Part VI. Dosimetry

0522 CONTRAST OF DOSE DISTRIBUTION IN PHANTOM HEADS DUE TO APERTURE AND PLANE WAVE SOURCES. *(E.)* Ho, H. S. (Bur. Radiol. Health, HEW, Rockville, Md.). *Ann. N.Y. Acad. Sci.* 247, 454-472, 1975.

The determination of dose rate patterns in biologic bodies provides a simple, useful indication of the interaction between tissues and EMFs. Theoretical calculations of dose rate patterns for phantom heads of monkeys and humans irradiated by both aperture and plane wave sources were compared. A 5 layered tissue equivalent sphere was also used to simulate the monkey head tissues more closely. A study of the dose rate patterns in the 5 layered head indicated that absorbed EM energy was primarily concentrated in the skin layer with weak penetration of the brain region. This skin heating may have served to mask out penetration of the EM energy into the deeper brain region. Drastic differences were seen when dose rate patterns of phantom heads were compared using the two sources; hot spots present in the plane wave irradiation were not present in aperture treatment and penetration of absorbed EM energy was weaker for the aperture case. The exposure fields of both sources were different, however, so results could not be directly compared. The amount of energy absorbed depended both on subject size and radiation source. The calculations also indicated that for the same exposure field detected by a survey meter, different EM absorptions may occur in a human head according to the source used. Research is needed to determine dose rate patterns in phantom heads that simulate actual heads most closely. Preliminary findings indicate general agreement between calculated and experimental results from aperture exposure. It is concluded that for different radiation sources, direct comparison of biological results by external field measurement may not be dosimetrically valid; for the same power density, the energy absorbed by a human head may vary according to the type of radiation source. (6 references)

0523 MICROWAVE ENERGY DISTRIBUTION MEASUREMENTS IN PROXIMITY TO MAN AND THEIR PRACTICAL APPLICATION. *(E.)* Beischer, D. E. (Naval Aerosp. Med. Res. Lab., Pensacola, Fla.) and V. R. Reno. *Ann. N. Y. Acad. Sci.* 247, 473-480, 1975.

Measurements of MW field strength in the immediate proximity to man were made. Radiation may be scattered, transmitted, reflected or absorbed by the body. A radiation system which furnished an approximate plane wave was used and the radiation scattered by man at 30 $\mu W/cm^2$ was measured using CW, PW, or swept frequency radiation between 1 and 12.4 GHz. Measurements were obtained in well defined EMFs from a cylinder, a conducting mannequin, man, and a reference field. The maxima of the standing wave in front of man had a different characteristic from the mannequin or metallic cylinder, with the intensity of the maxima diminishing with distance at a much slower rate, possibly due to man's dielectric composition. The parabolas formed by man and the mannequin nearly coincided, indicating that positions of the maxima were size and shape dependent rather than dependent on the dielectric constant. These measurements have several practical applications: (1) Consideration of the process of reflection and scattering may assist the biologist in planning irradiation experiments with living material; (2) It seems possible to develop quantitative measurements of scattered radiation at both the body surface and interior boundaries of man; (3) Comparisons of scattering by different size objects can furnish valuable information on the validity of purely dimensional scaling; (4) The question of distances between objects necessary to avoid interference by scattering may be solved with the shadow used to advantage for positioning equipment without disturbing the field; (5) Scattering must be considered in reading radiation probes as an isotropic probe will read a variety of values depending on its distance from the sample; and (6) From direct measurements of scattered, reflected, and transmitted radiation, information can be gained about absorbed energy in the biosystem, verifying extrapolations from static models and possibly replacing them. (6 references)

0524 A MINIATURE BROAD-BAND ELECTRIC FIELD PROBE. *(E.)* Bassen, H. (Bur. Radiol. Health, HEW, Rockville, Md.), M. Swicord, and J. Abita. *Ann. N.Y. Acad. Sci.* 247, 481-493, 1975.

A miniature broad-band electric field probe was developed for measuring the total electric field with a flat frequency response from 915 MHz to above 10 GHz in free space. The small probe will also be used for measuring fields within animal tissue or tissue equivalent materials at frequencies below 3 GHz, where the foreshortened wavelength makes microminiaturization imperative. The design employs three orthogonal dipoles with discrete diode detectors having high-resistance leads; the latter, which convey the detected signal to appropriate readout electronics, cause minimum scattering of the field and thus do not disturb the isotropicity of the receiver. The basic probe configuration is discussed with respect to isotropic reception and minimal field interaction requirements, dipole array, I-beam configuration, diode detector, high-impedance leads, and fabrication. Data are presented for dipole pattern and polarization tests at 2450 MHz, dynamic response at power densities from 20-100 mW/cm^2 and outputs of 18 and 145 mV, frequency response from 915 MHz to 10 GHz, and crosspolarization of the dipole with the electric field. Probe readout electronics are summarized and planned modifications of the probe are noted. (3 references)

0525 MEASUREMENTS OF POWER ABSORPTION BY HUMAN PHANTOMS IMMERSED IN RADIO-FREQUENCY FIELDS. *(E.)* Allen, S. J. (Radiobiol. Div., U.S. Air Force Sch. Aerosp. Med., Brooks Air Force Base, Tex.). *Ann. N.Y. Acad. Sci.* 247, 494-498, 1975.

Experiments were designed to measure the energy absorption of a human phantom exposed to HF band (10,

20, and 30 MHz) RF radiation fields. A rectangular Lucite phantom was loaded with Ringer's solution (8.6 g/l NaCl, 0.3 g/l KCl, and 0.33 g/l $CaCl_2$). The phantom was centered under the center conductor of the TEM mode RF exposure chamber. Uniform fields exist throughout a 4 x 20 x 2 ft exposure vol above and below the center conductor. The transmitter was operated at a constant power level in the CW mode and 3 sets of data were obtained for each frequency. There was no significant difference between data obtained with 50 W input power and with 13.8 kW input power when each was normalized to 1 mW/cm^2 incident power density. The technique provides a method of power absorption measurement in simulated far field conditions that can be used for many types of biological specimens. Further experiments will investigate effects of orientation, complex shape, and complex dielectric constants using prolate spheroid models. (4 references)

0526 FIELD MEASUREMENTS, ABSORBED DOSE, AND BIOLOGIC DOSIMETRY OF MICROWAVES. *(E.)* Phillips, R. D. (Biol. Dep., Battelle, Pacific Northwest Lab., Richland, Wash.), E. L. Hunt, and N. W. King. *Ann. N. Y. Acad. Sci.* 247, 499-509, 1975.

A comparison was made between the biologic effects produced by two microwave treatment arrangements at equivalent radiation doses: a multimodal resonating cavity system, in which the animal serves as the load and is exposed multilaterally; and a far-field exposure system in an anechoic chamber, in which the animal is exposed unilaterally to a well-defined incident field. Absorbed doses with cavity and far-field exposures were measured calorimetrically for three different sizes of rats. The total energy absorbed in a 1 min exposure for each watt of net cavity power increased with body mass. Mass absorption density (average energy absorbed/g) and area absorption density (average energy absorption/unit total surface area) decreased with an increase in body mass. With far-field exposure, the total energy absorbed/min per mW/cm^2 also increased with body mass. Mass absorption densities were the same for the two heaviest wt groups and slightly higher for the lightest wt group. Silhouette area absorption densities (average absorption/unit of shadow cross-sectional area) did not change with animal size. Cavity irradiation at an abosrbed dose rate of 11.5 mW/g for 30 min resulted in the death of rats within 24 hr; a similar response was observed in rats irradiated unilaterally in the far field at 8.3 mW/g for 30 min. With cavity irradiation, functional changes occurred within 1-3 hr after a 30 min exposure at 6.5-11.0 mW/g; these consisted of thermoregulatory overcompensation, a lowered metabolic rate, bradycardia, irregular heart rate, and incomplete heart blockage. None of these functional alterations were observed following 30 min far-field irradiations at comparable dose rates. Latency to convulsions, measured during cavity exposure of Wistar rats and C57BL/6J mice, was correlated with the average energy absorbed/unit mass. Comparison of energy absorption by rats and water models yielded different results for cavity and far-field exposures. With cavity irradiations, the mass absorption density is the appropriate unit for estimating absorbed doses with models. In unilateral far-field irradiations, the silhouette area absorption density is useful. These studies indicate that a safety standard based on incident field densities and on experimental data for far-field exposures may not be applicable under conditions of multilateral irradiation. (19 references)

0527 A PYROELECTRIC PROBE FOR MEASUREMENT OF MICROWAVE POWER DENSITY UNDER FAR-FIELD CONDITIONS. *(E.)* Huddleston, G. K. (Sch. Electr. Eng., Georgia Inst. Technol., Atlanta) and D. I. McRee. *Ann. N. Y. Acad. Sci.* 247, 510-526, 1975.

