that it has been most successful in the treatment of painful and noninflammatory ailments. The pains of rheumatism and gout have been markedly alleviated by this method; violent colics are promptly cured by this operation as if by magic. The Chinese use it to arrest vomiting [and] diarrhea and to cure convulsions, and with it they claim to treat successfully paralysis, hysteria, syncope, and all nervous afflictions

They are not even afraid to use acupuncture to combat inflammatory irritations of the vital organs: cephalitis, gastroenteritis, and pneumonia are all tackled by them as well. But when one observes them closely, one notes that they are not so confident while treating these afflictions, and if they meet with some success, they [tend to] owe it perhaps as much to nature as to the means they are using. There is more certainty of success with their method in [treating] chronic ailments, and especially in [afflictions] of organs lying outside the bony structure. However, it has been proved by experiment that acupuncture acts upon deep afflictions better than does electricity alone, and I can speak of it knowingly, having had occasion to use it rather frequently for more than 9 years. (I shall be mentioning the use I made of it on my cataleptic of Montaigu in 1815. Lest I be accused of plagiarism, see the *Bulletins de la société médicale d'émulation*, 1816.)

Electricity and Acupuncture Combined

Electro-puncture is the new procedure that I use, which has given me much cause to congratulate myself on my successes in treating rheu-

matism, gout, and many nervous disorders, successes I owe to no one, [as] I alone conceived of using this procedure. It has nothing in common with the acupuncture of the Japanese save the use of needles; it is the shock of the electrical fluid flowing through the conducting needle that constitutes my curative method. The point of the needle thrust into the affected tissue is in direct contact with the muscular or fibrous tissue to be influenced, while the handle and the knob at the end are put in contact with the electrical machine. At the moment the electricity is discharged into the knob at the top of the handle, the jolt is transmitted instantaneously to all the branches distributed within the muscle or fibrous tissue into which the point of my needle has penetrated. I am sure that this is so, because the whole muscle contracts at the smallest spark, and the sensation is felt only in the nonmuscular parts, or where contractions are prevented by the fascia that envelop them. If, after having withdrawn my needle, I repeat the experiment, using a metal rod that does not pass through the skin but, in order to reach the muscle fibers directly, is simply put in contact with the skin that the needle went through, the muscular contraction is not reproduced, and nothing is felt but the sensation of the spark striking the skin; in order to effect the contraction of the muscle through the teguments, a large amount of electrical fluid would have to be accumulated by using Lane's electrometer and then the shock would be released not only upon the muscle and in the suffering part—as would be the case where the needle is used—but would also be distributed throughout the surrounding tissues. Furthermore, the sensation would be dull, rather than distinct as when direct needle contact is used. The jolt then acts directly upon the nerve fibers that sense the pain.

DOES THIS NOT seem to unveil a great truth: that the electrical fluid does not pass through our organs when the shock occurs, or when the spark jumps toward the skin surface, but that only the shock or the jolt is transmitted? I would have the reader note that I am not claiming that the electrical fluid itself cannot be introduced into the interior of the body, nor that it cannot pass through the organs; the evidence would be disposed against me. I am speaking here only of the shock caused by the sparks and by all the electrical emanations directed abruptly against the surface of the body. Physicists have already noticed that the electrical fluid runs mainly through the surface of metals, and that hollow conductors with large surfaces transmit more electricity than those which, while having a smaller surface area, have a greater material density. If this is so, it would not be surprising if electricity often had little effect upon the deep afflictions to which it has been applied as a curative agent, and notably [little] effect in paralysis, the cause of which lies in the nerve centers rather than in the organs near the periphery of the body, organs whose nerve fibers are in such cases lacking in vital power to a large extent.

If all the intracutaneous afflictions alleviated by electricity up to now were relieved merely by means of a shock communicated from the exterior [of the body] to the interior, and not because the electrical fluid penetrated and acted directly upon the nerve fibers concerned, is it not obvious, therefore, that one can accomplish even more by effecting a direct contact with the electrical fluid and these same nerve fibers?

As we are no longer living in the century of guesswork in medicine but proceed only from a firm basis in fact, I shall establish my proposition in a solid manner by the following remarks.

I. If one were proposing only that electrical fluid be introduced to cure rheumatic afflictions, gout, and nervous disorders and to break up tumefactions, etc., it would suffice to use the electrical bath, saturating the body with the electrical fluid to attain the desired effect; but experiment has shown that that treatment does not suffice.

II. Having recognized the insufficiency of using the electrical bath, physicians no longer treat these ailments except by means of a jolt [caused by] sparks, or by a current, or sometimes by the sensation

caused by arcs or by friction, etc., but in any case it is always a sensation or a disturbance that they are producing, and not simply the introduction or removal of the electrical fluid. Strictly speaking, it is only when there is a sensation or a vibration that they effect a cure.

III. The question that remains to be examined is this: Does electrical fluid enter into the animal economy by way of the blows (*commotions*) striking our organs, whether in the form of sparks or shocks? To answer this question affirmatively, it would be necessary for these shocks to occur in the tissues only when the excitator is insulated and in contact with the conductors of the machine, that is, when they are conducting the electrical fluid toward the organs; and that, on the contrary, these shocks affect the excitator only when "drawing off" the electricity, that is, when the patient, who is insulated and connected to the machine, is saturated with electrical fluid, while the excitator, connected to the ground, receives the discharge of fluid escaping from the insulated body. Now, we observe that, whether the excitator be transmitting the electrical fluid or drawing it off, the blows always occur: consequently, one may conclude that the blow is not necessary for electricity to be introduced into the body, and yet it is by blows that cures are brought about.

