



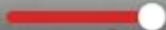
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DEFENSE INTELLIGENCE AGENCY



BIOLOGICAL EFFECTS OF ELECTROMAGNETIC RADIATION (RADIOWAVES AND MICROWAVES) EURASIAN COMMUNIST COUNTRIES (U)

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**PREPARED BY U.S. ARMY
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SECTION II

BIOLOGICAL SIGNIFICANCE OF RADIOWAVES AND MICROWAVES

PART 1 - BLOOD

(U) Effects of electromagnetic irradiation on the blood include biochemical variations, effects on erythrocytes, changes in coagulation, and alterations in the blood forming system. As would be expected, most communist country reports originate from in vitro or in vivo animal experiments rather than from human data.

(U) Long-term ultrahigh frequency (UHF) exposure in rats reportedly reduced the iron and copper content in both the blood and muscle with a concomitant increase in iron content in the liver. Similar exposure in chicks caused an increase in total proteins and globulins, but decreased the albumin in the plasma. Rats exposed to 0.04 W/cm^2 for 25 days demonstrated similar shifts. In some studies with dogs, irradiation with microwaves significantly decreased the lifetime of erythrocytes, while other studies showed no effect. In the case of humans, the only study of exposure to microwaves showed a decrease in the number of erythrocytes and hemoglobin. The authors concluded that the exposure was "not enough to impair the functional performance of humans. However, they are

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(U) The primary concern of the present study was with electromagnetic field effects, but numerous reports regarding the effects of constant magnetic fields on the blood system were noted during the review. As with electromagnetic effects, effects on coagulation, biochemical properties, and formed elements were observed.

(U) To summarize the effects of electromagnetic radiation exposure on the blood, the following general changes emerge although conflicting reports are also present:

- (1) General decrease in hemoglobin content.
- (2) Generally reduced coagulation times.
- (3) Decrease in leucocyte count.

These findings are based largely on animal experimentation. While detrimental in themselves, the extent of these changes would not be expected to be great enough to materially affect an individual's performance or general health, especially under stress conditions, where other factors

such as physiological protective responses would be far more important.

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(U) Histological techniques have been used extensively for evaluating the effects of electromagnetic radiation on cellular systems. Such studies have included in vivo investigations of the cellular effects resulting from whole body irradiation and in vitro studies employing cell cultures.

(U) The most popular cells for study appear to be those of rat or mouse liver. Nonthermal effects on subcellular structures include the formation of binuclear cells and irregular thickening of the nuclear membrane. Invagination of cytoplasm into the nucleus has also been observed, frequently accompanied by breaks in the nuclear membrane. Marked changes in the endoplasmic reticulum and the mitochondria have also been noted. The available data, although still insufficient and inconclusive, seem to indicate that the magnitude of these effects is frequency dependent.

(U) The liver cells of rats exposed for three hours to a 1.625 MHz field showed damage to the protein synthesizing structures. Distinct changes were seen in the nucleoli or ribosome synthesizing apparatus. The ultrastructure of mouse liver cells was investigated after exposure to the same frequency. The mitochondria became swollen and underwent lysis. Some giant mitochondria also appeared. The cellular reactions observed were largely the same as those observed after the action of many other environmental factors.

(U) Phagocytic function has reportedly been increased by exposure to an electromagnetic radiation field and induction of calciferol synthesis has

PART 4 - CENTRAL NERVOUS SYSTEM

(U) Research on the effects of radiowaves and microwaves on the central nervous system of humans was relatively widespread. A number of reports are discussed in this section, as well as research results regarding central nervous system effects on animal models and isolated nerves.

(U) Subjects exposed to microwave radiation exhibited a variety of neurasthenic disorders against a background of angiodystonia (abnormal changes in tonicity of the blood vessels). The most common subjective complaints were headache, fatigue, perspiring, dizziness, menstrual disorders, irritability, agitation, tension, drowsiness, sleeplessness, depression, anxiety, forgetfulness, lack of concentration.

(U) Various neurological disorders were investigated by studying the vestibular and visual analyzer functions in persons exposed to radio waves of varying types for various periods. Elevation of the threshold of excitability was also accompanied by a lengthening of the time required for dark adaptation. The magnitude and intensity of the changes tended to increase with length of exposure. Similar studies showed increases in the threshold of olfactory sensitivity. EEG automatic frequency analysis was performed on 80 persons exposed to one meter wavelength radiation and 80 healthy controls. No differences were found between the exposed group and the controls regardless of length of the exposure, intensity of the field, or frequency. Presumably, all of these exposures were of a nonthermal nature. Conversely, thirty-seven persons

during microwave irradiation were also characterized by a much faster increase, followed by a sharp drop to below the original level after irradiation and essential recovery in three minutes. In a series where the temperature increased to 31°C, the microwave effect at first was the same as the thermal effect; after thirty seconds the BA value was even lower than for the thermal effect alone, possibly due to overlap of ionic currents at such high temperature. This was followed by a substantial drop after irradiation, and very little recovery in three minutes. The differences in results in this series were attributed to different initial conditions of the preparations.

(U) These experiments indicate that microwaves may have a specific effect of a nonthermal nature on EC and BA, causing sharp and reversible changes in these functional parameters of nerve impulse. Further experimentation will be needed before extrapolations of similar functional changes to in vivo conditions, or to humans, are attempted. It is expected that Soviet research on these and other CNS responses will continue during the next five years.

PART 5 - DIGESTIVE SYSTEM

(U) A number of alterations in the function of the gastrointestinal system were observed. Reportedly, exposures of subjects working for long periods of time in the presence of low intensity centimeter and decimeter waves resulted in numerous disorders. These included dyspeptic disorders,