Contributors to this Issue

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John T. Bangert, B.S.E.E., 1942, University of Michigan; M.S.E.E., 1947, Stevens Institute; Bell Telephone Laboratories, 1942—. Mr. Bangert was first engaged in design of special circuits for military radar, investigation of fundamental problems in transmission theory, and exploration of new techniques for network analysis and synthesis in the time and frequency domain. Later he headed groups responsible for waveguide systems analysis, microwave network design and the application of analog and digital computers to the design of transmission systems. Since March, 1962, Mr. Bangert has been Director of the Transmission Technology Laboratory. Member, IEEE, Sigma Xi, Tau Beta Pi, Eta Kappa Nu, and Phi Kappa Phi.

Simon B. Bennett, B.E.E., 1959, City College of New York; M.E.E., 1961, New York University; Bell Telephone Laboratories, 1959—. He has been engaged in the study of noise in FM transmission systems and has participated in planning and performing the communications system tests for the Telstar and Relay projects. Member, IEEE, Tau Beta Pi and Eta Kappa Nu.

R. B. Blackman, A.B., 1926, California Institute of Technology; Bell Telephone Laboratories, 1926—. Mr. Blackman was first engaged in physical research in hearing, acoustics, and electromechanical filters. He later worked in applied mathematical research, specializing in linear networks and feedback amplifiers. Since 1940, he had been engaged in the development of data-smoothing and prediction techniques for anti-aircraft fire-control computers, air-to-ground bombing computers,

guided-missile computers and satellite launching computers. Member, IEEE and Tau Beta Pi.

R. W. Blackmore, B.S.M.E., 1940, Case Institute of Technology; Bell Telephone Laboratories, 1941—. He has engaged in mechanical design work on missile guidance systems, optical equipment for evaluating tracking performance of radar antennas, and flight control instruments. On the Telstar project he performed engineering liaison work with subcontractors and various Laboratories groups involved in the mechanical design, fabrication, erection, and alignment of the horn-reflector antenna. He is presently engaged in design and cost studies for future antennas. Member, Tau Beta Pi.

J. D. Bode, Ph.D., 1952, University of Pittsburgh; Bell Telephone Laboratories, 1960–63. Mr. Bode was first engaged in electroplating magnetic materials for the ESS semipermanent Twistor Memory Store. This was followed by work on the Telstar satellite project, which included the antireflection coating of the solar cells and their sapphire covers and work on the thermal control bellows. He was later involved in development work on long-wavelength sensitive photocathodes for laser applications. Member, American Chemical Society, Electrochemical Society, A.A.A.S., Electron Microscope Society of America, Faraday Society, Optical Society of America and Sigma Xi.

Max G. Bodmer, Dipl. El. Ing., 1946, Federal Institute of Technology, Zurich, Switzerland; Eng. D., 1950, Johns Hopkins University; Bell Telephone Laboratories, 1951—. Mr. Bodmer has specialized in the design and development of traveling-wave tubes, including exploratory development of TWT's, life studies for systems TWT's, the design of a high-power CW TWT for X-band, and the design and development of high-reliability long-life TWT's for satellite use. Member, IEEE and AIAA.

David C. Bomberger, B.S.E.E., 1934, and M.S.E.E., 1936, Lehigh University; Bell Telephone Laboratories, 1936—. He has worked on transmission measurements of coaxial cables, the design of broadband feedback amplifiers, the development of electromechanical gun director systems, and the analysis and simulation of complex dynamic systems. As Head, Power Systems Engineering Department, he was responsible for engineering the spacecraft power supply. Member, IEEE, Tau Beta Pi, Phi Beta Kappa; associate member, Sigma Xi.

STEPHEN J. BROLIN, B.S.E.E., 1957, M.S.E.E., 1959, New York University; Bell Telephone Laboratories, 1957—. He first worked on regulated power supplies for an experimental electronic telephone central office, and has since designed power supplies for a military project, a carrier system, and the Telstar project. He is currently working on power supplies for microwave radio relay systems. Member, IEEE, Tau Beta Pi, and Eta Kappa Nu.

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T. M. BUCK, B.S., 1942, Muskingum College; M.S., 1948, and Ph.D., 1950, University of Pittsburgh; Bell Telephone Laboratories, 1952—. He has been engaged in studies of the chemical and surface properties of semiconductor materials and devices. More recently, he has been responsible for development of the silicon p-n junction particle detectors for the Telstar satellite. Member, Electrochemical Society, Sigma Xi, Phi Lambda Upsilon, and Sigma Pi Sigma.

C. PAUL CARLSON, B.S. in E.E., 1926, University of Michigan; Bell Telephone Laboratories, 1926—. Until World War II he was engaged in equipment development of long-distance signaling, telephone repeaters, line balancing apparatus and transmission testing equipment. During the war he worked on radar test set development and has since been concerned with test sets, microwave radio, TASI, and undersea repeaters for transatlantic telephone cables. He presently supervises a group engaged in equipment design for the Andover, Maine, earth station. Registered Professional Engineer, State of New York.

J. G. CHAFFEE, S.B., 1923, Massachusetts Institute of Technology; Western Electric Co., 1923–25; Bell Telephone Laboratories, 1925—. He first engaged in short-wave transmission studies; this was followed by participation in the first ship-to-shore radiotelephone commercial installation. He then made extensive studies of frequency modulation and invented the FM-with-feedback receiver. During World War II he engaged in radar and guided-missile projects. Following this he spent the

next 15 years in studies for microwave radio relay systems. Since the inception of the Telstar project he has worked on circuit design, principally the design of the FMFB receiver for the ground station. Fellow of IEEE.

ROGER C. CHAPMAN, JR., B.S.E.E., 1954, University of Vermont; Bell Telephone Laboratories, 1954—. Mr. Chapman was first engaged in the study of pulse code modulation systems and pulse transmission. He developed circuits for regenerative repeaters, particularly the retiming and reshaping circuits. In 1961, he started work on command circuit design for the Telstar project, and later became supervisor of a group responsible for the command and telemetry portion of the ground station. Currently, Mr. Chapman is supervisor of a systems analysis group responsible for the Telstar systems tests and for analysis and system studies of possible future satellite communications systems. Member, IEEE; associate member, Sigma Xi.

