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Biological Effects of Nonionizing Electromagnetic Radiation

VOLUME II

NUMBER 3

MARCH, 1978

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A DIGEST OF CURRENT LITERATURE

A Quarterly Publication
Produced for
Office of Telecommunications Policy
and
United States Navy

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THE FRANKLIN INSTITUTE RESEARCH LABORATORIES
Science Information Services

410 64H

BIOLOGICAL EFFECTS
OF NONIONIZING ELECTROMAGNETIC RADIATION

A Digest of Current Literature

A Quarterly Publication
Produced for
Office of Telecommunications Policy
and
United States Navy



Literature Selected and Abstracted
by
Biomedical Group, Science Information Services Department

Bruce H. Kleinstein, Ph.D., J.D., Project Manager
Elena P. Saboe, Production Manager, Editor

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BIOLOGICAL EFFECTS OF NONIONIZING ELECTROMAGNETIC RADIATION

March, 1978 Volume II, Number 3

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PREFACE

Biological Effects of Nonionizing Electromagnetic Radiation is a publication researched and prepared by the Franklin Institute Research Laboratories, Science Information Services Department, under a contract with the U.S. Navy and administered by the Office of Telecommunications Policy.

This digest serves as a vehicle through which current documentation of research highlights on the biological effects and health implications of nonionizing electromagnetic radiation (microwave and radiofrequency radiation) are compiled, condensed, and disseminated on a regular basis. *Biological Effects of Nonionizing Electromagnetic Radiation* is intended to be a highly useful current awareness tool for scientists engaged in research or related activities. The great number and diversity of relevant publications make imperative the availability of this service to persons whose work requires that they keep abreast of current developments in the field.

Biological Effects of Nonionizing Electromagnetic Radiation is published quarterly. The issues of Volume II, and future volumes, will include materials received during the preceding three months. Each issue will include news items and announcements, a listing of meetings and conferences, abstracts of current literature, and a directory of current research. Materials for which full text is not available will be included as summary abstracts.

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ABBREVIATIONS AND ACRONYMS

A, amp - ampere(s)
Å - angstrom(s)
BRH - Bureau of Radiological Health
C - centigrade
cm - centimeter(s)
cps - cycles per second
dB - decibel(s)
EPA - Environmental Protection Agency
FDA - Food and Drug Administration
g - gram(s)
G - Gauss
GHz - gigahertz
HEW - Health, Education, and Welfare
hr - hour
Hz - hertz
IEEE - Institute of Electronic and Electrical Engineers
IMPI - International Microwave Power Institute
IU - international unit(s)
J - joule(s)
k - kilo--
l - liter(s)
m - meter(s)
m - milli--
M - mega--
mho - unit of measurement of conductivity
min - minute(s)
mo - month(s)
n - nano--
NBS - National Bureau of Standards
NIH - National Institutes of Health
NSF - National Science Foundation
NIOSH - National Institute for Occupational Safety and Health
NTIS - National Technical Information Service
Oe - oersted(s)
OSHA - Occupational Safety and Health Administration
OTP - Office of Telecommunications Policy
PHS - Public Health Service
rad - radiation absorbed dose
R - roentgen(s)
rpm - revolutions per minute
sec - second(s)
USAFSAM - U.S. Air Force School of Aerospace Medicine
USDA - U.S. Department of Agriculture
UV - ultraviolet
V - volt(s)
VA - Veterans Administration
W - watt(s)
Wb - Weber(s)
WHO - World Health Organization
wk - week(s)
wt - weight
yr - year(s)

μ - micro--

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NEWS ITEMS

IMPI PLANS BIOEFFECTS AND RADIATION SAFETY COURSE

A one-day intensive study course on microwave bioeffects and radiation safety, organized by IMPI and Radiation Protection Bureau, Health and Welfare Canada, has been scheduled for June 26, 1978 in Ottawa. The course is aimed at the health physicist, health inspector, physiologist, and radiologist who want to gain general knowledge about microwave radiation safety. The course curriculum will include basic definitions and concepts; quantification of hazardous microwave fields; biophysics--energy absorption, distribution, and interaction mechanisms; biologic and pathophysiologic effects of microwave exposure; comparative survey of microwave exposure standards; and control of microwave exposure in Canada. A panel discussion will conclude the course. Information may be obtained from Dr. M. A. Stuchly, Environmental Health Centre, Room 233, Ottawa, Ontario K1A 0L2, Canada.

IMPI Announcement

BRH CONDUCTS RADIOLOGIC HEALTH WORKSHOP

The BRH conducted a 2½-day workshop on radiologic health principles and issues for FDA's 55 consumer affairs officers during the Executive Director of Regional Operations' Annual Training Conference, November 14-18, 1977, in Rosslyn, Virginia. The workshop acquainted the consumer affairs officers with the basic mechanisms of ionizing, microwave, light, and sonic radiation; the effects of such radiation on the human body; the mandates to FDA on radiologic health; and the Bureau's regulatory and nonregulatory programs for protecting the public from unnecessary radiation exposure. Among the subjects addressed were the medical x-ray process, the roles of the radiologist and radiologic technologist, conventional x-ray equipment, computer tomography scanners, nuclear medicine, mammography, gonad shielding, the use of x rays and ultrasound in pregnancy, sunlamps, mercury vapor lamps, lasers, and microwave ovens. Attendees also received a three-volume manual, compiled by the Bureau's Division of Training and Medical Applications, emphasizing the Bureau's priority topics for consumer education in fiscal year 1978.

BRH Bull. 11(22): 3-4; 1977.

IEEE TO PUBLISH SPECIAL ISSUE: "MICROWAVES IN MEDICINE"

A special issue of the *IEEE Transactions on Microwave Theory and Techniques* on "Microwaves in Medicine, with Accent on the Application of Electromagnetics to Cancer Treatment" has been scheduled for publication in July 1978. Papers will emphasize the following areas: techniques for controlled local and general hyperthermia; applicator designs for producing hyperthermia; measurement of temperature distributions in tissue under microwave exposure; rapid heating of frozen or refrigerated biologic media; noninvasive sensing of tissue properties and conditions; microwave thermography; noninvasive transfer of energy or information to implants; medically beneficial effects; effects on tumor cells, bacteria, viruses, and other organisms; and effects on blood flow, mass transport, and local tissue metabolism.

IEEE Trans. Microwave Theory Tech. MTT25(3): 238; 1977.

NEW NBS RADIO FREQUENCY POWER METER AVAILABLE

A license and a design package to produce a new radio frequency (RF) power meter, recently developed and patented by the National Bureau of Standards (NBS), are now available. The meter, designated NBS Type IV RF Power Meter, was designed for use in automated measurement systems in which as many as 10 power meters would be under the control of a computer and would share a digital volt meter and digital-to-analogue connector. Like its predecessors, the NBS Types I and II meters, Type IV uses the direct current-RF substitution method for measuring power. Unlike Types I and II, it does not use a Wheatstone Bridge. The Type IV uses two operational amplifiers to automatically maintain equality between the resistance of a thermistor mount and the meter's internal standard resistor, to within one part in 10^5. Doing away with the bridge and the use of 4-terminal resistor connections eliminates the lead-resistance errors inherent in thermistor-to-bridge connections. It also permits longer connecting lines between meter and thermistor. The package and a license under U.S. Patent No. 4,008,610 are available through NTIS, U.S. Department of Commerce, Washington, DC.

