

Authors

F. E. Allen

Research Division, Yorktown Heights, New York

Ms. Allen is a research staff member in the Computer Sciences Department at the Thomas J. Watson Research Center. She joined IBM in the Research Division in 1957. One of her first assignments was teaching the new FORTRAN language to the research scientists and encouraging people to use it in preference to the symbolic assembly program (UA SAP) on the research division's 704. In 1959 Ms. Allen joined the Stretch-Harvest project, where she participated in the compiler design and managed the group responsible for a large part of the compiler development. At the completion of that project, she rejoined research to develop an experimental optimizing compiler for what was to become the Advanced Computing System project. Since that time Ms. Allen has been investigating program analysis and optimization and other language processor topics. Ms. Allen received a B.A. in mathematics from the State University of New York at Albany and an M.A. in mathematics from the University of Michigan. Ms. Allen is a member of the Association for Computing Machinery and is an associate editor of its *Transactions of Programming Languages Journal*. She has been an ACM national lecturer, an Institute of Electrical and Electronics Engineers distinguished visitor, a member of the National Science Foundation's computer science advisory board, a visiting professor at New York University, and a consulting professor at Stanford University.

Marc Auslander

Corporate Headquarters, Armonk, New York

Mr. Auslander is currently a member of the Corporate Technical Committee. He joined IBM in 1963 to work on the FORMAC language project. In 1968 he joined the Thomas J. Watson Research Center to work on operating systems and programming languages. He received an A.B. degree from Princeton University in 1963. Mr. Auslander is a member of the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers.

Paul S. Bagus

Research Division, San Jose, California

Dr. Bagus manages the surface structure and dynamics project. His primary research activity centers about the theoretical investigation of the electronic properties of atomic and molecular systems. In addition, he uses molecular cluster models for the investigation of the properties of solids. Dr. Bagus has studied a

variety of phenomena, ranging from atomic hyperfine structure to atomic and molecular chemisorption on solid surfaces. The studies have been based on the use of accurate *ab initio* wavefunctions determined both in the Hartree-Fock approximation and with the inclusion of correlation effects through the use of configuration interaction. He received his B.S. in 1959, M.S. in 1959, and Ph.D. in 1961 from the University of Chicago, all in physics. From 1963-1966, he was a resident research associate in the Solid State Science Division, Argonne National Laboratory. During the 1966-1967 academic year, he was a visiting associate professor at the University of Paris and Centre de Mechanique Ondulatoire Appliquée. He spent a year as a research associate in the physics department, University of Chicago, before joining the IBM San Jose Research laboratory in 1968. Dr. Bagus is a Fellow of the American Physical Society. As the recipient of a von Humboldt Foundation U.S. Senior Scientist award, he will spend the 1980-1981 academic year at the University of Erlangen-Nurnberg in West Germany, after which time he will return to the San Jose Research laboratory. Dr. Bagus received an IBM Outstanding Contribution Award in 1974 for his work on the theory of x-ray photoelectron spectroscopy and shared an IBM Outstanding Innovation Award in 1975 for work on ALCHEMY.

Yonathan Bard

Data Processing Division, Scientific Center, Cambridge, Massachusetts

Dr. Bard is currently working on system performance measurement and evaluation. He has been with IBM since 1957 and has worked on the development of computer applications in the field of multicomponent distillation, nonlinear programming, mathematical model fitting, and optimal control. He received a B.S. in 1954 from the University of Pennsylvania and an M.S. and a Ph.D. in chemical engineering in 1956 and 1966 from Columbia University, New York. He published a book entitled *Nonlinear Parameter Estimation* in 1974.

Charles J. Bashe

Research Division, Yorktown Heights, New York

Mr. Bashe, a research staff member, is currently preparing a technical history of IBM computers. He received the B.S. in electrical engineering from Rose-Hulman Institute of Technology, Terre Haute, Indiana, in 1947, and the M.S. in electrical engineering from Purdue University in 1949. He joined IBM in 1949 as a technical engineer and worked on arithmetic, logical, storage, and control circuits for an early experimental computer. He was development manager of the IBM 702 EDP machine at its announcement and was responsible for initial planning of the IBM 705 EDPM. Mr. Bashe was made a senior engineer in 1957. In 1959, he became manager of technical development for the General Products Division at its formation and director of input/output for the Systems Development Division when it was formed. He has held various product group and corporate staff

positions. During 1946, Mr. Bashe was an instructor in theory of operation of fire-control radar equipment at the U.S. Navy Radio Material School, Treasure Island, California. He was assistant author of *Theory and Application of Industrial Electronics*. He received an IBM Outstanding Invention Award in 1966 for work on an electronic data processing machine. Mr. Bashe is a member of Sigma Xi and Tau Beta Pi, and a senior member of the Institute of Electrical and Electronics Engineers.

H. S. Beattie

Retired

Mr. Beattie received his B.A. in 1931 from Williams College and his B.S. in mechanical engineering in 1933 from the Massachusetts Institute of Technology. He joined IBM in 1933 in Washington, DC. Subsequently, he was assigned to the IBM laboratory in East Orange, New Jersey. He was promoted to assistant engineer in 1940 and in 1943 to engineer. In 1944, he transferred with the laboratory to Poughkeepsie, New York. Mr. Beattie became manager of advanced machine development in 1952, and in 1956 he became manager of the Poughkeepsie product development laboratory. In 1957, he transferred to Lexington, Kentucky, as manager of engineering for the recently formed Electric Type-writer Division. In 1965, he was promoted to vice president of engineering for the Office Products Division. In 1971, he was awarded the ASME medal, given annually by the American Society of Mechanical Engineers. Following his retirement in 1972, he has continued to serve as a consultant to IBM. In 1976, he was elected to the National Academy of Engineering. Mr. Beattie is the holder of 39 U.S. patents.

Laszlo A. Belady

Research Division, Yorktown Heights, New York

Mr. Belady has been a staff member at the Thomas J. Watson Research Center since joining IBM in 1961. Currently he is senior manager of the software engineering area in the Computer Sciences Department, conducting research in program design and development methodology. His research interests include, and he is co-developer of, program evolution dynamics, a new concept and approach to cope with ever-changing large systems. Earlier he did work in program behavior, memory management strategies, computer graphics, and secure operating systems. He was a member of the team conceiving and developing the experimental M44/44X, IBM's first computer with virtual memory and time sharing. He worked from 1956 to 1959 as a design engineer for Ford Motor Company, Cologne, Germany, and from 1959 to 1961 as an aerodynamician for Dassault Aeronautics, St. Cloud, France. Mr. Belady graduated as Diplomingenieur in aeronautical engineering (with honors) from the Technical University of Budapest, Hungary. He received two IBM Outstanding Contribution Awards, one in 1969 for replacement algorithms for a paging machine and one in 1973 for a virtual machine, modular operating system. Mr. Belady is senior editor of the *IEEE Transactions on Software Engineering* and is a member of the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers.

Dwight W. Brede

General Products Division, San Jose, California

Mr. Brede is a senior engineer in the San Jose direct access storage technology group. Since joining IBM in 1960, he has been involved in the development of magnetic heads for several disk file products. In 1974 he received an IBM Outstanding Invention Award for the development of the IBM 3330 disk file head. Before joining IBM, he worked for Ampex Corporation on the development of advanced tape recorders, 1954 to 1960, and was a lecturer in electrical engineering at the University of California, Berkeley, 1948 to 1954. His education includes a B.S. in electrical engineering from Cornell University, 1945, and an M.S. in electrical engineering from Stanford University, 1948. Mr. Brede is a member of the Institute of Electrical and Electronics Engineers and Sigma Xi.

Werner Buchholz

Data Processing Product Group, Poughkeepsie, New York

Dr. Buchholz is a senior engineer in the Central Systems Architecture Department. He received the B.A.Sc. and M.A.Sc. from the University of Toronto, Canada, in 1945 and 1946 and the Ph.D. from the California Institute of Technology in 1950, all in electrical engineering. In 1949, he joined IBM at the Poughkeepsie laboratory, where he has worked on various assignments in architecture and performance evaluation, starting with the IBM 701 and 702, later as manager of systems planning for Stretch, and most recently on extensions of the System/370 architecture. He received two IBM Invention Achievement Awards and an IBM Outstanding Invention Award as a co-inventor on a patent for the tape processing machine. He has published a number of papers on computer organization and edited the book, *Planning a Computer System (Project Stretch)*. Dr. Buchholz is a Fellow and past Director of the Institute of Electrical and Electronics Engineers, and a past Chairman of what is now the IEEE Computer Society. He was a Director of the American Federation of Information Processing Societies.

