

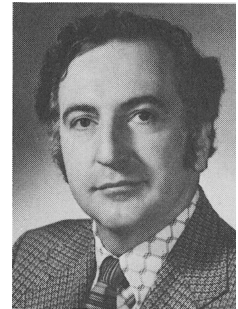


AUTHORS — SEPTEMBER 1975

NUCLEAR ENGINEERING EDUCATION

PREFACE—NUCLEAR ENGINEERING EDUCATION: THE PAST AND THE FUTURE

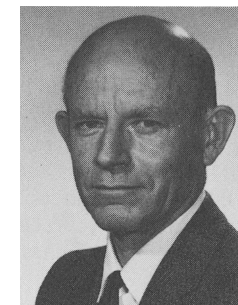
Forrest J. Remick



Forrest J. Remick (PhD, mechanical engineering, The Pennsylvania State University, 1963) is director of the Institute for Science and Engineering and coordinator of University Energy Programs at Penn State. He is Technical Program Chairman for this topical meeting, "Nuclear Engineering Education: The Past and the Future."

HISTORY OF NUCLEAR ENGINEERING CURRICULA

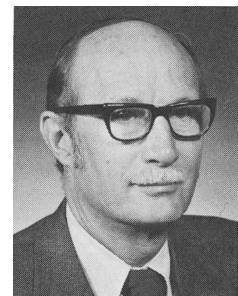
Glenn Murphy



Glenn Murphy (PhD, Iowa State University; honorary ScD, University of Colorado) is Distinguished Professor of Engineering at Iowa State University. He was instrumental in developing the nuclear engineering program at Iowa State and served as the head of that department from 1958 to 1973. Currently he is coordinator of engineering education projects at Iowa State with the concurrent responsibility for international programs in engineering.

REACTOR USE IN NUCLEAR ENGINEERING PROGRAMS

Raymond L. Murray



Raymond L. Murray (PhD, physics, University of Tennessee, 1950) is a veteran of the Manhattan Project. Since 1950 he has served as professor and administrator at North Carolina State University, where he helped develop the first university nuclear engineering and reactor programs. In 1970, he was the recipient of the American Nuclear Society's Arthur Holly Compton Award.

CURRENT STATUS OF NUCLEAR ENGINEERING EDUCATION

N. J. Palladino

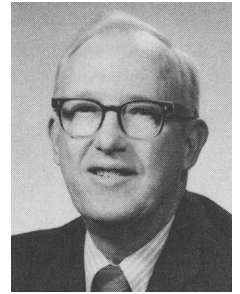


Nunzio J. Palladino (BS and MS, mechanical engineering, Lehigh University, 1938 and 1939; graduate work, nuclear engineering, University of Tennessee, and business and management, University of Pittsburgh; honorary degree of Doctor of Engineering, Lehigh University, 1964) is Dean of the College of Engineering and professor of nuclear engineering at The Pennsylvania State University. From 1950 to 1959, while working for Westinghouse, he was in charge of mechanical, thermal, and hydraulic design of the reactor for the Submarine Prototype Reactor, Mark I, the submarine Nautilus, and the Shippingport Atomic Power Station. He was a member of the U.S. Atomic Energy Commission's Advisory Committee on Atomic Reactor Safeguards.

WHERE DO WE GO FROM HERE?

Marvin E. Wyman (BS, physics, St. Olaf College; PhD, physics, University of Illinois) taught college physics for four years and worked at Los Alamos Scientific Laboratory for five years. He returned to the University of Illinois in 1958 to help develop a graduate nuclear engineering program. He has been chairman of the program since 1965. His research interests include experimental reactor physics, fission physics, and thermal systems.

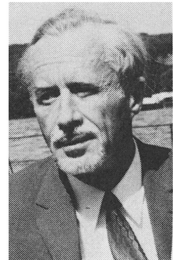
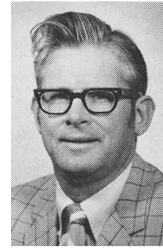
Marvin E. Wyman



FISSIONING URANIUM PLASMAS AND NUCLEAR-PUMPED LASERS

Richard T. Schneider (left) (PhD, Stuttgart University, West Germany, 1961) was a research scientist with General Motors in Indianapolis until 1965. Since 1965, he has been professor of nuclear engineering sciences at the University of Florida in Gainesville. Karlheinz Thom (PhD, Bonn University, 1949) was a research scientist at the NASA Langley Research Center. Since 1962 he has been plasma physics program manager at NASA headquarters.