Microwave J. 20(12): 32; 1977.

CANCER RESEARCHERS REEVALUATE HYPERTHERMIA

Electrohyperthermia, once considered the tool of cancer quacks, is beginning to enjoy a renaissance in the treatment of cancer. When used in conjunction with chemotherapy, therapists have found that electrohyperthermia achieves better results than just application of chemotherapy alone. Electrohyperthermia pretreatment makes the cancer tissue more permeable to the drug. In addition, microwave-induced preheating enables lower doses to be administered, reducing the chances of complications caused by the larger dosage required without electrohyperthermia. Some researchers indicate that electrohyperthermia alone may be enough to kill cancer tissue. One medical renegade claims that in using an H-wave-polarized, 434-MHz source, the frequency of the radiofrequency (RF) wave itself, and not the heating induced by RF, is sufficient to cure certain types of cancer. To date, the real problem facing researchers is the inadequacy

of existing microwave diathermy equipment. One investigator, though, sees the day when better equipment will become available: "Flexibility is what's important now. After the researchers determine the best frequencies and power levels, a smaller, fixed-parameter type of system will surely result."

Microwaves 16(9): 22-24; 1977.

MICROWAVES BOOST WHEAT CROP YIELD

Researchers in India are discovering that microwave irradiation can help improve diseased wheat seeds before planting and increase yield once the crop is sown. Exposure to microwave energy improves the process of seed mutation and thereby boosts the crop yield. Seeds are irradiated in a simple matched waveguide load, suspended on electrically transparent foam in the maximum E-field region. Crops are irradiated by means of high-gain, low-sidelobe antennas. By irradiating the seeds at a specific molecular resonant frequency, energy absorption is increased, speeding the mutation process. "One of the main aims is to improve the protein content of wheat," explains Chinmoy Das Gupta, Assistant Professor of electrical engineering at the Indian Institute of Technology, Kanpur. "Once the characteristic resonance frequency of isolated protein molecule is known, the crops will be subjected to irradiation centered on this resonant frequency."

Microwaves 16(9): 12, 18; 1977.

BOOK REVIEWS MICROWAVE RISKS

In *The Zapping of America: Microwaves, Their Deadly Risk, and the Cover-up*, Paul Brodeur, a staff writer on *The New Yorker*, examines the physiologic effects and environmental impact of microwave radiation. This 343-page volume is published by W. W. Norton, New York.

URSI CALLS FOR PAPERS FOR ELECTROMAGNETIC BIOEFFECTS SYMPOSIUM

An open symposium on Biological Effects of Electromagnetic Waves will be held as part of the 19th General Assembly of the International Union of Radio Science in Helsinki, Finland, August 1-8, 1978. The symposium will feature six or seven half-day sessions on the following and other related areas: theoretical and experimental dosimetry and field measurements, instrumentation, mechanisms of interaction with biologic systems, hyperthermia and biomedical applications, behavioral and central nervous system effects, philosophy of standards, and international cooperative studies. The deadline for submission of papers is April 15, 1978. Communications may be addressed to Professor A. W. Guy, Dept. of Rehabilitative Medicine, CC-814 University Hospital RJ-30, Univ. of Washington School Medicine, Seattle, Washington 98195.

International Union of Radio Science Announcement

NARDA DEVELOPS MICROWAVE BRIDGE

A precision matched microwave bridge has been developed by the Narda Microwave Corporation with a 35 dB directivity for the entire frequency range from 2 to 18 GHz or more and with all ports well-matched for minimum contribution to measurement error. The bridge performs the same function as a high directivity coupler, and the two devices may be used interchangeably in reflectometer and network analyzer applications.

Narda Probe 9(2): 1-8; 1977.

RADIO ENERGY HEALING SOCIETY FORMED

Although the effects of magnetic and electric fields in medicine and biology are little understood, interest in the benefits, dangers, and contraindications of electromagnetic energy associated with clinical application is rising. At a meeting at St. Bartholomew's Hospital, London, researchers last year decided to form "The Society for the Study of Electrical Phenomenon in Living Systems." Presentations at that meeting included a paper entitled "Callus Formation by Electret (see Current Literature 5281) and a discussion of the use of pulsed radio frequency energy for reducing bruising and edema following surgery. The society plans to hold two meetings each year and restrict membership to those actively working in the field.

J. Med. Eng. 1(5): 291-292; 1977.

ELECTRIC STIMULATION IMPROVES HONEY YIELD

Researchers in the Soviet Union have reported improved bee colony development by applying an electrical charge for short durations. The swarm is placed between two metal plates, 50 cm apart, and a potential of 20 kV with a frequency of 200-1,000 Hz is applied. A variable electric field is established in the order of 400 V/cm, which activates the bees. The time for one session is 5-10 min and the interval between sessions in the spring/summer session is 5-6 days and in the autumn, 1-3 days. The operations in spring and summer ensure the development of the colony to the start of nector flow and in autumn ensure growth of young bees going into hibernation. In one experiment, bees were treated from the start of June to mid-July. Every 12 days a check was made. The colony was found to gather 50% more honey and to reproduce at a rate of 40% more than non-treated bees. Treatment

at the end of August through early September (every 1-2 days for 2 wk) ensured reproduction increase by a factor of two.

Soviet Inventions Illustrated (Y42): 3; 1977.

ELECTRICAL SAFETY COLLOQUIUM SCHEDULED

The International Section for the Prevention of Occupational Risks due to Electricity of the International Social Security Association will hold a colloquium concerning safety for the electrical expert with emphasis on basic and advanced training. Details on the colloquium, to be held in Lucerne, Switzerland, on May 17-19, 1978, may be obtained from the Berufsgenossenschaft der Feinmechanik und Elektrotechnik, Oberlaender Ufer 130, D-5000 Koeln 51, West Germany.

Lancet 2(8047): 1092; 1977.

MICROWAVE DIAGNOSIS AND THERAPY WORKSHOP SCHEDULED

A one-day workshop on Diagnosis and Therapy using Microwaves will be held shortly after the Eighth European Microwave Conference scheduled for September 4-8, 1978, in Paris. The conference itself will include presentations on the Biological Effects and Medical Applications of Microwaves. Details on both the workshop and the conference may be obtained from Professor E. Constant, 8th EuMC Conference Chairman, Centre Hyperfrequence et Semiconducteurs, Universite des Sciences et Techniques, BP 36, 59650 Villeneuve d'Ascq, France.

