Mini-MicroSystems
A CAHNERS PUBLICATION
DECEMBER 1983

TECHNOLOGY

Developments in
- Computer architecture
- Microprocessors
- Office automation
- Database technology
- Coprocessors
- Software development
- Artificial intelligence

Also:
IBM moves onto superminicomputer turf
Computer marts scramble for acceptance
How the military helps robot builders

WIDE WORD™

200 MB/second!

World's Fastest Bulk Memory System

It's true. WIDE WORD, Dataram Corporation's new, third generation of its popular BULK SEMI memory systems, delivers an incredible data rate of 200 MB/sec! Achieved by utilizing a word length of 80 or 160 bits and four-way interleaving.

Much faster than even the fastest minicomputers can handle...but not too fast for your real-time applications, image processing, array processing or data acquisition needs.

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WIDE WORD BULK SEMI. 32 MB of high-performance memory in a compact 15¾" system. Word lengths up to 160 bits. And, of course, a data rate of 200 MB/second.

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Minicomputer _____

CIRCLE NO. 1 ON INQUIRY CARD

Introducing COMPAQ PLUS, the first high-performance portable personal computer.

The makers of the COMPAQ™ Portable Computer, the industry standard, announce another breakthrough—the COMPAQ PLUS™ Portable Personal Computer. No other personal computer can handle so much information in so many places.

The new COMPAQ PLUS offers an integrated ten-megabyte fixed disk drive in a portable.

Plus a bigger payload

How much is ten megabytes?

Enough to tackle jobs that can't be conveniently handled on most personal computers.

A mailing list of 100,000 names and addresses.

Information that would fill your company's ledgers can be stored on the fixed disk drive of the COMPAQ PLUS.

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The entire San Francisco phone book, with room left for Peoria.

Your most used programs can be permanently kept on the fixed disk drive of the COMPAQ PLUS, ready to call up and run.

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Your inventory control program and your inventory records can go with you to the factory. Your building specs and your project management programs can go with you to the construction site.

The high-capacity portable multiplies the productivity of every program it runs.

Plus more programs

The COMPAQ PLUS runs all the popular programs written for the IBM® Personal Computer XT, available in computer stores all over the country. And they run with no modification whatsoever.

You're buying a computer to solve problems. Why not have more problem-solving programs to choose from?

Plus a traveler's toughness

A true portable has got to be tough. The COMPAQ PLUS is.

Its fixed disk drive is designed specifically to travel. Rough roads and hard landings don't bother it because a specially designed shock isolation system protects the disk from jolts and vibration.

All the working components are surrounded by a unique aluminum frame with cross-members that strengthen it side-to-side, front-to-back, and top-to-bottom.

Does a portable personal computer really have to be this tough? Take a look at your briefcase and then decide.

Plus a lot more

The COMPAQ PLUS comes with a 360K byte diskette drive for entering new programs and copying data files.

The COMPAQ PLUS also works with optional printers, plotters, and communications devices designed for IBM's personal computer family.

It has two IBM-compatible slots for adding optional expansion boards. With companion programs, they'll let you network with other personal computers, communicate with your headquarters computer files or add memory capacity if your needs grow.

When you see all that COMPAQ PLUS has to offer, you'll be pleasantly surprised by the price. The fact is, it costs hundreds less than comparably equipped desktop personal computers.

See the first high-performance portable personal computer. The COMPAQ PLUS—performance, programs, productivity. Plus problem-solving power.

The problem-solving power of a high-performance desktop personal computer can now go where you need it.

For the name of the Authorized Dealer nearest you, call 1-800-231-0900.

