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Biological Effects of Nonionizing Electromagnetic Radiation

VOLUME 1
NUMBER 3
APRIL, 1977

A DIGEST OF CURRENT LITERATURE

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

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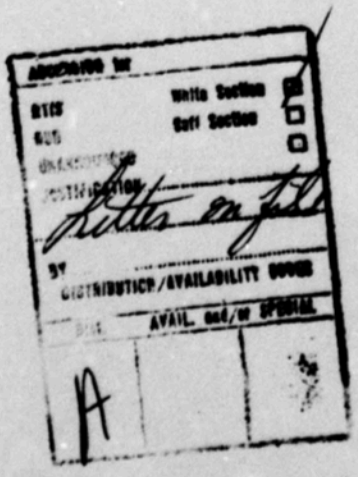
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BIOLOGICAL EFFECTS OF NONIONIZING ELECTROMAGNETIC RADIATION

April, 1977 Volume 1, 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 tne 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 I, 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.

ABBREVIATIONS AND ACRONYMS

A, amp - ampere(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(s)
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)
WHO - World Health Organization
wk - week(s)
wt - weight
yr - year(s)

NEWS ITEMS

GE MICROWAVE OVEN CORRECTIONS TO BE MADE

The Bureau of Radiological Health in early January approved the General Electric Company's plan to correct potential microwave leakage problems in GE "Versatronic" and Hotpoint "Cook Center" microwave ovens manufactured since November 1973. The corrective action program is scheduled to begin by February 1, 1977. A year ago, the Bureau found that some of the ovens were leaking microwaves in excess of the limit permitted by the Federal performance standard. In October 1975, the Bureau informed General Electric of the noncompliance and directed the firm to submit a corrective plan. The company contested the Bureau's finding at a Food and Drug Administration regulatory hearing. The Agency upheld the Bureau. General Electric then requested an exemption from the notification and repair requirements; the Bureau denied the request on the grounds that the company's evidence was insufficient to prove that the noncomplying ovens create no significant risk of injury and again asked the firm to submit a correction plan. The plan was submitted in September 1975 and approved by the Bureau. According to the Bureau-approved plan, General Electric will manufacture modification kits and train service personnel to install the new parts. Owners will be notified by letter and also will be sent a customer brochure explaining the problem and the nature of the repairs. The modifications will be made in owners' homes at no cost to consumers. The company estimates that repairs will be completed by December 31, 1977.

BRH Bulletin 11(1): 1; 1977.

HIGH VOLTAGE EFFECTS ON ANIMALS TO BE STUDIED

The Electric Power Research Institute (EPRI) and the U.S. Energy Research and Development Administration (ERDA) are cosponsoring a two-year, $2.3-million project to study the effect of exposure to electric fields from high voltage (HV) transmission lines on animals. EPRI project manager for electric field biologic effects, Dr. Harry Kornberg, explains that EPRI will study electric field effects on large animals. EPRI has awarded a $1.1-million contract to Battelle, Pacific Northwest Laboratories, to investigate the possible biologic effects on Hanford miniature swine of long-term exposure to electric fields of 30 kV/m. This is equivalent to a 15-kV/m exposure for a human, which is almost twice the field intensity anybody would be exposed to from transmission lines in the U.S. A number of studies have been conducted recently both in the U.S. and abroad in response to concern that exposure of humans to HV electric fields may have harmful biologic effects. The experiments at Battelle will involve 40 swine kept in four modules with electrodes activated on a 24-hr basis in addition to a control group of 20 swine. An interdisciplinary team of scientists will monitor the experiment. ERDA, companion sponsor in the project, will be studying the effect of HV transmission lines on small animals, such as, rats, mice, and hamsters.

Transmission & Distribution 28(12): 12; 1976

BUREAU'S MICROWAVE AND RF PROGRAMS REVIEWED AT SYMPOSIUM

A symposium on the Bureau of Radiological Health's current in-house and extramural activities in the area of microwave and radiofrequency research was held February 16-18, 1977 at Bureau headquarters in Rockville, Maryland. The Symposium on Biological Effects and Measurement of Microwave and Radiofrequency Sources was the second in a series of meetings the Bureau has convened to bring together all Bureau personnel, contractors, and grantees working in a single program area to exchange information on their research and to review the status of ongoing projects. The agenda for the February 1977 symposium included presentations on the genetic and somatic effects of human and animal exposure to various levels of microwave radiation, microwave and radiofrequency measurement instrumentation and techniques, and the health implications of occupational exposure. The proceedings will be published as a BRH report.

