BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION: COMPILATION AND INTEGRATION OF REPORT AND SEVEN SUPPLEMENTS

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This report is a compilation and integration of the first seven supplements, and the alphabetical addenda (appended to the original bibliography), with the revised bibliography of April 1972. The report is a successor to Naval Medical Research Institute (NMRI, Bethesda, MD 20014) Research Report No. 2, completed under Research Work Unit MF12.524.015-0004B in October 1971, by the senior author, and available from National Technical Information Service (Springfield, VA 22151) as AD #734-391. The original report was revised and reprinted in April 1972, and also contains the first three supplements; No. 1 dated October 1971, No. 2 dated November 1971, and No. 3 dated April 1972. The revised report which consists of more than 2300 literature citations, is available from NTIS as AD #750-271, and includes, as the first chapter, an outline of the effects which have been attributed to radio frequency and microwave radiation. Supplement No. 4 (containing 327 citations) was completed in June 1973, as an Electromagnetic Radiation (EMR) Project Office Report, Bureau of Medicine and Surgery (Navy), (Washington, DC 20372), and is available from NTIS as AD #770-621. Supplement No. 5 (containing 497 citations) was completed in July 1974 as an EMR Project Office Report, Naval Medical Research and Development Command (NMR&DC, Bethesda, MD 20014), and is available from NTIS as AD #784-007. The sixth Supplement (containing 241 citations) was completed in June 1975 (also as an EMR Project Office, NMR&DC Report), and is available from NTIS as AD #A015-622. The seventh Supplement (containing 345 citations) was completed in May 1976 as a NMRI Report, and is available from NTIS as AD #A025-354. Supplement No. 8 (not included in this report, but containing 331 citations), was completed in August 1976 as a NMRI Report, and is available from NTIS as AD #A029-430.

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(Supersedes AD #734-391, #750-271, #770-621, #784-007, #A015-622, & #A025-354)
ABSTRACT

More than 3700 references on the biological responses to radio frequency and microwave radiation, published up to May 1976, are included in this bibliography of the world literature. Particular attention has been paid to the effects of non-ionizing radiation on man at these frequencies. The citations are arranged alphabetically by author (where possible), and contain as much information as possible so as to assure effective retrieval of the original documents. Soviet and East European literature is included in detail.

This report is a compilation and integration of the first seven supplements, and the alphabetical addenda (appended to the original bibliography), with the revised bibliography of April 1972. The report is a successor to Naval Medical Research Institute (NMRI, Bethesda, MD 20014) Research Report No. 2, completed under Research Work Unit MF12.524.015-0004B in October 1971, by the senior author, and available from National Technical Information Service (Springfield, VA 22151) as AD #734-391. The original report was revised and reprinted in April 1972, and also contains the first three supplements; No. 1 dated October 1971, No. 2 dated November 1971, and No. 3 dated April 1972. The revised report which consists of more than 2300 literature citations, is available from NTIS as AD #750-271, and includes, as the first chapter, an outline of the effects which have been attributed to radio frequency and microwave radiation. Supplement No. 4 (containing 327 citations) was completed in June 1973, as an Electromagnetic Radiation (EMR) Project Office Report, Bureau of Medicine and Surgery (Navy), (Washington, DC 20372), and is available from NTIS as AD #770-621. Supplement No. 5 (containing 497 citations) was completed in July 1974 as an EMR Project Office Report, Naval Medical Research and Development Command (NMR&D, Bethesda, MD 20014), and is available from NTIS as AD #784-007. The sixth Supplement (containing 241 citations) was completed in June 1975 (also as an EMR Project Office, NMR&D Report), and is available from NTIS as AD #A015-622. The seventh Supplement (containing 345 citations) was completed in May 1976 as a NMRI Report, and is available from NTIS as AD #A025-354. Supplement No. 8 (not included in this report, but containing 331 citations), was completed in August 1976 as a NMRI Report, and is available from NTIS as AD #A029-430.

Relevant presentations made at technical meetings are included in a separate section.

The "outline of bio-effects" which appeared in the original Bibliography has been included in this report as an Appendix.

Key Words

Biological Effects  
Bibliography  
Electromagnetic Radiation Bio-Effects  
Radio Frequency (RF) Radiation  
Radiation Effects  
Thermogenesis  
Health Effects  
Radiobiology (Non-Ionizing)  
Non-Ionizing Radiation  
Microwave Radiation  
Electric-Field Bio-Effects  
Magnetic Bio-Effects  
Human Factors  
Pulsed Electromagnetic Radiation  
Stress Physiology  
Radar Safety


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BOMAN, R.R. (Nat'l Bureau of Standards), "Probes for measurements of electromagnetic fields".

BURN, E.D., & MAGIN, R.L. (Engineering Experiment Station, Georgia Tech.), "Potential medical and biological applications of electromagnetic radiation".

GROVE, H.M. (Walter Reed Army Institute of Research), "An overview of the problem of microwave hazards measurement and dosimetry".

CUT, A.W. (U. of Washington School of Medicine), "Infrared thermography in microwaves/biological research".

HATT, D.R., & KNOTT, R.P. (U. of Michigan), "Use of RF magnetic probes for measurement of penetration of microwave energy in biological specimens".

HOLLIS, J.S. (Scientific-Atlanta), "Pitfalls in electromagnetic field measurements".

HOPPER, S. (General Microwave Corp.), "An ultrabroad band probe for RF radiation measurements".

HUNT, E.L. (Mettlec-Northeast Laboratory), "Absolute dosimetry for whole animal experiments".

JUSSUMI, R.R. (Kansas City Veterans Administration Hospital), "Biodosimetry, [use of animal physiological or behavioral responses as indications of dose]".

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COHEN, D. (Massachusetts Inst. of Technology), "Technique for measuring ferromagnetic contamination in the human body".

DILLER, J. (Riverside Research Inst., N.Y.), "Magnetic materials as biological implants — Criteria for selection".

GRYNSFAN, F. (COPPE, Brazil), "Relationship between the magnetocardiogram and the electrical activity of the heart".

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LETH, I.S. (Australia), "A calibration facility for microwave monitors; design and operating experience".

LIBERMAN, A.N., BORISOVICH, I.E., GURZEV, V.V., SADOVSKAYA, M.S., CYPSKOVZOVA, A.P., & SHUBIK, V.M. (USSR), "Combined effect of ionizing radiation and a superhigh-frequency field on the body".

MOCHIACH, M.C., & THIEL, J.F. (USA), "Progress in the reduction of microwave exposure from microwave ovens, used in commercial food vending operations".

Pleenary Session. (WILLOUGHBY, J.C. (USA), Chair.)

JANKERT, H. (France), "Protection problems involved by non-ionizing radiation".


Session 1B. "Biomedical Applications and Effects" (VOSS, F.W.A., Univ. of Alberta, Canada, Chair.)

ALMAW, G., & MUSIK, S. (KE, Budapest, Hungary), "Determination of the properties of the bound water in biological samples by microwave methods".

BAILEY, N.C. (Ancoats & Crumpsall Hospitals, Manchester, UK), "A limited review of the recent biological effects of microwave radiation".

FERRI, E.S., CAPPARELLE, R.L., & HAGAN, G.J. (Northeastern Radiological Health Laboratory, Winchester, MA), "Use of a dielectric lens in microwave irradiation of animal subjects".

GRANT, E.R. (Queen Elizabeth College, London, UK), "Dialectic studies on biological materials near 1 GHz: Biophysical and medical implications".

(Continued)
Session 2A. "Microwave Heating Applications" (Relevant to this Bibliography) (TINGA, W.R., Univ. of Alberta, Canada, Cham.)

KASHYAP, S.C., & LEMIS, J.E. (Univ. of New Brunswick, Fredericton, Can.), "Microwave processing of tree seeds", [for germination enhancement].

Session 2B. "Biomedical Effects I", (ROSENTHAL, S.W., Polytechnic Inst. of Brooklyn, NY, Cham.)

CZERSKI, P., & PAPROCKA-SILOSKA, E. (National Res. Inst. of Mother & Child, Warsaw, Poland), "Microwave irradiation and the circadian rhythm of bone marrow cell mitoses".

GINS, E.I., ROSS, R., MD, H.S., LEACH, W., GILLESPIE, L., BUDD, R., & NAZJARD, D.D.G. (U.S. Dept. of Health Education & Welfare, Rockville, MD), "Microwave biological effects under reproducible dosimetric environmental conditions".

ROZZELL, T.C. (Office of Naval Research, Arlington, VA), JOHNSON, C.C., DURREY, C.H., LORDS, J.L., & OLESEN, R.G. (Univ. of Utah, Salt Lake City), "A nonperturbing temperature sensor for measurements in electromagnetic fields".