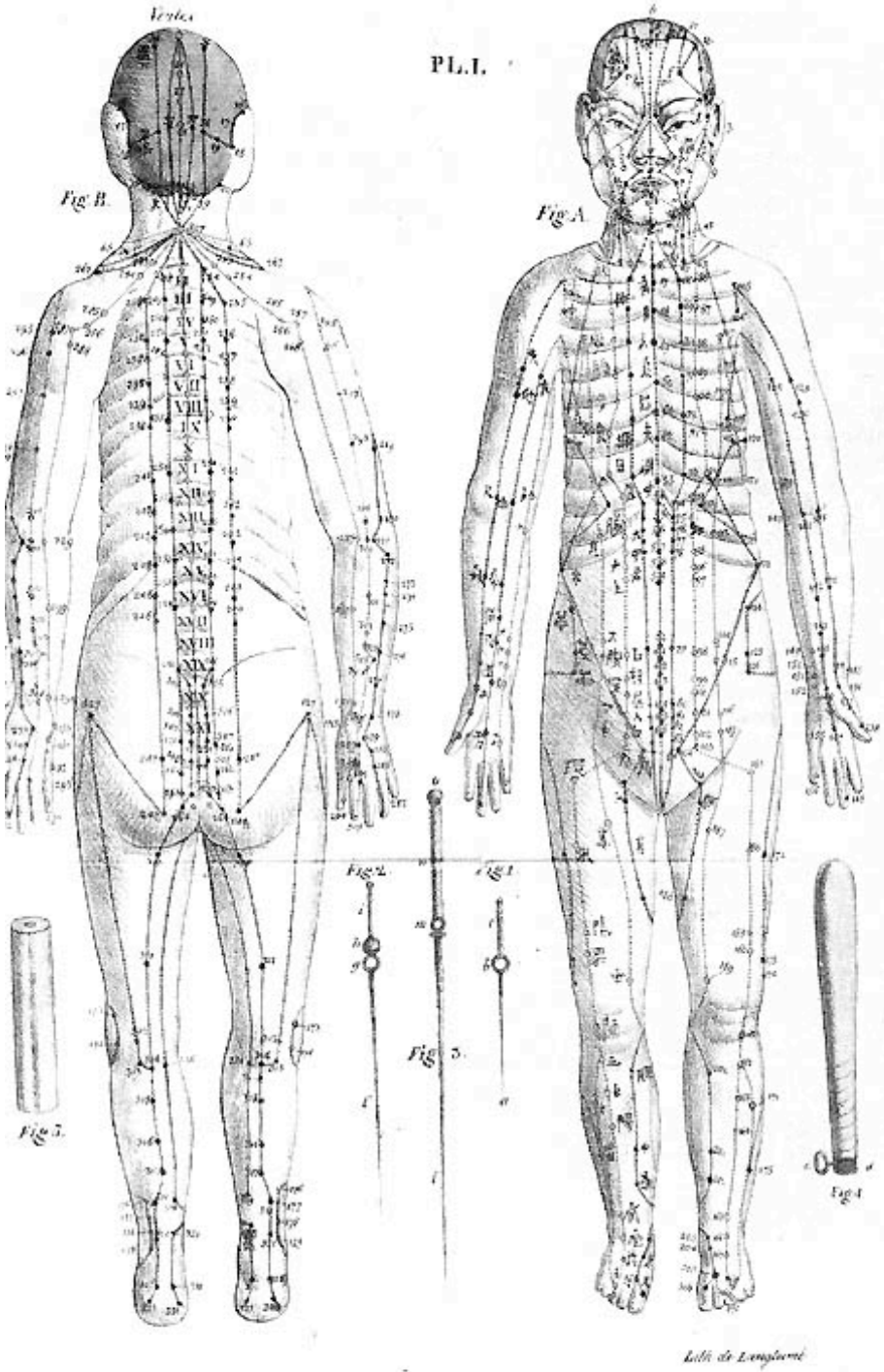
I have expressed myself in this way only to destroy the common belief; now I will express myself more scientifically.

IV. Electricity is neither drawn off nor transmitted by means of sparks or shocks. Vitreous electricity, on the one hand, and resinous electricity, on the other, seek to put themselves in equilibrium, and it is the transmission of one to the other, when the two differently charged bodies begin to come into contact, that causes the burst of sparks and the percussion of the shock. The noise made by the spark[s] is a result of the sudden displacement of the air. The transmission of the one [form of] electricity to the other, acting in contrary directions, hits against surfaces that are approaching one another; and if, instead of an excitator, a non-insulated person brings part of his body close to the body of one who is insulated, both persons receive the shock equally and [both] feel the percussion in the part[s] they were bringing into contact.

V. If one brings the knob of a grounded rod passing through a glass tube close to an insulated person, the shock, at the moment of emission of the two electricities, makes itself felt very weakly in the hand holding the glass tube, and if one pays close attention one can distinctly feel the shock being transmitted to the nerve fibers of the forearm. Yet the hand is insulated from the metal rod by means of the glass tube, and it could not have been penetrated by the electricity: thus it is manifestly the shock alone that is transmitted.

VI. It is not at all necessary that the electrical fluid be introduced and run through the course of a nerve fiber for the shock to be felt and to spread all along its length. Simply touching one of these fibers suffices to produce this effect. As we know, when a sharp blow is given to the elbow just above the cubital nerve, which is close to the surface of the skin, the shock is felt all along this nerve, and even in the branches of it that go into the fingers, and yet no electrical fluid has been introduced there at all.