The COMPAQ Portable, the industry standard in portable personal computers. ▼

The new COMPAQ PLUS, the first high-performance portable personal computer. ▼

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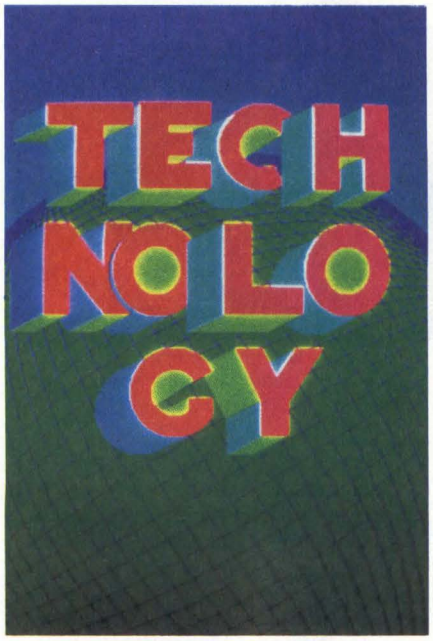
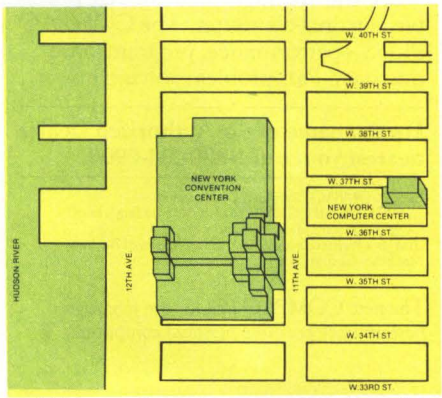


What drives technology? The second annual Mini-Micro Systems technology overview begins on p. 139. Cover art by Tom Norton. Art direction by Vicki Blake.



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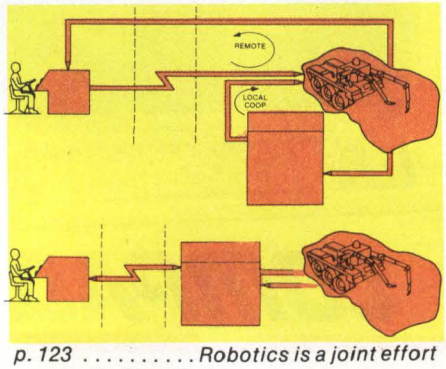

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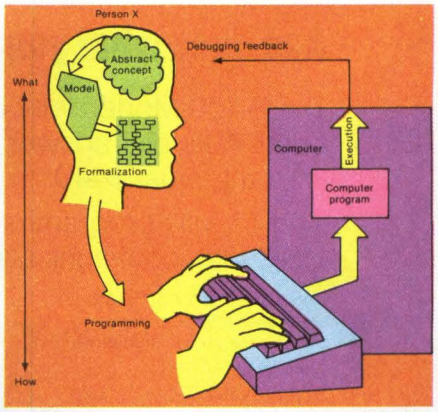

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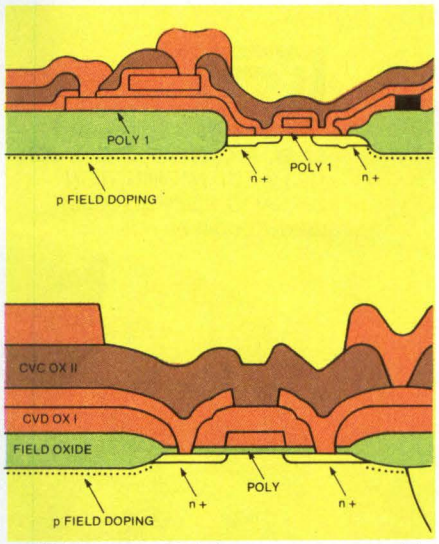

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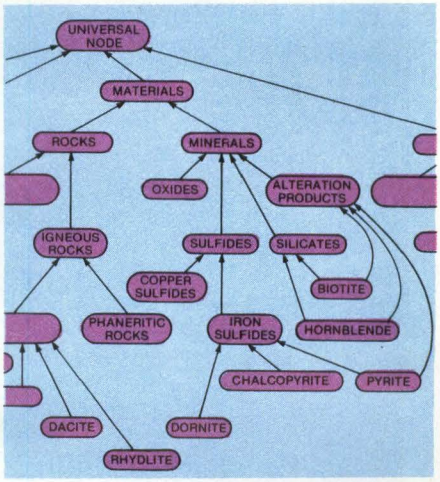

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Our first DEC compatible storage products are second to none.

They had to be good. We knew that, so we put a lot into them. We made sure they had all the important features you've been looking for but could never find until now.