TOLER, J.C. (Georgia Institute of Technology, Atlanta), "Accurate measurement of microwave fields for medical and biological applications".

Session 3A. "Microwaves in the Food Industry" (KENT, M., Toxic Res. Station, Aberdeen, UK, & DECARDEAU, R.V., U.S. Army Natick Labs., Natick, MA, Cham.)

ALEXANDER, D.W. (US Army Natick Labs.), "Process parameters for continuous microwave sterilization".

ARMBUSTER, G., & ECKROY, L. (Cornell Univ., Ithaca, NY), "The use of pulsed heating periods in 915 MHz and 2450 MHz microwave cooking of meat".


ONLSON, T., & BENGTSSON, N. (Swedish Institute for Food Preservation Res., Goteborg, Sweden), "Development of a Pilot-Plant microwave food sterilizer and results of preliminary experiments".

ONLSON, T., BENGTSSON, N. (Swedish Inst. for Food Preservation Res., Goteborg, Sweden), & RISHMAN, P.O. (Husqvarna AB, Husqvarna, Sweden), "Dielectric data of foods at 915 MHz and 2.8 GHz as a function of temperature: A comparison".

RZEPECKA, M.A., & PEREIRA, R.R. (Univ. of Manitoba, Winnipeg, Can.), "Dielectric properties of dairy products at 2450 MHz".

Session 3B. "Biomedical Effects II", (RICKETTI, C.R., Medical Res. Council, UK, & MICHAELSON, S.M., Univ. of Rochester, N.Y., Cham.)


LANGLEY, J.B., YEANDERS, E.K., SHEPPARD, A.P., & MIDDLESLON, G.K. (Georgia Inst. of Technology, Atlanta), "Effects of microwave radiation on enzymes".

LAWRENCE, J.C. (Medical Res. Council Unit, Birmingham, UK), "Effect of microwaves on isolated skin".

MCAFEE, R.D., CAZENAVEET, L.L., & HOLLAND, N.G. (University School of Medicine, New Orleans, LA), "Screening for cataracts".

MILROY, W.C., O'GRADY, T.C., & PRINCE, E.T. (Naval Weapons Laboratory, Dahlgren, VA), "Electromagnetic pulse radiation: A potential biological hazard".

PHILLIPS, R.D., KING, N.W., HUNT, E.L. (Battelle Northwest Labs, Richland, WA), "Thermoregulatory, cardiovascular and metabolic response of rats to single or repeated exposures to 2450 MHz microwaves".

Session 4B. "Equipment Safety and Interference", (OSEPCHUK, J.M., Raytheon Company, Waltham, MA, Cham.)

ASLAN, E. (Narda Microwave Corp., Plainview, NY), "A broad-band isotropic probe for microwave power density measurements".

MOORE, D.I. (National Inst. of Environmental Health Sciences, Res. Triangle Park, NC), "Determination of energy absorption of microwave radiation using the cooling curve system".

MOBLEY, N.C. (Federal Communications Commission, Laurel, MD), "Revisions of Federal Communications Commission type-approval test procedures".


(Continued)


Session I. "Biological Studies", (HINNICK, C., Univ. of Southern Calif., Los Angeles, CA, Chem.)


BECKER, R. (Veterans Administration Hospital, Syracuse, NY), "The basic biological data transmission and control system influenced by electrical forces".

BECKER, R., CONE, C.C., JAFFEE, L.F., PARSEGIAN, V.A., POHL, H., & MEISS, L. "Panel Discussion: The role of electrical potential at the cellular level in growth and development".

BRICK, I., SNAFFER, B., SNAFFER, R., & GERMANO, J.F. (New York Univ.), "Electrokinetic properties and morphological characteristics of amphibian embryo gastrula cells".

BRIGHTON, C., & FRIEDENBERG, Z. (Univ. of Pennsylvania, Phila.), "Electrical stimulation and oxygen tension".

CONE, C.D. (Eastern Virginia Medical School, Hampton), "The role of the surface electrical transmembrane potential in normal and malignant mitogenesis".

ERIKSSON, C. (Karolinska Institutet, Stockholm, Sweden), "On electrically induced bone formation".

FRY, A.H. (Randomline, Inc., Willow Grove, PA), "Differential biological effects of pulsed vs. continuous electromagnetic fields of the same carrier frequency".

GENESER, W. (Univ. of Arizona, Tucson), "Bioelectric potentials in higher plants and their relation to growth factors".

GUZELLI, A.M. (Scientific & Technical Res. Council, & ARIBAU, A. (Univ. of Istanbul, Turkey), "A piezoelectric model for nerve conduction".

HARRINGTON, D.J. (New York Univ.), "Effects of small amounts of electric current at the cellular level".

JAFFEE, L.F., McCITTELLI, R., & ROBINSON, K.R. (Purdue Univ., Lafayette, IN), "Transcellular currents, self-electrohydrophoresis and cell development".

PARSEGIAN, V.A. (National Inst. of Health, Bethesda, MD), "Changes in electrostatic potential expected from cell contact".


TELFER, W., & WOODRUFF, R. (Univ. of Pennsylvania, Phila.), "Electrical potential and transport across intercellular bridges".

MEISS, L. (Niourf Park Memorial Inst., Buffalo, NY), "Electrical heterogeneity of cell surfaces".

Session II. "Physical and Chemical Studies", (RUDENBERG, B., Michigan State Univ., Chem.)

ATMINSTART, H.A. (Inst. of Physical Chemistry, Julich, W. Germany), "Pyro and piezoelectric properties of vegetable extracts".

BLACK, J. (Univ. of Pennsylvania, Phila.), "Strain related potentials in living bone".

DIGBY, P.S.B. (McGill Univ., Montreal, Can.), "Electric fields in calcifying tissue".


FUKADA, E., LANG, S.B., MASCARENHAS, S., PILLA, A., SHANOS, M.H., & STANLEY, N.H., "Panel Discussion: The electrophysical and electrochemical properties of living tissue".

(Continued)
Session II (Continued)


MASCARENAS, S. (Inst. of Physics & Chemistry, Curitiba, Brazil), "The electret effect in bone and biopolymers and the bond water problem".

MENETTE, E. (U.S. Dept. of Agriculture, Peoria, Ill., "Charge separation associated with dipole disordering in protein".

OSTROWSKI, K. (Medical School, Warsaw, Poland), "Electromagnetic phenomena of normal and pathological mineralized tissues".

PIJMA, A. (Electric Storage Battery Co., Yardley, Pa.), "Electrochemical phenomena at platinum junctions".

ROYCE, B.S.H. (Princeton Univ., N.J.), "Field induced transport mechanisms in hydroxyapatite".


STOCKEN, W., HABERER, M., & ARAUJO-SCHADE, K. (Univ. of Bonn, W. Germany), "Electrophysiological studies of ameboid movement".

WILLIAMS, W., & BERRY, L. (Univ. of Illinois, Urbana), "Analysis of stress distribution and piezoelectric response in cantilever bending of bone and tendon".

Session III. "Clinical Studies", (RATIN, E.L., Harvard Univ., Cambridge, MA, Chair.)

BAKER, E., SPORAD, J.A., & MARINO, A. (S.U.N.Y. Upstate Medical Center, Syracuse, NY), "Electrical stimulation of articular cartilage regeneration".

BAHATTI, C.A.L., BECKER, R., BRIGHTON, C., FRIEDENBERG, Z.B., & LAVINE, L., "Panel Discussion: To what extent can electrical stimulation be used in treatment of human disorders?".

FRIEDENBERG, Z.B., & BRIGHTON, C. (Univ. of Pennsylvania, Philadelphia), "Electrical fracture healing".

HAMBURY, H.J. (Singleton & Morriston Hospitals, Swansea, UK), & WATSON, J. (Univ. College, Swansea), "Effect of microwaves on the properties of tissue in vivo".

KLAPP, L., & STYLZARD, R. (Boston Univ., MA), "Investigation into the mechanism of electrical stimulation of bone growth".


NORTON, L.A. (Univ. of Kentucky, Lexington), "Bone growth in a controlled electric field".

ORTZ, J., CORDON, J., BAYZITZ, R.J., & PRICE, R. (Vanderbilt Univ., Nashville, TN), "Effect of electrical stimulation on physical properties of healed fractures".

ROWLEY, R.A., McCarron, J.R., CHASE, G.R., & WOOLCOTT, L.F. (Texas Tech. Univ., School of Medicine, Lubbock), "The influence of electric current on infecting microorganisms in wounds".

SMITH, S.O. (Univ. of Kentucky, Lexington), "Electrically induced morphogenesis".

TOSUDA, I. (Kyoto Second Red Cross Hospital, Kyoto, Japan), "Mechanical callus and electrical callus".