MICHAEL CHRUNEY, B.S.E.E., 1948, and M.S.E.E., 1949, Pennsylvania State College; Bell Telephone Laboratories, 1949—. He has engaged in the design and development of beam devices such as the barrier-grid storage tube and the flying-spot scanner for the memory of an experimental electronic central office. He contributed to the microwave printed hybrids used in the Telstar satellite and the parametric amplifier used as a standby receiver at the Andover earth station. Member, IEEE.

A. J. CLAUS, B.S. in E.E. and M.E., 1956, University of Ghent, Belgium; Ph.D., 1961, University of Michigan; Bell Telephone Laboratories, 1961—. He has worked on orbit determination for the Telstar satellite and tracking studies for the Apollo project.

ROBERT J. COLLIER, B.S., 1950, M.S., 1951, and Ph.D., 1954, Yale University; Bell Telephone Laboratories, 1954—. He has been engaged in the development of microwave electron tubes, including the coaxial magnetron, the forward-wave crossed-field amplifier, and the traveling-wave tube for the Telstar transmitter. He presently heads a group which is designing high-power traveling-wave tubes for pulsed radar. Member, American Physical Society, Sigma Xi and Phi Beta Kappa.

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1961—. He has been concerned with the development of microwave solid-state devices, including isolators, power limiters and magnetoelastic devices. Member, IEEE, Eta Kappa Nu, Sigma Xi, and Tau Beta Pi.

J. S. Cook, B.E.E. and M.S., 1952, Ohio State University; Bell Telephone Laboratories, 1952—. He has engaged in microwave electron device research, including low-noise studies, coupled microwave circuits, electrostatic electron beam (slalom) focusing, and parametric amplification. He took part in the development of the autotrack system for the horn-reflector antennas used at Andover and Pleumeur-Bodou, France. He is presently engaged in studying special radar and communications antennas. Senior member, IEEE.

Arthur B. Crawford, B.S. in E.E., 1928, Ohio State University; Bell Telephone Laboratories, 1928—. Mr. Crawford has specialized in radio research, including work with measuring techniques, propagation, and antenna studies in the ultra-short-wave and microwave areas. He designed the horn-reflector antenna used in the Project Echo passive satellite communications experiments. As Head, Radio Research Department, he is in charge of a group which was responsible for transmission studies for the Telstar project. Fellow, IEEE; member, Eta Kappa Nu, Pi Mu Epsilon, Sigma Xi and Tau Beta Pi.

George F. Critchlow, B.E.E., 1942, and B.M.E., 1943, Cornell University; Bell Telephone Laboratories, 1943 —. He has been engaged in the development of precision impedance and transmission equipment and in the supervision of groups responsible for this work. He is presently head of a group which designs solid-state circuits for communications satellites. Member, IEEE, Eta Kappa Nu, Phi Kappa Phi and Tau Beta Pi.

C. Chapin Cutler, B.S., 1937, Worcester Polytechnic Institute; Bell Telephone Laboratories, 1937—. He has made significant contributions in the areas of microwave antennas, microwave tubes, and new radar and communication systems. As Director, Electronic Systems Research, he heads a group which has worked on communications engineering for both the Project Echo and Project Telstar satellite communications experiments. Fellow, IEEE.

Donald B. Cuttriss, B.S. in E.E., 1959, Newark College of Engineering; M.S. in E.E., 1961, New York University; Bell Telephone Labora-

tories, 1951—. Until 1959 Mr. Cuttriss worked on design and development of laminated-core inductors and semiconductor field-effect devices. In 1959 he transferred to semiconductor device development and was concerned with the development of diffused-base germanium transistors. Since 1960 he has been engaged in the evaluation of solar cell performance, particularly in the design and evaluation of solar power plants for communication satellites. Member, Tau Beta Pi.

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W. A. Dean, Bell Telephone Laboratories, 1955—. He has worked on solid-state microwave device development, including devices for tropospheric scatter systems, Project Echo, and the Telstar project. He is presently engaged in circulator development for a carrier transmission system.

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Alton C. Dickieson studied electrical engineering at Brooklyn Poly-

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J. C. Dolling, B.S. Eng., 1949, and M.S.M.E., 1952, Technical University of Hanover, Germany; Ph.D., Eng., 1955, Technical University of Brunswick, Germany; Weserhuette AG, Oeynhausen, Germany, Chief Development Engineer, 1954–56; Wuelfel AG, Hanover, Germany, Assistant to Vice-President, 1956–58; Bell Telephone Laboratories, 1958—. He has been engaged in electromechanical development of military radar and space communication antennas, including structural, mechanical, and system analyses for military projects. He was responsible for preliminary design of and engineering guidance on the Telstar horn-reflector antenna, and presently is developing this antenna for commercial use. Member of A.S.M.E. and German Engineers Association (VDI).

K. M. Eisele, Dipl. Phys., 1954, Institute of Technology, Stuttgart, Germany; M.A., 1955, and Ph.D., 1958, University of Toronto; Bell Telephone Laboratories, 1960—. He has been engaged in studies of low-noise performance in parametric amplifiers through cryogenic techniques and thermoelectric cooling. He is presently working on the noise performance figures of varactor diodes, determined independently of the system in which the diode is used.

Roy E. Elicker, B.S., 1950, and M.S., 1951, Michigan State University; Bell Telephone Laboratories, 1951—. He was first engaged in studies of low-temperature extrusion of aluminum as a sheath for cable. He then worked on development of a cooling system for an airborne bombing and radar system, after which he was concerned with the design and development of forward-scatter tropospheric antennas for early-

warning systems. He is currently engaged in development of communications structures and equipment resistant to nuclear blast effects. Member, Pi Mu Epsilon, Pi Tau Sigma, and Phi Lambda Tau.

RUDOLF S. ENGELBRECHT, B.S.E.E., 1951, and M.E.E., 1953, Georgia Institute of Technology; Bell Telephone Laboratories, 1953—. He was first engaged in the design of exploratory low-noise microwave receivers and parametric amplifiers for military projects. He presently supervises a group concerned with parametric device studies. Member, IEEE, Tau Beta Pi, and Eta Kappa Nu.