LSI-11 55MB TAPE-STREAMING BACKUP
Take the reliable CS-300, for example. It gives LSI-11 users a large capacity and very cost-effective storage backup for Winchester disk drives. The new system combines one of our powerful peripheral processors with a 1/4 inch cartridge tape streamer based on the new QIC-02 interface of the Archive Sidewinder or Cipher Quarterback tape drives. It fits into any LSI-11 chassis, requires no software driver or diagnostic changes, supports two drives and uses one dual slot. Two configurations are available, a 20MB or a 45MB system (extendable to 55MB).

PDP-11 SINGLE-BOARD EMBEDDED TAPE CONTROLLER
Then there is the high performance TC-200 which is a micro-programmed magnetic-tape peripheral processor designed to support the DEC line of PDP-11 Unibus computers. It is extremely cost-effective, takes only one SPC backplane slot instead of the 2-4 usually required and contains the logic necessary to control four tape drives at speeds from 25IPS to 125IPS. Data is verified while writing with read-after-write error checking logic.

This is just the beginning. We're going to keep coming at you with state-of-the-art developments from our storage products' pipeline which is already full of projects scheduled for early release. For more information call, write or send us the coupon today.

MM 12/83

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CIRCLE NO. 5 ON INQUIRY CARD

COMPUTER STORAGE TECHNOLOGY, INC.

WE'RE A BRAND NEW COMPANY WITH A BRAND NEW PRODUCT.

WATCH EVERYONE DUMP ON US.

And read with us. And design with us. And depend on us.

Introducing the Tandon Tape Drive Company.

We're the newest of Tandon's advanced micro peripherals companies.

Like all Tandon companies, we concentrate all our energies on a single related product line. And like them, we're dedicated to becoming the world's leading producer of what we make best.

That's a pretty brash goal for a company that just built its very first tape drive. But we have the product to back it up.

INTRODUCING THE TANDON TM951 TAPE DRIVE.

What's the world's biggest producer of micro peripheral disk drives doing in the tape drive business?

Building a half-inch tape drive with a capacity of 50 megabytes and an OEM price that's pure Tandon.

Everything about our streaming tape drive is pure Tandon. That's because we have the highest degree of vertical integration of any manufacturer in the business. Which means we can better control our costs and quality.

TO BUILD A DRIVE THIS GOOD, WE HAD TO USE OUR HEADS.

Tandon got its start as a head manufacturer. Our floppy heads quickly became the industry standard. Those are the very same heads we use on our new tape drive.

Our philosophy throughout has been to use evolutionary, rather than revolutionary, tape and floppy disk technology in our new drive. To lower costs and minimize risk for storing your back-up data.

That approach has paid off not only in a low price but also in high data reliability and performance. With a soft

error rate of 1×10^9 and an MTBF of 8000 power-on hours.

FEATURES EVERYONE WILL WANT TO DUMP ON.

Our low cost and high reliability will help us become number one in disk back-up. So will our drive's great features.

The TM951 is the same size as a standard 5¼" floppy drive. It records on half-inch tape on twenty tracks, arranged in a serpentine pattern, using standard MFM format. And dual heads allow instant data verification while writing.

We not only make the drives, we also make the cartridges. From a unique Tandon design, using a video-style, self-threading, single reel for high performance and reliability.

DISK BACK-UP THAT KEEPS COSTS DOWN.

Providing the most advanced technology at the lowest possible price has made all Tandon companies leaders in their fields.

That's exactly how we intend to succeed in ours.

Five years ago our floppy company was a newcomer in a highly competitive market. Today it's the world's leading supplier of 5¼" drives.

That success story gives us a lot to live up to. Which is just what we've set out to do.

For full information on the newest tape drive from the newest tape drive company, call us. It's your chance to dump on us before everyone else does.

Tandon

THE MOST SUCCESSFUL DRIVE COMPANIES YOU EVER HEARD OF.