3369 26th Annual Conference on Engineering in Medicine and Biology; Sponsored by the Alliance for Engineering in Medicine, Minneapolis, Minnesota, September 30 - October 2, 1973 (relevant presentations):

BICHLER, J. (Queens U., Kingston, Ont., Canada), "Active and passive properties of bird feathers: Their role as piezoelectric transducers and as receptors of microwave radiation".

SHORE, M.P. (U. of Pennsylvania, Philadelphia), "Selective heating, localized heating, and scaling theory".

STACK, D.A. "Microwave sterilization of water".

SUSS, M.J. (World Health Organization, Copenhagen, Denmark), "Overview of standards for safety from exposure to ionizing radiation".

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Session 10. "The Effects of Low Intensity Microwaves Upon the Brain", (WACHTEL, R., Chern.)

BARRIS, P.S. (Univ. of Colorado, Boulder), "Threshold effects of microwave radiation on embryo cell systems".

GOLIN, I. (Univ. of Colorado, Boulder), "An analysis of heat sensor via microwave stimulation".

POSTON, E. (Bureau of Medicine & Surgery (Navy), Washington, DC), "Two views of microwave effects on the CNS: East and West".

WACHTEL, E. (Duke Univ., Durham, NC), "Immediate effects of low intensity microwaves on isolated neurons".


ALBERT, E.W. (Georgetown Univ. Med. School, Washington, DC), & DeSANTIS, M.E. (Georgetown Univ. Medical & Dental School, Washington, DC), "Do microwaves alter nervous system structure?".

BARANES, S., & ENDELMAN, Z. (Inst. of Aviation Medicine, Warsaw, Poland), "Experimental morphologic and electroencephalographic studies on microwave effects on the nervous system".

BOWIN, S.M., CAVALAS-MEDICI, R., AGUI, W.N., & KACZMAREK, L. (Brain Res. Inst., UCLA, Los Angeles, CA), "Effects of modulated VHF fields on the central nervous system".

GRUDSKY, I.T. (Cleveland State Univ., OH), "Possible physical substrates for the interaction of electromagnetic fields with biological membranes".

GUJ, A.W. (Univ. of Washington, Seattle), "Microwave interactions with the auditory systems of humans and cats".

LEBOVITZ, R.M. (Univ. of Texas, Dallas), "Detection of weak electromagnetic radiation by the mammalian vestibulocochlear complex".


MAHDAWSON, S.M., J., S.-T., HOEK, W., LEENA, N., & MARGIN, R. (Univ. of Rochester, NY), "Biochemical and neuroendocrine aspects of exposure to microwaves".

SEVANNO, B., SEVANNO, A.-M., & ETIENNE, J. (ESSAM-CERF/Hospital J.A. Sainte Anne, Toulen, France), "Synchronization of cortical neurons by a pulsed microwave field: Evidenced by spectrum analysis of electroencephalogram of the white rat".

TAYLOR, E.M., ASHMAN, B.T., & GUJ, A.W. (Univ. of Washington, Seattle), "Some effects of electromagnetic radiation on the brain and spinal cord of cats".


Session II. "Electromagnetic Radiation Effect on Special Senses", (DONALDSON, D.E., Chern.)

APPLETON, B., & HIRSCH, S. (Walter Reed Army Medical Center, Washington, DC), "Experimental microwave cataractogenesis".

CARPENTER, R.L., FERRI, E.S., HAGAN, G.J. (Northeast Radiological Lab., Winchester, MA), "Some current studies on microwave ocular effects".

KHARAZ, P. (Univ. of Washington, Seattle), "Theoretical and experimental studies of microwave cataracts in rabbits".

(Continued)
Session II. (Continued)

MOFFETT, R.J., CASENNETTE, L.D. (Veterans Admin. Hospital, New Orleans, LA), & ROLLAND, H.G. (Tulane Univ. School of Medicine, New Orleans), "Screening for cataracts".

WINTER, J.J., FINCH, E.D., SCHULTZ, V., & FRATTALI, V. (Naval Medical Res. Inst., Bethesda, Md.), "Ascorbic acid changes in cultured rabbit lens following microwave irradiation".


Session III. "Biochemical and biophysical Effects." (STRANZ, K.D., Chmn.)


CEERSKI, P. (National Res. Inst. of Mother & Child, Warsaw, Poland), "Microwave effects on the blood-forming system with particular reference to lymphocytes".


FRAZIN, J.W., MURP, T., & HUNTER, J. (USAF School of Aerospace Med., Brooks AFB, Tex.), "A comparison of thermal and RF exposure effects on trace metal content of blood plasma and liver cell fractions of rodents".

KOTYNSKA, D., & VACEK, A. (Czechoslovak Academy of Sciences, Brno, Czech.), "The effect of electromagnetic radiation on the hematopoietic stem cells of mice".

STRAUB, R.D. (Univ. of Arkansas Med. School, Little Rock), "Effects on microsomal and mitochondrial preparations".

SEMIDELESKI, S. (Inst. of Aviation Medicine, Warsaw, Poland), & JUHJANWICZ, J. (Nat'l Inst. of Hygiene, Warsaw, Poland), "Acute staphylococcal infections in animals irradiated with 3 GHz microwaves".

SEMIDELESKI, S. (Inst. of Aviation Medicine, Warsaw, Poland), & JUHJANWICZ, J. (Nat'l Inst. of Hygiene, Warsaw, Poland), "Effect of microwaves (2 GHz) on cell function and virus replication in cell cultures irradiated in vivo".

YEAGER, F.K. (Georgia Inst. of Technology, Atlanta), "Effects of microwaves on enzymes".

Session IV. "Electromagnetic Radiation Effects on Genetics and Development." (LEACH, W.M., Chmn.)


KRUSE, W.F., GIORDA, A.J., BRADLEY, J.W., & SHREKEMANN, A. (Texas A&M Univ., College Station), "The effect of electromagnetic fields on fecundity in the chickens".

WRIGHT, D.I., RABIDES, P., & KINN, R. (Nat'l Inst. of Environmental Health Sciences, Res. Triangle Park, NC), "Effects of exposure of the coturnix quail embryo to 2.45 GHz microwave radiation".

PYE, S., NICHOLS, D., GAMOW, E., & BARNES, P.S. (Univ. of Colorado, Boulder), "Threshold effects of microwave radiation on embryo cell systems".

WEBB, S.J. (Univ. of Saskatchewan, Saskatoon, Canada), "Genetic continuity and metabolic regulation as seen by the effects of various frequencies of microwaves on these phenomena".

Session V. "Behavioral Effects of Electromagnetic Radiation." (JUSTEBROW, D.R., Chmn.)

FRAY, A.M. (Randomline, Inc., Willow Grove, PA), "Neural function and behavior: Defining the relationship".

GALLWAY, W.D. (Bureau of Radiological Health, Rockville, MD), "Microwave dose-response relations on the behavioral tasks".

HIEBELS, C.H. (Lab. of the Armed Forces, Department, The Netherlands), ROBERT, B., & WELTHUIS, D.L. (Medical Biological Lab. (TNO), Bijnjewijk, The Netherlands), "Preliminary investigation of the influence of low-level microwave radiation on the spontaneous motor activity of rats".

HUNT, E.L., RING, N.W., & PHILLIPS, R.D. (Battelle Pacific NW Labs., Richland, WA), "Behavioral effects of pulsed microwave irradiation".


Session VI. "Dosimetry of Electromagnetic Radiation." (BILING, R.C., Chmn.)

ALLEN, S.J. (USAF School of Aerospace Medicine, Brooks AFB, Tex.), "Measurement of power absorption by human phantom immersed in radiofrequency fields".

BEISCHER, R.E., & REED, V.R. (Naval Aerospace Medical Res. Lab., Pensacola, FL), "Microwave energy distribution measurements in the proximity of man and their practical application".

(Continued)
3117. Session VI. (Continued)


GRANDI, G.P. (Univ. of Utah, Salt Lake City), "Discussion Paper: Polarization and frequency effects".

HOLD, H.S. (Bureau of Radiological Health, Rockville, MD), "Contrast of dose distribution in phantom heads due to aperture and plane wave sources".

HUMBLETON, G.K. (Georgia Inst. of Technology, Atlanta), & MOORE, D.I. (Nat'l Inst. of Environmental Health Sciences, Res. Triangle Park, NC), "A pyroelectric probe for measurement of microwave power density under far-field conditions".

JENNINGS, C.C. (Univ. of Utah, Salt Lake City), "Discussion Paper: Fiberoptic liquid crystal probe for absorbed RF power measurement".

PHILLIPS, R.D., RINTY, E.L., & KING, H.W. ( Battelle Pacific NW Labs., Richland, WA), "Field measurements, absorbed dose, and biological dosimetry of microwaves".