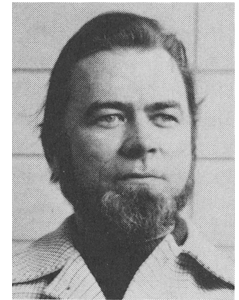
*Richard T. Schneider
Karlheinz Thom*



GASEOUS AND QUANTUM ELECTRONICS IN NUCLEAR ENGINEERING EDUCATION

William E. Wells (PhD, physics, North Texas State University) is a research assistant professor of nuclear and electrical engineering at the University of Illinois. He has previously been associated with the University of Texas at Dallas, CEA Saclay, and the University of Paris (Orsay). His current interests are quantum and gaseous electronics and fusion plasmas.

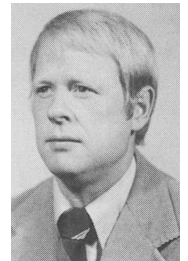
William E. Wells



LASERS AND SOLID-STATE APPLICATIONS IN NUCLEAR ENGINEERING

Chihiro Kikuchi (left) (BS, physics, University of Washington, 1939; MA, mathematics, University of Cincinnati, 1943; PhD, physics, University of Washington, 1944) is a professor of nuclear engineering at the University of Michigan. His interests are in radiation effects in solids and in environmental impacts and public acceptance of nuclear power. James J. Duderstadt (BE, electrical engineering, Yale University, 1964; MS, engineering science, California Institute of Technology, 1965; PhD, engineering science and physics, California Institute of Technology, 1967) is with the Department of Engineering at the University of Michigan. His interests are in reactor theory and design and in laser fusion.

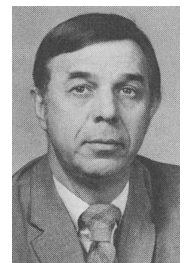
*Chihiro Kikuchi
James J. Duderstadt*



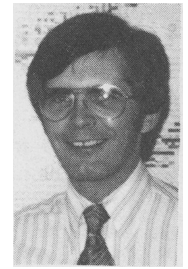
BIOMEDICAL ASPECTS OF NUCLEAR ENGINEERING EDUCATION

Gordon L. Brownell (right) (PhD, nuclear physics, Massachusetts Institute of Technology, 1950) was the first physicist at Massachusetts General Hospital (MGH). He is currently professor of nuclear engineering at the Massachusetts Institute of Technology (MIT) and head of the Physics Research Laboratory at MGH. He has made significant contributions in the areas of ^{10}B neutron-capture

*Gordon L. Brownell
Brian W. Murray*



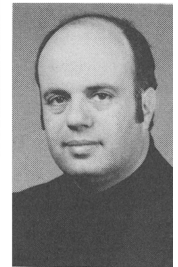
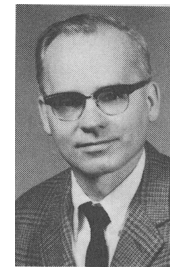
therapy, the use of short-lived cyclotron-produced radioisotopes, imaging systems for nuclear medicine (including the MGH positron camera), radiation dosimetry, and computer applications to diagnostic medicine. His current interests include x-ray tomography and helping to develop a new interinstitutional training program in radiological physics. Brian W. Murray (right) [BSc (hons), mathematics and physics, University of Manitoba, 1963; PhD, physics, Case Western Reserve University, 1970] joined the Physics Research Laboratory of the MGH in 1971 and is presently an assistant physicist in radiology. In 1972 he was appointed research associate in the Department of Nuclear Engineering at MIT. His research interests include the applications of neutrons to diagnostic and therapeutic medicine, investigations into effects on blood clotting meoties due to mechanical hearts, and developing new imaging systems for deep vein thrombosis.



