a time-weight exposure, the health specialist must consider how far the dose-time relationship can be extrapolated. Future standards should reflect environmental stress as well as other factors found to affect the biological response to MWs. (22 references)

0197 THE EFFECT OF THE UHF FIELD ON PATHOGENIC MICROORGANISMS. *(Rus.)* Reider, B. Sh. (Engels Inst. Trade, Leningrad, USSR). L. R. Afanasieva, and E. F. Antonova. *Vopr. Pitan.* 32: 77-78, 1973.

At present, UHF whole-product heating techniques are increasingly used in the food processing industries. Studies were made to investigate the effect of 2375 MHz radiation on dough microflora in sponge-cake baking, including colibacillus, coagulase-positive staphylococcus, salmonella and proteeae. The pathogenic microorganisms were introduced into the dough in the form of a 24-hr culture suspension. The dough was then mixed and baked in the Volzhanka type UHF oven. The results indicate that a 2-min oven baking at 60% and 100% of the generator's power output disposes of all salmonella and staphylococcus. The total number of bacteria in 1 g of product does not exceed 20-30 colonies. Examination of 10 g of the baked cake did not show any colibaccillus. (No references)

0198 GAMMA-AMINOBUTYRIC ACID METABOLISM IN RATS FOLLOWING MICROWAVE EXPOSURE. *(E.)* Zeman, G. H. (Armed Forces Radiobiol. Res. Inst., Bethesda, Md.), R. L. Chaput, Z. R. Glaser, and L. C. Gershman. *AFRRI* TN73-5, July 1973, 12p. NTIS: AD769299.

Gamma-aminobutyric acid (GABA) metabolism was studied in male Sprague-Dawley rats chronically exposed to 2.86 GHz microwaves at an incident power level of 10 mW/cm^2 or acutely exposed to incident power levels of 40 or 80 mW/cm^2. No changes occurred in whole-brain GABA levels or L-glutamic decarboxylase activity following these exposures. These results suggest that an altered GABA metabolism is not involved in reported responses of the nervous system to microwave exposure. (11 references)

0199 PROTECTION AGAINST MICROWAVE OVEN RADIATION LEAKAGE. *(E.)* Wheater, R. H. (Am. Med. Assoc., Chicago, Ill.). *JAMA* 228(10):1296-1297, 1974.

Federal standards now limit the allowable radiation leakage of new MW ovens to 1 mW/cm^2, measured at 5 cm (2 in) from the oven door; this limit may be allowed to rise as much as 5 mW/cm^2 over the life of the appliance. The regulation also specifies that electrical interlocks be provided to shut down the power sources when the door is open or the door seal broken. Thus, depending on the successful enforcement of these standards, there appears to be little risk from ovens that are used in accordance with the manufacturer's instructions. Where accessory shielding (e.g., a metal mesh) is impractical, the best protection is afforded by extending the physical separation of the body from the oven. For ovens manufactured before the new limit was set (Oct. 1971), it is advisable to stay an arm's length away from the door when the oven is operating. (No references)

0200 MICROWAVE CATARACTS - A CASE REPORT REEVALUATED. *(E.)* Hirsch, F. G. (Lovelace Fdn. Med. Ed. Res., Albuquerque, N.M.), *Electronic Product Radiation and the Health Physicist.* NTIS: PB-195 772. Oct. 1970, p. 111-140.

A 32-year-old man who had operated a microwave radiofrequency power source for a year developed blurred vision after three days in which his head was in close proximity to the near field zone of the horn antenna for about 24 hr. Due to the placement of the horn, the left side of his head had received the greater exposure. Examination revealed moderately advanced bilateral cataracts, chorioretinitis in the left eye, and numerous opacities in the vitreous humor of the left eye. The left lens was completely cataractous at the time of its removal 18 months later. The retinal and vitreous lesions stabilized with the passage of time and treatment with corticosteroids. The cataract in the right eye has remained stable for over 15 yr. The radiofrequency power source was a C-band megatron connected by waveguides to a standard S-band horn antenna. Oscillator output was between 5000-4000 MHz/sec, corresponding to a wavelength between 6.0-7.5 cm. Peak power output was 500 W. Peak power density in a plane at the rim of the horn was 0.9 W/cm^2, while the effective area of the horn was 550 cm^2. Based on these parameters the patient absorbed from 0.65-0.75 W/cm^2 of radiant energy, which is sufficient for the development of a cataract. (8 references)

0201 COMPREHENSIVE REPORT OF WORK ACCOMPLISHED FROM 1958 TO 1965 (FINAL REPORT). *(E.)* Michaelson, S. M. (Sch. Med. Dent., Univ. Rochester, N.Y.), R. A. E. Thomson and J. V. Rowland. *Univ. Rochester Report* No. 49-810, Contract No. AF (30-602)-2921. NTIS: AD 824 242. Sept. 1967, 138p.

The exact nature of the biological effects of microwaves is not completely understood. Evidence indicates that microwave energy can act as a stressor agent, and has an effect on regulatory and integrative body mechanisms with resultant alteration in homeokinesis. Animals exposed to microwaves at specific frequencies and flux densities experience thermal stress. Duration of exposure, environmental temperature, and drugs that effect the central nervous system (CNS) and temperature regulation influence the response of animals. High ambient temperature exaggerates the thermal response, while exposure in a cold environment prolongs the time interval for an increase in body temperature. The subtle nature of some microwave effects such

as modification of response to x-irradiation and effect on bone marrow and thyroid function require careful evaluation. Soviet reports allude to asthenic reactions, CNS, cardiovascular, and thyroid changes from radar exposure. The described effects are for the most part inseparable from responses which could result from thermal stress. It is recommended that all microwave workers undergo a thorough pre-employment and periodic medical examination. Persons with cardiovascular problems or lenticular defects should be considered as risks. Because of indication of bone marrow and thyroid sensitivity to microwaves, hematologic and thyroid function studies should be incorporated in the medical examination. An increase in the present maximum permissible exposure level of 10 mW/cm^2 could introduce risks that might be readily recognized. (191 references)

0202 ARE YOUR WORKERS EXPOSED TO NON-IONIZING RADIANT ENERGY? *(E.)* Michaelson, S. M. Sch. Med. Dent., Univ. Rochester, N.Y.). *Ind. Med. Surg.* 42(9):9-11, 1974.

The last 24 years have seen a marked development and increased utilization of equipment and devices that emit non-ionizing radiant energies. These include ultraviolet, infrared, visible light, microwaves, and radiofrequency waves that are classified as electromagnetic waves. Electromagnetic energies at certain frequencies, power levels, and exposure durations can produce biological effects or injury, depending on multiple physical and biological variables. Various protection guides and standards for these radiations are summarized. They are for the most part based on the concept of maximum permissible exposure and threshold for reversible or irreversible damage to critical biological structures. Occupations potentially associated with ultraviolet radiation exposures are listed and infrared radiation threshold doses for minimum ocular damage are given. (No references)

0203 THE IMPACT OF THE ELECTRONIC PRODUCT RADIATION CONTROL PROGRAM (P. L. 90-602). *(E.)* Britain, R. G. (Bur. Radiol. Hlth., Rockville, Md.) and D. J. McConeghy. *Electronic Product Radiation and the Health Physicist* NTIS: PB-195 772, Oct. 1970, p. 40-50.

The Radiation Control for Health and Safety Act of 1968 (Public Law 90-602) authorizes the Bureau of Radiological Health to develop and administer performance standards for electronic products capable of emitting ionizing, non-ionizing EM radiation, particulate radiation, or sonic, infrasonic, and ultrasonic waves which result from the operation of an electronic circuit in a product. Examples of electronic products to be controlled are microwave ovens, color television, x-ray machines, and particle accelerators and lasers. The evolution of two performance standards is described: one for television receivers which is now in effect, and the second for MW ovens which will appear in the Federal Register in the next several months. The television receiver standard specifies an 0.5 mR/hr limit, the lowest level practical at this time. The standard will be reviewed as technology improves and the radiation limits will be reduced accordingly. The problem of evolving a MW oven standard is reviewed at length. (No references)

0204 BIOLOGICAL DOSIMETRY OF 2450 MHZ MICROWAVE IRRADIATION WITH MICE. *(E.)* King, N. W. (Battelle, Richland, Wash.), E. L. Hunt and R. D. Phillips. *Proc. Microwave Power Symp., IMPI,* May 29-31, 1974.

Mice of the C57BL/6J strain in two sizes, and of the SJL/J strain in one size were exposed to 2450 MHz microwave irradiation in a multimodal cavity. Latency to massive clonic convulsion was measured. As with an earlier study using several sizes of Wistar rats, convulsion latency was more closely associated with absorbed power per gram of animal than with net power to the cavity. At lower irradiation levels, where absorbed dose was 80 mW/g or less, and convulsive latencies were more than five minutes, the mouse data diverged from the rat data, the mice taking longer to convulse. The mouse's greater surface-to-volume ratio gives it a cooling advantage over the rat during longer periods of irradiation.(No references)

0205 CALORIMETRIC CALIBRATION METHOD FOR A COMMERCIAL POWER MONITOR FOR USE WITH HIGH POWER MICROWAVE GENERATORS. *(E.)* Herman, W. A. (Bur. Radiological Hlth., Rockville, Md.), D. W. Peak, D. L. Conover, and L. W. Strong. *DHEW Publication* No. (FDA) 73-8010, BRH/DEP 73-1, Sept. 1972, 23p.

A power monitor used with a high-power (2.5 kW) microwave generator operable in the 2450-MHz industrial-scientific-medical (ISM) band was calibrated by a calorimetric method. Several measurements of the forward and reflected power were made at two positions one-quarter of a guide wavelength apart on the waveguide assembly connecting the generator and the load. The normalized average of the two determinations of the forward and reflected power yielded calibration factor values that were independent of the voltage standing wave ratio of the load and the directivity of the coupler which monitored the forward and reflected power. A linear equation was empirically derived to specify the power delivered to the load as a function of the forward and reflected power meter indications. When the equation was used to predict the power delivered to the load, the total 2σ uncertainty limit (including the uncertainty limit of calorimetric measurement of delivered power values) was $\pm$ 0.40 dB. The method described requires only equipment generally available to researchers interested in the biological effects of MW radiation. (4 references)

0206 LATEST DEVELOPMENTS IN UHF-THERAPY DOSIMETRY PROCEDURES. *(E.)* Skurikhina, L. A. (All-Union Sci. Res. Inst. Med. Instr. Eng., Moscow, USSR) and O. V. Shereshevskiy. *Med. Tekh* (5):10-15, 1973. Translated by Joint Publications Research Service, Arlington, Va., JPRS 60754, December 1973.

