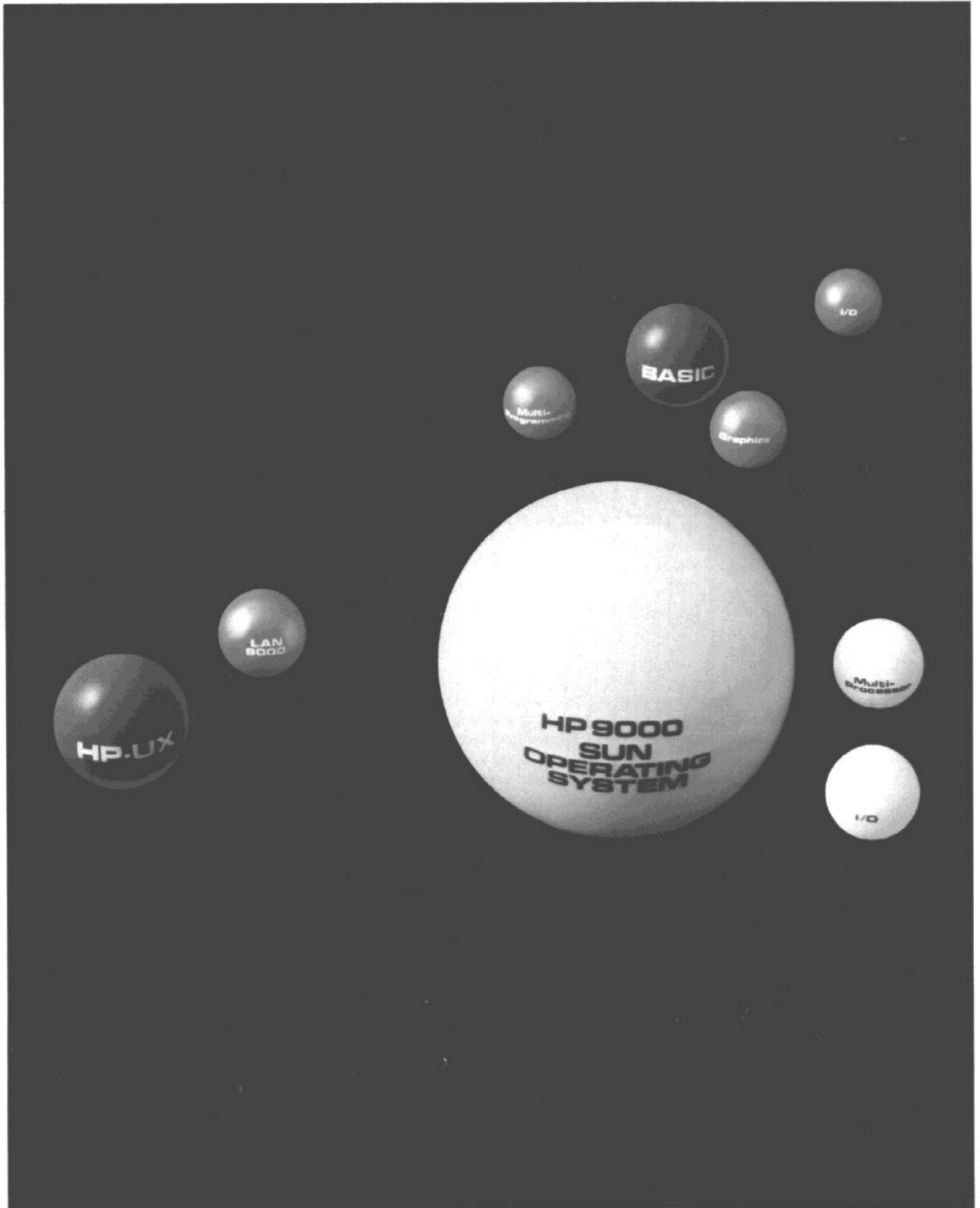


HEWLETT-PACKARD JOURNAL

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In this Issue:



The solar system on this month's cover represents the system software for the HP 9000 Series 500 Computers. We first told you about the HP 9000 in our August 1983 issue, which was devoted to the advanced technology that makes the Series 500 possible. You may recall reading about the HP 9000's five VLSI (very large-scale integration) chips—among them a 32-bit, 450,000-transistor central processor chip—made by a high-tech integrated circuit process called NMOS III. To help manage the heat generated by all those densely packed circuits, a new kind of circuit board, called a finstrate, was developed. The finstrates in each HP 9000 Series 500 Computer are contained in a lunchpail-sized module that holds up to three central processors. These technological developments make it possible to put on an engineer's desk a computer that has more power than some mainframe computers—"mainframe" being the name applied only to the largest computers. The HP 9000 Model 520 is the desktop mainframe. Models 530 and 540 are, respectively, rack-mount and cabinet versions designed to serve multiple users.