8th European Microwave Conference Announcement

ELECTRIC FIELD EFFECTS RESEARCH EXPANDS

"If electric fields can cause biological effects, it appears that they will be subtle, possibly elusive, and extremely difficult to identify," according to Dr. Harry Kornberg, Environmental Assessment Department of the Electric Power Research Institute (EPRI). Kornberg notes that research on the possible effects of electric fields from high-voltage transmission lines began in the 1960s. Public awareness increased in the late 1970s, triggered primarily by reports from the Soviet Union describing medical complaints from switchyard workers exposed to high-voltage gradients for long periods. A similar experience occurred in Spain, where five of eight switchyard workers, transferred to a new 500-kV power station, reported headaches, fatigue, and loss of appetite. However, examinations of line workers in Canada, England, France, West Germany, Italy, and the U.S. have shown no adverse biologic effects. "No experiment thus far has clearly established that electric fields even 20 times as high as those encountered under 765-kV transmission lines can cause a biological effect of significance," states Kornberg. A number of studies are under way both in the U.S. and in other countries to pinpoint electric field effects. The EPRI is sponsoring research amounting to $2 million/yr in the area and the Energy Research and Development Agency (ERDA) is sponsoring $1 million/yr. According to Kornberg, both EPRI and ERDA are optimistic that some definitive answers on electric field effects will be forthcoming within the next few years.

Mech. Eng. 99(11): 20-21; 1977.

BRH REVIEWS RADIATION CONTROL EFFORTS

In a brief report entitled "A Look at FDA's Program to Protect the American Consumer from Radiation," the BRH provides a brief overview of FDA's major regulatory and voluntary effort in the area of radiation control and examines the impact of the agency's programs to eliminate unproductive radiation exposure to the consumer. The report concludes with a summary of present and future concerns about newly-emerging radiation-emitting products and uses and the potential public health problems that they may engender.

HEW Publication (FDA) 77-8032; 18 pp.; April, 1977.

ENVIRONMENTAL IMPACT OF ELECTRIC FIELDS STUDIED

Under contract to the Electric Power Research Institute (EPRI), Westinghouse Advanced Systems Technology, in conjunction with the Pennsylvania State University, is performing a research project to study the effects of electric fields on plants and animals typically found in the vicinity of power transmission lines. The contract is a portion of EPRI's comprehensive program committed to determining the environmental impact of the electric fields produced by extremely high voltage and ultra high voltage transmission lines. The research team coordinates the skills of Westinghouse engineers familiar with electric utility operations and instrumentation techniques with the work of biologists from the Pennsylvania State University specializing in the practical and theoretic aspects of plant and animal growth and behavior. Biologic studies that have and will be performed include effects studies monitoring hatching time, weight, and activity of developing avian embryos; growth, activity, electrocardiographic and electroencephalographic responses of young chicks; and the capability of field detection by domestic pigeons. Biologic effects studies on several species of green plants are also being performed.

J. Microwave Power 12(1): 42; 1977.

ITEMS FROM THE COMMERCE BUSINESS DAILY

☐ **CONTINUATION OF RESEARCH ON MICROWAVES, ELECTROMAGNETIC THEORY AND INFORMATION PROCESSES.**

The Directorate of Procurement, Air Force Office of Scientific Research, Bolling Air Force Base, Washington, DC, has contracted with the Polytechnic Institute of New York, Brooklyn for the above study. (November 2, 1977)

☐ **FURTHER RESEARCH DESIGNED TO ASSESS THE EFFECTS OF CHRONIC, LOW-LEVEL MICROWAVE EXPOSURE ON THE HEMATOPOIETIC SYSTEM OF MICE.**

The Office of Naval Research, Arlington, Virginia, is negotiating with Battelle Memorial Institute, Pacific Northwest Laboratories Division, Richland, Washington for the above study. (November 17, 1977)

☐ **BIOLOGICAL CONSEQUENCES OF PULSED VS CONTINUOUS WAVE RADIOFREQUENCY RADIATION STUDY.**

The Directorate of R & D Procurement, Wright-Patterson Air Force Base, Ohio, has contracted with Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta, Georgia for the above study. (December 2, 1977)

☐ **RESEARCH ON THE TEMPORAL RELATIONSHIP BETWEEN THE ELF FIELD FROM THE PROJECT SEAFARER WISCONSIN TEST FACILITY AND PATH DEVIATIONS BY MIGRATING BIRDS.**

The Office of Naval Research, Arlington, Virginia, has contracted with Marine Biological Laboratory, Woods Hole, Massachusetts for the above study. (December 19, 1977)

☐ **RESEARCH ON THE EFFECT OF 60 Hz FIELDS ON THE MAMMALIAN CENTRAL NERVOUS SYSTEM.**

The Office of Naval Research, Arlington, Virginia, has contracted with the Regents of the University of California, Los Angeles for the above study. (January 5, 1978)

☐ **CONTINUATION OF NECESSARY SERVICES TO COORDINATE FEDERAL/STATE RADIATION CONTROL ACTIVITIES AND ASSISTANCE IN SOLVING RADIATION CONTROL PROBLEMS.**

The FDA, PHS, HEW, Rockville, Maryland, is negotiating with the Conference of Radiation Control Program Directors, Inc. for the above study. (January 16, 1978)

NON-IONIZING RADIATION: EUROPEAN HIGHLIGHTS

Dr. Paul D. Gillespie, Managing Director

The Franklin Institute, GmbH, Munich, Federal Republic of Germany

An investigation of currently funded research programs in the United Kingdom reveals that the only study of the bioeffects of nonionizing radiation is being conducted at the Physics Department of Queen Elizabeth College, London University. This project, sponsored by the Medical Research Council, is under the direction of Dr. E. H. Grant. Dr. Grant, a biophysicist, defines the thrust of the study as an effort to provide information that will lead to recommendations for establishing maximum permissable microwave exposure levels as a function of radiation frequency. Power-patterned after the U.S. exposure limits, current British limits are quoted in units of incident radiation, and they employ the same value, 10 mW/cm^2. The concept of a frequency factor in establishing radiation exposure limits is particularly interesting. While there are no cases where it has been clearly and unambiguously established that biologic injury to man has been observed resulting from microwave radiation at incident power levels of 10 mW/cm^2 or below, furnace workers and glassblowers without eye protection experience the development of cataracts. While the cataracts were all attributed officially to infrared radiation exposure, the low frequency end of the infrared region merges with the high frequency end of the microwave region. Further, various tissue damages have been reported in laboratory animals at microwave incident power levels one full order of magnitude lower than presently accepted as permissable. Another compelling reason to consider the frequency factor in the establishment of maximum permissable limits is that the ability of various tissues to absorb energy is frequency dependent.