A method and a device are described for continuous measurement of high-frequency power absorbed by a patient during ultrahigh-frequency (UHF) therapy. The readings of the metering device give the magnitude of power being absorbed directly by the patient, and its scale can be graduated in watts. Clinical investigations with the device yielded the actual magnitudes of power absorbed by a patient in a number of typical UHF-therapy procedures. A close correlation was found between a patient's heat-sensing ability and the magnitude of power density, which made it possible to determine the required values for a broad range of UHF-therapy procedures. Results of the clinical investigations provide the basis for the transition to objective dosage metering in accordance with the magnitude of absorbed power. (4 references)

0207 POSSIBLE EFFECTS OF ELECTROMAGNETIC RADIATIONS. *(E.)* Bond, V. P. (Brookhaven Natl. Lab., Upton, N.Y.) and E. P. Cronkite. *Naval Research*, 27(7):20-21, July, 1974.

Essential to the Navy's communications systems are electromagnetic radiations (EMR) of a wide spectrum of frequencies or wave lengths. Because of possible deleterious biological effects of EMR, a primary exposure limit of 10 mW/cm^2 has been established in the U.S.; the USSR recommended exposure limit is considerably less than this. The authors reviewed the Navy's research programs designed to determine what, if any, effects on man may occur as a result of EMR. Five intramural facilities were visited and the programs of a number of university and other laboratories reviewed. Definite effects of microwaves at higher power densities (of the order of 100 mW/cm^2) have been observed, and are considered to be secondary to the heating of tissues. Characteristic opacifications of the lens of the eye, and the alignment of some microorganisms in electrical fields have been reported. At the longer wavelengths there is no significant heating of tissues. Some "athermal" effects of microwaves and radiations of lower frequencies, including ELF, have been reported. A series of concentrated and well-controlled studies, particularly of low-power densities, is recommended. (No references)

0208 METABOLIC AND THERMOREGULATORY RESPONSES TO MICROWAVE RADIATION IN YOUNG MALE RATS. *(E.)* Houk, W. M. (Naval Aerospace Med. Res. Lab., Bethesda, Md.) and S. M. Michaelson. *Proc 45th Scientific Meeting, Aerospace Medical Assocation*, May 9, 1974.

To assess the magnitude and pathophysiological implications of thermoregulatory neuroendocrine and metabolic changes secondary to microwave exposure, 400 8-week old male Long-Evans rats were illuminated by whole-body irradiation techniques using 2450 MHz (CW) microwaves. During and after 150-minute irradiation (at 9, 18, and 36 mW/cm^2 exposures) rats were removed from chambers, colonic temperature taken within 60 secs., weighed, decapitated and exsanguinated. Compared to sham-exposed groups for each time point during the irradiation period, 9 mW/cm^2 exposure caused a distinct temperature rise that was maintained through exposure ($p \leq 0.05$). The 18 mW/cm^2 exposure induced a significant whole-body temperature rise compared with sham-exposed group ($p \leq 0.001$) and the 9 mW/cm^2 group ($p \leq 0.05$) except at 120 minutes, where no statistically significant difference between the 9 and 18 mW/cm^2 groups was evident ($p > 0.10$). A statistically significant temperature rise was induced and maintained the entire exposure period by 36 mW/cm^2 ($p \leq 0.001$). All groups returned to pre-exposure levels of temperature within 60 minutes after irradiation. At 36 mW/cm^2 rat serum GH dropped with 60 minutes of irradiation and pulsatile GH release no longer occurred. Within one-half hour after radiation mean serum GH rose to very high levels in all exposure groups. Though not statistically significant ($p > 0.10$) the trend was obvious even at 9 mW/cm^2. Serum triglyceride responses were not markedly affected at 36 mW/cm^2 incident energy. The levels dropped following the pattern observed for serum GH but tended to recover in the post-exposure period. Serum glucoses demonstrated no significant changes throughout the exposure and post-exposure period. The compatibility of these rat serum GH results with those of general stress reactions, and the sensitivity of serum GH levels to subjective influences, are discussed. (No references)

0209 MICROWAVE HAZARD MEASUREMENTS NEAR VARIOUS AIRCRAFT RADARS. *(E.)* Tell, R. A. (U.S. Environ. Prot. Agcy., Silver Spring, Md.) and J. C. Nelson. *Radiation Data and Reports*, 15(4):161-179, April 1974.

In order to determine the potential for exposure of individuals when in the vicinity of aircraft radar units when aircraft are on the ground, the Electromagnetic Radiation Analysis Branch monitored four radar units that were typical of radars used by commercial aircraft. Two of the units were surveyed at a radar simulation laboratory and the other units were surveyed while in their operating positions in aircraft. The survey determined that the radar beams from navigational and weather radar units in commercial aircraft rotate in either a sector-scanned or 360 degree rotation at approximately 15 r/min. The radar beams emanated from the aircraft above 6 feet from the ground. It was determined that power density exposures of 10 mW/cm^2 can occur from 8 to 18 feet from the antenna of an aircraft radar unit. No radiation levels in excess of 0.2 mW/cm^2 existed in the aircraft cockpits. (6 references)

0210 CALCULATED FIELD INTENSITIES NEAR A HIGH POWER UHF BROADCAST INSTALLATION. *(E.)* Tell, R. A. (U.S. Environ. Prot. Agcy., Silver Spring, Md.) and J. C. Nelson. *Radiation Data and Reports*, 15(7):401-410, July 1974.

A UHF transmitter site in the Washington, D.C. area, which is used cooperatively by two UHF television stations, was chosen for calculations of effective radiated power (ERP), field strength, and power density. Using the specifications for the two broadcasting stations, field strengths and power densities were calculated and presented graphically. The calculated power densities for this broadcasting installation showed that the exposure values fall very sharply as the distance from the tower increases to about 1 mile. At distances beyond 0.5 miles, the maximum exposure values calculated were about 2.7 $\mu W/cm^2$ occurring at 0.5, 3.3, and 4.5 miles. As the height above ground at the receiving point is increased, the exposure value generally increases. Based on the calculations for the 135 degree radial and the computed population distribution, it appears that approximately 86,000 people reside in an area within which the estimated exposure is 1 $\mu W/cm^2$ or more. (19 references)

0211 RF PULSE SPECTRAL MEASUREMENTS IN THE VICINITY OF SEVERAL AIR TRAFFIC CONTROL RADARS. *(E.)* Tell, R. A. (U.S. Environ. Prot. Agcy., Silver Spring, Md.) and J. C. Nelson. *U.S. Environ. Protection Agency, Off. of Rad. Programs, Md.*, May 1974.

The purpose of this study was to determine the response characteristics of a microwave scanning spectrum analyzer in the presence of a relatively intense and complex electromagnetic environment. Measurements of ambient field intensities were made in the vicinity of three different ground radars used in air-traffic-control operations. Maximum peak field strengths of 960 V/m were measured about 1000 feet from the radar site. Characteristic radar spectrum signatures were recorded by photographing visual displays on the analyzer CRT. (11 references)

0212 PRENATAL EXPOSURE TO AN EXTREMELY LOW FREQUENCY, LOW INTENSITY ROTATING MAGNETIC FIELD AND INCREASES IN THYROID AND TESTICLE WEIGHT IN RATS. *(E.)* Ossenkopp, K. P. (Dept. Psychol., Univ. Manitoba, Canada). *Dev. Psychobiol.* 5(3):275-285, 1972.

Extremely low frequency (ELF) electromagnetic fields and waves (0.1-40 Hz) which occur daily in the environment, are associated with lightning discharges, atmospheric lability, solar eruptions, and geomagnetic micropulsations. In 3 experiments, adult rats that had been exposed to a 0.5-3 or 3-15 gauss ELF (0.5 Hz) rotating magnetic field (RMF) during various periods of gestation, had significantly heavier thyroid and testicle weights than controls. The difference in these measures was a function of the field intensity and duration of exposure. Rats exposed prenatally to a sham-RMF (no magnets) did not differ from controls in the above measures. No significant differences were found between the thymus weights, adrenal weights, blood sugar, or circulating blood eosinophil levels of RMF-exposed and control rats. The implications of the thyroid and testicle changes are discussed in terms of the physiological and physicochemical effects of ELF electromagnetic phenomena. (31 references)

0213 THERMAL REGULATION IN LONG-EVANS RATS EXPOSED TO 2450 MHz MICROWAVE RADIATION. *(E.)* Houk, W. M. (Dept. Radiol. Biol. Biophys., Univ. Rochester, N. Y.), S. M. Michaelson and A. Longacre, Jr. *Proc. Am. Physiol. Soc.*, Aug. 24, 1973.

Colonic temperature was measured in 400 unrestrained young male Long-Evans rats which had been exposed to various power levels (9, 18, 36 mW/cm^2) of 2450 MHz (CW) far field microwave irradiation, and maintained under constant environmental conditions. *Equilibration times* of up to three hours were required in the experimental enclosure, to avoid masking the temperature elevations induced by this unique volume heating agent. Temperature responses appear to be related to power density (exposure) and duration of exposure. Microwave illumination at these power densities causes an increase in colonic temperature in a manner analogous to a fever. However, the problems encountered when altering external environmental conditions, using radiant heat, or injecting pyrogens to analyze the effects of increased body temperature were avoided. A simple model of a microwave irradiated rat and rat carcass is presented, and its use in studying thermal regulation is discussed. (No references)

0214 CARDIAC PACEMAKER ELECTROMAGNETIC INTERFERENCE (3050 MHz). *(E.)* Hurt, W. D. (USAF Sch. Aerospace Med., Brooks AFB, Tex.). *Aerospace Med. Div. Report* No. SAM-TR-72-36, NTIS: AD-757 930, Dec. 1972, 20p.

Tests were performed to determine the effect of 3050 MHz radiofrequency radiation on cardiac pacemakers. Five pacemaker models were implanted in large dogs, and electrocardiographs of each animal were continuously monitored during exposure to continuous wave, sine wave half-wave rectified, or square-wave modulated signals. Most of the pacemakers exhibited some electromagnetic radiation interference under certain test conditions. The most sensitive unit cut off at 100 volts/meter at pulse repetition frequencies less than 35 pulses/sec, while one pacemaker was unaffected throughout the tests. (1 reference)

0215 A MICROWAVE DECOUPLED ELECTRODE FOR THE ELECTROENCEPHALOGRAM. *(E.)* Larsen, L. E. (Baylor Coll. Med., Houston, Tex.), R. A. Moore and J. Acevedo. *IEEE Trans. Microwave Theory Tech.* MTT-22(10):884-886, Oct. 1974.

