with light from either a mercury or tungsten lamp at particular radiation time intervals causes an increase in the initial velocity of the enzyme catalyzed reaction. Aliquots of urease were evaporated to dryness and irradiated for 0, 20, 25, or 30 sec with light from a high-pressure Hg lamp. Urease activity was measured by a modified Nessler procedure. Previous experiments had shown that crystals irradiated for 25, 55, 85, 115, 145, and 175 sec showed increased reaction velocity. A significant increase in the reaction velocity (0.255 mean OD/5 min reaction time) was observed only after the 25 sec irradiation, with other radiation times giving no detectable response (0.236, 0.234, and 0.235 mean OD/5 min for 0, 20, and 30 sec, resp.). Preliminary experiments have also confirmed the effect with glucose-6-phosphate dehydrogenase and a yeast auxotroph. (7 references)

0555 ENVIRONMENTALLY CONTROLLED WAVEGUIDE IRRADIATION FACILITY. *(E.)* Ho, H. S. (HEW, PHS, BRH, Rockville, Md.), E. I. Ginns, and C. L. Christman. *1973 IEEE-G-MTT Int. Microwave Symp.*, 255-256, 1973.

An environmentally controlled MW waveguide irradiation facility has been developed to irradiate small animals in such a manner that the integral dose and integral dose rate can be determined. The chamber surrounding the waveguide permits temperature and relative humidity control by drawing conditioned air through the waveguide at controlled flow rates. The integral dose is determined without significant perturbation of the field interacting with the animal and the integral dose rate can also be continuously recorded. The generator provides up to 100 W of CW power at 2450 MHz. The WR 430 waveguide is designed to operate at TE_{10} mode from 1.7 to 2.6 GHz. The forward, reflected and transmitted power can be measured with calometric power meters. The animal is contained in a thin holder of low loss dielectric material and loss due to the waveguide walls and holder are negligible. As the integral dose rate varies with movement of the animal, stages of stress can be quantitatively determined by monitoring reflected and transmitted power. Techniques such as thermographic cameras and miniaturized MW diode probes are also being explored since the spacial distribution of absorbed MW energy is non-uniform. (10 references)

0556 BRAIN FREE FATTY ACID LEVELS IN RATS SACRIFICED BY DECAPITATION VERSUS FOCUSED MICROWAVE IRRADIATION. *(E.)* Cenedella, R. J. (Inst. Pharmacol. Pharmacognosy, Univ. Milan, Italy), C. Galli, and R. Paoletti. *Lipids* 10(5):290-293, 1975.

Although cerebral free fatty acids (FFA) influence enzymatic processes of the brain to a large extent, reported concentrations vary widely. This is due to a rapid increase in brain FFA occurring within a few min after sacrifice, presumably because of normal enzymatic activities. Male Sprague-Dawley rats were sacrificed by decapitation or a 3 sec exposure to a focused MW beam and FFA content was measured colorimetrically. Following decapitation or irradiation, the brains were either removed immediately or allowed to remain in situ at room temperature for 5 min. They were frozen in liquid N_2 within 60 sec after removal. The brains were weighed, homogenized, extracted and recovered on TLC. The extracts contained 100-180 mg total lipid. The concentration of FFA in brain samples frozen immediately after sacrifice was ~0.3 μM/g wet wt (90 μg/g) after decapitation or irradiation. Brains removed 5 min after decapitation contained >100% more FFA than those removed immediately, with a disproportionate increase in arachidonic acid content. There was no increase in animals sacrificed by focused MW irradiation. Thus, focused MW irradiation appears to be a superior method for quantitating heat stable components of brain which are generated rapidly or catabolized during post mortem processes. Total rat brain enzyme deactivation occurs within 3 sec of exposure. (13 references)

0557 ELECTROMAGNETIC SIGNALS IN LIVING NATURE: FACTS, HYPOTHESES, DIRECTIONS OF RESEARCH. *(E.)* Presman, A. S. (no affil.). (Moscow: Soviet Radio Publishers, 1974), trans. for JPRS, No. 64228, 53p., 1975.

This book reviews the data and theory on the interaction between EM signals and living matter. The diversity of organisms on earth evolved due to continuous interaction with environmental factors including the various components of the EM spectrum, from γ-radiation to frequency changes in geomagnetic and geoelectric fields. Many organisms are found to have a high sensitivity to EMF's with parameters close to those of natural fields. These biological effects which cannot be explained by energy relationships may stem from information interactions of EMFs with the cybernetic systems of the organism which perceive the information from the environment and regulate its vital processes. The advantages of EMFs as compared to sound, light, etc., are fourfold: (1) LF EMFs can penetrate all environments inhabited by organisms; (2) information can be transmitted by EMFs over any distances and under any meteorological conditions; (3) periodical changes in meteorological factors appear to be coordinated with corresponding changes in natural EMFs and (4) solar flares are always accompanied by 'flash-ups' in EMFs. Biologists tend to study EMR as it affects biological organisms at all levels of the hierarchy of living organisms while engineers and physicists are interested in specific mechanisms of EM signaling in living nature so corresponding technical devices can be modeled. Success will be achieved when all scientists develop a single viewpoint and common approach to their solution. (101 references)

0558 RESPONSES OF THE MOUSE TO MICROWAVE RADIATION DURING ESTROUS CYCLE AND PREGNANCY. *(E.)* Rugh, R. (HEW, PHS, BRH, Div. Biol. Eff., Rock-

ville, Md.), E. I. Ginns, H. S. Ho, and W. M. Leach. *Radiat. Res.* 62(2):225-241, 1975.

A radiation facility was developed in which animals could be exposed in a temperature and humidity controlled environment and both integral dose and integral dose rate could be calculated. Mature, 25-35 g, CF1 white mice were exposed individually to 2450 MHz MW radiation in this waveguide. Seventy-seven males were irradiated, plus 164 females in various stages of estrus and 855 litters. After determining the stage of estrus from a vaginal smear, females were acclimated in the environmental chamber for 20 min and irradiated during a 4 hr period. Those in diestrus showed an absorbed lethal dose of 11.50 cal/g body mass while the absorbed lethal dose for estrus was 10.65 cal/g. The mean lethal absorbed dose was significantly greater ($p \leq 0.01$) during diestrus than during estrus, indicating a true differential sensitivity of the female to MW radiation during the estrous cycle. This may be due to a slight increase in tissue hydration or a hormone-dependent change in radiosensitivity. Females were time mated for fetal studies so that they were irradiated at the 8.0 day gestation stage, as this day is particularly sensitive to ionizing radiation. Pregnancies were terminated at 18 days and litters were examined for abnormalities including exencephalies, resorptions, dead fetuses, and stunting. The most frequent abnormality was exencephaly (brain hernia). The mice were irradiated with a forward power of 7.37 W at 25 C and 50% relative humidity and variable exposure times up to 5 min. The average absorbed dose was 3-8 cal/g. In studies on male mice the average lethal dose was 12 cal/g at 6.94 W forward power, with radiation continuing until death. Normal litters and anomalous fetuses were observed throughout the range of average MW exposures used. However, the number of litters without anomalous fetuses decreased as the average absorbed dose increased, suggesting the possibility of a dose-effect relationship. The maximum production of anomalies by MW radiation involved ∿60% of a single litter and the average frequency of exencephaly at 8 cal/g was ∿12%. There is no direct correlation between dose and anomaly production, but with increased doses there is an increased probability that the litter will have at least one anomalous fetus. (9 references)

0559 PERCUTANEOUS RADIOFREQUENCY ELECTROCOAGULATION IN THE CONTROL OF CHRONIC PAIN. *(E.)* Pawl, R. P. (Abraham Lincoln Sch. Med., Univ. Illinois, Chicago). *Surg. Clin. North Am.* 55(1):167-179, 1975.

Electrocoagulation of sensory pathways using RF currents is used as a treatment mode for pain control. With ready access to RF currents, insulated electrodes thin enough to pass through spinal needles, and temperature monitoring devices to permit controlled coagulation of neural tissues, this technique often gives relief of pain without permanent sensory loss in a relatively large body area. Neurosurgeons are piercing pain pathways percutaneously in places where scapels were previously utilized. Three methods are described in this article which are very simple: Gasserian ganglion coagulation, lumbar facet denervation, and dorsal root ganglion coagulation. Necessary equipment for each of these includes x-ray, a radio frequency generator, an electrical stimulator, and a variety of electrodes. Pinpoint placement of small electrode tips in the neural pathway of specific trigger regions often results in preservation of most sensory modalities while relieving serious sensory symptoms. Further work is needed to perfect this technique in the areas currently treated and to expand to treatment of other pain syndromes. (20 references)

0560 HEAT IN MALE CONTRACEPTION (HOT WATER 60°C, INFRARED, MICROWAVE, AND ULTRASOUND). *(E.)* Fahim, M. S. (Dep. Obstet. Gynecol., Univ. Missouri, Columbia), Z. Fahim, R. Der, D. G. Hall, and J. Harman. *Contraception* 11(5):549-563, 1975.

Normally the scrotal testis of mammals is 3-4 C below that of the body core. The effect of heat in suppressing spermatogenesis without altering Leydig cell secretion has been investigated. Three hundred male Sesco rats (250-300 g) were divided into control and 9 different treatment groups. Following treatment and progeny tests, 10 rats from each group were sacrificed at 10 days and 60 days. The remaining 10 males were mated regularly for 10 mon and sacrificed. The rats were divided as follows: (1) controls; (2) testes exposed to a 60 C water bath for 15 min; (3) testicular temperature raised to 60 C for 15 min with an IR heater; (4) testes radiated at 2450 MHz for 5 min, with testicular temperature raised to 65 C; (5, 6, 7) MW radiation at 20 W for 1 min (39 C final temperature), 5 min (39 C), and 15 min (45 C final temperature, resp.; (8, 9, 10) US exposure at 1 W/cm^2 for 5 min, two 5 min exposures at 1 W/cm^2, and exposure at 2 W/cm^2 for 5 min. All animals were mated with proestrus females 24 hr after treatment and each 5 days following until pregnancy was documented to have occurred. The fertility endpoint was the amount of time for every surviving male in each group to impregnate a female. For group 2, females were found impregnated 30-35 days after male treatment. Group 3 animals were fertile 60-75 days after IR application. MW radiation at 100 W resulted in infertility over the entire 10 mon period. Treatment in group 5 was ineffective; those in group 6 impregnated females after 65-80 days; and group 7 were infertile 10 mon after treatment. When US was applied, females were impregnated 150-210 days after male treatment with 1 W/cm^2, but no females conceived after 10 mon when the dose was doubled and when 1 W/cm^2 was applied twice. No significant changes were noted in sex organ wt during the test period and no change of blood testosterone levels was noted. Intracellular penetration of heat was more effective by MW radiation than water or IR treatment. Duration of treatment was an important factor, as noted in MW and US treatment. US was more effective than MWs at a lower temperature because of the combined effects of heat and mechanics. No pain was observed in US treated animals when they were awake. No abortions were noted among females and pups were similar to controls. (12 references)

0561 EFFICACY OF PULSE UHF, DECIMETER AND CENTIMETER WAVELENGTH THERAPY IN PATIENTS WITH CERVICOTHORACIC OSTEOCHONDROSIS AND CONCOMITANT ISCHEMIC HEART DISEASE. *(Rus.)* Sorokina, E. I. (Centr. Inst. Health Resorts Physiother., Moscow, USSR) and A. I. Krupennikov. *Ter. Arkh.* 47(1):104-105, 1975.

