DIGEST of the 1961

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THURSDAY, JULY 20, 1961 . . . . . 9:00 A.M. . . . . GRAND BALLROOM

SESSION 21. Biological Effects of Microwaves I (Athermal aspects)

21-1. Changes in Micromolecules Produced by Alternating Electrical Fields

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A GOOD DEAL OF WORK has been done with respect to the absorption of electromagnetic energy in solutions of various macromolecules, particularly proteins. Anomalous dispersions in dielectric constant and conductivity in such solutions have shed light onto molecular shapes and sizes, and onto such factors as the degree of hydration.

There is fragmentary evidence also of the production of actual changes in such molecules by exposure to high frequency electrical fields.

Such factors as temperature and viscosity have been shown to be important in determining whether or not changes will occur at a given frequency.

However, the production of gross changes in a narrow frequency range at low power with failure to produce changes at much higher powers in a closely adjacent region of the radio frequency (rf) spectrum has never been demonstrated clearly.

This paper describes changes in the electrophoretic pattern and the antigenic reactivity of human gamma globulins exposed to rf energy in the frequency range of 10 to 40 megacycles and it describes changes in the activity of crystalline amylase exposed in the range of 10 to 20 megacycles.

The gamma globulins were exposed in a 2.2% buffered solution in a chamber with two silver electrodes forming the sides. About 3,000 exposures have been made at various power levels.

Electrophoretic changes and increases in antigenic reactivity have been found to occur in several narrow regions of the spectrum; around 10.6, 11.3, 11.6, 13.1, 13.2, 13.3, 13.4 and 14.4 megacycles when the temperature was kept constant at 37.5°C.

Preliminary work on dilute crystalline amylase (from hog pancreas) indicates that this enzyme can be completely deactivated when exposed to certain frequencies around 12, 14, 15, and 16 megacycles, again at 37.5°C. These exposures were made in a test tube surrounded by a constant temperature water jacket which was in turn surrounded by a coil which was part of a circuit resonant at the operating frequency. The input signal was tapped down on the coil to a point where the voltage standing wave ratio was very close to 1:1. The power absorption was such that no detectable temperature rise occurred during exposures.

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SESSION 21. Biological Effects of Microwaves I (Athermal aspects)

21-2. Non-Tnermal Effects of Radio Frequency in Biological Systems

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NON-THERMAL EFFECTS OF radio frequency have been explored in this laboratory. Experiments have been carried out on inert materials, but primary interest has been devoted to living biologic systems. These include viruses, bacteria, plants, protozoa, mammalian cells, and tumors.

Some work has also been carried out at the molecular level primarily involving biological macromolecules. The radio frequency is pulsed in order to reduce dielectric heating to a point where it is not significant biologically. In addition to being able to orient both parallel to and at right angles to the lines of force, intracellular changes occur involving a variety of chromosomal abberations and mutations.

Cytological changes in dividing cells which occur following treatment with radio frequency include a wide variety of mitotic abberations including anaphase bridges and fragments, deletions, non-disjunction, etc. Spindle inhibition and C-mitoses also were observed. Many chromatids showed irregularities in their configuration. Interphase nuclei were joined by wide chromatin bridges. At 24 and 48 hours after exposure many cells exhibited micronuclei lethals and dominant visible mutations. Elimination of dividing cells through production of chromosomal aberrations could provide a tool for cancer study and control.

The frequency specificity and the importune of voltage threshold become quite obvious in many of these phenomena. For many systems it appears to be a peak power dependent series of events. Comparable experiments with high frequency AC magnetic fields will also be described. In addition to the biological effects, some theory will be explored in relation to the observed phenomena.

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