In studying the time course of microwave radiation in an unanesthetized animal, one of the measurable electro-physiological responses of the CNS, the EEG figures prominently. The recording of the EEG in an amplitude-modulated microwave field presents two related but distinct problems when conventional electrodes are employed. The electrode and its associated conductors extract power from the incident radiation, resulting in increased local power deposition which confounds dosimetric arguments and imposes local thermalization; the electrode tissue interface is a nonlinear system that demodulates amplitude-modulated signals with the results that the demodulate is additively mixed with the EEG. The problems were studied in a series of bench tests with conventional and thin-film microwave integrated circuit (MIC) electrodes. The latter are decoupled from the magnetic component of the field by virtue of radically reduced dimensions of the thin-loop component of its geometry, and suppression of dipole (i.e., electric field interaction) currents by use of integrated Nichrome series resistance. The result is that the demodulation artifact is undetectable in the ensemble averaged-power spectrum from the *in vitro* electrode up to an *S*-band incident-power density of 100 mW/cm^2. Thermalization was studied in a dielectric brain phantom with high-resistance monofilament leads to the MIC with a result that 0.6 C heating is attributable to the electrode with prolonged exposure to a 50-mW/cm^2 field. (No references)

0216 POLARIZATION AND FREQUENCY EFFECTS ON WHOLE ANIMAL ABSORPTION OF RF ENERGY. *(E.)* Gandhi, O. P. (Dept. Electr. Eng., Univ. Utah, Salt Lake City). *Proc of IEEE,* 62(8):1171-1175, Aug. 1974.

A parallel-plate waveguide is used to determine wide-band RF (285 to 4000 MHz) absorption characteristics of 96- to 390-g Wistar rats, 25-g mice and brain-phantom prolate spheroidal bodies of several aspect (a/b) ratios to 5.75 (the value taken for humans). The results compare well to those of free space irradiation. From the absorption characteristics of 25-g mice and prolate spheroidal bodies for three orientations $\hat{E} \| \hat{a}$, $\hat{H} \| \hat{a}$, and $\hat{k} \| \hat{a}$ (where $\hat{a}$ is along the major length) a strong orientational effect is observed. Alternative experiments using plane waves at 1700 MHz to heat saline-filled prolate spheroidal bodies of fixed aspect ratio 5.75 but changing overall dimensions, corroborate the main features of the WG results. From the excellent correlation between the two sets of values the viability of using parallel-plane WG as a simple method of determining broad-band absorption characteristics of biological systems is indicated. The RF power deposition is found to vary significantly with orientation and frequency. RF absorption, larger by an order of magnitude or more than for other configurations, may occur at resonance for $E \| \hat{a}$ orientation, which should be taken into account in microwave biological effects research. (4 references)

0217 COMPARATIVE EFFECTIVENESS OF 39- AND 2450-MHz ELECTRIC FIELDS FOR CONTROL OF RICE WEEVILS IN WHEAT. *(E.)* Nelson, S. O. (Agric. Res. Serv., USDA, Lincoln, Neb.) and L. E. Stetson, *J. Econ. Entom.* 67(5):592-595, Oct. 1974.

A comparison of 39-MHz and 2450-MHz radiofrequency (RF) electrical treatments to control adult *Sitophilus oryzae* (L.) in hard red winter wheat revealed that the 39-MHz treatment was much more effective than treatment at 2450 MHz. Complete insect mortality was achieved by 39-MHz treatments that raised grain temperatures to 40 C; whereas, grain temperatures of ca. 80 C were required for complete mortality in 2450-MHz treatments. Insect mortalities from 39-MHz exposures were much greater 1 day after treatment than were those from 2450-MHz exposures producing comparable grain temperatures. The degree of injury and delayed mortality resulting from 39-MHz exposures also was much more severe than that resulting from 2450-MHz exposures. The results confirmed predictions, based on measurements of dielectric properties of adult rice weevils and wheat, that 39-MHz treatments should provide a much better opportunity for selectively heating the insects than would treatments at 2450 MHz. (11 references)

0218 NUMERICAL ANALYSIS OF ELECTROMAGNETIC FIELDS IN BIOLOGICAL TISSUE. *(E.)* Wu, T. K. (Dept. Electr. Eng., Univ. Mississippi, University) and L. L. Tsai. *Proc. IEEE* 62(8):1167-1169, Aug. 1974.

The feasibility of using integral equation techniques to predict EM fields in biological tissues is demonstrated by analyzing the scattering from arbitrary cylinders composed of lossy dielectric materials. For the circular cylinder case, good agreement is obtained between moment method solutions and exact solutions. To show the applicability to arbitrary geometries, an elliptical cylinder is also considered. (6 references)

0219 LETHAL EFFECTS OF 3000 MHz RADIATION ON THE RAT. *(E.)* Schrot, J. (Dept. Microwave Res., Walter Reed Army Inst. Res., Washington, D.C.) and T. D. Hawkins. *Radiat. Res.* 59:504-512, 1974.

Rats were exposed for short durations (30, 60, 120, and 240 sec) to electromagnetic irradiation at a frequency of 3000 MHz. At each duration of exposure percent mortality increased with increases in inci-

dent energy density (power density X duration). The incident energy density required to kill 50% (LD_{50}) increased monotonically with increasing exposure durations. Lethal power density (LD_{50}) was a decreasing monotonic function of exposure duration. In addition, body weight was found to be a factor in determining mortality. (5 references)

0220 PACEMAKER PERFORMANCE IN THE VICINITY OF FM AND TV TRANSMITTERS. *(E.)* Vreeland, R. W. (Res. Dev. Lab., Univ. California, San Francisco) and M. D. Shepherd. *Proc. 26th ACEMB, Sept.* 30-Oct. 4, 1973.

Nine pacemakers were tested at a mountain top transmitter site. They included six external demand pacemakers, one of the bipolar implantable demand type, one monopolar implantable demand pacemaker and one monopolar implantable fixed rate unit. Various pacemaker terminations including several standard catheters as well as transmission lines and dipole antennas were studied. Pacemaker performance was clearly a function of the type of termination. Eight of the nine pacemakers were affected. Six of them stopped pacing. The strongest signals at the mountain top were 0.71 and 1.3 volts per meter from two TV stations and 0.47, 0.56, 0.84 and 2.8 volts per meter from FM transmitters. (2 references)

0221 OPERANT BEHAVIOR OF RHESUS MONKEYS IN THE PRESENCE OF EXTREMELY LOW FREQUENCY-LOW INTENSITY MAGNETIC AND ELECTRIC FIELDS: EXPERIMENT 1. *(E.)* de Lorge, J. (Naval Aerospace Res. Lab., Pensacola, Fla.) *Naval Aerospace Med. Res. Lab. Report* No. 1155, Nov. 1972, 18p.

In an exploratory study of the biological effects of extremely low-frequency magnetic and electric fields of low intensity, two rhesus monkeys were trained on three tasks with food or water as reinforcement: Fixed Interval, Reaction Time, and Match-to-Sample. Following 39 training sessions, the animals were given 26 experimental sessions in the presence of a magnetic field of 10 gauss at 75 Hz, or the magnetic field combined with an electric field of 4 V/m at 75 Hz. Although behavioral changes occurred, no significant changes could be related to the electromagnetic fields. Instead, most changes in performance were a consequence of continuous experimental sessions and elapsed time, or of equipment problems. These results provide supportive evidence that these specific EM fields have no general behavioral influence on nonhuman primates. (20 references)

0222 OPERANT BEHAVIOR OF RHESUS MONKEYS IN THE PRESENCE OF EXTREMELY LOW FREQUENCY-LOW INTENSITY MAGNETIC AND ELECTRIC FIELDS: EXPERIMENT 2. *(E.)* de Lorge, J. (Naval Aerospace Med. Res. Lab., Pensacola, Fla.). *Naval Aerospace Med. Res. Lab. Report* No. 1179, March 1973, 25p.

Consonant with the U.S. Navy's exploration of the biological effects of extremely low-frequency EM radiation, two rhesus monkeys were exposed to 10-gauss 45-Hz and 10-Hz fields. Low-intensity electric fields occurred simultaneously. No effects of the 45-Hz fields on immediate memory, operant responding, reaction time, or activity were observed. Statistically significant effects were produced by 10-Hz fields, but not in both animals nor in a replication of the experiment. The study failed to provide unequivocal evidence that extremely low-frequency magnetic and electric fields affect behavior, although weak support for effects on 10-Hz fields on general motor activity was afforded. (18 references)

0223 OPERANT BEHAVIOR OF RHESUS MONKEYS IN THE PRESENCE OF EXTREMELY LOW FREQUENCY-LOW INTENSITY MAGNETIC AND ELECTRIC FIELDS: EXPERIMENT 3. *(E.)* de Lorge, J. (Naval Aerospace Med. Res. Lab., Pensacola, Fla.). *Naval Aerospace Med. Res. Lab. Report* No. 1196, Nov. 1973, 14p.

A magnetic field of 10^{-3} with its associated electric field alternating at 60 Hz and 10 Hz had no discernible effect on operant response-rate, reaction time, match-to-sample behavior, or general motor activity of 2 female rhesus monkeys. No abnormalities in hematological samples or general physical condition were observed at the conclusion of the experiment. The results agree with those obtained in previous experiments on male rhesus monkeys. (20 references)

0224 STUDIES OF THE BIOMEDICAL EFFECTS OF MICROWAVE RADIATION: PAST, PRESENT AND FUTURE. *(E.)* Glaser, Z. R. (Bur. Med. Surg., Dept. Navy, Washington, D.C.). *Proc. Microwave Power Symp., IMPI,* May 29-31, 1974.

An introduction is given to the study of the biological effects of non-ionizing electromagnetic radiation at radio and microwave frequencies, and the historical perspective is outlined. Studies (including philosophy) conducted during the "Tri-Service Era" (1957-1960), and those described at the Richmond, Virginia (1969), and New York Academy of Sciences meetings (1974) are compared. Biological "effects" reported in the literature prior to 1971 are described, as are current RF/microwave biological studies and experimental problems. Human exposure "standards"; future research needs; and the beneficial effects, uses, and applications of RF/microwave radiation are also discussed. (No references)

0225 CENTRAL MECHANISM OF ACTION OF ELECTROMAGNETIC FIELDS. *(E.)* Sudakov, K. V. (no affil.) and G. D. Antimonity. *USP Fiziol Nauk* (2):101-135, 1973. Translated by Joint Publications Research Service JPRS 60711, Dec., 1973.

