

The Sciences

Electromagnetic Pollution

by Robert O. Becker
and Andrew A. Marino

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High-tension wires
may be hazardous
to your health

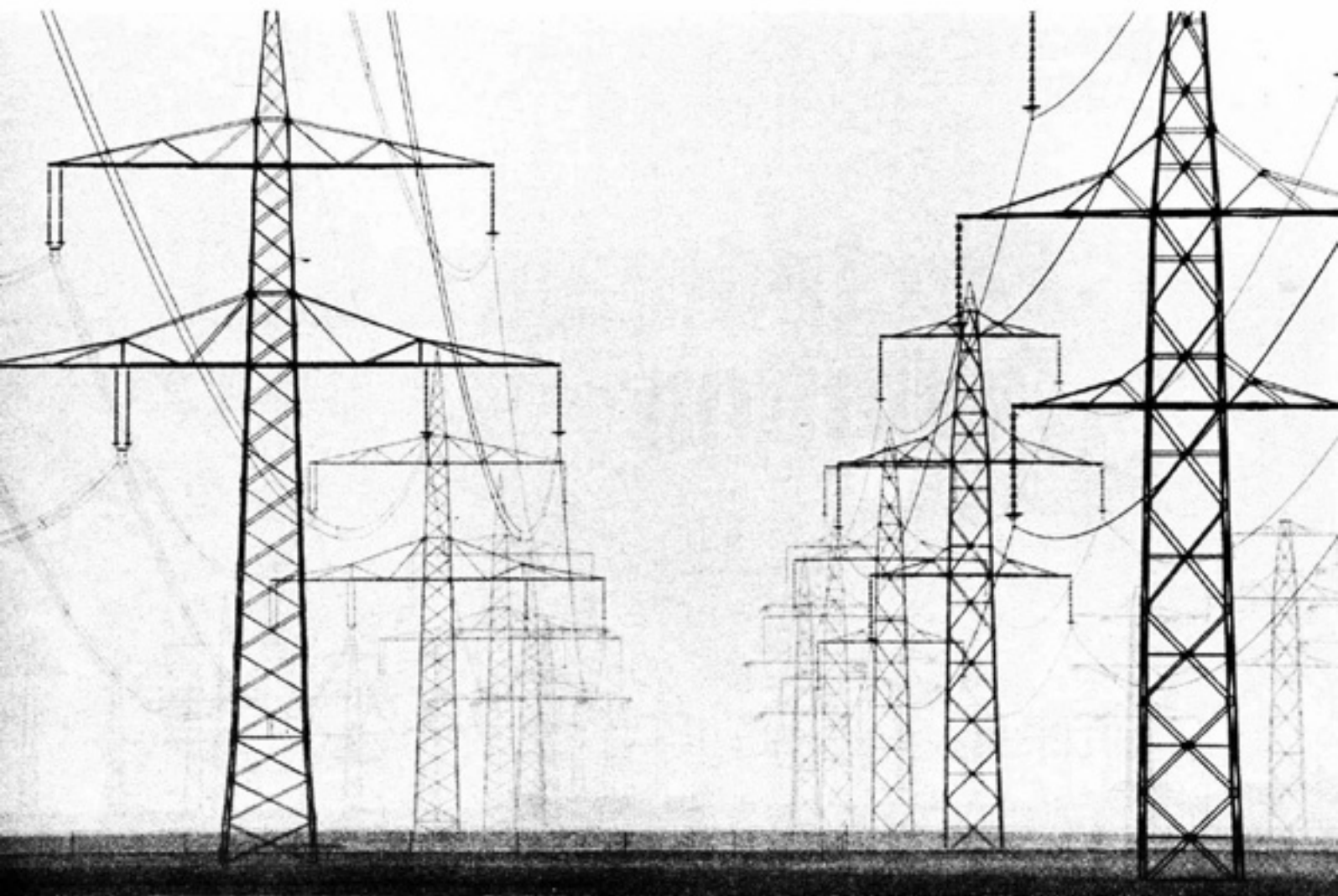


Photo by René Burri (Magnum)

The American landscape would be unfamiliar were it lacking high-voltage transmission poles standing like metal skeletons strung with high-tension wires. These and other products of modern power and communications industries, such as radio, television, and radar, all operate in the electromagnetic spec-

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trum—those waves present in our environment (produced both naturally and artificially) which we cannot hear, see, feel, or otherwise detect with our senses without instrumental intervention.

Until recently, scientists believed that electromagnetic radiation had no effect on life. No obvious diseases had been identified as having been caused by such energy. Expert opinion held that there was little or no connection in nature between electromagnetic radiation and biological tissue, other than gross heating effects from high doses. And so industry has gone ahead expanding its use of the electro-

magnetic spectrum with the assurance that no danger exists. We now live submerged in a sea of unperceived electromagnetic radiation.

What Is Electromagnetic Radiation?

The electromagnetic spectrum extends from wavelengths of millions of meters to ultrashort cosmic rays. Light is a special case. It is the only part of the spectrum which we can actually perceive directly. The others, like the long wavelengths used in seismic exploration, are masked from our direct perception. Clinical medicine uses the very short wavelengths in x-rays and industry exploits the largest share of the spectrum which lies between one hertz and one hundred gigahertz. The most commonly used frequency—sixty hertz—is used by electric power systems.