VII. Finally, electro-puncture, as compared with external electrical shock and with the electrical bath, proves: (1) that a large amount of electrical fluid can be introduced into our bodies with no jolt or shock being produced, but does not suffice to bring about a cure; (2) that shocks normally limited to the cutaneous surface can be transmitted through the skin and sensed by the nerve fibers by means of Lane's electrometer or the Leyden jar, or even by strong sparks, and in [such cases] electricity has been used successfully in the treatment of diseases, but that the cures have worked very slowly; (3) that when electrical fluid flows into our tissues and comes into direct contact with the nerves of the painfully afflicted tissue, it causes a disturbance at the moment of the electrical discharge, a disturbance that spreads through the whole suffering organ; this disturbance, which changes the nature of the pain and is directly felt, is much more advantageously applied to curing gout, rheumatism, and nervous disorders than are shocks transmitted through the skin, and so it is conceivable that



Tsoë-Bosi.

if some advantage were to be gained by introducing the needles alone, infinitely more would be gained by combining with acupuncture the good effects to be obtained from electricity.

THESE REMARKS should suffice to convince the reader of the ascendancy that electrical shock should have over electrification without shocks, and the advantage that immediate and direct shock, applied to the interior of the suffering organs, should have over externally applied shock communicated through the skin. They should also convince him of the advantages that electro-puncture can have over simple acupuncture; therefore, I will not discuss these points any further.

As to the active principle: what does it matter what it is, provided that the desired results are noticed? There is no danger here regarding the nature and mode of action of electricity, it is only a matter of the effects it produces and the benefits one may expect from using it.

I shall also make one observation on the introduction of needles into our organs: It is vain to attribute to them any magnetic virtue by which they operate. For that [to be true] they would have to be made of steel, preferably, and we see that the Japanese, who report so many marvelous things about this method, use exclusively needles made of gold or silver. The galvanic fluid which, it is claimed, is extracted by these needles is the natural result of the contact between a metal and a nerve: physicians know that even the contact between two nerves is enough to produce this effect. Thus, leaving aside what appears to be marvelous in this method, we shall compare it with electro-puncture and we shall establish, first of all, that acupuncture and electricity combined will have a greater effect that either of these techniques alone, and in this experience will not contradict us.

I know of no one [before me] who has thought of introducing electricity directly into the organs. The successes which I knew the Japanese to be having with acupuncture, and my own successes, as well as the advantages I gained by administering electricity, suggested the idea to me: Thus electro-puncture was born, and its results surpassed my expectations.

At the time when I was treating my cataleptic of Montaigu, 9 years ago (1815), I had already thought of combining the administration of electricity with treatment by acupuncture. (See the *Bulletins de la soc. méd. d'émulation*, 1816.) It is certain that if I had had an electrical machine at my disposal in my hospital at that time, the idea of introducing the fluid through needles into the very muscles I was trying to stimulate would have occurred to me. The shocks I would have produced in that way, whose intensity I could have increased without fear in such an individual, would probably have disturbed the nervous system to such an extent that my efforts would promptly been crowned with success, and, instead of futilely prescribing the most powerful stimulants for 7 months, I could perhaps have been repaid in a few hours for all my pains by seeing a favorable response.

My procedure causes scarcely any pain; a very light pricking sensation occurs at the moment the needle goes through the neurovascular part of the skin. I carefully avoid nerve trunks, arteries, and large veins; the twinges of pain that might occur unexpectedly stop as soon as the needle has penetrated to the depth of a few *lignes*.

I use three types of needles. They are made only of gold or silver, like those of the Japanese. The first (see plate, *Fig. 1*) consists of a needle point *(a)* 1 *pouce* in length, very thin, topped by a round eye or ring *(b)* large enough to admit gold wires of various dimensions or a loop of brass wire. At its upper end this eye [or ring] ends in a small cylindrical rod, slightly knobbed *(c),* which is designed to fit into a crystal handle (*Fig.* 4), which has a collar *(d)* through which passes a pressure screw *(e)* for securing the needle. This pressure screw ends in a ring, which permits the attachment of a gold wire or the discharge of the excitator. The section of the crystal handle adjoining the collar is made in the form of a spiral, so as to allow the handle to be rolled easily between the fingers when the needle is being introduced: this handle is made of crystal, by preference, so that in some cases it can be held by a person placed outside the insulated apparatus,

who should not be in contact with either the needle or the patient. These small needles are used when one wants to penetrate to a medium depth, but when it is necessary to go farther, longer needles must be used. In such cases I employ a needle *(Fig. 2)* 2 *pouces* in length *(f)* at the upper end of which, as before, is a ring *(g)* to which a ball may be added at its upper end *(h),* to receive a stronger discharge of sparks, and finally terminating in a cylindrical rod *(i)* designed, like that on the preceding needle, to fit into the collar of the crystal handle *(Fig. 4).* When these needles have been well inserted through the skin and it is desirable to leave them in contact with the tissues for a certain time, one can retract the crystal handle by unscrewing the pressure screw revealing the needle's eye or ring, which can be connected to the machine by means of a brass conductor or a gold wire.

I also use a third sort of needle *(Fig. 3),* especially when I wish to move [it] obliquely under the skin and need to have the needle cover a greater distance. This needle is usually 3 *pouces* in length *(l).* On the upper end of it, as on the others, is a ring *(m)* used for attaching the gold or brass wires, which are then connected to one of the main conductors of the electrical machine: this ring ends in a heavy rod of the same material *(n),* cylindrical, turned in spiral or threaded like a screw, so that it may easily be rolled between the fingers; this rod is 1 *pouce* in length; its upper extremity forms a rather heavy ball *(o),* upon which the fluid is discharged.