In experiments in which a biologic specimen is irradiated with a transverse electromagnetic (TEM) wave, the field parameter of interest is the EM power density (mW/cm^2) at the location of the specimen insertion. Investigative results are reported on the use of pyroelectric material in the realization of a probe to measure power density in the 2-12 GHz frequency band. This type of probe operates on the principle of energy absorption in a lossy substance rather than as an antenna *per se*. A pyroelectric crystal with a lossy substance applied to it serves as the absorber of MW energy and the detector of the same via the pyroelectric effect. A mathematical model of a pyroelectric detector is included together with a description of lossless and lossy probes and their associated instrumentation. The responses of these probes are compared with respect to square wave amplitude-modulated MW radiation at selected frequencies in the 2-12 GHz frequency band under far-field (TEM wave) conditions. The maximum responsivity (2480 $mV/mW/cm^2$) of the lossless probe was obtained at 8.2 GHz. Addition of lossy materials to the crystal enhanced the bandwidth of the pyroelectric probe but at the expense of maximum responsivity. Additional work is necessary to develop the potential of such probes fully. Further studies should include the development of an implantable pyroelectric probe for measuring volumetric power density inside biologic materials. (9 references)

0528 DISCUSSION PAPER: FIBEROPTIC LIQUID CRYSTAL PROBE FOR ABSORBED RADIO-FREQUENCY POWER AND TEMPERATURE MEASUREMENT IN TISSUE DURING IRRADIATION. *(E.)* Johnson, C. C. (Dep. Bioeng., Univ. Utah, Salt Lake City), C. H. Durney, J. L. Lords, T. C. Rozzell, and G. K. Livingston. *Ann. N.Y. Acad. Sci.* 247, 527-531, 1975.

A temperature probe, which employs fiberoptics to transmit information to and from a liquid crystal sensor tip, has been designed to be transparent to EMFs in tissue. The probe is sheathed in polyvinyl chloride and the liquid crystal is encapsulated between 2 nested glass cups. The device should solve many dosimetry problems and should allow calculation

of local absorbed RF power density by measuring the rate of change of tissue temperature rise. The probe has a sensitivity of 20-40 mV/C. It gives reproducible results over an 8 hr period with absolute and relative temperature calibrations of 0.25 and 0.1 C. It has been shown to measure the rate of tissue temperature change with time accurately, and to perturb the tissue fields minimally. Tests are being performed in various laboratories to identify problems which may arise with different types of biological experiments. (No references)

0529 DISCUSSION PAPER: STRONG DEPENDENCE OF WHOLE ANIMAL ABSORPTION ON POLARIZATION AND FREQUENCY OF RADIO-FREQUENCY ENERGY. *(E.)* Gandhi, O. P. (Electr. Eng. Dep., Univ. Utah., Salt Lake City). *Ann. N. Y. Acad. Sci.* 247, 532-538, 1975.

A 2-plate stripline was used to generate plane wave fields to measure wide-band RF absorption of biological systems. Absorption characteristics of 96 390 g Wistar rats, 25 g mice and brain phantom prolate spheroid bodies were measured at 100 frequencies in the 285-4000 MHz region. For the 3 orientations $\hat{E} \parallel \hat{a}$, $\hat{H} \parallel \hat{a}$, and $\hat{k} \parallel \hat{a}$, a strong orientation effect is observed with $\hat{E} \parallel \hat{a}$ being the most absorbing. Peak absorption in the $\hat{E} \parallel \hat{a}$ configuration occurs at the lowest frequency of the 3 orientations. Experiments with free space plane wave irradiation at 1700 MHz to heat saline-filled prolate spheroid bodies collaborate the main features of the stripline results. The values of the relative absorption coefficient S measured by the stripline are consistent with the value obtained for the free space irradiation, confirming the viability of using the stripline to determine broadband absorption characteristics. RF power deposition is found to vary significantly with orientation and frequency. Absorption at resonance for the $E \parallel \hat{a}$ orientation may be greater by a factor of 10 or more than for other configurations. By extrapolation, important frequencies for absorption for humans are 40-55 MHz for $\hat{E} \parallel \hat{a}$ and 135-165 MHz for the other 2 configurations, implying that whole animal absorption is size and shape dependent. (5 references)

0530 FUTURE RESEARCH DIRECTIONS AND NEEDS IN BIOLOGIC ELECTROMAGNETIC RADIATION RESEARCH. *(E.)* Guy, A. W. (Sch. Med., Univ. Washington, Seattle). *Ann. N. Y. Acad. Sci.* 247, 539-545, 1975.

There is an urgent need for international cooperation in developing a quantitative scientific data base, from both a physical and biological standpoint, on which to evaluate biological hazards of EMR. The interaction of EM fields with biologic tissues is a function of the magnitude of the electric and magnetic fields, stored energy in these fields, tissue configuration and composition, frequency, environmental factors, etc. There is a lack of knowledge concerning the internal field distributions which produce radiation effects in biologic objects. The effect of biological instrumentation on the EM fields in the animals and vice versa is important, but little in known about it. More must be learned about extrapolating *in vitro* studies to the establishing of safety standards. International adoption of the following suggestions would help resolve and quantify problems which have developed: (1) techniques for measuring near-zone field components should be standardized; (2) methods to determine what field, absorbed power density, or current density will be induced by various fields with known parameters should be established; (3) standardized EM sources and exposure chambers should be developed; (4) standard biological specimens, containers, and restraining apparati should be agreed on; (5) methods to record biological potentials without disturbing the induced field should be improved; and (6) rationale for quantitative extrapolation of information from animal exposure to human exposure should be developed. A working team of biological and physical scientists and engineers with a thorough training in the field are necessary, as are good laboratory facilities. Close collaboration between laboratories and among nations should be encouraged for maximum utilization of specialities and facilities available. (1 reference)

0531 CURRENT MICROWAVE STUDIES. APPENDIX I. *(E.)* Schwan, H. P. (Dep. Biomed. Eng., Univ. Pennsylvania, Philadelphia) and H. N. Kritikos. *Off. Naval Res. Rep.*, Contract No. N00014-67-A 0216-0015, 1971, 10 p, NTIS: AD/A-001 409.

Two sets of experiments have been performed, the first to compare and evaluate pulsed *vs* continued fields of the same average power and the second to study the possibility of creating "hot spots" in tissues by MW irradiation. Studying field evoked force effects, including pearl chain formation and other effects which alternating fields have on small particles, it was concluded that unless fundamental thermodynamic principles are violated, any reversible effect takes place in accordance with the average value of the applied field, and continuous fields are the most efficient. In the second study a computer was programmed to evaluate the heating potential in a spherical object filled with tissue which has dielectric properties similar to cerebral tissues. The computer was to search for "hot spots" in this model of the brain. Using a head with a radius of 5 cm (monkey size), a hot spot of substantial magnitude was created inside the head and occurred from 150 to 3000 MHz. When a larger model (10 cm radius) typical of man was considered, the hottest spot was always at the surface of the head facing the radiation source. Thus, for small objects hot spots definitely exist, but none are anticipated for the human head as MWs become too attenuated to create resonances. Little can be learned about MW hazards for man from small animal experiments. (No references)

0532 EFFECT OF 2450 MHz MICROWAVE RADIATION ON HORSERADISH PEROXIDASE. *(E.)* Henderson, H. M. (Dep. Food Sci., Univ. Manitoba, Winnipeg, Canada), K. Hergenroeder, and S. S. Stuchly. *J. Microwave Power*, 10(1):27-35, 1975.