William Caswell Carter

Research Division, Yorktown Heights, New York

Dr. Carter is manager of microprogram validation, studying ways to extend program verification techniques to microprograms and communication protocols at the Thomas J. Watson Research Center. He joined IBM in the Research Division in 1959 at Poughkeepsie, New York. From 1959 to 1961, he was a member of the technical staff at the Research laboratory with responsibilities for cryogenic machine organization for Project Lightning and for planning a specialized programming system. From 1961 to 1966, he was in the Systems Development Division in charge of systems automation for IBM System/360. His responsibilities included System/360 diagnostic programs, design for System/360 recovery, diagnostics and automatic test generation, design automation for ROS-controlled computers, and computer systems evaluation and planning. In 1966, he rejoined the Research Division and continued work in the field of fault-tolerant computing. From 1966 to 1972, he worked on architecture, modeling, and design procedures. Since 1972, he has been studying microprogram validation techniques as well. From 1947 to 1952, he was at Aberdeen Proving Ground using the ENIAC to obtain new solutions for compressible fluid flow problems and

was adjunct instructor at the University of Maryland and at Johns Hopkins University. From 1952 to 1955, he was head of the Systems Section, Raytheon Computer Department, with responsibilities for computer system evaluation, reliability and serviceability, methods of logic design, programming systems, and preparation of government proposals; and in addition, he was adjunct professor at Boston University until 1956. From 1955 to 1959, he was manager of the Systems Analysis Department, EDP Division, of Minneapolis Honeywell, with design automation added to his responsibilities. Dr. Carter received the B.A. (*magna cum laude*) from Colby College, Waterville, Maine, in 1938 and the Ph.D. in mathematics from Harvard University in 1947. Dr. Carter is a Fellow of the Institute of Electrical and Electronics Engineers and a member of the American Association of Rhodes Scholars, American Men and Women of Science, Association for Computing Machinery, Phi Beta Kappa, Society for Industrial and Applied Mathematics, and Sigma Xi. He was an ACM National Lecturer on combinatorial mathematics from 1962 to 1964 and 1967 to 1968 and an IEEE Computer Society Distinguished Visitor from 1973 to 1974. He was a member of the IEEE (AIEE) Computer Society Technical Committee on systems from 1954 to 1964 and helped form the Technical Committee on fault-tolerant computing in 1970. He was Vice Chairman of this committee from 1970 to 1972 and Chairman from 1973 to 1976. He has frequently served on FTCS program committees (Chairman 1971), is general Chairman of FTCS-11, and edited an IEEE TC special issue on fault-tolerant computing in 1973. He was named to the Computer Society Honor Roll in 1974 and was a member of the Computer Society Technical Interest Council from 1976 to 1978. Dr. Carter is a U.S. representative to IMEKO TC.10, Technical Diagnostics.

Paul W. Case

System Communications Division, Kingston, New York

Mr. Case is currently doing systems planning for future office systems. He joined IBM in 1949 as a customer engineer, transferred to the IBM 701 project in Poughkeepsie, New York, in 1952, and managed the testing of IBM's 700 series computer systems. Mr. Case became manager of systems design automation in the Poughkeepsie laboratory in 1957, manager of development of the CLEAR/CASTER conversational program development support system in 1965, and director of IBM's design automation development in 1970. In 1973, he became a senior staff member, systems, of the IBM Corporate Technical Committee. Mr. Case received a B.S. in electrical engineering from Cornell University in 1949. He is a recipient of IBM's Outstanding Contribution Award for his work in design automation. Mr. Case is a senior member of the Institute of Electrical and Electronics Engineers.

Manuel Correia

General Technology Division, East Fishkill, New York

Mr. Correia is currently manager of production control at the East Fishkill facility. He joined IBM at Endicott, New York, in 1957. He worked in test engineering, where he was responsible for the development of logic test generation systems for logic card assemblies. In 1970, in East Fishkill, he managed logic test generation development. In 1979 he became manager of site release, responsible for RIT acceptance into the manufacturing line, and later that year assumed his current position. Mr. Correia received his B.S. in electrical engineering from Northeastern University, Boston, Massachusetts, in 1957 and his M.S. in management sciences from the State University of New York, Binghamton, in 1970. He is a member of the Institute of Electrical and Electronics Engineers.

Robert Jay Creasy

Data Processing Division, Scientific Center, Palo Alto, California

Mr. Creasy joined the newly formed IBM Systems Research and Development Center in Cambridge, Massachusetts, in 1964. He was commissioned by its manager to design and build a general-purpose time-sharing system for the System/360 announced earlier that year. His systems group produced the CP/CMS system which became the basis for VM/370. Prior to joining IBM, he participated in the development of CTSS at the Massachusetts Institute of Technology. As a member of Project MAC at its inception, he was involved in the first Multics design. He holds a degree in physics from the Massachusetts Institute of Technology. Mr. Creasy is manager of the interactive systems group at the Palo Alto Scientific Center, where he has applied interactive graphics to neutron cross section analysis. His group produced an experimental high-level APL machine, APL/CMS, for VM/370, the original APL assist microcode, an experimental capability based on array theory, and is exploring the application of Pascal to VM/370, outboard sensor-based computers, and real-time operating systems.

Dale L. Critchlow

General Technology Division, East Fishkill, New York

Dr. Critchlow has been manager of a group in the East Fishkill laboratory, responsible for the development of advanced MOSFET memory products, since 1977. He joined IBM Research in 1958 to do research on new logic devices. He worked on data transmission and transferred with this project to the La Gaude, France, laboratory in 1963. Dr. Critchlow returned to Research in 1964 and became manager of a group responsible for device, circuit, and chip design using the n-channel MOSFET technology. During the early 1970s, he was manager of a Research area with the responsibilities of developing very-low-cost MOSFET memory, exploring the practical limits for high-speed MOSFET logic and arrays, and the development of design concepts and tools for VLSI. He received a B.S. in electrical engineering from Grove City College, Pennsylvania, in 1953 and an M.S. and a Ph.D. in electrical engineering from Carnegie Institute of Technology, Pittsburgh, Pennsylvania, in 1954 and 1956. Dr. Critchlow was Assistant Professor of Electrical Engineering at Carnegie Institute of Technology from 1956 to 1958.

C. Dennis Elzinga

General Products Division, Tucson, Arizona

Mr. Elzinga received his B.S. in physics and mathematics from Utah State University in 1964. He obtained the M.S. in engineering economic systems at Stanford University in 1978 and has completed course work for his engineer's degree there. Upon joining IBM in 1964, he had the responsibility for an electron beam controller and then for cathode ray tube development for a high-resolution photocomposer. He began work on electrophotographic printers in 1967 and was the manager of the development of the IBM 3800 laser printer head, forms overlay, print reflectance control, and print quality. He was granted a one-year sabbatical for graduate study at Stanford University in 1976. He is currently a senior engineer in advanced printer technology development at the Tucson laboratory. Mr. Elzinga is a member of the American Institute of Physics.

James T. Engh

Information Systems Division, Rochester, Minnesota

Mr. Engh joined IBM in 1957 at Rochester. Currently he is manager of the computer quality and reliability laboratory. Prior to that he directed the development engineering programs for diskette drives at the Rochester laboratory. Earlier experience included the development of punched card machines and banking equipment. Mr. Engh received his B.S. in mechanical engineering in 1957 from the University of Colorado.

Irving Feinberg

General Technology Division, East Fishkill, New York

Mr. Feinberg is a senior engineer and manager of an advanced package design function at the East Fishkill facility. He joined IBM in 1964 in East Fishkill, where he held the positions of MST device development manager and packaging and device technical program manager. In 1976 he transferred to the Poughkeepsie laboratory as manager of systems technology. Prior to joining IBM, he was employed by Sylvania, Woburn, Massachusetts, as manager of device development concerned with high-speed switching devices and monolithic integrated circuits. Mr. Feinberg received his B.S. in chemical engineering from Clarkson College, Potsdam, New York, in 1951.

Horace P. Flatt

Data Processing Division, Scientific Center, Palo Alto, California

Dr. Flatt is currently manager of the Scientific Center in Palo Alto. He joined IBM in Los Angeles in 1961 as a special representative working on large-scale scientific computations. In 1964 he became a manager of an applications group in the Palo Alto Scientific Center and after an assignment in Washington, D.C., he returned to Palo Alto as manager of the Center. Prior to joining IBM, he was manager of an applied mathematics group at the Atomic International Division of North American Aviation. He received a B.A. in physics from Rice University, Houston, Texas in 1951, as well as an M.A. in 1953 and a Ph.D. in 1958 in mathematics. Dr. Flatt is a member of the American Mathematical Society, the Association for Computing Machinery, and the Society for Industrial and Applied Mathematics.