BRH BULLETIN 10(22): 3; 1976

SEMINAR ON MAGNETIC FIELDS AND ORGANISMS

A seminar was held in November, 1975, on the effect of magnetic fields on organisms; it was organized by the Faculty of Electrical Engineering of the Technical University of Prague. The presented papers dealt with the physical laws of the formation and measurement of magnetic fields and the effect of magnetic fields on biologic processes in organisms.

Cesk. Cas. Fyz. 26(3): 319-320; 1976

ROBINS NEED MAGNETIC NORTH TO FIND THE STARS

Investigators at the University of Frankfurt previously reported that birds seemed to use their magnetic compass "even if other cues were present and that the magnetic information possibly overrode to some extent the other systems." Recently, "As a test of this hypothesis, they kept some migratory robins underneath an artificial starry sky in a magnetically screened room. The migratory tendency, measured by the perching time in each part of the cage, was randomly scattered. When they applied an artificial magnetic field of the same intensity as

that of the Earth, a flutter trend in the normal migratory northerly direction immediately evolved. The next night, in the absence of the magnetic field and under the same sky, which first gave a random scatter, the northerly trend was maintained just as strongly. It seems that the robins are able to label the stars in the same way, given a magnetic north, as we label a landmark using a compass and then manage without the compass."

New Scientist 71: 642; 1976

MILLIMETER WAVE TISSUE SPECTROSCOPY

Using available millimeter waveguide equipment and components, a special waveguide cell has been developed for making millimeter wave measurements on tissue samples and cell suspensions. Preliminary tests conducted by Dr. Om Gandhi with a cylindrical pipet tissue holder have not produced striking differential absorption effects. However, tests will be performed with the new sample holder in an attempt to duplicate selective absorption effects (tumor versus normal cells) reported in the literature.

Utah Bioengineering Newsletter 4(1): 1; 1976

MAGNETIC DIRECTION FINDING IN MIGRATORY INDIGO BUNTINGS

An investigation was conducted to study the orientational capabilities of caged migratory indigo buntings under differing magnetic field conditions. "When tested in a situation allowing minimal exposure to visual cues but in the presence of the normal geomagnetic field, the birds demonstrated a significant orientation in the appropriate migratory direction (to the north)." The authors report that when the "horizontal component of the magnetic field" was deflected, the orientation of the bunting shifted accordingly. They conclude that "Indigo buntings are not only able to detect the geomagnetic field, but also can use this information in the finalization of their migratory direction."

Science 193: 505-508; 1976

PANEL DISCUSSION ON MICROWAVE SAFETY AND HAZARDS

Included in the agenda of the 1976 Microwave Power Symposium was a panel discussion on microwave safety and hazards chaired by Dr. Sol Michaelson of the University of Rochester. Various considerations required for microwave safety hazard assessment were discussed. It was suggested that in any discussion of microwave safety hazard assessment, the definitions of such terms as biologic effect, hazard, and standard are required. In addition, important concepts of threshold, cumulative effect, and adaptation must be considered. The laboratory environment for experimental animals and the real-life situation for man, which includes the clinical evaluation and epidemiologic assessment, have to be kept in perspective. Of considerable importance is the question of extrapolation; this requires consideration of physical scaling by size, volume, and wavelength in relation to physiologic scaling for interspecies comparison and extrapolation to man. In a discussion of standards or protection guides, it is important to consider personnel exposure standards in relation to occupational exposure standards, including the military. In some countries the military is not subject to the constraints as are other occupational groups. The discussion also touched on whether a separate standard is required for the general population vis-a-vis workers. The relation of product emission standards in contrast to personnel exposure standards was noted. The question of international standards and whether uniform standards on an international basis can be developed were also discussed.

Microwave Energy Applications Newsletter 9(5): 6-7; 1976

HAD YOUR RADIATION DOSE TODAY?

With all the discussion about pollution of the environment, very little attention has been focused on radiofrequency radiation as a possible health hazard, according to Frederic B. Jueneman, director of research for Integrated Navigation and Communications Automatics (INCA). Jueneman states that twentieth-century man has had "to undergo continuous exposure to electromagnetic radiation where the broadcast spectrum of quarter- and half-wave lengths spans our growth cycle from infants to adults." Although the evidence on subliminal broadcast energy as a health hazard is conflicting, Jueneman cites a case from a Texas metropolis where a person of unusual sensitivity was nervously affected in some urban areas and not in others. This peculiarity was traced in part to FM reception and the variability of signal strength throughout the city. This individual was most affected in a horizontal position, so that it might be assumed that the body-antenna was receiving a planar wave, of the sort used for reception of FM or TV broadcasts. Jueneman points out that the height of children (between 0.5 and 1.5 m) makes them particularly receptive to wavelengths (full, half, and quarter) of 50 to about 600 MHz—the wavelength range of TV-FM channels well into the ultra high frequency region. For adults whose heights range from 1.5 to 2 m, there is a little more selectivity that confines them to the very high frequency band, which ranges from around 37 to 200 MHz. Jueneman concludes that "There may be several alternative and perhaps more effective means of

communication on the horizon [e.g., cable or light pipe communication], but until then we can bask in the 'radio-active' wastes of twentieth-century civilization and take our daily dose of inspiring messages."