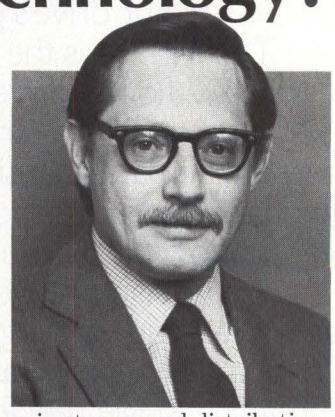
TANDON TAPE DRIVE COMPANY

Tandon Corporation. 20320 Prairie, Chatsworth, CA 91311, (213) 993-6644, TWX: 910-494-1721, Telex: 194794. Regional Sales Offices: Boston (617) 938-1916 • New York (201) 851-2322 • Atlanta (404) 934-0620 • Chicago (312) 530-7401 • Dallas (214) 423-6260 • Irvine (714) 675-2928 • Santa Clara (408) 727-4545 • Frankfurt, West Germany 6107-2091, Telex 411547 • London, England (0734) 664-676 Telex: 848411.

CIRCLE NO. 6 ON INQUIRY CARD

Editorial

What drives technology?



"Science in the service of humanity" is one of the two common ways we define technology. The other is "applied science." Recent events should make us rethink those definitions. *Why* are we "applying science"? *How* do we expect technology to serve us? What are our objectives?

For example, Congress has committed $20 billion over 10 years to fusion research. As a long-time pre-gas-crunch fusion booster, $20 billion—only two-thirds of the amount spent *annually* on the Vietnam War—doesn't overwhelm me. Cheap generation of electrical power, coupled with advances in storage and distribution technologies, would not only conserve dollars but also reduce pollution and prevent translating natural resources into smoke.

If reaching these objectives requires $20 billion—or even a bit more—I'm for it. But the reason fusion researchers want more is not because fusion won't be accomplished without this money, but because Japan threatens to get there first. The Japanese, with minimal natural resources, need fusion even more than we do. Consequently, we might save money by letting the Japanese spend most of the expensive research dollars and, instead, concentrate on down-line development and engineering. While related, the goals of science and the goals of technology are not the same. We should consider this distinction and ponder whether it's worth spending billions to be first or conceding a year to have the best for less.

Consider now a corollary of the previous example. U.S. manufacturers of capital equipment for integrated-circuit fabrication are concerned that the Japanese might beat us at our own game. Japanese manufacturers produced less than 25 percent of the value of wafer-fabrication equipment sold in Japan in 1980, but this year they produced more than 50 percent. Japanese penetration into the U.S. market is also increasing. Significantly, none of this influx of Japanese technology is seen as unique—not even by the Japanese. Instead, it's seen as sometimes faster, usually less expensive, occasionally easier to use, but definitely un-original. Apparently, we develop the science and share the technology; they develop the technology and share the market.

American technology is driven by men and women who invest their time and dollars developing products for which they expect a generous return. Whether a company is technology- or market-driven is less important than the fact that both elements are vital to attain that return.

Japan seems to understand this principle better than we do. The excellence of Japanese nationally-funded research is matched by the excellence of Japan's management. Japan is better at recognizing that research is a limited national resource and that nationally-funded research is best directed toward national techno-economic goals. Little Japanese public money is allocated to the soft, or descriptive, sciences, such as the study of dying languages or the analysis of animal social patterns. Further, Japanese attention to U.S. hard-science developments far exceeds our own. Japanese scientists and engineers read English, receive English-language journals and regularly attend U.S. technical conferences.

The United States cannot continue to play philanthropic wheelwright to a world of increasingly profit-oriented wagonmakers. Publicly-funded research must be more responsible to public goals. We must have more and better mechanisms to capture, analyze, coordinate and distribute offshore technological information. We must wean ourselves from our not-invented-here mentality and discipline ourselves to accept occasional scientific leadership by other countries.