Only part of our electromagnetic environment occurs naturally—most of it is artificially produced. Naturally occurring long-wavelength electromagnetic radiation in the Earth's atmosphere primarily results from geophysical processes and from lightning. Extraterrestrial sources, such as radiation from the sun, account for the short wavelengths.

Human activities within the last hundred years have profoundly changed the natural electromagnetic background waves which have prevailed since the beginning of evolution. Power and communication systems have drastically altered the frequencies and the strength of the nonionizing electromagnetic radiation (NIEMR) in the environment.

Biological Effects

Recent research on the solid-state properties of biological tissue now offers us some new and troubling clues as to the interaction of life with very weak NIEMR waves. A number of scientists have begun to report biological effects due to exposure to these waves.

In some cases, investigators have succeeded in identifying the biological significance of naturally occurring nonionizing electromagnetic radiation, while other reports describe the nonthermal responses of organisms exposed to artificial radiation.

First, consider the findings that at least some birds use geomagnetic clues in their orienting processes and that disturbances in the magnetic environment disrupt this ability. Another link between life and electromagnetic energy can be found in the work of James D. Hays and Neil D. Opdyke of the Lamont-Doherty Geological Observatory. Studying oceanic sediments, they claimed that in those geologic periods during which the Earth's magnetic field reversed its direction, an unusually large number of organisms died and some species of marine life became extinct. Frank A. Brown of Northwest-

ern University has shown that living organisms exhibit changes in their behavior and physiology relating to corresponding periods in the Earth's electromagnetic environment. In still another series of experiments, this time on humans, Rutger Wever of the Max Planck Institute found that circadian rhythms are affected by the existing atmospheric electromagnetic environment.

Other laboratory experiments exposing animals and humans to artificially produced electric and magnetic fields further suggest the connection. In 1973, Dietrich E. Beischer of the Naval Aerospace Medical Research Laboratory, using ten subjects, reported that certain levels of artificially produced magnetic field exposure to humans result in elevated serum triglycerides, substances related to arteriosclerotic disease. James H. McElhane of West Virginia University showed that certain levels of low frequency electric fields can cause bone tumors in rats and Gordon Marsh of the University of Iowa found that even lower doses can interfere with the growth pattern of flatworms. James R. Hamer of UCLA reported that an electric field about one hundred times weaker than that employed by Marsh can affect animal reaction-time performance. In the microwave region, Milton M. Zarat of New York University and others reported that exposure to non-thermal intensity levels could cause cataracts in mammals.

In our laboratory, we found that rats exposed to a sixty hertz electric field for one month exhibited hormonal and biochemical changes similar to those caused by stress. The study employed an electric field comparable in strength to that produced at ground level by a typical high-voltage transmission line. In another experiment, we continuously exposed three generations of rats to the electric field and found increased infant mortality and severely stunted growth. Our results appear to indicate that the applied electric field primarily affects the central nervous system and activates the stress-response mechanism. Chronic stress can produce a wide variety of diseases and pathological conditions.

Health Hazards?

Now that abundant evidence establishes that both natural and artificially produced NIEMR can produce some biological effects, it raises serious questions of possible health hazards for humans. Nonetheless, the Environmental Protection Agency and state health or environmental agencies have not significantly supported the necessary research to establish safe exposure levels. Until now, on the assumption that the fields and energy levels associated with power and communication systems could not produce nonthermal biological effects, Western

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nations have evolved no standards to protect populations from excessive exposure. Note, however, that the Soviet Union has stringent regulations governing human exposure at both the low and high frequency regions of the spectrum.

This odd discrepancy emerges in the current diplomatic squabble between the USSR and the U.S. over Soviet bombardment of the U.S. embassy in Moscow with microwave energy. The in-

tensity level being employed by the Soviets is less than the U.S. safety level (which is based solely on the possibility of inducing tissue heating), but greater than the level which the open Soviet scientific literature indicates can cause biological effects. As a consequence, the U.S. government has no formal basis upon which to claim embassy employees may be suffering hazards to their health.

A recently released Defense Intelligence Agency report suggested that nonthermal levels of microwaves might have offensive weapons applications. The report found that Soviet scientists are aware that chronic exposure to non-thermal microwave energy has great potential for development as a means of disrupting behavior patterns and for use as an interrogation tool. It has been reported that the Soviet bombardment of the American embassy which occurred between October 1975 and January 1976 was highest at 18 microwatts per square centimeter. In contrast, the American microwave oven emission standard is 1,000 microwatts per square centimeter and the American occupa-

tional exposure standard is 10,000 microwatts per square centimeter. The Soviet exposure standard is ten microwatts per square centimeter.

The use of electromagnetic energy in the U.S. continues to expand. The generation of high-voltage transmission lines currently being constructed will operate at 765,000 volts, as compared to the present maximum of about 500,000 volts. The electric utility industry has begun developing the technology to operate at more than a million volts. The U.S. Navy has proposed to build a gigantic antenna in Michigan which would radiate at very low frequencies. Communications facilities at all frequencies continue to proliferate.

Recent scientific evidence on the biological effects of nonionizing radiation requires that we know whether or not chronic exposure is hazardous to health. This may be the right moment to halt those technologies which may result in further electromagnetic pollution until scientific studies establish safe levels not only for humans but for the entire ecosystem. □