Industrial Research 18(2): 9; 1976

BRITISH STUDY EXPLORES RADIATION HAZARDS

The proliferation of high-power troposcatter communications systems in England has led to a comprehensive study to define radiation hazard zones associated with antennas propagating nonionizing energy. A report by D. H. Shinn indicates that a typical tropo installation has a biologic hazard zone that extends 1 km or more from the antenna. Shinn developed an easy-to-use graphic method for locating the approximate boundaries of danger zones for biologic damage, ignition, and detonation. The curves are based on the peak and average radiated power, and the size and gain of the antenna; all data are referenced to the accepted biologic hazard level of 100 W/m^2. A threshold for detonation depends upon the material in question. Circular, eliptical, and rectangular antenna apertures are covered, along with the phenomenon of ground enhancement, which may be as high as 6 dB.

Microwaves 15(12) 30; 1976.

HIGH POWER MICROWAVE GENERATOR

A 750 W, 915 MHz microwave generator has been completed for use in microwave hyperthermia research. The system will be used for studies of localized tissue hyperthermia with different types of microwave applicators. In addition, the generator will be used in rewarming infants after hyperthermic surgery, in localized hyperthermia in mice for cell sensitization studies, and in hyperthermic cell culture research.

Utah Bioengineering Newsletter 4(1): 1; 1976

MICROWAVE DOSIMETRY HANDBOOK

Detailed graphs of specific absorption rate versus microwave frequency have been developed for a series of man and animal models. These data are based on theoretic calculations and preliminary experimental verification below resonance, projections based on approximate models above resonance, and combined theoretic and experimental studies near the resonance region. The resonance region for many of the smaller animals is described by a numeric field theory technique, but results are only partially available near the resonance region for the man model. This research was sponsored by the School of Aerospace Medicine, Brooks Air Force Base.

Utah Bioengineering Newsletter 4(1): 1; 1976

MICROTRANSDUCER PACKAGING

An integrated circuit pH microtransducer has been packaged at the tip of 5 and 6 French 2-lumen catheters. This particular packaging configuration has proven to be so convenient that it will be used in future *in vitro* studies and is additionally suitable for planned animal studies. Recent long-term tests have indicated that these pH transducers respond well after 3 mo of continuous testing. This project is supported by a grant from the National Institute of General Medical Sciences.

Utah Bioengineering Newsletter 4(1): 1; 1976

ITEMS FROM THE COMMERCE BUSINESS DAILY

□ **FURTHER RESEARCH ON THE EFFECT OF ELECTROMAGNETIC FIELDS ON THE CENTRAL NERVOUS SYSTEM OF MAMMALS.**

The Office of Naval Research, Arlington, Virginia, has contracted with the Regents of the University of California, Los Angeles, California, for the above study. (December 8, 1976)

□ **RELIABILITY GROWTH MICROWAVE STUDIES.**

The Naval Electronic Systems Command, Washington, DC, will conduct negotiations with Tractor, Incorporated, Austin, Texas, for the above contract. (December 24, 1976)

□ **EFFECTS OF MICROWAVE RADIATION ON THE NERVOUS SYSTEM.**

The National Institutes of Health, Bethesda, Maryland, are negotiating with the University of Washington at Seattle for additional work under the above contract. (December 15, 1976)

MEETINGS AND CONFERENCES

THIRD INTERNATIONAL CONFERENCE ON STATIC ELECTRICITY

Date: April 18-20, 1977
Place: Grenoble, France
Sponsor: European Federation of Chemical Engineering; Society of Industrial Chemistry (Fr)
Requests for Information: Society of Industrial Chemistry

INTERNATIONAL RADIATION PROTECTION: ASSOCIATION IV INTERNATIONAL CONGRESS

Date: April 24-30, 1977
Place: Paris, France: Paris Convention Center
Sponsor: IRPA
Requests for Information: Gilbert Bresson, BP 33, 92260-Fontenay-aux-Roses, France