DAVID FELDMAN, B.S.E.E., 1947, M.S.E.E., 1949, Newark College of Engineering; Assistant Professor of Electrical Engineering, 1949–1954, Cooper Union School of Engineering; Bell Telephone Laboratories, 1956—. He was first engaged in the design of magnetic amplifiers and transistorized regulator circuits for military systems and later supervised activities in the field of energy conversion. He was responsible for the initial design of the Telstar spacecraft power supply and for development of the nickel-cadmium storage battery. Currently he is Head, Transmission Component Department, responsible for the design and development of reliable passive components for satellite and submarine cable systems. Member, A.A.S.E. and IEEE.

J. D. GABBE, B.A., 1950, New York University; M.S., 1951, University of Illinois; Ph.D, 1957, New York University; Bell Telephone Laboratories, 1956—. Mr. Gabbe was first associated with video telephone studies. At present, he is engaged in research on the earth's radiation belts.

ADOLF J. GIGER, Diploma in Electrical Engineering, 1950, and Doctor of Electrical Engineering, 1956, Swiss Federal Institute of Technology; Bell Telephone Laboratories, 1956—. Mr. Giger heads a group working on development of ground receivers for satellite communications systems. His earlier work was in development of circuits for the TH microwave transmission system. Senior member, IEEE.

JOHN A. GITHENS, B.S.E.E., 1951, Drexel Institute of Technology; Bell Telephone Laboratories, 1951—. He has been engaged primarily in computer research, including design of solid-state circuits, computer systems, and logical design. He took part in the design and develop-

ment of Tradic and Leprechaun, early transistorized computers. He later supervised logical design of the data conversion unit used for antenna steering on Project Echo. On the Telstar project, he was responsible for the digital control portion of the antenna pointing system. Member IEEE, Eta Kappa Nu, Tau Beta Pi, and Phi Kappa Phi.

HERMANN K. GUMMEL, Dip. Phys., 1952, Philipps University (Germany); M.S., 1952, and Ph.D., 1957, Syracuse University; Bell Telephone Laboratories, 1956—. His work has been in research and development of semiconductor devices. Member, American Physical Society and Sigma Xi.

EDWIN G. HALLINE, B.S.E.E., 1953, Bucknell University; Bell Telephone Laboratories, 1953—. He has primarily been concerned with computer programming for military research and development projects, including work with the Leprechaun computer for TRADIC and work on Project Mercury. He supervised the computer programming group on the Telstar project and is presently working on the Apollo project for Bellcomm, Inc. Member, IEEE and Tau Beta Pi.

D. C. HANSON, B.S. in E.E., 1959, University of Wisconsin; M.S. in E.E., 1961, New York University; Bell Telephone Laboratories, 1959—. He has been engaged in military system analysis, transistor circuit design for a Vocoder, the design and analysis of varactor diode amplifiers for the Telstar ground station receiver, the TD-3 radio relay system, and a parametric amplifier operating at liquid helium temperature. Member, Pi Kappa Delta, Tau Beta Pi, Eta Kappa Nu, and IEEE.

EARL T. HARKLESS, M.S., 1949, Case Institute of Technology; Bell Telephone Laboratories, 1949—. He has been engaged in the development of transmission systems, including the TH and TJ microwave radio relay systems, and the L3 coaxial cable system. He has worked on the exploratory development of millimeter-wave networks. On Project Telstar, he contributed to the antenna system design. Member, IEEE, Sigma Xi, and Tau Beta Pi.

RICHARD W. HATCH, B.S. in E.E., 1952, Northeastern University; M.S., 1958, Stevens Institute of Technology; Bell Telephone Laboratories, 1952—. For several years he worked on design of FM terminals for the TH microwave system. In 1961–62 he supervised a group working on systems analysis for a satellite communications system. Presently he is

Head, Transmission Studies Department, concerned with studies of objectives and maintenance of facilities for long-distance telephone transmission. Member, IEEE, Eta Kappa Nu, and Tau Beta Pi.

PAUL T. HAURY, B.E., 1941, Vanderbilt University; Bell Telephone Laboratories, 1942—. His first assignment was with the trial installation group preparing models of radar test equipment. Later he designed airborne and portable radar equipment, and after the war turned to equipment engineering related to carrier telephone systems. He worked on submarine cable systems for military communications from 1951 to 1956, and in 1957 he became supervisor of a group engaged in design of TH microwave equipment. Since early 1961 he has supervised mechanical design and construction work on electronic assemblies for satellite repeaters.

GEORGE D. HELM, B.S.E.E., 1947, Rensselaer Polytechnic Institute; M.S., 1955, Northeastern University; Bell Telephone Laboratories, 1956—. He first worked on long-range search radar, automatic data processing, and missile integration in connection with the SAGE system. More recently, he has worked on high-power microwave amplifiers for Telstar and other projects. Member, IEEE and Sigma Xi.

EDWARD F. HIGGINS, JR., B.S.E.E., 1961, Newark College of Engineering; Bell Telephone Laboratories, 1953—. He was first engaged in test and evaluation of missile ground guidance equipment and later worked on the development and evaluation of guided-missile systems. On the Telstar project, he was involved with system performance of the precision tracker receiver. At present he is concerned with the development of radio guidance systems.

J. NED HINES, B.S.E.E., 1943, University of Connecticut; M.Sc., 1949, Ohio State University; Bell Telephone Laboratories, 1958—. His first assignment was work on the design, construction and testing of an electronically scanned array. On the Telstar project he worked on the autotrack system and on measurements of the horn-reflector antennas at Andover and Pleumeur-Bodou. He is presently concerned with the design of a low-noise antenna for satellite communications systems. Member, IEEE and Sigma Xi.

WILLIAM C. HITTINGER, B.S. in Metallurgical Engineering, 1944, Lehigh University; Western Electric Co., 1946–52; National Union

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DANIEL F. HOTH, B.S. in M.E., 1935, Stevens Institute of Technology; Bell Telephone Laboratories, 1936—. Mr. Hoth was first concerned with studies of local plant transmission; he later engaged in the study and planning of development projects for wire and radio systems, engineering of initial Distant Early Warning (DEW) Line installations, and long-range planning studies for transmission systems. As Director, Transmission Studies Center, his responsibilities include engineering studies of satellite communication systems. Senior member, IEEE; member, Sigma Phi Epsilon.

PETER HRYCAK, B.S., 1954, M.S., 1955, and Ph.D., 1960, University of Minnesota; Instructor, Mechanical Engineering Dept. of University of Minnesota, 1955–60; Bell Telephone Laboratories, 1960—. He has worked on low-temperature refrigeration problems, thermal design and thermal testing of the Telstar satellite. Member, American Institute of Aeronautics and Astronautics.