To test the possible use of MWs in dry blanching techniques, their effects on peroxidase, which has high thermostability and is involved in undesirable oxidative changes in food flavoring, was studied. Solutions (2.0 g/ml water) of horseradish peroxidase were made up immediately prior to use. Control samples were run identically to test samples in the same MW equipment, but in the absence of MW radiation. The sample system was designed to maintain sample temperature at 25 C during the exposure period and to allow measurement of MW power dissipated in the sample. The peroxidase was subject to MW radiation of a power density range of 62.5 - 375 W/cm^3 from 5 to 40 min. Temperatures were maintained within ± 2 C. Exposure to MW radiation for 5 min resulted in steadily decreasing activity with a 20% loss on exposure to 375 W/cm^3. Longer time periods and higher power densities resulted in greater losses. Inactivation was 96.2% at 250 W/cm^2 and 30 min exposure; however, total inactivation was never obtained. There were no statistically significant differences between MW power absorption and conventional heating methods. Although the sample temperature was macroscopically kept constant at 25 C, enzyme destruction could conceivably be due to local heat denaturation. Significant inactivation is possible at room temperature, but the required radiation doses are very high and have no practical utilization. (24 references)

0533 EVALUATION OF THE EFFECT OF AN ELECTROMAGNETIC FIELD OF THE MODERATE WAVE LENGTH RANGE ON HEALTH IN POPULATED AREAS. *(Rus.)* Mukharskii, M. S. (A. N. Marzeev Res. Inst. Gen. Communal Hyg., Kiev, USSR). *Vrach. Delo* (1):118-121, 1975.

Measurements made at distances of 100-1000 m from the antennas of radio stations transmitting at moderate wave lengths showed that field intensities ranged from 0.2-56 W/m. Studies of male albino rats exposed continuously to the same type of radiation for 120 days at intensities of 5, 10, 20, 35, and 140 W/m demonstrated that weight gains were inversely related to field intensity; this effect was most evident in the third month of the experiment. Field intensities of 20, 35, and 140 W/m inhibited the development of conditioned reflexes to a number of weak stimuli. This effect depended upon the length of exposure and was most pronounced at the greatest field intensity. While this radiation had no effect on the RBC, it produced significant changes in the WBC at an intensity of 140 W/m and in the eosinophil count at intensities of 20 W/m or greater. Cholinesterase activities in the blood decreased significantly in rats irradiated with 140 W/m for more than 2 mon; normalization occurred 2 mon after exposure was discontinued. Exposure to an intensity of 140 W/m also reduced blood glucose levels and liver glycogen contents and increased liver lactic acid contents, suggesting that RF radiation causes disorders in glycogen synthesis in the liver. Morphological examination of the rats revealed dystrophic changes in the nervous system, parenchyma of organs, and regenerative epithelium of the testes. Proliferative changes in the brain and reticuloendothelial cells in the liver and hyperplasia of follicles in the spleen with the appearance of less mature cells suggests that exposure to radio waves interferes with protective and adaptive processes in the body. Examinations of children and adults living near radio stations broadcasting at moderate wave lengths confirm that this radiation has a deleterious effect on the CNS in children, interferes with immunity, and has some tendency to cause disorders in protein metabolism. On the basis of this study, it is proposed that the maximum permissible field intensity for populated areas be 10 W/m. (No references)

0534 MICROWAVES AND BEHAVIOR. *(E.)* Justesen, D. R. (Lab. Exp. Neuropsychol., VA Hosp., Kansas City, Mo.). *Am. Psychol.* 30(3):391-401, 1975.

Psychologists are interested in biological studies of EMFs because the CNS is considered to be a biological amplifier whose behavioral response is a very sensitive indicator of reactivity to EM energy. Scientists, with no satisfactory theory of the role of intrinsic electrical events in organisms, lack an understanding of basic electrobiological mechanisms. Photon energies of RF radiation are very small, but exposure to high densities can result in excessive heating. MW energy penetrates deeply into tissue and may do much damage before being detected. Eastern Europeans have interpreted results of animal studies and case histories of people chronically exposed to low level MW radiation as resulting in a neurasthenic syndrome. No reliable evidence of this syndrome was ever reported in the U. S. However, Frey has reported that humans can "hear" MW energy at levels much lower than those of current safety standards, probably due to some form of thermoacoustic transduction. Also it has been shown that the total energy absorbed by phantom models is sometimes much higher than that predicted by measuring the density of the MW field. There may be EM receptor and transmitter systems in the human comparable to or greater than either the visual or auditory although there are no known EM emissions to warrant more than guarded speculations. (47 references)

0535 HEALTH ASPECTS OF RADIOFREQUENCY ELECTROMAGNETIC RADIATION. *(Ital.)* Grandolfo, M. (Higher Inst. Health, Rome, Italy). *Res. Rep.*, No. N75 13511, 1974, 29p.

The dielectric properties of various tissues exposed to MWs, the pathological effects of MW exposure, and current standards for MW exposure are reviewed.

While empirical expressions have been formulated to calculate the dielectric constant, ε, for tissues containing large amounts of water (blood and some fatty tissue), this cannot be done for tissues containing little water (subcutaneous fat, bone, and bone marrow) because of inadequate knowledge of the various forms of water "bound" to the surface of macromolecular constituents of these tissues. When the dielectric properties of a tissue are known, it is possible to evaluate absorption coefficients and the depth to which radiation penetrates. The index of effective penetration, defined as the ratio between total energy absorbed and incident energy, is also useful in analyzing these phenomena. Exposure to MW radiation can produce changes in the blood, gonads, eyes, and CNS as well as serological changes. These changes are attributed primarily to the conversion of MW radiation into heat, but nonthermal effects have also been implicated. In the USA and many Western European countries, 10 mW/cm^2 is recommended as the maximum acceptable level for a continuous 8 hr work day, and 1 mW/cm^2 is recommended by some organizations as the maximum level for continuous exposure or for the civilian population. In the Soviet Union and some Central European countries, lower values are recommended because more emphasis is placed on the importance of nonthermal effects of MW radiation. (8 references)

0536 MICROWAVE OVENS: WHAT'S COOKING? *(E.)* Mennie, D. (Assoc. Ed., *IEEE Spectrum*, Piscataway, N.J.). *IEEE Spectrum*, 34-39, March, 1975.

MW ovens are becoming a normal household appliance. They are much more efficient than standard ranges because they heat only food, which has a high water content, while electrically neutral containers and cookware remain cool. There is much controversy, led by Consumer's Union (CU), over acceptable guidelines for MW ovens due to lack of consistent repeatable results related to longterm biological effects of exposure to low level radiation. Work is now being coordinated by OTP to assess biological hazards of NIR emphasizing low level effects over extended periods of time. CU wants a warning label on every oven to include: (1) warning against operating the oven empty, (2) instructions to unplug after use, (3) instructions on the importance of clean door seals, (4) warning to those with pacemakers, (5) instructions on the importance of keeping the face away from the door when the oven is on, and (6) warning against use by children. The Association of Home Appliance Manufacturers (AHAM) objected and presented guidelines to place warnings in the first 10 pages of the users' manual. The BRH is evaluating all proposals and will announce legally binding recommendations evolving from all suggestions. (No references)

0537 EFFECT OF MICROWAVE RADIATION ON THE CONTENTS OF COPPER, IRON, AND COBALT AND METALLOPROTEINS BOUND TO THEM IN THE ORGANS AND TISSUES OF EXPERIMENTAL ANIMALS. *(Rus.)* Mints, S. M. (Med. Inst., Ivano-Frankovsk, USSR) and V. G. Lazarovich. *Gig. Tr. Prof. Zabol.* (2):54-55, 1975.