RADIATION IMAGING—AN INTERESTING UTILIZATION OF NUCLEAR ENGINEERING METHODOLOGY

*Edward S. Kenney
Alan M. Jacobs*

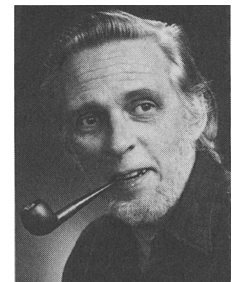
Edward S. Kenney (left) (PhD, physics, The Pennsylvania State University, 1964) is professor of nuclear engineering at The Pennsylvania State University. In addition to his current work in radiation imaging, his research interests include reactor kinetics, instrumentation, and delayed-neutron spectrometry. Alan M. Jacobs (PhD, physics, The Pennsylvania State University, 1963) is a professor of nuclear engineering at The Pennsylvania State University. His research and teaching are in the areas of radiographic imaging techniques, radiation transport, statistical mechanics, and nuclear reactor analysis.



NUCLEAR CHEMICAL ENGINEERING

Robert C. Axtmann

Robert C. Axtmann (PhD, chemistry, Johns Hopkins University, 1950) has been Mobil Professor of Chemical Engineering at Princeton University since 1959. Before that he was at the Argonne National Laboratory and the Savannah River Plant. He currently works on fusion and geothermal technology, and on the environmental effects of both.



FUSION POWER BY MAGNETIC CONFINEMENT: PLANS AND THE ASSOCIATED NEED FOR NUCLEAR ENGINEERS

*Robert L. Hirsch
Donald S. Beard*

Robert L. Hirsch (left) (BS, mechanical engineering, University of Illinois, 1958; MS, nuclear engineering, University of Michigan, 1959; PhD, nuclear engineering, University of Illinois, 1964) has been director of the Division of Controlled Thermonuclear Research at the U.S. Energy Research and Development Administration (ERDA) since 1972. His activities and interests range from plasma physics to nuclear engineering and component design details. Prior to joining the U.S. Atomic Energy Commission (AEC) in 1968, he worked at Atomics International on space nuclear systems (1959-1960) and at ITT Industrial Laboratories on experimental plasma physics research (1964-1968). Donald S. Beard (BS, Rensselaer Polytechnic Institute, 1953; Oak Ridge School of Reactor Technology, 1961) has been a member of the Engineering Design and Component Development Branch of the Controlled Thermonuclear Research Division of ERDA since 1973, primarily



involved with the energy storage, component development, and fusion reactor design areas. He has had prior experience in nuclear reactor operations at Brookhaven National Laboratory (1953-1956), nuclear weapons evaluation with the U.S. Navy (1956-1960), and various light-water reactor and fast thermionic reactor research and development programs with the AEC (1962-1973).

FUSION PHYSICS AND ENGINEERING—A PART OF THE NUCLEAR ENGINEERING CURRICULUM

Terry Kammash (undergraduate work in aerospace engineering, Pennsylvania State University; PhD, nuclear engineering, University of Michigan, 1958) has conducted research in nuclear fusion for more than a decade at several national laboratories and at the University of Michigan, where he is a professor of nuclear engineering. He has been a consultant to both government and industry for research projects on controlled thermonuclear fusion and nuclear rocket propulsion for the past 15 years.

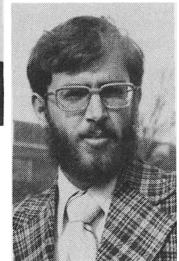
T. Kammash



TEACHING AND RESEARCH IN FUSION PLASMAS AND TECHNOLOGY AT THE UNIVERSITY OF ILLINOIS

George H. Miley (left) (PhD, University of Michigan) worked at the Knolls Atomic Power Laboratory before joining the staff at the University of Illinois in 1961, where he is professor of nuclear and electrical engineering. In addition to reactor kinetics, he is actively involved in research on fusion, direct energy conversion, and nuclear-pumped lasers. Finis H. Southworth (PhD, nuclear engineering, University of Florida) is assistant professor of nuclear engineering at the University of Illinois in Champaign-Urbana. His current interests include fusion reactor neutronics, advanced fusion fuel systems analysis, and fusion plasma numerical models.