P. T. HUTCHISON, B.S., 1944, Mississippi State University; M.S., 1947, California Institute of Technology; Ph.D., 1960, Georgia Institute of Technology; Bell Telephone Laboratories, 1960—. Mr. Hutchison was first engaged in development work on microwave reflectometers used in TH radio test equipment. He has done development work on the microwave portion of the 4-gc ground receiver used in the Telstar experiment. Later he was responsible for electrical aspects of the microwave repeater in the Telstar satellite. Currently, he is responsible for development work on microwave antennas and microwave circuitry to be used in future communications satellites. Member, IEEE and Sigma Xi.

MORIMI IWAMA, B.S., 1954, M.S., 1955, and Ph.D., 1960, University

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WILLIAM C. JAKES, JR., B.S. in E.E., 1944; M.S. in E.E., 1947; Ph.D., 1949, Northwestern University; Bell Telephone Laboratories, 1949—. Mr. Jakes has been engaged in research in microwave radio antennas and microwave propagation. He was project engineer in charge of the Bell Laboratories team participating in the Project Echo passive satellite communication tests. During the Telstar system tests he has been test conductor at the Holmdel, N.J., satellite communication station. He is presently head of the Mobile Radio Research Department. Member, Eta Kappa Nu, Pi Mu Epsilon, and Sigma Xi; Fellow, IEEE.

GENE C. JONASSON, B.S.E.E., 1961, University of Washington; Western Electric Co., 1961—. He has been engaged in the development of environmental test specifications and in the environmental testing and evaluation of the Telstar satellite. He has also analyzed data received from the Telstar satellite and evaluated its performance in space. Member, IEEE.

H. P. KELLY, B.S.E.E., 1937, M.S.E.E., 1938, Virginia Polytechnic Institute; Bell Telephone Laboratories, 1943—. Mr. Kelly was first engaged in the design and development of military radio equipment. Later he was responsible for the design of transmission test equipment for telephone carrier systems and the development of video and microwave radio systems. At present he is Head of the Ground Station Design Department, responsible for planning, design, and coordination of construction of the satellite ground station near Andover, Maine. Member, IEEE, Tau Beta Pi and Phi Kappa Phi.

W. J. KINDERMANN, A.B., 1933, Columbia College; B.S., 1934, and M.E., 1935, Columbia University School of Engineering; New York Telephone Co., 1935–1941; Bell Telephone Laboratories, 1941—. He was first responsible for the design and construction of precision potentiometers employed in analog computers for missile guidance systems and flight instrumentation equipment. He later supervised work on data take-off devices for the Command Guidance system and Project Echo antennas. On the Telstar project, he performed liaison work with contractors on horn-reflector antenna mechanical design and supervised

work on data take-off devices, drives and electromechanical equipment for both the Andover and Pleumeur-Bodou antennas.

JOHN P. KINZER, M.E., 1925, Stevens Institute of Technology; B.C.E., 1933, Polytechnic Institute of Brooklyn; Bell Telephone Laboratories, 1925—. Except for an initial two years spent on loudspeakers for the first sound movies, and the four war years on radar test sets, he has been concerned with long-haul transmission systems. His work has included the development of two-wire and four-wire voice and program repeaters and the negative-feedback repeater used in cable carrier systems. Following the war, he was engaged in systems studies, first on the L1 and L3 coaxial systems and, more recently, on the TH microwave radio relay system. Since early 1961, he has been participating in the planning and analysis of the communications tests for the Telstar system. Senior member, IEEE.

A. ROBERT KOLDING, B.S.E.E., 1941, Polytechnic Institute of Brooklyn; Bell Telephone Laboratories, 1930—. Mr. Kolding first worked on the exploratory development of cable transmission of television, which later evolved into television transmission over the L1 system. During World War II he worked on the development and field evaluation of airborne radar bombing systems. He returned to television systems after the war, taking part in the development of the L3 coaxial system, the A2A local television system, and terminals for the TH microwave system. He supervised a development group on the TASI system. At present, he is supervisor of the Telstar Launch Operations Group. Member, IEEE, Eta Kappa Nu.

RUDOLF KOMPFNER, Diplom. Ingenieur, Technische Hochschule, Vienna, 1933; Ph.D., Oxford, 1951; Bell Telephone Laboratories, 1951—. Dr. Kompfner invented the traveling-wave tube while at Birmingham University during World War II. At Bell Laboratories, he has specialized in microwave electronics, work which has more recently been enlarged to include research on quantum electronics and satellite communications. Director of Electronics Research, 1955; Director of Electronics and Radio Research, 1957; Associate Executive Director, Research, Communications Systems Research Division, 1962. Fellow I.R.E., 1950; Duddell Medal, Physical Society, 1955; A.I.E.E. David Sarnoff Award, 1960; Franklin Institute Stuart Ballentine medal, 1960.

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M.S. in Chemistry, 1948, Ph.D. in Chemistry, 1951, University of Pittsburgh; Bell Telephone Laboratories, 1952—. Mr. Koontz was first engaged in studies of electron tube materials and processing. For the Telstar project, he was responsible for the selection and application of materials for the space vehicle and their evaluation in simulated space environments. He is presently Head of the Electron Device Technology Department, responsible for chemicals and materials associated with the development of electron devices. Member, American Chemical Society, Sigma Xi and Phi Lambda Upsilon; Chairman of Committee F1-X of the American Society for Testing Materials.

Ronald W. Kordos, B.E.E., 1957, University of Detroit; M.S.E.E., 1959, Northeastern University; Bell Telephone Laboratories, 1957—. He has engaged in the design of microwave ferrite devices, including field-displacement and resonance isolators for several microwave radio relay systems. At present he is working on circulator development for a military radar system. Member, IEEE, Tau Beta Pi, and Eta Kappa Nu.

Joseph P. Laico, M.E., 1933, Brooklyn Polytechnic Institute; Bell Telephone Laboratories, 1929—. He has been engaged in the mechanical design and development of electron tubes from early amplifiers through magnetrons, klystrons, and traveling-wave tubes used in radar, coaxial cable, radio relay, missile guidance, and the Telstar satellite. He is presently engaged in the design and development of high-power traveling-wave tubes for use in a radar system.