Albino rats were exposed for 10 min/day to 60 mW/cm^2 SHF (λ = 12.6 cm) radiation for 28 days. By day 14, the Fe content of the liver had increased by 28%, apparently due to decreases in the Fe content of muscle and blood and to a decrease in the Fe saturation of transferrin in the serum. The Cu content of muscle and blood increased more than 1.5-fold, while that of bone decreased throughout the experiment. No appreciable change occurred in the Cu content of the liver or serum ceruloplasmin activity. Blood and bone Co contents decreased significantly. During the first 14 days, the Co content of liver and muscle decreased and then, toward the end of the experiment, increased but failed to reach normal levels. It is suggested that radiation induced changes in Fe, Cu, Co, and metalloprotein metabolism are due to radiation induced disorders in hematopoiesis and protein and lipid metabolism and to some enzymatic and functional changes. (6 references)

0538 MYSTERY. *(E.)* Aaronson, T. (no affil.). *Our World in Peril: An Environment Review*, S. Novick and D. Cottrell, Ed., Fawcett Premier Publishers, pp 256-270, 1971.

This article for an environmental review book summarized existing knowledge of MW radiation and explained the difference between U. S. and USSR standards. It pointed out the increasing use of MW radiation, in particular in MW ovens and emissions from TV antennas, and suggested that concentrated research should be undertaken to find what levels may be a potential danger to human health. (24 references)

0539 THE SAFE TREATMENT OF FOOD SUPPLIES WITH HIGH-FREQUENCY HEAT. *(Ger.)* Hafner, T. (no affil.). *Brown Boveri Mitt.* 62(1/2):52-55, 1975.

From pilot plant experiments on wheat and rice, it has been demonstrated that these food products can be successfully sterilized by HF heating. Although the initial temperature of the grain can vary, the temperature at the outlet of the HF generator should be held constant between 60 and 66 C to kill off insects, insect eggs, and molds. The grain must then be cooled to room temperatures below 45 C. No changes occur in the appearance of the grain or in its vitamin content, germination, or baking and cooking properties. Excellent results have also been obtained with both packaged and unpackaged flour, flour products, and oat flakes. The amount of heat required for sterilization depends upon the dielectric constant of the material and the loss factor. Depending upon the dimensions of the condensor, the HF generators operate at frequencies of 13.56 or 27.12 MHz and are provided with filters to suppress harmonic frequencies. Before heating in

the HF generator, grain must be pretreated to remove foreign material and metals to prevent obstruction of the electrodes and interference with the high-frequency field. (No references)

0540 EFFECT OF MAGNETIC, ELECTRICAL, AND GRAVITATIONAL FIELDS ON THE TUNNEL BUILDING OF TERMITES. *(Ger.)* Becker, G. (Fed. Inst. Material Testing, Berlin-Dahlem, Germany). *Umsch. Wiss. Tech.* 75(6):183-185, 1975.

It has been demonstrated that the directions in which termites build their tunnels can be changed by using a Helmholtz coil to compensate for or change the direction of the earth's magnetic field. Among other factors, the feeding activity of termites is apparently affected by "atmospherics" (10 kHz radiation from lightning discharges). No relation has been found between their feeding activity and tunnel building, but both activities are affected by various physical factors, particularly changes in electrical field. When termites are shielded with aluminium plates or copper sheets, tunnel building in a vertical perpendicular upward direction is significantly reduced while feeding activity follows a different pattern. The effect of slight changes in the magnetic field on tunnel building has yet to be investigated. (8 references)

0541 THE EFFECT OF A HIGH-INTENSITY SUPER HIGH FREQUENCY FIELD ON BLOOD CLOTTING. *(Rus.)* Ivanov, V. I. (no affil.), B. V. Maleniuk, and L. N. Kriukova. *Voen. Med. Zh.* (5):54-55, 1974.

Blood clotting parameters were studied in ten 3-yr-old mongrel dogs, weighing 11 - 13 kg, before and 10 min to 30 days after a single exposure to a pulsed SHF field (intensity 200 mW/cm^2, λ = 3 cm) for 5 min. The clotting time, clot retraction, platelet count, recalcification time, heparin tolerance, prothrombin time, fibrinogen content, and true heparin values were determined. These parameters returned to their original values by day 15 at the earliest and, in some cases, had not yet completely normalized by day 30. The changes were phase-like in nature: a tendency toward hypocoagulation after 10 min, after 2 hr, and again on day 8. A gradual decrease in the prothrombin time may have been caused by a drop in true heparin. It is suggested that radiation-induced changes in blood clotting might be secondary to disorders in CNS regulation. (No references)

0542 MICROWAVE THERAPY IN THE DECIMETER RANGE OF PATIENTS WITH RHEUMATOID ARTHRITIS. *(Rus.)* Tsarfis, I. G. (Inst. Balneol., Physiother., Moscow, USSR), A. A. Fiveiskii, V. D. Grigorieva, I. F. Rabotalova and G. V. Vasilieva. *Vopr. Kurortol. Fizioter. Lech. Fiz. Kult.* (5):411-415, 1974.

One hundred patients with rheumatoid arthritis (43 exudative and 57 proliferative cases) with a 1-20 yr history of the disease were exposed to MW radiation (65 cm, 460 MHz) at 40 - 55 W for no more than 25 min during 12 - 15 daily sessions. A Soviet-made Volna-2 apparatus was used with a rectangular 17 x 34 cm emitter. The distance between the emitter and the exposed area (D_{10} - L_4 area of the adrenal glands, the solar plexus and affected joints) was 3 - 4 cm. The cardio-vascular system was affected in most of the cases (myocardosis, atherosclerotic cardiosclerosis, high blood pressure and thyrotoxicosis). As a result of the treatment, the easing of pain and an increase in the bioelectrical activity was observed in 76% of the patients. The therapeutic effect of the MW irradiation was accompanied in most of the patients by an improvement of the gluco-mineralcorticoid function of the adrenal glands, activation of sympathico-adrenal system, an increase in the bioelectrical activity of the skeleton muscles and electrical activity of the heart. (No references)

0543 THE EFFECT OF MICROWAVE THERAPY IN THE CENTIMETER RANGE ON VEGETATIVE FUNCTIONS IN PATIENTS WITH MULTIPLE SCLEROSIS. *(Rus.)* Starostenko, L. I. (Belorussian Inst. Post-Grad. Med. Stud., Minsk, USSR), G. E. Bagel and I. I. Kardash. *Vopr. Kurortol. Fizioter. Lech. Fiz. Kult.* (3):230-233, 1974.

Twenty patients aged 20 - 40 years with multiple sclerosis were exposed to MW irradiation of the upper cervical sympathetic ganglions at 3 - 5 W power level for 2 - 5 min during 5 - 6 sessions. Ten patients had ataxia, intention tremor, scanning speech, hypotony and incoordination; six had symptoms of ataxia but could walk without help; four patients had slight ataxic disorders. Measurements were taken of the arterial pressure, cardiovascular reflexes, diagnostic dionine-adrenaline electrophoresis, histamine level in the blood, and ECG before and after the exposure. The results indicate that the arterial blood pressure went down from 170/80 - 110/70 mm before the treatment, to 130/80 - 100/70, after. At the same time, headaches and sympathico-adrenal crises disappeared, and the sensation of heat or chill in the extremities was relieved. A significant decrease was observed in the results of galvano-adrenal tests from 3.8 ± 0.3 cm^2 before the treatment, to 2.5 ± 0.25 cm^2 after (norm, 2.1 ± 0.1 cm^2). The time of the reaction went down from 98.3 ± 5.3 min to 60.4 ± 4.6 min (norm, 57.7 ± 4.3 min). ECG tracings showed changes in 11 patients, mostly in the alpha rhythm. It is suggested that low-dosage MW therapy in the cm wavelength range has a beneficial effect on patients and is to be recommended as part of combined therapy for predominantly cerebellar multiple sclerosis to relieve vegetative disorders. (17 references)

0544 MICROWAVE LENS EFFECTS IN HUMANS; II. RESULTS OF FIVE-YEAR SURVEY. *(E.)* Appleton, B. (Walter Reed Army Med. Cent., Washington,

D.C.), S. Hirsch, R. O. Kinion, M. Soles, G. C. McCrossan, and R. M. Neidlinger. *Arch. Ophthalmol.* 93(4):257-258, 1975.