Studies of 148 patients with cervicothoracic osteochondrosis and condomitant atherosclerotic cardiosclerosis or stenocardia were conducted. They were treated with pulsed UHF therapy (40 patients) with flexible plates (5-6 kW, pulse length 2 sec), and with decimeter (57 patients) and centimeter (6 patients) wavelength therapy with rectangular plates (30-40 W for 10 min). The results of the treatment indicated that exposure to pulsed UHF and decimeter range radiation had a beneficial effect on the function of the ventricular myocardium while treatment by centimeter irradiation either had no effect or had an adverse effect on five patients with stenocardia. Pulsed UHF therapy was particularly effective in lowering high arterial pressure. After 10-15 sessions, significant improvement was observed in 12, improvement in 20 and no change in 8 patients treated by pulsed UHF therapy. The results for decimeter and centimeter therapy were: 21, 29, 7 and 10, 28, 11, resp. The condition of 7 patients exposed to centimeter radiation deteriorated. The followup from 6 to 24 mon showed a stable therapeutic effect in most of the patients after pulsed UHF and decimeter therapy and in nearly half of the patients treated by centimeter wavelength radiation. (No references)

0562 ACTION OF ELECTROMAGNETIC FIELDS OF SUPER-HIGH FREQUENCIES ON ERYTHROCYTES PRESERVED AT LOW TEMPERATURE. *(Rus.)* Zalyubovskaya, N. P. (Inst. Cryog. Biol. Med., Kiev, USSR), O. I. Gordienko, and R. I. Kiselev. *Probl. Gematol. Pereliv. Krovi* 20(4):31-33, 1975.

Studies were made of the effects of 5-8 mm SHF radiation at 1 mW/cm^2 on erythrocytes prior to their freezing in polyethelene oxide. No significant morphological changes were observed in exposed erythrocytes. Free hemoglobin content in erythrocytes after freezing and thawing decreased to 300 mg% at 6.50 mm exposure. Erythrocytes exposed prior to freezing appeared to be more resistant to the lytic action of HCl. The maximum destruction of erythrocytes (50%) occurred after 3.5 min of the hemolytic action, while complete hemolysis was observed after 5 to 6 min. Unexposed controls showed the highest erythrocyte destruction (72%) within 1.5-2.5 min with complete hemolysis occurring in four min. Exposed erythrocytes also exhibited greater resistance to NaCl after thawing; the content of hemolysed erythrocytes in 0.48% NaCl was 60%; for unexposed cells, 80% in 0.52% NaCl. No effect of 6.5 mm exposure was observed on hemoglobin mobility and composition in the erythrocytes after freezing. It is suggested that SHF exposure of erythrocytes prior to polyethelene oxide freezing enhances their resistivity to low temperatures. (1 reference)

0563 THE EFFECT OF ELECTROMAGNETIC FIELDS ON THE COAGULABILITY OF BLOOD. *(Rus.)* Rusiaev, V. F. (Chita Med. Inst., USSR), and Mulindina, G. I. *Gig. Sanit.* (4):107-108, 1975.

Studies were carried out of the effects of UHF electromagnetic fields on coagulability and fibrinolytic characteristics of the blood and cardiovascular tissues. Mice were exposed to 40 MHz for 15 min at 80 V/m or to the static electrical field for 15 minutes at 330 V/cm perpendicular to the earth's surface. The findings indicated that exposure to UHF radiation inhibited the thromboplastic and fibrinolytic activity of the tissues contributing to hypercoagulability. It is suggested that the changes in the EM environment may result in disrupted cellular membrane structures containing protein-bound phospholipids. The breakage of bonds between phosphatidylcholine, phosphatidylserine and phosphatidylethanolamine, known for their powerful thromboplastic action, may result in their liberation from the cell and subsequent massive pouring into the blood stream. The decrease in the thromboplastic activity of the tissues was accompanied by hypercoagulability. (8 references)

0564 THE RATIONALE FOR AND EXPERIENCE IN THE APPLICATION OF ELECTROMAGNETIC STIMULATION IN THE SURGICAL THERAPY OF BONE FRACTURES AND FALSE JOINTS. *(Rus.)* Tkachenko, S. S. (S. M. Kirov Mil. Med. Acad., Leningrad, USSR), and V. V. Rutzky. *Ortop. Travmatol. Protez.* (1):1-6, 1975.

Experimental studies of the effect of EM stimulation of osteosynthesis in 92 patients with bone fractures and false joints showed a correlation between the reparative regeneration of the bone tissue and the nature and regimen of EM exposure. Osteosynthesis was carried out by the use of metal screws, plates, spikes, etc. in 55 patients; ultrasound adhesive technique in 9 patients; and transosseous osteosynthesis in 28 patients. Electromagnetic stimulation involved the use of a portable electronic device connected with the metal electrodes sunk into the bone tissue, or implanting the conductor in the bone bed prepared for polymer joining. The results showed that after 7-10 days of EM action there were signs of callous formation, while 2-3 weeks later, x-ray examination showed the formation of regenerative bone tissue around the electrodes. The follow-up of 3-24 mon showed that the joining of the bone fragments was significantly faster in patients treated by EM stimulation. (No references)

0565 APPLICATION OF NONTHERMAL EFFECTS IN HIGH DIELECTRIC MATERIALS TO MICROWAVE DOSIMETRY. *(E.)* Vetter, R. J. (Bionucl. Dep., Purdue Univ., West Lafayette, Ind.), D. R. Elle, D. J. Fehringer, and P. L. Ziemer. *1973 IEEE-G-MTT Int. Microwave Symp.* 260-261, 1973.

Dosimetry is one of the most pressing problems in research on the effects of MWs. A study was designed

to examine the thermoluminescent response of high dielectric inorganic materials before and after MW irradiation. In addition, activation and thermoluminescent characteristic studies of the materials were designed and the materials were examined for a change in thermal stimulated exo-electron emission (TSEE) after MW exposure. The materials studied were powdered or ceramic samples of phosphors of the perovskite class, including $BaTiO_3$ activated with various concentrations of Dysprosium and $(BaSr)TiO_3$ with various ratios of Ba to Sr. Control samples were run by heating in an oven to the maximum temperature reached during MW exposure. The reduction in thermoluminescent response of the $(Ba_{.8}Sr_{.2})TiO_3$ phosphor was significantly greater than that of the thermal control as was the response of the activated phosphors $BaTiO_3$ containing 0, 0.1, and 0.5 mole percent Dy. This fading is considered nonthermal since it was greater than an oven heated control. It may provide a method to determine MW absorbed energy. The reduction in TSEE was due to thermal buildup and would have little or no use in MW dosimetry. (9 references)

0566 BIRD FEATHERS AS DIELECTRIC RECEPTORS OF RF FIELDS. *(E.)* Bigu del Blanco, J. (Dep. Anat., Queen's Univ., Kingston, Ontario, Canada), C. Romero-Sierra, and J. A. Tanner. *1973 IEEE-G-MTT Int. Microwave Symp.* 268-270, 1973.

Feathers have a fundamental role in the life and survival of birds. In birds exposed to MW radiation, they may act as selective sensors of the surrounding medium. Their characteristics as dielectric aerials were investigated in experiments conducted with the calamus of bird feathers at about 10 GHz. Radiation pattern measurements were made with and without the feather in place and with single feathers and an array of three feathers about $\lambda_g/2$ distant from each other (λ_g is the waveguide wavelength). When the feather is in place an increase in the power received in the forward direction and a decrease in the beamwidth occurs. The increase is larger for the array of feathers than for the single feather. The effects are probably due to a combined guiding and focusing effect on the MW field by the feather. If a similar effect takes place in the bird, an increase in the MW field strength should be sensed by the bird. The sensory mechanism probably involves the feather as a receptor of the incoming signal. (8 references)

0567 THE EFFECT OF A SINGLE DOSE OF LETHAL AND NON-LETHAL SUPER HIGH FREQUENCY RADIATION ON DIFFERENT NEURONAL FORMATIONS IN THE BRAIN. *(Rus.)* Galkina, N. S. (Riazan Med. Inst., USSR) *Zh. Nevropatol. im S. S. Korsakova* 5(2):223-229, 1975.

Experiments were performed on albino male rats exposed to SHF radiation at a power density of 150 mW/cm^2 for 10 min (group 1) and 5 min (group 2) to study the effect on cerebral neurons. All the animals in group 1 died during the exposure; the animals from group 2 survived and were decapitated within 1-30 days to study the residual effect of the exposure on the brain. Histological studies showed acute venous hypervolemia, arteriostenosis and large cerebral hemorrhages. The findings indicated that exposure to SHF radiation of medium density resulted in cerebral hypoxia causing destructive changes in the cerebral neurons, including neuronal swelling accompanied by tigrolysis, hypochromatosis, decrease in the RNA content, and dehydration of the neurons which persisted after the exposure. The most intensive damage was observed in Betz cells, the neurons of the large hippocampus, the optic thalamus and afferent reticular neurons. Certain adaptive and compensatory reactions in the survivors were observed during the month after the exposure. (19 references)

0568 PROLIFERATION OF ELECTROMAGNETIC POLLUTION; OR LOOK WHAT WE'RE DOING TO OURSELVES! *(E.)* Lynn, J. F. (no affil.) *1974 IEEE Electromagn. Compat. Symp. Rec.*, 41-49, 1974.