Alan R. Kaplan

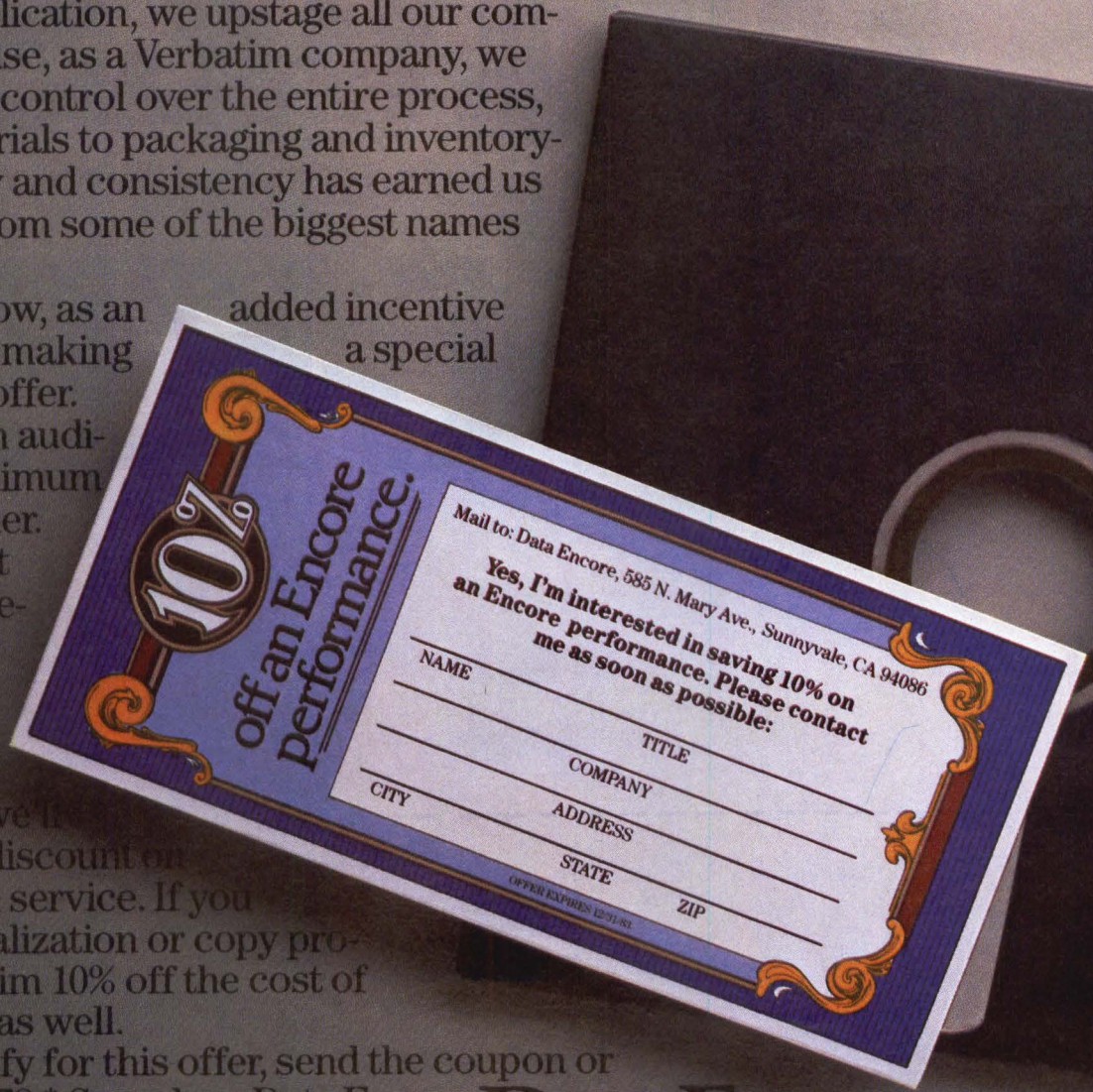
Alan R Kaplan
Executive Editor

Give us an audition for diskette duplication.

Save 10% on the encore.

In diskette duplication, we upstage all our competitors. Because, as a Verbatim company, we have complete control over the entire process, from raw materials to packaging and inventorying. Our quality and consistency has earned us rave reviews from some of the biggest names in software.

Right now, as an added incentive to try us, we're making a special money-saving offer. First, give us an audition with a minimum 1,000 piece order. We're confident you'll like the results so much, you'll want to use us regularly. So, on your second order, we'll give you a 10% discount on the duplication service. If you also order serialization or copy protection, we'll trim 10% off the cost of these services as well.



To qualify for this offer, send the coupon or call 800-872-8778.* See why a Data Encore performance is such a tough act to follow.

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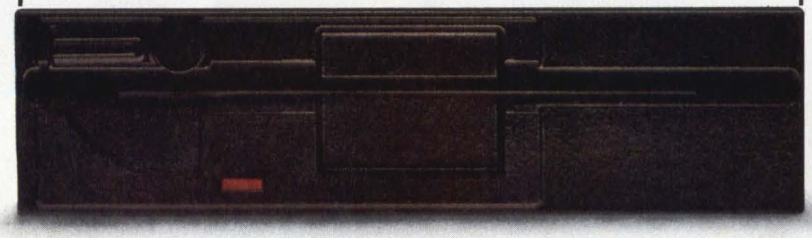
CIRCLE NO. 8 ON INQUIRY CARD

SHUGART DRIVES.