Military active duty or civilian employees of the Department of the Army involved in work with MW equipment since 1943 have been given semiannual biomicroscopic examination of the lens of the eye. These examinations were given to 2343 subjects from November 1968 to September 1973. All personnel had histories of working with equipment using MWs, lasers, xenon arcs, UV lights, or welding equipment, or were in occupations considered eye-hazardous but not involving exposure to EM radiation. Controls were individuals who never worked with or near this equipment. Examiners were not aware of the exposure history of the subjects. Results showed no difference between the two groups. Conclusions are: (1) no lens damage due to MW radiation from military equipment occurred, and (2) the existing 10mW/cm^2 safety level and the degree to which it is enforced is adequate to protect humans from MW lens effects. (3 references)

0545 THE EFFECT OF SUPERHIGH FREQUENCY FIELD ON THE ACTIVITY OF CERTAIN ENZYMES AND PYRIDOXINE CONTENT IN THE ORGANS OF ALBINO RATS. *(Rus.)* Minaiev, V. V. (I. P. Pavlov Riazan' Med. Inst., USSR), N. V. Zhdanovich, Y. F. Udalov, and O. I. Bazilevich. *Gig. Sanit.* (3):11-14, 1975.

The effect of the SHF field on vitamin metabolism was studied in 48 albino male rats weighing 140-150 g on a normal diet. Twenty-four animals were given daily 4-desoxypyridoxine (25 mg/kg) to produce pyridoxine deficiency. Half the animals from each group were exposed to 2,000 MHz at 570 μW/cm^2 for three hours. The results indicate the SHF exposure reduced pyridoxine content in the blood, brain, kidneys and heart, while increasing it in the skeletal muscles. In vitamin B_6 deficient animals, SHF field induced the redistribution of pyridoxine in the body: pyridoxine content rose in the brain tissues, heart and muscles, while it fell in the liver, kidneys and blood. In the exposed animals, the activity of aspartase-aminotransferase decreased while that of alanine-aminotransferase increased. In the vitamin deficient animals, the activity of both enzymes tended to decrease. The activity of succinic dehydrogenase fell under the action of SHF field, but pyridoxine deficiency did not affect the enzyme activity. It is suggested that continuous exposure to SHF fields may reduce vitamin supply to the organism. (9 references)

0546 THE EFFECT OF UHF, SHF, ULTRASOUND AND ULTRASOUND IN COMBINATION WITH MICROWAVE THERAPY ON THE PROTEIN CONTENT IN THE BLOOD SERUM OF PATIENTS WITH CHRONIC TONSILITIS. *(Rus.)* Krushevskaia, I. I. (Minsk Med. Inst., USSR) *Zh. Ushn. Nos. Gorl. Bolezn.* (3):69-71, 1974.

Studies of the changes in the albumin composition of sera were conducted on 120 children aged 6-15 years with chronic tonsilitis treated with UHF, SHF, ultrasound (US) and US in combination with MWs. The children were divided into 5 groups: (1) 20 controls; (2) 25 children treated with UHF; (3) 25 children treated with SHF; (4) 25 treated with US (5) 45 treated with US in combination with MWs. Proteinograms of the healthy children showed the average total protein content at 7.53 g%; albumins, 57.46%; α_1, α_2, β & γ globulins, 3.21, 9.76, 11.90 and 17.49, resp.; albumin/globulin coefficient was 1.36. Before the treatment, the children with decompensation form of chronic tonsilitis had elevated protein content of 9.73 g%; decrease in the albumin content to 47.9%; increase in α-globulins to 7.1%, α_2-globulins to 10.77%; α-globulin fraction was up to 20.71 - 23.93%. Thirty-seven patients had a/g coefficient down to 0.95. Fourteen days after the treatment the proteinograms of the children with tonsilitis approached those of the healthy children in all the groups. Particularly good results were obtained in group 5 where 39 patients showed improvement. It is suggested that US in combination with MW is the most effective method of treating chronic tonsilitis. (11 references)

0547 EXPRESS METHOD FOR VISUALIZING THE STRUCTURE OF THE SHF FIELD. *(Rus.)* Sevastianov, V. V. (no affil.) *Voen. Med. Zh.* (12):53-54, 1974.

Express method for visualizing SHF structure is based on the ability of cobalt chloride mixed with hemamethylenetetramine ($CoCl_2 \cdot 5H_2O + C_6H_{12}N_4$) to change its color from red to blue when exposed to an EM field. SHF-sensitive thermoactive paper was developed by impregnating chromatographic paper with an aqueous solution of cobalt chloride. Exposure to SHF radiation altered the moisture content of the test paper and consequently its color. Tests showed that distinct indications of SHF field were visible when the paper was exposed at 500-550 mW/cm^2 for 2 min. and at 140-150 mW/cm^2 for 4 min. It is suggested that the method can be effectively employed for assessing SHF structures in the emitter zone. (7 references)

0548 THE EFFECT OF ELECTROMAGNETIC RADIATION ON THE FUNCTION OF THE OPTIC NERVE. *(Rus.)* Melnikova, S. I. (Kharkov Inst. Labour Hyg. Occupat. Dis., USSR) and G. I. Nemtseiev. *Vestn. Oftalmol.* (6):82-84, 1974.

Studies were made of the function of the optic nerve in workers exposed to EM fields, mechanical vibrations, and nitrocompounds. Chronoperimetric techniques were used to determine the limits of visual perception and the early stage of the loss of conductivity in the optic nerve.(parabiosis). No significant difference was found in the limits of the field of vision of the 17 operators exposed to UHF radiation at TV retransmitting facilities and 105 unexposed controls. However, 11 of the exposed operators exhibited a shorter reaction time in all the meridians.

No deviations from the norm were observed in the 15 operators of HF hardening installations either in the field of vision or the reaction time. The findings indicate that occupational exposure to mechanical vibrations or nitrocompounds results in the conduction disorders in the peripheral sections of the field of vision. (6 references)

0549 MICROWAVE AND INFRA-RED EFFECTS ON HEART RATE, RESPIRATION RATE AND SUBCUTANEOUS TEMPERATURE OF THE RABBIT. *(E.)* Birenbaum, L. (Dep. Electr. Eng. Electrophys., Polytech. Inst. New York, Farmingdale), I. T. Kaplan, W. Metlay, S. W. Rosenthal, and M. M. Zaret. *J. Microwave Power* 10(1): 3-18, 1975.