WHEN OPERATING on a patient, after ascertaining the nature of his complaint, he is placed on the insulator in a chair the different parts of which can be removed, allowing the areas under treatment to be easily exposed. I then carefully examine the affected part, determining the limits of the complaint and noting the best area to apply the treatment. With the left hand I take hold of the skin at the spot where I have decided to operate, make a fold by pinching it between middle finger and thumb, to facilitate the entrance of my needle, and place on this fold a glass tube of a specified length.* I hold this tube [against the skin] with the index finger of the same hand with which I am pinching the skin, and with the other hand I select the appropriate needle; I thread it into the tube, which serves ãs a guide and, when it reaches the skin, I insert the needle by rolling the handle between my fingers and pressing very lightly. When I judge that the point is through the skin, I carefully let go of the skin fold, keeping the glass tube in place, and then, as the skin is now held against the subjacent muscles or fibrous tissues, I continue to roll the needle and to let it penetrate, pausing from time to time to ask the patient if he feels any pain. When I believe I have penetrated the affected tissue, I stop moving the needle. I ask the patient to hold the glass tube or have it held by a watchful assistant, either directly or by means of a handle cemented to the tube, especially if I do not think the insulation is complete enough; after which I place the needle in contact with one of the conductors of the electrical machine by means of a gold wire, which I thread through the needle's eye or the ring, or by means of a brass wire the thickness of which is calculated according to the amount of electricity I want to accumulate.

The needle having penetrated the affected tissue and, consequently, being in direct contact with the nerves that are giving rise to the pain, while also being in contact with the electrical machine by means of the gold or brass wire attached to one of the conductors, I have the plate [of the machine] set in motion, and the electrical fluid, released into the conductors, is soon transmitted to the needle point. Then I bring

*Note. The glass tubes, being of specified lengths, allow one to estimate the depth the needle has penetrated by that length of the needle still extending beyond the tube; they also serve to keep the needle held in the same direction while one rolls it between the fingers; they keep the needle in place, without one's having to touch it, when one has stopped moving it. The material of which they are made serves to insulate the support and to prevent it from coming in contact with the needle or the affected area. Finally, their transparency enables one to notice whether or not the puncture is bleeding: thus we see that these glass tubes are very useful.

the knob of the excitator in contact with the earth, close to the knob on the upper end of the needle by means of a chain, from which I am insulated by holding the excitator with a tube or sleeve of glass so as not to divide up the sparks (*pour ne pas partager les commotions*). At the instant the spark leaves one knob to move toward the other, the shock is communicated from the needle's point to all the nerves of that part of the body it is touching.

When, instead of an excitator with a knob, I use a pointed excitator, I pass the [electrical] arcs over the knob of the needle, and the patient feels a rather sharp prick in the tissue penetrated by the needle's point. Often these small shocks are deeply felt, shaking the whole part of the body being touched. Large metal balls, discharging onto the needle's button, give rise to very strong shocks, which greatly shake the muscles or fibrous tissues. Lane's electrometer, set to a very weak discharge, causes heavy shocks that are felt far from the site and seem to bore through the organs, especially when one applies one of the excitators to the knob at the end of the needle and the other to the opposite side of the part being touched by the needle. I have not yet dared to experiment in this way with a Leyden jar applied to a needle, fearing the effects of such a strong detonation upon the organs; but it is possible that in cases of paralysis this method could be used to advantage. I do not know to what extent such a shock, communicated from a needle's point to the spinal marrow, would be of use; but I think it would be extremely risky to try it. I have decided to perform such experiments on living animals, not daring to use a human being. I will make known the results I obtain by [repeating] many experiments that I have in mind, which will be undertaken shortly.

In spite of this series of shocks impressed on the interior of the body, and the discomfort that one would assume would be caused by introduction of a needle to any depth, it must be re-emphasized that the operating procedure is scarcely painful at all, and the treatment is so promptly successful that any feelings of pain disappear as soon as a few sparks have been shot from the needle, which when inserted was scarcely felt at all by the patient.*

SOMETIMES ALSO the pain being treated is not displaced by the first introduction of the instrument; in that case, one starts over, firing each time about 30 or 40 sparks or administering 8 or 10 shocks. It is rare to get as far as the fifth or sixth treatment without complete relief of the pain. The needle must remain in contact at least 5 to 10 minutes each time.

There are few methods that act as quickly as electro-puncture in relieving simple afflictions of the nerves and attacks of newly acquired gout or rheumatism. Cases of longer standing call for a little more time; but, if one keeps after the pain relentlessly, one is certain to relieve it in time. When several muscles are involved, they must be treated one after the other.

As I have said, even the lightest discharges upon the needle introduced into the tissues will cause a feeling of vibration all through the suffering part. If this part be a muscle, one can feel and even see the contraction through the skin. Heavy discharges result in a sort of convulsion, and, by being shaken in this way, the ner-vous function of a suffering part is magnified and the pain is relieved.

Today all physicians agree that gout and rheumatism are not caused by a humor that must be forcibly expelled; this belief is relegated to the ignorant. Modern research has taught us what we know on this subject: that irritation of a muscular or nervous tissue, whether it be caused by cold, by gastric excesses, by immoderate exercise of the genital organs, etc., is the sole source [of these disorders]. This irritation, fixed in or moving vaguely about through the muscles or fibrous tissues of the joints, appears to reside especially in the nerves. Every time that inflammation combines with nervous affliction, we see the antiphiogistics—and especially leeches, cataplasms, fomentations, baths, diet, calming agents—succeed, but, when there is no inflamma-

*Note: I will often introduce the needle rapidly and thrust it in all at once rather deeply, without the patient's feeling any real pain.

tion, one is most often successful in displacing the pain only with the help of violent revulsives, such as mustard, frictions, vapors, moxas, vesicants, strong purgatives, the Pradier cataplasm, etc . ... and all the excitants founded on this principle. I have put this question to enlightened practitioners and to disinterested physiologists: how do these methods work? They evidently serve as perturbators; they set up other feelings, other stimulations, which, when communicated to the nervous system of the affected part, act by changing the mode of irritation, [thus] destroying the pain that was contracted. ... But all these methods, violent in themselves, fatigue the patient by an alternation of stimulations and pains; the patient's strength is exhausted by these contending forces; too often the sensitivity of the viscera is heightened, and it is at their expense that [freedom from pain] in the outer parts is obtained. Hence there follow those intense [cases of] gastroenteritis, nervous fevers, delirium, black sickness, and that whole series of symptoms due to affection of the viscera, which is sometimes characterized as "gout mounted to the stomach" or "rheumatism lodged in the chest," names hereafter relegated to the vulgar, and which are avoided by those [devoted to] the art.