SMITH, M.L., BASSIN, H. (Bureau of Radiological Health, Rockville, MD), & ABITA, J. (Johns Hopkins Applied Physics Lab., Silver Spring, MD), "A broadband, miniature electric field probe".

Panel Discussions

CZERKIES, F., GUY, A.W., JUSTESEN, D.R., SERVANTIS, R., & STRAUB, K.D. "Future research directions and needs in biological electromagnetic radiation research".

APPLETON, B., BARAŃSKI, S., BOWMAN, R.C., EIBER, R.L., MICHAELSON, S.M., SHORE, M.L. "Results of the Polish conference".


DIACHENKO, J.A., ELLIS, R.L., LAWTON, L.E., MILROY, W.C., O'GRADY, T.C., & PRICE, E.T. (Naval Weapons Laboratory, Dahlgren, VA), "Biomedical aspects of non-ionizing radiation: An overview of the NWL effort".

MICHAELSON, S.M. (Univ. of Rochester, NY), "Comparative biology in assessment of electromagnetic bioeffects".


ROSE, M.P. (Naval Weapons Laboratory, Dahlgren, VA), "High power pulse transmitters".

SCHWANN, H.P. (Univ. of Pennsylvania, Philadelphia), "Some guidelines for the development of EM radiation standards".

TYLER, P.E. (Bureau of Medicine & Surgery, Washington, DC), "Where are we and where are we going?".

3370. Aerospace Medical Association 45th Annual Meeting, held in Washington, D.C., May 6-9, 1974 (relevant sessions):

Panel: "Aerospace Medical Implications of Non-Ionizing Radiation" (PICKERING, J.E., Moderator)

APPLETON, B. (Walter Reed Army Med. Ctr., Washington, D.C.), "Ocular status of personnel occupationally exposed to microwaves" (not presented).


FRASER, J.W. (U.S. Air Force School of Aerospace Med., Brooks AFB, TX), "Interactions of man and animals with radio-frequency fields".

MITCHELL, J.C. (U.S. Air Force School of Aerospace Med., Brooks AFB, TX), "Special problems of general public exposure to RF radiation".

PICKERING, J.E. (USAF School of Aerospace Med., Brooks AFB, TX), "Overview of the problem".


Session: "Electromagnetic Radiation" (FRIEDRICH, W., & BURKE, A.M., Co-Chair)

GRISSETT, J.D. (Naval Aerospace Med. Res. Lab., Pensacola, FL), "Exposure of man to magnetic fields alternating at extremely low frequency".


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Toxicity, (MICHAELSON, Milwaukee, Wisconsin), (Continued)

Session B2. "Biological Effects of Microwaves", (BIGU DEL BLANCO, J., Chmn.)

ALBERT, E.N. (The G. Washington Univ., Washington, DC, & DESANTIS, M.E. (Georgetown Univ., Washington, DC), "Histological alterations in central nervous system after microwave irradiation".

FASION, G.E., TULEPTSON, J.J., & OWENS, J.C. (Iowa State Univ., Ames), "Ovicidal effects of electromagnetic energy at 2.45 GHz on eggs Diabrotica undecimpunctata howardi barber".

GAMBI, O.P. (Univ. of Utah, Salt Lake City), "A method of measuring RF absorption of whole animals and bodies of prolate spheroidal shapes".


KING, N.W., HUNT, R.F., & PHILIPS, R.D. (Batelle Pacific NW Labs., Richland, WA), "Biological dosimetry of 2450 MHz microwave irradiation with mice".

LASTIO, T.S., & STEPHENS, W.K. (Philip Morris (USA) Res. Center, Richmond, VA), "The effect of microwaves on the tobacco beetle".

Session No. A1. "Medical and Biological Applications", (BAILIE, H.D., Chmn.)


CARTER, J.L., FLETSCHER, D.A., & ISHII, T.K. (Marquette Univ., Milwaukee, WI), "Microwave oven techniques for biological solids determination of wastewater samples".

LEMON, R.N. (Walter Reed Army Inst. of Res., Wash., DC), GAMBI, O.P. (Univ. of Utah, Salt Lake City), MEYERHOFF, J.L., & BROWN, P.V.K. (Walter Reed Army Inst. of Res.), "Modifications of in vivo rapid microwave inactivation of enzymes in the central nervous system".

THURGILL, L., PAREILLIGUIN, A., THURGILL, B., & AUGE, C. (Department d'Etudes et de Recherches en Micro-Ondes, Toulouse, France), "Microwaves specific effects on beer yeast".


STONE, W.R. (Raytheon Company, Waltham, MA), "Multi-energy source cooking device (oven) with programming means", (incorporating 915 and 2450 MHz microwave energy, infrared, and steam).


Session No. B5. "Microwave Applicators", (BAMID, M.A.K., Chmn.)

HAMID, M.A.K., MOSTOWY, N.J. (Univ. of Manitoba, Winnipeg, Can.), & BHATTIA, P. (Univ. of Saskatchewan, Regina, Can.), "Microwave bean roaster" ("To destroy the anti-trypsin enzyme (or growth inhibitor), thus facilitating safe nutritional consumption by humans and animals")


Flenary Session. (GEEFCHUK, J.M., Chmn.)

NELSON, S.O., & STETSON, L.E. (Univ. of Nebraska, Lincoln), "Use of microwave and lower frequency RF energy for improving alfalfa seed germination".

Session B2. "Biological Effects of Microwaves", (BIGU DEL BLANCO, J., Chmn.)

ALBERT, E.N. (The G. Washington Univ., Washington, DC, & DESANTIS, M.E. (Georgetown Univ., Washington, DC), "Histological alterations in central nervous system after microwave irradiation".

FASION, G.E., TULEPTSON, J.J., & OWENS, J.C. (Iowa State Univ., Ames), "Ovicidal effects of electromagnetic energy at 2.45 GHz on eggs Diabrotica undecimpunctata howardi barber".

GAMBI, O.P. (Univ. of Utah, Salt Lake City), "A method of measuring RF absorption of whole animals and bodies of prolate spheroidal shapes".


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LASTIO, T.S., & STEPHENS, W.K. (Philip Morris (USA) Res. Center, Richmond, VA), "The effect of microwaves on the tobacco beetle".

Session No. A1. "Medical and Biological Applications", (BAILIE, H.D., Chmn.)


CARTER, J.L., FLETSCHER, D.A., & ISHII, T.K. (Marquette Univ., Milwaukee, WI), "Microwave oven techniques for biological solids determination of wastewater samples".

LEMON, R.N. (Walter Reed Army Inst. of Res., Wash., DC), GAMBI, O.P. (Univ. of Utah, Salt Lake City), MEYERHOFF, J.L., & BROWN, P.V.K. (Walter Reed Army Inst. of Res.), "Modifications of in vivo rapid microwave inactivation of enzymes in the central nervous system".

THURGILL, L., PAREILLIGUIN, A., THURGILL, B., & AUGE, C. (Department d'Etudes et de Recherches en Micro-Ondes, Toulouse, France), "Microwaves specific effects on beer yeast".


STONE, W.R. (Raytheon Company, Waltham, MA), "Multi-energy source cooking device (oven) with programming means", (incorporating 915 and 2450 MHz microwave energy, infrared, and steam).


Session No. B5. "Microwave Applicators", (BAMID, M.A.K., Chmn.)

HAMID, M.A.K., MOSTOWY, N.J. (Univ. of Manitoba, Winnipeg, Can.), & BHATTIA, P. (Univ. of Saskatchewan, Regina, Can.), "Microwave bean roaster" ("To destroy the anti-trypsin enzyme (or growth inhibitor), thus facilitating safe nutritional consumption by humans and animals")

Session II. "Energy Absorption", (Handy, J.D., Chmn.)

Bligh, J. (Inst. of Animal Physiology, Babraham, Cambridge, UK), "Physiological responses to heat".

Lele, P.P. (Massachusetts Inst. of Technology, Cambridge), "Ultrasonic heating of tissues".


Session III. "Microwaves — Biological Effects", (Lown, K., Chmn.)

Guy, A.W., & Long, J. (Univ. of Washington, Seattle), "Electrophysiological effects in animals".

Lehmann, J.F. (Univ. of Washington, Seattle), "Therapeutic heat".

Michaelis, S.M. (Univ. of Rochester, New York), "Review of the biological effects of microwaves".

Session IV. "Ultrasound — Biological Effects", (Casamed, G.W., Chmn.)

Hill, C.R. (Inst. of Cancer Res., Belmont, Sutton, Surrey, UK), "Effects of ultrasound on isolated cells and cell cultures".

Wyn Gol, W., Gendron A., & Miller, D. (The Univ. of Vermont, Burlington), "Effects of ultrasound on plant tissues".