Tingye Li, B.Sc., 1953, University of Witwatersrand (South Africa); M.S., 1955, and Ph.D., 1958, Northwestern University: Bell Telephone Laboratories, 1957—. He has been engaged in studies of microwave antennas and microwave propagation. Recently he has been primarily concerned with work on optical masers. Member, IEEE, Eta Kappa Nu, and Sigma Xi.

Robert Lowell, B.S.E.E., 1948, New York University; M.S.E.E., 1951, University of Maryland; M.S. (Applied Math), 1959, Stevens Institute of Technology; Bell Telephone Laboratories, 1953—. Mr. Lowell was first engaged in military systems studies. At present, he supervises a group in the military antenna and microwave research department. Member, IEEE.

John C. Lozier, A.B., 1934, Columbia University; Bell Telephone

Laboratories, 1936—. He was first concerned with the theoretical aspects of toll transmission systems, feedback amplifiers and control systems. On the Telstar project he headed a group which designed and developed the control system for the antennas. He presently supervises research and exploratory development work on military guidance and control systems. Senior member, IEEE.

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CHARLES MAGGS, B.S. in M.E., 1941, New York University; Bell Telephone Laboratories, 1928—. He has chiefly been engaged in the design of electron tubes, including early magnetrons and klystrons and the close-spaced triode. More recently he has worked on magnetrons and supervised a group working on beam-deflection tubes. He headed a group which worked on the frame and solar power plant for the Telstar satellite and presently supervises a mechanical engineering group developing millimeter-wave power amplifiers and microwave printed circuits.

HENRY MANN, B.A., 1950, Brooklyn College; M.S. in E.E., 1955, Columbia University; Bell Telephone Laboratories, 1954—. His work has included the design of the synchronizing circuits, the demultiplex gate, and portions of the encoder for the experimental pulse code modulation system. He also engaged in the development of a system for the transmission of two PCM groups over short-haul microwave carrier circuits. He was responsible for the design and production of a command decoder for an experimental active satellite communications system. At the present time he supervises a group responsible for the design of an improved single-frequency signaling unit. Member, IEEE and Pi Mu Epsilon.

H. I. MAUNSELL, B.S., 1950, University of the Witwatersrand; Bell

Telephone Laboratories, 1957—. For several years he worked on the terminal equipment, test sets and protection switching circuits for the TH microwave radio relay system. In late 1960, he became concerned with communication circuits for the Telstar satellite, and he is presently responsible for transmitter design for the satellite system ground station. Member, IEEE.

JOHN S. MAYO, B.S. in E.E., 1952, M.S. in E.E., 1953, Ph.D. in E.E., 1955, North Carolina State College; Bell Telephone Laboratories, 1955—. He was first engaged in computer research, including studies relating to the use of digital computers for measurement and automatic tracking of pulsed radar range information, and in military weapons control systems. His recent work has involved the development of line repeaters for an exchange carrier PCM system, and high-speed PCM terminals for an experimental transmission system. He has been in charge of the PCM terminal department since December, 1960. Member, IEEE and Sigma XI.

ROBERT J. MCCUNE, B.S.E., 1948, U.S. Coast Guard Academy; Bell Telephone Laboratories, 1954—. He was first engaged in military systems engineering, concerned with operational studies and planning for SAGE and related air defense systems. In 1961–62 he worked on operational planning for the acquisition, tracking, and command complex of the Telstar ground station, and supervised a group responsible for design and operation of the control console, including provision of operations procedures and training of the operations team. He has since been engaged in special operations studies for Bellcomm, Inc., of communication and tracking system requirements for the Apollo project. Member, IEEE.

B. A. MCLEOD, B.S.E.E., 1954, Northeastern University; Bell Telephone Laboratories, 1954—. He first worked on the development of transmission systems, including test set development for the TH microwave radio relay system. He engaged in early studies for the TASI system and worked on TASI development until 1961, when he became associated with the launch operations group for the Telstar project. Member Tau Beta Pi, Eta Kappa Nu.

L. V. MEDFORD, Bell Telephone Laboratories, 1955—. At Bell Laboratories Mr. Medford has participated in the study of adsorption of gases on metal and semiconductor surfaces by use of the photoelectric effect.

Early in 1961 he began development of space radiation instrumentation for the Telstar project, followed by a similar and concurrent undertaking for the NASA Project Relay. Later he participated in the development of radiation instrumentation for the Explorer XV satellite and was active in the launch operations for Project Relay. At present, Mr. Medford is studying development problems related to future space radiation experiments.

G. L. MILLER, B.Sc. (Physics), 1949, M.Sc. (Mathematics) 1952 and Ph.D. (Physics), 1957, University of London; Brookhaven National Laboratories, 1957—. Since his association with Brookhaven Laboratories, he has been engaged in the study and development of nuclear instrumentation.

LOUIS F. MOOSE, B.S.E.E., 1940, University of California; Bell Telephone Laboratories, 1945—. After graduate study at the University of California and Massachusetts Institute of Technology, Mr. Moose joined the Laboratories and worked on microwave tubes for radio relay and radar applications, and semiconductor diodes for microwave usages. Currently, he is engaged in the final design of alloy transistors and applied mechanics at the Allentown Laboratory. Member, IEEE, Tau Beta Pi, Sigma Xi and Eta Kappa Nu.

J. L. MURRAY, B.E.E., 1955, Rensselaer Polytechnic Institute; Bell Telephone Laboratories, 1955—. He has specialized in missile electronics, including design of pulse logic circuitry, and has designed experiments to characterize the system aspects of several radars for a guided missile system. On the Telstar project, he supervised a group responsible for electronic design of the precision tracker. Since then, he has supervised a group responsible for the electronic design of a solid-state missile guidance radar transmitter and receiver. He presently supervises a group responsible for electronic design of the Nike Sprint missile-borne guidance transmitter and receiver. Member, IEEE.

R. J. NIELSEN, Bell Telephone Laboratories, 1941—. At Bell Telephone Laboratories, he was first engaged in design drafting of automatic central office equipment. He has also been concerned with the study of metal-ceramic sealing and other special problems in connection with the mechanical design of electron tubes. During this time he also studied at the University of Idaho and Fairleigh-Dickinson University. From 1960 to the present, Mr. Nielsen has worked on the Telstar project and

is now engaged in the mechanical design of special microwave oscillator tubes.

