



Effects of 6-10 Hz ELF on Brain Waves ^[32]

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There is evidence that ELF magnetic waves can affect brain waves. This set of experiments was designed to study the effects of ELF rotating magnetic fields on the brain.

The specific ELF frequencies I was interested in studying are 6-10 Hertz. These frequencies are the same as those produced by the human brain in the theta and alpha states. Generally, specific brain wave frequency ranges can be associated with mood or thought patterns. Frequencies below 8 Hertz are considered theta waves. While these seem to be some of the least understood frequencies, they also seem to be associated with creative, insightful thought. When an artist or scientist has the "aha" experience, there's a good chance he or she is in theta. Alpha frequencies are from 8 to 12 Hertz and are commonly associated with relaxed, meditative states. Most people are in an alpha state during the short time immediately before they fall asleep. Alpha waves are strongest during that twilight state when we're half asleep and half awake. Beta frequencies (above 12 Hertz) coincide with our most "awake" analytical thinking. If you are solving a math problem, your brain is working at beta frequencies. Most of our waking hours as adults are spent in the beta state.

A question of importance is: "If we can electronically shift the brain wave frequencies to alpha or theta, will a person's moods or thought patterns change to those commonly associated with those frequencies?" In other words, if we can electronically move a person's brain waves to the alpha frequencies, will they become more relaxed? Will their state of consciousness change to coincide with their brain waves, even if those brain waves were electronically induced? These are important questions with far reaching implications.

When I began these experiments, I was well aware of the possible ethical implications involved in ELF research. For example, if I were carrying an ELF transmitter operating at alpha frequencies, would the people around me be affected as well? Would they unconsciously gravitate toward me because they'd become more relaxed as they moved closer to me? Would they like me more because they felt "good" when they were around me? What if a salesman were carrying an ELF transmitter? Would people be influenced to buy something because they were more relaxed around the salesman? Could entire populations be influenced to be comfortable with ideas they would normally reject? These, and many others, are serious ethical considerations involved with ELF research. They cannot be taken lightly.

I decided to undertake this research with full knowledge of the ethical implications. While there is the potential for misuse, a desire for knowledge and understanding are part of being human, and the potential benefits to humanity are great. What if we could treat depression, insomnia, anxiety, stress and tension with ELF magnetic fields? What if we could increase intelligence or improve learning? As in any scientific endeavor, there are both positive and negative potential uses for any discovery. One only need look at the development of atomic energy to understand the benefits/misuse dichotomy. It is my personal belief that the potential benefits to humanity justify the research.

I began by collecting all the available research on ELF fields. Lana Harris, a secondary research specialist, did an excellent job in acquiring virtually all the available research in this area. In addition to a multitude of published journal articles, several military and NASA research reports were ordered. A review of the research showed that most studies had been

performed to determine the effects of 50-60 Hertz high voltage power-line fields. Since these are the frequencies of most of the world's electrical power distribution systems, the importance of understanding the effects on plant and animal life are evident. To a much lesser degree, a few researchers had concentrated on lower power and lower frequencies (the focus of this study).

EQUIPMENT

The equipment required for this research was easily attainable, with the notable exception of a stable frequency counter with .01 Hertz resolution. Accurate frequency measurements were essential for this research, so I designed and built a digital frequency counter capable of measuring frequency to the hundredth of a Hertz (plus or minus .005 Hertz). A 100 KHz crystal Colpitt's oscillator (calibrated with WWV) was used as a time base and divided by ten to the seventh power to attain the desired resolution.