The dorsal aspect of the head of unanesthetized New Zealand albino rabbits was irradiated with MWs (CW, 2.4 GHz) at power levels from 0-80 mW/cm^2. Respiration rate, heart rate, and s.c. temperature were monitored during the 10 min preirradiation period and during irradiation and the rates of increase were greatest at the highest power levels. Increases in respiration rate (9.39 breaths/min at 80 mW/cm^2) were 20 times greater than those in the heart rate (0.32 beats/min at 80 mW/cm^2). The effects of CWs and pulsed MWs (2.8 GHz, 20 mW/cm^2 average power level) were compared by exposing the entire dorsal surface to pulsed MWs and CWs in counterbalanced order. The respiration rate and temperature increased markedly during the 20 min exposure period, while the heart rate remained nearly constant. Differences in the responses to CW and pulsed irradiation were not significant. CW 2.4 GHz MW and infrared (IR) whole back irradiations were carried out at 0, 10, and 20 mW/cm^2. Heart and respiration response to CW MWs and to IR were substantially the same; in contrast, s.c. temperature increased more rapidly and reached higher values with IR. This result is consistent with the finding that IR is absorbed near the surface to a greater degree than MWs. Differences between the 0 and 10 mW/cm^2 MW respiration and heart response, as well as a difference between the 0 and 10 mW/cm^2 IR respiration rate response, indicate that 10 mW/cm^2 is not athermal for the rabbit. This is presumably the first demonstration of a physiological response to 10 mW/cm^2. (21 references)

0550 THERMOREGULATORY, METABOLIC, AND CARDIOVASCULAR RESPONSE OF RATS TO MICROWAVES. *(E.)* Phillips, R. D. (Battelle, Pacific Northwest Lab., Richland, Wash.), E. L. Hunt, R. D. Castro, and N. W. King. *J. Appl. Physiol.* 38(4):630-635, 1975.

The physiological response of rats to MW exposure at doses within the limits of tolerance for survival, i.e., at the basal metabolic rate reported for rats, at the metabolic rate for alert but unexcited rats, and at a rate 2.5 times the basal rate, near the upper limit of tolerance for survival, was characterized. Young adult male Wistar rats underwent adaption for 47 hr over a 4 wk period, and were then exposed to MWs in a multimodal resonating cavity. They were exposed for 30 min at 27.7 cal/min (4.5 mW/g), 40.1 cal/min (6.5 mW/g), and 68.2 cal/min (11.1 mW/g). Ten animals were used for each dose and paired irradiated and control rats were given simultaneous physiological measurements after exposure. Measurements included colonic temperature, skin temperature, oxygen consumption, CO_2 production, respiratory quotient, and heart rate, monitored continuously from 10 min to 5 hr after exposure was completed. A radiation dose of 27.7 cal/min had no effect on functions measured beyond a transient increase in skin and colonic temperatures. At 40.1 cal/min colonic temperature elevation was followed by overcompensation for 3 hr, changes in cardiovascular function, and a depressed metabolic rate, indicated by change in the rate of oxygen consumption. Physiological response at 68.2 cal/min was more severe, with colonic temperature of 42.4 C at the end of exposure, near the upper survival limit for the rat. A pronounced overcompensation was observed with body temperature less than controls for most of the 5 hr period. Skin temperature was also lower, oxygen consumption and CO_2 production were depressed, and pronounced cardiovascular changes were observed, including bradycardia followed by tachycardia and incomplete heart block. This was a consequence of excessive heating by irradiation and was caused by the action of toxic materials, by elevated serum potassium, or by myocardial ischemia. (40 references)

0126 EFFECT OF MICROWAVES ON CNS, LIVER, AND HEART. Albert, E. N. (Sch. Med., George Washington Univ., Washington, D. C.).

See CR 0060, Volume I(2), for description of this research. (Renewed 10/74-9/75)

Supporting Agency:HEW, Public Health Serv.

0127 ELECTROMAGNETIC FIELDS GENERATED FROM NEURONAL ACTIVITY. Anninos, P. A. (Sch. Med., Univ. California, Los Angeles).

This project is part of a broader program whose summary states: The primary functions carried out under this grant include the development of statistical and mathematical methods of aid to medical research; the provision of a computing system to support medical research; and the development of programs and techniques to make the use of the computer more effective. (9/73-8/74)

Supporting Agency:HEW, Public Health Serv.

0128 NON-THERMAL EFFECTS OF MICROWAVE RADIATION ON THE GROWTH, DEVELOPMENT AND BEHAVIOR OF BIOLOGICAL SYSTEMS. Barnes, F. S.; Gamow, E. I. (Sch. Eng., Univ. Colorado, Boulder).

See CR 0082, Volume I(3), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Air Force

0129 THE EFFECTS OF EXTREMELY LOW FREQUENCY (ELF) RADIATION ON MAN. Beischer, D. E.; Grissett, J. D. (Aerosp. Med. Res. Lab., Pensacola, , Fla.).

See CR 0059, Volume I(2), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Navy

0130 EFFECTS OF MICROWAVE RADIATION ON NAVAL PERSONNEL. Beischer, D. E.; Reno, V. R. (Aerosp. Med. Res. Lab., Pensacola, Fla.).

See CR 0019, Volume I(1), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Navy

0131 BIOLOGICAL EFFECTS OF VLF BAND ELECTROMAGNETIC RADIATIONS. Birgel, S. H. (Southwest Res. Inst., San Antonio, Tex.).

See CR 0057, Volume I(2), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Air Force

0132 USE THE DEVELOPED DNA MODEL SYSTEM TO DETECT PHYSICAL AND BIOLOGICAL (GENETIC) CHANGES INDUCED BY NON-IONIZING RADIATION EXPOSURE. Blackman, C. F. (Natl. Environ. Res. Cent., Durham, N. C.).

Alterations in chemical/physical properties of a selected genome (bacteriophage phi-x174) will be used to monitor the biological significance of MW induced genetic damage. Attention will be given to thermal/nonthermal effects and dose response relationships. (7/74-6/75)

Supporting Agency:EPA, Off. Res. Dev.

0133 EFFECTS OF ELECTROMAGNETIC FIELDS ON GENETIC PHENOMENA. Braver, G. (Univ. Oklahoma, Norman).

A renewal of the contract reported in CR 0015, Volume I(2), is being conducted to study the effects of athermal MW radiation and homogeneous and heterogeneous ES and magnetic fields on mutation and on chromosome behavior as measured by meiotic exchange frequencies and rates of nondisjunction. Biological effects of EMFs which do not produce heating, are being investigated. Studies are in the preliminary stages of attempting to determine the internal temperature of flies irradiated with MWs. The methods of attack on the internal problems include: (1) irradiating different numbers of flies in enclosed vials with MWs; (2) use of cholesteric liquid crystal mixtures which exhibit brilliant color changes over specified temperature ranges; and (3) use of IR thermographic techniques. These studies will contribute to the knowledge of the genetic effects of MW fields in X-brand as well as effects of strong ES and magnetic fields and finally yield some information on safe levels of exposure. (7/74-6/75)

Supporting Agency:EPA, Off. Res. Div.

0134 ACCELERATION OF FRACTURE HEALING BY ELECTRICAL FIELDS. Brighton, C. T.; Friedenberg, Z. B.; Black, J.; Korostoff, E.; Heppenstall, R. B. (Sch. Med., Univ. Pennsylvania, Philadelphia).

The object of the proposed research is to continue investigating the effects of an applied electrical current and/or field on the acceleration of fracture healing in laboratory animals. The research is designed: (1) to determine the comparative effectiveness of direct constant and pulsed current, alternating current, ESFs, and magnetically induced electrical fields in producing osteogenesis and in accelerating fracture healing in laboratory animals;

and (2) to determine the site and mechanism of action of electrical stimulation on medullary canal cells and on fracture callus cells. Methods to be used include point-counting analysis of histologic sections for new bone formation produced in an intact medullary canal around a cathode in response to various parameters of current, voltage, ES, and EM fields; mechanical testing for maximum resistance to bending of healing fractures in laboratory animals; point-counting analysis of electron micrographs of fracture callus cells in order to quantitate changes in cytoplasmic components; electron microscopy combined with histochemistry of fracture callus cells in order to detect changes in cell membrane surface charges; and determination of changes in tissue pO_2, O_2 consumption, and pCO_2 by means of a tissue tonometer system. (9/74-8/75)

Supporting Agency:HEW, Public Health Serv.