AMERICAN INDUSTRIAL HYGIENE CONFERENCE

Date: May 22-27, 1977
Place: New Orleans, LA: Fairmount
Sponsor: American Industrial Hygiene Assn.; American Conference of Governmental Industrial Hygiene
Requests for Information: W. E. McCormick, AIHA

FOURTH INTERNATIONAL CONFERENCE ON ELECTRICITY DISTRIBUTION (CIRED)

Date: May 23-27, 1977
Place: London, United Kingdom: Royal Lancaster
Sponsor: CIRED
Requests for Information: Org. Comm., 4 CIRED, c/o IEE Conference Dept., Savoy Place, London, WC2R OBL, UK

MICROWAVE POWER SYMPOSIUM

Date: May 25-28, 1977
Place: Minneapolis, Minnesota
Sponsor: International Microwave Power Institute
Requests for Information: Mr. O. P. Snyder, University of Minnesota, Saint Paul, MN

INTERNATIONAL IEEE/AP SYMPOSIUM 7 USNC/URSI MEETING (RADIO SCIENCE/ANTENNAS AND PROPAGATION)

Date: June 20-24, 1977
Place: Palo Alto, California
Sponsor: Inst. of Electrical & Electronics Engineers (AP, Int.); Int. Union of Radio Science--US National Committee (USNC/URSI)
Requests for Information: J. B. Damonte, 1716 Hillman Avenue, Belmont, CA 94002

URSI SYMPOSIUM ON ELECTROMAGNETIC WAVE THEORY

Date: June 20-24, 1977
Place: Palo Alto, CA: Stanford Univ.
Sponsor: URSI (US National Committee)--International Union of Radio Science
Requests for Information: Dr. F. M. Tesche, Science Applications, Inc., Box 277, Berkeley, CA 94701

1977 IEEE MTT INTERNATIONAL MICROWAVE SYMPOSIUM

Date: June 21-23, 1977
Place: San Diego, California
Sponsor: Institute of Electrical & Electronics Engineers (MTT)
Requests for Information: D. Rubin, Code 2330, NELC, San Diego, CA 92152

SECOND ELECTROMAGNETIC COMPATIBILITY SYMPOSIUM AND EXHIBIT

Date: June 28-30, 1977
Place: Montreux, Switzerland
Sponsor: Conv. of Natl. Electrical Engineering Assn. of W. Europe (EUREL); Int. Union of Radio Science (URSI); Inst. of Electrical and Electronics Engineers (EMC Gp) (Int.); Soc. of Auto Engineers (AE-4) (USA); et al.
Requests for Information: T. Dvorak, ETH Zentrum (HF), 8092 Zurich, Switzerland

INTERNATIONAL SYMPOSIUM ON MICROWAVE DIAGNOSTICS OF SEMICONDUCTORS

Date: July 13-15, 1977
Place: Porvoo, Finland: Haikko Manor
Sponsor: Technical Research Ctr. of Finland--VTT (Semiconductor Lab.); Helsinki Univ. of Technology (Electron. Physics Lab.) Finland
Requests for Information: R. Paananen, VTT

ELECTROMAGNETIC COMPATIBILITY SYMPOSIUM

Date: July 26-28, 1977
Place: Seattle, WA: Washington Plaza
Sponsor: Inst. of Electrical & Electronics Engineers (EMC)
Requests for Information: B. L. Carlson, Jr., Boeing Co., Box 3029, Seattle, WA

SEVENTH EUROPEAN MICROWAVE CONFERENCE

Date: September 5-8, 1977
Place: Copenhagen, Denmark: Bella Center

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Sponsor: Dansk Ingeniorgorening
Requests for Information: Professor Preben Gudmandsen, Conf. Chairman, Electronics Inst., 348 Technical Univ. of Denmark, DK--2800 Lyngby, Denmark

INTERNATIONAL SYMPOSIUM ON BIOLOGICAL EFFECTS OF ELECTROMAGNETIC WAVES

Date: October 30-November 4, 1977
Place: Airlie, Virginia
Sponsor: International Union of Radio Science Commissions A and B
Requests for Information: Professor Saul W. Rosenthal, Chairman, Symposium Steering Committee Polytechnic Inst. of NY, Route 110, Farmingdale, NY 11735

***ENGINEERING IN MEDICINE AND BIOLOGY* CONFERENCE**

Date: November 5-9, 1977
Place: Los Angeles, California
Sponsor: Alliance for Engineering in Medicine and Biology
Requests for Information: Mrs. P. I. Horner, Asst. Dir. & Conf. Coordinator, Alliance for Engineering in Medicine and Biology, Suite 1350, 5454 Wisconsin Ave., Chevy Chase, MD 20015