Dr. Grant reports that they are fifteen months into what is seen initially as a three-year project. Their accomplishments to this point, he continues, have been twofold: first, the construction of devices designed to measure electrical permittivity and conductivity of

human eye lens tissue in the 100 MHz to 10 GHz frequency range, and second, the conduction of irradiation experiments upon lens. To date, the experimental data have convinced Dr. Grant that the research will produce sufficient evidence in two year's time to support a strong case for establishing exposure limits for nonionizing radiation based on frequency dependence. Dr. Grant reports that their findings also show that the bound water of lens tissue absorbs more readily than unbound water in tissues.

Parallel to the above work, Dr. Grant's group is conducting microwave hyperthermia experiments.

In connection with Dr. Grant's work on establishing frequency factors in exposure limit determinations, it is interesting to note that the effort of the Commission of the European Communities' Working Group to set the ground rules for a common nine-nation policy for establishing exposure limits for nonionizing radiation has now been delayed for a year. According to Dr. Hans Eriskat of the European Commission, the report of the Working Group, which was due in the Fall of 1977, is not expected until the last quarter of 1978. Eriskat indicates that for a variety of reasons, including the frequency factor argument, no agreement could be reached in the Working Group, which is composed of experts in the field of biological effects of nonionizing radiation from from all nine of the member states. Although the group meets regularly, as yet there is no pressure from individual nations for action.

(Note: Direct inquiries regarding "European Highlights" care of the Editor, *Biological Effects of Nonionizing Electromagnetic Radiation*, Science Information Services, Franklin Institute Research Labs., The Benjamin Franklin Parkway, Philadelphia, PA 19103)

MEETINGS AND CONFERENCES

THIRD INTERNATIONAL SUB-MILLIMETER WAVES CONFERENCE-1978

Date: March 29-April 1, 1978
Place: Guildford, England: Univ. Surrey
Sponsor: Inst. Physics, in collaboration with Inst. of Electrical Engineers, Inst. Electrical & Electronics Engineers, Inst. Electronic and Radio Engineers
Requests for Information: Mtgs. Officer, Inst. Physics, 47 Belgrave Sq., London, SWIX 8QX, England

ELECTROMAGNETIC COMPATIBILITY CONFERENCE

Date: April 4-7, 1978
Place: Guildford, England: Univ. Surrey
Sponsor: Inst. Electronic and Radio Engineers in association with Inst. Electrical & Electronics Engineers, Inst. Quality Assurance, Inst. Marine Engineers, Royal Aeronautical Society
Requests for Information: P. M. Elliott, IERE

AMERICAN OCCUPATIONAL HEALTH CONFERENCE

Date: April 9-14, 1978
Place: New Orleans, LA: Fairmont
Sponsor: American Occuaptional Medical Assoc., American Assoc. Occupational Health Nurses
Requests for Information: H. N. Schulz, AOMA, 150 N. Wacker Dr., Chicago, IL 60606

FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY: Annual Meeting

Date: April 9-14, 1978
Place: Atlantic City, NJ
Sponsor: Federation of American Societies for Experimental Biology (FASEB)
Requests for Information: Mrs. H. B. Lemp, FASEB, Off. of Scientific Meetings, 9650 Rockville Pike, Bethesda, MD 20014

INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN BIOMEDICAL ENGINEERING

Date: April 17-21, 1978
Place: Sheffield, England: Univ. Sheffield
Sponsor: Biological Engineering Society (BES)
Requests for Information: Dr. K. Copeland, BES, Dept. Biophysics,Univ. College London, Gower St., London WCIE 6BT, England

INTERNATIONAL MAGNETICS CONFERENCE (INTERMAG)

Date: May 9-12, 1978
Place: Florence, Italy
Sponsor: Inst. Electrical & Electronics Engineers--Magnetics Group; Italian Physical Soc.; Italian Assoc. Electrical & Electronics Engineers
Requests for Information: J. Suozzi, Bell Telephone Labs., Whippany, NJ 07981

USNC-URSI/IEEE AP-S (Radio Science/Antennas and Propagation) Meeting

Date: May 15-19, 1978
Place: Washington, DC
Sponsor: International Union Radio Science-U.S. National Committee (USNC-URSI); Inst. Electrical & Electronics Engineers (IEEE)--Antennas & Propagation Society
Requests for Information: G. Hyde, Propagation Studies Dept., Comsat Labs, Box 115, Clarksburg, MD 20734

NINTH INTERNATIONAL CONGRESS OF THE SOCIETE FRANCAISE DE RADIOPROTECTION: Risks associated with the utilization of nonionizing radiations

Date: May 22-26, 1978
Place: Chateau de Naninville-les-Roches near Paris, France
Sponsor: Societe Francaise de Radioprotection
Requests for Information: M. Regis Marchand, Congress President, DSC-18 Rue Ernest-Cognacq, 92300-Levallois-Perret, France

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS: Annual Convention (ELECTRO/78)

Date: May 23-25, 1978
Place: Boston, MA: Sheraton Boston & Hynes Auditorium
Sponsor: Inst. Electrical & Electronic Engineers, Electronic Reps. Assoc.
Requests for Information: W. C. Weber, Jr., C/O IEEE Boston Office, 31 Channing St., Newton, MA 02158

CONFERENCE ON PRECISION ELECTROMAGNETIC MEASUREMENTS

Date: June 26-29, 1978
Place: Ottawa, Canada: Government Conf. Cent.
Sponsor: Inst. Electrical & Electronics Engineers--Instrumentation and Measurement Group; National Bureau Standards; International Union of Radio Science-U.S. National Committee

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Requests for Information: K. Charbonneau, Executive Secretary, C/O National Research Council of Canada, Ottawa, Canada K1A 0R6

IEEE MTT-S INTERNATIONAL MICROWAVE SYMPOSIUM

Date: June 27-29, 1978
Place: Ottawa, Canada: Chateau Laurier Hotel
Sponsor: Inst. Electrical & Electronics Engineers (Microwave Theory & Technique)
Requests for Information: S. J. Kubina, Publicity Chairman, Electrical Engineering Dept., Concordia Univ., 7141 Sherbrooke St. W. Montreal, Quebec H4B 1R6

1978 SYMPOSIUM ON ELECTROMAGNETIC FIELDS IN BIOLOGICAL SYSTEMS

Date: June 27-30, 1978
Place: Ottawa, Canada: Holiday Inn (Centre)
Sponsor: Microwave Theory & Techniques Society, Inst. Electrical & Electronic Engineers, International Microwave Power Inst. with the cooperation of U.S. Committee for URSI and Canadian Commission A of URSI
Requests for Information: M. H. Repacholl, Local Arrangements Chairman, Dept. National Health & Welfare, Environmental Health Centre, Room 233, Tunney's Pasture, Ottawa, Canada K1A 0L2

IMPI MICROWAVE POWER SYMPOSIUM: 1978

Date: June 28-30, 1978
Place: Ottawa, Canada: Chateau Laurier Hotel
Sponsor: International Microwave Power Institute (IMPI)
Requests for Information: W. Wyslouzil, Local Arrangements Chairman, Electrical Engineering Div., National Research Council of Canada, Ottawa, Canada K1A 0R8