The published literature on the biological effects of electromagnetic fields (EMF) is reviewed. The

different aspects considered are the role of natural EMF in the evolutionary processes and their influence on animals and man, participation of EMF in the activity of the central nervous system, sensing of EMF by living organisms, effect of EMF on human and animal behavior, and current concepts of the neurophysiological mechanisms of action of EMF. Data from the authors' own experiments show that EMF acts selectively on limbic structures. Brief exposure of rats to 39 MHz at low intensities (30-100 V/min) stimulated convulsive activity in the limbic structures (mostly in the hippocampus). With increased duration of exposure, the activity spread to other limbic structures and to the cortex. Subsequently, generalized slow-wave activity occurred; and, finally, with exposure of 1 1/2 to 2 hr, a state resembling catalepsy developed. The results suggest disruption of the protective functional system by EMF. (216 references)

0226 EEG CONCOMITANTS OF EXPOSURE TO OSCILLATING ENVIRONMENTAL ELECTRIC FIELDS. *(E.)* Adey, W. R. (Brain Res. Inst., Univ. California, Los Angeles). *Final Report to ARPA*, DOD, Research Contract, U. S. Army DADA-17-67-C-7124, Sept. 30, 1970.

Experiments were conducted to determine the effect of low-level (2.8 volts p-p), low-frequency (7 and 10 Hz) fields on EEG and behavior in *Macaca nemestrina*. Behavioral results for 4-hr exposures showed that the three test monkeys responded slightly faster to the 7 Hz fields. The 10 Hz field did not show a reliable effect. Analysis of the EEG data revealed relative peaks in power at the frequency of the field (7 or 10 Hz) for certain brain structures. These peaks appeared most reliably in the hippocampus and less consistently in the amygdala and center median. The most marked EEG changes occurred in samples of predominantly incorrect responses taken near the end of the 4-hr exposure; a review of the responses showed that they tended to the responses which were too fast rather than too slow. In two monkeys, analysis of peak quotients showed that there was a greater peak in power at the frequency of the field for fast than for slow responses for four of five responsible brain structures. These results suggested that the observed behavioral effect was mediated by a change in the electrical field activity of the brain (especially the hippocampus) at the frequency of the imposed 7 Hz field. No systematic behavior effect was observed in 2-hr exposure tests, while the results of 24-hr exposure showed great variability in behavioral performance. Monkeys were not awakened from sleep by the presence of 7 Hz fields, nor was there any gross distortion in their EEG patterns. External electromagnetic fields of low intensity (1 μV, 1-100 mV p-p) and low frequency (4-24 Hz) caused no changes in waveform or latency of a visually evoked response in three cats. (4 references)

0227 CATARACTS FOLLOWING USE OF MICROWAVE OVEN. *(E.)* Zaret, M. M. (Bellevue Hosp. Ctr., New York, N. Y.). *NY State J. Med.* 74(11):2032-2049, 1974.

A 51-yr-old woman was examined to determine the etiology of her cataracts which were not of a hereditary or senile type. The previous year the patient had undergone cataract extraction for the right eye after examination revealed that extensive posterior subcapsular opacities were present in both lens but were more advanced in the right eye. Symptoms of early cataract had appeared almost 3 yr earlier, 3 yr after the woman had a microwave oven installed in her home. The current examination indicated aphakia of the right eye and an advanced capsular cataract in the right eye which involved the posterior region of the capsule more than the anterior. At the posterior surface, many regions of the contiguous cortex were also opacified, giving rise to multiple areas with a honeycombed appearance. Before the appearance of early cataract, the patient had used the microwave oven for about 500 hr, opening its door approximately 5000 times. Subsequently, until the oven was found to be leaking microwave radiation (2 mW/cm^2 during operation and 40 mW/cm^2 with the door open), she used the oven for about 350 hr and opened the door about 3500 times. The distinctive capsulopathy, the latency period, and the pattern of opacification were concluded to be typical of microwave cataracts. This conclusion is disputed in 5 appended letters of comment and supported in 1. In his response to these comments, the author argues against the concept that all microwave effects are thermal and maintains that this case meets the criteria for a delayed microwave cataract. (5 references)

0228 LONG-TERM PROGRAMME IN ENVIRONMENTAL POLLUTION CONTROL IN EUROPE: HEALTH HAZARDS FROM EXPOSURE TO MICROWAVES. *(E.)* Evaluation Group, *World Health Organization Report*, WHO Regional Office for Europe, Copenhagen, 1974, 14p.

The Evaluation Group convened by the WHO Regional Office for Europe has recommended a number of measures to determine and reduce the risk to public health from microwave radiation (300 GHz-300 MHz). The recommendations include an interdisciplinary symposium on the physical and biologic aspects of microwave radiation; standardization of nomenclature; a literature survey of biologic effects; interaction between physical, engineering, and biologic scientists; development and standardization of dosimetry and measuring instruments; evaluation of ambient electromagnetic fields; establishment of criteria for epidemiologic studies; personal exposure and product performance standards; evaluation of the compatibility between microwave radiation and medical electronic equipment; evaluation of the risk from diathermy; and training programs for health physicists and public health personnel. (No references)

0229 REVIEW OF A PROGRAM TO ASSESS THE EFFECTS ON MAN FROM EXPOSURE TO MICROWAVES. *(E.)* Michaelson, S. M. (Sch. Med. Dent., Univ. Rochester, N. Y.). *J. Microwave Power* 9(2):147-161, 1974.

An analysis is given of the papers presented at the International Symposium on Biologic Effects and Health Hazards of Microwave Radiation, Warsaw, October 15-18, 1973. Of the 38 papers, 9 were related to the physiopathology of the central nervous and neuroendocrine systems, 8 to epidemiological surveys, and 7 to energy/absorption measurement techniques. Other subjects included cellular and molecular biophysics (4), ocular effects (3), thermal regulation (3), mammalian development (1), combined effects (1), and applications (2). Symposium participants recommended that microwave intensities be classified in three broad categories: (a) above 10 mW/cm^2, at which potentially hazardous thermal effects occur; (b) below 1 mW/cm^2, where thermal effects are improbable; and an intermediate range of weak but noticeable thermal effects. The need of further research was stressed for cumulative effects, delayed effects, differential sensitivity, and effects related to cellular transformations. Based in part on the symposium papers, an Evaluation Group convened by the WHO Regional Office for Europe formulated a program to reduce the public health risk from microwave radiation. The program covers the exchange of information, standardization of nomenclature, interaction between physical, engineering, and biologic scientists, evaluation of ambient electromagnetic fields, compatibility between microwave radiation and medical electronic equipment, the significance of diathermy, protection standards and guides, and training programs for the evaluation of microwave and radiofrequency radiation. (No references)

0230 EXPOSURE OF MAN TO MAGNETIC FIELDS ALTERNATING AT EXTREMELY LOW FREQUENCY. *(E.)* Beischer, D. E. (Naval Aerosp. Med. Res. Lab., Pensacola, Fla.) J. D. Grissett and R. E. Mitchell. *Naval Aerosp. Med. Res. Lab.*, NAMRL-1180, July, 1973.

Ten subjects were confined for periods up to 7 days and during this time were exposed to a low-intensity magnetic field (10^{-4} Wb/m^2 at 45 Hz) for periods up to 24 hours. Five subjects were confined but were not exposed. A large battery of physiological and psychophysiological tests were given throughout the confinement period. No effects were seen that could be definitely linked with the magnetic field. The only changes that could be correlated with the time course of exposure to the ELF magnetic field were in serum triglycerides of blood samples drawn 14 hours after the evening meal. In 9 of the 10 exposed subjects, serum triglycerides reached a maximum value 24 to 48 hours after the ELF field exposure. Similar trends were not seen in any of the 5 control subjects. For the corresponding period chylomicrons were negligible for all subjects while cholesterol levels were stable and within the normal range; therefore, the serum triglycerides were in the form of very low density lipoproteins. The number of subjects is too small, however, to exclude statistically other factors such as psychophysiological reactions to forced changes in personal living habits, modified activity, restricted diet, and confinement. A final conclusion must await further experiments and the establishment of a relationship between field strength and physiological effects, as well as establishment of a threshold for the effects. (28 references)

0231 CHANGES IN THE FUNCTIONAL STATE OF THE BODIES OF WORKERS SERVICING HIGH-FREQUENCY CURRENT GENERATORS. *(Rus.)* Stefanov, B. (Hygien. Epidem. Inst., Varna, Bulgaria) and S. Solakova. *Gig. Tr. Prof. Zabol.* (7):44-45, 1973.

Studies were made of 45 male workers, 22-43 yrs of age, exposed to 33 HFC generators of 60-300 KHz, 10-125 kW. The workers were divided into 3 groups depending on the length of exposure: 1 yr, 1-5 yrs, and over 5 yrs. The average daily exposure was 4-5 hr. Twelve nonexposed subjects served as controls. Exposed workers generally complained of asthenia, poor memory, and excessive perspiration. Group 3 had higher irritability, somnolence, poor eyesight, hyperhidrosis, and cardiac pains. Workers in the induction zone had tremor, red dermography, hyperhidrosis and acrocyanosis. Disturbance of the vasomotor and thermoregulating functions as result of exposure to EM fields was also observed. Findings indicate a weaker vascular tonus of 12 mm in systole and 11 mm in diastola. Group 3 exhibited the greatest incidence of asymmetry and hypotonia--33.3% and 41.7%, resp. Pulse rate in exposed workers was higher by 10 per min; cholinesterase function of the blood was inversely proportional to the length of service: 2.9 units in Group 2, 2.6 in Group 3, and 3.1 in controls. Results indicate that workers servicing HFC generators have functional changes in the vegetative nervous system correlated to their length of work. (15 references)

0232 POSSIBLE USE OF MICROWAVES IN THE MANAGEMENT OF LUNG DISEASE. *(E.)* Susskind, C. (Dept. Electr. Eng. Computer Sci., Univ. California, Berkeley). *Proc IEEE* 61(5):673-674, 1973.

Microwave techniques may be adaptable to the detection and mapping of excessive fluid accumulation in the interstitial regions of the lung. Adaption of microwave devices for fluid detection is contingent on development of a methodology that would normalize the effects of variations in skin, fat, and muscle layer thickness, the effect of the curvature of the torso, and those of body size and position in the field. Once the difficulties of normalization are overcome, systematic investigation should quickly yield optimum power levels and wavelengths. The relative merits of continuous wave *versus* pulsed sources should also be investigated;

because thermal effects depend on average power densities, pulsed operation at a suitable duty cycle may permit more efficient operation without hazard to the subject than the continuous wave regime. Radar and scanning-electron-microscope techniques could be applied to the mapping of fluids abnormally present in the lung area. (9 references)

0233 PHYSIOLOGICAL CHANGES IN ADULT RATS EXPOSED TO AN ELF ROTATING MAGNETIC FIELD. *(E.)* Persinger, M. A. (Dept. Psychol., Laurentian Univ., Sudbury, Canada), G. B. Glavin and K. P. Ossenkopp. *Int J Biometeor* 16(2):163-172, 1972.