The use of EMR began with broadcast radiation around 1900 and is now being used in ever increasing amounts with a continuous increase in the quantity and kind of device producing the radiation. Man-made sources of EM pollution have increased about 20% each year for the last 35 years, creating conditions from minor annoyances to catastrophic failures of complex systems. Technology is rapidly outdistancing the regulation of EMR. Among those devices emitting are telephones, TVs, cable TV, MW ovens, land mobile equipment, office automation, household appliances and gadgets, auto electronics, lasers, and industrial and defense products. New and revised standards, measurement techniques, and instrumentation should be expected. (14 references)

0569 THE EFFECT OF CONTINUOUS AND PULSED UHF ELECTRIC FIELDS ON THE METABOLISM OF SEROTONIN IN PATIENTS WITH PEPTIC ULCER. *(Rus.)* Komissarova, I. V. (Cent. Inst. Health Resorts Physiother., Moscow, USSR) *Vopr. Kurortol. Fizioter. Lech. Fiz. Kult.* (2):170-174, 1975.

Studies were carried out on 76 patients with peptic ulcer treated by UHF therapy in pulsed (2 μsec) and continuous regimens. The patients received treatment every other day for 8-10 min (PW) or 6-12 min (CW) during 10-12 sessions. The findings indicate that exposure to continuous UHF irradiation stimulated serotonin synthesis in the duodenum and increased its secretion with gastric juices. Pulsed UHF exposure tended to reduce serotonin content in the blood and gastric juices. It is suggested that the different effect of the CW and PW radiation may be accounted for by the absence of thermal action in UHF pulsed regimen. (12 references)

0570 THE EFFECT OF ULTRA HIGH FREQUENCY ELECTRIC FIELD ON SPERMATOGENESIS IN PATIENTS WITH EPIDIDYMITIS. *(Rus.)* Grachev, Y. I. (Cent. Inst. Skin, Vener. Dis., Moscow, USSR) and G. A. Voskresenskaya. *Vestn. Dermatol. Venerol.* (2):75-79, 1975.

The effect of UHF electric field on spermatogenesis was studied in 19 patients with gonorrheal and non-

gonorrheal epididymitis 20-25 days after the exposure of the patients' testes to two disk plates emitting 39-40 million oscillations per sec (generator power 40 W). The treatment consisted of ten 10 min daily sessions. The microscopic examination of the seminal fluid showed no detrimental effect on spermatozoa. Comparison with the results obtained in the control group of patients treated by autohemotherapy failed to reveal any significant difference in the morphological composition of the seminal fluid or the motility of spermatozoa. (15 references)

0571 BLINDNESS, DEAFNESS AND VESTIBULAR DYSFUNCTION IN A MICROWAVE WORKER. *(E.)* Zaret, M. M. (no affil.) *Eye, Ear, Nose, Throat Mon.* 54(7):291-294, 1975.

An unusual case of bilateral blindness, bilateral deafness and bilateral vestibular dysfunction was presented. The patient, a 53-year-old radar repairman, worked as a MW troubleshooter for 27 yr. During this time no meaningful control was exercised over his environmental exposures. He was found to be in excellent health in independent examinations in 1942, 1944, and 1948. In 1949 he was involved in an accidental exposure to intense MW energy at less than 2 ft. A few hr later he became dizzy and lost hearing in his right ear. The dizziness disappeared after several days, but the hearing loss in his right ear became complete irreversible deafness within 2 wk. He also developed dysfunction of the vestibular apparatus of his right ear. The patient gradually developed recurring keratitis, recurring chorioretinitis resulting in retinal perivasculitis, retinitis proliferans and vitreous hemorrhages, and secondary glaucoma intractable to treatment which ultimately included multiple surgical procedures. In March, 1970, the patient became blind bilaterally and shortly thereafter became deaf in his left ear. As none of his findings fit any previously known medical disease or syndrome, the implication of MW irradiation etiology was logical and prudent. Otologic examination concluded that there was a total loss of hearing and substantial loss of vestibular function in both ears probably secondary to MW exposure. On opthalmic examination, no useful visual acuity was present in either eye. Repeated differential diagnostic examinations by various physicians excluded all possible known causes for each finding other than MW irradiation. (No references)

0572 MICROWAVE PASTEURIZATION OF MILK. *(E.)* Jaynes, H. O. (Dep. Food Technol. Sci., Univ. Tennessee, Knoxville) *J. Milk Food Technol.* 38(7):386-387, 1975.

The pasteurization of milk with a MW energy source was studied in a system mechanically resembling conventional equipment in the heating-holding-cooling sequence of operations. MW energy at 2450 MHz was applied through a rectangular brass waveguide enclosing a Teflon flow-through liquid applicator. A regenerator was used to warm incoming cold milk and cool milk after heating. The milk was heated to 72 C for 15 sec and compared to controls treated at 62.8 C for 30 min. The phosphatase test, standard plate and coliform count, and taste were compared. Milk was pasteurized at 200, 300, and 400 ml/min. In all instances the phosphatase tests were negative and comparable count reductions were found at all 3 flow rates. A taste panel found MW treated milk to be equal or superior to conventionally handled milk. MW energy may be used as an alternate heat source for continuous pasteurization of milk and could be financially feasible in a situation in which atmospheric pollution should be minimized. (6 references)

0573 OBSERVATIONAL EVIDENCE THAT SHORTWAVE RADIATION GIVES ORIENTATION TO VARIOUS INSECTS MOVING ACROSS HARD-SURFACE ROADS. *(E.)* Gunter, G. (Gulf Coast Res. Lab., Ocean Springs, Miss.) *Am. Nat.* 109(965):104-107, 1975.

The relationship of various insects to hard surface roads which form part of the environment over much of the earth has been observed. The salt-marsh caterpillar, the larva of the moth *Estigmene acrea*, always goes straight across the road no matter what direction the road runs. On curves, they bisect a symmetrical pattern of the road. At the edge the caterpillar resumes a meandering path. The rove beetle Staphylinidae and the beetle *Pasimachus* cross in the same manner. Butterflies singly and in large groups fly straight across the road. A common southern Texas grasshopper spends the night on paved roads in the fall in search of warmth. All the grasshoppers are turned by morning so the long axis of their bodies was perpendicular to the long axis of the road. They thus present a symmetrical placement with respect to the radiant energy coming from the road. All these insects balance themselves with respect to a symmetrical source of SW radiant energy outside the range of light. They cross hard surface roads by the shortest possible route in a tropistic response to the symmetry of radiant energy coming from the road. This response has survival value for insects as they cross bare spots of the earth in the shortest possible time. (4 references)

0574 THE OTP/OT SPECTRUM MANAGEMENT PROGRAM - AN OVERVIEW. *(E.)* Dean, W. (OTP, Executive Off. Pres., Washington, D.C.) and S. I. Cohn *1974 IEEE Electromagn. Compat. Symp. Rec.* 110-112, 1974.

The Radio Spectrum is a reusable vital national resource. The Federal Government has exclusive use of 25% of the spectrum and shares 45% with non-government users. The responsibility for management of the Government's use of the spectrum is assigned to OTP. The goal of management is to make efficient and effective use of this resource. Presently the Federal Government has more than 120,000 frequency assignments which change at the rate of 5000 per mon. OTP's spectrum management program concentrates on 6 areas: Policies, Allocation and Management, Analysis of Specific Impact of Communications - Electronic Systems, Requirements and Assignments, Compliance and Side Effects (both biological and nonbiological). (No references)

0575 THE EFFECTS OF AN ELECTRIC FIELD ON SOLUBLE COLLAGEN. *(E.)* Kahn, L. D. (U.S. Dep. Agric., Philadelphia, Pa.) and L. P. Witnauer. *Biochim. Biophys. Acta* 393(1):247-252, 1975.

The presence of an electric field induces changes in the permanent dipole moment and electric susceptibility of collagen. In this study, electric birefringence in a single pulsed field was measured as functions of pulse width and amplitude, and samples were subjected to trains of pulses to investigate the effect of repeated application of an electric field. The electric birefringence decay curves were resolved into 2 components: one was assigned the rotary diffusion coefficient of collagen monomer and the other was assumed to be an average for all aggregated collagen species present; it served as a measure of the extent of aggregation. The collagen was from fresh calfskin corium. The shape of the curve of D_B, the average rotatory diffusion coefficient for aggregated collagen at constant pulse amplitude *vs* pulse width, was typical of all soluble collagen preparations with plateau values indicating that the range of aggregate stays within definite limits. A progressive decrease in D_B with increasing pulse width indicates that either the electric field is inducing aggregation or there is an ES interaction between neighboring particles. It was determined that particle interaction takes place only at lower values of ionic strength. At low pulse widths, monomeric collagen makes a large contribution to the electric birefringence, but at higher pulse widths the aggregate species account for a greater portion, a natural consequence of a population of aggregates being built at the expense of monomeric units. On repeatedly pulsing a dissolved collagen preparation, electric birefringence increases with each succeeding pulse until a maximum is reached. Thus, the presence of an electric field promotes aggregation of collagen particles suspended in an aqueous buffered medium. In fields of short duration the aggregate is of a transient nature, but the bonds become progressively stronger as field strength and duration increase. The bonds are probably of an ES nature. (4 references)

0576 EFFECT OF MAGNETIC FIELD ON OSCILLATING BLOOD FLOW IN ARTERIES. *(E.)* Sud, V. K. (Dep. Biophys., All India Inst. Med. Sci., New Delhi), P. K. Suri, and R. K. Mishra. *Stud. Biophys.* 46(3): 163-171, 1974.

Magnetohydrodynamics is the study of the motion of an electrically conducting fluid in the presence of EMFs. If the moving magnetic field is applied to a tube flowing with electrically conducting fluid in such a way that the speed of the field is more than that of the moving fluid, the rate of movement of the fluid will be accelerated, and vice versa. Since blood is an electric conductor, it seems possible to regulate its movement by the application of a magnetic field. In the mathematical model an artery is replaced by a long rigid tube of uniform diameter. The flowing liquid blood is considered as a Newtonian, viscous, incompressible, homogeneous and electrically conducting fluid. The constant applied magnetic field B_o is along the radial r-direction. The following assumptions are made regarding the EM interaction: (1) the induced magnetic field and the electric field produced by the motion of the electrically conducting fluid are negligible; and (2) no external electric field is applied. The results indicate that the effect of the uniform stationary magnetic field is to slow down the movement of blood. (5 references)

0577 ORIENTATION OF GULL CHICKS EXPOSED TO PROJECT SANGUINE'S ELECTROMAGNETIC FIELD. *(E.)* Southern, W. E. (Dep. Biol. Sci., Northern Illinois Univ., DeKalb). *Science* 189(4197):143-145, 1975.