BY OFFERING here a new method of combating nervous irritation and doing so directly within the affected tissues, without being obliged to have recourse to that crowd of painful and fatiguing treatments, that long series of physical torments, which buy so dearly such an uncertain cure, I have had only the relief of humanity in view, along with the desire to see spread and propagate a practice that has succeeded so well in my hands. If I have de-layed in making it known up to now, it is because I wanted to have an imposing mass of facts to counter the critics, who are always ready to attack new discoveries with a Pyrrhonism, sometimes envious, sometimes carefully [formulated] (*méticuleux*), or dictated by motives of [selfish] interest, which tend to check the progress of the enlightened. For by destroying with insidious remarks the nascent confidence of the public or of interested parties, [such skepticism] little encourages those who would be disposed to consecrate their energies to the progress of an art that they love above all else. The wea-pon of ridicule, the fear of being charged with charlatanism, is a Medusa head to the doctor who aspires to follow his course with honor: He is petrified [when he must confront] the swarm of journalists, the crowd of writers whose only métier is to tarnish everything they approach.

In justifying my lack of haste, moved as I was by my desire not to advance except where experience led, I also did not wish to be accused of making a secret of my proceedings; and it is this which prompted me to publish this report. It would have gone to press even later had I not known that others were actively engaged in [practicing] acupuncture, and—as I had spoken of my cures and carried them out in the presence of many people—had I not been afraid that others would go ahead of me and appropriate my method, as had already happened to me on other occasions. Happily, in this case, the publication on the Montaigu observations assures me priority; but I really would have preferred to wait longer in order to add to my work all the material that I have gathered since then, which bear witness to the cures I have brought about. Some of these observations are very remarkable and surprising, but none of this material is in order, as I was not expecting to be obliged to write hurriedly about this subject, being unaware that others were working on this (I speak here only of acupuncture), and as I have devoted every moment of leisure to my practice.

Electro-puncture is, in my opinion, the most proper method for treating rheumatism, nervous afflictions, and attacks of gout, when the inflammatory symptoms that sometimes accompany them have been sufficiently subdued, which calls for a well-understood medical approach. One attacks the illness directly and, so to speak, at its root; one changes the mode of being of the very nerves that make the pain felt; one forces the pain to disappear by the power of electrical vibrations, and one *administers shocks* gradually and in relation to the intensity of the pain felt. Since, in this operation, one has at hand an agent whose strength always surpasses that of the nervous activity and over-

comes it, no matter how tenacious it may be, one can always be sure of attaining the desired goal; namely, of changing the defective mode of sensitivity and the faulty mode of action, provided, of course, that no organic lesion exists and provided that there be no inflammation that might cause the shocks to be felt with greater intensity. It is for this reason that it is so urgent to combat any such inflammation before [using the] counterirritant method, undertaking treatment with electric shocks.

Since this report contains no specific observations [on cases] being devoted rather to setting forth the method and discussing its general applications, I shall limit myself here to certain general remarks, deduced from my experience, whose value may easily be estimated, reserving for another report the specific applications and practical proofs.

I. All physicians today agree that the use of antiphlogistics is a method more rapid and sure than any other for efficiently fighting inflammation. When this phenomenon complicates an attack of gout, rheumatism, or some such affliction, one must always turn to the antiphlogistics first of all, and not until the inflammatory symptoms have been subdued should one introduce the more violent method [of treatment with electricity].

II. When no inflammation is present, the electrical method may be used with impunity.* In former times—and even up to the present day—physicians fearlessly applied revulsives and did not hesitate to treat severe pain by inducing pain that was even more agonizing. But their momentary effect is not comparable with the less acute but continuing [effect] felt by the organs in certain disorders.

It may not seem reasonable to combat an irritation by stimulating it; nevertheless, it is a well-known law of our profession that one pain combats another, and that the stronger [sensation] destroys the weaker one: this law was already known to Hippocrates, who included it among his Aphorisms. (*Duobus doloribus simul obortis, non in eodem loco, vehementior obscurat alterum.)*

MOST OF THE therapeutic and hygienic methods employed up to now in treating gout and rheumatism have been based on stimulants, the action of which was noticeably effective on the afflicted part. Thus it was observed that gout only rarely attacks individuals who must be very active, even to the point of fatigue in their joints and muscles; consequently, manual laborers very seldom [suffer from this disease]. For this reason, gouty patients are often told to take exercise. Severe muscle strain and accidental muscular irritations have been seen to cure these fibrous and muscular irritations; men who were tortured were cured of gout permanently. (Fabricii Hildani, *Obs. chir*.,vol. I, p. 87). In other individuals, a forced march stopped an attack of the disease as they were beginning to feel it (Grant, *Traité des fièvres,* vol. II, p. 227).

It is well known that one can obtain relief from rheumatism, and even bring about a cure, by rubbing the afflicted part, stimulating perspiration, and using flannel garments, irritating liniments, vapors, and sulphur baths. All these methods are stimulants principally used externally.

III. Sometimes one also uses internal excitants, sudorifics, tonics, drastic remedies; but this approach is less sure, and if the gastric organs are at all likely to contract the irritation, if the stimulation is too strong, or if the individual is at all sensitive or easily irritated, it can bring about feverish movements and nausea, and all the morbid gastrointestinal sympathies can arise to complicate the external irritation.

