



Radio Waves & Life

by Tom Jaski
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In a recent editorial (August, 1959), Hugo Gernsback called for a serious reappraisal of the effects of radio waves on human and animal physiology. In view of the almost casual use of high-power radar and industrial RF (radio frequency) heating equipment, this is certainly a timely word of warning.

It is not surprising then that the Air Force is already keenly aware of these problems, and has a number of projects under way to discover the exact effects of high-intensity radar pulses and microwaves on human and animal tissue. These projects are being carried out at our major universities, each specializing in one particular frequency. For example, the project at the University of California, under the direction of Prof. Charles Susskind, is primarily investigating the effects of 3-CM radar energy. Test subjects are mice, ants, and yeast cells.

Thermal Effects

Of great importance, and therefore under intensive investigation, are the thermal effects of such waves, and these have been measured rather precisely under a variety of conditions.

Using mice as subjects, it was found that near-lethal doses of radiation do not seem to cause any pathological changes in them, and that the lethal effect is primarily an overtaxing of the mice's temperature-balancing system. It was found that the major heating effect took place immediately under the skin, but of course heat generated there is rapidly distributed through the body. The temperature of the mice was monitored continuously.

The photograph shows zoologist Susan Prausnitz monitoring the temperature of a mouse suspended in the wire cage right in front of the waveguide just visible on the left. The mouse is slowly rotated to insure even radiation over the entire body. Death occurred in 50% of the mice when a critical temperature of 44.1 Centigrade was reached.

Other interesting findings include the fact that radar waves appear to have no significant effect on the fertility of the male mice. The effects of radar waves on the longevity of the mice are currently being investigated.

An intensive series of experiments was carried out on cellular organisms, such as yeast cells, but, other than showing thermal effects, the experiments with insects such as ants delivered relatively minor data.

But one interesting item which emerged was that the ants, normally moving every which way, in a Petri dish, will all line up in a 3-CM field, aligning their antennas parallel to the field, apparently to minimize the effects.

The project is continuing, and more research on mice, ants and other animals is contemplated. Psychological effects will be looked into. One promising item in the ant experiments was that the ants which were exposed to 3-CM waves apparently lost the ability, at least temporarily, to communicate the source of food to their fellows, as ants usually do.

It may be significant that the large ants used have antennas which measure very nearly one-fourth the wavelength of the 3-CM radiation.

Incidentally, mice are so frequently used for this kind of experiment because they are easily handled, easily obtained and relatively inexpensive, while their physiology and metabolism bear a useful resemblance to human counterparts in some ways. The life span of a mouse is limited, permitting experimenters to evaluate genetic effects over several generations.

Meanwhile other service branches are carrying out research programs concerned with the effects of radio waves on animal life, not necessarily limited to radar frequencies.

A public announcement by scientists at the National Institute for Neurological Diseases concerning the lethal effects of 388-MC radio waves on monkeys also shows there is great interest in other frequencies and effects besides thermal.

Some Early Reports

As long ago as 1930, Nrunori claims to have seen evidence that the human organism "radiates" and "reacts to" radio waves of 2.33 meters and its harmonics -- in other words: 129, 258, 387 and 596 MC (megacycles i.e. million cycles per second).

This brings to mind the work of a man who started publishing articles on this kind of subject more than 35 years ago. An Italian university professor named Cazzamalli placed human subjects in a shielded room, subjected them to high-frequency radio waves, and claimed to be able to record a "beat" which, he received on a simple untuned receiver consisting of a galena crystal, a small capacitor, antenna and sensitive galvanometer. Cazzamalli's equipment, as well as it can be determined from his early articles, is shown in Fig. 1.

The one item which he never mentions, perhaps because he could not accurately determine it, is the power of his transmitter.

He published oscillograms purportedly showing variations of the "beats" when his subjects were emotionally aroused or engaged in creative efforts.

Later experiments delivered much more startling results: he found that some of his subjects would hallucinate under the influence of the high-frequency radio waves, which ranged all the way up to 300 MC.

The Cazzamalli experiments were carefully duplicated with modern equipment, of much greater sensitivity than his. His "oscillatori telegrafica" (presumably a transmitter as used for wireless telegraphy) was replaced with a very modest low-power oscillator. The reason for this was twofold.

In the first place, university authorities take a very dim view of experiments on human beings, even if these subjects are the scientists themselves, volunteering for the part.

Second, a previous experiment had indicated in a rather startling way that power was not required to evoke effects in the human nervous system. In fact, there seemed to be some form of resonant frequency applicable to each individual human.

Effects on Humans

That experiment was suggested by the behavior of the monkeys we cited. These animals went through a sequence of behavior which would indicate that something besides thermal effects was operating.

To discover if this "something" was subjectively noticeable by an individual, a weak oscillator swept through the band of 300 to 600 MC with the request that the subject indicate any points at which he might notice anything unusual. The subjects were not allowed to see the dial.

At a particular frequency between 380 TO 500 MC for different subjects, they repeatedly indicated a point with almost unbelievable accuracy (as many as 14 out of 15 times).

Subsequent experiments with the same subjects showed that at the "individual" frequency, strange things were felt. Asked to describe the experience, all subjects agreed there was a definite "pulsing" in the brain, ringing in the ears and a desire to put their teeth into the nearest experimenter.

The oscillator in this case was putting out only milliwatts of power, and was placed several feet from the subject.

Optical and Growth Effects

It was not the first time that such phenomena had been observed. Van Everdingen, a Dutch scientist, had discovered many years ago that radiation would affect the heartbeat of chicken embryos, when he was experimenting with the effects of high-frequency radiation on growth (specifically working toward any effect it might have on malignant growths).