Other equipment used is: a Biosone II Brainwave Monitor and Myosone 404 EMG Monitor (Bio-Logic Devices, Inc., 81 Plymouth Rd., Plainview, NY 11803); a Model 3011 Digital Display Function Generator (BK Precision Dynascan Corp., 6460 West Cortland St., Chicago, IL 60635); and IBM PC compatible computer with a clock speed of 7.16 MHz (the faster the clock speed the better); a SAC-12 A to D signal acquisition board (Qua Tech, Inc., 478 E. Exchange St., Akron, OH 44308); a Cudas II video board and software release 3 (Dataq Instruments, Inc., 825 Sweitzer Ave., Akron OH 44311); a Fluke 77 digital multimeter (John Fluke Mfg. Co., Inc., PO Box C9090, Everett, WA 98260); and StatPac Gold statistical analysis software (Walonick Associates, Inc., 6500 Nicollet Ave. S., Minneapolis, MN 55423).

The transducer was a 24" diameter hand-wound coil, consisting of 1000' of #25 magnetic wire. The coil had a DC resistance of 32.4 ohms. It was mounted on a 26" square piece of Bakelite board for stability. Two dowels were mounted with plastic ties onto the board so they extended 24" from opposite sides of the board and the entire apparatus was secured by two microphone stands.

EXPERIMENTAL DESIGN

All twenty-two subjects were friends or acquaintances of the author. There was no remuneration to participants. The excitement or novelty of participating in a brain wave research experiment seemed to provide sufficient reward in and of itself.

Subjects were sent a pre-experiment letter briefly describing the intent of the experiment and what they could expect. They were asked not to use any drugs or alcohol for 24 hours before their appointment, and not to wear any metal jewelry. (It was thought that metal jewelry might distort the magnetic field, thus creating uncontrolled inconsistencies between subjects.)

Upon arrival at the laboratory, participants were given a short orientation to the procedure and any questions they had were answered. They were hooked up to the EEG monitor (frontal to occipital, midline) and then allowed to listen to a relaxation tape for five minutes. The purpose of the relaxation tape was to establish a "relaxation level" baseline and to relieve some of the anxiety associated with the experiment. At the end of five minutes, the headphones were removed and the subject was told they were at a relaxation level of 5 on a scale from zero to ten (0 being very tense and 10 being very relaxed). This was the baseline they were to use for reporting their relaxation level following each ELF exposure. Subjects were told that they could choose to stop the experiment at any time.

Each ELF exposure consisted of a ten second, sine-wave transmission separated from one another by 45 - 60 seconds of no exposure. The voltage fed to the coil was 3.1 VAC (RMS).

The coil was positioned 18" in front of the subjects head. The outputs from the ELF transmitter (function generator) and the brain wave monitor were fed directly into the computer A to D board, allowing both to be displayed on the computer monitor (and recorded on disk) simultaneously. The sampling rate of the A to D converter was set at 2000 samples per second for the entire experiment. This was sufficient to visually detect differences of .1 Hertz between the ELF and brain wave frequencies. Subjects were not told

when a transmission was beginning. However, at the end of each transmission, they were asked to "report". This was their current relaxation level based on the zero to ten scale. They also reported any feelings they had experienced and these were recorded verbatim.

Twenty-one frequencies were presented to each subject (from 6 to 10 Hertz in increments of .2 Hertz. For half the subjects, these frequencies were randomly selected. For the other subjects, they began at 10 Hertz and were decreased by .2 Hertz with each transmission. Subjects were not told the order of frequencies that would be presented to them.

Post acquisition software was used to visually examine the coherence (frequencies) and synchronously (phase relationship) between the transmitted ELF and prominent brain waves.

RESULTS

Examination of the computer data revealed substantial differences between subjects. Some subjects showed lock-on (entrainment) over a wide frequency range, while other subjects showed no lock-on whatsoever. In general, lock-on occurred most frequently from 8.6 to 10 Hertz and less frequently below 8.6 Hertz.

One subject displayed lock-on for all frequencies from 7.4 to 10 Hertz. Two subjects displayed no lock-on over the entire frequency range. While I did not test a sufficient number of subjects to be statistically significant, I suspect that susceptibility to ELF entrainment follows the normal (bell-shaped) curve. At this time, I do not have any hypothesis that would allow us to predict who is susceptible and who is not.