Savage, J.R.K. (MRC Radiobiology Unit, Harwell, Didcot, Berks, UK), "Are chromosomal aberrations reliable indicators of environmental hazards?"

Taylor, K.S.W. (The Royal Marsden Hospital, London, UK), "The biological effects of ultrasound on intact tissues".

Session V. "Medical Applications", (Grimalak, R., Chmn.)


Lele, P.P. (Massachusetts Inst. of Technology, Cambridge), "Uses of ultrasound in surgery".


Session VI. "Occupational Aspects", (Tyler, P.E., Chmn.)

Ciesielski, P., & Siekierskiewski, M. (Mat'1 Res. Inst. of Mother & Child, Warsaw, Poland), "Analysis of occupational exposure to microwave radiation".

Ely, T. (Eastman Kodak Company, Rochester, NY), "Control of occupational exposure to non-ionizing radiation".

Oeland, L.T. (Wright-Patterson Air Force Base, Dayton, Ohio), "Military role in safe use of microwaves".

Session VII. "Future Applications and Controls", (Tompkins, E., Chmn.)

Maynard, O., & Glaser, P.E. (A.D. Little, Inc., Cambridge, MA), "Satellite solar power station: An option for large scale solar power generation on earth".

Osipchuk, J.M. (Raytheon Company, Waltham, MA), "Prospects for expansion of industrial and consumer uses of microwaves".

Suess, M.J. (World Health Organization, Regional Office to Europe, Copenhagen, Denmark), "Overview of standards for safety from exposure to non-ionizing radiation".

(Presenters: underlined)


Special Session. "Technical Forecasting and Assessment"

Guarrera, J.J. (Guide Scientific Inds., Sun Valley, CA), "Microwave sensors for military and civil use", (Invited).

Saad, T.S. (Sage Labs., E. Matick, MA), "Microwave applications for material and food processing", (Invited).
3171. (Continued)


BURNS, C.P., & BURDETT, C.E. (Georgia Inst. of Technology, Atlanta), "Multi-frequency electromagnetic shielding of frozen kidneys".

JOHNSON, C.C., DURAY, C.M., & LORDS, J.L. (Univ. of Utah, Salt Lake City), "Liquid crystal ferroelectric temperature probe for the measurement of electromagnetic power absorption in tissue".

JOHNSON, C.C., LORDS, J.L., & COOMBS, M.A. (Univ. of Utah, Salt Lake City), "Nerve stimulation by implanted diode".

LIVETAL, D., & CHEW, K.-M. (Michigan State Univ., East Lansing), "Electromagnetic fields induced inside of biological bodies".

NELSON, S.O. (Univ. of Nebraska, Lincoln), "Insect control possibilities using microwaves and lower frequency RF energy".


Session 5: "Biological Effects of Microwaves", (GUY, A.W., Chem.)

CHRISTIAN, C.L., NO, H.S., & YARROW, S. (Bureau of Radiological Health, Rockville, MD), "A microwave dosimetry system for measuring sampled integral dose rate".

COURTNEY, X., LIN, J.C., GUY, A.W., & CHOU, C.K. (Univ. of Washington School of Med., Seattle), "Microwave effect on rabbit superficial cervical ganglion".

CZERNI, P. (Nat'l Inst. of Mother & Child, Warsaw, Poland), "Experimental models for the evaluation of microwave biological effects", (Invited).

LIN, J.C., GUY, A.W., & CUMMALL, L.B. (Univ. of Washington Med. School, Seattle), "Behavioral changes of rats exposed to microwave radiation".

LU, S.-T., BOGADOPS, R., COHEN, J., JONES, J., KINNIN, Z., MICHAELSON, S., & MAGIN, R. (Univ. of Rochester, NY), "Thermogenetic and cardiomyographic regulation in dogs cranially exposed to 2450 MHz (CW) microwaves".

MICHAELSON, S.M. (Univ. of Rochester, NY), & SUSS, M.J. (World Health Organization, Regional Office for Europe, Copenhagen, Denmark), "An international program for microwave exposure protection".

WEIR, C.M. (Environmental Protection Agency, Res. Triangle Park, NC), "Absorption characteristics of multi-layered sphere models exposed to UHF/microwave radiation".

(Precedes: Underlined)


BASSON, H. (Bureau of Radiological Health, Rockville, MD), "An optically-linked telemetry system for use with electromagnetic hazard probes".

3372. 19th Annual Meeting of the Health Physics Society, Houston, TX, July 7-11, 1974 (relevant presentation).

NICHOLAS, N.J., MILLER, E.A., & JAMES, B.C. (U.S. Environmental Protection Agency, Silver Spring, MD), "Assessing the potential for exposure to hazardous levels of microwave radiation from high power sources".


CUNITZ, R.J., GALLOWAY, W.D., & BERMAN, C.M. (Bureau of Radiological Health, Rockville, MD), "Behavioral suppression by 243 MHz radiation".

ANDERSEN, F.D., & PAY, T.L. (Bureau of Radiological Health, Rockville, MD), "Survival of drosophila eggs exposed to microwave energy and to heat".

EDWARDS, W.P., & ROY, H.S. (Bureau of Radiological Health, Rockville, MD), "Microwave cavity irradiation dosimetry".


JENKINS, R.F. (Univ. of Colorado, Boulder), & CHANCE, R. "Clinical applications and bio-effects of microwaves".

CHANCE, C.L. (Univ. of Colorado Medical Center, Denver), "Fundamental principles of microwaves".

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Earth Environment and Resources Conference (EERC); sponsored by the Institute of Electrical and Electronics Engineers, Philadelphia, PA, Sept. 12, 1974:

CORT, W.E., & FREDERICK, C.L. (Southwest Res. Inst., San Antonio, TX), "Environmental health effects caused by non-ionizing electromagnetic energy".

National Academy of Science/National Research Council, 1974 Annual U.S. National Committee/International Union of Radio Science (URSI) Meeting, University of Colorado, Boulder, October 14-17, 1974:

Session #3a - URSI Commission I, Sess. 5 (ROSENTHAL, S.W., Chmn.)

BOWMAN, R.B. (National Bureau of Standards, Boulder), "Electromagnetic field measurements for bioeffects experiments and the control of potential hazards".

GUY, A.W. (University of Washington, Seattle), "Measurement of power absorbed in the tissues of man and animals exposed to electromagnetic fields".

DUNN, C.H., JOHNSON, C.C., & MASSOUDI, H. (University of Utah, Salt Lake City), "Long wavelength analysis of planewave electromagnetic power absorption by a prolate spheroidal tissue body".

BARBER, P.W. (U. of Utah, Salt Lake City), "Electromagnetic fields in a homogeneous model of man".

Meeting of the Electromagnetic Radiation Management Advisory Council (ERMAC), Executive Office of the President, Washington, D. C., October 31 - November 1, 1974:

Work Session on: "Nervous System and Behavioral Effects of Nonionizing EM Radiation".

GALLOWAY, D. (Bureau of Radiological Health, Rockville, MD)

BAVIN, S.M. (Brain Research Inst., UCLA, Los Angeles, CA)

FRASER, J., STAVIKAUSKAITE, J. (USAF School of Aerospace Medicine, Brooks AFB, TX)

GUY, A.W., & LOVELY, R. (U. of Washington, Seattle)


THOMAS, J. (Naval Medical Res. Inst., Bethesda, MD)

JUSTESSEN, B. (Veterans Admin. Hospital, Kansas City, MO)

HUNT, E.L. (Battelle Pacific NW Labs., Richland, WA)

FRAY, A. (Randomline Inc., Huntington Valley, PA)

SEAMAN, R. (Duke University, Durham, NC)

ALBERT, E. G. Washington University, Washington, DC)

Neurosciences Research Program of the Mass. Inst. of Tech., Boston, Work Session on "Brain interactions with weak electric and magnetic fields" November 10-12, 1974.

The University of New Orleans School of Engineering Short Course on "The Biological Effects of Microwave Radiation: Sense and Nonsense", New Orleans, LA, February 18-21, 1975:

SCHWAN, N.H. (U. of Pennsylvania), "Biological effects of microwave radiation".


JUSTESSEN, D.D. (Veterans' Administration Hospital, Kansas City, MO), "Behavioral effects of microwave radiation".

CARPENTER, R. (Bureau of Radiological Health WE Lab, Winchester, MA), "Cancerogenic effects of microwave radiation".

OSEPCHUCK, J. (The Raytheon Co., Waltham MA), "The 'microwave controversy': Congressional investigation and federal regulation".

1975 Microwave Power Symposium, sponsored by the International Microwave Power Institute, May 26-30, 1975, to be held at the Univ. of Waterloo, Ontario, Canada.


