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Editorial

A Problem That Won't Go Away"

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A long, long time ago, in the days of World War II, I was part of a group of engineers assigned to the U. S. Naval Submarine Base in New London, Connecticut. The group spent their relaxation hours in the office assigned to them on the second floor of the E & R Shop, typing their reports, discussing their problems, and testing their company's radars before reassembling them on board the submarines moored close by. Of particular interest were the new-fangled, extra-high frequency (1,000 MC) sets just in from Western Electric.

Because of the small antenna dimensions, it was a logical step to rig up the output of each new-type transmitter undergoing test to homemade horns – a far simpler arrangement than required for testing an SD or SA radar. It was a cozy arrangement – five contractors' engineers and four types of radars – all firing away. However, it seemed as if the fellows seated across the room from the new WE system used to have early-afternoon headaches, certainly not attributable to hang-overs, inasmuch as at least one engineer was a teetotaler.

Being of a curious breed of engineers, the thought entered the minds of at least two, that cause and effect seemed to indicate a correlation between new radar-and-horn and the sudden onslaught of headaches. Since the commissary was just one flight down, it was quite simple to arrange an experiment to determine if some unseen force was at work. Accordingly, a test was arranged whereby two raw eggs in their shells were secured to the interior of the horn. Then the transmitter was fired up.

When the residue was finally cleaned off the walls and the desks, a repeat test was conducted, with only one small change. This time a sheet of cheesecloth was fastened to the periphery of the horn. The resultant clean up task was far simpler.

The next step was to repeat the test for the E & R Commanding Officer, who appeared to be properly impressed by the experiment, and readily agreed that tests of the new type radar would be conducted in a non-populated area. Thus, for the first time in the lives of several radar engineers, was brought up the problem of hazardous electromagnetic radiation. It may be of interest to our readers to learn that each man subjected to the radiation later successfully sired at least one child. Perhaps we were all fortunate in that the axis of the horn had been oriented at head height instead of seat height!

Some twenty-eight years later, I had the pleasure of sitting in on a session devoted to the subject of electromagnetic radiation hazards, held in conjunction with the 100th Annual Meeting of the Public Health Association at Atlantic City, N.J. My pleasure was somewhat tempered by the fact that each speaker on the program had at least one theme in common, openly expressed, "The rapid proliferation of electromagnetic propagation of data and communication in the past 25 years has created an invisible, destructive power which is reaching into the biological lives of most of the urban population and much of the suburban population."

These speakers were not concerned only with the population of the United States. The problem is an international one. Just a few months ago, at a session of URSI International Commission I, held at Warsaw, I listened to the concern expressed by members attending from the United Kingdom, Germany, France, Poland, Russia, and the US. It is a concern tempered by the knowledge of how little is presently known of the exact type and amount of damage that can be caused to the *human* system by electromagnetic radiation. But – and it is an important but – it would

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seem that after the first flurry of excitement over the possible hazards that could be created by improperly designed microwave ovens, a huge ground swell of determined research is building.

The research is concerned with many facets of the problem. Are the effects of radiation cumulative or reversible? What is the radiation intensity level to which the human body is tolerant? How frequency-sensitive is the toleration? What measurement techniques are available to determine radiation levels? How does one apply the test equipment presently available? Is it possible to shield against radiation in a simple and practical manner? The questions go on and on.

The government of the United States is somewhat concerned about the entire problem inasmuch as a number of its operations contribute directly to the problem and its solution. The "Radiation Control for Health and Safety Act of 1968" (PL 90-602), passed by Congress, was intended to protect the public health and safety from the dangers of electronic-product radiation. This was followed by the enactment of the "National Environmental Policy Act of 1969" (PL 91-190), intended to promote efforts which will prevent or eliminate danger to the environment and biosphere, and will stimulate the health and welfare of man. It established the Council of Environmental Quality to advise the President of the US; it also requires all Federal agencies to file environmental-impact statements. An important fallout of the act was establishment of the Environmental Protection Agency (EPA) under the Reorganization Plan No. 3 of 9 July 1970. EPA is the authorized *standards-setting activity* for environmental problems, including radiation.

The "Occupational Safety and Health Act (OSHA) of 1970" (PL 91-596) brought about concrete actions, via the Secretary of Labor, to establish mandatory occupational safety and health standards. Included was a standard for non-ionizing electromagnetic radiation from 10 MHz to 100 GHz, originally established by ANSI Standards Committee C-95.

As pointed out by H. Janet Healer, Office of Telecommunications Policy (OTP) at the Public Health meeting on 14 November 1972, the existence of scientifically-undefined possible hazards to large numbers of people *can* and *has already* presented many problems. These include establishment of regulatory legislation and safety standards, resolution of medico-legal controversies (some of which already are in court and may be resolved without benefit of adequate scientific basis for decision), and susceptibility of US foreign-based radar and communication equipment to shut-down because of foreign national standards of radiation more stringent than those of the US.

The Electromagnetic Radiation Management Advisory Council (ERMAC), which assists the Director of Telecommunications Policy, proposed (December 1971) a coordinated 5-year program of survey, testing, and research among the cognizant federal agencies. Estimated 5-year cost for the program (FY '74-'78) is $63M, contrasted to FY '72 appropriations close to $4M and FY '73 level of approximately $6M. The most important feature of the program is the attempt to *coordinate national effort* to generate pertinent and dependable data for the evaluation of biological hazards from dc to 3000 GHz. Priority order has been established as 1) Microwave, 2) MF-UHF, 3) ULF-LF.

The program will take into consideration the various properties of the EMC environment. Consideration will be given to near- and far-field effects, cross modulations, polarization, harmonics, natural body frequencies, molecular-absorption resonances, etc. As Mrs. Healer pointed out in her presentation, effects of multiple frequencies and of RF in combination with other factors must be researched. Very early in the program it is necessary to emphasize instrumentation and measurement techniques and, in particular, to relate external to internal fields.

Since the program involves many agencies in which available funds must be shared, the utmost in coordination of efforts is required. It is well known that large-power RF handlers, such as the military and their radars or worldwide transmitting facilities, already are engaged in study programs. Accordingly, OTP, with responsibility to coordinate the program and to eliminate duplication (or voids), has established close ties with ERMAC. A bio-effects working group meets monthly and acts as a technical subcommittee within the Interdepartment Radio Advisory Committee (IRAC) structure.

The Department of Health, Education, and Welfare is responsible for a major biological research program which includes animal experimentation, basic-mechanism studies, and effects upon people. EPA will assess and determine the controls for non-ionizing radiation in the coordination of the three military research programs and determine their complementation with programs of other agencies. The Department of Commerce has responsibility for developing new instrumentation, dosimetric methodologies, and measurement-device standardization. Even the National Science Foundation will support the efforts by ensuring that voids in knowledge of basic mechanisms, involved in electromagnetic radiation interaction with biological systems, are studied.

In subsequent issues, we will present material related to the efforts of the government, industry, and universities to analyze and to cope with this problem. ■