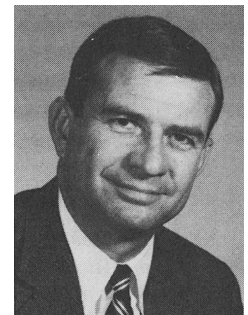
*George H. Miley
Finis H. Southworth*



COMPUTER APPLICATIONS IN CONTROLLED FUSION RESEARCH

John Killeen (AB, physics, 1949; PhD, mathematics, University of California, Berkeley, 1955) is professor of applied science at the University of California at Davis, and director of the National CTR Computer Center, Lawrence Livermore Laboratory, University of California. His current interests are computational physics, equilibria, stability, and transport of plasma confined by magnetic fields, and computer applications in controlled fusion research.

John Killeen



EVALUATION OF FUSION RESEARCH AND INSTRUCTION AT THE UNIVERSITY OF WISCONSIN

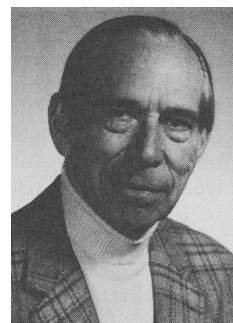
Charles W. Maynard (BS, electrical engineering, University of Maryland; PhD, applied physics, Harvard University, 1961) has been a professor of nuclear engineering at the University of Wisconsin, Madison, since 1965. He was employed at the Bettis Atomic Power Laboratory in the Reactor Theory and Methods Section, and was appointed associate professor of nuclear engineering at the University of Wisconsin in 1961. His research interests are centered on design and neutronics analysis of reactors.

Charles W. Maynard



A HISTORICAL SKETCH OF THE DISCOVERY, PRODUCTION, AND APPLICATION OF RADIOISOTOPES

Clarke Williams

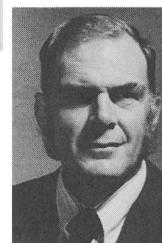
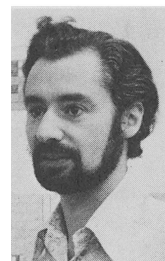


Clarke Williams (BS, civil engineering, MIT, 1924; PhD, physics, Columbia University, 1935) served on the Manhattan Project and in 1946 came to Brookhaven, where he became deputy director in 1962. He has been very active in the American Nuclear Society, serving as president in 1963.

RADIOCHEMISTRY TEACHING AND RESEARCH AT THE UNIVERSITY OF CALIFORNIA AT IRVINE

*V. P. Guinn
G. E. Miller
F. S. Rowland*

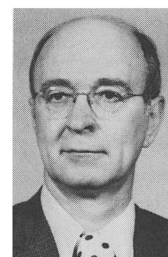
Vincent P. Guinn (top) (PhD, chemistry, Harvard, 1949) has been a professor of chemistry at the University of California at Irvine since 1970. Prior to that, he was technical director of the Activation Analysis Program at General Atomic for 8 years, and before that was with the Shell Development Company for 12 years, where he was supervisor of the Radiochemistry Group. His principal fields of teaching and research are activation analysis and radiochemistry. G. E. Miller (center) (PhD, chemistry, Oxford University, 1963), has been lecturer in chemistry and reactor supervisor at the University of California at Irvine since 1969. His current interests are in applications of neutron activation analysis to archaeology and in development of reactor utilization by chemists. F. S. Rowland (bottom) (PhD, chemistry, University of Chicago, 1952) has been professor of chemistry at the University of California at Irvine since 1964, and was the first chairman of the department at the new campus. His research interests in applications of radiation and radioactivity in chemistry have concentrated in recent years on chemical kinetics, with particular interest in reactions of significance to atmospheric chemistry.