CHUNG, A. (Univ. of Maryland), & SWICORD, M.J. (Div. of Electronic Products, DHEW), "Development of electromagnetic modeling materials for x-band dosimetry studies".

KANTOR, G., SWICORD, M.J., & BLAIR, M.J. (Div. of Electronic Products, DHEW), "Heating patterns of enclosed and direct contact microwave diathermy applicators".

KELLOGG, R. (Univ. of Maryland), & MEIJER, S. (Div. of Electronic Products, DHEW), "A finite element method for calculating electromagnetic fields in complex geometries."

Baker, _, "Medical Aspects of Ionizing and Non-ionizing Radiation."


Session 2A - II, EMC and Spectrum Management in Electro-Optics: A Panel Discussion (ASEN, M.D., & ATKINSON, J.H. (co-chmn)).

Hamm, W.T., Jr. (Medical College of VA, Richmond), "Hazards: The effects of optical radiation on biological environments and materials."

RICHARDS, W. (Naval Electronics Laboratory Center, San Diego, CA), "Standards: Systems, components, safety, etc."

(Continued)
Session 5B - II. EMC Related Bio-Instrumentation (MITCHELL, J.C., Chmn.).

BASSEN, H.I. (Bureau of Radiological Health, Rockville, MD), "A broadband miniature, isotropic electric field measurement system."

BRONAUER, E.L., & KERNS, D.R. (Southwest Research Institute, San Antonio, TX), "Calibration of a multimode microwave exposure chamber."

HOFF, R.J. (McDonnell Douglas Astronautics Co., St. Louis, MO), "EMC measurements in hospitals."

RUGGERA, P.S. (Bureau of Radiological Health, FDA, Rockville, MD), "Radiofrequency E-field measurements within a hospital environment."

TOLEI, J.C. (Georgia Institute of Technology, Atlanta), "Electromagnetic interference levels in hospitals."


Session B-1a: Auditory Effects (FREY, A.H., Chmn.)

CAIN, C.A., & RISSMANN, W.J. (U. of Illinois, Urbana), "Microwave hearing in mammals at 3.0 GHz."

CHOU, C.K., GUY, A.W. (U. of Washington School of Medicine, Seattle), & GALAMBOS, R. (U. of California, San Diego, CA), "Microwave-induced auditory response—cochlear microphonics."

EICHERT, E.S., & FREY, A.H. (Randomline, Inc., Huntingdon Valley, PA), "RF sound: possible mechanisms as defined by recent research." (withdrawn)


LIN, J.C., & LAM, C.K. (Wayne State U., Detroit, MI), "A theoretical study of microwave-generated auditory phenomena in mammalian cranial structures."

Session B-1b: Microwave Cataractogenesis (ROSENTHAL, S., Chmn.)

AL-BADWAIHY, K.A., & YOUSSEF, A.B. (Cairo U., Egypt), "Biological thermal effect of microwave radiation on human eyes." (not given)


KRAMAR, P., HARRIS, C., GUY, A.W., & EMERY, A. (U. of Washington School of Medicine, Seattle), "Mechanism of microwave cataractogenesis in rabbits."


Combined Session: (RICHARDSON, J.M., Chmn.)

JUSTESEN, D.R. (V.A. Hospital, Kansas City, MO), "A rose by another name is a cabbage."

Session B-2a: Therapeutic Applications (LEHMANN, J.F., Chmn.)

AL-BADWAIHY, K.A., & YOUSSEF, A-B. (Cairo Univ., Egypt), "Steady state temperature profiles in microwave diathermy" [paper not presented].


GUY, A.W., MCDONUGAL, J.A., & WEBB, M.D. (Univ. of Washington, Seattle), "Shortwave diathermy applicators."

KANTOR, G., BASSEN, H., & SMICORD, M. (BRH, Rockville, MD), "Mapping of free space and scattered fields in microwave diathermy."

LEHMANN, J.F., GUY, A.W., & STONEBRIDGE, J.B. (Univ. of Washington, Seattle), "Physiologic design criteria for therapeutic applicators operating at 915 MHz."

WEST, R., & RESELSON, W. (M.C.V./V.C.U., Richmond, VA), "Biologic effects of pulsed high frequency electromagnetic radiation" [using a Diapulse Machine].

Session B-2b: Diagnostic Applications (JOHNSON, C.C., Chmn.)

LANDT, J.A. (U. of California, Los Alamos, NM), "Antenna design for a passive temperature monitoring and identification system for livestock."


Session B-3: Field Survey Instruments (BOWMAN, R., Chmn.)


BASSEN, H. & PETERSON, R. (BRH, Rockville, MD). "Complete measurement of hazardous electromagnetic fields with electrooptical crystal."


RUGGERA, P.S. (BRH, Rockville, MD). "E- and H-field instrumentation and calibration below 500 MHz."

SMICORD, M.I., BASSEN, H.I., HERMAN, W.A., DUFF, J.E., & RING, J.B. (FD, Rockville, MD). "Methods and instrumentation for the evaluation and calibration of microwave survey instruments."


Session B-4: Cellular and Mutagenetic Effects (MCREE, D., Chmn.)


FRAZER, J.M. (USAF School of Aerospace Medicine, Brooks AFB, TX). "A summary of cell and tissue level events produced by RF fields predicted from consideration of regional hyperthermia."


SKALNOWICZ, R.J. (EPA, Research Triangle Park, NC). "The Effect of microwaves (2450 MHz) on lymphocyte blast transformation in vitro."


Session B-5: Exposure Systems (SHORE, M., Chmn.)


GUJ, A.W., CHD, C.K., & LOVELY, R.H. (U. of Washington School of Medicine, Seattle). "Chronic exposure of a rat population by circularly polarized guided waves."


HOUK, W.M., GRISSETT, J.O., & LONGACRE, A., Jr. (Naval Aerospace Medical Research Laboratory, Pensacola, FL). "Conduct of chamber design, environmental control, and microwave field interactions in small animal experimentation."


RENO, V.R., & DELORGE, J.O. (Naval Aerospace Medical Research Laboratory, Pensacola, FL). "Field measurements for a series of behavioral studies."

Session B-6a: Behavioral Effects (Low Level Exposure) (JUSTISEN, D., Chmn.)

CLARBY, S.F. (Virginia Commonwealth U., Richmond). "The effects of 1.7 and 2.45 GHz microwaves on drug-induced sleeping time in the rabbit."


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MANTHEL, R.C., & GLASER, Z.R. (Naval Surface Weapons Center, Dahlgren, VA), "Alterations in the sleep process of the rabbit as a function of chronic low intensity electromagnetic radiation exposure."

THOMAS, J.R., YEANDLE, S.S., & BURCH, L.S. (Naval Medical Research Institute, Bethesda, MD), "Modification of internal discriminative stimulus control of behavior by low levels of pulsed microwave radiation." [not presented]

Session B-6b: Behavioral Effects (High Level Exposure), (HUNT, E., Chmn.)


deORGE, J.O. (Naval Aerospace Medical Research Laboratory, Pensacola, FL), "The effects of microwave radiation on behavior and temperature in Rhesus monkeys."

KRAFTEE, R.D., ELDRD, S.T., LIPSCHMID, T.J., MAY, J.G., & HOLLAND, M.G. (Veterans Administration Hospital, New Orleans, LA), "Microwave and infrared radiation effects on an operant response in Rhesus monkeys."

MOE, K.E., LOVELY, R.H., & GUIY, A.W. (U. of Washington, Seattle), "Physiological and behavioral effects of chronic low level microwave radiation of rats."

MONOHAN, J.C., & MO, H.S. (Bureau of Radiological Health, Rockville, MD), "Microwave-induced avoidance behavior in the mouse."

Session B-7a: Assessment of Power Deposition in Tissues by Mathematical and Phantom Models (SCHWANN, H., Chmn.)

ALLEN, S.J., HUNT, W.D., KRUPP, J.H., RATLIFF, J.A. (USAF School of Aerospace Medicine, Brooks AFB, TX), DURNED, C.J., & JOHNSON, C.C. (U. of Utah, Salt Lake City), "Measurement of radio frequency power absorption in monkeys, monkey phantoms, and human phantoms exposed to 15-50 MHz fields."

GANDOTTI, O.P., SEDIGHI, K., BECK, G.S. (U. of Utah, Salt Lake City), & HUNT, E.L. (Walter Reed Army Institute of Research, Washington, DC), "Distribution of electromagnetic energy deposition in models of man with frequencies near resonance."


Session B-7b: Dielectric Properties of Tissues (SCHWANN, H., Chmn.)


ILLINGER, K.H. (Tufts U., Medford, MA), "The attenuation function for biological fluids at millimeter and far-infrared wavelengths."

PYLE, S.D., HU, C.L., CORDWELL, R., & BARNES, F.S. (U. of Colorado, Boulder), "Electric dipole interactions for microwave pulses and damage to embryos."

