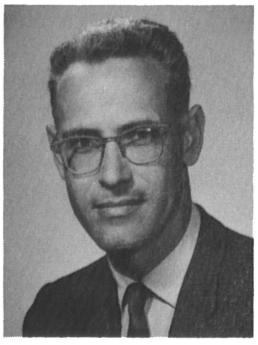
nuclear technology
CONTINUING NUCLEAR APPLICATIONS & TECHNOLOGY

AUTHORS — JULY 1971

NUCLEAR EXPLOSIVES

PREFACE: NUCLEAR EXPLOSION ENGINEERING

Joseph B. Knox



Joseph B. Knox (PhD, meteorology, University of California at Los Angeles, 1955), with the Plowshare Program at Lawrence Radiation Laboratory since 1960, is currently group leader for Fluid Mechanics. Active in many facets of Plowshare and meteorological and geohydrological nuclear safety programs, he has served as secretary, vice-chairman, and chairman of the American Nuclear Society Technical Group for Nuclear Explosives Engineering. Joseph Knox has coordinated this special issue on nuclear explosives.

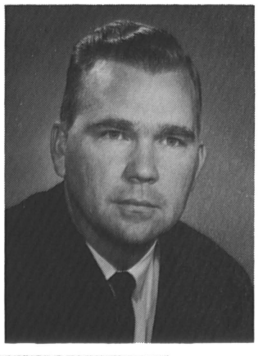
THE SOVIET PROGRAM ON NUCLEAR EXPLOSIVES FOR THE NATIONAL ECONOMY

Glenn C. Werth

Glenn C. Werth is the associate director for the Plowshare program at Lawrence Radiation Laboratory. He also served as a member of the U.S. delegation for the Soviet-American technical talks on the use of nuclear explosions for peaceful purposes held in Vienna in April 1969 and Moscow in February 1970.

THE USE OF MULTIPLE NUCLEAR EXPLOSIVES FOR GAS STIMULATION

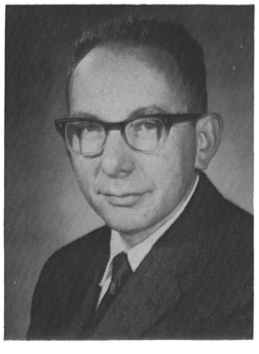
Milo D. Nordyke



Milo D. Nordyke has been active in various capacities in the Plowshare program since its inception at the Lawrence Radiation Laboratory in 1957. Most recently he has been serving as assistant to the associate director for Plowshare and as a technical consultant on Plowshare to IAEA in Vienna.

PLOWSHARE AND THE ENVIRONMENT

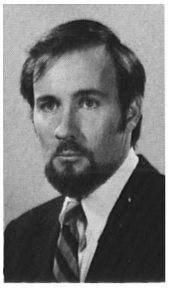
Alfred Holzer

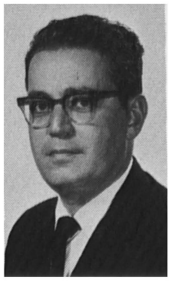


Fred Holzer (PhD, physics, Case Institute of Technology, 1959) is interested in the design and effects of underground nuclear explosions. He served as project scientist on the Plowshare Gasbuggy experiment in 1967 and is presently division leader of K-Division, Lawrence Radiation Laboratory.

A METHOD FOR ESTIMATING THE RISK FROM A PLOWSHARE DETONATION

Harry J. Otway
Ronald K. Lohrding
Morris E. Battat

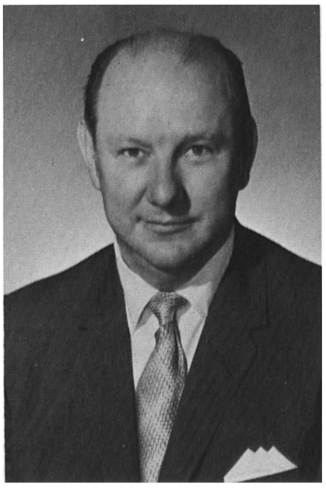




Harry J. Otway (top) (PhD, UCLA) has been at LASL since 1958, involved in both the design and testing of Rover project nuclear rocket reactors. More recently he has been in the Test Division working on the Plowshare program and nuclear-related environmental problems. Ronald K. Lohrding (center) (PhD, mathematical statistics, Kansas State University) has been in the Statistical Consulting Group at LASL for over two years. His research interests are in nonparametric statistics and hypothesis testing. Morris E. Battat (bottom) (PhD, physics, Washington University) is a member of the Theoretical Division at LASL and is presently engaged in evaluating and testing nuclear data for reactor applications. He has also taught courses at the University of New Mexico in reactor shielding and interactions of radiation with matter.

THE NEED FOR PLOWSHARE GAS

Sam Smith



Sam Smith is assistant vice president of El Paso Natural Gas Company. He is responsible for all land, geological, geophysical, and nuclear explosive activities conducted by El Paso Natural. In addition, he is on the management committee of Geonuclear Nobel Paso, a company formed by El Paso Natural Gas Company and three major European corporations for the purpose of developing and promoting peaceful uses of nuclear explosives outside the United States.