Several interesting observations were readily apparent. Lock-on generally occurred very rapidly . . . within a quarter of a second in most cases. If lock-on did not occur at a specific frequency in the first second, it didn't at all. When the brain did lock on, the amplitude of the brain waves increased to nearly double their normal size. This is typical for naturally (non-ELF) produced alpha patterns. The brain locked on to higher frequencies (9-10

Hertz) more readily, and maintained the lock-on for the entire duration of the transmission. As the frequency was lowered (below 8.6 Hertz), lock-on for most subjects occurred in bursts, rather than being continuous. For example, there might be immediate lock-on for two seconds; then the brain would "fight" the ELF frequency for a quarter of a second, and then lock-on again for another few seconds, etc.. I use the word "fight" because it looked like the brain was fighting the ELF to maintain its own frequency. The "fight" was characterized by low amplitude beta frequencies in the 15-20 Hertz range. These may, of course, have simply been analytical type thoughts, but they were not observed when the frequency was in the 9-10 Hertz range. This "fight" became more frequent as the frequency was lowered, until no lock-on was observed at all.

None of the subjects were able to consciously detect the presence of the ELF field. One female subject was able to detect whenever the field started or ended, but could not accurately say when if it was on or off at any given time. In other words, she was able to detect the change in the magnetic field, but not the presence or absence of the magnetic field itself. She thought she felt it because it aggravated her sinuses. When lock-on occurred, the brain waves lagged behind the transmitted ELF. This appeared to have been the "reaction time" of the brain to the ELF waves (approximately 60-80 milliseconds). More accurate experimentation is needed to explore this relationship.

Subjects verbatim reports were quite revealing. (Keep in mind that none of the subjects actually said they felt the ELFs.) The most common verbatim reports occurred between 8.6 and 9.6 Hertz. Common statements were subtle "tingling" sensations in the fingers, arms, legs, teeth, and roof of the mouth. Two subjects reported a "metallic" feeling in their mouth. One subject reported a "tightness" in the chest and another subject reported a "tightness" in the stomach. Several subjects also reported sensations when the ELF frequency was between 6 and 7 Hertz. The verbatim responses in this range were "ringing" in the ears, "flushed" face, "fatigued", "tightening" in the chest and "increasing" pulse.

Lock-on occurred at lower frequencies more often when the transmitted frequencies were progressively lowered, rather than randomly presented. It would seem that the brain prefers a gradual lowering of frequency rather than a sudden or abrupt change in frequency. This may have been due to the extremely short duration of each transmission (10 seconds). It may be that this effect would disappear if longer transmission times were used.

There was no significant correlation between subjects reported level of relaxation and the ELF frequency or the occurrence of lock-on. Again, this may have been due to the extremely short duration of each transmission.

Summary

It is clear from these experiments that brain waves do in fact lock on to artificially produced ELFs in the 6 - 10 Hertz range. It is equally clear that the 10 second transmission was not sufficient to alter subjects moods to any consistent degree.

Additional Observations

Since my original experiment, I have continued to study the interaction of ELF's and brain waves. These mini-experiments were conducted more informally than my original experiment and the observations are based on only one or two subjects. They should be considered only observations until confirmed by additional study.

- 1.** A sine wave produces lock-on more readily than a square wave or a triangle wave. A sine wave output produces a rotating magnetic field where there is a gradual build up, collapse and reversal of the field intensity. A square wave output produces a pulsed alternating magnetic field where the build-up, collapse and reversal of the magnetic field is more abrupt.

- 2.** The brain is sensitive to a wide range of intensities. I have observed lock-on with power settings down to one half of a milliwatt.

3. Psychics and "sensitives" are neither more or less prone to lock-on than anyone else. I have tested two well-known psychics and a Kahuna from Hawaii. While all three subjects produced more alpha than usual, it was not related to the ELF generator and they did not show unusual lock-on. It is interesting to note, that the woman who could "feel" when the field switched off and on (in my first experiment) was one of these psychics.