OPEN SYMPOSIUM ON BIOLOGICAL EFFECTS OF ELECTROMAGNETIC WAVES

Date: August 1-8, 1978
Place: Helsinki, Finland
Sponsor: International Radiation Protection Association (IRPA) and Commissions A & B
Requests for Information: Professor A. W. Guy, Dept. Rehabilitation Medicine, CC-814 Univ. Hospital RJ-30, Univ. Washington School of Medicine, Seattle, Washington 98195

EIGHTH EUROPEAN MICROWAVE CONFERENCE

Date: September 4-8, 1978
Place: Paris, France: Hotel Meridien
Sponsor: Societe des Electriciens, des Electroniciens et Radioelectriciens (Groupement des Industries Electriques)
Requests for Information: Professor E. Constant, Conference Chairman, Centre Hyperfrequences et Semiconducteurs, Universite des Sciences et Techniques, BP 36, 59650, Villeneuve d'Ascq, France

AMERICAN ACADEMY OF OCCUPATIONAL MEDICINE: Thirtieth Annual Meeting

Date: September 20-22, 1978
Place: Williamsburg, VA
Sponsor: American Academy of Occupational Medicine (AAOM)
Requests for Information: AAOM, 150 N. Wacker Dr., Chicago, IL 60606

WESTERN OCCUPATIONAL HEALTH CONFERENCE

Date: October 12-14, 1978
Place: Los Angeles, CA: Hyatt Regency Hotel
Sponsor: American Industrial Hygiene Assoc., Health Physics Society; Western Occupational Medical Assoc. (WOMA); Western Assoc. Industrial Nurses; American Society Safety Engineers
Requests for Information: B. H. Bravinder, WOMA

ENGINEERING IN MEDICINE & BIOLOGY: Thirty-first Annual Conference

Date: November 4-8, 1978
Place: Atlanta, GA: Marriott
Sponsor: Alliance for Engineering in Medicine and Biology (AEMB)
Requests for Information: Mrs. P. I. Horner, AEMB

INTERNATIONAL UNION OF RADIO SCIENCE-- U.S. NATIONAL COMMITTEE MEETING

Date: November 5-10, 1978
Place: Boulder, CO
Sponsor: International Union of Radio Science--U.S. National Committee
Requests for Information: S. W. Maley, Dept. E , Univ. Colorado, Boulder, CO 80309

0209 ELECTRON SPIN RESONANCE STUDIES OF EFFECTS OF 1.0, 2.45, AND 9 GHZ EMR ON CELL MEMBRANES. Fisher, H. L. (Bioengineering Branch, Environmental Protection Agency, Experimental Biology Div., Durham, NC 27111).

Expanding uses of nonionizing electromagnetic radiation require adequate safety and protective measures. To apply these measure, the biologic and biophysical effects of the radiation must be understood. Although acute exposures and effects have been investigated, studies of chronic low-level exposures are lacking due to the experimental difficulties. Two approaches to this problem are to study the final result or biologic effect or to study the initial biophysical processes occurring upon radiation exposure. This project will examine the erythrocyte plasma membrane following exposure. This membrane has been well-characterized, and damage to it from ionizing radiation and other insults has been tabulated. In this study, the presence of temporary or permanent structural changes in the membrane at the molecular levels will be investigated using spin labels. These changes, if present, will be correlated with accumulated doses and dose rate. (10/76-9/77)

Supporting Agency:EPA

0210 EFFECTS OF CHRONIC, FRACTIONATED EXPOSURE TO MICROWAVES ON LEARNING AND MEMORY OF RATS. Gage, M. I. (Neurobiology Branch, Environmental Protection Agency, Health Effects Res. Lab., Durham, NC 27711).

Rats, trained to perform a task of alternating between two levers a fixed number of times for food reinforcement, are being exposed to low levels of 2,450 MHz microwaves. After training, the rats will be exposed to a power density of 10 mW/cm^2 3 nights/wk for 3 or 6 mo, to determine whether chronic exposures to microwaves altered learned behavior. The rats will then be given single exposures to various power densities of 2,450 MHz radiation to determine the threshold level that would alter the performance of the learned task. Currently, chronic exposures have been terminated and single exposures are nearing completion; data analysis is in progress. (10/76-9/77)

Supporting Agency:EPA

0211 FERROMAGNETIC SILICONE VASCULAR OCCLUSION IN NEOPLASMS. Rand, R. W.; Poe, N.; Snow, H.; Ditullio, M.; Snyder, M.; Scholten, S. (Univ. California, Sch. Medicine, 405 Hilgard Ave., Los Angeles, CA 90024).

Ferrosilicone occlusion research for cerebral aneurysms, vascular malformations, and hypervascular tumors will be continued along the same lines as in the past. Different types of iron compounds will be tested in animals to study which, if any, has more ability to be effective by an external electromagnetic field. Work will be closely carried out with the scientists at the Jet Propulsion Laboratory in Pasadena who are in the process of constructing appropriate electronic instrumentation to carry out the basic research. Results of in vivo experiments in dogs and bench experiments in the laboratory indicate that there is great promise if the ferromagnetic silicone material can be significantly influenced in electromagnetic fields. The ability to produce intense necrosis of tissue, especially cancerous tissue, in a very localized, selective manner will be enhanced. (2/77-1/78)

Supporting Agency:HEW, PHS, NIH, NCI

0212 THE THERAPEUTIC RATIO AND EXPERIMENTAL RADIOTHERAPY. Phillips, T. L.; Fu, K. K.; Goldstein, L. S.; Begg, A.; Baker, R. J.; Kane, L. (Univ. California, Sch. Medicine, 551 Parnassus Ave., San Francisco, CA 94122).

Quantitative systems, which measure normal tissue damage and tumor response in the mouse, will be applied to evaluate factors and agents that modify radiation response in ways favorable to the therapeutic ratio. Fractionation, hyperthermia, cancer chemotherapeutic agents, and heavy particle irradiation potentially increase tumor response, a lesser increase in normal tumor response, and therefore increase the therapeutic ratio. Normal tissue endpoints will be measured in the brain, lung, esophagus, kidney, small intestine, skin and bone marrow; tumor response will be measured in the EMT6 carcinoma assayed as a solid tumor, as small metastases, and in vitro. Hyperthermia will be generated by a specially designed microwave apparatus and irradiation chamber for segmental heating of mice. Drugs investigated include adriamycin, actinomycin, BCNU, cyclophosphamide, and bleomycin. High linear energy transfer (LET) radiations under investigation include 15 MeV neutrons, helium ions, and neon ions, as well as carbon and argon. (5/77-4/78)

Supporting Agency:HEW, PHS, NIH, NCI

0213 HYPERTHERMIA AND RADIATION: X-RAYS VS FAST NEUTRONS. Nagle, W. A.; Moss, A. J.; Baker, M. L.; Prior, R. M.; Straub, K. D. (Univ. Arkansas, Sch. Medicine, 4301 W. Markham St., Little Rock, AR 72201).