Van Everdingen used 1,875 MC and 3,000 MC and discovered that this kind of radiation would change the optical properties of a glycogen solution.

Glycogen is a substance which provides our muscles with energy! Van Everdingen found that this change of optical polarization had some connection with tumor growth. He proceeded to re-rotate the polarization in extracts obtained from tumor-producing mice.

When this optically "pure" substance was injected into mice with malignant tumors, and these mice were kept on a diet free of animal fats, the tumors would cease to grow. Only radiation at UHF (ultra-high) or SHF (super-high frequency) would produce these effects in the substances he used.

But Van Everdingen was not the only one who discovered important facts about radiation on living tissues. Years before, a Frenchman name Lakhovsky claimed to have removed tumors from patients with high-frequency radiation treatments, and his book, *The Secret of Life*, has a number of attestations in it from grateful patients who were cured.

Lakhovsky stated that healthy plant growth is materially aided by placing a copper ring about 8 inches in diameter and supported on an insulating wooden stick (Fig. 2) around the plant.

So-called tumorous growths on plants disappeared within such a ring. Lakhovsky's experiment with plants has been duplicated successfully. But then we should also note that the same kind of thing has been done by a group of devout citizens using group prayer!

But the people who have published the most data on the subject of UHF radiation effects on animals and human subjects are the Russians. In BIOFISICA, the Russian biophysics journal, a scientist named Livshits published two survey articles on the work that had been in this field by 1958 and 1959. They are too extensive to repeat in great detail here, but some of the more impressive highlights will be reported.

Many experiments were carried out on animals with conditioned reflexes, and one by Glezer showed that a weak UHF field would inhibit the conditioned reflex, indicating that some inhibition of the cortex was taking place.

As in Van Everdingen's experiment with chicken eggs, Pardzhanidze showed that the EEG's of rabbits were drastically change when the animals were subjected to a UHF field. Bludova, Kurilova and Tikhonova showed that the field produced an increase of sensitivity in the retina, and simultaneously reduced the area of color sensitivity.

It is interesting to speculate how this would correlate with the Land effects. (Land, of Polaroid camera fame, has shown recently that our concepts of three-color vision seems to depend primarily on the presence of two images stimulated by two different frequencies of light!)

Turlygin similarly showed that the sensitivity of the eyes of dark-adapted subjects at marginal levels was increased as much as 100% by the presence of a UHF field.

Nerve Effects

Of importance in the light of Lakhovsky's claims is the experiment by Grigoreva, who showed that short exposures to UHF would expedite the regrowth of severed nerve tissue, while prolonged exposure would suppress the regrowth.

A fact discovered many years ago is that a UHF field will have an analgesic (pain-reducing) effect on nerves, and radiation therapy of patients with painful diseases such as arthritis is fairly common practice here and abroad.

If the field gets very intense, the situation reverses, and the effects on the nerves can be extremely painful, as Lebedinskii reports.

Numerous experiments are cited which deal with the simultaneous effects of various kinds of drugs, stimulants and toxins, and UHF fields. Many of these deal with very specific reactions and conditions, and any generalization would be rather meaningless. One particularly was of interest because of its relation to the experiments of the late Pavlov, the father of the conditioned reflex.

This experiment shows that the field increases the secretion of histamine in the stomach, and in related experiments that the secretion of digestive juice which was artificially stimulated by such drugs as atropine is materially reduced by the field.

Closer to home, we find that Hugh Fleming at Oregon State College carried out experiments on the effects of high-frequency effects on microorganisms. Fleming used radiation at frequencies varying from 10 meters to 90 CM (30 to 270 MC).

One result was that the rate of growth of cells will increase to a certain power level, and then will sharply decrease.

Time of exposure and conductivity of the medium are important variables (as was also discovered by Van Everdingen, who also found the viscosity of the medium to be most important).

Summing it up

Now what does all this mean in terms of Mr. Gernsback's warning statement?

If you consider the few items we have been able to quote (more detail can be found in the articles cited in the bibliography), it is obvious that we are in some way susceptible to radio waves, and that our susceptibility is not necessary limited to a particular frequency. Nor are large amounts of power required to produce some of the effects within us.

But precisely what these effects are, we understand not at all. Van Everdingen points out that the possibility of molecular resonance, affecting the chemical bonds in our very substance.

The egg experiments certainly indicate some sort of interference with the cortex (our "gray matter") which may affect our thinking and our control over the "baser" drives (generally considered to be generated in the lower sections of the brain, but normally controlled or inhibited by the cortex).

Our physiological functions, such as our digestion, our ability to see and recover from damage when nerves are involved may well be drastically affected if we are subjected to a high enough power level.

Tumors may be inhibited by the proper kind of radio waves yet, in other cases, particularly when coupled with the "wrong" kind of diet, radiation may also promote the growth of tumors. (This too was demonstrated by Van Everdingen in Holland).

We do not know if our longevity will be affected. Certainly we should consider the possibility that there may be some relationship between the increase of cancer and the amount of radiation we indiscriminately spew into the atmosphere.

Or even that there may be some connection between that radiation and our sharply increasing crime rates.

We simply do not know enough about the effects, but what little we do know would tend to make Mr. Gernsback's warning all the more urgent.

For while there is nothing lethal about the doses of radio-frequency energy we absorb daily, neither is there anything lethal in the steady drip of water on a man's forehead -- but it was effectively used by medieval torturers to drive him completely out of his mind.

Perhaps we have a responsibility to mankind, before we fill in all the gaps in the radio spectrum, to discover once and for all if we are affecting human life on this planet. And if so, in what manner, as we finally had to do for another surprise out of Pandora's box, man-made radioactivity.

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