4. Extended exposure to ELF's does alter moods, but the effect is subtle. I was not able to duplicate the "dramatic psychoactive" effect that Robert Beck has reported. Low frequencies (below 8 Hz) seem to produce a general agitation or uneasiness, while higher frequencies (8.6-10 Hz) produce a general feeling of relaxation. These are not profound effects like drug induced mood changes. The subject is not aware of any change in his consciousness or mood. From his perspective, nothing has changed. However, an outside observer can detect subtle changes (e.g. body movement). I have confirmed this by monitoring muscle activity with an EMG monitor.

5. I have exposed myself to ELFs for one and two hour durations and have found that the frequencies from 8.6 to 9.8 Hertz to be sleep inducing; however, it is impossible to eliminate the placebo effect from experiments I performed on myself.

6. I built and distributed several portable ELF generators for testing. I have received many reports that indicate that falling asleep with the ELF generator operating is probably not a good idea. People don't feel rested when they sleep with the ELF generator on. My personal experience supports this. ELF's may inhibit dreaming which is necessary for normal brain functioning.

7. I have found three definite beneficial uses for the ELF generator: a) for relaxation, b) to eliminate jet lag, and c) the elimination of seizures in a dog.

THE STORY OF MAYNOOTH

Shortly after completing my first experiments, my neighbor's dog began to have seizures. Maynooth was a one year old, 190 pound Irish Wolfhound. His seizures were occurring four to five times a week. A seizure by a 190 pound dog is not a small affair. He would trash around wildly with no awareness of his surroundings. The seizures would last 10-30 minutes. My neighbors took Maynooth to the vet, who prescribed phenobarbital to control the seizures. The drug was not effective and Maynooth continued to have regular seizures.

After discussing Maynooth's condition with my neighbor, we decided to try a portable ELF generator that Maynooth could wear to control his seizures. Seizures are accompanied by wild fluctuations in brain wave activity. We hypothesized that a portable ELF generator could control the seizures by stabilizing Maynooth's brain waves. If we could get Maynooth's brain to lock-on to an ELF frequency, we could in effect, eliminate the seizures.

I constructed a portable ELF generator about the size of a pack of cigarettes. The ELF generator was powered by a nine volt battery and had two frequencies, selectable by a toggle switch (10.0 Hz and 7.83 Hz). The 10 Hz frequency was chosen because previous experiments had shown that lock-on was more likely to occur at higher frequencies (i.e., closer to the prominent frequency of the brain). The 7.83 Hz frequency was chosen because it is the resonant frequency of the Earth and naturally occurring low intensity magnetic radiation can be detected at this frequency (Schumann, 1952).

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The schematic for the portable ELF generator is illustrated. It is a twin-T oscillator followed by a high power 386 amplifier. The twin-T was chosen because of its high stability and low distortion sign wave. Construction is straight forward and the placement of parts is not critical. All parts are readily available. The two 10K frequency adjustment pots should be 10-20 turn trim pots to allow precise frequency adjustment. The 10K output level adjustment pot should be set so that the output feeding the coil is less than 100 milliwatts to comply with FCC regulations (I set Maynooth's to 10 milliwatts). The coil itself is not critical and can be wound on any iron core. Use only an alkaline or nickel-cadmium battery.

Maynooth began wearing the generator in the spring of 1988. We tried the 10 Hz frequency first. The results of the experiment were astounding to say the least. Maynooth's seizures stopped immediately when he began wearing the generator. Furthermore, Maynooth was able to completely stop taking the phenobarbital and the seizures have remained in remission. For the first three months, Maynooth wore the generator all the time in a cloth pouch from his collar. After that, the generator was only used at night and simply placed near his sleeping area.

Maynooth has had a total of three seizures following his first use of the generator. Two of these could be traced to malfunctions with the generator. The first was a broken wire from the battery connector and the second was a dead battery. The third seizure could not be explained by a hardware malfunction, although Maynooth was only using the generator during the night and the seizure occurred during the day. It should be noted, however, that this seizure was mild in comparison to his prior episodes.

