

# RADIATION HEALTH AND SAFETY

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HEARINGS  
BEFORE THE  
COMMITTEE ON COMMERCE,  
SCIENCE, AND TRANSPORTATION  
UNITED STATES SENATE  
NINETY-FIFTH CONGRESS

FIRST SESSION  
ON  
OVERSIGHT OF RADIATION HEALTH AND SAFETY

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*Radiation Research with Nuclear "Phantoms".*—Alderson Research Laboratories developed a life-like radiological test subject called "REMAB" (Railroad Equivalent Manikin-Absorption). These dummies or "phantoms" are equivalent to an average man in size and contours; they are filled with "a solution that has the same radiation-interaction properties as human soft tissues." REMAB was designed for radiation research and can be used for "depth-dose" measurements and "nuclear-accident re-creation." The dummies can be loaded with radioactive materials to determine the exposure effects to adjacent areas. ("Alderson Nuclear Phantoms," Alderson Research Laboratories, Inc., Stamford, Conn.)

*Radiation Inhalation.*—Over the past 30 years at institutions all across the country, animals have been forced to inhale radioactive materials. In contrast, scientists at Pacific Northwest Laboratories, under contract to the U.S. Atomic Energy Commission, designed a computer program that "permits rapid and consistent estimates of the effective radiation dose to the human respiratory tract and other organs resulting from the inhalation of radioactive aerosols." They also constructed mathematical models to describe the atmospheric dispersion of radioactive material "for the purpose of evaluating doses resulting from either accidental or chronic atmospheric releases of radionuclides." In the model, the respiratory tract was divided into three regions: the nasopharyngeal (nose-pharynx); the tracheobronchial (air passages to lungs); and the pulmonary (lung). The scientists employed "complex mathematics" to design the computer program input which consisted of several variables: duration of inhalation exposure, ventilation rate, time interval within which the dose is delivered, organs of interest, quantity of radionuclide inhaled, and "solubility class" and particle size. Output from the "CDC CYBER 74" computer consisted of the effective radiation dose to "any of 18 organs and tissues" in the human body. The model was extended "to include calculating organ doses resulting from chronic inhalation," as well as acute inhalation of radioactive particles. The scientists said that most of the basic data required to complete the calculations are available at "data libraries." The data in the libraries are set up such that "additional data or changes to existing data may be made with little difficulty." (BNWL-B-389 UC<sup>41</sup>, Dec., 1974).

*Biological Effects of Radioactive Material on Cultured Cells.*—Researchers at Rutgers University Agricultural Experiment Station are using cultured mammalian cells to test the damaging effects of tritium and other radioactive materials. They are conducting a comparative study of the chemical effects of radiation and of high energy, heavy ions (electrically charged atoms) and gamma rays on the isolated cells. Methods will be used to "accurately" relate deposition and absorption of radioactive energy to biological damage. Though the work is still in progress, the scientists have already found "significant chemical differences between the effects of tritium beta rays and gamma rays." More interpretation is needed, but results so far are "potentially important since the present basis for tritium maximum permissible concentration assumes little difference between these radiations." (SSIE, Notice of Research Project, No. GY-60353-4, July 1977)

UNIVERSITY OF OREGON HEALTH SCIENCES CENTER,  
Portland, Oreg., June 13, 1977.

Hon. WARREN G. MAGNUSON,  
Chairman, The Senate Commerce Committee,  
Russell Old Senate Office Building,  
Washington, D.C.

DEAR SENATOR MAGNUSON: Your hearings on the adequacy of United States safety standards for microwaves and radiowaves are timely indeed. In recent years evidence has steadily mounted concerning the likelihood of low power level microwave cumulative dose effect hazards. It has also become apparent that certain federal agencies and private contractors have vested interests in obstructing the public scrutiny and adequate research support for accurate determination of the risks of these apparent hazards. Most people do not realize that certain types of non-ionizing radiation (e.g. microwaves and radiowaves) can have similar effects to the readily recognized dangers of ionizing radiation (X rays and gamma

rays), with the principal difference being the much lower incidence of tissue damage due to the much lower energy content of the non-ionizing radiation. However, the lifetime accumulation of non-ionizing radiation dose, the damage to the posterior capsule of the ocular lens, and the suspicion of increased cancer risk are all characteristics in which the effects of non-ionizing radiation resemble those of ionizing radiation. The continuing rapid increase in use of radiowaves for military and civilian communication and sensor systems as well as the growing popularity of microwave cooking in the home, means that it is imperative to develop accurate and adequate health risk estimates from sources which cannot be accused of vested interest in health hazard information suppression. This will require epidemiologic and experimental research of a whole array of circumstances over considerable periods of time because of the intricate influence of environmental variables and the latent periods between exposures and potential chronic disease manifestations.