Male Holtzman rats between 80 and 150 days of age were exposed either to a 0.5 to 3 gauss or a 3 to 30 gauss extremely low frequency (ELF) (0.5 Hz) rotating magnetic field (RMF) for 5, 10, or 26 days. Among the animals aged at least 115 days, the RMF exposed group consumed more water than an unexposed control group; this difference was significant among the animals exposed to the RMF for 10 or 26 days. The ELF-RMF-exposed rats also showed a progressive decrease in relative thyroid weight with increased body weight up to 10 days of exposure and an increase in testicular weight up to 26 days of exposure. Nonsignificant differences were found between the groups in terms of circulating blood eosinophil count and relative adrenal weight. None of these changes were noted in the 80-day-old rats. The ELF-RMF field may have initiated correlative changes in physiology and behavior by altering the characteristics of the colloid contained in the thyroid follicles of the exposed rats. (26 references)

0234 BEHAVIORAL CHANGES IN ADULT RATS EXPOSED TO ELF MAGNETIC FIELDS. *(E.)* Persinger, M. A. (Dept. Psychol., Laurentian Univ., Sudbury, Canada), M. A. Persinger, K. P. Ossenkopp and G. B. Glavin. *Int J Biometeor* 16(2):155-162, 1972.

Male Sprague-Dawley, Holtzman, and Wistar rats between 30 and 100 days of age were exposed to an extremely low frequency (ELF) (0.5 Hz), 3-50 gauss rotating magnetic field (RMF) for 21 to 30 days. The subsequent ambulatory behavior of the exposed rats in an open field was significantly increased. In another experiment, the animals were exposed to a different RMF apparatus (3-30 gauss) and tested in a different open field apparatus for a longer period of time. Again, the RMF-exposed group was significantly more active than the control group. The effect showed a high degree of consistency. (14 references)

0235 MATURATION AND OPEN-FIELD BEHAVIOR IN RATS EXPOSED PRENATALLY TO AN ELF LOW-INTENSITY ROTATING MAGNETIC FIELD. *(E.)* Ossenkopp, K. P. (Univ. Manitoba, Canada). *Psychol. Rep.* 30:371-374, 1972.

Rats that had been exposed continuously during their prenatal development to a 3 to 12 gauss, 0.5 Hz rotating magnetic field (RMF) were significantly retarded, in comparison to control group, in time of eye opening ($p < .01$) and time of teeth eruption ($p < .01$), but did not differ significantly in maturation of startle response. The RMF-exposed animals traversed significantly fewer squares than their controls in an open-field situation ($p < .01$), but defecated ($p < .05$) and urinated ($p < .01$) significantly more often, and entered the center circle in the open field significantly less often ($p < .01$). There was no significant difference in the number of rearing responses for the two groups. These results are consistent with the hypothesis that extremely low frequency (ELF) waves alter the ion-milieu near synaptic clefts in such a manner that action potentials result and that the ELF effect is greatest where the synapse density is highest and where the summation of action potentials is likely to take place. (13 references)

0236 THE BASIC BIOLOGICAL DATA TRANSMISSION AND CONTROL SYSTEM INFLUENCED BY ELECTRICAL FORCES. *(E.)* Becker, R. O. (VA Hosp., Syracuse, N. Y.). *Ann NY Acad Sci* 238:236-241, 1974.

All the reported effects of electrical and magnetic forces are on nerve functions or on activities, such as growth and repair, that are under some degree of neuronal control. Most of these effects are on biological functions that are under precise control by mechanisms which elude description by solution biochemistry. Apparently a basic property of living material is responsible for initiating, directing, and controlling responses to trauma and is sensitive to alterations in the electromagnetic parameters of the environment. The presence of two data transmission and control systems in most present-day animals may explain reported electromagnetic phenomena. The one system is a sophisticated, action potential digital-type system, while the other is a more basic primitive analog-type system that antedated the former. The analog system, which resides primarily in the supportive or perineural cells of the nervous system, deals with notification of trauma and the detection of alterations in the environmental electromagnetic field. The general level of activity of the digital action potential system is controlled by direct-current fields in the central and peripheral nervous systems. The overall level of activity of the neural action potential system is set by the perineural system. The influences of low-level electromagnetic parameters on biological systems and parallel phenomena indicate the possibility of an underlying biological control system of considerable import. (36 references)

0237 MICROWAVE AND ULTRASONIC THERAPY OF TAPETORETINAL DEGENERATION OF THE RETINA. *(Rus.)* Lutsker, L. S. (Gelmgolts Moscow Sci. Res. Inst. Eye Diseases, USSR) and S. M. Nurieva. *Vest. Oftolmol.* 5:69-71, 1973.

Studies were made of both consecutive and combined microwave and ultrasonic treatment of retina degeneration of 126 eyes in 65 patients aged 7-60, of whom 53 had retinitis pigmentosa, 9 had Stargardt's disease, and 3 Best's disease. Microwave therapy included 20 daily sessions of 10-15 min at 20 W, distance 9 cm, emitter diameter 9 cm. Ultrasonic therapy included 20 daily sessions of 5 min at 800 KHz, power density 0.3 W/cm^2. Nearly all the patients received vasodilative therapy of nicotinic acid administered by injections or electrophoretically. Mean average visual acuity before the treatment was 0.25, after treatment 0.33. Combined therapy proved to be more effective (increase of mean average visual acuity of 0.13) than each method used separately (increase of 0.07 for microwave, and 0.06 for ultrasonic treatment). The combined treatment is recommended for managing tapetoretinal degeneration of the retina. (12 references)

0238 BIOLOGICAL EFFECTS OF NON-IONIZING RADIATION: AN OUTLINE OF FUNDAMENTAL LAWS. *(E.)* Romero-Sierra, C. (Dept. Anat., Queen's Univ., Kingston, Canada) and J. A. Tanner. *Ann NY Acad Sci* 238:263-272, 1974.

Exposure of the sciatic nerve of the rat to a continuous-wave electromagnetic field at 27 MHz for 5-30 min produced demyelination and hypermyelination, changes in the collagen content, and varying degrees of axonal and Schwann cell damage. Demyelination ranged from a minimal alteration of myelin lamellar array to the complete denudation of axons. The effect was directly proportional to exposure time and inversely related to distance. Collagen content increased after a brief exposure and collagen-like fibrils protruded from Schwann cell cytoplasm into the endoneural space. In other experiments, rats with a 1-15-cm wound below the scapulae were treated with saline, saline and 15-min exposure to 27 MHz, histamine (1.0 mg/ml), or histamine and a 27-MHz field. The cosmetic appearance of wounds treated with an electromagnetic field and histamine was superior to that of the other three treatment groups, and fewer white blood cells were present in the incisional gap of rats receiving this treatment. These findings show that electromagnetic fields imposed on a living system modify the electromagnetic interaction that exists between glial and neuronal cells inside a nervous structure. To predict the consequences of any interaction, all parameters that characterize the electromagnetic field, the environment, and the subject radiated must be quantified and integrated. (30 references)

0239 USE OF A BACTERIOPHAGE SYSTEM FOR INVESTIGATING THE BIOLOGICAL EFFECTS OF LOW INTENSITY PULSED MICROWAVE RADIATION. *(E.)* Walker, C. M. (Surg. Med. Res. Inst., Univ. Alberta, Edmonton, Canada), K. G. McWhireter and W. A. G. Voss. *J Microwave Power* 9(3):221-229, 1974.

The influence of 2450 MHz microwave radiation, pulsed at 8 KHz, on the number of infections of *Escherichia coli* B by phage T4r$_{II}$ was examined. Low level radiation at a power density between 1 and 10 mW/cm^2 was used, the biological samples being irradiated in S-band waveguide. The results indicate that this pattern of radiation does not have a statistically significant effect on the number of infections. (30 references)

0240 A PILOT STUDY OF THE INTERACTION OF EXTREMELY LOW FREQUENCY ELECTROMAGNETIC FIELDS WITH BRAIN ORGANELLES. *(E.)* Riesen, W. H. (IIT Res. Inst., Chicago, Ill.), C. Aranyi, J. L. Kyle, A. R. Valentino and D. A. Miller. Contract N00039-71-C-0111, Proj. E6185, Tech. Memo. #3, Aug. 1971, 27p.

Two types of subcellular particles (mitochondria and nerve ending particles) were exposed in vitro to extremely low frequency (ELF) non-ionizing and magnetic fields. An appropriate biochemical function was monitored simultaneously for both exposed and unexposed particles. Exposure to a 60-Hz, 100-gauss magnetic field, at 10 C for up to 110 min, had no demonstrable effect on isolated brain mitochondria from young adult male guinea pigs. Isolated brain synaptosomes from weanling or aged Sprague-Dawley rats were exposed to a 60-Hz field at 50-100 gauss at 37, 25, 10, and 0 C for 30 min. Uptake of ^{3}H-norepinephrine was measurably depressed only under the 0 C condition. No trends were suggested by the data from weanling or aged rats. Exposure of guinea pig brain and liver mitochondria to an electric field of 6.3 V/m at 60 Hz for 60 min at 4 C had no demonstrable effect on oxidative phosphorylation. Exposure of brain mitochondria to an electric field of 155 V/m for 15 min had no effect, but after 40 min resulted in complete loss of respiratory control and total uncoupling of oxidative phosphorylation. (9 references)

0241 OCULAR HEATING DURING DENTAL DIATHERMY TREATMENT. *(E.)* Tell, R. A. (Off. Res. Monitoring, Environ. Prot. Agency, Rockville, Md.) and J. B. Kinn. *J. Oral Surg.* 30:284-287, 1972.

A dielectrically equivalent phantom human head was given a typical diathermy treatment of the jaw. Irradiation was performed with a diathermy unit operating at 2450 MHz and capable of delivering 100 W of power to the applicator. Temperature measurements were made to assess the degree of microwave hazard to the eye. The results show that treatments as long as 8 min can produce temperature elevations of 1.6-2.4 C in the midpoint of the eye on the treated side. Extra caution against radiation of the orbital region should be exercised during any facial diathermy treatment technique. (9 references)

0242 HEALTH SURVEILLANCE OF PERSONNEL OCCUPATIONALLY EXPOSED TO MICROWAVES. I. THEORETICAL CONSIDERATIONS AND PRACTICAL ASPECTS. *(E.)* Czerski, P. (Dept. Sanit. Inspection, Ministry Hlth. Social Welfare, Warsaw, Poland), M. Siekierzynski and A. Gidynski. *Aerospace Med* 45(10):1137-1142, 1974.