1/2 OFF.

SA810



SA455

No, it's not a sale.

It's just a way of telling the world that Shugart now has a whole line of half-height floppy disk drives.

Half of which are our new 5.25" Minifloppies. Or, if you will, mini Minifloppies.

The SA455/465 double-sided drives.

Both offer improved performance and reliability over conventional minis. And more design flexibility, because of a technology that demands only half as much space.

So you can create smaller, more competitive systems. Or build more storage capacity into existing designs by putting two drives in the space of one.

Moreover, both the 48tpi SA455 and 96tpi SA465 are compatible with their relatives, the industry standard SA400/405 and SA410/460. So there's no need for a major revamping of hardware or software.

And once they're in place, you'll find they use 45% less power than ordinary 5.25" drives. While delivering snappier access times (in the case of the SA465, 3 msec track-to-track). And even better reliability—an impressive 10,000-hour MTBF. A 25% improvement over most full-height drives.

Then there's the other half of the story. Our new 8" half-heights, the SA810 single-sided and SA860 double-sided floppies.

They too give you more performance and reliability out of a lot less hardware.

They too eliminate major redesign. Since the controller interface, mounting holes and internationally recognized DC power supply requirements are fully compatible with the industry standard SA801 and SA851 8" drives.

The SA810/860 are also the only half-heights offering true electrical compatibility with the existing user base of over 4 million 8" disk drives.

And all our half-height drives feature rapid-start direct drive DC motors for better reliability, speed control and longer media life than any other floppy disk drive.

Of course, Shugart still offers the industry's most complete line of full-height floppy and Winchester drives. Plus an extra-economical 2/3-height Minifloppy,™ the entry level SA200.

And our newest small wonder, the SA300 3.5" microfloppy.

All backed by the largest and most experienced engineering, sales and service organizations in the business.

Which is our way of giving you more.

Even if it's only half as much.

For more information, contact Shugart Corporation, 475 Oakmead Parkway, Sunnyvale, CA 94086, 408/733-0100 (Hamilton/Avnet, authorized distributor).

Shugart

Right from the start.

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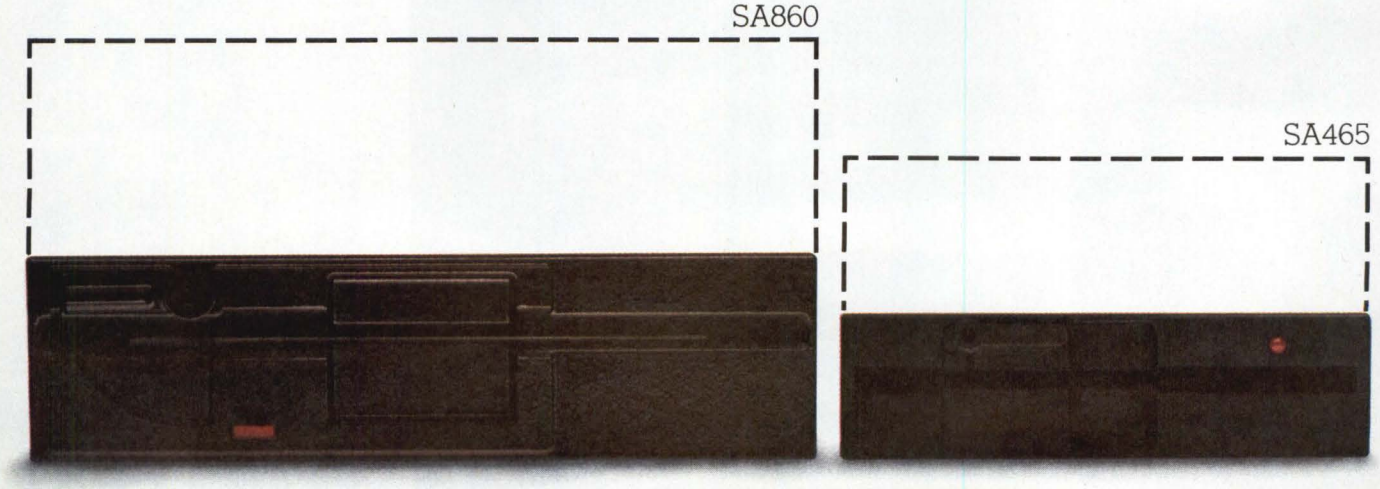

CIRCLE NO. 9 ON INQUIRY CARD

2X the speed, 3X the density, 4X the capacity, ⅓ the cost.