INSTRUCTIONAL PROGRAMS IN THE APPLICATION OF RADIATION AND RADIOISOTOPES AT TEXAS A&M UNIVERSITY

*James B. Smathers
Robert G. Cochran*

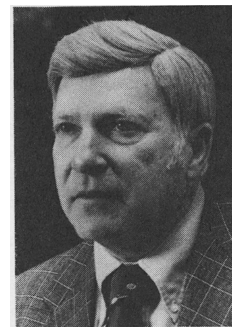
James B. Smathers (left) (BNE, nuclear engineering, North Carolina State College, 1957; MS, nuclear engineering, North Carolina State College, 1959; PhD, nuclear engineering, University of Maryland, 1967) is currently professor of nuclear engineering at Texas A&M University. He has been active in the application of isotopes and radiation for the past 15 years, and his current research interests are in the utilization of high energy neutrons in cancer radiation therapy. Robert G. Cochran (PhD, The Pennsylvania State University; associate professor, The Pennsylvania State University; professor and head, Department of Nuclear Engineering, Texas A&M University, since 1959) has professional interests in reactor engineering, fuel cycle analysis, power reactors and their environmental effects, and reactor operation and training. He is a registered professional engineer and a nuclear engineering consultant to industry and government.



CAREER OPPORTUNITIES IN THE APPLICATIONS OF RADIATION AND RADIOISOTOPES

Kennard H. Morganstern (PhD, nuclear physics, Washington University, St. Louis, 1951), former president of Nuclear Consultants, consulting in the application of isotopes in medicine and industry, became executive vice president of Nuclear Corporation of America when it took over Nuclear Consultants in 1953. In 1958, Morganstern started Radiation Dynamics, Inc., a major producer of high-power accelerators and a supplier of radiation services.

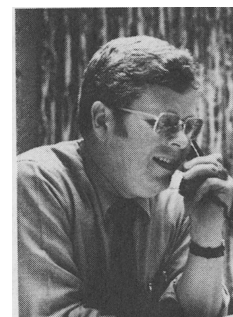
Kennard H. Morganstern



ATOMIC INDUSTRIAL FORUM PUBLIC INFORMATION SEMINARS

Paul Turner (BA, political science, Western Michigan University) is vice president of the Atomic Industrial Forum, Inc. He joined the Forum in 1967. From 1952 to 1955 he was editor for the Borg-Warner Corporation, and in 1955, he became editor for the Kroehler Manufacturing Company. From 1961 to 1964 he was at Argonne National Laboratory and he served as Public Information Director for the American Nuclear Society from 1964 to 1967.

Paul Turner



CITIZENS' WORKSHOPS ON ENERGY AND THE ENVIRONMENT

Lawrence K. Akers (left) (BS, University of Georgia, 1949; MS, University of Georgia, 1950; PhD, Vanderbilt University, 1955) was associated with the Oak Ridge Associated Universities (ORAU) for 21 years until January, 1975, when he became director of the University of Tennessee Oak Ridge Resident Graduate Program. While at ORAU, he served in a variety of technical and administrative posts, and, as chairman of the Special Training Division, he was responsible for the development and direction of the Citizens' Workshops Program. John F. Yegge (BS, mathematics, Marquette University, 1960; MS, science education, University of Tennessee, 1966; EdD, science education, Harvard University, 1971) was assistant chairman of the Special Training Division of ORAU. He participated in the development of the Citizens' Workshops Program and now is responsible for its administration as head of the Education Department of the American Museum of Atomic Energy at Oak Ridge.

*Lawrence K. Akers
John F. Yegge*



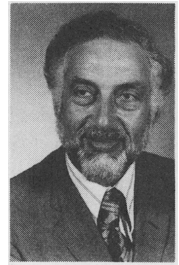
SUMMER WORKSHOPS FOR HIGH-SCHOOL SCIENCE TEACHERS

Harold H. Young (right) (BS, chemistry, St. Michael's College, Winooski, Vermont, 1951) is currently responsible for the university relations training and education program in the Division of Biomedical and Environmental Research, U.S. Energy Research and Development Administration, Washington, D.C. He had six years of industrial experience with the General Electric Company and E. I. duPont de Nemours Company as a laboratory supervisor in the Separations Laboratory at the Savannah River Production Plant. He joined the Atomic Energy Commission's Isotope

*Harold H. Young
Jerome Kohl*



Division in Oak Ridge, Tennessee in 1957, and from 1962 to 1973 he was with their Division of Nuclear Education and Training. Jerome Kohl (right) (BS, applied chemistry, California Institute of Technology, 1940; MS, marine sciences, North Carolina State University, 1975) has been a member of the North Carolina State University Nuclear Engineering Department for the past six years. He has participated in developing and presenting courses in "Environmental Consequences of Nuclear Power," "The Nuclear Power Controversy," and "The Energy Crisis." He has been project director for three summer workshops of the type discussed in his paper. His present areas of interest are in energy conservation and in environmental problems connected with electrical power production.