It is possible that factors which interfere with the magnetic environment of a bird may disrupt its orientation. Tests were conducted at the Wisconsin Test Facility of Project Sanguine to determine whether man-made structures which generate high intensity EMFs have similar effects. The Sanguine System will use ELF waves to communicate with the submarine fleet. The experiments were designed to test effects of frequency, current, and mode of transmission. The test antenna was operated at 45 or 76 Hz and 260 or 300 amp. Groups of sixty 3-to-9-day-old ring-billed gull chicks were used for 2-3 days each and were maintained at a site of minimal effects from Sanguine, reducing the possibility of acclimation. Controls were tested when the system was not energized. Data were obtained on clear days so the sun would be available as a supplemental guide for orientation. Previously tested chicks had shown significant directional preference for southeast, as did control gulls. The 642 birds tested under experimental conditions had no significant mean bearing indicating a random dispersion in the test apparatus. Thus, the EM field encountered at ground level is sufficient to disrupt their orientation. Further tests are required to show if this observation holds true at various distances from the antenna. Since the magnetic field decreases rapidly as distance increases, birds migrating over Sanguine might pass unaffected. (16 references)

0578 CATCH SELECTIVITY BY ELECTRICAL FISHING SYSTEMS. *(E.)* Stewart, P. A. M. (Mar. Lab., Aberdeen AB9 8DB, Scotland). *J. Cons. Int. Explor. Mer.* 36(2):106-109, 1975.

Experiments have shown that large fish react to uniform electric fields at lower field strengths than small fish. A linear relationship exists between fish length and voltage along the fish. Therefore, a fishing system which incorporates an electric stimulus should preferentially capture the larger members of a fish stock. Electrotaxis and electronarcosis can also be used to aid capture. Selectivity is the probability, expressed as a function of fish length, of reactions being induced in fish within the electric field. The fraction of the electrified region in which the field strength is greater than the threshold level for a given size of fish represents the probability of a reaction being induced in that size fish. Electric fishing systems can act with imperfect selectivity, with a compromise being reached between efficiency in capturing large fish and inefficiency in capturing small fish. The voltage and separation can be chosen

to give a probability-length curve which reaches 100% at the maximum fish size. The size selectivity can be calculated if the relationship between threshold strength and fish length is known for that species and if the path of the fish throughout the system is known so that the appropriate electric field distribution can be obtained. (7 references)

0579 THE DEVELOPMENT OF A NEW METHOD OF HEPATECTOMY BY RADIATION OF MICROWAVES. *(E.)* Osaka, A. (Dep. Int. Med., Sapporo City Hosp., Japan). *Bull. Soc. Int. Chir.* 33(3):166-171, 1974.

The ability of MWs to coagulate protein rapidly was utilized in a procedure for the resection of the liver. The livers of 25 rats and 25 rabbits were irradiated with 2450 MHz and an output power of 550 W. Protective jackets were made for the animals to protect the body from irradiation. A hole in the jacket allowed the lobe of the liver to be inserted. The liver was exposed for 1.5 min in rats and 3-4 min in rabbits. There was no bleeding or cholerrhagia from the cut surface of the liver following resection, and disinfection was unnecessary as the lobe was sterilized with MWs. Resection of 50% of the liver was possible with the radiation apparatus used. With a suitable jacket designed, 75-80% of the liver could be resected. All liver function tests were normal within a week. The animals survived well without anemia or hypoproteinemia. (No references)

0580 MEASUREMENTS FOR RADIATION SAFETY. *(E.)* Wyckoff, J. M. (NBS, Washington, D.C.) *Contract Number COM-74-51058/7W3,* 6p.

The varieties of radiation included in safety measurement development are x-rays, nuclides, UV, lasers, EM, and US. NBS is not a regulatory agency, but works closely with these agencies in developing realistic regulations. In this process, the first step is developing a radiation source and observing radiation hazards shortly thereafter. The quantity of the hazard threshold is established as the radiation is used, and both biological and physical scientists as well as radiation technicians are gathered to recommend permissible exposure limits and safe procedures. After these recommendations are reviewed and amended, they are adopted by federal or state legislatures. It is necessary to establish a field measurement system to monitor radiation levels. NBS develops primary standards, and then transfer standards for use in the field. Their EM hazard meter has contributed to the best commercial hazard meters, and is complimentary to them. (No references)

0581 BIOLOGICAL EFFECTS OF MICROWAVES: A BIBLIOGRAPHY WITH ABSTRACTS. *(E.)* Harrison, E. A. (Natl. Tech. Inf. Serv., Springfield, Va.). *NTIS No. NTIS/PS-75/384,* Mar. 1975.

This bibliography is an update of an earlier publication [see CL 0283, Volume I(3)]. It contains about 100 abstracts of government sponsored research covering biological effects on man and animals resulting from MW exposure. It includes regulations and standards as well as dosages and tolerances. Articles from 1960 through 1974 are included. Each abstract includes document availability and price. (No references)

0582 AN EVALUATION OF POSSIBLE EFFECTS OF 45 Hz, 60 Hz AND 75 Hz ELECTRIC FIELDS ON NEUROPHYSIOLOGY AND BEHAVIOR OF MONKEYS. *(E.)* Gavalas-Medici, R. (Environ. Neurobiol. Lab., Univ. California Los Angeles) and S. R. Magdaleno. *Off. Naval Res. Tech. Rep.,* Contract No. N00014-69-A-0200-4037, 296p., 1975.

Previous studies of ELF electromagnetic fields seemed to indicate that the effect of these fields involved timing behavior in animals. A series of experiments was conducted to provide evidence for a behavioral response in monkeys to ELF, low voltage, electric fields. Five female *Macaca nemestrina* monkeys (3-6 kg) were housed in standard cages and fed a standard laboratory diet. Three of the animals were implanted under anesthesia with a variety of EEG electrodes; the 2 remaining served as controls. The animals were trained in a fixed interval (FI) schedule of reinforcement with differential reinforcement of low rates (drl) and a limited hold (LH). After performance stabilized, they were transferred to a screened testing room and training continued until performance was stable for 6 or more days. The task chosen was not intrinsically challenging and did not require extensive deprivation so that demands of the task would not override possible responsivity to the presence of the fields. The fields were randomly selected from frequencies of 7, 45, 60, or 75 Hz and voltage levels of 1, 10, 56, or 100 V/m. There was no discernable effect on behavior or EEG patterns at 1 V/m. At 10 V/m there was evidence of a frequency-specific threshold at 7 Hz. Time between responses was significantly shorter and variability of responding was reduced. At 56 V/m the direction of the effect was the same as that at 10 V/m and the magnitude increased markedly for the 7 Hz and 75 Hz fields. At 100 V/m there was evidence of a carry-over effect from one day to the next. In the EEG, there may have been a decrease in percentage power at low frequencies at 56 and 100 V/m, suggesting heightened arousal. There were no differences between implanted *vs* unimplanted monkeys at any of the levels tested. The detection of weak electric field effects depends on frequency, voltage, duration of exposure, and the exact behavioral assay being used. Weak electric fields will not affect laboratory behavior in experiments demanding the animal's attention. The detection of such an effect requires a precise and detailed record of behavior during prolonged exposure to the field. There is no indication of whether the pertubation noted is good or bad. (24 references)

0583 THE αβγs OF BIOELECTRIC MEASUREMENTS. *(E.)* *Electr. Des.* 23(16):68-72, 1975.

There are many problems associated with trying to extract a bioelectric signal from the human body. A low level voltage is being pulled from high level noise while protecting both the patient and the instrumentation. Bioelectric signals are usually in the low millivolt range while the noise level is about 10 volts. To discard unwanted noise ideally, a differential scanner, which takes the difference between two input signals and multiplies by the gain, is used. However, different currents may flow through different parts of the body, unbalancing the impedance. This results from unequal capacitances to ground and unequal electrode impedences. At high input impedances, the susceptibility to capacitive coupling from outside sources is increased. The problem may be avoided by grounding the patient's right leg, but dangerous alternating currents may then flow directly through to the ground. New devices such as pacemakers, catheters, electrodes, intracardiac thermistors and intracardiac microphones all provide direct electric paths to the heart and tiny currents through these may cause ventricular fibrillation. Other more subtle obstacles also exist. (3 references)

0584 IMPROVED SUPPRESSION OF RADIATION FROM AUTOMOBILES USED BY THE GENERAL PUBLIC. *(E.)* Shepherd, R. A. (Stanford Res. Inst., Menlo Park, Calif.), J. C. Gaddie, and D. L. Nielson. *Fed. Commun. Comm. Rep.* No. FCC/OCE RS75-03, 175p., 1975.

A project was undertaken by the Stanford Research Institute to develop methods to improve the suppression of EMR created by automobile ignition systems over the frequency band from 30 to 500 MHz. This broad band EMR is observable wherever automobiles are used. Having this noise in the environment results in the necessity to increase transmitter power to overcome noise, in turn raising ambient noise level to other spectrum users in a never-ending cycle. The three major sources of incidental radiation are due to HF fast rise time currents flowing in the vehicle's wiring. These fast rise times occur when the gap between the distributor rotor and post breaks down, when the spark plug gap breaks down and when the breaker points close. Each source can be treated individually at little or no extra cost while not increasing air pollution and not affecting engine performance and fuel economy. Spark plug noise is suppressed by a low pass filter built into the spark plug, requiring no new materials and parts. Distributor noise is suppressed by a low-pass filter incorporated into the distributor installed during assembly or later without a need for special tools or training. Breaker point noise can be suppressed by filtering to prevent HF currents from flowing on the breaker point-to-coil wire. However, this noise is so much less than that from the other 2 sources that its suppression may not be warranted. Application of these techniques resulted in suppression improvement of 13-20 dB over the 30-500 MHz range. Measurement of horsepower and exhaust pollutants indicated no effect on these characteristics of the automobile. (24 references)

0585 EFFECT OF THE MAGNETIC FIELD ON THE DIRECTIONAL BEHAVIOR OF GOLDFISH. *(E.)* Becker, G. (Fed. Inst. Mater. Test., Berlin-Dahlen, West Germany). Trans. of *Naturwissenchaften* 61(5):220-221, 1974.