Although the lunchpail-sized module is the beginning, between it and that desktop mainframe is a great deal of development in both hardware and software. This month's issue covers the system software development. In May, we'll cover the hardware development, and in future issues, we'll carry articles on significant applications software packages. In this issue you can read about operating systems, languages, input/output, networking, and multiprocessor management. An unusual aspect of the HP 9000 Series 500 is that there are two levels of operating system. What the user sees is either an advanced version of the HP BASIC system or an HP version of Bell Laboratories' UNIX operating system. Underlying those systems is the Series 500's SUN operating system, whose name gave us the idea for our cover photo. The SUN concept proved invaluable in the development of the two user operating systems.

-R. P. Dolan

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H. Michael Wenzel

Mike Wenzel holds the BSEE (1969) and MSEE (1971) degrees from the University of Denver. His first project after joining HP in 1974 was developing firmware for a raster printer. More recently, he worked on data communications and network software, including design of the message manager and architecture for LAN 9000. He currently is working on new network architecture for the Series 200 and Series 500 Computers. Before coming to HP, he served five years in the U.S. Air Force as a contract officer for the space shuttle program. Mike was born in Alton, Illinois, and now lives in Fort Collins, Colorado. Married and the father of two daughters, he is interested in music, hiking, stained glass, and the use of computers in education (he advises a local grade school regarding networking and computer/software availability to students).

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Vincent C. Jones

Vince Jones joined HP in 1979. Now a project manager, his group is responsible for IBM and asynchronous connections to the HP 9000 Computers. Before coming to HP, he specified computer network access and remote sensing systems for the U.S. Air Force and was an occasional consultant to small business computer users. A graduate of Rutgers University (BA and BSEE, 1970), he continued his studies in electrical engineering at the University of Illinois for the MS (1972) and PhD (1975) degrees. He lives in Fort Collins, Colorado, with his wife and three daughters and "enjoys family life in the shadows of the Rockies."

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Stephen D. Scheid

Born in Bryan, Texas, Steve Schied was raised in Phoenix, Arizona, where he attended nearby Arizona State University and received a BS degree in engineering science in 1975 and an MSE degree in electrical engineering in 1978. He then joined HP and

worked on QUERY/45—a data base inquiry program, enhanced microcode for the HP 9845 Computer, and most recently, the virtual memory portion of the Series 500 operating system. Outside of work, Steve is a volunteer instructor and trip leader for the Boulder Mountaineering School. He is married to another HP engineer, lives in Fort Collins, Colorado, and has a variety of pets—among them Amazon parrots, which he breeds. An active outdoorsman, he enjoys rock climbing, mountaineering, cross-country and downhill skiing, snowshoeing, and backpacking—last year he backpacked more than 50 miles across Big Bend National Park from east to west.

Dennis D. Georg

Born in Algona, Iowa, Denny Georg studied at Iowa State University, receiving a BS degree in mathematics in 1971 and the MS and PhD degrees in computer science in 1973 and 1975. After teaching computer science for three years, he joined HP in 1978.

He worked on HP 9000 software and managed the SUN operating system kernel project before assuming his current responsibility as an R&D section manager. His work on the HP 9000 memory system has resulted in two patent applications. A member of the IEEE, the ACM, and the Planning and Zoning Board of Fort Collins, Denny is married and lives in Fort Collins, Colorado. He enjoys fishing, hiking, amateur radio, skiing, and technical reading.

Benjamin D. Osecky

Dan Osecky is project manager for HP 9000 operating system software. Earlier, he contributed to the operating system for the HP 9835 Computer. He is coauthor of a paper on a self-configuring computer network and coinventor for a patent application related to memory management for the HP 9000 Computers. Dan received BSEE (1972) and MSEE (1974) degrees from Virginia Polytechnic Institute and State University, before joining HP in 1976. He was born in Washington, D.C., and is a member of the ACM. Married to another HP engineer, he lives in Fort Collins, Colorado, and is interested in amateur radio, science fiction, hiking, and cross-country skiing.

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Robert J. Bury

A native of Chicago, Illinois, Bob Bury studied computer science at the University of Illinois (BS 1979). He joined HP in 1980 and helped develop the SUN operating system for the Series 500 Computers. A member of the IEEE, he is married, lives in Fort Collins, Colorado, and enjoys gardening, photography, and cross-country skiing.

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Charles E. Mear, Jr.

Charlie Mear studied computer science at Colorado State University (BS 1977) and the University of Texas (MS 1979) before joining HP. He worked on the file system for the Series 500 Computers and currently is working on the HP-UX kernel for the Series 200 Computers. Born in Midland, Texas, he now lives in Fort Collins, Colorado, is single, and is interested in boardsailing, skiing, and golf.