J. A. NORTON, B.A.Sc., 1957, University of Toronto; A.M., 1959, Princeton University; Bell Telephone Laboratories, 1960—. He has been engaged in the design of antenna control systems on the Echo and Telstar projects. He is also engaged in research in the stochastic aspects of nonlinear computer-controlled systems. Member, IEEE and Sigma Xi.

EDWARD G. OLSEN, Bell Telephone Laboratories, 1927—. He has specialized in the mechanical design and development of electron devices, including devices used in early radio transmission, special research structures, and traveling-wave tube amplifiers for microwave radio relay and guided-missile systems. On the Telstar project he was concerned with the mechanical design and development of the traveling-wave tube amplifier for the spacecraft repeater.

E. F. O'NEILL, B.S. and M.S. in Electrical Engineering, 1940 and 1941, Columbia University; Bell Telephone Laboratories, 1941—. Mr. O'Neill's early work was in the development of radar transmitters and of amplifiers and regulators for cable and radio-relay systems. Beginning in 1956 he headed a group responsible for the development of the Time Assignment Speech Interpolation (TASI) system terminals. Mr. O'Neill is Director, Satellite Communications Laboratory at Bell Laboratories, and is Project Manager for the Telstar experimental system. Member, Tau Beta Pi and Sigma Xi.

S. PARDEE, JR., A.B., 1939, Harvard University; M.S. in E.E., 1960, Stevens Institute of Technology; Bell Telephone Laboratories, 1946—. He has been engaged in the design and development of military electronic equipment, fire control radar, and missile guidance systems. At present, he is working on a military communications system. Member, IEEE.

D. STEWART PECK, M.S. in E.E., 1940, University of Michigan; Bell Telephone Laboratories 1947—. Mr. Peck has been concerned in the design for production of gas-filled electron tubes such as rectifiers, thyratrons and cold-cathode tubes. More recently, he has been in charge of work on reliability studies, applications engineering, and specifications for electron devices. On the Telstar project Mr. Peck's department has been generally responsible for the specification, aging and selection

programs for semiconductor components used in the satellite. Member, IEEE, American Standards Association, Tau Beta Pi, Eta Kappa Nu, Sigma Xi and Phi Kappa Phi.

T. R. PETERS, B.S.E.E., 1955, Virginia Military Institute; Bell Telephone Laboratories, 1955—. He has participated in the systems and logic design of a military special-purpose digital computer, studies of logic connectives for integrated circuits, and cryogenic logic studies. On the Telstar project he was involved in the system and logic design for the antenna pointing system and later was concerned with development, installation and maintenance of the digital equipment at Andover, Maine. He is currently working on studies for a military digital computer.

E. JARED REID, B.S., 1956, Trinity College; B.S.E.E., 1957, Rensselaer Polytechnic Institute; M.E.E., 1959, New York University; Bell Telephone Laboratories, 1957—. He was first engaged in development work on the TASI system, and took part in final field tests of TASI installations in the U.S. and overseas. He subsequently worked on the development of the Telstar satellite electronics system.

WILLIAM C. RIDGWAY, III, B.S.E., 1957, Princeton University; M.E.E., 1959, New York University; Ph.D., 1962, Stanford University; Bell Telephone Laboratories, 1957—. He has worked chiefly in the field of data processing, first for the Nike Zeus anti-missile system and more recently for the Telstar project. Member, A.C.M., IEEE, Phi Beta Kappa, Sigma Xi.

W. ROSENZWEIG, B.S., 1950, Rutgers University; M.S., 1952, University of Rochester; Ph.D., 1960, Columbia University. Brookhaven National Laboratory, 1951–1953; Radiological Research Laboratory, Columbia University, 1953–1960; Bell Telephone Laboratories, 1960—. At Bell Laboratories, Mr. Rosenzweig has been mainly engaged in studies of radiation damage to semiconductors. Member, American Physical Society, Radiation Research Society, Sigma Xi and Phi Beta Kappa.

A. THOMAS ROSS, B.S.E.E., 1939, Lafayette College; Bell Telephone Laboratories, 1946—. Mr. Ross was first engaged in the field of high-altitude bombing systems. Subsequently he worked on the development and testing of a high-powered, tunable magnetron. Prior to his work on

the Telstar project, he was concerned with the development of tubes for broadband submarine telephone cable systems. He is currently engaged in the development of parametric amplifiers. Senior member, IEEE.

R. E. SAGEMAN, B.E.E., 1944, and M.E.E., 1948, Renssalaer Polytechnic Institute; Long Lines Department of the American Telephone and Telegraph Co., 1948—. He has engaged in plant engineering for the overseas radiotelephone division and statistical analyses for the accounting and traffic operations departments. He has been Director of Electronic Data Processing Activities for the Long Lines Department and Satellite Projects Engineer, responsible for coordinating the activities of the Long Lines Department in the Telstar and Relay projects. He is presently Service Engineer, Southeastern Area, Long Lines. Member, Eta Kappa Nu, Tau Beta Pi, and Sigma Xi.

FRED J. SCHAEFER, B.E.E., 1950, Syracuse University; Bell Telephone Laboratories, 1951—. His early assignments included circuit design and field evaluation of a target designation system; operations and system planning for the DEW Line project, including evaluation of the VHF scatter system. He later supervised groups working on circuit design and performance analysis of missile systems, and is presently supervisor of a group developing missile guidance radar. He supervised a group responsible for the design of the Telstar precision tracker. Member, IEEE, Tau Beta Pi, and Eta Kappa Nu.

R. H. SHENNUM, B.S. in E.E., 1944, and M.S. in E.E., 1948, Montana State College; Ph.D., 1954, California Institute of Technology; Bell Telephone Laboratories, 1954—. He first worked on the design of microwave parts for the TJ microwave system. Later, he was responsible for companding, signaling, and voice-frequency development and field experiments for the T1 carrier system (PCM). As Head, Satellite Design Department, he was responsible for the development of the electronic circuits for the Telstar satellite. Mr. Shennum was also responsible for the assembly of the spacecraft and final testing at the Hillside, N. J., laboratory. Member, IEEE, Sigma Xi, Tau Beta Pi, and Phi Kappa Phi.