William Gianopulos

Data Processing Product Group, White Plains, New York

Mr. Gianopulos began his IBM career in 1966 at the IBM development laboratory in Kingston, New York, as a circuit design engineer, after several years of employment as a member of the engineering staff at Bell Telephone Laboratories. He has held a number of positions in the development of LSI applications, including manager of advanced LSI technology development and laboratory manager of IBM Kingston. He is currently manager of storage subsystems evaluation in the Product Group staff. He received a B.S. from the New Jersey Institute of Technology in 1966 and an M.S. from Syracuse University in 1973, both in electrical engineering. He is a recipient of an IBM Outstanding Contribution award for his contributions to LSI applications development and is holder of several IBM patent disclosures in LSI applications.

T. Milton Hallmark

Information Systems Division, Boulder, Colorado

Mr. Hallmark is manager of input/output development in the distribution systems area of the Boulder development laboratory. He joined IBM at the Lexington development laboratory in 1960 after completing his B.S. in electrical engineering at the University of Tennessee and his M.S. in electrical engineering at the University of Illinois. His product development experience includes communicating typewriters, dictation equipment, copiers, and the IBM 6670 Information Distributor. Mr. Hallmark transferred to the Boulder laboratory in 1974. He is a member of the Institute of Electrical and Electronics Engineers.

William E. Harding

General Technology Division, East Fishkill, New York

Mr. Harding is an IBM Fellow and manager of semiconductor technology development at the East Fishkill facility of the General Technology Division. In 1950 he started with the Radio Receptor Company, Inc. and from 1954 to 1957 was its Director of Germanium and Silicon Semiconductor Research and Development. He joined IBM in 1957 and has been engaged in semiconductor device and electronic packaging development and manufacturing ever since. He has received IBM Invention Achievement and Outstanding Contribution Awards in semiconductor technology. He received his B.S. in 1949 and M.S. in 1950, both in physics, from the Polytechnic Institute of Brooklyn. Mr. Harding is a member of American Physical Society, Institute of Electrical and Electronics Engineers, New York Academy of Science, Research and Engineering Society of America, and Sigma Xi.

John M. Harker

General Products Division, San Jose, California

Mr. Harker received a B.S. from Swarthmore College in Pennsylvania and an M.S. from the University of California, Berkeley, both in mechanical engineering. In 1962, he received an M.S. in electrical engineering from Stanford University. He joined IBM in 1952 in San Jose. He participated in the development of the first successful magnetic disk storage device and system (the IBM 305 RAMAC) and in the development of subsequent disk file families. He also initiated and led the development of the IBM 1311 disk storage drive. Under his direction, the first trillion-bit beam-addressable storage system was delivered to the Lawrence Radiation Laboratories. Mr. Harker subsequently was responsible for IBM's work on magnetic disk storage technology. In 1970, he became product manager for the IBM direct access storage devices, initiating development of a line of integrated system attachments that could be shared by the IBM 3330, 3340, and 3350. In 1972, Mr. Harker was named director of the San Jose development laboratory in the General Products Division. In 1974, he was appointed an IBM Fellow. He is currently director of technology in the General Products Division. He received an IBM Corporate Contribution Award in 1968 for a removable disk pack. Mr. Harker is a member of the Institute of Electrical and Electronics Engineers and Tau Beta Pi.

John P. Harris

General Products Division, San Jose, California

Dr. Harris is director of assurance for the General Products Division, where he is responsible for division assurance and the assurance laboratories in San Jose and Santa Teresa, California and Tucson, Arizona. He joined IBM in 1954 in the Poughkeepsie development laboratory. He worked on magnetic materials and magnetic particle clutches in Poughkeepsie, New York; mass storage magnetic devices in the Research laboratory; semiconductor module design and module processing in the East Fishkill, New York, development laboratory; and magnetic tape drives in the Boulder, Colorado, development laboratory. In 1978 and 1979, he was manager of technology development in the newly formed Tucson development laboratory, where he was responsible for magnetic recording head and media technology and development and read/write circuits, systems performance and evaluation, and component engineering prior to his recent appointment to director of assurance. Dr. Harris received his B.S. in 1954 and his Ph.D. in 1965 from the University of Michigan, Ann Arbor, in mechanical engineering. Dr. Harris is a member of the American Society of Mechanical Engineers and Sigma Xi.

Thomas J. Harrison

Information Systems Division, Boca Raton, Florida

Dr. Harrison joined IBM in 1958 at Poughkeepsie, New York. He transferred to San Jose, California, in 1961 as part of the process control computer group. While in San Jose, he was involved in the design of analog equipment for the IBM 1720, 1710, and 1800. In 1968, he transferred to Boca Raton and has managed several advanced development groups. Dr. Harrison joined the Corporate Technical Committee (CTC) in 1979 at Armonk, New York, for a one-year assignment. In 1980, he returned to Boca Raton, as manager of advanced software engineering technology. Since 1960, he has been involved in most IBM systems related to computer control. His special interests are in the development of system architecture and concepts applicable to small industrial computer systems. He is involved in national and international standardization activities, and is currently serving as Vice President of the Instrument Society of America (ISA), Standards and Practices Department. He is a Fellow of the Institute of Electrical and Electronics Engineers and a senior member of ISA. He is a registered Professional Engineer (control systems) in California and is listed in *Who's Who in America* and *Who's Who in the World*. Dr. Harrison has remained active in the field of education and is presently a member of the Engineering Advisory Councils for both the University of Florida and Florida Atlantic University. He has written over 30 articles, contributed to four books and encyclopedias, and written two other books. He holds four patents and has received IBM's Outstanding Invention Award and Invention Achievement Award. Dr. Harrison holds B.S. and M.S. degrees in electrical engineering from Carnegie-Mellon University, and a Ph.D. from Stanford University.

George V. Hawkins

Corporate Headquarters, Armonk, New York

Mr. Hawkins is a senior system advisor in the Corporate Litigation Analysis Department. He joined IBM in 1949 at the Endicott, New York, facility. His past work assignments in IBM have been in circuit and logic design of arithmetic units (1949 to 1951); development of IBM 608 transistor calculator (1955 to 1957); development of data communications products (1958 to 1961); and managing data communications products (1962 to 1971). Mr. Hawkins received his B.S. in 1948 and his M.S. in 1949 in electrical engineering from the Massachusetts Institute of Technology.

William R. Heller

Data Systems Division, Poughkeepsie, New York

Dr. Heller is currently a senior physicist in the electronic design automation group at the Poughkeepsie laboratory, working on design algorithms and analysis of large computer systems. He has been in his present position since 1979. Before joining IBM, he received his B.S. in applied mathematics from Brown University in 1945 and, after military service in 1946 and 1947, he received his Ph.D. in theoretical solid-state physics as an AEC predoctoral fellow at Washington University, St. Louis, Missouri. After postdoctoral work at the University of Illinois and a year as assistant professor at Yale University, he worked at Shell Development Corporation, Emeryville, California, involved in studies of materials science from 1953 to 1959. Joining IBM at the Thomas J. Watson Research Center, Yorktown Heights, New York, in 1959, he continued to work in materials science until 1964, when he became manager of physics in San Jose Research. In 1967 he joined the technical staff of the director at San Jose, and in 1969 came to the Components Division, East Fishkill, New York, to manage a group in engineering analysis and design techniques development. In 1978, Dr. Heller was on leave as Visiting Professor of Computer Science at the California Institute of Technology, as IBM's representative to the Silicon Structures Project developing VLSI design techniques. Dr. Heller is a Fellow of the American Physical Society, and a member of the Computer Society, the Institute of Electrical and Electronics Engineers, and the New York Academy of Sciences.

R. A. Henle

Research Division, Yorktown Heights, New York

Mr. Henle is an IBM Fellow and is presently director of the advanced silicon technology laboratory. He is responsible for the development of silicon technology for future logic and memory applications. He joined IBM in 1951 at Poughkeepsie, New York, and worked on the possible application of transistors to computers. He was involved in the development of SMS and SLT technologies. He was responsible for work on high-speed logic technologies utilized in project Stretch and following that, the IBM 7000 series. In 1964 he started an effort on monolithic memories. He was made an IBM Fellow in 1964 and since that time has worked on the development of LSI and VLSI technologies. From 1970 to 1972 and again in 1978, he was a member of the Corporate Technical Committee. He received an M.S. in electrical engineering from the University of Minnesota in 1951. He is the recipient of IBM's Twelfth Invention Achievement Award. Mr. Henle is a Fellow of the Institute of Electrical and Electronics Engineers and has been active as an officer and member of the Computer Society and IEEE committees. He is also a member of Sigma Xi.