The first low cost GCR Tri-Density Tape System offering large system performance.

Kennedy is, and has always been, the leader in peripheral tape technology. With Model 9400, Kennedy has done it again. For instance:

2X the speed. Model 9400 is a dual speed transport, operating at 45 ips in the GCR mode and 75 ips in the PE/NRZI modes with a maximum rewind speed of 500 ips.

3X the density. The drive utilizes Group Coded Recording at 6250 BPI along with previous industry standard densities of 1600 BPI/PE recording and 800 BPI/NRZI recording.

4X the capacity. In GCR mode, the Model 9400 can store up to 180M BYTES of data (four times more capacity than the traditional 1600 BPI drive).

More? The Model 9400 features multiple processors to separate data handling and control functions. An 8088 processor provides overall system control and accommodates a variety of industry standard interfaces.

Among the many features of the 9400 is its RS-232 communication port and complete internal software which permits off-line diagnostic operations via a terminal, the host computer or by a remote test facility with a phone modem.

1/3 the cost. Best of all, the Model 9400 is priced at about 1/3 the cost of a conventional GCR tape system. Kennedy Company . . . designers of the finest peripheral tape products for 20 years.

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(213) 357-8831 ITT TELEX 472-0116 KENNEDY
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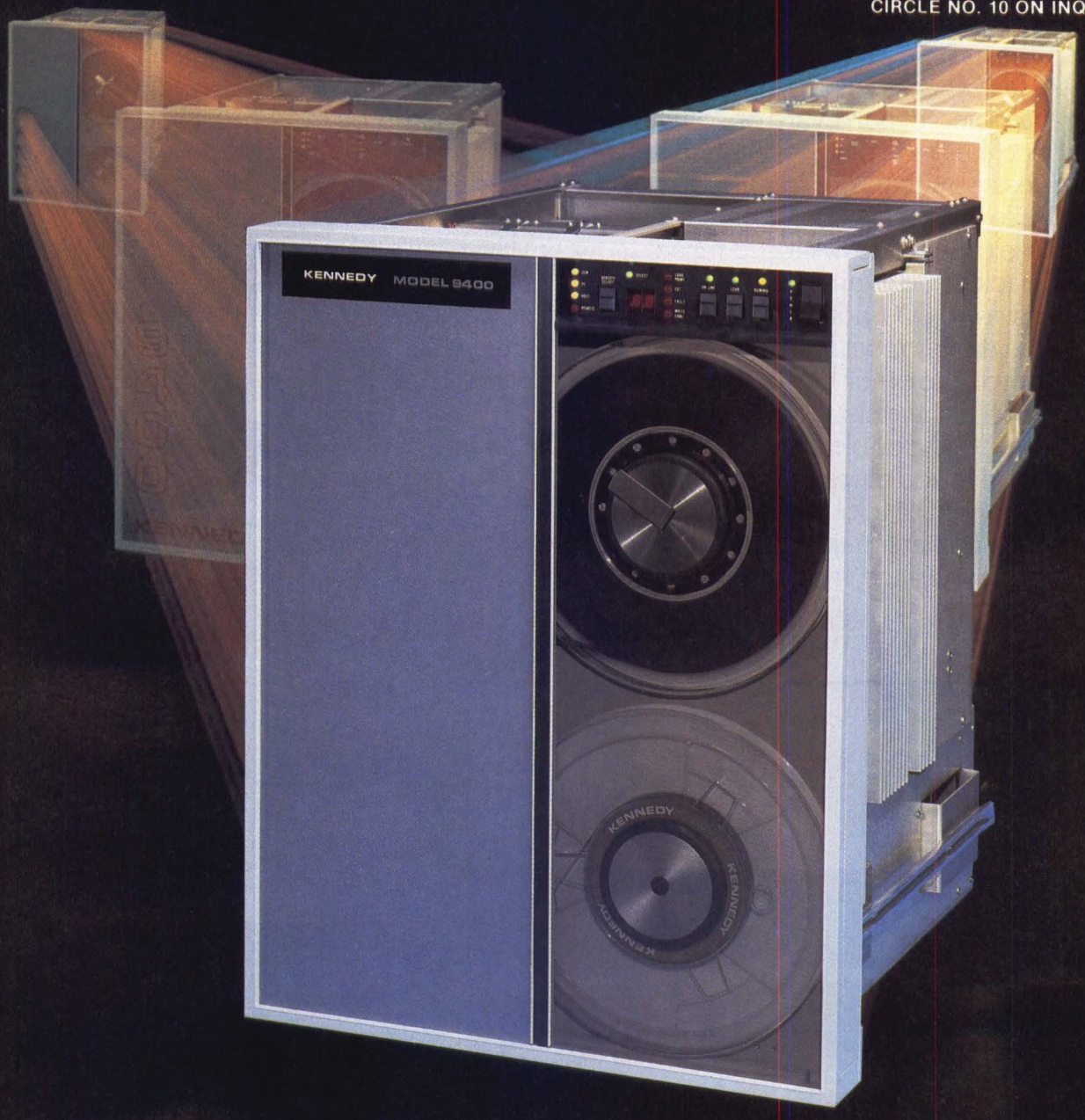