JOHN T. SIBILIA, B.S. in Physics, 1955, Rutgers University; M.A., 1957, and Ph.D., 1962, Princeton University; Bell Telephone Laboratories, 1960—. He has been engaged in maser development, including studies of the use of rutile for a 10-kmc maser. He presently supervises

a group responsible for the development of masers for the Telstar project and military projects.

D. H. SMITH, B.S.E.E., 1944, University of Minnesota; M.S. in Industrial Management, 1961, Stevens Institute of Technology; Bell Telephone Laboratories, 1947—. He has been engaged in development work on voltage regulating apparatus, including rectifiers and regulated exciters, and advance engineering and development of power systems, including long-range planning. From 1952 to 1961 he supervised a group concerned with power systems engineering. In 1961, as Head, Reserve Power Systems Department, he became responsible for development work on power systems, which included the power generating and reserve power systems at the Andover earth station, and for development of the timing mechanism to shut off the beacon transmitter in the Telstar satellite. Member, IEEE and its Subcommittee on Definitions, Magnetic Amplifier Committee; Chairman of American Standards Association Sectional Committee C85 on terminology for automatic control.

KENNETH D. SMITH, M.A. in Physics, 1930, Dartmouth College; Bell Telephone Laboratories, 1930—. He has worked on high-frequency test equipment, coaxial cable system development, proximity fuses, radar bombing equipment, and microwave radio relay systems. Since 1951, he has been engaged in semiconductor device development, including high-frequency transistors, power rectifiers, voltage limiters, and the Bell Solar Battery. He currently supervises a group concerned with high-frequency transistor development. Senior member, IEEE.

FRIEDOLF M. SMITS, Dipl. Phys., 1950, Dr. rer. nat., 1950, University of Freiburg, Germany; research associate, Physikalisches Institut, University of Freiburg, 1950–54; Bell Telephone Laboratories, 1954–62. Mr. Smits went to the Sandia Corporation in May 1962. His work at Bell Telephone Laboratories included studies of solid-state diffusion in germanium and silicon, device feasibility, and process studies, as well as the development of UHF semiconductor devices. He supervised a group that conducted radiation damage studies on components, particularly solar cells, used in the Telstar satellite. Member of the American Physical Society and the German Physical Society.

R. V. SPERRY, B.S.E.E., 1949, M.S.E.E., 1951, West Virginia University; Bell Telephone Laboratories, 1952—. Mr. Sperry was first engaged in the development of transmission networks for coaxial, radio

and military systems. He has worked on repeater development for an exploratory waveguide transmission system and on the antennas and several circuits used on the Telstar satellite. At present, Mr. Sperry supervises a group working on the development of repeaters for a high-speed PCM coaxial cable system. Member, Eta Kappa Nu, Pi Tau Sigma, and Tau Beta Pi.

JOHN W. STAFFORD, B.S.A.E., 1954, Massachusetts Institute of Technology; M.S.A.M.; 1959, Brooklyn Polytechnic Institute; Bell Telephone Laboratories, 1961—. Mr. Stafford participated in the mechanical design and testing of the Telstar satellite. He is now engaged in development studies of an orientation system for communications satellites. Member of American Institute of Aeronautics and Astronautics.

ALBERT L. STILLWELL, B.A., 1925, M.A., 1928, Gonville and Caius College, Cambridge, England; Bell Telephone Laboratories, 1927—. His early assignments included the design of filters, special networks, and the first three-stage cathode feedback amplifier for coaxial transmission. After wartime activity in the development of proximity fuses and radar, he worked on television transmission apparatus. Later he developed special circuits for the research department and is presently in a group concerned with the design of solid-state microwave circuits. Senior member, IEEE.

KURT M. STRINY, B.S.M.E., 1953, and M.S., 1961, Newark College of Engineering; Bell Telephone Laboratories, 1956—. He has been engaged in the mechanical design and development of electron tubes such as the coaxial magnetron and low-noise traveling-wave tubes. He is currently working on high-power traveling-wave tubes used for the Telstar ground transmitter and other applications. Member A.S.M.E.

R. A. SWIFT, B.S. in E.E., 1943, Union College; Bell Telephone Laboratories, 1946—. He has been engaged in mechanical and equipment design aspects of system design, and was responsible for mechanical design and evaluation of missile-borne guidance equipment for the Titan and Thor-Delta Missiles. On the Telstar project he was responsible for the formation and conduct of the design, qualification, and acceptance test program for the satellite. Member, IEEE.

WILLIAM J. TABOR, B.S. in Chemistry, 1953, Renssalaer Polytechnic Institute; A.M. (Physics) and Ph.D. (Chemical Physics), 1954 and 1957, Harvard University; Bell Telephone Laboratories, 1959—. Since

coming to the Laboratories, he has engaged in research and development work on microwave masers, including the maser for the Telstar ground station receiver.

E. W. THOMAS, Bell Telephone Laboratories, 1961—. He has contributed to the design and development of radiation experiments for the Telstar experimental communications satellite and other satellite programs. Following the Telstar satellite launch, he assisted in interpretation of the radiation data. He is currently conducting experiments to aid in more precise understanding of the Telstar results as well as results of other satellite radiation experiments.

LEROY C. TILLOTSON, B.S.E.E., 1938, University of Idaho; M.S.E.E., 1940, University of Missouri; Bell Telephone Laboratories, 1941—. Mr. Tillotson's early work included design of filters and networks; he has since been concerned with microwave radio relay systems. From June, 1958, to July, 1959, he served as a member of technical staff of the Advanced Research Projects Agency division of the Institute for Defense Analyses. As Assistant Director, Radio and Electronics Research, and Head, Radio Systems Research Department, he has been active in planning the communications aspects of Project Telstar. Senior member, IEEE; member, Sigma Xi.

DAVID E. TRUCKSESS, B.S.E.E., 1926, Pennsylvania State University; Bell Telephone Laboratories, 1926—. He has worked in the field of regulation for motor generators and rectifiers. During World War II, he supervised a group which designed power supplies for military systems. He is presently Head, Power Conversion Department, and is concerned with the development of power facilities for submarine cable systems, microwave communications systems, PBX equipment, and military sonar systems. Fellow and Deputy Director of Technical Operations, IEEE; member, N.S.P.E.