Medical data for 841 men (aged 20-45 yr) occupationally exposed to microwaves were analyzed for incidence of causes of inability to continue work. The population was divided into two groups: one consisting of 507 men exposed to mean power densities above 2 W/m^2; the second of 334 men exposed to power densities below 2 W/m^2. Each group was further subdivided according to age or duration of work. Causes of inability to continue work were classified as ophthalmologic contraindications, severe functional disturbances, and other causes including endocrinologic disorders, blood and blood-forming system disorders, traumas, and disorders of the digestive tract. The difference in microwave exposure levels of the two groups did not influence the incidence of disorders considered contraindications for continued exposure. No significant correlation between causes of inability to continue work and level or duration of microwave exposure was demonstrated. In the second group, there was a significant correlation with age. Comparison of low- and high-level exposure groups may be helpful in perfecting the method of health surveillance of microwave workers. (15 references)

0243 HEALTH SURVEILLANCE OF PERSONNEL OCCUPATIONALLY EXPOSED TO MICROWAVES. II. FUNCTIONAL DISTURBANCES. *(E.)* Siekierzynski, M. (Military Med. Acad., Warsaw, Poland), P. Czerski, H. Milczarek, A. Gidynski, C. Czarneck, E. Dziuk, and W. Jedrzejczak. *Aerospace Med* 45(10):1143-1145, 1974.

The incidence of functional disturbances (neurotic syndrome, gastro-intestinal tract disturbances, cardio-circulatory disturbances with abnormal ECG) was analyzed in 841 males aged 20 to 45 years, occupationally exposed to microwaves for various periods of time. The whole population was subdivided into two groups differing only in respect to microwave exposure--low; i.e., below 0.2 mW/cm^2 and high; i.e., between 0.2 mW/cm^2 and 6 mW/cm^2. No dependence of the incidence of functional disturbances on the exposure level or duration of occupational exposure (years) could be demonstrated. (4 references)

0244 HEALTH SURVEILLANCE OF PERSONNEL OCCUPATIONALLY EXPOSED TO MICROWAVES. III. LENS TRANSLUCENCY. *(E.)* Siekierzynski, M. (Military Med. Acad., Warsaw, Poland), P. Czerski, A. Gidynski, S. Zydecki, C. Czarnecki, E. Dziuk and W. Jedrzejczak. *Aerospace Med* 45(10):1146-1148, 1974.

The incidence of lenticular opacities was examined in 841 workers (aged 20-45 yr) exposed to microwave mean power densities from 2-60 W/m^2 (507 individuals) or below 2 W/m^2 (334 individuals). The incidence of opacities was compared between both these groups, subdivided according to age or duration of occupational exposure. Lens opacities were not dependent on microwave exposure level or on duration of exposure. A clear-cut dependence on age was demonstrated. (8 references)

0245 THE EFFECTS OF PULSED ELECTROMAGNETIC ENERGY ON PERIPHERAL NERVE REGENERATION. *(E.)* Wilson, D. H. (Gen. Infirm., Leeds, England), P. Jagedeesh, P. P. Newman and D. G. F. Harriman. *Ann NY Acad Sci* 238:575-585, 1974.

The median ulnar nerve in the left forelimb of a series of pairs of Wistar rats was divided and sutured under a general anesthetic. Subsequently, 1 rat from each pair was exposed 15 min/day to pulsed electromagnetic radiation (975-W emission for 65 μsec at 27.12 megacycles). Clinical observations showed that the wounds in the treated animals healed in 4 days, whereas wounds in the controls required 7 days. Treated rats began to use their left forelimb after 10 days; the untreated rats required 3 weeks to reach this same stage of recovery. Nerve conduction studies at 12 days showed a modified biphasic response to an 0.5-V stimulus in the treated nerve but none in the untreated one. At 30 days, a biphasic action potential was demonstrated in the treated animals after a stimulus of 1.0 V; and at 45 days, the nerve conduction tracing was indistinguishable from that of a normal nerve. Nerve conduction in untreated rats did not return before 60 days. Histologic preparations revealed that at 30 days, the nerve in the treated animal had progressed further toward recovery than had the nerve of an untreated animal at 60 days. Nerve dissection was relatively simple in treated animals but was difficult in untreated rats due to considerable scarring and fibrous tissue around the nerve suture site. Problems of applying these findings to the treatment of patients include the daily dosage of pulsed electromagnetic energy involved and the possibility that damage to surrounding tissue may complicate the treatment. (1 reference)

0246 DIFFERENTIAL BIOLOGIC EFFECTS OF PULSED AND CONTINUOUS ELECTROMAGNETIC FIELDS AND MECHANISMS OF EFFECT. *(E.)* Frey, A. H. (Randomline, Inc., Huntingdon Valley, Pa.). *Ann NY Acad Sci* 238:273-279, 1974.

Specific examples of electrical fields and tissue interactions are given. Human subjects perceived "sounds" when illuminated with pulsed, but not with continuous, electromagnetic energy at 0.3-3 GHz,

the portion of the electromagnetic spectrum at which electromagnetic energy passes into and through the head. The effect was related to peak power; average power was relatively unimportant. In the cat brain, responses were evoked with pulse-modulated ultrahigh-frequency energy (1.2-1525 GHz). The threshold power required to elicit activity was 30 $\mu W/cm^2$ average and 60 mW/cm^2 peak. Variation in power density had a distinct effect on the evoked activity. In another experiment, heart beat increased significantly when the heart was illuminated 200 millisec after the P wave, about the time the QRS complex occurred (in ECG). Arrhythmias occurred in 1/2 the cases and were associated with radiofrequency illumination. Electrical fields at low levels could influence neural conformational changes that are significant in information transfer and storage in the nervous system. Other possible hypotheses are concerned with field-induced forces on the neural junction and its effects; the apparent ability of tissue to act as a wax electret; and the possibility of microthermal effects. Previous investigators have suggested that radiofrequency energy can produce localized temperature gradients that cause thermoosmotic and thermoelectric aftereffects. Further study of electrical field interactions with tissue should add to the understanding of growth processes and repair. (29 references)

0247 RADIATION LEAKAGE CONTROL OF INDUSTRIAL MICROWAVE POWER DEVICES. *(E.)* Elder, R. L. (Bur. Radiol. Hlth., Rockville, Md.), J. A. Eure and J. W. Nicolls. *J Microwave Power* 9(2):51-61, 1974.

The current responsibilities and activities of the Bureau of Radiological Health in carrying out the requirements of the Radiation Control for Health and Safety Act of 1968 are reviewed, especially in relation to industrial uses of microwave power. Power levels of industrial microwave units range from 1.0-200 kW and average 25 kW/unit compared to ranges of up to 2.0 kW for commercial ovens and 0.5-1.0 kW for household ovens. Although the industrial operator of microwave equipment constitutes a very small fraction of the total population exposed or potentially exposed to radiation leakage, the duration of his exposure can be on the order of hours. Based on a survey conducted at manufacturers' facilities, the Bureau has recommended a number of safety features to ensure that microwave leakage does not exceed design limits. Another investigation has resulted in recommendations for improving the operating safety of 15 conveyorized, industrial microwave processes operating at 915 or 2450 MHz. Means for accurate power density measurements at other wavelengths are not available. Performance standards which have been promulgated include those for microwave ovens, television receivers, demonstration cold-cathode gas-discharge tubes, and diagnostic x-ray systems. Responsibilites of the manufacturer under the Radiation Control for Health and Safety Act include submission of initial reports on new electronic products, reports of model changes, annual reports, and reports of accidental radiation occurrences. Close cooperation between the Bureau of Radiological Health and state and local agencies should ensure the proper maintenance and use of industrial electronic products. (23 references)

0248 GENERATION OF ACOUSTIC SIGNALS BY PULSED MICROWAVE ENERGY. *(E.)* Sharp, J. C. (Walter Reed Army Inst. Res., Washington, D. C.), H. M. Grove and O. P. Gandhi. *IEEE Trans Microwave Theory Tech.* MTT-22(5):583-584, May 1974.

An acoustic signal was produced when short microwave pulses were directed at a carbon-impregnated polyurethane absorber used to shield portions of an observer's head from radiofrequency radiation. When the distance from the absorber to an acoustically coupled sound meter was 1.43 m, the sound arrived approximately 4.68 millisec after application of triggered pulses 14 µsec long. The net transmitted power was determined to be 4500 W/pulse, yielding a calculated power density of 7.5-15 kW/m^2 for a working distance between 0.3-0.6 m. The quality and amplitude of the acoustic signal did not differ when the carrier frequency was changed from 1200 through 1600 and 2450 MHz. Several types of absorber produced audible sounds as did loosely crumpled aluminum foil. The threshold power/pulse for audibility, under less than ideal conditions, was 275 W peak for an estimated peak power density from 0.46-0.92 kW/m^2. The phenomenon may be due to the fact that radiation pressure exerted on surfaces causes changes in the magnitude and/or orientation of impinging electric and magnetic fields. Other transduction mechanisms may be operating when humans "sense" microwave pulses. Bone has piezoelectric properties and the difference of potential resulting from bone deformation has been measured; if the radiation pressure or electrostrictive forces are sufficient in the irradiated cranium to engender such a potential difference, there could be an electrically mediated sensation. Direct acoustic excitation of the auditory organ may occur via bone conduction of such a vibration or the basilar membrane may directly couple with the microwave energy. (4 references)

0249 MICROWAVE CATARACTS. *(E.)* Appleton, B. (Walter Reed Army Med. Ctr., Washington, D. C.). *JAMA* 229(4):407-408, 1974.

Over a 5-yr period detailed lens examinations were performed on personnel with the greatest likelihood of exposure to microwaves at military bases. Age- and sex-matched personnel with minimal exposure served as controls. Biomicroscopically physical signs that are considered to be components or pre-

cursors of cataract occurred equally in both groups. It was therefore concluded that no lens damage was caused by occupational exposure to microwave energy. None of 7 persons with presumed acute exposure to microwave energy sustained any physical evidence of superficial burn production, nor was there any evidence of eye damage; the ocular status of all individuals examined was consistent with their age. Some persons previously identified as having "early microwave cataract" or "early microwave lens effect" were also studied. Their visual acuity and the appearance of their lenses by slitlamp examination changed very little over the 5-yr survey period. This suggested that if microwave lens effects existed, they were nonprogressive, or that the physical signs previously identified as microwave lens effects were nonspecific changes with very little progression. In another study, 19 diathermy workers were compared with age- and sex-matched controls from the same hospital. Ocular examination showed no differences between the diathermy workers and the controls. The data indicate that (1) lens damage probably has not occurred in humans from cumulative exposure to low levels of microwave energy and (2) lens damage probably could not occur in a human from acute exposure without associated severe facial burns. (No references)

0250 ELECTROMAGNETIC RADIATION INTERFERENCE WITH CARDIAC PACEMAKERS. *(E.)* Ruggera, P. S. (Bur. Radiol. Hlth., Div. Electron. Prods., Rockville, Md.) and R. L. Elder. *Bureau of Radiological Health* Publication 71-15, April, 1971, 36p.