RADIOLOGICAL CONSIDERATIONS IN THE USE OF NATURAL GAS FROM NUCLEARLY STIMULATED WELLS

C. J. Barton
D. G. Jacobs
M. J. Kelly
E. G. Struxness

Donald G. Jacobs (left) (PhD, University of Illinois, 1958) is group leader in the Health Physics Division of Oak Ridge National Laboratory for the theoretical evaluation of consumer products from nuclearly stimulated wells. His interests include movement of radionuclides in the soil and environmental behavior of tritium. Charles J. Barton (seated, center) (PhD, University of Virginia, 1939) has interests in molten salt chemistry and atmospheric transport of radionuclides, while Minton J. Kelly (standing, center) (PhD, Texas A&M University, 1956) is interested principally in instrumentation and radiation effects. Both are staff members in the Reactor Chemistry Division of ORNL, presently performing Plowshare research in the Health Physics Division. Edward G. Struxness (right) (BS, Luther College, 1935) is assistant director of the Health Physics Division, ORNL, with responsibility for Plowshare and waste disposal research.

RECOVERY OF HIGH-VISCOSITY PETROLEUM BY STEAM FROM GEOTHERMAL HEAT

Fernando A. Paz-Castillo
Paul Kruger

Fernando A. Paz-Castillo (right) graduated from Universidad Central de Venezuela as a civil engineer with a major in hydraulic engineering. Since 1964 he has been with the Instituto Nacional de Canalizaciones of Venezuela working with problems related to the maintenance of the Maracaibo Canal. Since 1970 he has been at Stanford working toward an engineer degree in nuclear civil engineering. Paul Kruger (PhD, nuclear chemistry, University of Chicago) is director of the nuclear civil engineering program at Stanford University where he is active in the application of nuclear techniques to civil engineering practices.

NEUTRON SHIELDING OF UNDERGROUND NUCLEAR EXPLOSIVES

Joseph B. Green, Jr.
Richard M. Lessler

Joseph B. Green, Jr. (right) (MS, nuclear engineering, University of California, Berkeley, 1966) has worked as a research associate at Lawrence Radiation Laboratory since 1969 and has been active in neutron activation calculations for Plowshare applications. R. M. Lessler (PhD, nuclear chemistry, University of California, Berkeley, 1959) is a senior chemist at LRL. He has directed projects in neutron-induced activation, nuclear reactions, and nuclear explosive effects. His current interests include Plowshare applications.

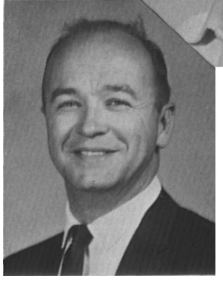
LEACHING OF CHALCOPYRITE ($CuFeS_2$) WITH SODIUM CHLORIDE SULFURIC ACID SOLUTIONS

Fausto J. Muñoz-Ribadeneira
Henry J. Gomberg

Henry J. Gomberg (right) (PhD, electrical engineering, University of Michigan) has been the director of the Puerto Rico Nuclear Center since 1966 and also served as director of the Phoenix Memorial Project at the University of Michigan. His technical interest extends broadly into the peaceful applications of nuclear energy with specific interest in nuclear engineering. He is currently a member of the ANS Board of Directors. Fausto Muñoz-Ribadeneira (MS, nuclear engineering, University of Puerto Rico) is a chemical engineer from the Escuela Politecnica Nacional in Ecuador. He is a senior associate in the Puerto Rico Nuclear Center Nuclear Engineering Division and has directed the PRNC programs in the U.S. Atomic Energy Commission Latin American Atoms in Action Exhibit Program. His current technical interest is in hydrometallurgy.

THE MARVEL EXPERIMENT

B. K. Crowley
H. D. Glenn

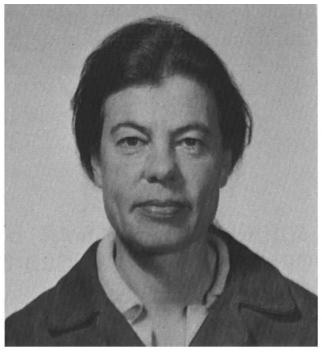


Barbara K. Crowley (right) (BA, physics, San Diego State College, 1957) has been associated with Lawrence Radiation Laboratory since 1958 in the development of breeder reactor calculations. After graduate studies at the University of California, Berkeley, she joined the Plowshare effort at LRL in 1964. She is currently developing and applying numerical models to problems in gas and rock dynamics and seismology. H. David Glenn (PhD, physics, Washington State University) was a physicist at Lawrence Radiation Laboratory from 1966 to 1970. Currently, he is employed

at Systems, Science, and Software, La Jolla, California. His research interests are high energy gas shock or jet phenomena and the containment problems associated with the nuclear weapons testing program.