Marcel E. Meier

Marcel Meier joined HP in 1979 after receiving a BS degree in computer engineering from Case Western Reserve University. He worked on the operating systems for the Series 500 Computers before beginning his current work on HP-UX for the Series 200

Computers. He is a member of the ACM. A citizen of both the U.S.A. and Switzerland, Marcel was born in Manitou Springs, Colorado, and now lives in Fort Collins, Colorado. An avid bicyclist, he enjoys touring and pedals to work year-round. He is also interested in skiing, hiking, sports cars, and audio systems.

Robert M. Lenk

Bob Lenk's contributions have resulted in two papers related to a system for software performance instrumentation. Joining HP in 1981, he worked on the I/O primitives and local area network services for the Series 500. Now he is working on the HP-UX kernel for the Series 200 Computers. A member of the ACM, he holds a BA degree in mathematics (1975) and an MS degree in computer science (1981) from the University of Connecticut. Born in New York, New York, he now lives in Fort Collins, Colorado. He is married and likes square dancing and cross-country skiing.

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Donald L. Hammond

Don Hammond was recently named director of Hewlett-Packard Laboratories, Bristol, England. He joined HP in 1959 as manager of the quartz crystal department, and in 1963, he became manager of physical research and development. From 1966 to

1979, he was director of the Physical Electronics Laboratory of Hewlett-Packard Laboratories, and from 1979 until his move to England, he was director of the Physical Research Center of HP Laboratories, with responsibility for R&D in medical and analytical instruments, computer peripherals, factory automation, and lithography. He is a member of the American Physical Society, a fellow of the IEEE, and a member of the National Academy of Sciences evaluation committee for the U.S. National Bureau of Standards and the U.S. Naval Observatory. He holds BS, MS and DSc degrees in physics from Colorado State University. A native of Kansas City, Missouri, Don is married and has five children. He served for ten years on the board of trustees of the Palo Alto, California Unified School District, and has been a member of various presidential, gubernatorial, and industry committees on education and technology.

Coping with Prior Invention

by Donald L. Hammond

THIS MONTH, HEWLETT-PACKARD is introducing a new printer, the ThinkJet (HP 2225), which offers what we believe is an unprecedented combination of features: 150 character-per-second printing speed, archival print on ordinary paper, small size, quiet operation, and low cost—both initial cost and total cost of ownership. Power requirements are so low that one model is available with a battery pack that provides more than three hours of printing, or about 200 pages. These advantages have been made possible by a new ink jet printing technology, which we have called thermal ink jet, or more picturesquely, "ThinkJet," to differentiate it clearly from the more common kind of thermal printing, which requires special paper.

We think the story of this technology development is an interesting example of what can happen in today's fast-moving technological environment. In our HP Laboratories at Palo Alto, in the fall of 1978, John Vaught was looking for a new printing method that would have the advantage of inherent simplicity compared with the rather complex electrophotographic process used in the HP 2680A Laser Printer, for which John had designed the optical scanning package.

He started with the idea of turning ink into vapor by high-speed electrolysis and heating, using pressure to eject drops. When this was found to work but with serious failure rates, he conceived the idea of using a small resistor, which when heated for a few microseconds by a current pulse, created bubbles, thereby ejecting drops of ink from a nozzle. This was first demonstrated in March 1979.

We proceeded to develop this idea, amidst some skepticism that the necessary performance and reliability could ever be achieved. The ThinkJet printer is testimony that these concerns were dispersed by extensive development work in several HP organizations on the process and structure. One of the key concepts, originated at HP's Corvallis Division, was a totally disposable ink jet head

with a self-contained ink supply.

It is not uncommon, when an important problem such as quality printing receives the attention of many people, that independent conception occurs in isolated research centers. Such was the case with ThinkJet. In September 1981 we learned of the existence of the same concept under development at Canon, Inc., in Japan. Ichiro Endo had conceived the idea independently, with an earlier invention date. Canon referred to the technology as "Bubblejet."

Since we in HP were convinced that this new technology had great promise, the arrival of a new player in this arena caused some concern as to our respective technical positions. There were a number of options but the most attractive for HP was to work with Canon. Excellent ties between the two companies had already been established as a result of our acquisition from them of technology for electrophotographic printers several years earlier.

Hewlett-Packard and Canon have agreed to cooperate in the technology development. Because this process started in 1983, the sharing of technical data has had no major impact on our first product release, but we can feel the positive effect that it is having on our continuing developments. Canon has reflected to us similar feelings. Working with a group that represents a combination of cooperation and competition has provided a valuable perspective, especially increased objectivity, for the technical and management teams of both companies.

This experience has reinforced the principle that technology alone can rarely make a significant contribution in this complex, fast-moving world. There are equally valuable elements, sometimes involving the resolution of relationships in the spirit of international competition and cooperation, that can have dramatic effects on our ability to bring that technology to the market.

We will be reporting in a future issue on more details of these developments, including the ThinkJet printer.

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