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A Program to Study the Effects of Microwave Radiation on Various Biological Systems

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ABSTRACT

A program for studying the biological effects of microwave radiation is summarized. Particular attention is given to a controlled environmental chamber and its utility in studying experimental animals' responses to microwave irradiation. An experiment is discussed which demonstrates the importance of temperature and humidity parameters, and suggests experimental approaches that may resolve the "thermal vs. non-thermal" controversy surrounding microwave irradiation. Also discussed is a proposed biochemical system employing ribonuclease for determining the existence of temperature gradients in solutions exposed to microwave fields.

Man has been exposed to various types of electromagnetic radiation for thousands of years in the form of light, heat, and ionizing radiation from cosmic particles and naturally occur-

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ring radioactive isotopes. More recently man has received exposure from various electronic devices including x-ray machines and particle accelerators, and from activities associated with the development, testing, and use of nuclear devices. During the last four decades, nonionizing electromagnetic radiations have become increasing factors in the environment via the media of radio, television, microwaves and other industrial, consumer, and communications devices.

Until about 1950, the population directly associated with microwaves and most likely to be affected by them was fairly well confined to military and civilian technicians and engineers working in the vicinity of microwave transmitters. During the last 20 years, the number and kinds of devices employing electromagnetic energy in the region of 3 MHz to 3 GHz have vastly increased. This increase has been accompanied by the development of a potential for exposing large populations to these radiations.

The military in particular and a few civilian installations were aware of possible potentially high exposures of employees (1). In the 1950's the thermal effects associated with high exposures of microwave frequencies were considered to be the most obvious and most important biological effect. Investigators noted sterility in laboratory animals exposed to microwaves and some cases of cataracts in microwave workers (2). Some individuals noted dizziness or "sound" (3) or other symptoms of awareness when they were in particular electromagnetic fields. To minimize the risk from occupational exposure to these non-ionizing radiations, the military and the United States of America Standards Institute (now the American National Standards Institute) adopted what might be considered as occupational and industrial exposure guides (4). However, no specific guides were de-

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