Goldfish (*Carassius carassius auratus*) frequently orient themselves over a prolonged period of time with their body axis in a N/S, S/N, E/W, or W/E direction. The preferential position along one of the 4 primary orientations of the magnetic field was unmistakable. When not swimming, the fish may be in one of 2 behavioral states: in a random direction oriented by the water motion, or in a more alert condition oriented in the same direction or at a 90° angle to it. If a fish is knocked or vibrated, it spontaneously adopts a N/S, E/W, S/N or W/E orientation in trying to escape. To determine whether the earth's magnetic field actually determines the animal's orientation, fish were individually put in a glass at the center of a Helmholtz coil 1 m in diameter. If the total earth magnetic field of 445-450 mOe is reduced to 220 mOe in the Helmholtz coil, the fish could still orient themselves. When reduced to 110 mOe, they could do so only after several minutes. Eventually orientation in the quiescent state and as a shock reaction ceased, thus demonstrating the ability of the fish to perceive the earth's magnetic field and use it as a direction finder. (10 references)

0586 CONDITIONED CONTROL OF CARDIAC ACTIVITY AND RESPIRATION, AND MORPHOLOGICAL CHANGES IN THE BRAIN OF PIGEONS UNDER THE ACTION OF A CONSTANT MAGNETIC FIELD. *(E.)* Yakovleva, M. I. (Inst. Exp. Med., USSR Acad. Med. Sci., Leningrad), and M. V. Medvedeva. JPRS No. 64361, trans. from *Zh. Vyssh. Nervn. Deyat. im I. P. Pavlova* 22(2):288-293, 1972.

The effect of a CMF on conditioned control of cardiac activity and respiration was studied. Five pigeons were exposed to an 800 Hz, 60 dB tone produced by an acoustic generator as the conditioning stimulus. A 15% ammonia solution was used as the uncontrolled stimulus. Eight combinations of conditioned and unconditioned stimuli were used in the experiment. The size of the response was the increase in cardiac contraction rate within 1 min. Data obtained were compared with the results of morphological research on the brain. The brains were removed for histological examination immediately after the exposures (2 birds) or 3 mon after exposure (2 birds). A distinct rise in reaction rate was observed in 3 pigeons after 8-10 CMF exposures. Examination of the brains of 2 of these pigeons showed edema of the nervous tissue, particularly in the *corpus striatum* of the forebrain and to a lesser degree in the cortical plate and formations of the midbrain. Sharp dilation of the lumens of large and small capillaries and excessive blood volume were noted in the *corpus striatum*. Clearly pronounced hyperplasia and hypertrophy of glial

elements were noted. Sharp changes in nerve cells near the dilated vessels were observed. In histological examinations done 3 mon after termination of the CMF, only a weak vascular reaction was observed in brain sections and altered neurons and glia were not noted, suggesting that the changes described are reversible. Results do suggest that the CMF affects metabolic processes in the body, especially the CNS, and may lie at the basis of changes in regulation of cardiac activity in response to a CMF on the part of higher regions of the bird CNS. (22 references)

0587 THE EFFECTS OF HIGH POWER PULSED AND LOW LEVEL CW MICROWAVE RADIATION ON AN OPERANT BEHAVIOR IN RATS. *(E.)* Diachenko, J. A. (U. S. Naval Weapons Lab., Dahlgren, Va.) and W. C. Milroy. *NSWC/DL Tech. Rep.* No. TR-3230, 16 p., 1975.

Two sets of experiments were performed to study the effects of PW and CW MW radiation on an operant behavior in rats. The rats were trained to perform on a DRL schedule and were tested immediately after a one hr exposure to radiation. In the first experiment 12 female Sprague-Dawley rats were maintained at 80% of their ad-lib feeding wt and trained to push a lever not less than 12 nor more than 18 sec after the preceding response. When all had learned they were run for 5 days to establish baseline performance and were assigned to one of 6 pairs depending on the power level of exposure: (1) none (morning control pair); (2) 1 mW/cm^2; (3) 5 mW/cm^2; (4) 10 mW/cm^2; (5) 15 mW/cm^2; and (6) none (afternoon control pair). The frequency of exposure was 2450 MHz. They received 5 days of EM exposure, 1 hr/day, 2 days sham exposure, then one more day of exposure. Performance testing immediately followed each exposure and lasted 1 hr. No significant changes were noted except on the 5th day of exposure of the pair at 15 mW/cm^2. These animals showed obvious signs of heat stress and remained completely inactive up to 7 min after removal from the exposure chamber. In the 2nd experiment, 8 male Sprague-Dawley rats maintained at 80% of their ad-lib feeding wt were trained as in experiment 1 and 4 of these were exposed to PW radiation with a field strength of 125 kV/m and 4-10 pps. The others were exposed to 5 or 10 mW/cm^2 CW radiation. None of the rats showed any appreciable change in performance. The results suggest that acute exposure to CW radiation at 10 mW/cm^2 or less for 1 hr or high power PW radiation has no deleterious effect on operant behavior. Exposure at 15 mW/cm^2 produces obvious signs of heat stress but the subject recovers quickly. This also suggests that the margin of safety is slim for a radiation standard of 10 mW/cm^2. (11 references)

0588 CUTANEOUS MICROWAVE INJURY: REPORT OF TWO CASES. *(E.)* *Year Book Dermatol.* :125, 1974.

A 50-yr-old woman who operated a MW oven routinely for 4 yr noticed a lesion on the left index finger near the nail base when a malfunction of the oven resulting in burning of food occurred. The disorder spread to 3 fingers of the right hand. Transverse ridging and deformity of the nails was observed. After application of a topical steroid cream there was gradual improvement over 6 wk. A similar nail problem was observed in a 56-yr-old woman employed in the same place for 1.5 yr. Up to 10,000 MHz, MW energy is absorbed by the more superficial tissues. At 2450 MHz, the radiation level of MW ovens, the damage from heat may occur without being perceived by the operator. (No references)

0589 NEURONAL EFFECTS OF LOW LEVEL MICROWAVES. *(E.)* Seaman, R. L. (Duke Univ., Durham, N. C.) *Diss. Abstr. Int. B* 35(12):5867-B, 1975.

The neurons in the abdominal ganglion of *Aplysia californica* were used to study individual neuron responses to irradiation. The neurons were placed in a stripline which allowed both direct observation of, and electrical recording from, the sample during irradiation. The electrical activity of white cells and bursting neurons, which exhibit endogenous firing patterns, were studied. Most of the changes noted resembled responses to temperature rises. However, a small number of observed responses could not be explained in terms of temperature rise and mechanisms for *induced current during irradiation are proposed.* Half of the neurons were affected by absorbed powers of 15 mW/cm^2 or less. These facts suggest that a reconsideration of thermal criteria presently used to predict MW effects may be necessary. (No references)

0590 THE EFFECT OF ULTRAHIGH FREQUENCY ELECTROMAGNETIC FIELD ON IMMUNOBIOLOGICAL REACTIVITY. *(Rus.)* Vinogradov, G. I. (V. A. Marzeiev Res. Inst. Gen. Munic. Hyg., Kiev, USSR). *Vrach. Delo* (6): 122-125, 1975.

Studies were conducted of the effect of UHF on the total number of leukocytes, white blood cells, phagocytosis and complement titer in 75 guinea pigs which were divided into groups exposed daily at power densities 50, 10, 5 and 1 $\mu W/cm^2$ for four weeks (7 hr total exposure). The findings showed that exposure at 1 and 5 $\mu W/cm^2$ resulted in the increase of leukocytes immediately after the experiment (6.86 ± 0.14 and 7.72 ± 0.19, resp.) while at 10 $\mu W/cm^2$ the increase was observed only eight wk after the experiment. Neutrophils and eosinophils increased significantly (51.8 ± 3.9 and 2.7 ± 0.009) two weeks after the exposure at 5 $\mu W/cm^2$. The rise of the phagocytic activity, both ingestive and digestive, was most pronounced at 5 and 1 $\mu W/cm^2$ lasting up to 8 wk after the exposure. Complement titer increased markedly (0.08 ± 0.004) 4 wk after the exposure at 1 $\mu W/cm^2$. It is concluded that UHF irradiation stimulates white blood cell circulation immediately after the exposure and 2-4 wk later. It was observed that lower power densities tended to enhance cellular and humoral immunity. (No references)

0591 ABSENCE OF HEART-RATE EFFECTS IN ISOLATED FROG HEART WITH PULSE MODULATED LOW-LEVEL MICROWAVE ENERGY. *(E.)* Clapman, R. (Dep. Electr. Eng., Univ. Illinois, Urbana) and C. Cain. *1974 IEEE Electromagn. Compat. Symp. Rec.*, 107-109, 1974.

Isolated hearts from the frog *Rana pipiens* were irradiated with pulsed MW energy for 1 min (peak power density 5.5 W/cm^2, 2 μsec pulses). The radiation occurred either at the peak of the P wave, 100 msec after the P wave, 200 msec after or during the minute but not synchronous with the P wave. The heart was placed on a lucite mount dorsal side up with the longitudinal axis parallel to the E vector. The heart was moistened with 5 ml of frog Ringer's solution and heart rate was stabilized. In all experiments there was one minute of stabilized heart beat with no irradiation, one min of irradiation and one min afterwards of no irradiation. Temperature changes were found to be insignificant. The small differences between experimental and control groups were not statistically significant. No sign of positive feedback was seen. (10 references)

0592 EFFECT OF 2450-MHz RADIATION ON THE RABBIT EYE. *(E.)* Guy, A. W. (Dep. Rehabil. Med., Sch. Med., Univ. Washington, Seattle), J. C. Lin, P. O. Kramar, and A. F. Emery. *IEEE Trans. Microwave Theory Tech.* MTT-23(6):492-498, 1975.