Maynooth's owners were so convinced of the efficacy of the ELF generator, that they asked me to make a spare generator in case the one they had broke. Maynooth's vet (at the University of Minnesota) showed curiosity in the generator, but not enough to explore it further. They preferred to remain with a drug treatment, even though it had proven to be ineffective. Fortunately, Maynooth's owners had more sense.

Maynooth still uses the ELF generator in his sleeping area at night. The rechargeable battery is charged during the day so it is fresh each night. (The battery lasts about 6-8 hours at a 10 milliwatt power setting).

Andrija Puharich's Watch

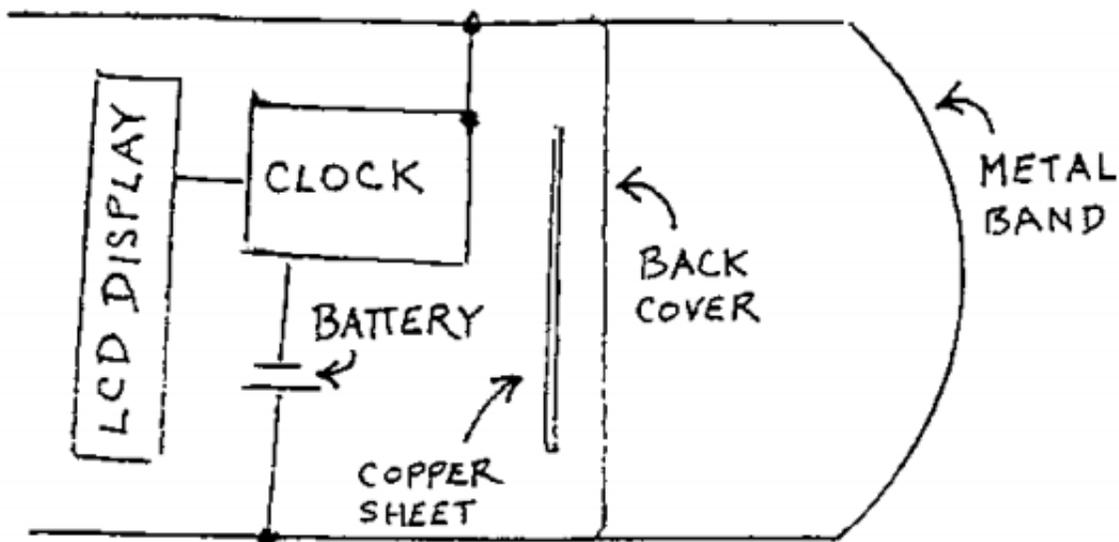
Dr. Andrija Puharich sells a watch that he claims will work a shield for ambient high frequency ELF's (40-100 Hz). An important feature of this watch would include shielding from 60 Hz power lines. I had the opportunity to try one of his watches for a few days. The owner was quite reluctant to part with it so I had to run all tests over just one weekend.

It is quite easy to monitor ambient 60 Hz radiation being absorbed by your body. Simply touch the probe of any oscilloscope and you can watch the 60 Hz wave. Your body is acting as an antenna and the amplitude on the oscilloscope is an indication of the amount of radiation you're absorbing. I found no difference in the amplitude when I was wearing the watch or when it was removed by a distance of four miles.

I attempted to determine if there was any measurable magnetic output from the watch. I used a large roll of magnetic wire as a pickup coil and connected it to the input of an EEG monitor with five microvolt sensitivity. The EEG voltage was fed directly to the A to D board of the computer. The equipment was tested for proper functioning by bringing a magnet in proximity to the pickup coil. A weak magnet moving within six inches of the pickup coil would drive the EEG monitor into saturation. The watch was placed against the coil but I could not pick up any magnetic fields from the watch. This surprised me because I was using very sensitive equipment and the watch had to be producing a magnetic field because it was using a battery. Anytime there is a current flowing (even the small current required to power a watch), there is always a magnetic field created. Either the watch was cancelling its own magnetic field or my equipment was not sensitive enough to measure it. (It turned out to be the latter).