M. Y. (Ben) Hsiao

Data Systems Division, Poughkeepsie, New York

Dr. Hsiao is a senior technical staff member and manager of the laboratory Engineering Analysis Department. His current professional interests include research and development in computer reliability, availability, serviceability, error-correcting codes, error detection, failure-isolation techniques, and system engineering analysis. He joined IBM in Poughkeepsie in the Advanced Reliability Technology Department in 1960. From 1965 to 1967 he was on educational leave to the University of Florida, after which he returned to IBM as advisory engineer in the Reliability and Diagnostic Engineering Department. In 1969, he

was promoted to senior engineer and manager of the Reliability Technology Department. He assumed his present position in 1979. Dr. Hsiao received his B.S. in electrical engineering in 1956 from Taiwan University, Taipei, his M.S. in mathematics in 1960 from the University of Illinois, and his Ph.D. in electrical engineering in 1967 from the University of Florida. He has seven IBM Invention Achievement Awards and two IBM Outstanding Innovation Awards in the areas of error-correction codes, error detection, and failure-isolation techniques. Dr. Hsiao is a Fellow of the Institute of Electrical and Electronics Engineers.

J. James Ingram

System Communications Division, Research Triangle Park, North Carolina

Mr. Ingram is a senior engineer working on the development of point-of-sale systems for the distribution industries. He joined IBM in 1950 in the development laboratory in Endicott, New York, where he worked on the magnetic drum storage for the IBM 650 data processing system from 1950 to 1954. From 1957 to 1962, he was manager of central processing unit development for the IBM 1401 data processing system; and from 1963 to 1965, he was program manager of the IBM 1070 process communications system at the IBM laboratories in Stockholm, Sweden, and San Jose, California. Mr. Ingram received his B.S. in electrical engineering from Georgia Institute of Technology in 1947 and his M.S. in electrical engineering from Purdue University in 1950. Mr. Ingram is a member of Eta Kappa Nu, the Institute of Electrical and Electronics Engineers, and Sigma Xi.

Samuel E. James

Federal Systems Division, Houston, Texas

Mr. James is responsible for IBM's Space Shuttle operations at the NASA Johnson and Kennedy Space Centers, NASA's Marshall Space Flight Center and Vandenberg Air Force Base. This includes the onboard data processing complex for the Shuttle orbiter, the ground control data processing facilities for mission control, the automated launch checkout system, Shuttle cargo integration and space lab activities, and support to Shuttle operations planned by the Department of Defense. Mr. James joined IBM as a programmer in 1963 in Houston. His early assignments involved mathematical analysis support for the ground control programs of the Gemini and early Apollo missions. He was promoted to management in 1967 and given responsibility for developing the Apollo maneuver control programs. Later management responsibilities included development of mission planning, trajectory and command programs for Apollo ground control, the simulation computer system for the real-time flight controller and astronaut training, and the earth resources application system to support analysis of earth observation data from aircraft, satellite, and Skylab experiments. In 1973, Mr. James led the proposal team for the Space Shuttle software procurement for the Mission Control Center and received an IBM Outstanding Contribution Award for his role in this effort. With the contract award to IBM in 1974, he was named manager of ground-based space systems and was responsible for development and implementation of the Shuttle ground control systems. This included responsibility for the commercial computers award to IBM in 1976. In 1978, he was promoted to manager of Shuttle software development and managed all Space Shuttle software development activities in Houston. He was named manager of Shuttle operations in 1979 and assumed his present position in 1980. Mr. James holds a B.S. in mathematics from West Texas State University and an M.S. in mathematics from the University of Utah.

David R. Jarema

System Communications Division, Research Triangle Park, North Carolina

Mr. Jarema presently has managerial responsibility for technical support, maintenance strategy, portable tool development, telecommunications product development, and keyboard technology at the Raleigh laboratory. From 1950 to 1957, he held various marketing positions in the Data Processing Division. He was appointed manager of industrial process control in 1958, and in 1959 he was promoted to national account manager—Western Union, where he was heavily involved in the Comlognet (Autodin) store-and-forward message-switching system for the U.S. Air Force. In 1959, he was named manager of teleprocessing in the Eastern Region, and in 1960 to Eastern Region systems engineering manager. In 1962, he joined the Corporate marketing staff as director of market requirements planning. Mr. Jarema joined the Systems Development Division in 1965 as communication systems manager. In this role, he was responsible for the development of the majority of IBM's data communications products. He is currently manager of systems technology and design support. He received his B.S. in mechanical engineering from Purdue University in 1950. Mr. Jarema served as a member of the North Carolina State Board of Science and Technology from 1971 to 1979.

Frank J. Kania

System Products Division, Endicott, New York

Mr. Kania joined IBM as a customer engineer in the Roanoke, Virginia, branch office. After spending ten years as a resident customer engineer in Lynchburg, Virginia, he transferred to the Glendale laboratory in Endicott, New York, as an associate engineering writer developing customer and maintenance information manuals for various IBM products. During the past ten years, he has held both management and staff positions in product publications, service cost estimating, and serviceability engineering.

Robert W. Keyes

Research Division, Yorktown Heights, New York

Dr. Keyes is the manager of the exploratory devices group at the Research Center. He received his M.S. and Ph.D. degrees in physics, 1950 and 1953, at the University of Chicago. From 1946 to 1950 he worked in solid state physics at the Argonne National Laboratory, and from 1953 to 1960 at the Westinghouse Research Laboratory. In 1960, he joined IBM Research at Poughkeepsie, New York, where he has worked on various semiconductor research projects. He received an IBM Outstanding Contribution Award in 1963 for his work on the development of the injection laser. Dr. Keyes is a fellow of the American Physical Society and the Institute of Electrical and Electronics Engineers, and a member of the National Academy of Engineering.

Bruce W. Landeck

General Systems Division, Atlanta, Georgia

Mr. Landeck is currently manager of application development architecture for the General Systems Division. He has been with IBM since 1965. Mr. Landeck was programming manager for the

MPX/1800 data acquisition and control system. He was also the product requirements manager for the Series/1, with responsibility for both hardware and software requirements. His education includes a B.S. in engineering science from Purdue University and an M.S. in aerospace engineering from the University of Arizona. Mr. Landeck is a member of Tau Beta Pi.

David C. Larkin

System Communications Division, Kingston, New York

Mr. Larkin joined IBM in 1966 at Poughkeepsie, New York, and held various positions in generating and managing external documentation for operating systems including OS/360, OS/370, and CP/CMS. In 1972, he was involved with the reworking of the OS/370 scheduler functions for MVS. Other assignments have included internal development tools and design support for potential new operating systems. He is currently a senior programming manager in the DPPX design group for the IBM 8100 and recently returned from an assignment in Tokyo, Japan, assisting with initial installation of DPPX there. Mr. Larkin received his B.A. from Ohio State University in 1965.

Gerald W. Leeahan

Corporate Headquarters, Armonk, New York

Mr. Leeahan joined IBM in Poughkeepsie, New York, as a logic circuit designer in 1965. His present position is consultant on the Corporate Engineering, Programming, and Technology staff. He was responsible for the Component Division's MOS logic circuit development department in 1969 and for the establishment of small system and I/O component development and manufacturing in Manassas, Virginia, in 1970. In 1977 he became responsible for all General Technology Division FET logic and bipolar special component development. Mr. Leeahan received a B.S. in electrical engineering from the Massachusetts Institute of Technology in 1969.

Peter Lucas

Research Division, San Jose, California

Mr. Lucas is a member of the Computer Science Department at the San Jose Research laboratory. He is currently working on programming language and data base problems related to interactive business applications. He joined IBM at the Vienna laboratory in 1961. He received his academic degree (Dipl.Ing.) in telecommunications from the Technical University of Vienna, Austria, in 1959. From 1958 to 1961, he participated in various programming and research projects at the Technical University of Vienna, was responsible for an implementation of ALGOL 60, and contributed original work in automatic syntax analysis. Since 1961, he has been associated with IBM research and development, initially at the Vienna laboratory; at the La Gaude, France, development laboratory, from 1962 to 1963; at the Palo Alto, California, development laboratory, from 1974 to 1975; at

the Yorktown Heights, New York, Research laboratory, from 1978 to 1979; and at the San Jose, California, Research laboratory since then. Between 1963 and 1974, he was mainly involved in projects focusing on compiler technology and formal semantics of programming languages. In 1968, he received an IBM Outstanding Contribution Award for his achievements in the formalization of PL/I. In 1969, together with K. Walk, he received the ACM Programming Systems and Languages Paper Award. From 1966 to 1972, he was a lecturer at the Technical University of Vienna and at the Johannes Kepler University, Linz, Austria. Mr. Lucas serves as a member of the editorial boards of *Acta Informatica* and *Computer Languages* and is a member of the Association for Computing Machinery.

Richard H. Mattern, Jr.

General Products Division, San Jose, California

Mr. Mattern is director of planning for the General Products Division. He joined IBM at the Endicott product development laboratory in 1960 after completing his A.B. and M.S. in economics at the University of Pittsburgh. Initially he worked on plans for the IBM 1401, 1440, and 1460 data processing systems, and in 1964 he joined the Instructional Systems Development Department at the Thomas J. Watson Research Center. In 1966, he transferred to the Los Gatos, California, laboratory to work on advanced instructional devices. From 1967 to 1969, Mr. Mattern served on the Corporate Planning staff; then he returned to San Jose in several successive assignments in business planning and market requirements. From 1977 to 1979, he was product manager, non-impact printer products. Mr. Mattern became assistant to the GPD vice president, development, and subsequently became director of planning in 1979. In 1975, he received an IBM Outstanding Contribution Award for his business management of the IBM 3800 Printing Subsystem. Mr. Mattern is a member of Phi Beta Kappa.