A volunteer member of our faculty, Mr. William Bise, has been instrumental in bringing to our attention the fact that foreign scientists have gathered a great deal of evidence suggesting the existence of significant hazard from low level microwave radiation. He is an experienced radio broadcaster and has formed a non-profit corporation (Pacific Northwest Center for the Study of Non-Ionizing Radiation) for the purpose of promotion and support of investigation of these hazards. He is writing to you under separate cover. We endorse your efforts to look into this matter and anticipate the eventual facilitation of radiowave health hazard investigation as a result.

Sincerely,

Wm. E. MORTON, M.D., DrPH, *Professor*

PACIFIC NORTHWEST CENTER FOR THE STUDY OF NON-IONIZING RADIATION,  
Portland, Oreg., June 6, 1977.

Hon. WARREN G. MAGNUSON,  
U.S. Senate, Russell Senate Office Building, Washington, D.C.

DEAR SENATOR MAGNUSON: Enclosed is material that I would like to submit in lieu of verbal testimony in the upcoming senate subcommittee hearings on microwaves. In a telephone conversation with Sharon Nelson on Wednesday June 1, 1977, I pointed out that my limited budget does not allow me to appear in person. The material describes a pilot study of central nervous system radiofrequency (RF) effects which I conducted on ten human volunteers at a power level on the order of 67 microvolts per meter intensity, previous to founding a non-profit research corporation. As you know, Public Law 90-602 set the so called safe level for human exposure to this energy at about 195 volts per meter. The pilot study findings suggest that brain waves (and possibly behavior) are affected at specific frequencies at substantially lower power levels of RF than people can be exposed to in their daily lives. Whereas further research is necessary to verify or deny the pilot study findings, it is my opinion that a meaningful risk factor already exists for the population at large. The technical paper entitled Radiofrequency Induced Interference Responses in the Human Nervous System has been submitted for consideration in the upcoming URSI International Symposium on Biological Effects of Electromagnetic Waves to be held at Airlie, Virginia on October 30-November 4, 1977. Also enclosed is a popular technical article that I authored which describes the pilot study which appeared (without references) in the January 1977 issue of Communications/Engineering Digest.

I have worked out an experimental design using the ambient RF as a signal source for a follow up study. The design conforms to all H.E.W. guidelines for protection of human subjects. If funds can be granted for this research, many questions concerning RF biological hazards can be answered.

Electronics engineers are dedicated to designing, building and maintaining better and ever more sophisticated products for radiating and detecting all kinds of electromagnetic waves. With the exception of careful respect for high voltages, currents and power, a good engineer will insist that low power microwaves or radiowaves cannot possibly affect human behavior and/or health. As an engineer

who held that view for fourteen years, I can attest to this fact. Except for a rather dramatic incident in 1970 involving my wife, who was nearby while I was troubleshooting some gear with a low power microwave generator, I might not have done a pilot study of RF effects; and I might still have remained unconvinced that low level microwaves/radiowaves are hazardous at specific frequencies.

Since I became a clinical instructor in environmental medicine at the University of Oregon Health Sciences Center, it has become apparent to me that most physicians are unaware that low-level radiowave biological effects can mimic many symptoms of various defined diseases. I have found the entire subject of radiowave hazards very unpopular to science, business, industry and the military; perhaps because recognizing these hazards would cause so many necessary changes in these various areas.

An international radiowave conflict has been going on for some time and was intensified dramatically in July 1976 with the addition of the Soviet 10 Hz pulses which may produce serious biological effects on people regardless of the real intent of these intense pulses of radiant energy. It is not necessary for nations to declare war of this nature since it is silent and invisible to our normal senses.

Using the legal power limit of 10 milliwatt per square centimeter, a malicious person could easily build (or buy surplus) equipment that could physically and mentally damage people, over a period of time, without the victim ever knowing what was happening to him. The members of the executive, legislative and judicial branches of government may even be more vulnerable to this kind of personal harassment than the ordinary citizen.

It is conceivable that special interest groups have already resorted to tactics of this nature. I was called as a consultant in April of 1976 in a case in Seattle, Washington where the microwaves and lasers which my instruments detected possibly were the result of personal harassment. One motive could be the desire to buy property at bargain prices from people who are anxious to sell in order to leave the neighborhood because they no longer feel well in their home or business. Because I was working alone in Seattle, my findings remain inconclusive. Military radar scatter also seemed to be one of the sources of radiation in the two different areas which I checked.

To paraphrase an engineer formerly with the North American Air Defense Command, "You'd never really know the cause of death from this stuff . . . you could hit someone, coagulate their blood and no one would ever know what happened."

I hope that there is something that your committee can elicit from the upcoming hearings to at least inform, if not protect, the people of the United States from electromagnetic hazards. The specialization of science unfortunately limits the scientists' ability to bridge the interdisciplinary gap necessary to realize the urgent need for a joint effort of investigation into low power level microwave hazards.