0135 EMP EFFECTS ON CARDIAC PACEMAKERS. Brunhart, G.; Martz, J. R. (Armed Forces Radiobiol. Res. Inst., Bethesda, Md.).

See CR 0043, Volume I(2), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Def. Nucl. Agency

0136 EFFECTS OF LOW INTENSITY MICROWAVE RADIATION ON MAMMALIAN SERUM PROTEINS. Cleary, S. F.; Berry, E. R. (Virginia Commonw. Univ., Richmond).

This project investigates the molecular effects of low intensity MW radiation on mammaliary serum proteins to support the effort to define the military medical problems associated with exposure to MW hazards. It is relevant to the mission of the Army Medical Department in maintaining military forces in the field. This study will be conducted in three phases: (1) broad survey of *in vivo* effects of MW radiation on bio-micromolecules in the rabbit and monkey to detect specific sensitivities to nonthermal levels of radiation; (2) identification, isolation, and characterization of the MW-sensitive molecular species; (3) detailed *in vitro* experimental and theoretical investigation of sensitive molecules to attempt to determine the basic mechanism(s) of interaction with the EMF. (7/74-6.75)

Supporting Agency:U. S. Dep. Def., Army

0137 INVESTIGATION OF RF INDUCED BIOCHEMICAL CHANGES. Conover, D. (Public Health Serv. Cent. Dis. Control, Cincinnati, Ohio).

The utility of biochemical changes as indicators of RF induced biological damage will be investigated in experimental animals. These biochemical changes will be monitored by observing the relative concentrations of selected ions to identify the most sensitive indices of RF biological damage and to study the mechanisms involved in these biochemical changes. Based on findings from the industrial surveys and available RF biological effects data, a RF biological effects research program will be developed to determine the adequacy of the OSHA MW/RF standard from 10 to 40 MHz. Dielectric materials will be developed which have electric and thermal properties which are similar to human tissues so that phantom simulations of humans may be constructed. (7/74-6/75)

Supporting Agency:HEW, Public Health Serv.

0138 INVESTIGATION OF RADIOFREQUENCY RADIATION IN INDUSTRY. Conover, D. (Public Health Serv. Cent. Dis. Control, Cincinnati, Ohio).

Magnetic and electric field probes will be utilized to measure the magnitudes of these fields. The survey will include various types of industrial RF power sources operating at 13.56, 27.12, and 40.68 MHz. Power sources will be carefully surveyed to determine the potential for hazardous occupational exposures. A RF irradiation facility will be developed for the Physical Agents Branch of HEW by the EM Fields and Antennas Section, NBS, Boulder, Colorado, to evaluate probes and to expose phantom simulation of human beings. The facility will be capable of generating RF fields at 13.56, 27.12, and 40.68 MHz. (7/74-6/75)

Supporting Agency:HEW, Public Health Serv.

0139 PERFORMANCE IN NON-HUMAN PRIMATES AS INFLUENCED BY LOW FREQUENCY ELECTROMAGNETIC FIELDS. deLorge, J. O.; Grissett, J. D. (U. S. Navy Aerosp. Med. Res. Lab., Pensacola, Fla.).

See Cr 0006, Volume I(1), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Navy

0140 TO DESIGN AND STUDY THE EFFECTS OF BIOMEDICAL SYSTEMS ON ANIMALS. Dracy, A. E.; Sander, D. E.; Bush, L. F. (Agric. Exp. Stn., South Dakota State Univ., Brookings).

This project is to design and test the validity of a volume conduction system for measuring body temperature continuously and to study the effects of MWs for partial and complete sterilization of farm animals. It will also design and test a unit which will have an exciting effect on rats and mice and will be used to help keep rodents out of buildings. Circuitry built during the school year will be used and the water stability problems as they effect the operation of the circuit will be improved. The

project will place implants to monitor temperatures of the internal organs of the animal, and will build a MW cavity and obtain equipment to irradiate the testicles of a sheep safely. The subject will be irradiated and the amount of sterility will be tested as a function of radiation power and time of exposure. A power supply will be designed and built from existing sources and the effectiveness of the sound source will be tested on the eradication of rats and mice. (7/74-6/75)

Supporting Agency:South Dakota State Gov.

0141 EFFECT OF PHYSICAL STIMULI ON INSECTS. Earp, U. F.; Perumpral, J. V. (Sch. Agric., Virginia Polytech. Inst., Blacksburg).

The objective of this project is to determine the response to physical stimuli, especially EMF energy, of certain insects of economic importance in Virginia, and to determine the feasibility of the physical stimuli as an attractant or repellent, or as a population suppressant, of insects. Insect behavior in two different fields in the zero frequency range, namely, the magnetic and the ES fields will be studied. Experiments will be conducted to determine the effect of EMFs, including flight chambers for orientation behavior, homogeneous fields for egg laying and hatchability, and CO_2 production monitoring for insect activity. Experiments to study the effects of low intensity magnetic and ES fields are in progress. The data to date indicate the following: magnetic fields of two strengths (60 and 120 gauss) had no effect on the orientational behavior of cabbage loopers of either sex. Continuous exposure of cabbage looper eggs to magnetic fields of 10, 48, 180, and 2000 gauss had no effect on hatchability. The effects of magnetic fields on other looper activities are being evaluated. An ES field of about 200 V/cm apparently affects the orientation behavior of house flies. These data are considered desirable to evaluate their possible use for insect control. (7/74-6/75)

Supporting Agency:Virginia State Gov.

0142 RADIOFREQUENCY HEAT FOR CANCER THERAPY. Edwards, W. S.; Doss, J. D.; Weiss, G. K.; Key, C. (Sch. Med., Univ. New Mexico, Albuquerque).

See CR 0047, Volume I(2), for description of this research. (Renewed 1/75-12/75)

Supporting Agency:HEW, Public Health Serv.

0143 MICROWAVES - ENVIRONMENTAL FACTOR - A MOLECULAR VIEW. Eisenbud, M.; Rabinowitz, J.; Mumford, W. (New York Univ. Sch. Med., New York).

The purpose of this project is to investigate the biological effects of MW radiation on the molecular level. The mechanisms for the basic interactions between MW radiation and biological molecules, along with possible functional implications have been considered. A model for the direct interference of MW radiation with biomolecular functions that are dependent on the internal three dimensional structure of the absorbing molecule has been developed. Specific systems where MW effects suggest the possible operation of this mechanism on the molecular level are being studied. In addition, the effect of MW radiation on the uptake of ascorbic acid by rabbit lenses and the effect on the activity of acetylcholinesterase both in its pure form and in whole blood are being studied. Future plans include a look at the effect of MW radiation on the uptake of known actively transported compounds in rabbit lens and a look at the effects of MW radiation on cation transport in red blood cells and possible local state changes in membranes. (9/74-8/75)

Supporting Agency:HEW, Public Health Serv.

0144 CYTOGENETIC EFFECTS OF MICROWAVE RADIATION ON CHINESE HAMSTERS (VARIABLE POWER DENSITY). Everts, J. M. (Natl. Environ. Res. Cent., Durham, N. C.).

See CR 0033, Volume I(1), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:EPA, Off. Res. Dev.

0145 CYTOGENETIC EFFECTS OF MICROWAVE RADIATION ON TISSUE CULTURE. Everts, J. M. (Natl. Environ. Res. Cent., Durham, N. C.).

See CR 0026, Volume I(1), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:EPA, Off. Res. Dev.

0146 GENETIC EFFECTS OF MICROWAVE RADIATION ON CHINESE HAMSTERS. Everts, J. M. (Natl. Environ. Res. Cent., Durham, N. C.).

See CR 0014, Volume I(1), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:EPA, Off. Res. Dev.

0147 CARDIAC OUTPUT MEASUREMENT BY MEANS OF RF ATTENUATION MEASUREMENT. Frazer, J. W. (U. S. Air Force Sch. Aerosp. Med., Brooks Air Force Base, San Antonio, Tex.).