Fred T. May

Information Systems Division, Austin, Texas

Mr. May is manager of advanced applications development at the Austin laboratory. He joined the IBM Electric Typewriter Division as an associate engineer in Lexington, Kentucky, in 1961, with an M.A. in electrical engineering. In 1966, he assumed management responsibility in a development project that evolved into the Mag Card I. In 1968, he moved to Austin to head a new development laboratory in conjunction with the release to production of the Mag Card I. Also in 1968, he was awarded a first-level invention achievement award. He remained as head of the development laboratory in Austin until 1972. In 1973, he was promoted to director of the Office Products Division engineering organization in Lexington, Kentucky. He was vice president of OPD development from 1973 to 1976, when he returned to Austin as vice president of office systems with responsibility for Austin manufacturing and development. He was director of the Austin laboratory from 1977 to 1978.

William C. McGee

Data Processing Division, San Jose, California

Mr. McGee is currently a senior programmer in data systems software planning. He joined IBM in 1964 as a staff member of the Palo Alto Scientific Center, where he specialized in physics applications, computer graphics, and data base systems. In 1969 he received an IBM Outstanding Contribution Award for work on data base/data communication requirements and strategy. In 1970 he joined the DB/DC development group in Palo Alto, where he was manager of the DB/DC architecture department. Other assignments in DB/DC development have included performance evaluation, program product management, and distributed data requirements and planning. From 1951 to 1959, Mr. McGee was with the General Electric Hanford Atomic Products Operation in Richland, WA, as manager of the numerical analysis unit and as a reactor data specialist. From 1959 to 1964, he was head of systems programming and research at Ramo Wooldrige Corporation in Canoga Park, California. Mr. McGee received the A.B. degree in physics from the University of California at Berkeley in 1949 and the M.A. degree in physics from Columbia University in 1951. He is a member of the Association for Computing Machinery.

K. Alex Müller

Research Division, Zurich, Switzerland

Dr. Müller joined the IBM Research Division at the Zurich Research laboratory in 1963 as a research staff member in the physics group. Since 1973 he has been manager of that group. His principal area of interest is structural phase transitions, which he has studied experimentally using the technique of electron paramagnetic resonance. Dr. Müller received his Ph.D. in physics from the Swiss Federal Institute of Technology in 1958 and worked at the Batelle Institute in Geneva prior to joining IBM. He has also been a professor at the University of Zurich since 1962. In 1970 he received an IBM Outstanding Contribution Award for his work on structural phase transitions and in 1980 an IBM Outstanding Innovation Award for experiments that demonstrated the essential role of fluctuating clusters in structural transitions.

Richard B. Mulvany

General Products Division, San Jose, California

Mr. Mulvany is manager of advanced mechanical development at the San Jose development laboratory. He joined the Advanced Systems Development Division in 1959 to work on a prototype computer-voice output system. Subsequent assignments included technology planning, work on the photo-digital mass memory system, and image systems development. From 1969 to 1973 he was manager of mechanical development in the IBM 3340/3348 development program. At San Jose he has served as manager of mechanical development of the IBM 3340/3348 development program, as manager of exploratory development, and in staff capacity at division headquarters. He also worked on development projects at the Hursley laboratory, 1977-1979. Before joining IBM, he was engaged in the development and marketing of food product equipment and was President of Mulvany Automatic Equipment (1958-1959). Mr. Mulvany's educational background includes a B.A. in industrial economics from the University of California, Berkeley, in 1952, and an M.B.A. from the University of Santa Clara in 1965. In 1966 he received an IBM Outstanding Invention Award for "A High Pressure Ammonia Development Method," another in 1974 for "Magnetic Disk Storage Apparatus," and an IBM Outstanding Innovation Award in 1979 for the "The 3370 Disk File Configuration."

Marshall J. Nathan

Research Division, Yorktown Heights, New York

Dr. Nathan joined IBM Research in 1958 and has served in various staff and managerial positions in the field of semiconductor research. He is currently a manager of the microstructure device physics group at the Thomas J. Watson Research Center. He received his B.S. in physics from the Massachusetts Institute of Technology in 1954 and his M.A. in physics, 1956, and his Ph.D. in applied physics, 1958, from Harvard University. Dr. Nathan is a fellow of the American Physical Society, and a member of the Institute of Electrical and Electronics Engineers and Sigma Xi. In 1980, he received the David Sarnoff Award of the IEEE for outstanding achievement in electronics for his role in the discovery of the injection laser and other contributions to the physics of semiconductor lasers.

Ted Y. Nickel

System Products Division, Endicott, New York

Mr. Nickel is a senior engineer and manager in printer products. He joined IBM in 1962 in Endicott and worked on development of optical character readers until 1966, when he moved to the Boulder, Colorado, laboratory to work in advanced tape drive development. He returned to Endicott in 1967 and has worked in processor development and printer products development since that time. Mr. Nickel received a B.S. in 1960 and a M.S. in 1962, both in electrical engineering, from Lehigh University, Bethlehem, Pennsylvania.

Hillel Ofek

General Technology Division, Poughkeepsie, New York

Mr. Ofek joined IBM in 1965 in the Systems Development Division, where he designed special hardware for NASA and experimental logic for prototype digital machines. He also did work in the area of reconfigurable systems. In 1969 Mr. Ofek joined the engineering design system, where he has worked on logic partitioning, test generation, and Boolean analysis. From 1973 to 1976, he worked at the Thomas J. Watson Research Center, where he participated in design automation research addressing the topics of analysis and symbolic simulation techniques for hardware design verification, and the definition of the language for computer design (LCD). In 1976 Mr. Ofek returned to the engineering design system, where he is currently the manager of the VLSI Design and Verification Tool Development Department. In his current assignment, Mr. Ofek has been responsible for advanced development work in design verification, computer hardware description languages, and design transformation aids. Mr. Ofek received his B.Sc. in electrical engineering from the Technion (Israel Institute of Technology) in 1963 and his M.E. in electrical engineering from New York University in 1965. Mr. Ofek is the recipient of a first-level IBM invention award. He is a member of the Institute of Electrical and Electronics Engineers.

Philip F. Olsen

Federal Systems Division, Owego, New York

Mr. Olsen is a senior engineer and project manager of advanced computer systems. He joined IBM at Owego in 1962 after receiving a B.S. in mechanical engineering in 1961 and an M.S. in electrical engineering in 1962, both from Rensselaer Polytechnic Institute, Troy, New York. In addition to computer development, he has been involved in display development, I/O technology, and systems integration. Mr. Olsen received an IBM Outstanding Contribution Award for his work in displays.

Robert J. Orrange

Federal Systems Division, Owego, New York

Mr. Orrange is manager of the light airborne multipurpose system (LAMPS) advanced programs, responsible for performing conceptual design studies of future combat capability improvements. He joined IBM as a designer in Endicott, New York, in 1950. His first management assignment was the development and flight test of the B-52 inertial guidance system. In 1959, he became manager of the Titan II inertial guidance. He was assigned the staff responsibility for planning IBM's Saturn instrument unit integration effort at Huntsville, Alabama, in 1961. As manager of FSD's Air Force space systems engineering function from 1965 to 1968, he headed the development of the U.S. Air Force Manned Orbiting Laboratory digital computer subsystem group, including displays and controls. In 1969, he was appointed manager of RF systems development which led to the radar homing and warning system for the Air Force Wild Weasel aircraft. Mr. Orrange was responsible for preparation of the technical proposal which led to the award of the system prime contract for the Navy LAMPS program and his appointment as LAMPS engineering manager in 1974. He received a B.S. in chemical engineering from Worcester Polytechnic Institute, Massachusetts, in 1947. He was awarded an IBM Invention Achievement Award in 1966, an IBM Outstanding Contribution Award in 1974, and an IBM Outstanding Achievement Award in 1979, for work in the areas of navigation, antisubmarine warfare, and combat system architecture. Mr. Orrange is a member of the American Institute of Aeronautics and Astronautics and the American Society of Naval Engineers, and is on the Antisubmarine Warfare Committee of the National Security Industrial Association.