*Several times I have taken the risk of treating very slight inflammations by electro-puncture, and I often succeeded in lessening the pain and in reducing the inflammation afterwards; but this success does not keep me from regarding similar attempts as uncertain. I would still advise practitioners to have recourse by preference to the proven use of the antiphlogistics. …

I shall close this report by noting down a few precepts from my practice and observations.

I.

IN TREATING cephalalgia and epigastralgia, I have had the greatest success with electro-puncture applied to the epigastrium. I insert my needle to a depth of 2 or 3 *pouces*, but obliquely, and almost parallel to the skin; [this operation] is repeated in various directions, administering a shock—by sparks or arcs—about 10 to 20 times at each insertion. With this method I have succeeded in getting rid of stubborn stomach pains of long standing, which no medication had been able to alleviate. I have also relieved agonizing, recurrent migraines in this manner; I was obliged to repeat the procedure several times, however, which has not been necessary in treating accidental and nonrecurrent migraines.

Generally, in all disorders of the stomach and the head or of any organ when the stomach may be inflamed, I focus upon the epigastrium. The famous *tyuquan* point of the Chinese is located at that spot, and—according to them and according to all ancient and modern observers—it is the center where the great sympathetics are reflected.

However, I have observed that in head pains, relief is less marked than in cases of pain in other viscera: in that event I am obliged to operate on the nape of the neck; this occurs frequently in ophthalmias.

M. Demours has been successfully using simple acupuncture over a long period of time in diseases of the eye, and—if I remember correctly—he applies it upon the nape.

II.

In treating the fixed type of pain that seems to be piercing the chest, I have obtained successful results by [applying sparks] to the large pectoral muscles, the trapezium, and the long dorsal, in front of the sternum.

III.

In [cases of] asthma, suffocation, choking, difficulty in breathing, and convulsive cough, I have provided relief by operating on the same above-mentioned points and [on] the epigastrium [lit.]. In all such cases, it is best to insert the needle obliquely and to administer shock, by means of sparks, which can be regulated in strength.

IV.

Costal pleurisy, or "stitch in the side," is very effectively treated by inserting the needle perpendicularly to the painful area as far in as the intercostal spaces and there electrifying by arcs or light sparks, using the soft point (*pointe mousse*). Twice in a similar case, I think the needle penetrated as far as the pleura.

V.

For violent colics of whatever type, I insert my needle above and below the navel, more or less perpendicularly, depending on the quantity of fat surrounding the cellular tissue [there]; but I always go in as far as the peritoneum, and often beyond it. I do not penetrate into the intestines, however. In any event, there would probably be no danger if I did so. The Japanese claim thay always penetrate the viscera; I am inclined to believe that they go as far as their muscular membrane.* Rousset, P. Lowe, and Sabatier (*Médecine opér.,* vol. 1, p. 11) have practiced intestinal puncture without the slightest complication.

Once I cured a case of "painter's colic" in this way (i.e., I punctured the navel) as if by magic. The electrical shocks I was administering caused the patient no pain; on the contrary, he felt such a delicious sensation that he begged me to continue forever!

*[The Japanese] generally insert their needles into the belly to a depth of 10 to 15 of their *liqnes*; this is equal to about 20 *lignes* of our *pied de roi.*

Often in the above-mentioned cases, one must carry out the operation at the epigastrium as well as in the region of the navel.

VI.

In treating nephritis, it is necessary to introduce the needle into the lumbar region, through the sacrolumbal muscle, and to penetrate carefully close to the abdominal cavity; at this spot, in a moderately stout person of medium stature, the needle can be inserted to a depth of 2 *pouces*. It must be withdrawn and reinserted several times, producing each time about 20 sparks, before any relief is obtained: one may even have to transmit 4 or 5 shocks with the graduator, letting enough time elapse between each shock for the patient to rest and to prepare him for the next.

VII.

The shooting pains that women feel in the womb, and the heaviness in the loins, the pelvic region, and the thighs during an affliction of the uterus, are very efficiently relieved by applying the needle carefully to each side of the white line through the vertical muscles of the abdomen, at the lower part, being careful to avoid the branches of the epigastric artery and directing each puncture the one toward the other in such a way that, were one using two needles, their points would touch after having penetrated the abdomen.* The needle should be inserted with caution, to a depth measured according to the amount of fat contained in the adipose cells of this region. In a patient of medium height (5 *pieds*) and average weight, the needle may be inserted 10 to 12 *lignes*: the sparks should be restricted at first, and electric shocks should only be introduced gradually, after the operation has been repeated several times, and when the pains are fairly stubborn.

VIII.

FOR RHEUMATIC pains of the head, I insert the needle at a low angle (*à plat*) into the scalp, penetrating into the fibers or the fascia of the occipitofrontal muscle. Then I electrify with arcs, using the wooden points with care so that the shocks may not be felt too strongly; then I use the metal points, and finally the balls. One is rarely obliged to use [stronger] shocks, but, if one does use them, one must insert the needle into the portion of the muscle where the fleshy fibers are.

When rheumatism is attacking the muscles of the neck and trunk, I take fewer precautions; but I still have regard for sensitivity, which is always greater in the muscles near the trachea, the pectorals, and the muscles of the lateral walls of the chest and abdomen. The muscles of the back and of the posterior part of the neck will withstand shocks very well, to whatever degree of intensity they are administered. In the vagus type of rheumatism of the thoracic muscles, the pain is sometimes so acute that the patient experiences great difficulty in breathing and coughing. In such cases, when one inserts the needle into the affected muscles and electrifies by sparks, the patient is able to breathe and cough again after a few shocks, and soon the pain ceases entirely.