The final test was to hook myself up to the EEG monitor while I was wearing the watch. The output was fed into the computer so that I could do posthoc analysis. I wore the watch for 15 minutes and recorded my brain waves. The incidence of beta and alpha frequencies was not different from my "usual" brain waves. I could not substantiate Puharich's claim that the watch would act as a filter with a center frequency of 10 Hz. This particular finding may not be accurate because my excitement with the experiment may have inhibited the alpha centering that Puharich refers to.

Since I had told the person I borrowed it from that I'd take good care of the watch, that precluded the idea of disassembling it. I carried the watch with me in my backpack that weekend. As luck would have it, the back cover of the watch fell off and I got to examine the inside.



(Andrija Puharich Watch diagram.png)

It is a digital "over-the-counter" type watch. As far as I could tell, the watch was normal in every way except that there was a square sheet of copper (about 1 cm square), wrapped in plastic packing tape inside the back cover. The tape was obviously used to insulate the copper from the electronics of the watch and the back cover.

With the copper removed, my equipment could still not detect the magnetic fluctuations produced by the watch. If the copper sheet does do anything, my equipment was not sensitive enough to measure it. This indicates that the amplitude of the magnetic field produced by the watch was very low, probably around the amplitude of the naturally occurring magnetic fluctuations of the earth.

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I do not know whether Puharich's watch works. It did not reduce the electromagnetic radiation that my body was absorbing, nor did it alter my brain wave pattern in any way I could detect. My current understanding of ELF's, electronics and magnetics does not provide a theoretical foundation for the efficacy of the watch.

Electromagnetic Pollution

When I began my research, I was only interested in the effects of ELF's on brain waves. I have since come to believe that ELF's are only the tip of the iceberg. Electromagnetic radiation may be the most harmful pollutant in our society. There is mounting statistical evidence that cancer and other diseases can be triggered by electromagnetic waves.

ELF pulse-modulated radio waves work at the cellular level. Cancer and birth defects have been increasing in this country since about 1950 (as television became popular). The average resonant frequency of the body is around 82 MHz. It is no coincidence that this is near the middle of the VHF TV band.

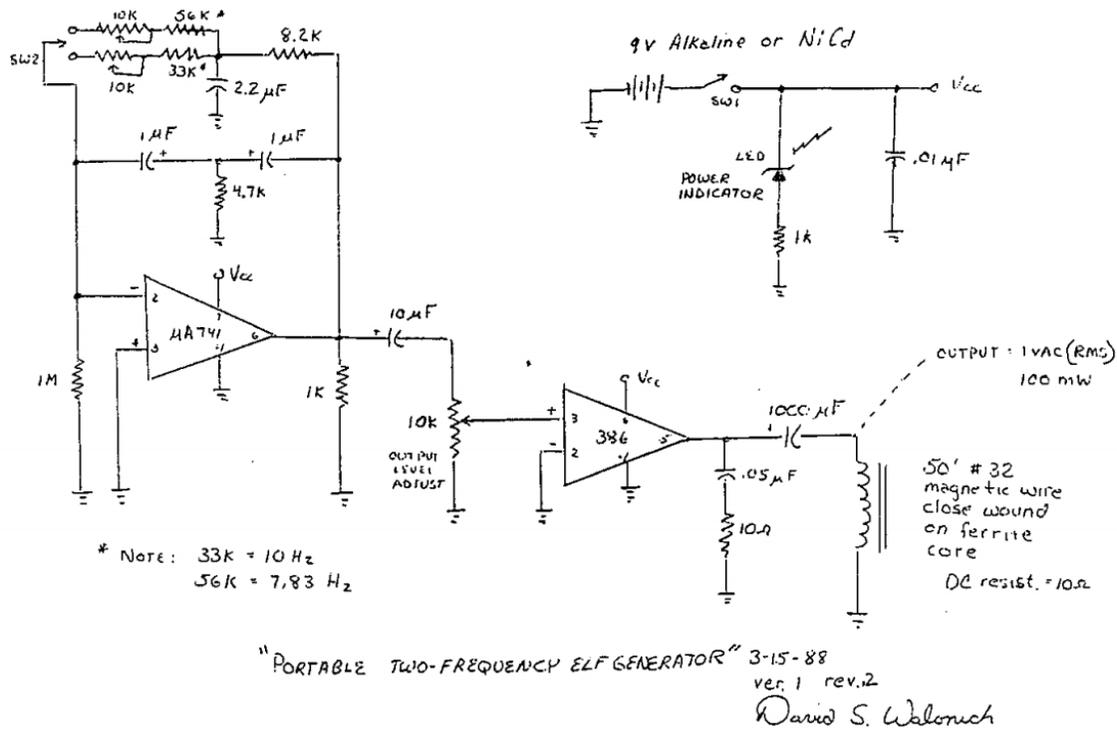
Even low intensity 60 Hz fields are capable of causing DNA damage and weakening the immune system. Cancer cells exposed to 60 Hz electromagnetic fields for 24 hours show a sixfold increase in their growth rate.