Andris Padegs

Data Processing Products Group, Poughkeepsie, New York

Dr. Padegs is the manager of a systems architecture department, with responsibility for System/370 input/output and central-processor architectures and their extensions. He joined IBM in Poughkeepsie in 1958. After participating in the planning of the Stretch system, he was involved in developing channel architecture for System/360. In 1968 he became manager of central-processing-unit architecture for System/370, and subsequently has managed the development of other architectures. Dr. Padegs received an A.B. degree (*magna cum laude*) from Dartmouth College, Hanover, New Hampshire, in 1953, an M.S. in electrical engineering from Thayer School of Engineering in 1954, and a Ph.D. in electrical engineering from Carnegie Institute of Technology, Pittsburgh, Pennsylvania, in 1958. He received an IBM Outstanding Contribution Award in 1964 for his contribution to System/360 architecture, an IBM Outstanding Invention Award in 1966 for development of the System/360 input/output interface, an IBM Outstanding Contribution Award in 1973 for his work on System/370 architecture, and an Invention Achievement Award in 1974. Dr. Padegs is a member of Sigma Xi and the Institute of Electrical and Electronics Engineers.

Richard P. Parmelee

Data Processing Division, Scientific Center, Cambridge, Massachusetts

Dr. Parmelee has been a staff member in the operating systems technology group at the Scientific Center since 1975. Prior to that, he worked for three years at the Scientific Center, Paris, France, where he managed a computer networking project. Dr. Parmelee originally joined the Cambridge Scientific Center in 1967 and worked on virtual machine systems (including the CP/67) and computer networking. Before joining IBM, he worked at the Massachusetts Institute of Technology as a research associate. Dr. Parmelee holds a B.S. from the University of Illinois in 1959 and an M.S. and Ph.D. in 1966 in mechanical engineering from the Massachusetts Institute of Technology.

Robert E. Pattison

General Products Division, San Jose, California

Mr. Pattison joined IBM at the Endicott laboratory in 1951. He received his M.S. in engineering mechanics in 1948 from the University of Michigan. Before joining IBM, he was Assistant Professor of Engineering Mechanics at Wayne State University, Detroit, Michigan. In 1958 he transferred to the San Jose development laboratory. His work in San Jose included technical management assignments on the IBM 1311, 2311, 2314, and 3330 disk storage limits as well as in file technology and non-impact printer technology. He served on the Corporate Technical Committee in 1975-1976 and received an IBM Outstanding Invention Award for his patent on disk packs, an IBM Outstanding Contribution Award for his work on the IBM 1311/2311, and a Corporate Award for his contributions to the 3330 program. Mr. Pattison is an IBM Fellow. His current interests are in disk file actuators.

William B. Phillips

General Products Division, Tucson, Arizona

Dr. Phillips is media development manager at the Tucson development laboratory. He received a B.S. and a Ph.D. in electrical engineering from the University of Illinois and Purdue University, respectively. After joining IBM in 1957, he worked with magnetic recording and magnetic recording systems at the Poughkeepsie, New York, development laboratory. From 1962 to 1966, he was an instructor in the Department of Electrical Engineering at Purdue University. In 1966 he joined the IBM Boulder development laboratory and worked in advanced circuit development, magnetic recording heads, and magnetic recording media. He assumed his current position in development in 1979. He is a member of the Institute of Electrical and Electronics Engineers, the Research and Engineering Society of America, and Sigma Xi.

Nicholas Pippenger

Research Division, San Jose, California

Dr. Pippenger received a B.S. in natural science from Shimer College, Mt. Carroll, Illinois, in 1965 and the B.S., M.S., and Ph.D. degrees in electrical engineering from the Massachusetts Institute of Technology in 1967, 1969, and 1973. From 1969 to 1972, he was a staff member of the Draper Laboratory (formerly

the MIT Instrumentation Laboratory) in Cambridge. He joined the Mathematical Sciences Department of the IBM Thomas J. Watson Research Center in 1973 and served as the department's assistant director from 1975 to 1976. In 1978 he served as a visiting associate professor to the Computer Science Department at the University of Toronto, Canada. He returned as manager of the theoretical computer sciences group and served in that capacity from 1979 to 1980, at which time he transferred to the Computer Science Department at San Jose.

Emerson W. Pugh

Research Division, Yorktown Heights, New York

Dr. Pugh is a member of the Applied Research Department at the Thomas J. Watson Research Center. He joined the IBM Research Division in 1957. In 1962, he transferred to the Components Division to manage the development of the magnetic film memory array used in the IBM System/360/95 computer. From 1964 to 1970, he held a variety of positions including SDD group director of operational memory, research manager of technical planning, and special assistant to the IBM vice president and chief scientist. In 1971, Dr. Pugh returned to the Research Division as consultant to the director of research, where he initiated the interdivisional magnetic bubble program. During 1974, he served as Executive Director for the Committee on Motor Vehicle Emissions of the National Research Council, on sabbatical from IBM. Dr. Pugh received his Ph.D. in physics from Carnegie-Mellon University, Pittsburgh, Pennsylvania, in 1956. He is the coauthor of *Principles of Electricity and Magnetism*. Dr. Pugh is a Fellow of the Association for the Advancement of Science, the American Institute of Physics, and the Institute of Electrical and Electronics Engineers. He has served as President of the Magnetism Society and Editor of the *IEEE Transactions on Magnetism*.

Eryling Pytte

Research Division, Yorktown Heights, New York

Dr. Pytte first joined the Research Division at the Zurich, Switzerland, laboratory in 1965, where he worked in the theoretical physics group. In 1969, he transferred into the quantum electronics group at the Thomas J. Watson Research Center in Yorktown. Since 1977, he has been manager of the theoretical physics group. Dr. Pytte received his B.S. degree in physics from Princeton University in 1959, and his M.S. and Ph.D. degrees in physics from Harvard University in 1961 and 1964. He received an IBM Outstanding Contribution Award in 1975 for his work on the theory of structural phase transitions. Dr. Pytte is a fellow of the American Physical Society.

Robert A. Rahenkamp

Information Systems Division, Lexington, Kentucky

Mr. Rahenkamp received his BS. in electrical engineering in 1950 from the University of Pittsburgh, Pennsylvania. He joined IBM in 1950 in Pittsburgh. Subsequently, he was assigned to programs in the Data Processing, Office Products, and Information Systems Divisions. He is now manager of product acceptance in Lexington. Mr. Rahenkamp is a member of the Institute of Electrical and Electronics Engineers.

Torrance C. Raymond

General Technology Division, Poughkeepsie, New York

Mr. Raymond is a senior engineer and is currently responsible for managing the Design Methodology and Assurance Department within the engineering design system organization. He joined IBM in the Poughkeepsie, New York, laboratory in 1960 and has participated in the design and development of three generations of design automation systems in a variety of assignments. Mr. Raymond received his B.S.E. in electrical engineering from Princeton University in 1960 and his M.S. in industrial engineering/operations research from Syracuse University in 1969.

Nathaniel Rochester

Data Processing Division, Scientific Center, Cambridge, Massachusetts

Mr. Rochester, an IBM Fellow, is currently working on the development of a portable personal computer. After working on radar in the Massachusetts Institute of Technology Radiation Laboratory and at GT&E, he joined IBM in 1948 in Poughkeepsie, New York. He was the architect of the test assembly and headed the architecture efforts for the tape processing machine and the IBM 701. He wrote the first symbolic assembly program, a predecessor of SAP. He managed the IBM 700 series engineering during the design of the IBM 703, 704, 705, and the start of the 709. He joined IBM Research when it began in 1955 and directed work in computer theory and experimental computer design. In 1961, he joined the Data Systems Division to start a group that, among other things, designed IBM's first two time-sharing systems, QWIKTRAN and CPS, and accomplished the initial design of the PL/I language. His patents on the arithmetic unit of the 701 and on the variable-word-size architecture of the tape processing machine earned him an Outstanding Invention Award from IBM. He has served on government panels on air defense, antisubmarine warfare, cryptanalysis, and air traffic control. At M.I.T., Mr. Rochester received a B.S. in electrical engineering in 1941 and was elected a member of Tau Beta Pi and Sigma XI; in 1958 he was a Visiting Professor; and currently he is a Visiting Scientist there. Mr. Rochester is a Fellow of the Institute of Electrical and Electronics Engineers.

Louis A. Russell

Corporate Headquarters, White Plains, New York

Mr. Russell is a senior litigation analyst in the Litigation Analysis Department. He joined IBM in 1953 at the Poughkeepsie, New York, development laboratory. His work in IBM has included staff and managerial assignments primarily on memory technologies and projects in Poughkeepsie, Harrison, and Endicott, New York; Zurich, Switzerland; and Manassas, Virginia. During 1976 and 1977 he served for one year as executive director of the Engineering Colleges Consortium for Minorities through IBM's social service leave program. Mr. Russell received his B.S. in 1950 from the Massachusetts Institute of Technology and an M.S. from Syracuse University in 1961, both in electrical engineering. He also has pursued postgraduate work and attained candidacy for a Doctor of Business Administration at George Washington University. Mr. Russell is a member of the Institute of Electrical and Electronics Engineers and an associate member of Sigma Xi.