The muscles of the limbs are much simpler to have an effect on than are those of the trunk and of the head: they bear shock well. However, since these are the muscles that are more commonly subject to rheumatic afflictions, and can become extremely sensitive, it is prudent to begin treatment by electrification with a tingling sensation. To this end I use an excitator with a wooden point with which I set off a light "puff" of electricity upon the knob of the needle, and if I want to work even more gently I set up this current between my wooden point and the eye or ring of the needle, without touching the knob at the end. I measure out the amount of current very precisely and I use in succession the sharp brass point, the soft point, the knobs, and the balls. The pain

*The Japanese are not afraid of inserting the needle into the uterine organ.

disappears, and—what is even more remarkable—the more acute it is, the more easily it disappears. This, of course, may be explained in the following way: the less painful rheumatisms are the chronic ones, but they are also the most stubborn; the sensation they make one feel is identified more closely with the organ than is the sensation caused by a recent [attack of] rheumatism, which is also more acute. It is in the muscular parts enveloped by tough fascia, like those that cover the *fascia lata*, where the shocks require more careful administration, and when the pain is more lively, because the contraction that takes place as a result of electricity is then very painful—at least at the beginning of the treatment. The rheumatism already called sciatic requires great care.

IX.

Irritations of the fibrous tissues, called fibrous rheumatisms, articular rheumatisms, lumbago, gout, and gouty rheumatism, may be treated as easily as muscular irritations, especially when they are recent, and not complicated by inflammation or affliction of the viscera; but a much greater number of shocks is needed. Often the pain disappears in the tissue penetrated by the point of the needle, which tissue the electricity has modified; but the pain is merely displaced, and is carried extremely rapidly into the surrounding tissues or toward other fibrous parts. In such cases, one must follow it relentlessly. However, in treating very acute irritations in the small joints—those of the big toe, for example—I have displaced the irritations or modified the pain so that I believed that the rest of the sensation would disappear after the procedure; but, some time later, the pain reappeared with the same intensity. And when I happened to be dealing with a patient who was easily discouraged and did not want to submit to any more treatments, the pain would be relieved the next day or 2 days after the electro-puncture and then grew every day more bearable; but when I was dealing with a courageous and perseverant soul, I began the treatment over again, carefully following the pain wherever it reappeared, and my efforts were crowned with complete success. I have some reason to believe that the irritations that appear to be so intractable are also less disposed to reappear when they are fought with determination and traced to their source: this seems to be a compensation for the pains one has taken and the suffering the patient must undergo to endure this constantly renewed combat against intolerable pain.

X.

LUMBAGOS, the vague sort of pain one feels between the shoulders as as a result of great fatigue, and most non-periodic articular joint pains, when attacked with electro-puncture, cease very easily and do not recur.

XI.

I have also used electro-puncture to treat pain caused by sprains and contusions (when there is no abrasion or open wound), and they have disappeared in a few seconds. If afterward I had the affected part plunged into very cold water, all the complications that could have followed were aborted or rapidly diminished.

XII.

I have not had the chance to use this method in treating intermittent fevers; but I presume that if one applied it a few seconds before the onset, one would weaken the attack, and perhaps it could be prevented altogether. The treatment would have to be repeated at each attack in case the first treatment did not bring about any change. I think that the operation should be carried out at the epigastrium.

*In my experiments, I believe that I have several times reached nerve fibers of rather considerable size; the force of the contraction caused by very weak sparks has shown me this, and, despite my expectation, no complications resulted.

In some of the afflictions mentioned above, I have been able to compare the effects of simple acupuncture with those of electro-puncture, and I have no hesitation in according preeminence to the latter method. I have not been able to include in this report the comparative experiments I have made on this subject, but I reserve the right to make them known as soon as I shall have completed the work at hand.

TRANSLATOR'S NOTES

1. In old French system of measurement, l *ligne* = 1/12 *pouce*, or about 1/12 inch.

2. A corruption of the Japanese *mogusa*, an escharotic made from the plant *yomogi*. In medicine, the soft woolly mass prepared from the young leaves of a Chinese wormwood (*Artemisia moxa*) and its use as a cautery by burning it on the skin.

3. 1 *pouce* = about 1 inch.

4. This and the other citations in the body of the text are simply translations of Sarlandière's citations.

5. 1 *pied de roi* = 12 *pouces*, or about 1 foot.

TRANSLATOR'S ACKNOWLEDGMENTS

Grateful thanks to PETER ROBINSON, Professor of French at the University of Minnesota for reviewing and commenting on the manuscript; and to DENNIS STILLINGS, for his help in translating early French medical and technical terms. Thanks to the Bakken Library of Electricity in Life, for access to the original text.

LETTER TO THE EDITOR

To the Editor:

Re Eisenbud's paper on squiggles—"Visions, Old and New: An Addendum …" (*ARCHAEUS* 3 [1985])—this rang some bells for me. In the late 40s and early 50s, when I was working on my postgrad thesis, I was on a team investigating present-life (as opposed to past-life) regression therapy. We noted that in regressing subjects to the birth experience, we often overshot and got subjective reports of *preconception* activity—admittedly of questionable validity but with a common behavioral pattern: subjects wriggled eellike, heels together, arms pressed together against sides, inching upward until their heads pressed hard, even painfully, into pillow or wall. They reported visualizing themselves as spermatozoa attracted upward with desperate urgency.

In fact, I went through this area myself while being regressed and can empathize with the motions and emotions I've seen in others.

In one case, which I recall vividly, an unusually bright 3-year-old boy who lacked the vocabulary to describe his experience under these conditions was asked to draw what he thought he looked like: he made a remarkably accurate picture of a whip-tailed spermatozoon, even including a smudgy little flange (capellum) at the juncture of the body and the tail (flagellum). The team was split on the issue of whether this surprising drawing represented an actual spermatozoon or his conceptualization of a seed, based on observing thistledown or something similar; his verbalization of his conception involved "Daddy pushing a seed into Mommy."