The evidence is becoming overwhelming that cellular functions can be switched on and off through frequency specific electromagnetic radiation that induces nuclear magnetic resonance in the cell. We may find that many diseases can be caused or cured by frequency specific radiation that is ELF pulse modulated.

In our technological society, there are few places to go where you will not be exposed to electromagnetic radiation. Television, radio and microwave radiation are abundant in all metropolitan areas. High voltage 60 Hz power lines crisscross the country. Microwaves (one of the most dangerous) are becoming increasingly common. The FCC has started to grant licences to use microwaves for cellular phones.

The powers that control the energy and communications industries will stop at no end to prevent the public from learning the truth. Their financial health depends on it. Since the military is one of the largest producers of high power electromagnetic radiation, it is not likely that we can count on government intervention.

We have probably reached a point where the only solution is in the form of a portable shield device. ELF generators may be one possible solution. My current research is in this area.



(PortableTwoFreqELFGenerator 3-15-88-v1rev2.png)

Seeking **more information** on the potential applications of ELF? Explore our growing selection of articles on the use and misuse of ELF (Extremely Low Frequency) (../../../topic/elf.html), as well as other forms of radio research and variable frequency phenomena.

References

1. Dr. Puharich's watch was branded as **"Tesla"** (<http://www.trademarkia.com/teslar-73601129.html>), named (naturally) for Nikola Tesla, and sold through **ELF Cocoon Corp.** The technology has been reported to have been a small electromagnetic generator that

imitates the Earth's natural magnetic field frequency; refer to Philip Coppens' "The Stargate Conundrum: The US Government's Secret Pursuit of the Psychic Drug" (http://www.philipcoppens.com/starconundrum_2.html) (philipcoppens.com) for Puharich's own words, and and Dr. Anthony Scott-Morley's "The Teslar Wrist Watch" (<http://web.archive.org/web/20010728165120/http://members.ozemail.com.au/~teslarwatch/ScottMorley.html>) (archive.org). A number of imitators have appeared since the passing of Puharich, though, as one might expect, it is unclear if any of them offer anything resembling the original.

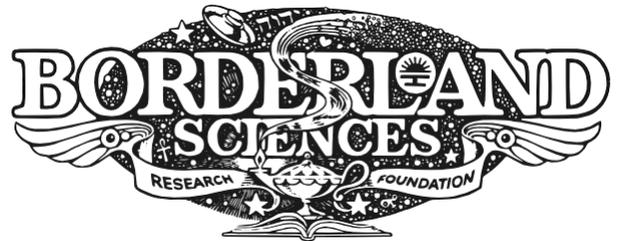
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