Eugene J. Rymaszewski

General Technology Division, East Fishkill, New York

Mr. Rymaszewski is currently manager of the packaging engineering organization responsible for developing, designing, releasing to manufacturing and providing engineering support for first-level packaging (single and multichip modules) of IBM logic and array chips. Mr. Rymaszewski joined IBM Research at the Poughkeepsie, New York, laboratory in 1956 as a member of advanced circuit development for project Stretch. He continued in this field in the Poughkeepsie product development laboratory for the next five years. Shortly after formation of the Components Division, he transferred to component manufacturing in charge of test equipment engineering. He returned to component development in East Fishkill in 1964. After several management positions in logic products engineering, he advanced in 1970 to director of European component development. He returned to East Fishkill in 1972 and after several management assignments, from 1975 to early 1981 was in charge of the products design organization responsible for all bipolar logic and associated array chips. Mr. Rymaszewski graduated from the Technical University in Munich, Germany, in 1950. Prior to joining IBM, he designed microwave communications equipment at C. Lorenz AG in Pforzheim, Germany. He is a senior member of the Institute of Electrical and Electronics Engineers and a member of the Research and Engineering Society of America and Sigma Xi.

Jean E. Sammet

Federal Systems Division, Bethesda, Maryland

Miss Sammet is currently software technology manager in the Federal Systems Division Headquarters. She is responsible for assessing the state of the art for software technology and determining new techniques which are suitable for use by the division's business area. Since 1977 she has been responsible for leading and coordinating FSD's involvement with the major new language, Ada, developed under Department of Defense auspices. Miss Sammet joined IBM in 1961 to organize and manage the Boston Advanced Programming department in the (then) Data Systems Division. She initiated and led the development of FORMAC (FORMula Manipulation Compiler), for which she received an IBM Outstanding Contribution Award. She has done considerable work in programming languages, including the publication of the book *PROGRAMMING LANGUAGES: History and Fundamentals*. Prior to joining IBM, she organized programming groups at Sperry Gyroscope and Sylvania Electric Products. While at the latter company she served as a member of the original group which designed COBOL. She was elected Vice President, 1972-1974, and then President, 1974-1976, of the Association for Computing Machinery. She is currently Editor-in-Chief of the *ACM Computing Reviews*. She received a B.A. in mathematics from Mount Holyoke College and an M.A. in mathematics from the University of Illinois. In 1977 she was elected to the National Academy of Engineering. In 1978 she received an honorary Doctor of Science degree from Mount Holyoke College.

George R. Santana

General Products Division, San Jose, California

Mr. Santana joined the San Jose development laboratory of IBM in 1959 after having completed his B.S. and M.S. degrees in electrical engineering from Stanford University. In 1963, while

with IBM, he completed requirements for the Degree of Engineer, also from Stanford. He initially worked on servo systems for positioning recording heads in disk files and later on recording electronics, also for disk files. He has held various management positions in the direct access storage product and technology organizations. He is currently advanced recording technology manager. Mr. Santana is a member of the Institute of Electrical and Electronics Engineers and Tau Beta Pi.

Charles H. Sauer

Research Division, Yorktown Heights, New York

Dr. Sauer has been a Research staff member at the Thomas J. Watson Research Center since 1975. His current work is on performance modeling methodology and software. He received his B.A. in mathematics and Ph.D. in computer sciences from the University of Texas in 1970 and 1975. From 1977 to 1979, he was Assistant Professor of Computer Sciences at the University of Texas, Austin, while on leave of absence from IBM. Dr. Sauer has recently completed a textbook, *Computer System Performance Modeling: A Primer*, coauthored by K. M. Chandy. He has received an IBM Outstanding Innovation Award for the creation and basic design of the Research queuing package (RESQ). Dr. Sauer is a member of the Association for Computing Machinery.

Casper A. Scalzi

Data Systems Division, Poughkeepsie, New York

Mr. Scalzi is a senior programmer working in the Design and Architecture Analysis Department, working on new architecture and configurations for future large systems. He joined IBM in 1956 in Poughkeepsie and worked on Stretch architecture from 1957 to 1959, was part of the original OS/360 design and development team and continued his association with OS/360 design and development from 1963 to 1969, and served on the Corporate Engineering, Programming and Technology staff from 1969 to 1972. Since then, he has been involved in various large system programming and architecture activities in the Poughkeepsie laboratory. Mr. Scalzi received his B.S. in mathematics from Fairfield University, Connecticut.

Allan L. Scherr

System Communications Division, Kingston, New York

Dr. Scherr received a B.S. and an M.S. in electrical engineering from the Massachusetts Institute of Technology in 1962. He earned his Ph.D. in 1965 in electrical engineering and computer science, also from the Massachusetts Institute of Technology. Currently, he is director of communications programming for the System Communications Division, responsible for communications-oriented programming products for large-scale IBM computer systems; he manages groups in Kingston, New York, Raleigh, North Carolina, and Hursley, England. Dr. Scherr joined IBM in 1965 and was assigned engineering design responsibilities for large computer systems. He was the design manager for the IBM OS/360 Time Sharing Option (TSO), a programming package that was first used in 1971. He was the overall project manager of the effort that produced the first version of MVS in 1974. He then began a series of assignments that led to his managing the effort that in 1979 produced DPPX, a set of software support for the IBM 8100 Distributed Computer Sys-

tem. In 1980, he was appointed a member of the Corporate Technical Committee. In 1975, he received the Association of Computing Machinery's Grace Murray Hopper Award for his "pioneering work" on performance analysis of time sharing systems. Dr. Scherr is a senior member of the Institute of Electrical and Electronics Engineers.

Donald P. Seraphim

System Products Division, Endicott, New York

Dr. Seraphim is manager of the materials and process development for packaging, printers, and processors. He joined IBM in 1957 following graduation from Yale University, New Haven, Connecticut, with a Ph.D. in engineering in metallurgy. His B.S. and M.A. in applied science were awarded in 1951 and 1952 at the University of British Columbia, Vancouver, Canada. He has participated in management of component development for IBM systems beginning with MST chips and modules for the System/370 systems in 1965 in East Fishkill, New York. In 1970, he transferred to Endicott to manage packaging process development for the IBM 4300 and 3081 series. Dr. Seraphim has reached the second IBM invention plateau in filed and published invention disclosures. He was a member of the IBM Corporate Technical Committee in 1978 and 1979. He was made an IBM Fellow in 1981. He is a member of the American Institute of Mechanical Engineers and the American Physical Society.

Robert L. Simek

Data Systems Division, Poughkeepsie, New York

Mr. Simek is manager of design systems and release engineering responsible for electronic, mechanical, and power design/release methodologies and systems. He joined IBM in 1954 at Poughkeepsie in manufacturing systems test of the IBM 700 series equipment. In 1956 he established the Poughkeepsie design and records automation function. He was responsible in 1957 for the development of the first automated machine level control and product release system for the IBM System/360 release. He has been responsible for work in the areas of design automation, process control systems engineering, and manufacturing information systems. Mr. Simek is a graduate of RCA Institutes. He is a charter member of the National Computer Graphics Association and a past president of the Poughkeepsie chapter of the Association for Computing Machinery.

Hal K. St. Clair

Information Systems Division, Boca Raton, Florida

Mr. St. Clair received his B.S. and M.S. at the University of California, Berkeley, where he was elected to Phi Beta Kappa, Tau Beta Pi, Eta Kappa Nu, and Sigma Xi. In 1954 he joined the IBM applied research laboratory in San Jose, California, where he contributed to IBM's pioneering development of direct-access disk-file storage, receiving an IBM Outstanding Invention Award for self-clocking systems. He joined the IBM industrial process control program in San Jose in 1960 and participated in the development of all of IBM's small, real-time computer systems through 1973. He is currently manager of new development programs for the IBM entry level systems area at the development laboratory in Boca Raton. Mr. St. Clair is a senior member of the Institute of Electrical and Electronics Engineers.

Louis D. Stevens

General Products Division, San Jose, California

Mr. Stevens joined IBM in 1949 at the Poughkeepsie, New York, development laboratory, where he worked on early magnetic tape and drum devices and contributed to the design of the input/output system of the IBM 701. In 1952, he joined the newly established San Jose research and advanced development laboratory, where he managed the IBM 305 RAMAC and IBM 350-355 disk file development programs from 1953 to 1956. He served as the first manager of the San Jose development laboratory from 1956 to 1959. During this period, he initiated the development projects that resulted in the IBM 1301 and 1311 disk files. From 1959 to 1961, he served as a member of the Corporate staff. He returned to San Jose in 1961 as manager of information storage and retrieval and was involved in the development of optical storage devices. In 1965, he was appointed manager of the Los Gatos, California, laboratory, a position he held until 1975. Following a sabbatical at the Digital Systems Laboratory of Stanford University, he assumed his present position as manager of advanced development on the staff of the GPD director of technology. Mr. Stevens received a B.S. in electrical engineering from Texas Technological University, Lubbock, in 1948 and an M.S. in electrical engineering from the University of California, Berkeley, in 1949. He holds a Distinguished Engineer citation from Texas Technological University. Mr. Stevens is a senior member of the Institute of Electrical and Electronics Engineers and a member of the Association for Computing Machinery and Sigma Xi.