The MW field and power patterns inside and outside the head and eye when exposed to near-zone 2450 MHz radiation were determined using New Zealand white rabbits. Time and power thresholds for cataractogenesis were clarified and computer models to study intraocular temperature during radiation were applied. In all experiments the rabbits were placed in an acrylic box with head and hind legs outside and were exposed to the near-zone of a 2450 MHz corner reflector with horizontal polarization. The distance between the crossing point of the dipole feed and the corneal surface of the eye was 5 cm. For dosimetry measurements, a fast-reacting thermocouple was passed into a probe in the eye and intraocular temperature measurements were taken at 2 mm increments prior to and just after a 20 sec exposure to 540 mW/cm^2 high intensity radiation. The absorption reached peak values within the vitreous body 1.5 cm behind the cornea and had a mean of 0.92 W/kg for each mW/cm^2 incident power. The rabbits showed an increase of about 0.97 C in rectal temperature and 30% pulse rate increase. In the 2nd experiment MW radiation at a predetermined level was performed at 5 min intervals with the temperature recorded by a thermocouple probe in the eye. The peak temperature for 100 mW/cm^2 for 60 min, 200 mW/cm^2 for 35-40 min, and 300 mW/cm^2 for 30-35 min was determined. The absorbed power was 90, 180, and 270 W/kg, resp. Each power level reached its own specific temperature plateau after 15-20 min due to an increase in body core temperature. The orbital temperature never rose as high as the vitreous due to greater blood flow and heat regulatory capacity. Rabbits exposed to 200 and 300 mW/cm^2 all developed lens opacities. Eighty-one rabbits were used to determine the cataractogenic threshold for near-zone 2450 MHz radiation. Under sedation the right eye was irradiated in an anechoic chamber while the left eye served as control. Low and high power densities were used at various exposure durations. Slit lamp examinations were performed immediately after irradiation and periodically thereafter. At lower exposure levels mild, reversible changes were noted. At higher levels, more advanced and permanent cataract changes were seen, generally confined to the posterior cortical area. The control eye remained normal. The minimum cataractogenic power density was 150 mW/cm^2 for 100 min, or 138 W/kg maximum absorbed power. Computer modeling of the temperature distribution of an intact eye gave results in complete agreement with the measured retrolental temperature rise. Comparison of measured and computer estimates revealed a possible threshold cataractogenic temperature of about 41 C in the eye, suggesting a possible localized heating mechanism responsible for MW cataractogenic effects. (13 references)

0593 BIOMEDICAL APPLICATIONS OF EM RADIATION. *(E.)* Ecker, H. A. (Georgia Inst. Technol., Atlanta). *Microwave J.* 18(7):47-50, 1975.

Three potential new applications of EMR for medicine and biology are discussed in this paper, including heating of cancer tumors, thawing of frozen organs, and thawing of granulocytes. Selective heating of tumors in deeply cooled animals enhances the effectiveness of chemotherapy treatment. The animal is cooled to 40-50 F and EMR is used to raise and maintain the tumor temperature at 98 F through selective, uniform heating. The cooled healthy tissue utilize little of the destructive drug while the warm tumor, with a high metabolic rate, is affected to a much greater degree. A modified technique combines the HF radiation with doping the tumor with high loss particles. This concentrates the heating in the doped area. Thawing of frozen organs offers hope for the development of long-term organ banks. The heating must be uniform and rapid and may be accomplished by using multiple frequencies and configurations of EMR, as well as inserting small spheres within the organ to enhance thawing from the center toward the surface. Conventional thawing of blood kills granulocytes which are given to patients on anticancer drugs to enable the body to fight common infections. With a properly shaped horn and multiple frequencies, frozen bags of granulocytes and lymphocytes were thawed in 70 sec from -196 C to +1 C. *In vitro* viability tests were positive in each case. (7 references)

0594 ENERGY METABOLISM OF THE HYPOTHALAMO-HYPOPHYSEAL PART OF RAT BRAIN IN THE ANTITUMORAL EFFECT OF A MAGNETIC FIELD. *(E.)* Ukolova, M. A. (Sci. Res. Oncol. Inst., Rostov-on-Don, USSR), Y. B. Kvakina, and G. Y. Chernyavskaya. JPRS No. 64370, trans. from *Vopr. Onkol.* 15(12):60-64, 1969.

The antitumoral effect of a magnetic field stems from both direct cytostatic action on tumor cells and from

regulatory mechanisms of the hypothalamic regions of the brain. Indices of energy metabolism in the hypothalamo-hypophyseal region of the brain of Wistar rats and common male rats were studied. These rats had 1st generation sarcomas induced by 3,4-benzpyrine in the presence of magnetic fields. The magnetic field was created with permanent bar magnets with an induction of 500-700 G. Tissue respiration and glycolysis were determined manometrically. The determinations were made with intact rats, rats without tumors after 5-6 magnetic exposures, rats having tumors resorbed after magnetic exposure, rats with tumors not subject to magnetic exposure, and rats in which tumors continued to grow despite the magnetic field. In response to the magnetic field the intensity of tissue respiration increased in the hypothalamo-thalamic region of the brain of intact animals and animals with resorbing tissues. Free oxidation increased in intact animals and the level of all oxidative processes rose in rats with resorbing tumors. Glycolysis increased sharply in intact animals in response to a magnetic field, and remained high in rats after resorption of tumors. In rats with resorbed tumors, change in energy metabolism occurred in the hypothalamo-thalamic region of the brain characterized by intensification of oxidative processes. These changes were not observed when the magnetic exposure was ineffective. (23 references)

0595 *EFFECT OF A HIGH-INTENSITY MAGNETIC FIELD* ON ENZYMATIC HYDROLYSIS OF NUCLEIC ACIDS. *(E.)* Komolova, G. S. (Inst. Biochem. im. A. N. Bakh, USSR Acad. Sci., Moscow), G. D. Er'igin, T. B. Vasil'yeva, and I. A. Egorov). JPRS No. 64370, trans. from *Dokl. Akad. Nauk SSSR* 204(4):995-997, 1975.

DNA is known to orient itself with the long axis perpendicular to the lines of a magnetic field. Changes in the kinetics of enzymatic processes associated with the rod-shaped macromolecules of DNA and RNA can be expected in a magnetic field. Studies were made of the DNA-DNAase and RNA-RNAase enzyme systems in a constant magnetic field. Enzymatic hydrolysis was conducted at 25 C for 1.5 hr while the mixture was circulated through a closed system of tubes in the presence or absence of a magnetic field. The enzyme-substrate ratio was 1:5000 for RNAase and 1:50 for DNAase. The field intensities used were 0.8×10^3, 1.2×10^3, and 3.2×10^3 Oe. In the range used, no differences were observed between experimental and control RNAase activities. For the DNA-DNAase system maximum action of the magnetic field was detected at 3.2×10^3 Oe with a decrease in the effect at lower intensities. The effect disappears at 0.8×10^3 Oe. Thus, the magnetic field effect is expressed as a heightening of DNAase activity by 30% at the maximum. There is a definite threshold below which the effect is not manifested - between 1.2×10^3 and 0.8×10^3 Oe for DNA. Much higher intensities are required for manifestation of the effect on RNAase activity. The data indicates that a magnetic field can have a modifying effect on a whole series of biochemical processes associated with enzymatic breakdown of DNA under normal conditions and in the pathology of cells *in vivo*. (10 references)

0596 EFFECT OF A PULSED MAGNETIC FIELD ON CHICK EMBRYOS IN THE 48TH HOUR OF INCUBATION, AND ON HATCHING RATE. *(E.)* Khananayev, L. I. (no affil.) and D. T. Borodaykevich. JPRS No. 64370, trans. from *Biol. Nauki* (5):54-58, 1973.

The effect of a PMF on development of chick embryos and on the hatching rate was studied. Eggs from white Leghorn chickens were distributed into 3 groups as follows: (1) 56 eggs subject to a PMF for 30 min; (2) 53 eggs subject to a 60 min exposure; and (3) 53 eggs served as control. Prior to incubation the eggs were subjected to a single 14,000 Oe PMF exposure (pulse length 220 μsec, interpulse interval 20 sec). Some embryos were used in histological preparations after 48 hr of incubation and some were used on the 6th day for measurements of embryo development stages. All chicks hatched on the 21st day. Hatching was simultaneous in controls and group 2, but was 8-10 hr earlier in group 1. The largest number of abnormal embryos were in group 2 while the smallest were in the first group. The large and small diameters of the area vasculosa were greater in group 1 after 48 hr of incubation than in the other 2 groups. Length of embryos were 4.2, 3.8, and 3.7 mm in groups 1, 2, and 3, resp. Thus, irradiation in a 14,000 Oe pulsed magnetic field for 30 min had a favorable effect on development and hatching rate of the chick while a 1 hr exposure had a moderately inhibitory effect. (26 references)

0597 ELECTROMAGNETIC POWER ABSORPTION IN ANISOTROPIC TISSUE MEDIA. *(E.)* Johnson, C. C. (Dep. Bioeng., Univ. Utah, Salt Lake City), C. H. Durney, and H. Massoudi. *IEEE Trans. Microwave Theory Tech.* MTT-23(6):529-532, 1975.

Below 100 Hz, a strong conductance anisotropy is known to exist in muscle tissue. In this work an idealized anisotropic tissue medium, consisting of infinitely long parallel muscle fibers, is assumed. These fibers generate relaxation effects only when there are E-field components perpendicular to the fibers. A theory for field effects in anisotropic tissue is developed based on this model. In analyses carried out for multiple tissue layers, the one-layer model predicts a 10:1 difference in power absorption with polarization at 0.01 MHz and below, the 2-layer model predicts a 12% difference, and the 5-layer model predicts a 5:1 difference. Thus, it is predicted theoretically that marked differences in tissue-absorbed power density can occur due to tissue anisotropy at frequencies below 10 MHz. A finite layered model such as an anisotropic sphere is needed to extend these results. (4 references)

0598 MODIFICATION OF THE CYTOGENETIC EFFECT OF IONIZING RADIATION UNDER THE INFLUENCE OF PERMANENT MAGNETIC FIELDS. *(E.)* Galaktionova, G. V. (no affil.) and A. D. Strzhizhovskiy. JPRS No. 63856, trans. from *Kosm. Biol. Aviakosmicheskaya Med.* 8(6):25-28, 1974.

A study was performed of the modifying effect of a

PMF on post-radiation changes in the mitotic index and frequency of aberrant mitoses in the epithelial cells of the cornea in mice. Mice of the CBA and $C_{57}Bl$ strains were subjected to ionizing radiation of 400 rad separately and in combination with a PMF of 1000-4500 Oe. After exposure the animals were decapitated and total preparations of the cornea were made. In the 2 lower layers of reproductive cells the number of mitoses/5000 cells and frequency of aberrant mitoses were counted. Four series of experiments were carried out. In the first 2, the cytogenic effects of ionizing radiation of Co^{60} separately and in combination with 3 hr exposure to a 4500 Oe PMF were studied. No statistically significant differences in values of the mitotic index were noted. In the 3rd series, after exposure to ionizing radiation, the animals were subsequently exposed to a PMF of 1000 Oe for 5 days. No significant differences in post-radiation changes were observed. In the 4th, the animals were exposed to a PMF of 1000 Oe for 15 days before exposure to ionizing radiation. A modifying effect was noted due to preliminary changes in animal metabolism under the influence of PMF, but there was no direct influence on the formation or development of radiation damage itself in any of the experiments. (10 references)

0599 BIOLOGICAL EFFECT OF PERMANENT MAGNETIC FIELDS. *(E.)* Nakhil'nitskaya, Z. N. (no affil.). JPRS No. 63856, trans. from *Kosm. Biol. Aviakosmicheskaya Med.* 8(6):3-15, 1974.