For what it's worth, the vermiform squiggles in Eisenbud's Fig. 4 (p. 11), Fig. 5 (p. 12), and Fig. 8 (p. 13) all closely resemble spermatozoa. Fig. 7 (p. 13) may do so as well. Crescentia Hoess' representation of multiple tails in Fig. 5 could be interpreted as a sort of time-lapse visualization of a moving flagellum. This suggests the (bare) possibility that people in the introspective-meditative state of consciousness required to produce such representations may in fact be drawing upon some extremely primitive preconceptual imprints, and that the headless or semihooked squiggles may suggest single or multiple competing spermatozoa to individuals who have no mental image of what they actually look like.

—Charlie Wallach

Editor's Note: Well, Charlie, it looks as though you have drawn our attention to a physiological correlate to the ancient idea of the *logos spermatikos*. In my "Addendum to Jule Eisenbud's "Paranormal Film Forms and Paleolithic Rock Engravings" (*ARCHAEUS* 2 [1984]), I draw the connections between meanders, writing, and the *logos* as represented through the operations of the Holy Spirit. The image of the *logos spermatikos* first formulated by the Stoics, made reference to the formative powers of nature. According to Marcus Aurelius, this term meant certain germs of future existences, endowed with productive capacities of realization, change, and phenomenal succession." So "the Word made flesh"—and, may we add, the flesh made word—creates its images in several media.

NOTES ON CONTRIBUTORS

EARL E. BAKKEN cofounded Medtronic, Inc. He served as the company's Chief Executive Officer and Chairman of the Board from 1957 until 1976; he is currently Senior Chairman of the Board. Earl Bakken developed the first wearable, external, battery-powered cardiac pacemaker in 1958 for Dr. C. Walton Lillehei. Among many engineering awards received by Earl Bakken is included one from the National Society of Professional Engineers, recognizing the cardiac pacemaker as one of the ten most outstanding engineering achievements of the last 50 years. During the 1970s, Earl Bakken created the Bakken Library of Electricity in Life, an institution containing perhaps the finest collection of historical publications and artifacts documenting the history of bioelectricity and biomagnetism. More recently, he has turned his support to Archaeus Project and the investigation of new approaches to medicine with a view toward solving current and developing problems in health care delivery.

ROBERT C. BECK, D.Sc., is widely known for his instrumentation of altered states, his development of state-of-the-art medical electrical stimulators, and his investigation of Tesla electromagnetics. Bob is a consultant to Sondia Corporation and Senior Staff Scientist at Eyring Research Institute, and he has been a consultant to the USN Office of Surface Weaponry on the subject of ELF detection. He has designed and built extremely sensitive magnetometers for the Navy. Bob Beck is founder and president of Mon-itor Electronics Research Corporation and Alpha-Metrics Company (1969–), a firm manufacturing ethical biofeedback equipment. Bob owns the basic patents on low-voltage electronic flash and several patents involving electro-optical systems. He is currently investigating psychophysiology and electro-medical modalities.

ELDON A. BYRD, Ph.D., Medicine, National Institutes of Health, is a physical scientist and research electrical engineer at the Naval Surface Weapons Center, Silver Spring, Md. Dr. Byrd is an authority on the physics of unexplained phenomena, biological aspects of plant response to various stimuli, including paranormal phenomenological response, and the interaction of nonlinear fields with biological processes.

JACK HOUCK, M.S.in Aeronautical and Astronautical Engineering (University of Michigan), has worked as a systems engineer for a southern California aerospace company since 1961. Jack pioneered the technique of psychokinetic metal-bending, and he developed a conceptual model of paranormal phenomena (*ARCHAEUS* 1 [19831), which has had considerable influence on practical parapsychologists, particularly on the West Coast. Jack Houck also developed the format for the PK party, where "ordinary people" can personally experience psychic metal-bending. Jack will be conducting the 161st such party in January 1987; so far 7000 people have attended PK parties. Jack is also conducting a study on remote viewing.

OLIVER NICHELSON, B.A. in Philosophy (Kalamazoo College) and M.Div. (Harvard University), is a writer and consultant on the history of scientific theories. Oliver Nichelson is a well-known specialist on the history of Nikola Tesla's work and relevant historical scientific theorizing. He has presented briefings on Tesla technology to members of the Canadian Prime Minister's Cabinet, the US Office of Technology Assessment, the US Congressional Science and Technology Committee, and selected members of the US Congress. He has also acted as consultant on a number of projects involving the actual use of Tesla technology for purposes of energy transmission.

KAREN N. OLNESS, M.D., F.A.A.P., is Director of Research, Minneapolis Children's Medical Center. She is also Associate Professor of Pediatrics and Associate Professor of Family Practice and Community Health, University of Minnesota. Karen Olness focuses her research on psychophysiology with em-phasis on the ability of children to control autonomic responses and on the mechanisms of pain control. The Children's Medical Center division of Special Projects recently received a $50,000 grant from Archaeus Project (with matching funds from Surdna Foundation) for the purpose of investigating cyberphysiological behavior in chidren. Karen is on the Board of Directors of Archaeus Project.

DENNIS STILLINGS graduated from the University of Minnesota in Philosophy and Mathematics. While doing graduate studies in German Literature and teaching Humanities and Beginning German at the University of Minnesota, he began work as technical library researcher and translator for Medtronic, Inc. In the early 1970s, he created the Historical Department at Medtronic and began to collect and write about those materials now composing the collections of the Bakken Library of Electricity in Life, for which he served as Director from 1975 to 1980. In 1982, he organized and began to serve as Director of Archaeus Project, a group of professional people interested in the investigation of unusual claims and anomalies for potential use in medicine and technology.

ARCHAEUS