SNICORD, M., SAFFER, J. (BRH, Rockville, MD), & CHEUNG, A. (U. of Maryland, College Park), "A two impedance method for wide range dielectrometry."

Session B-8a: CNS Effects-I (AIDEY, R., Chmn.)

ALBERT, E.N. (The George Washington U. Medical Center, Washington, DC), "Light and electron microscopic investigation of brains exposed to nonionizing radiation." [Read by E. Postow]

WAKINS, T.D., & HUNT, F.L. (Walter Reed Army Institute of Research, Washington, DC), "Reduction in sensitivity to audiogenic seizure following a single, 2450 MHz, CW irradiation of rats."

KRITHKOS, E., & TAKASHIMA, S. (U. of Pennsylvania, Philadelphia), "Nonthermal effects of electromagnetic fields on the central nervous system." [Read by H. Schwan]


Session B-8b: CNS Effects-II (CRESSY, S., Chmn.)

CHAMPNESS, F., SCHOLS, H., SEGAUER, S., & FRAZER, J.W. (USAF School of Aerospace Medicine, Brooks AFB, TX), "The effect of 1.6 GHz CW fields on trace metal content of specific regions of rat brain."

MERRITT, J.H., HARTZEL, R., & FRAZER, J.W. (USAF School of Aerospace Medicine, Brooks AFB, TX), "The effect of 1.6 GHz radiation on neurotransmitters in discrete areas of the rat brain."

MIBKUNBBY, H. (Institute of Occupational Medicine, Lodz, Poland), "Microwave-induced shifts of goutotrophic activity in anterior pituitary gland of rats." [Withdrawn]

MU, C.L., & LIM, J.C. (Wayne State U., Detroit, MI), "Interaction of modulated electromagnetic fields with nervous structures."

(Continued) 170
Session B-10a: Effect of ELF Fields on Biological Systems—I (PHILIPS, R., Chmm.)

DAWIS, S.M., & ADEY, W.R. (U. of California, Los Angeles), "Effects of weak low frequency electric fields on calcium efflux from isolated chick and cat brain."

BLISS, V., & HEFFNER, F. (U. of Rhode Island, Kingston), "Effects of the field free space on the circadian activity rhythm of the house sparrow, Passer domesticus, and of the song sparrow, Melospiza melodia."

DURFEE, W.R., PLANTE, P.R., MARTIN, P., MUTHURISHMA, S., & POLK, C. (U. of Rhode Island, Kingston), "Exposure of domestic fowl to ELF electric and magnetic fields."

GREENBAUM, B., GOODMAN, E.M., & MARRON, M.T. (U. of Wisconsin-Parkside, Kenosha), "Long-term effects of weak 45-75 Hz electromagnetic fields on the slime mold Physarum polycephalum."

MATHIESON, N.S., OLIVA, S.A., & BLASCO, A.P. (AFRRI, Defense Nuclear Agency, Bethesda, MD), "Effects of 45 Hz electric field exposure on rats."

Session B-10b: Effect of ELF Fields on Biological Systems—II (BURENBAUM, L., Chmm.)

MEDICI, R.A. (U. of California, Los Angeles), "The effects of weak ELF electric fields on schedule-controlled behavior of monkeys."

MORAN, W.P. (U. of Tulsa, OK), "Physiological basis of human electric shock threshold."

SUGIYAMA, S., & MIZUM, K. (Kansai Gakuen U., Hyogo, Japan), "Effect of AC electric field application upon human visual threshold."

GREENBURG, B. (U. of Illinois at Chicago Circle, Chicago), "Impact of extremely low frequency electromagnetic fields on animals in nature."

Session B-11: Measurement of Power Deposition in Biological Tissues (ROZZELL, T., Chmm.)


CETAS, T.C. (BRN, Rockville, MD), "A birefringent crystal optical thermometer for measurements of electromagnetically induced heating."

CHEN, K.M., GURU, B.S., & NYQUIST, D.P. (Michigan State U., East Lansing), "Quantification and measurement of induced fields inside finite biological bodies."

CHEUNG, A.T. (U. of Maryland, College Park), SMICORD, M.L., & BASSEN, H.I. (BRN, Rockville, MD), "Experimental calibration of a miniature electric field probe within muscular tissues."

CHRISTENSEN, D.A. (U. of Utah, Salt Lake City), "Optical etalon temperature sensor for microwave tissue heating applications."

DEFICIS, A. (O.N.E.R.A.-C.E.R.T., France), "Use of dielectric microprobes for electromagnetic fields measurement."


(Continued)
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Session B-12: General Biological Effects (MICHAELSON, S., Chmn.)

BURKS, D.G., & GRAF, E.R. (Auburn U., AL), "Investigation of electromagnetic effects of a 1000-foot TV tower on migratory birds."


MACINTYRE, E.S. (Miami Heart Institute, Miami, FL), "Critical aspects of human versus terrestrial electromagnetic symbiosis."

MITCHELL, J.C., & HURT, W.D. (USAF School of Aerospace Medicine, Brooks AFB, TX), "The biological significance of radiofrequency radiation emission characteristics on cardiac pacemaker performance."

O'GRADY, T.C., MIRANDO, W.C., & GLASER, Z.R. (Naval Surface Weapons Center, Dahlgren, VA), "Long term exposure to studies of high peak power (HPF) pulsed electromagnetic radiation on mice."


WOODS, K.D. (WDO, United Kingdom), "Health hazards in microwave fields."

Session B-13: Selected Topics (ALTSCHULER, H.M., Chmn.)

ALLIS, J.W., & FROMME, M.L. (EPA, Research Triangle Park, NC), "Pseudosubstrate binding to ribonuclease during exposure to microwave radiation at 1.70 and 2.45 GHz."

CARPENTER, R.L., & HAGAN, G.J. (BRH, Winchester, MA), "Comparison of thermal effects in the rabbit eye from microwave radiation and from external heating."

FERMI, E.S., & HAGAN, G.J. (BRH, Winchester, MA), "Chronic low-level exposure of rabbits to microwaves."


HAGAN, G.J., & CARPENTER, R.L. (BRH, Winchester, MA), "Microwave frequency as a factor in the induction of lens opacities in the rabbit eye."

MAGIN, R.L., LU, S-T., & MICHAELSON, S.M. (U. of Rochester, NY), "Thyroid response to localized microwave exposure."

MASSOUDI, H., DURNEY, C.H., JOHNSON, C.C. (U. of Utah, Salt Lake City), & ALLEN, S. (Brooks AFB, TX), "Theoretical calculations of power absorbed by an ellipsoidal model of man and animals in an electromagnetic plane wave."

MICHAELSON, S.M. (U. of Rochester, NY), "The influence of microwave exposure on neuroendocrine function in the rat and dog."

MINACCA, G.J., Jr., & FERRI, E.S. (BRH, Winchester, MA), "A study of the effects of microwave irradiation of the rabbit testes."

SANDLER, S.S. (Northeastern U., Boston, MA), "Electromagnetic field effects on isolated nerve tissue."


3719. The Congenital Anomalies Research Association of Japan and the Japan Society of Human Genetics—Joint Conference, Tokyo, Japan, November 7-9, 1975. (Presentation given by title only.)

RUSH, R., & LEACH, W.M. (Division of Biological Effects, BRH), "Microwave teratogenesis in mice."


CZIRISKI, P. (FOR Visiting Scientist, Division of Biological Effects, and Dept. of Genetics, National Research Inst. of Mother & Child, Warsaw, Poland), "Comparison of the USA, USSR, and Polish microwave permissible exposure standards."

Session on Measurement System


Session on Standardization and Measurement Assurance


Session on Environment and Personal Protection


THIEL, J.F. (Texas Dept. of Health Resources). "Radio-frequency electromagnetic radiation from portable and mobile telecommunication transmitters."


ALBRECHT, A.M. (Division of Biological Effects, USH). "Potential adverse effects of exposure to nonionizing radiation."