RICHARD H. TURRIN, B.S.E.E., 1956, Newark College of Engineering; M.S.E.E., 1960, New York University; Bell Telephone Laboratories, 1956—. He has been chiefly concerned with propagation and antenna work at micro and millimeter wavelengths. He participated in the design of the Telstar ground-station antennas. Member, IEEE, Eta Kappa Nu and Tau Beta Pi.

MICHIYUKI UENOHARA, B.E., 1949, Nihon University (Japan); M.S., 1953, and Ph.D., 1956, Ohio State University; D.E., Tohoku University

(Japan), 1958; Bell Telephone Laboratories, 1957—. He has been engaged in exploratory studies of microwave variable reactance amplifiers, Esaki diode amplifiers, and related devices. He was also engaged in microwave tube research at Nihon University from 1949 to 1952, and taught there in 1957. Member, American Physical Society, IEEE, Institute of Electrical Communication Engineers (Japan), Eta Kappa Nu, Pi Mu Epsilon, Sigma Xi, and R.E.S.A.

Burton A. Unger, B.S.M.E., 1954, Purdue University; M.S.M.E., 1960, Newark College of Engineering; Bell Telephone Laboratories, 1960—. Mr. Unger participated in the thermal test program of the Telstar satellite. He is now engaged in development studies of orientation systems for communication satellites.

H. Nelson Upthegrove, B.S., 1945, U.S. Naval Academy; S.B., 1948, Massachusetts Institute of Technology; Ph.D., 1954, California Institute of Technology; Bell Telephone Laboratories, 1953—. Mr. Upthegrove served in the U.S. Navy, 1945–49, and was a Teaching Fellow in engineering at Cal. Tech., 1949–53. At the Laboratories, he was first engaged in submarine cable development and later in the planning and acquisition of new cable ships and equipment. On the Telstar project, he was Head of the Satellite Launch Operations Department, responsible for integration of the satellite and the Delta launch vehicle. He is presently Head of the Missile and Tracking Department. Member, IEEE, Sigma Xi, and Tau Beta Pi.

Paul W. Ussery, B.S. in Physics, 1951, Upsala College; M.S.E.E., 1956, Newark College of Engineering; Bell Telephone Laboratories, 1957—. He has engaged in the development of regulated power supplies for an experimental electronic switching system, solid-state inverters and regulators, microwave radio relay systems and missile guidance equipment. He worked on the design of the Telstar spacecraft power supply system and is presently engaged in development work on thermoelectric regulators and power supplies for radio relay systems. Member, IEEE and Sigma Pi Sigma.

L. J. Varnerin, S.B., 1947, Ph.D., 1949, Massachusetts Institute of Technology; Bell Telephone Laboratories, 1957—. He has been engaged in the development of components and solid-state devices, and was first concerned with the development of very high frequency germanium transistors, field-effect devices, thin film components and circuits. He is

presently Head, Solid-State Microwave Device Department, concerned with the development of microwave ferrite, magnetoelastic and optical devices. Fellow, American Physical Society; senior member, IEEE.

EDWARD J. WALSH, Bell Telephone Laboratories, 1928—. He has chiefly been engaged in the mechanical design of electron tube structures and enclosures, including the design during World War II of proximity fuse tubes and the thermally tuned klystron, and later of the frame-grid tube used in microwave radio relay systems. More recently he has supervised a group responsible for mechanical design of electron tubes for a submarine cable system; he is presently in charge of a group working on structures for the gaseous optical maser, photomultipliers, and other electron devices.

IRWIN WELBER, B.S.E.E., 1948, Union College; M.E.E., 1950, Rensselaer Polytechnic Institute; Bell Telephone Laboratories, 1950—. Mr. Welber has worked on the design and analysis of long-haul microwave radio relay circuits and the Time Assignment Speech Interpolation (TASI) switching system. As Head, Ground Station Design Department, he has been responsible for over-all systems analysis, ground communications equipment and technical planning with foreign participants for the Telstar project. Member, IEEE, and Sigma Xi.

PAUL R. WICKLIFFE, JR., B.S.E.E., 1949, Purdue University; S.M., 1951, Massachusetts Institute of Technology; Bell Telephone Laboratories, 1951—. He was first concerned with development of antennas and traveling-wave tube amplifiers for the TH microwave system. He later worked on a narrow-band radio system for order wire and alarms. In 1961 he became supervisor of a group engaged in the design of the ground transmitter for the Telstar project. Member, IEEE, Eta Kappa Nu, and Tau Beta Pi.

FRANCIS J. WITT, B.S.E.E., 1953, M.S.E.E., 1955, Johns Hopkins University; Bell Telephone Laboratories, 1954–55, 1957—. At Bell Laboratories, he has engaged in active and sampled-data network exploratory research and in solid-state circuit development for short-haul carrier systems. Later he was in charge of a group responsible for the development of some of the solid-state circuits in the Telstar experimental communications satellite. At present he is concerned with the development of digital processing circuitry for a high-speed PCM transmission system. Member, IEEE, Tau Beta Pi and Sigma Xi.

ALBERT M. WITTENBERG, B.S. in Physics, 1949, Union College; Ph.D., 1955, Johns Hopkins University; Bell Telephone Laboratories, 1955—. His early work at the Laboratories concerned the development of gas tube devices for switching applications. He later engaged in studies on photoconductive and electroluminescent materials. At present he is involved in developing techniques for space simulations, and is also concerned with the effects of space environment on the thermal and mechanical properties of satellites and satellite materials. Member, American Physical Society, Sigma Xi and Institute of Environmental Sciences.

K. B. WOODARD, B.S. in M.E., 1943, Georgia Institute of Technology; Bell Telephone Laboratories, 1946—. He has been engaged in the mechanical design and testing of components and structures for guided missile systems, including the antennas for the Nike Zeus system. For the Telstar project, he was responsible for mechanical design of the precision tracker antenna and the large air-supported structures and slip rings for the horn-reflector antenna. Member, A.S.M.E., Pi Tau Sigma, and American Rocket Society.

M. C. WOOLEY, B.S. in E.E., 1929, Ohio Northern University; Bell Telephone Laboratories, 1929—. He has been engaged in the design and development of inductors and capacitors, including capacitors for the Havana-Key West submarine cable. He has worked on fundamental development of capacitor materials and processes and presently supervises a group responsible for development capacitors and resistors for ultra-high reliability applications such as the Telstar experiment. Member, Nu Theta Kappa.