

radiation biology

Gathered at the Symposium on the Biological Effects of Microwave Radiation last week in Richmond, Va.

BIOLOGICAL EFFECTS

Thermal vs. nonthermal

Many Western scientists believe it is solely the heat from microwave radiation that produces clinically significant biological effects. Soviet and Polish scientists, such as L. Minecki and A. A. Letavet, however, claim to have observed such effects on humans and animals when the radiation was too weak to produce a biologically significant temperature rise.

Skeptical U.S. scientists, such as Dr. H. P. Schwan of the University of Pennsylvania, point out that there are no known physical principles to account for such effects in man or large animals when the impinging microwave power level is held to 10 milliwatts per square centimeter, a value used as the upper limit for safe tissue heating.

However, a case for nonthermal effects was made by Dr. John H. Heller of the New England Institute for Medical Research, Ridgefield, Conn. Using radio-frequency waves which produce no discernible heat, he created changes in cells and organisms, changes usually associated with ionizing radiation such as X-rays and nuclear radiation.

The formation of abnormal extra, small nuclei (micro-nuclei), broken chromosomes and extra chromosomes in animal and plant cells, and mutations in fruit flies (bristles which appear singed, black spots on red eyes and bubble formations on wings) were some of the observed radio-frequency effects.

HEMATOLOGY

Warning flag

Dr. Gopal P. Kamat of the U.S. Public Health Service cautioned those scientists who favor defrosting refrigerated blood with microwaves. Taking the portion of human gamma globulin called immunoglobulin G, he and David E. Janes heated the fluid with microwaves and formed insoluble aggregates. If either whole blood or the gamma globulin portion, which contains these aggregates, is used in another human being, the recipient will respond by producing antibodies, which could result in adverse effects such as skin sensitization and presumably, in the long run, death. Dr. Kamat adds that the remaining soluble portion of the immunoglobulin was unchanged by microwaves.

RADIO WAVES

Toward a safer level

The high-frequency radio band, which is below the microwave level, has been the least explored from the standpoint of hazardous biological effects. In an attempt to determine the radiation levels that would be harmful to tissue, Dr. George C. Henny of Temple University irradiated rats with an electric field and a magnetic field.

The electric field produced three times the pathological damage of the magnetic field for the same amount of energy. Dr. Henny found that the higher the frequency,

the greater the damage, which showed up as injury to blood vessels and serum seepage into liver and lung tissue.

Dr. Henny's next step will be to work back down from the high levels (14 megahertz) to find a safer level that can be used for communication.

CYTOLOGY

Mammalian chromosome damage

Microwave damage to mammalian chromosomes was reported by Dr. Kenneth T. S. Yao and Mayme M. Jiles of the U. S. Public Health Service's Bureau of Radiological Health, Rockville, Md. Chromosomes of kangaroo cells exposed to high-energy microwaves for 10 minutes at a distance of 10 centimeters broke, dilated, uncoiled and stuck together, the amount of damage increasing with exposure time.

The percentage of cells with damaged chromosomes grew to a high of 26 percent after 48 hours. The researchers also found that although powerful doses of microwaves inhibit cell growth, small amounts promote it.

MICROWAVE PATTERN

Irregular shape indicated

Scientists have assumed that the heat pattern formed by microwaves from a circular antenna was uniform and doughnut shaped. Work by Dr. Robert S. Pozos of the University of Tennessee indicates that this is not so.

The first indication came when rats exposed to microwaves died at different time rates, depending on their position within the pattern. To map the microwave pattern, a simple medium of cornstarch and water in the form of a gel was used. Thermometers placed in the gel detected irregular hot spots which indicated a nonuniform microwave pattern. One part of the doughnut was hotter than another.

Applying the results of the gel study to rats, Dr. Pozos found—using surface thermistors (electrical thermometers)—that two hot spots appeared on rats placed across the microwave antenna: one spot at the throat and the other in the intestinal region. Rats placed across the pattern at another angle showed no such effect.

Dr. Pozos postulates that the blood selectively heated in the throat contributed to death by overheating the brain.

GENERATORS

Electromagnetic effects on workers

Pulsating generators are worse culprits than continuously working generators in producing complaints from workers, reports Dr. Karel H. Marha of the Institute of Industrial Hygiene and Occupational Disease, Praha, Srobarova, Czechoslovakia. The workers' complaints include a decrease in sexual potency, headaches, memory and hearing losses and changes in the menstrual cycle.