The Division of Electronic Products, Bureau of Radiological Health, has initiated a study to determine the relative danger presented to cardiac pacemaker patients by the microwave oven in comparison with other known sources of electromagnetic radiation. This report explains how pacemakers and microwave ovens function, describes the mechanism of electromagnetic interference, and outlines the status of Division of Electronic Products activities in this area. The microwave oven performance standards specify a maximum average leakage of 5 mW/cm^2 for the life of the product. At this rate of leakage, assuming a plane wave, power density 5 ft from the oven would be 5.4 $\mu W/cm^2$; the electric field intensity in the air at the same distance would be 44 mV/cm. Assuming that 50% of this is absorbed by the body, 31 mV could be available to every cm of exposed circuitry. Comparing this to the 5- to 15-mV sensitivity of the pacemaker, the probability of interference cannot be dismissed. However, the oven is not the only or most dangerous source of interference. Any signal with a fast rise time, thus containing many high-frequency components, is capable of disrupting pacemaker function. (49 references)

0251 ELECTRIC FIELD EFFECTS IN SELECTED BIOLOGIC SYSTEMS. *(E.)* Marino, A. A. (VA Hosp., Syracuse, N. Y.), T. J. Berger, J. T. Mitchell, B. A. Duhacek and R. O. Becker. *Ann NY Acad Sci* 238:436-444, 1974.

Since low-level, trigger effects induced by electromagnetic fields do occur in mammalian systems, this study investigates the question of whether such effects are induced by electrostatic fields (ESFs). Male Sprague-Dawley rats were continuously exposed to ESFs for 30 days, to determine the biologic effects of the fields. In another experiment, female Swiss Ha/ICR mice were injected with Erhlich ascites tumor cells and studied for the effect of ESFs on the ascites cell chromosome pattern after 14 days exposure. Secondary glaucoma developed in 16% of 56 Sprague-Dawley rats exposed to vertical ESFs (6-197 V/cm) but the effect was not seen in the 42 rats subjected to horizontal ESFs (3-98 V/cm) or in the 72 control rats. Significant differences in serum proteins occurred between rats exposed to the three highest vertical ESF fields (28, 56, and 197 V/cm) and controls. The ratio of albumin proteins to nonalbumin proteins increased for vertical ESFs of 197 and 28 V/cm and decreased for the vertical ESF of 56 V/cm. The percentage of abnormal chromosomes in Ehrlich ascites tumor cells increased 4-fold after 14-day exposure to ESFs at 8-160 V/cm. The average number of abnormalities/cell in experimental animals was more than twice that of controls. These results confirm the existence of ESF-induced trigger phenomena in biologic systems. (18 references)

0252 BENEFICIAL AND HARMFUL ACCELERATED GROWTH INDUCED BY THE ACTION OF NON-IONIZING RADIATION. *(E.)* Tanner, J. A. (Control Systems Lab., National Res. Council, Ottawa, Canada) and C. Romero-Sierra. *Ann NY Acad Sci* 238:171-175, 1974.

Both beneficial and noxious effects of microwaves were observed in experiments on birds and plants. Exposure of Leghorns to 7.06 GHz at field intensities up to 1000 $\mu W/cm^2$ increased egg production, but the death rate of the irradiated colony was almost double that of controls. In other experiments, the reactions of chickens with and without tail feathers were compared. After 1-20 sec irradiation at 9.29 GHZ (burst frequency, 416 pulses/sec; pulse width, 2.35 μsec), chickens with feathers showed mounting signs of distress in the form of vocalization, defecation, and initiation of flight. Similar and much longer irradiation periods produced little or no reaction in defeathered birds. Experiments at 16 GHz revealed that the elicited response was frequency dependent. To determine the nature of the interaction with feathers, sections of the calmus of chicken feathers were subjected to electrical excitation at 0.1-10 kHz. An axial twisting of the long fibrous molecules was induced, with

high cholesterol diet and was continued for 5 weeks. A large discrepancy in lipid levels between the experimental and control animals developed two weeks after the treatments were begun. Animals irradiated for 180 min/day, rather than 90 min, showed a greater and more prolonged lowering of cholesterol levels. Treated animals showed about 15% gross aortic lipid deposits, compared with about 30% for controls (6 controls; 6 experimental). The effects described may be due to an activation of lipid catabolism caused by the radiation treatments. (1 reference)

0253 PANCREATIC FUNCTION IN GASTROINTESTINAL DISEASES FOLLOWING ULTRA-HIGH FREQUENCY THERAPY. *(Rus.)* Korepanov, A. M. (Izhevsk Med. Inst., USSR). *Sov. Med.* (6):101-105, 1973.

Data on the effect produced by UHF-therapy administered in oligothermal doses on the external and internal secretory function of the pancreatic gland, both when it is dispensed in a single sitting and course-wise, are offered. The external secretory function was investigated in 207, internal secretory in 196, patients who suffered mainly from chronic cholangiohepatitis (318 cases). Single sittings were seen to cause an increased external secretion and activity of the blood enzymes (within the limits of normal fluctuations). With initial hypo- and hyperglycemia there was noted a tendency towards normalization of glycemia on an empty stomach. Course-wise treatment showed positive dynamics in many of the parameters under study. (3 references)

0254 THE EFFECT OF SLIGHT DROPS IN ELECTROMAGNETIC FIELDS ON THE BIOELECTRIC ACTIVITY OF THE HUMAN BRAIN. *(Rus.)* Mikhailova-Lukasheva, V. D. (Gerontology Section, Acad. Sci., Beloruss. SSR), A. V. Skripal, V. P. Melnikov, and V. P. Korotkii. *Dokl. Akad. Nauk BSSR* 17(7):672-674, 1973.

Studies were made to elucidate the effects of electromagnetic fields (EMF) on the information action functioning of the human brain. EEG measurements of the bioelectric activity of the sinciput were made in 7 subjects, aged 20-30, exposed for 25-30 sec to an EMF drop of the order of 10^{-14} W/sec and frequency spacing of 2.8-10 and 400 Hz of coherent radiation. Three subjects were exposed to the same frequency spacing and white noise drop of 50 Hz to 6 mHz. Preliminary data indicate that the reaction of the subjects to EMF action varies considerably. Substantial changes in bioelectric activity were observed in 6 subjects exposed to 400 Hz, and only in 4 exposed to 2-10 Hz. The most pronounced decrease of bioelectric activity was observed in β_2, α and δ rhythms. Distinct changes were observed in θ rhythms of the 3 subjects exposed to the action of white noise, with only minor responses in other rhythms. (8 references)

0255 PECULARITIES IN METABOLISM OF SKELETAL MUSCLES IN RATS UNDER EFFECT OF PULSED ELECTROMAGNETIC FIELD OF LOW FREQUENCY. *(Ukr.)* Kolodub, F. A. (Res. Inst. Labor Hyg. Prof. Diseases, Kharkov, USSR) and H. P. Evtushenko. *Ukr. Biokhim Zh.* 45(3):356-361, 1973.

The effects of pulsed electromagnetic fields (PEMF) on the supply of macroergic compounds to the skeletal muscles of rats was studied using low frequency (7kHz, 72 and 24 kA/m) radiation. Oxidative phosphorylation processes, carbohydrate metabolism, and the systems participating in the formation and removal of ammonia in muscle tissues were also examined. It was found that PEMF causes a decrease in ATP content and creatinephosphate, due to separation conjugation of oxidation with phosphorylation and glycolysis intensification. Increases were also observed in protein desamidization (a decrease in the content of protein nitrogen amide), desamidization of adenosine, adenylic (activation of adenosine- and adenylate-desaminases) and glutaminic acids, with the absence of corresponding intensification of glutamine synthesis resulting from ATP deficit. A considerable increase in the content of ammonia in the skeletal muscles, reaching in some periods to 76.3%, also resulted. (23 references)

0256 ACTION OF ELECTROMAGNETIC WAVES AND OF MAGNETIC FIELDS ON LIPID CHANGES IN THE RABBIT CAUSED BY THE ADMINISTRATION OF A HIGH CHOLESTEROL DIET. *(Fr.)* Pautrizel, R. (UER Médicale, Bordeaux, France), A. Priore, M. Dallochio and R. Crockett. *C. R. Acad. Sci. [D] (Paris)* 274:488-491,1972.

Forty-two male Fauves de Bourgogne rabbits were fed a diet containing about 1 g cholesterol/animal/day; 24 experimental animals also received daily exposure to electromagnetic waves and magnetic fields for 90 or 180 min. Blood samples were taken weekly from each animal and analyzed for lipid content; 30 animals were examined for the extent of lipid deposits on the aorta. Experimental animals were divided into 3 groups: (1) Blood sampling, irradiation, and high cholesterol diet began at the same time. Irradiation continued for 15 days. Blood samples taken 3 weeks after the beginning of the experiment were the first to show a significantly lower lipid content for the experimental than for the control animals. The difference in cholesterol levels was the most pronounced (6 controls; 6 experimantal animals). (2) Radiation was given from 2 to 4 weeks. In all cases, the difference in lipid content between experimental and control animals became noticeable after the third week. The effect continued for 2 to 3 weeks after discontinuation of the treatment. Gross lipid deposits covered about 20% of the surface of the aorta for experimental animals, compared with about 50% for controls (6 controls; 12 experimental). (3) Radiation treatment was instituted 5 weeks after the clearly defined resonance characteristics. Based on measures of trajectory, frequency of escape responses, and feeding behavior, a 16 GHz pulsed-radiation field had an aversive effect on parakeets in flight. The effect was enhanced by steam and reduced by cold vapor. Other harmful effects of electromagnetic radiation were demyelination of nerve tissue in rats exposed to 9.29 GHZ (burst frequency, 416 pulses/sec; pulse width, 2.35 usec)

and permanent wilting of most plants exposed to continuous-wave 10 GHz fields at a field intensity of 190 mW/cm^2. The results indicate that electromagnetic field intensity *per se* is a meaningless quantity without also defining the parameters that relate to the biological effects of the field. (9 references)

0257 THE EFFECT OF DECIMETER WAVES ON THE HYPOPHYSEAL AND ADRENOCORTICAL FUNCTION IN RABBITS. *(Rus.)* Grigorieva, V. D. (Central Sci. Res. Inst. Hlth. Resorts Physiotherapy, Moscow USSR.), A. I. Zolnikova, S. Kh. Kubli, and L. I. Maksimova. *Vopr. Kurortolog.* (38):488-490, 1973.