There is another serious matter which involved a breach of security in Seattle concerning the President's "Doomsday" airplane. If at any time you might wish to talk to me, please let me know.

Sincerely,

WILLIAM BISE.

Enclosures.

RADIOFREQUENCY INDUCED INTERFERENCE RESPONSES IN THE HUMAN NERVOUS SYSTEM

(By William Bise)

Summary: Interest in lowpower athermal RF effects on biological systems has grown in recent years among American researchers and the foreign literature on the subject is prolific. Against this background a pilot study was conducted on five men and five women volunteers. Participants in a group of eight experiments completed from July 1975 through June 1976 were, of necessity, highly preselected. They ranged in age from 18 to 48 years. Three had been occupationally exposed to RF energy; the other seven had not and all were in apparent

good health. The RF ranges covered from .1 to 960 Mhz CW and 8.5 to 9.6 Ghz pulse modulated. Power levels were varied from  $10^{-16}$  wt/cm<sup>2</sup> to  $10^{-13}$  wt/cm<sup>2</sup>. Three variable frequency low power output test alignment generators served as signal sources. Subjects were seated and oriented so that they could not see the equipment or the operator. During data gathering they did not know to what frequencies the sources were tuned nor did they know when the signal source was off or on. A 1 meter free space impedance coupled antenna was placed parallel to and 1 meter from the upper torso and head during CW tests. The open wave guide output of the pulse modulated source was oriented 1 meter from and perpendicular to the sternum. Any changes in the EEG traces were photographed from a cathode ray tube display and/or note was taken of the frequency which produced them. Previous to irradiation, the normal EEG tracings of the subjects were noted or photographed. Experimental time for each volunteer was typically 50 minutes. Tests were done at different times of the day at various locations, both in and out of a Faraday room. Signal source accuracy and power output levels, at the subject to antenna distance, were measured with two spectrum analyzers.

The EEG instrumentation used gave sequential recording of a single trace from an electrode pair and was specially designed for use in RF fields. Artifacts were identified and controlled out of the tests. Pushbutton switchable selectivity allowed sampling from the three different cranial areas without changing electrode placement. Plastic covered skin surface type electrodes were used.

Subjects' EEG traces displayed desynchronized alpha waves of 15 to 25 percent higher than normal amplitude and slow waves appeared at certain radiofrequencies. Conversely, diminution and desynchronization of alpha wave amplitude on the order of 20 to 50 percent occurred at other radiofrequencies and 2 to 6 Hz slow waves appeared. These two anomalous patterns were found in both men and women volunteers. Mental attitudes appeared to change during the tests. CW frequencies at a power density of about 10-15 wt/cm<sup>2</sup> which produced EEG changes in males, were found between 130 and 780 Mhz. Female volunteers' EEG alterations occurred between 350 and 960 Mhz. Pulse modulation tests on two males, at a power density of about 10-12 wt/cm<sup>2</sup> showed EEG changes around 9.1 and 9.15 Ghz. Brain waves changed almost immediately upon tuning a generator to a frequency which produced them and then almost immediately reverted to their normal patterns when the generator frequency was altered or turned off. Various lead configurations and antenna orientations were tried during the CW tests and demonstrated that active sampling from the right frontal parietal to the right occipital, with antenna presented 1 meter from left hemisphere, yielded repeatable results. This suggests that the right hemisphere is the more responsive one to RF energy. Experiments performed near noon and midnight showed the most significant EEG pattern changes thus a circadian bio-rhythm dependence may be involved.

Notably, the CW RF energy of about 67 microvolts per meter which was seen to alter brain waves is characteristic of the average EEG voltage level which exists at the surface of the head. The EEG changes seen in most of the participants were produced by this RF energy level at frequencies between 130 and 960 Mhz. Since most researchers agree that the relaxation frequency of protein bound water must lie between 100 and 1,000 Mhz, it is possible that resonance absorptions occurred. The shape of the human head (spherical antenna bandwidth), the piezoelectric characteristic of bone and the possible up and down frequency shifts of radio energy entering and leaving protein bound water in near surface tissue are considerations in this phenomenon. Altered EEG patterns resulting from electrical stimuli should be expected to reflect corresponding behavior changes. It is known that both the thalamus and hypothalamus are especially sensitive in this respect. The 6 Hz waves which appeared in some subjects' EEG patterns are similar to those waves associated with annoyance seen in earlier EEG research. Brain wave changes were triggered in alert volunteers by external energies which they could not perceive. At very low RF field densities the body's neurointegrative systems evidently do not function normally or somehow may be prevented from normal functioning. RF induced stimulation of the mid-brain structures may be a fundamental factor. The full impact on biological systems of long exposure to low intensity RF energy is not known, but the likelihood of cumulative dose effects means that small doses are important.