Charles B. Stieglitz

System Products Division, Endicott, New York

Mr. Stieglitz is a senior engineer working on computer design for serviceability. He joined IBM in 1958 at the Endicott laboratory and initially worked on automatic test generation. In 1964, he transferred to Owego, New York, to work on various aspects of design automation. Since returning to Endicott in 1969, he has had assignments in design automation and system design. Mr. Stieglitz received his B.S. in electrical engineering from Rensselaer Polytechnic Institute in 1957 and his M.S. in electrical engineering from Cornell University in 1958. He has received IBM Outstanding Contribution Awards for his work on card test generation and card writing. Mr. Stieglitz is a member of the Institute of Electrical and Electronics Engineers.

William R. Stringfellow

Field Engineering Division, Research Triangle Park, North Carolina

Mr. Stringfellow is presently assigned to the Field Engineering Division, where he has the management responsibility for a group which develops test equipment used in product service. Prior to his present assignment, he managed a group in the Poughkeepsie, New York, laboratory which was responsible for the development of circuits and electronic packaging. He joined IBM in 1948 in Tulsa, Oklahoma. He attended the Texas A & M University, College Station. Mr. Stringfellow is the recipient of an IBM Outstanding Invention Award in the area of computer architecture.

Edward H. Sussenguth

System Communications Division, Research Triangle Park, North Carolina

Dr. Sussenguth is an IBM Fellow. He joined IBM in 1959 at the Thomas J. Watson Research Center. He transferred to the Systems Development Division's Advanced Computing Systems Department, Menlo Park, California, in 1964 as manager of systems architecture, remaining there until 1969, when he was promoted to assistant to the SDD president. He moved to Raleigh in 1970 as manager of communication systems architecture and was promoted to director in 1975 and division director in 1976. In 1977 he moved to SCD headquarters, Harrison, New York, and subsequently returned to Raleigh in 1980. In the communication architecture position, his responsibilities included definition of teleprocessing and communications systems as well as being IBM's technical contact point with telecommunications carriers worldwide. Dr. Sussenguth is a graduate of Harvard University with an A.B. and Ph.D. in applied mathematics. He has received two IBM Outstanding Contribution Awards for his work on systems network architecture and advanced computing systems. Dr. Sussenguth is a member of Sigma Xi and the Association for Computing Machinery.

Lewis G. Taft

General Products Division, San Jose, California

Dr. Taft joined IBM in 1962 at the Supplies Division laboratory in Vestal, New York. His assignments in IBM include computer memory tape development in Poughkeepsie, New York; a technical liaison assignment in Tokyo, Japan; and disk development and printer technology in San Jose, California. Dr. Taft received his B.S. in 1954 from Trinity College, Hartford, Connecticut, and his M.S. and Ph.D. in chemistry from the University of Notre Dame.

Roger L. Taylor

Information Systems Division, Rochester, Minnesota

Mr. Taylor is the technical assistant to the general-purpose systems manager, who is responsible for business area management of the System/3, System/32, System/34, System/38, and their replacement products in Rochester. He joined IBM in 1964 at Rochester. Since then, he has held a number of development, staff, and line management positions. These include assistant for system programming in 1970, assistant for systems architecture in 1973, manager of programming technology and standards in 1974, manager of programming architecture for general-purpose systems in 1972, manager of technical support for the System/38 in 1975, and System/38 Operating System (CPF) development manager in 1976. He assumed his current responsibility in 1979. Mr. Taylor received his B.A. in 1964 from the University of Colorado.

James W. Thomas

Data Processing Products Group, Poughkeepsie, New York

Mr. Thomas joined the Federal Systems Division of IBM in 1955 as a member of the SAGE project in Kingston, New York. He held numerous management positions in the SAGE program until 1963 when he joined the Data Systems Division at the develop-

ment laboratory in Poughkeepsie, New York, where he was a member of the engineering team that developed System/360. Since 1965 he has managed several advanced RAS (Reliability, Availability, and Serviceability) technology projects, which have included the development of error detection, isolation and correction techniques, and the design of a fault-tolerant computer. In 1972, he was given the management responsibility for advanced systems availability. Since 1975 he has held several management positions in DPPG with responsibilities in the RAS and systems performance areas. Mr. Thomas is currently the manager of systems RAS in DPPG.

Leonard H. Thompson

General Products Division, San Jose, California

Mr. Thompson received his B.S. in electrical engineering from Duke University, Raleigh, North Carolina, in 1948. His first IBM assignment was as customer engineer in the Raleigh, North Carolina, branch office. Later he served as an instructor in IBM customer engineering education. In 1950, he entered the Poughkeepsie development laboratory, where he held various assignments developing paper tape communication and magnetic tape component equipment. From 1964 to 1966, he was responsible for the development of magnetic tape communication equipment for the Office Products Division in Lexington, Kentucky. In 1967, he joined the General Products Division and has since worked in direct access storage device development and manufacture. Mr. Thompson has received an IBM Outstanding Invention Award for a binary data detection system, the SMD Presidents Award, the Second Level Invention Achievement Award, and the Master Design Award by *Product Engineering* magazine for a tape handling system for computers. Mr. Thompson has served as division manager of manufacturing engineering and is currently magnetic disk manufacturing product manager.

James L. Walsh

General Technology Division, East Fishkill, New York

Mr. Walsh is currently managing the advanced technology organization in East Fishkill. He joined IBM in 1952 and has had various assignments in advanced technology and product areas. Mr. Walsh received a B.S. in electrical engineering from the University of Rhode Island in 1949. He received an M.A. in physics from Hofstra University in 1952.

Jack F. Wells

System Products Division, Charlotte, North Carolina

Mr. Wells began his career in IBM in 1954 as a customer engineer in Springfield, Massachusetts. In 1957, he transferred to the Poughkeepsie, New York, laboratory as part of the magnetic tape drive development group. He worked in that capacity in Poughkeepsie from 1957 to 1965. In 1966, he transferred to the Boulder, Colorado, laboratory, where he served as a manager of several tape products. In 1977, Mr. Wells accepted an assignment in Tucson as the flexible media product manager. He recently accepted an assignment at the Charlotte laboratory as manager of check processing products.

Arthur Robert Williams

Research Division, Yorktown Heights, New York

Dr. Williams joined IBM in 1968 as a postdoctoral fellow. He became a regular staff scientist in 1969 and manager of the electronic structure theory group in 1977. Dr. Williams is mainly concerned with electronic structure theory, photoemission, microscopic origins of interatomic bonding, surface physics, chemisorption, and computational techniques of electronic structure theory. He received his A.B. in 1962 from Dartmouth College, Hanover, New Hampshire, and his Ph.D. in 1977 from Harvard University. From 1963 to 1964 he was a Fulbright Scholar at the University of Paris. Dr. Williams has received two IBM Outstanding Contribution Awards, one in 1971 for band theory and the other in 1975 for properties of atoms chemisorbed on a metal surface. Dr. Williams is a member of the American Physical Society.

Wayne D. Winger

General Products Division, Tucson, Arizona

Mr. Winger is manager of laboratory operations at the Tucson product development laboratory. His responsibilities include planning and development of information storage and retrieval products for computing systems. He joined IBM in 1950 and, except for the years from 1960 to 1965, has been involved in the design, development, and manufacturing support of various systems with emphasis on magnetic tape products. He began as an

engineer at the laboratory in Poughkeepsie, New York. His work there involved solving problems in magnetic tape recording technology and designing magnetic tape units. He was a member of the engineering group that designed and developed IBM's first production tape drive. He later was involved in the development and planning of various systems. He held several managerial positions in the Poughkeepsie laboratory and managed the planning department at the former Components Division, East Fishkill, New York, from 1960 to 1965. In 1966 he became manager of half-inch tape unit development and moved that function to Boulder, Colorado. Later he became product manager of library systems product development, which included half-inch tapes. He subsequently held a variety of management assignments in the Boulder laboratory before moving to Tucson in 1979 as manager of laboratory operations. He holds a B.S. and M.S. in electrical engineering from Purdue University. Mr. Winger is a member of the Institute of Electrical and Electronics Engineers and Sigma Xi.

John M. Woodward

Information Systems Division, Boulder, Colorado

Mr. Woodward is manager of engineering/work stations responsible for electronic typewriters. He joined IBM in 1964 in Lexington, Kentucky, and has held various engineering management positions. Mr. Woodward received a B.S. in 1960 and an M.S. in 1963, both in electrical engineering from the University of Tennessee.