This article is a review of the literature on the biological effects of PMFs of high and low strength which may be of interest for predicting the after effects of man's and animal's exposure. There are few studies, and many of them are contradictory. Beischer has concluded that no cumulative effects are seen after a year of exposure to a field with a strength up to 20,000 Oe over the entire body. Others have shown that 10-150 Oe fields can cause local vasoautonomic disturbances and general functional disorders, primarily in the cardiovascular, nervous, and blood systems. Despite this sensitivity, animals are capable of tolerating exposure to uniform MFs with a very high strength without any influence on their lifetime. Most effects discovered were transient and regressed immediately after exposure ceased. The question of adaptation to this exposure is still open. The effects of MFs less strong than the geomagnetic field have not been widely studied and results are contradictory. Joint efforts by physicians, biologists, physicists and chemists are necessary to study the complex problems in this field. (194 references)

0600 THE COMBINED EFFECT OF ALS, ALG AND ELECTROMAGNETIC RADIOWAVES ON THE ABSOLUTE AND RELATIVE BLOOD COUNT IN EXPERIMENTAL SKIN TRANSPLANTATION. *(Ukr.)* Gorodetskaya, S. F. (Dep. Exp. Ther., Acad. Sci., Kiev, USSR). *Fiziol. Zh. Acad. Nauk RSR* 20(4):502-507, 1974.

Intensification of the immunodepressive effect of UHF radiation in conjunction with the application of ALG and ALS (biological immunodepressants) during skin transplants in rabbits was investigated. The effect on absolute and relative numbers of lymphocytes in peripheral blood with transplantation was also studied. Radiowaves 1 cm in length and 100 mW/cm^2 intensity were used. Experimental data showed that there was a correlation between the decrease of the absolute and relative number of lymphocytes in peripheral blood, and the increase in the lifetime of skin transplants. Also, the combined effect of ALG and ALS with irradiation prolonged the average lifetime of the skin transplants approximately 200% over the average lifetime of such transplants in control species. Irradiation alone (without use of ALG and ALS) prolonged the lifetime of transplants over control species by approximately 100%. (10 references)

0601 NEUROLOGICAL CHANGES IN SUBJECTS EXPOSED TO HIGH FREQUENCY ELECTROMAGNETIC FIELDS. *(Pol.)* Langauer-Lewowicka, H. (Clin. Occup. Dis., Inst. Med. Occup. Coal Mine Ind., Sosnowiec, Poland). *Neurol. Neurochir. Pol.* 9(2):203-210, 1975.

The effect of prolonged occupational exposure to HF radiation was studied in 33 women, aged 21-53, exposed daily for 1.5-17 yr to a 1-1000 V/m field. Observations were rendered more difficult by the nonspecific nature of the symptoms appearing in the affected subjects: headaches, pain in the region of the heart, irritability, insomnia, dizziness, and general weakness. Interruption of occupational duties for a period of 6-12 mon eliminated part of the symptoms (headache and insomnia) in some of the subjects and none in others. EEG recordings of the investigated subjects led authors to the conclusion that high frequency EMR may cause permanent structural damage in the nervous system. (19 references)

0602 DIELECTRIC MEASUREMENTS FOR HYDRATION OF GLOBULAR PROTEINS. *(Ukr.)* Kashpur, V. A. (no affil.), V. Y. Maleev, and T. V. Shchegoleva. *Dopov. Akad. Nauk Ukr. RSR*, Ser. B:150-152, 1975.

The degree of hydration of a group of globular proteins was studied by dielectric measurements, applying 0.76 cm UHF radiation. Proteins examined included: protein of blood serum of bull, egg albumin, chymotrypsinogen, ribonuclease, pepsin, papain, cytochrome c, hemoglobin and myoglobin. When compared with other methods for determining the degree of hydration (calorimetric, sorption and NMR) the dielectric method showed proper correlation with these, as to the relative magnitudes of hydration among individual proteins investigated. With respect to absolute magnitudes of hydration, it showed consistently lower values. On the other hand, hydration values obtained by the dielectric method agreed very well, with a few exceptions, with the values theoretically predicted by models of Bull and Kuntz, emphasizing the importance of the first hydration layer. Only experimental values for cytochrome c and hemoglobin obtained by the dielectric method showed hydration values considerably higher than those predicted by models of Bull and Kuntz. (11 references)

0603 LONG-WAVELENGTH ELECTROMAGNETIC POWER ABSORPTION IN PROLATE SPHEROIDAL MODELS OF MAN AND ANIMALS. *(E.)* Johnson, C. C. (Dep. Bioeng., Univ. Utah, Salt Lake City), C. H. Durney, and H. Massoudi. *IEEE Trans. Microwave Theory Tech.* MTT-23(9):739-747, 1975.

The time-averaged volumetric tissue-absorbed power density, defined as the time rate at which energy is absorbed by the tissue, was determined. The low *ka* perturbation theory was applied to prolate spheroid models of man and experimental animals to obtain internal EM absorbed power distributions and total absorbed power for different orientations and frequencies. Comparisons were made with experimental measurements. A strong orientation effect, which is a critical factor in determining absorbed power, was found. Theoretical data was obtained for absorbed power distribution and total absorbed power for 3 orthogonal orientations of the prolate spheroid with respect to the plane-wave field vectors. Once biological effects due to tissue-absorbed power density are established, the plots may be used to extrapolate back to find what incident plane wave power densities generate the same tissue absorbed density in the man model. This will serve as a guide to establishing EM radiation safety standards. (18 references)

0604 MEASUREMENT OF PERMITTIVITY OF SOLUTION OF SMALL BIOLOGICAL MOLECULES AT RADIOWAVE AND MICROVAVE FREQUENCIES. *(E.)* Lawinski, C. P. (Phys. Dep., Queen Elizabeth Col., London, U.K.), J. C. W. Shepherd and E. H. Grant. *J. Microwave Power* 10(2): 147-162, 1975.

A coaxial line cell was designed which extended the lower frequency limit to give accurate values of the complex permittivity $\hat{\epsilon}$ for aqueous solutions in the 50 to 200 MHz range. Measurements of the complex permittivity of 0.25 M triglycine were made at 24 different frequencies between 55 MHz and 4 GHz and 5 temperatures (5, 12.5, 20, 30, and 40 C) using the coaxial line cell. This cell operates on the principle of measuring the waveform in the sample contained in the cell by means of a probe projecting through a sliding inner conductor moving within the sample. The main purpose of the work was to determine the dispersion of the triglycine molecule accurately. A continuous increase in $\hat{\epsilon}$ between 40-800 MHz, followed by a small peak before rising again at frequencies above 2 GHz was seen. This has relevance to the biological effects of MWs and to MW hazards as these rises are paralleled by considerable increases in conductivity and attenuation coefficients, which are parameters directly determining energy absorption from MWs. (28 references)

0605 THE EFFECTS OF COMBINED SHF AND GAMMA IRRADIATION ON HEMOPOIESIS. *(E.)* Tikhonchuk, V. S. (no affil.). JPRS No. 62942, trans. from *Kosm. Issled.* 12(3):478-482, 1974.

The effect of the biological interaction of EM waves and ionizing radiation was studied with respect to the hemopoietic system. Female $C_{57}Bl$ mice were exposed to a 100 mW/cm^2 power flux density SHF for 4 min/day for 31 days, followed by a 400 r dose of γ radiation (Co-60). The weights of the spleen and thymus were measured and the number of cellular elements in the peripheral blood were counted. Following exposure to SHF radiation both the spleen and thymus decreased in weight and rose to initial values by the 31st day of exposure. Following termination of SHF exposure, weights again fell to 76% and did not recover. Four hr after the 1st exposure to SHF radiation leukocytosis was evident, primarily due to the increase in the number of lymphocytes. After 20 days leukopenia was found, and an unsteady situation remained for some time after termination of exposure. After irradiation a decrease in weights of the spleen and thymus was evident to a combination of SHF and γ rays and to γ radiation alone. Weight recovery was more rapid in the group exposed to γ radiation alone. Four hr after γ radiation the number of leukocytes was 71% of control, while that of animals who were pretreated with SHF was 46% of controls. Thus, SHF has an inhibitory effect on the function of the hemopoietic system and significantly alters its responsiveness to such extreme factors as ionizing radiation. (9 references)

0606 THE EFFECTS OF SUPERHIGH FREQUENCY ELECTROMAGNETIC FIELDS (SHF-EMF) ON THE BODY. *(E.)* Molchanova, N. S. (Acad. Med. Sci. USSR) and Y. V. Gembitskiy. JPRS No. 62942, trans. from *Voyenno-Polevaya Terapiya* (Leningrad, 1973), pp. 198-206.

A review of the effects of SHF electromagnetic fields on the body is presented. The biophysical mechanism of SHF absorption is not completely understood but may rest on the appearance of fluctuations in ions and water dipoles. High intensity irradiation is accompanied by thermal effects, particularly in poorly vascularized organs and tissues. The nervous system is also highly susceptible to MW effects. Studies demonstrating a nonthermal, specific effect of low doses of radiation are available. These include headache, weakness, vertigo, nausea and various symptoms of CNS dysfunction with vegetative vascular and visceral dysfunctions. Detection of malfunctions requires both careful clinical evaluation and a study of occupational history and nature of the hygienic working conditions. The most successful treatment is termination of contact with SHF EMFs, psychotherapy to dissipate unbased fears, and CNS stimulants. Preventive measures include control over working conditions and protective clothing and glasses. (No references)

0607 AN EVALUATION OF ELECTROANESTHESIA AND ELECTROSLEEP. *(E.)* Comm. Electr. Stimul. Brain, Natl. Res. Counc., FDA Contract No. 70-22, 54p., 1974.