(Finis)
17. Alterations in the Biocurrents (EEG?) of the Cerebral Cortex (in animals)
18. Changes in the Rate of Clearance of Tagged Ions from Tissue
19. Reversible Structural Changes in the Cerebral Cortex and the Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
19. Reversible Structural Changes in the Cerebral Cortex and the Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
22. Functional (a) and Pathological (b) Changes in the Eyes: (a) decrease in size of blind spot, altered color recognition, changes in intraocular pressure, lacrimation, trembling of eyelids; (b) lens opacity and coagulation, altered tissue respiration, and altered reduction-oxidation processes
23. Myocardial Necrosis
24. Hemorrhage in Lungs, Liver, Gut, and Brain At Fatal Levels
25. Generalized Degeneration of all Body Tissue of Radiation
26. Loss of Anatomical Parts
27. Death
28. Dehydration
29. Altered Rate of Calcification of Certain Tissue

C. Central Nervous System Effects
1. Headaches
2. Insomnia
3. Restlessness (Awake and During Sleep)
4. Electroencephalographic (EEG) Changes
5. Cranial Nerve Disorders
6. Pyramidal Tract Lesions
7. Conditioned Reflex Disorders
8. Vagomimetic Action of Heart; Sympaticomimetic Action
9. Seizures, Convulsions

D. Autonomic Nervous System Effects
1. Neuro-vegetative Disorders (e.g., alteration of heart rhythm)
2. Fatigue
3. Structural Alterations in the Synapses of the Vagus Nerve
4. Stimulation of Parasympathetic Nervous System (Bradycardia), and Inhibition of the Sympathetic Nervous System

E. Peripheral Nervous System Effects

Effects on Locomotor Nerves
P. Psychological Disorders ("Human Behavioral Studies") - the so-called "Psychophysiologic (and Psychosomatic) Responses"

1. Neurasthenia - (general "bad" feeling)
2. Depression
3. Impotence
4. Anxiety
5. Lack of Concentration
6. Hypochondria
7. Dizziness
8. Hallucinations
9. Sleepiness
10. Insomnia
11. Increased Irritability
12. Decreased Appetite
13. Loss of Memory
14. Scalp Sensations
15. Increased Fatigability
16. Chest Pain
17. Tremor of the Hands

G. Behavioral Changes (Animal Studies)

Reflexive, Operant, Avoidance, and Discrimination Behaviors

H. Blood Disorders

(\(V = \text{in vivo}\))

(\(v = \text{in vitro}\))

Changes in:

1. Blood and Bone Marrow
2. Phagocytic (polymorphs) and Bactericidal Functions of Blood \((V,v)\)
3. Hemolysis Rate (increase), (a shortened lifespan of cells)
4. Sedimentation Rate (increase), (due to changes in serum protein levels or amount of fibrinogen (\(?\)))
5. Number of Erythrocytes (decrease), also number of Lymphocytes
6. Blood Glucose Concentration (increase)
7. Blood Histamine Content
8. Cholesterol and Lipids
9. Gamma (also \(\alpha\) and \(\beta\)) Globulin, and Total Protein Concentration
10. Number of Eosinophils
11. Albumin/Globulin Ratio (decrease)
12. Hemopoiesis (rate of formation of blood corpuscles)
13. Leukopenia (increase in number of white cells), and Leukocytosis
14. Reticulocytosis

I. Vascular Disorders

1. Thrombosis
2. Hypertension
J. Enzyme and Other Biochemical Changes

Changes in activity of:
1. Cholinesterase (V,v)
2. Phosphatase (v)
3. Transaminase (v)
4. Amylase (v)
5. Carboxydismutase
6. Protein Denaturation
7. Toxin, Fungus, and Virus Inactivation (at high radiation dose levels), Bacteriostatic Effect
8. Tissue Cultures Killed
9. Alteration in Rate of Cell Division
10. Increased Concentration of RNA in Lymphocytes, and Decreased Concentration in Brain, Liver, and Spleen
11. Changes in Pyruvic Acid, Lactic Acid, and Creatinine Excretions
12. Change in Concentration of Glycogen in Liver (Hyperglycemia)
13. Alteration in Concentration of 17-Ketosteroids in Urine

K. Metabolic Disorders

1. Glycosuria (sugar in urine; related with blood sugar?)
2. Increase in Urinary Phenol (derivatives? DOPA?)
3. Alteration of Rate of Metabolic Enzymatic Processes
4. Altered Carbohydrate Metabolism

L. Gastro-Intestinal Disorders

1. Anorexia (loss of appetite)
2. Epigastric Pain
3. Constipation
4. Altered Secretion of Stomach "Digestive Juices"

M. Endocrine Gland Changes

1. Altered Pituitary Function
2. Hyperthyroidism
3. Thyroid Enlargement
4. Increased Uptake of Radioactive Iodine by Thyroid Gland
5. Altered Adrenal Cortex Activity
6. Decreased Corticosteroids in Blood
7. Decreased Glucocorticoidal Activity
8. Hypogonadism (usually decreased testosterone production)

N. Histological Changes

1. Changes in Tubular Epithelium of Testicles
2. Gross Changes
0. Genetic and Chromosomal Changes

1. Chromosome Aberrations (e.g., linear shortening, pseudochiasm, diploid structures, amitotic division, bridging, "sticky" chromosomes, irregularities in chromosomal envelope)
2. Mutations
3. Mongolism
4. Somatic Alterations (changes in cell not involving nucleus or chromosomes, cellular transformation)
5. Neoplastic Diseases (e.g., tumors)

F. Pearl Chain Effect (Intracellular orientation of subcellular particles, and orientation of cellular and other (non-biologic) particles)

Also, orientation of animals, birds, and fish in electromagnetic fields

Q. Miscellaneous Effects

1. Sparking between dental fillings
2. Peculiar metallic taste in mouth
3. Changes in Optical Activity of Colloidal Solutions
4. Treatment for Syphilis, Poliomyelitis, Skin Diseases
5. Loss of Hair
6. Britteness of Hair
7. Sensations of Buzzing Vibrations, Pulsations, and Tickling About the Head and Ears
8. Copious Perspiration, Salivation, and Protrusion of Tongue
9. Changes in the Operation of Implanted Cardiac Pacemakers
10. Changes in Circadian Rhythms

The Outline of Reported Biological Phenomena ('Effects') and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, is patterned after that given by R. Murray, et al., in an article entitled, "How safe are microwaves", which appeared in Non-Ionizing Radiation 1(1):7-8 (1969). Some of the "effects" were listed in the report by S. F. Cleary and W. T. Ham, Jr., entitled, "Considerations in the evaluation of the biological effects on exposure to microwave radiation", (Background document, Part I, 1969, for the Task Force on Research Planning in Environmental Health, Subtask Force on Physical Factors in the Environment). The discussion and suggestions offered by Byron McLees, Edward Finch, Lewis Gershman, and Christopher Dodge relating to the Outline are also gratefully acknowledged.
BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION: COMPILATION AND INTEGRATION OF REPORT AND SEVEN SUPPLEMENTS

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Abstract (Continue on reverse side if necessary and identify by block number):

More than 3700 references on the biological responses to radio frequency and microwave radiation, published up to May 1976, are included in this bibliography of the world literature. Particular attention has been paid to the effects of non-ionizing radiation on man at these frequencies. The citations are arranged alphabetically by author (where possible), and contain as much information as possible so as to assure effective retrieval of the original documents. Soviet and East European literature is included in detail.

(cont'd)
19. KEY WORDS (cont'd)

Electric-Field Bio-Effects  Pulsed Electromagnetic Radiation
Magnetic Bio-Effects       Stress Physiology
Human Factors             Radar Safety

20. ABSTRACT (cont'd)

This report is a compilation and integration of the first seven supplements, and the alphabetical addenda (appended to the original bibliography), with the revised bibliography of April 1972. The report is a successor to Naval Medical Research Institute (NMRI, Bethesda, MD 20014) Research Report No. 2, completed under Research Work Unit MFJ2.524.015-0004B in October 1971, by the senior author, and available from National Technical Information Service (Springfield, VA 22151) as AD #134-391. The original report was revised and reprinted in April 1972, and also contains the first three supplements; No. 1 dated October 1971, No. 2 dated November 1971, and No. 3 dated April 1972. The revised report consists of more than 2300 literature citations, is available from NTIS as AD #750-271, and includes, as the first chapter, an outline of the effects which have been attributed to radio frequency and microwave radiation. Supplement No. 4 (containing 327 citations) was completed in June 1973, as an Electromagnetic Radiation (EMR) Project Office Report, Bureau of Medicine and Surgery (Navy), (Washington, DC 20372), and is available from NTIS as AD #770-621. Supplement No. 5 (containing 497 citations) was completed in July 1974 as an EMR Project Office Report, Naval Medical Research and Development Command (NMR&DC, Bethesda, MD 20014), and is available from NTIS as AD #784-007. The sixth Supplement (containing 241 citations) was completed in June 1975 (also as an EMR Project Office, NMR&DC Report), and is available from NTIS as AD #A015-622. The seventh Supplement (containing 345 citations) was completed in May 1976 as a NMRI Report, and is available from NTIS as AD #A025-354. Supplement No. 8 (not included in this report, but containing 331 citations), was completed in August 1976 as a NMRI Report, and is available from NTIS as AD #A029-430.

Relevant presentations made at technical meetings are included in a separate section.

The "outline of bio-effects" which appeared in the original Bibliography has been included in this report as an Appendix.