The effects of 65 cm radiation (460 MHz) at subthermal (110 mW/cm^2) and thermal (330 mW/cm^2) doses on the back, in the area of D_{10} - L_4 vertebrae including the adrenal glands, were studied in 70, 2.5 kg - 3 kg, rabbits. Six-minute daily exposures lasted for 12 days. The animals were divided into 6 groups. The first two were exposed to 110 mW/cm^2, the third to 330 mW/cm^2, the fourth was unexposed controls. In the fifth group, exposed to 110 mW/cm^2 a pathological condition was induced by s.c. injection of Freund adjuvant. The sixth group was also injected with adjuvant and used as unexposed controls. Exposure at 110 mW/cm^2 stimulated the hypophyseal and adrenocortical function; content of 11-hydroxycortico steroids in the blood rose by 93%, noradrenalin by 50%. Elevation of adrenalin and noradrenalin in the adrenal glands rose by 13% and 4-fold, resp. In hypothalamus noradrenalin and adrenals rose by 12% and 80%, respectively, and dopa rose 10 times. In the heart, noradrenalin rose 25%. The stimulating effect of the exposure persisted for 20 days. Exposure at 330 mW/cm^2 had an adverse effect on the hypophyseal and adrenocortical function. Findings indicate that Freund adjuvant injected s.c. (0.7-0.8 mg/kg) inhibits inflamations and results in far lesser injuries of the joints and viscera in the animals exposed to 110 mW/cm^2 power density than in the controls (Group 6). The latter had an acute inflamatory process. The results indicate that certain exposure levels in the decimeter range may be used as a preventive measure to protect the organism from adverse effects of some agents. (6 references)

0258 THE EFFECTS OF EXPOSURE TO THE UHF FIELD. *(Rus.)* Gembitskii, E. V. (no affil.). *Voen. Med. Zh.* (10):58-63, 1973.

Biophysical, physiological and clinical aspects of UHF effects are reviewed. The biophysical mechanism of microwave absorption is believed to involve the vibration of ions and water dipoles and resonance power absorption by cellular protein molecules. Studies of the nonthermal effects of the UHF exposure indicate that radiation of large animals at power density 1-3 mW/cm^2 results in central nervous system disorders, bradycardia, hypotension, and slight biochemical and immunological changes. The mechanism of subcellular disorders caused by nonthermal radiation has not been elucidated. It may be assumed that direct heating of cellular microstructures is involved. Pathogenic UHF effects include functional changes in the cells, above all in the central nervous system and receptors; disorders of the reflectory-humoral regulation of the viscera and metabolism; and secondary changes in the viscera. Disorders caused by the UHF field may be acute and chronic. Prior literature describes no more than 10 cases of acute cataract (2-3 months) after exposure from several hundred mW/cm^2 to several W/cm^2. Chronic disorders are more frequent. Generally, patients begin to complain of asthenia, tremors in the hands and lids, hyperhidrosis and acrocyanosis, 2-5 years after occupational exposure. In severe cases various diencephalic disorders are observed. Treatment aims at restoring the central nervous functions. The use of valeriana, bromine, somnifacients, antihistaminic drugs and tranquilizers has been effective. Other methods include parenteral administration of vitamin B_1, injections of cortin and anabolic hormones. The USSR Ministry of Health has set the following maximum exposure times for UHF hazardous jobs: 8 hr at under 10 μW/cm^2, 2 hr at 100 μW/cm^2, 15-20 min at 1,000 μW/cm^2. (6 references)

0259 THERAPEUTIC EFFECT OF MICROWAVES ON CHRONIC NONSPECIFIC DISEASES OF THE RESPIRATORY TRACT IN CHILDREN. *(Rus.)* Stepanova, L. T. (Moscow Inst. Pediatr. Child Surgery, USSR). *Vopr. Kurortol. Lech. Fiz. Kult.* 38:143-147, 1973.

Studies to evaluate microwave therapy of chronic bronchial and pulmonary pathology in the active inflamatory period, and to elucidate the physiological reaction to microwave exposure, involved 95 children, aged 7-14 yrs. Sixty-five of the children had chronic pneumonia, and 30 bronchial asthma; 104 healthy children, aged 7-15, served as controls. The children with chronic pneumonia were divided into three groups: 13 with moderate pulmonary fibrosis without grave localized deformation of the bronchial trunk, 18 with anatomic changes in the bronchial trunk, and 34 with chronic pneumonia with diffuse bronchiopulmonary changes. Treatment consisted of ten 6-8 min daily exposures of the interscapular region at 2-6 W, depending on age. The treatment had a favorable effect on the pulmonary ventilation and gaseous exchange. The respiration rate in children with chronic pneumonia and bronchial asthma dropped from 118 to 109, and from 111 to 106, respectively. The alveolar-total ventilation ratio increased from 50 ± 1.2% to 56 ± 1.8% in Group 1, and from 45 ± 3.1% to 53 ± 2.1% in Group 2. Most of the children in Group 1 showed positive clinical and roentgenological changes. The treatment was least effective in Group 3 with irreversible bronchial and pulmonary changes. The results indicate that microwave treatment has a spasmolytic effect which is particularly manifested in children with bronchial asthma. (12 references)

0260 CHANGES IN TISSUE RESPIRATION AND OXIDATION-REDUCTION ENZYMES IN THE GASTROINTESTINAL ORGANS AFTER EXPOSURE TO ELECTROMAGNETIC FIELDS IN METER RANGE. *(Rus.)* Faitelberg-Blank, V. R. (Odessa Agricultural Inst., USSR) and E. V. Bykova, *Vopr. Kurortol. Fizioter. Lech. Fiz. Kult.* (37):426-432, 1972.

Oxygen uptake of the liver, mucosa of the stomach, and small and large intestines was measured in 143 albino rats to study the effects of inductothermy at 13.56 MHz, and UHF fields at 39 MHz, on tissue respiration and the activity of peroxidase and catalase. Anode current of 120-280 milliamps were used in inductothermy and UHF fields of 40-300 watts. Measurements were made immediately after exposure, and after 30 and 60 min. At UHF exposure of 40 W for 10 min, oxygen uptake in the liver and respiration in the small and large intestines tended to increase, while in the gastric mucosa it decreased from 6.7 to 5.6 µl. Exposure at 80 W for 20 min. inhibited O_2 uptake in all the organs. Findings indicate that inductothermy and UHF fields affect tissue respiration and the activities of peroxidase and catalase. The changes correlate with the intensity of the field and duration of exposure. The intensity and direction of change obviously depend on the different patterns of energy absorption in the organs involved. Changes in the peroxidase and catalase activity in the gastrointestinal organs exposed to UHF radiation were as follows:

	Exposure Time/UHF Field (Minutes/Watts)				
	Controls	10/40	10/80	20/80	20/300
Liver					
Perox.	57.8	68.5	63.0	40.2	49.3
Catal.	15.7	16.8	10.9	17.8	17.8
Stomach					
Perox.	31.4	23.6	15.0	39.4	45.7
Catal.	10.0	6.4	4.9	7.4	5.6
Sma. Intest.					
Perox.	44.1	54.2	16.3	30.2	35.7
Catal.	11.6	8.7	4.8	6.7	6.1
Lrg. Intest.					
Perox.	18.1	18.3	18.0	10.0	13.3
Catal.	4.8	8.2	8.2	4.7	3.0

(22 references)

0261 THE EFFECT OF STIMULANTS OF THE CENTRAL NERVOUS SYSTEM AND ADRENAL GLAND HORMONES ON THE OUTCOME OF ACUTE INJURIES IN MICE EXPOSED TO UHF RADIATION. *(Rus.)* Koldaiev, V. M. (Vladivostok Med. Inst., USSR). *Biull. Eksp. Biol. Med.* 76:27-28, 1973.

Studies were made of the effects of stimulants of the central nervous system and adrenal gland hormones on the survival of animals exposed to UHF electromagnetic field. The experiment involved 175 male 20-30 g albino mice exposed for 16 min to UHF radiation (λ=12.5 cm) at power density of 62 ± 5 mW/cm^2. Pentylenetetrazole (20 mg/kg) and strychnine nitrate (0.2 - 50 mg/kg) injected subcutaneously, and noradrenalin bitatrate (0.25 - 2.0 mg/kg) and hydrocortisone (0.5, 1.0, 2.0 mg/kg) injected intraperitoneally were administered immediately after the exposure. Controls were injected with 10 mg/kg of NaCl isotonic solution. The survival rate of the mice treated with 1.0 mg/kg hydrocortisone was twice that of the controls, and 1.5 times higher than animals treated with noradrenalin and strychnine. Pentylenetetrazole was least effective. Findings indicate that an early administration of stimulants and hormones may have a favorable effect on the recuperative period. (1 reference)

0262 THE EFFECT OF SLIGHT DROPS IN ELECTROMAGNETIC FIELDS ON MAN. *(Rus.)* Mikhailova-Lukasheva, V. D. (Gerontology Section, Acad. Sci., Beloruss. SSR) A. V. Skripal, V. P. Melnikov, V. P. Korotkii, and L. V. Naimitenko. *Dokl. Akad. Nauk BSSR.* 16(12):1147-1149, 1972.

It is assumed that living organisms in their evolution have used electromagnetic fields to obtain information on the environmental changes as EMF are the most reliable information carriers of all alternative geophysical factors. Living organisms must therefore possess systems to enable them to respond to EMF which carry useful information only. According to prior experiments, the response to a certain range of EMF frequences depends on the duration, form and frequency spacing of the pulses. Assuming that the receptor cells would have the greatest response when exposed to a signal similar to the rhythms of the excited receptor, viz 200-400 pulse/sec, the experiment studied the effect of optimum parameters of EMF pulses on animal behavior. The greatest response was evoked by exponential pulse fields of 2×10^{-4} sec. To investigate human reactions to weak EMF the subjects were exposed to 200-400 Hz, which corresponds to the rhythms of physiological processes (f = 0.5-30 Hz). Studies also involved "white noise" drop in the 50 Hz-6 MHz range. Testees were shielded from all outside light and noise interferences. Exposure time was 10-25 sec. The following physiological data were monitored: EEG, ECG, phonocardiogram, rheobasegram, plethysmogram, arterial pressure, and respiration. The data obtained showed certain physiological changes in humans and animals, reported in later papers (see, for instance, CL 0300, below). (3 references)