MICROFRACTURING IN POSTSHOT GASBUGGY CORE GB-3

I. Y. Borg



Iris Y. Borg (PhD, geology, University of California, Berkeley, 1954) is a mineralogist-geologist with the Plowshare group of Lawrence Radiation Laboratory. Her primary interests have been in the fields of natural rock deformation, laboratory triaxial deformation of rocks at high pressures and temperatures, and for the past five years, phenomenology associated with nuclear shocked rock.

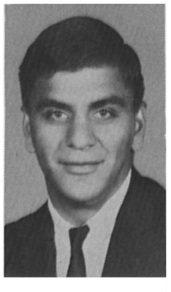
THE CHEMISTRY OF THE GASBUGGY CHIMNEY

Russell E. Duff
Lew Schalit

Russell E. Duff (left) (PhD, University of Michigan, 1951), manager of Applied Nuclear since 1968, was formerly associated with Lawrence Radiation Laboratory and LASL, working in the fields of detonation physics and material studies at high temperatures and pressures. Lew Schalit (PhD, New York University, 1962) has worked on the calculation of material properties at Systems, Science, and Software since 1967.

ON-LINE MONITOR OF NATURAL GAS LINES FOR HYDROGEN-3 AND KRYPTON-85

Robert S. Brundage
Bill G. Motes
Preston Gant



R. S. Brundage (left) (MA, physics, University of Texas, 1952 and nuclear engineering, University of Maryland, 1959) has followed an Air Force career in research and development management with active association with CER Geonuclear Corporation, particularly in the environmental aspects of underground engineering with nuclear explosives. Bill G. Motes (top right) (BS, chemistry and math, Northeastern State College, 1966) has been associated with the Research and Development Department, Atomic Energy Group, of Continental Oil Company since 1967. Since then his work has been in the area of nuclear instrumentation development. Recent interest involves isotopic x-ray fluorescence analysis of low Z elements. Preston Gant (bottom right) (MS, Baylor, 1950) is a research associate responsible for the Atomic Energy Group Research and Development Department, Continental Oil Company. During the past 17 years he has been involved in various radiochemical problems including tritium-organic compound reaction rates and mechanisms.

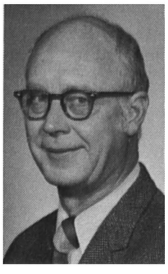
FATE OF SCHOONER FALLOUT RADIONUCLIDES INGESTED BY THE DAIRY COW

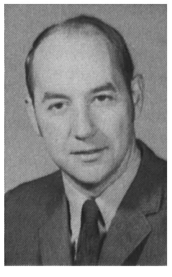
G. D. Potter
G. M. Vattuone
D. R. McIntyre

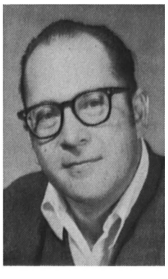
Gilbert D. Potter (left) (PhD, physiology, University of California, Berkeley), G. M. Vattuone (center) (BS, University of California, Davis), and D. R. McIntyre (right) (MS, Oregon State College) are members of the Bio-Medical Division of the Lawrence Radiation Laboratory. At present they are primarily concerned with the biological availability of man-made radionuclides in the dairy cow and the transport of these radionuclides to man.

RADIONUCLIDE DISTRIBUTION IN THE PARTICLE POPULATION PRODUCED BY THE SCHOONER CRATERING DETONATION

Robert E. Heft
William Phillips
William Steele







Robert Heft, William Phillips, and William Steele are with the Bio-Medical Research Division, Lawrence Radiation Laboratory. Robert Heft (top right) is a physical chemist, whose work with radioactive particulates extends over many years both at LRL and with the Air Force Technical Application Center. William Phillips (bottom right) is a physicist whose specialties are nuclear spectroscopy and computer applications, and William Steele (left) is a research associate in physical and nuclear chemistry. The group is presently engaged in the study of radionuclide transport in marine ecosystems.

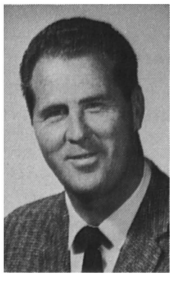
BIOLOGICAL IMPLICATIONS OF NUCLEAR DEBRIS IN AQUATIC ECOSYSTEMS

Florence L. Harrison

Florence L. Harrison (PhD, University of Washington, 1954) is a member of the Bio-Medical Division, Lawrence Radiation Laboratory and is currently engaged in research on the effects of radionuclide releases into aquatic ecosystems.

DISTRIBUTION, RESIDENCE TIME, AND INVENTORY OF TRITIUM IN SEDAN CRATER EJECTA

J. R. Martin
J. J. Koranda



J. R. Martin (left) (MS, Columbia University, 1966) and J. J. Koranda (PhD, University of Tennessee, 1960) are involved in a variety of radio-ecological research projects with the Bio-Medical Division of the Lawrence Radiation Laboratory. Their main studies are on the distribution, movement, and biological significance of radionuclides in the environment with particular emphasis on tritium. Their field research has been conducted in the tropical rainforest of Puerto Rico and in the Alaska tundra, as well as in the Nevada desert.