See CR 0069, Volume I(2), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Air Force

0148 BEHAVIORAL AND BIOLOGICAL EFFECTS OF RESONANT ELECTROMAGNETIC POWER ABSORPTION IN RATS. Gandhi, O. P.; Johnson, C. C. (Sch. Eng., Univ. Utah, Salt Lake City).

See CR 0080, Volume I(3), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Army

0149 SCIENTIFIC AND TECHNICAL PROGRAMS FOR MONITORING OF ENVIRONMENTAL RADIATION LEVELS AND INVESTIGATION OF BIOLOGICAL EFFECTS. Grove, H. M. (U. S. Army, Walter Reed Army Inst. Res., Washington, D. C.).

See CR 0028, Volume I(1), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:EPA, Off. Res. Dev.

0150 DEVELOP AND VALIDATE EQUATIONS TO ALLOW EXTRAPOLATION OF RF ANIMAL DATA TO MAN FOR HAZARD ASSESSMENT PURPOSES. Guy, A. W. (Sch. Med., Univ. Washington, Seattle).

See CR 0052, Volume I(2), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Air Force

0151 BIOLOGICALLY IMPORTANT RF POWER ABSORPTION MEASUREMENTS FOR SAFETY CRITERIA. Howell, W. A. (Block Eng. Inc., Cambridge, Mass.).

See CR 0054, Volume I(2), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Air Force

0152 UHF BAND RADIOFREQUENCY RADIATION FOR CARDIAC PACEMAKER EMI STUDIES. Toler, J. C. (Georgia Inst. Technol., Atlanta).

See CR 0081, Volume I(3), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Air Force

0153 HATCHABILITY OF CHICKEN AND TURKEY EGGS. Krueger, W. F. (Agric. Exp. Stn., Texas A & M Univ., College Station).

Incubational and preincubational factors influencing hatchability of chicken and turkey eggs under southern climatic conditions will be investigated and evaluated. Causes of egg spoilage during incubation will be determined and methods of preventing this condition will be established. Incubational and preincubational factors necessary for optimum embryonic development with seasons will be correlated. The project will investigate interrelationships between hatchability and other genetic characteristics of economic importance under varying incubational and pre-incubational conditions. Pedigree hatching eggs will be characterized after treatment by making various chemical and weight measurements of the shell, albumin and yolk of eggs one week each month. Similar eggs from the same pedigreed hens will be incubated usually under three incubation conditions to determine treatment effects. Egg spoilage during incubation and public health pressures are problems of considerable importance to the hatchery industry. Studies are in progress to determine methods of efficiently preventing spoilage of hatching eggs and of sanitizing hatching eggs prior to and during incubation. Genetic differences in the various egg characteristics must eventually be related to other physiological characteristics of the bird to avoid genetic antagonisms. Maintaining records on a pedigree basis allows one to study these potential antagonisms. Continuous exposure of breeder males and females to low level EM fields had no significant effect on fertility, hatchability, chick quality or sex ratio. Birds lived in these environments for four months. (7/74-6/75)

Supporting Agency:Texas State Gov.

0154 EPIDEMIOLOGICAL FIELD STUDY OF ATHERMAL NON-IONIZING ELF ELECTROMAGNETIC RADIATION EFFECTS. Krumpe, P. E. (U. S. Navy Med. Res. Unit #4, Waukegan, Ill.).

See CR 0002, Volume I(1), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Navy

0155 ELECTROMAGNETIC FIELD ORIENTATION. McCleave, J. D.; Albert, E. H. (Sch. Arts, Univ. Maine, Orono).

The proposed research is to examine the hypothesis that migratory fish can orient to the earth's magnetic field and to the electric fields generated by ocean currents. The specific objectives, using American eels and Atlantic salmon, are to determine: (1) a conditioned behavioral d.c. electric current sensitivity threshold; (2) if the fish can discriminate the polarity of a weak d.c. electric field; (3) if the orientation of a weak electric or magnetic field can influence the fishes' body orientation; and (4) if electroreceptors are present in the integument of eels. (9/74-8/75)

Supporting Agency:HEW, Public Health Serv.

0156 ELECTRICAL AND ACOUSTIC PROPERTIES OF BIOLOGIC MATERIALS. Schwan, H. P.; Takashima, S. (Sch. Eng., Univ. Pennsylvania, Philadelphia).

See CR abstract, Volume I(3), p. 51, for description of this research. (Renewed 10/74-9/75)

Supporting Agency:HEW, Public Health Serv.

0157 BIOLOGICAL EFFECTS OF PULSED ELECTROMAGNETIC FIELDS. Skidmore, W.; Brunhart, G. (Armed Forces Radiobiol. Res. Inst., Bethesda, Md.).

See CR 0041, Volume I(2), for description of this research. (Renewed 7/74-6/75)

Supporting Agency:U. S. Dep. Def., Def. Nucl. Agency

0158 FURTHER STUDIES ON THE HAZARDS OF MICROWAVE IRRADIATION AS INDICATED BY CNS NEUROTRANSMITTERS. Snyder, S. H.; Sharp, J. C. (Johns Hopkins Univ. Sch. Med., Baltimore, Md.).

This project is designed to investigate the nature and extent of hazards to the CNS and its function due to MW and RF emanations from military devices and equipment such as radar and communications gear. Chemical determination of changes in CNS levels and turnover rates of important neurotransmitters (5-hydroxytryptamine and norepinephrine) involved in thermoregulation as well as levels of consciousness and behavioral excitation will be studied. (7/74-6/75)

Supporting Agency:U. S. Dep. Def., Army

0159 LABILE METABOLITES, TRANSMITTERS IN THE HEART CYCLE. Stavinoha, W. B.; Medina, M. A.; Modak, A. T.; Deam, A. P.; OBrien, L. J. (Univ. Texas Sch. Med., San Antonio).

MW radiation will be used to inactivate in 130 msec the enzymes in the isolated perfused turtle heart. ECG and pressure records will enable us to know precisely the moment of inactivation within the cardiac cycle. The cardiac cycle will be stopped at 6 different intervals and the following measurements will be done in the left auricle, right auricle and ventricle: acetylcholine, choline, norepinephrine, cyclic AMP, cyclic GMP, the high energy phosphates, ADP, ATP, AMP, phosphocreatine, lactate, pyruvate, and the ions calcium and magnesium. This should provide extensive new information about the metabolism and regulation of the heart beat. (9/74-8/75)

Supporting Agency:HEW, Public Health Serv.

0160 STUDY OF BRAIN METABOLISM THROUGH MICROWAVE HEATING. Stavinoha, W. B.; Medina, M. A. (Sch. Med., Univ. Texas, San Antonio).

See CR 0055, Volume I(2), for description of this research. (Renewed 2/75-1/76)

Supporting Agency:HEW, Public Health Serv.

0161 RADIOFREQUENCY ELECTROMAGNETIC ENVIRONMENT SIMULATION AND MEASUREMENT. Allen, S. J. (U. S. Air Force Sch. Aerosp. Med., San Antonio, Tex.).

The objective of this work unit is to develop the RF radiation simulators and instrumentation required to reproduce Air Force (AF) operational RF environments in the laboratory to support bioeffects studies. The results of such studies will continue to provide the basis for modifying the personnel exposure criteria for AF RF operations. Instrumentation will be developed to measure E- and H-fields independently and simultaneously at frequencies up to 1 GHz. The instrumentation and theory which will allow complex dielectric measurement in fields of 1 to 10 GHz using six-port theory will be developed. An orthogonal dipole instrument which will measure peak energy density in pulsed RF environments will be developed. A study to compare RF field measuring techniques will be performed in the USAFSAM exposure chambers by USAFSAM/RAP and Keesler AFB personnel. Power absorption studies in the 10-50 MHz region, setup of multiple frequency fields for bioeffects studies and a study to determine potential problems in phased array systems will be completed.

Supporting Agency:U. S. Dep. Def., Air Force

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