An in-depth study of the interaction of 1) agents that cause heating (thermal heat, ultrasound, and microwaves) and 2) ionizing radiations of both low (250 kV X-rays) and high (fast neutrons) linear energy transfer (LET) will be performed. The use of hyperthermia in combination with low LET radiation to simulate high LET will be evaluated. Cultured cells of three different mammalian lines will be used; cell populations will be synchronized where appropriate. The experiments will be performed under conditions of hypoxia as well as normal oxygenation. Both cellular (proliferative

integrity) and molecular (production and repair of DNA single strand breaks) will be measured. These data will help to establish a biologic base from which rational clinical trials can be formulated. (7/77-6/78)

Supporting Agency:HEW, PHS, NIH, NCI

0214 RADIATION AND HYPERTHERMIC CANCER THERAPY. Robinson, J. E. (Univ. Maryland, Sch. Medicine, 1420 N. Charles St., Baltimore, MD 21201).

The action of hyperthermia alone and in combination with ionizing radiation will be investigated to answer current questions on the use of this combined modality in cancer therapy. Laboratory data show that radiation sensitivity is markedly enhanced at elevated temperatures. The objectives of research, which are aimed at clinical applicability, are: (1) to develop and evaluate a technique of microwave heating of animals and animal tumor systems that are clinically relevant; (2) to assess the relative thermal sensitivities and radiosensitivities of normal and malignant tissues under microwave-induced hyperthermic conditions and (3) to compare results with existing experimental data in which elevated temperatures were obtained by tumor immersion in water baths. Localized and generalized hyperthermia, as an adjunct to radiotherapy, offers the potential of further increasing rates of local tumor control. (7/77-6/78)

Supporting Agency:HEW, PHS, NIH, NCI

0215 GENETIC AND CELLULAR EFFECTS OF MICROWAVE RADIATION. Dutta, S. K.; Brusick, D.; Blackman, C. (Dept. Botany, Howard Univ. Sch. Liberal Arts, 2400 6th St. N.W., Washington, DC 20001).

To determine whether microwave radiation can affect normal cellular processes associated with the utilization of genetic information, a battery of cellular systems having a variety of genetic structures and functions will be used to distinguish between perturbations caused solely by temperature rise and those caused by other mechanisms. Several genetic systems have been established, standardized, and characterized over a range of environmental temperatures. These include strains of *Saccharomyces cerevisiae*, *Salmonella typhimurium*, and *Escherichia coli*. These cell types have been exposed to pulsed radiation between 8.6 and 9.6 GHz, and the data are being analyzed. (10/76-9/77)

Supporting Agency:EPA

0216 BEHAVIORAL AND EEG RESPONSES OF MONKEYS EXPOSED IN UTERO TO LOW LEVEL EMR. Kaplan, J. N.; Polson, P. (Dept. Psychology, Stanford Res. Inst., 333 Ravenswood Ave., Menlo Park, CA 94025).

Teratogenesis as well as certain behavioral, biochemical, and electroencephalographic parameters will be evaluated in pregnant squirrel monkeys exposed to chronic low-level microwave irradiation throughout gestation. The behavioral, biochemical, and electroencephalographic measures to be monitored are those likely to be sensitive to stress-related conditions. In addition, similar measurements will be made on half of the offspring, who will be exposed chronically for 12 mo after birth, and on their mothers, who will continue on the exposure regimen for 6 mo after birth. Whole-body microwave exposures of unrestrained animals (pregnant females, mothers, offspring) will be conducted approximately 0.1, 1.0, and 10 mW/cm^2 at 2,450 MHz for 3 hr/day, 5 days/wk in multimode, modestirred microwave cavities, each containing a dielectric cage. This permits whole-body irradiation of an unrestrained monkey in a modulated, pulsed radio frequency field. Currently, pregnant females are being exposed to the microwaves. Offspring have been or are being born, and offspring will continue to be exposed and examined for various indicators of behavioral development. (10/76-9/77)

Supporting Agency:EPA

0217 DEFINE SPECIFIC ABSORPTION FREQUENCIES OF NON-IONIZING ELECTROMAGNETIC RADIATION IN BIOLOGICAL SYSTEMS. Blackman, C. F.; Weil, C. M.; Allis, J. W.; Elder, J. A. (Environmental Protection Agency, Experimental Biology Div., Durham, NC 27111).

To study the interactions of nonionizing electromagnetic radiation with biologic systems, a microwave spectrometer will be constructed and used to determine the frequencies in the microwave radiation spectrum that interact with molecules, subcellular systems, cells, and tissues. Initial tests with a simplified spectrometer demonstrated the need for a more elaborate system utilizing a dual beam method. A prototype instrument is being constructed. (10/76-9/77)

Supporting Agency:EPA

0218 ENHANCEMENT OF CHEMOTHERAPEUTIC AGENTS BY LOCAL TUMOR HYPERTHERMIA. Magin, R. L.; Adamson, R. H.; Cysyk, R. L. (Chemical Pharmacology Lab., U.S. Dept. Health, Education, Welfare, Natl. Cancer Inst., Bethesda, MD 20014).

The feasibility of enhancing the effectiveness of chemotherapeutic agents and decreasing their toxicity will be investigated by using local tumor hyperthermia to augment drug therapy. Microwave radiation (2,450 MHz) will be applied locally to small mouse tumors to produce local tumor hyperthermia (43 C). The effect of drugs on tumor growth and animal survival will be determined in animals with locally hyperthermic tumors. Tumor drug uptake, DNA/drug binding, and DNA repair enzyme inactivation will be investigated. Solid tumors to be studied include subcutaneously implanted mammary, Lewis lung, B-16 melanoma, colon, and glioma in mice.

A microwave system for the production of a controlled localized tumor hyperthermia in four mice simultaneously has been assembled. Intratumor temperature uniformity of ± .5 C has been achieved. Preliminary studies with adriamycin are being conducted. (10/76-9/77)

Supporting Agency:HEW, PHS, NIH, NCI.

0219 EFFECTS OF CHRONIC MICROWAVE EXPOSURE ON IMMUNE DEFENSE MECHANISMS. Liddle, C. G.; Smialowicz, R. J. (Environmental Protection Agency, Experimental Biology Div., Durham, NC 27111).