It has been pointed out that some permanent physiologic damage may result from the passage of electric

current through the human brain. The efficacy of devices for delivering such current has not been thoroughly evaluated. 'Application of electric current to the head' (AECH) is used to describe electrosleep, electronarcosis, electroanesthesia, and electrical cerebral stimulation. Electric current for anesthesia is administrated only after pharmacologic agents and intubation are given, controlled ventilation is established, and some measure of anesthesia by pharmacologic means is induced. The physiologic effects of AECH depend on current amplitude, electrode location and wave form or frequency. The ultimate goal of AECH for anesthesia is to produce quickly and maintain effectively a state of surgical anesthesia without cardiovascular and respiratory depressant effects of pharmacologic drugs. The patient returns to consciousness within seconds of cessation of the current, and postanesthesia nausea and discomfort are rare. However, muscular activity, tachycardia, hypertension with excessive bleeding and increased salivation have been described, as well as some cases of minor skin burns at the electrode site. An understanding of the specific anesthetic mechanism of AECH has not been established. Recommendations for further study include (1) considering AECH as a potentially useful adjunct in the maintenance of anesthesia, (2) limiting AECH to investigational use until documentation of its effects, advantages, and standardization are attained and (3) studying the effect of AECH on cerebral tissue. (94 references)

0608 SEARCH FOR CORRELATION BETWEEN GEOMAGNETIC DISTURBANCES AND MORTALITY. *(E.)* Lipa, B. J. (Inst. Plasma Res., Stanford Univ., Calif.), C. W. Barnes, P. A. Sturrock, M. Feinleib, and E. Rogot. *SUIPR Rep.* No. 623, NSF Grant GA-42401 and NASA Grant NGL 05-020-272, 11p., 1975.

Speculative research on solar terrestrial relations has been concerned with possible associations between solar activity or geomagnetic disturbances and human disorders. Various authors have claimed a real association between these disturbances and myocardial infarction, psychological behavior, CNS activities and various diseases. In this research, statistical analyses were performed on mortality data obtained from the National Center for Health Statistics and geomagnetic data from the World Data Center. Daily deaths due to coronary heart disease and stroke *vs* magnetic activity, death rate *vs* magnetic index, mortality rates *vs* geomagnetic indices in individual cities, and death rate *vs* the W-index for micropulsations were measured. No statistical evidence for a real correlation was found to exist in any of this work. (9 references)

0609 MORTALITY IN RATS EXPOSED TO CW MICROWAVE RADIATION AT 0.95, 2.45, 4.54, AND 7.44 GHz. *(E.)* Polson, P. (Stanford Res. Inst., Menlo Park, Calif.), D. C. L. Jones, A. Karp, and J. S. Krebs. *Tech. Rep.* No. DAAKO2-73-C-0453, 90p., 1974.

Little quantitative data has been available on MW lethality. In this study 1400 male Sprague-Dawley rats were exposed to CW microwave radiation of 0.95, 2.45, 4.54, or 7.44 GHz, with power density levels of 0.2 to 12 W/cm^2. The rats were habituated to handling for 3 wk, then irradiated in an exposure box designed to minimize movement by the animal. Each animal was observed for mortality at removal from the box and during the next 3 days. After 3 days the surviving animals were sacrificed. Deep rectal temperatures were taken immediately after exposure at the 2 lower frequencies. Twenty-four animals were subjected to a gross necropsy, and histological examination of the brain, kidney, liver, spleen and lung. No histological abnormalities associated with MW irradiation were observed. At 0.95 GHz, with few exceptions, animals which died usually showed a foamy mucus nasal discharge and were either limp or in convulsions. At 2.45 GHz in addition to symptoms noted at 0.95 GHz, frank hemorrhage of the lung and froth in the trachea was apparent. At 4.54 GHz, 193 of the 208 rats died by the end of the first post irradiation day. Marked salivation was present, along with frank burning of ears, eyes and skin in the muzzle area and swelling of the muzzle. Convulsion and respiratory insufficiency were again common at 7.44 GHz. Mortality was associated with asphyxia primarily due to blockage of the nasal passages by hemorrhage or 3rd degree burns. No apparent relationship was found between either body wt or rectal temperature and mortality. Regardless of frequency, the primary site of damage appeared to be the blood vessels with edema and hemorrhage representing the result of changes in permeability of vessel walls. The blood vessels appear to be the most sensitive tissue as sites for deposition of MW energy. The area of damage appeared to move from the lungs to the nose as frequency increased from 0.95 to 7.44 GHz. LD_{50}s and power densities form a rectangular hyperbola for each frequency. Lethality of radiation decreased with frequency in the order 0.95>2.45>7.44>4.54 GHz. The difference in effectiveness between 4.54 and 7.44 GHz implies a real difference in biological response. At each frequency the energy density required to achieve LD_{50} is a linear function of the exposure duration. No effects which would be attributed to circadean rhythms were observed. (9 references)

0610 A PRIMATE RESTRAINT CHAIR FOR USE IN MICROWAVE RADIATION STUDIES. *(E.)* Reno, V. R. (Naval. Aerosp. Med. Res. Lab., Pensacola, Fla.), J. O. deLorge, G. D. Prettyman, C. S. Ezell, and T. A. Griner. *Tech. Rep.* No. NAMRL-1211, 10p., 1974.

A common method of indirect measurement of energy absorbed by an animal from an incident MW field is by introduction of the animal into a previously measured field. The field incident on the animal is assumed to be that measured in its absence. This assumption is valid only if the animal is the only object in the field or if the restraint device is essentially nonreflective and nonabsorptive. By careful consideration of theoretical and practical factors, it is possible to design animal restraint chairs which eliminate many of the problems caused by MW reflection. A restraint chair which is nonreflective and causes minimal pertubation of the incident field has been developed for subhuman primates in MW research. The

chair is made of Styrofoam HD-300, a foam plastic of low MW reflectivity. The material is a closed cell, polystyrene foam with reasonable mechanical strength. It is resistant to moisture penetration and therefore easy to clean. Dovetailed grooves are used at the joints since conventional fasteners are highly reflective. The animal is introduced into the chair from the back and the neck yoke is inserted and locked. The seat is inserted so that the animal assumes a sitting posture. The chair can be oriented in any direction. Field scans at the same location with and without the chair give excellent agreement, indicating minimal reflection. This device reduces some of the uncertainties in the complex problems of MW biodosimetry. (3 references)

0611 PERMEABILITY OF THE MUCOUS MEMBRAINE OF THE FRONTAL SINUS UNDER THE INFLUENCE OF MICROWAVES. *(E.)* Faitel 'berg-Blank, V. R. (Dep. Pathol. Physiol. Biophys., Odessa Agric. Inst., USSR) and M. P. Khareyn. *JPRS No. 62520, trans. from Fiziol. Zh. (Kiev)* 20(1):100-107, 1974.

High frequency EMFs are widely used for the treatment of frontal and maxillary sinuses. The effects of various doses of MWs on the permeability of the mucous membrane of the frontal sinus was studied. Sixty cats were used as controls. Disubstituted phosphoric acid salt ($Na_2HP^{32}O_4$) was injected into the left frontal sinus. At various times up to 120 min blood samples were obtained and activities measured. After 120 min the animals were electrocuted and samples were obtained from different regions of the brain and parenchymatous organs. Radioactive phosphorus activity was determined in these. Sample cats were irradiated with 30, 50, and 72 W microwaves applied for 10 or 20 min to the frontal sinus. The permeability of P^{32} and its distribution among the organs under investigation were measured. Under normal conditons, radiophosphorus is absorbed rapidly and deposited in the parenchymatous organs. The intensity and rate of absorption is markedly enhanced by exposure to 30 W MWs for 10 min with maximum accumulation in the blood occurring within 45 min and amounting to 16.6% of incorporation compared with 7.72% at that time in controls. There was a significant decrease in radioactive phosphorus in the brain tissue and increase in parenchymatous organ tissue. Exposure to 50 W MWs for 10 min also resulted in enhanced absorption, but little difference is seen after exposure to 75 W MWs. Thus, MWs alter permeability of the mucous membrane to an extent dependent on intensity and duration. Tissue of the brain and parenchymatous organs change permeability in relation to MW dose, indicating an alteration in metabolism in these organs. This data may be used by otolaryngologists in selecting MW doses in therapy of frontal sinus diseases. (22 references)

0612 A PERSPECTIVE ON ENVIRONMENTAL HEALTH IN THE USSR. *(E.)* Glass, R. I. (Dep. Med., Mt. Sinai Hosp., New York, N.Y.). *Arch. Environ. Health* 30(8):391-395, 1975.

Soviet methods for setting and enforcing environmental standards have been observed. The Soviet government operates as both the prime source of pollution and the sole regulator of pollution levels. The Ministry of Health of the USSR is responsible for planning and promoting research on new pollutants, translating the results into national standards, and ensuring the enforcement of these standards. Environmental standards are based on research in health effects alone, without regard to considerations of available technology, economic feasibility or ability to measure these concentrations in practice. Duplication of scientific effort is not allowed, preventing verification of controversial results. The MW standard is a thousandfold lower than the American equivalent because it is based on nonthermal effects. As interest in effects of physical factors in the environment has increased in the West, Soviet research serves as a basis for further study. (14 references)

0613 A PSYCHOBIOLOGICAL STUDY OF RHESUS MONKEYS EXPOSED TO EXTREMELY LOW FREQUENCY-LOW INTENSITY MAGNETIC FIELDS. *(E.)* deLorge, J. (Naval Aerosp. Med. Res. Lab., Pensacola, Fla.). *Tech. Rep.* No. NAMRL-1203, 25p., 1974.

The effects of low intensity ELF magnetic fields were studied using four rhesus monkeys (*Macaca mulatta*). The experiments were designed to explore possible changes in time dependent behavior and blood chemistry. Blood samples were taken before, during and after the experiments. Various tests were run, including an interresponse time (IRT) schedule and a fixed ratio (FR) schedule with animals held at different percentage body weights and exposed to 15-45 Hz magnetic fields. Triglycerides were previously reported to increase following ELF exposure in man, but no significant changes were noted in this study. ELF fields have been shown to be useful to drive a drug induced failing heart in the rat, but no significant differences were seen in CPK, cholesterol, LDH, potassium and SGOT. Calcium, RBC, hemoglobin and hematocrit were measured because of a purported relationship between respiration, oxygen uptake and ELF electromagnetic fields, but no influence of the magnetic fields was observed. No effects were seen on WBC, monocytes, eosinophiles, polycytes, etc., and no effect was noted on kidney or liver functions. ELF magnetic fields showed no obvious behavioral influence on either FR or IRT schedules, and general activity was not affected. The tests showed no initiating effects of the fields and no evidence that the animals adapted to the fields. While the behavior of the animals, as measured, was not affected to any practical extent, the possibility of an individual being influenced is not precluded. (14 references.)

0614 THE EFFECTS OF ELECTROSLEEP ON INSOMNIA REVISITED. *(E.)* Cartwright, R. D. (Dep. Psychol., Univ. Ill., Chicago) and M. F. Weiss. *J. Nerv. Ment. Dis.* 161(2):134-137, 1975.

Ten subjects suffering from objectively and subjectively defined insomnia participated in a double