EUROPEAN PUBLIC INFORMATION ACTIVITIES

André J. Gauvenet

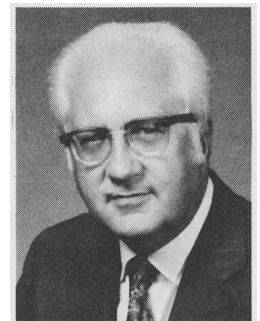
André Jean Gauvenet (University of Paris, physics and mathematics, 1942-1943; Ecole Normale Supérieure de St. Cloud, 1940-1942) is Delegate to Nuclear Protection and Safety (Delegue à la Protection et à la Sûreté Nucléaires). He is responsible for health physics and safety studies carried out in the CEA centers. He also participates occasionally in public debates on nuclear energy. Formerly he was Commissariat à l'Energie Atomique (since 1956), directeur de Cabinet du Haut-Commissaire à l'Energie Atomique (in charge of peaceful applications of nuclear explosions), and directeur de la Protection et de la Sûreté Radiologiques (1962-1970).



AMERICAN NUCLEAR SOCIETY PUBLIC INFORMATION ACTIVITIES

Warren F. Witzig

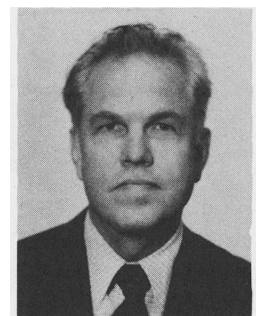
Warren F. Witzig (BS, electrical engineering, Rensselaer Polytechnic Institute, 1942; MS, electrical engineering, 1944; PhD, physics, University of Pittsburgh, 1952) is professor and department head of nuclear engineering, The Pennsylvania State University. He has extensive experience in reactor research, testing and design from his work with the Westinghouse Research Laboratories, the Manhattan District Project, and Knolls Atomic Power Laboratory. He was reactor and physics manager at Westinghouse Bettis, and senior vice president and technical director of NUS Corporation (co-founder). His special interests include fuel management, reactor design, nuclear safety and licensing, and environmental problems associated with radiation waste and thermal effects.



ENVIRONMENTAL ASPECTS OF BREEDERS

Raymond D. Cooper

Raymond D. Cooper (PhD, nuclear engineering, Massachusetts Institute of Technology, 1967) is presently with the Analysis and Assessment Programs, BER, U.S. Energy Research and Development Administration. His current technical interest is risk-benefit assessment of alternative energy systems.



ENVIRONMENTAL ASPECTS OF FUSION REACTORS

Franklin E. Coffman (left) (PhD, nuclear physics; MA, plasma physics, Vanderbilt University) is currently in charge of the Systems and Applications Studies Branch of the U.S. Energy Research and Development Administration (ERDA) Division of Controlled Thermonuclear Research. His responsibilities include the environmental and safety activities of that division. Coffman has also served for four years as an environmental scientist with the U.S. Atomic Energy Commission (AEC) Division of Operational Safety. James M. Williams (MS, nuclear engineering, University of New Mexico, 1964) is currently assistant director for development and technology in the ERDA Division of Controlled Thermonuclear Research, where he is responsible for research and development in engineering and technology in support of present- and next-generation plasma devices and fusion reactors. He was previously associated with the AEC in international and domestic safeguards systems analysis, and prior to that, he worked at Los Alamos Scientific Laboratory on reactor fuels and materials, reactor analysis, and nuclear power fuel cycle economics.

F. E. Coffman
J. M. Williams