The objective of this project is to examine the effects of repeated low-level microwave exposure on immunologic responses in rats and mice. Rats will be exposed daily to low levels of 2,450, 425, or 100 MHz radiation under controlled environmental conditions throughout gestation and early postnatal life. In one group of studies, the metabolic and proliferative capacity of lymphocytes obtained from irradiated animals will be evaluated by measuring the incorporation of radioactive precursors into DNA and/or RNA following addition of mitogens that stimulate subpopulations of lymphocytes. In other studies, the circulatory antibody response will be measured after immunization against *Streptococcus pneumoniae*. Circulatory antibody response will also be assayed in mice exposed during antibody production. In an earlier study it was found that microwave (2,450 MHz) irradiation of cultured mouse lymphocytes did not alter the proliferative potential of either T or B lymphocytes. Preliminary studies on rats chronically exposed to 425 and 2,450 MHz suggested changes in lymphocyte function, including DNA synthetic capacity; apparent increases in circulating antibody titers were noted at 2,450 MHz. Results of a preliminary study with mice exposed to 9 GHz during antibody production indicated an increased antibody titer. More extensive chronic studies with rats are underway at 425 and 2,450 MHz, and similar studies are planned at 100 MHz. Exposure of additional mice during antibody production is planned. (10/76-9/77)

Supporting Agency:EPA

0220 EFFECTS OF ACUTE AND CHRONIC EXPOSURE TO PULSED UHF RADIATION ON MONKEYS' MEMORIES. Gage, M. I. (Neurobiology Branch, Environmental Protection Agency, Health Effects Res. Lab., Durham, NC 27711).

Effects of low level electromagnetic radiation on the learning and memory ability of primates will be studied. Specifically, the ability of monkeys to learn and to repeatedly perform a visual discrimination task requiring the choice of a visual pattern that matches a sample stimulus will be performed. The animals will then be exposed to various power densities of microwaves to determine threshold levels for producing changes in behavioral performance. Finally the monkeys will be exposed to microwaves at threshold effect levels for extended periods to determine whether performance deteriorates further. To date, apparatus is being constructed, and animals have been obtained. During the next year the monkeys will be trained, and threshold levels will be determined. (10/76-9/77)

Supporting Agency:EPA

0221 INTERACTIONS OF AMPLITUDE MODULATED (AM) NON-IONIZING EMR WITH BIOLOGICAL SYSTEMS. Elder, J. A. (Environmental Protection Agency, Health Effects Res. Lab., Durham, NC 27711).

The Ca_2 ion efflux in brain tissues exposed to microwave radiation amplitude modulated at 0-32 Hz will be examined. Brains from 2- to 7-day-old chicks will be labeled in vitro with 45 Ca_2 and exposed to 147 MHz microwave radiation amplitude modulated at 0, 8, 16, 24, and 32 Hz. The samples will be analyzed for changes in Ca_2 ion efflux as a function of both carrier wave and amplitude modulation frequencies, power density, pH, and other physiologic parameters. A Crawford Cell irradiation chamber has been constructed, and preliminary experiments are underway. (10-76-9/77)

Supporting Agency:EPA

0222 NEUROPHYSIOLOGIC AND BEHAVIORAL RESPONSES OF ANIMALS REPEATEDLY EXPOSED TO LOW LEVEL EMR. Reiter, L. W.; Gray, L. E. (Environmental Protection Agency, Health Effects Res. Lab., Durham, NC 27711).

The effects of 100-MHz electromagnetic radiation on central nervous system development in the rat will be studied. Animals will be exposed both pre- and postnatally to nonionizing radiation. Neurologic (reflex) and behavioral (spontaneous motor activity and social behavior) development will be measured. The results should provide data helpful in assessing nervous system effects of chronic exposure to microwaves. (10/76-9/77)

Supporting Agency:EPA

0223 EFFECTS OF CHRONIC MICROWAVE EXPOSURE ON IMMUNE DEFENSE MECHANISMS. Huang, V. T. (Dept. Internal Medicine, Duke Univ. Sch. Medicine, Box 3711, Durham, NC 27706).

The effects of microwave radiation on the immune system and chromosomes in animals will be determined, and the minimum radiation exposure that causes detectable effects will be defined. Experimental animals will be exposed to microwave frequencies of 500, 2,450, and/or 9,000 MHz at average power densities below 30 mW/cm^3. Immunocompetent cells from these animals will be studied for morphologic and biochemical changes including lymphoblastoid transformation; mitotic figures; and DNA, RNA, and protein synthesis. In addition, peripheral lympho-

cytes and bone marrow cells from rats and mice chronically exposed to microwaves will be examined by both standard immunologic and cytogenetic techniques. (10/76-9/77)

Supporting Agency:EPA

0224 ABSORPTION CHARACTERISTICS OF PROLATE SHPEROIDAL MODEL OF MAN AND ANIMALS AT AND NEAR RESONANCE FREQUENCY. Tripathi, V. K. (Oregon State Higher Education System, Sch. Engineering, Dept. Electrical & Computer Engineering, 200 Covell Hall, Corvallis, OR 97331).

The absorption characteristics of prolate spheroid models of man and animals exposed to electromagnetic radiation are being investigated. Specifically, the field distribution inside the prolate spheroid model consisting of homogeneous tissue characterized by known values of epsilon (omega), sigma (omega), and mu omicron at and near resonance will be calculated as a function of frequency of the incident radiation. The electromagnetic radiation will be a plane wave propagating in an arbitrary direction, polarized either in the plane of the wave vector and the major axis of the spheroid or normal to it. The power absorption pattern for these two cases will be evaluated as a function of frequency, eccentricity of the ellipsoid, and the direction of the wave vector. The total power absorbed and the relative absorption cross section also will be calculated. The analytic techniques to be employed include the spheroidal wave function expansion and the point matching technique using either the spheroidal or the spherical wave functions. The findings are essential for tissue absorbed power density estimates in terms of incident electromagnetic radiation to establish a sound electromagnetic safety standard. (9/76-9/77)

Supporting Agency:EPA

0225 INTERACTION OF AMPLITUDE (AM) NON-IONIZING EMR WITH BIOLCGICAL SYSTEMS (PART 5). Allis, J. W. (Developmental Biology Branch, Environmental Protection Agency, Experimental Biology Div., Durham, NC 27111).

Amplitude modulated or pulsed nonionizing electromagnetic radiation has been shown to affect animal behavior and the chemistry and physiology of certain isolated organ systems. Calcium ion has been attributed to interaction between the radiation and cellular membranes but has not yet been experimentally verified. This work will utilize membrane bound or calcium enzyme systems during irradiation by amplitude modulated radiation to determine if such effects can be inferred from changes in enzyme activity. Membrane bound or calcium dependent enzyme systems will be prepared and irradiated at 2,450 MHz amplitude modulated at various frequencies between 1 Hz and 5 kHz. Simultaneous spectrophotometric measurements of enzyme activity will be made and compared to controls. Measurements will be carried out using a crossed beam spectrophotometric and microwave irradiation apparatus. The microsomal enzyme, nicotinamide adenine dinucleotide phosphate cytochrome C reductase is being investigated, and experiments with other membrane bound enzymes are planned. (10/76-9/77)

Supporting Agency:EPA

0226 MICROWAVE EXPOSURE SYSTEMS AND MICROWAVE DOSIMETRY. McRee, D. I. (Environmental Biophysics Lab., HEW, Natl. Inst. Environmental Health Science, Durham, NC 27709).

Exposure systems for bioeffects research and test techniques for measuring energy absorption are being developed. During the past year a waveguide system for exposing isolated neurons was fabricated and tested. Equipment for stimulating the nerves and measuring action potentials has been assembled. The 2,450 MHz absorber-lined horn system has been altered so that pregnant mice can be exposed from above. A wheatstone bridge circuit that can accomodate six small thermistor probes has been designed and built. The thermistor probes will measure colonic temperature in mice exposed to microwave radiation. (10/76-6/77)

Supporting Agency:HEW, PHS, NIH, Natl. Inst. Environmental Health Sciences

0227 DESIGN, CONSTRUCTION AND MODIFICATION OF MICROWAVE EXPOSURE SYSTEMS FOR BIOLOGICAL EXPERIMENTATION. Weil, C.; Allis, J. (Environmental Protection Agency, Health Effects Res. Lab., Durham, NC 27711).

An ultra high frequency exposure facility suitable for simultaneous irradiation of a sample with spectrofluorimetric observations will be designed and built. The exposure system will consist of a rectangular coaxial transmission line (Crawford cell) suitable for operation in the frequency range 0.5-2 GHz. The sample will be contained in a standard instrument cuvette, which will be located between the plates of the transmission line. Windows in the plates will allow passage of the ultraviolet light beams used for fluorimetric observations. The instrument will be modified using mirrors on an optical bench to provide for remote observations of the exposed sample. The transmission line exposure system was completed and tested in March, 1977. The optical modification to the spectrofluorimeter was received in January, 1977. (10/76-9/77)

Supporting Agency:EPA

0228 DESIGN, CONSTRUCTION AND MODIFICATION OF MICROWAVE EXPOSURE SYSTEMS FOR BIOLOGICAL EXPERIMENTATION. Weil, C. (Bioengineering Branch, Environmental Protection Agency, Health Effects Res. Lab., Durham, NC 27711).

A simple and economic exposure system will be

developed that is suitable for chronic low level exposures of rodents with a capability of directly measuring absorbed dose in each animal. Each exposure cell will consist of a length of 8-inch diameter circular waveguide, which contains a circularly polarized wave propagating at 915 MHz. Each cell will contain a single animal, and a power divider network will feed a total of 12 cells. A similar system using larger diameter cells is under consideration for exposing squirrel monkeys. Construction of the first unit commenced in March, 1976 and parts of the system have been completed. (10/76-9/77)

Supporting Agency:EPA

0229 EFFECTS OF 2450 MHZ MICROWAVE RADIATION ON BIOLOGICAL MATERIALS AT CELLULAR LEVEL. Hamrick, P. E.; McRee, D. I. (Environmental Physics Lab., HEW, Natl. Inst. Environmental Health Science, Durham, NC 27709).

The objectives of this project were to determine how 2,450 MHz microwave radiation interacts with biologic material at the cellular and macromolecular level, to observe any effects of this interaction, and to relate the amount of microwave energy absorbed to the effects. Biologic systems employed in the study were: bacteria and bacteriophage, solutions of DNA, 2-4 cell stage embryos from mice, rabbit erythrocytes, and rat lymphocytes. The temperature, humidity, and other growth conditions were carefully monitored to eliminate any effects not intrinsically caused by the microwave radiation. Very few non-thermal differences between exposed and control samples were detected. (10/76-9/77)

Supporting Agency:HEW, PHS, NIH, Natl. Inst. Environmental Health Sciences

0230 STUDIES OF MICROWAVE RADIATION AS A TOOL IN SOIL STERILIZATION AGAINST MAJOR DISEASES AND PESTS OF AGRICULTURAL CROPS. Wutoh, J. G. (Dept. Biology, Univ. Maryland, Princess Anne, MD 21853).

Soil samples from different soil types and locations were analyzed for soil microorganisms and arthropods before and after exposure to 2,450 MHz, 60 kW fully conveyorized microwave source. The effect of radiation on the soil organisms was assessed using the classical microbiologic method and the Dry-Funnel method for extraction of small arthropods. Current results indicate that: (1) all fungi were detected after treatment; (2) all bacteria except spore-forming types were killed; (3) all nitrogen fixing bacteria were inactivated and killed; (4) no nematodes survived; (5) all isolated arthropods (eggs, larvae, and adults) were killed; (6) there were no residual effects of the microwaves; (7) the effect of microwaves on the soil organisms was nonselective; (8) there was a correlation between moisture loss, and increase in soil temperature, and the associated mortality of the organisms; and (9) seed germination and growth of soybeans was excellent in soil after 6 min of soil exposure but both germination and growth were retarded after 10 min of soil exposure. The effect was probably due to a change in soil structure and compactability caused by breakdown of organic matter. Future plans include a chemical analysis of soils from all 12 sites before and after a 20-min microwave exposure and growth studies of soybeans and peanuts in microwave sterilized soil to be performed in sterile gnotobiotic growth chambers. (10/77-9/78)

Supporting Agency:NASA

0231 EFFECTS OF MICROWAVES ON NEURAL RESPONSE. McRee, D. I.; Wachtel, H. (HEW, Natl. Inst. Environmental Health Science, Durham, NC 27709).

The effect of microwave radiation on neurologic response will be determined. Isolated neurons, such as, the abdominal ganglion of *Aplysia*, the sciatic nerves of frogs, and the saphenous nerves of cats will be exposed to continuous wave, pulsed, and modulated microwave radiation in the power density range of 1-10 mW/cm^2. The effects of the radiation on the strength-duration of a stimulus to produce an action potential, amplitude of the response, and conduction velocity will be investigated. Fatigue and recovery of the neurons under rapid, multiple stimulation will also be studied. A waveguide exposure system has been designed and built, and equipment for stimulation and recording of neural responses has been assembled. Baseline data on the sciatic nerve of frogs without microwave exposure have been accumulated and analyzed. (10/76-9/77)

Supporting Agency:HEW, PHS, NIH, Natl. Inst. Environmental Health Sciences

0232 BEHAVIORAL SYSTEMS DEVELOPMENT AND SUPPORT. *Anderson, G. (Bioengineering Branch,* Environmental Protection Agency, Health Effects Res. Lab., Durham, NC 27711).

A distributed minicomputer network will be provided within the laboratory for experiment monitoring and control. Specialized hardware interfaces will be developed for each remote minicomputer; a cathode ray tube (CRT)/terminal will provide operator interaction and access to programs and data within the host system. Data files generated at the remote minicomputer will be saved in the host disk files. Specially written software will provide a high-speed (4,800 baud) communication network between the various remote minicomputers and the host minicomputer. This approach provides the sharing of certain expensive peripherals, i.e., high speed line printer, graphics CRT-hardcopy, plotter, cartridge disks, etc., while keeping the distributed controllers' costs at a minimum. The system at present consists of a host and three remote minicomputers. One