KENNEDY • QUALITY • COUNT ON IT

Breakpoints

FUJITSU OFFERS NEW JUPITER SERIES OF LINE PRINTERS

Undaunted by the failure of any Japanese vendor to make a significant dent in the U.S. line printer market, Fujitsu America Inc., Santa Clara, Calif., will begin offering the new Jupiter Series of band printers in 1984, with evaluation units expected by the second quarter. The M3040, M3041, M3042 and M3043 will print at speeds of 300, 600, 900 and 1200 lines per minute, respectively. In OEM quantites of 250 or more, prices are expected to be $3,300, $4,100, $6,500 and $7,950 for the four line printer models. Fujitsu claims to have achieved a noise level of 55 decibels adjusted (dBa) and a mean-time-between-failures (MTBF) specification of 4,000 hours for the two lower-speed models and 6,000 hours for the higher-speed versions.

DIGITAL RESEARCH ANNOUNCES PORTABLE COMPILERS

Digital Research Inc., Pacific Grove, Cailf., has announced that its line of high-level-language compilers, including a new one that implements a complete and very fast version of FORTRAN-77, will soon be transportable among a variety of microcomputer operating systems. Having modularized the compilers into front-end, code-generator and run-time sections, the company says it can now move them easily to new chip architectures and operating systems. Use of a common intermediate language in the compilers' implementations also aids portability. The $500 FORTRAN compiler should be available this month for Concurrent CP/M and CP/M-86 and in March for PC-DOS. Compilers for Pascal, C, PL/1 and CBASIC should be available soon.

QUBIX INTRODUCES CAD WORKSTATION FOR TECHNICAL PUBLISHING

Qubix Graphic Systems, Saratoga, Calif., is announcing a high-resolution computer-aided-design workstation for electronic technical publishing. The Qubix system uses multiple MC68010 microprocessors and as much as 8M bytes of RAM to manipulate text and graphics directly on its 19-inch, 2,240-by-1,680-pixel monitor. A digitizing pen allows graphics to be drawn directly on-screen, and photographs can be entered through a high-resolution scanner. The system allows fonts to be viewed in exact size and supports all common layout functions. The company expects to ship the system in April. One workstation sells for $70,000, and a four-station system sells for as much as $200,000.

CANON LDP-CX LASER PRINTER TARGETS DAISY-WHEEL MARKET

Speculation about the as-yet-unannounced LDP-CX laser printer from Canon U.S.A. Inc. continues to cause turmoil in the printer industry. The removable-cartridge device, which prints 8 pages per minute with a resolution of 300 dots per inch, and a video interface is rumored to sell for less than $1,000 in OEM quantities. Peter Steiner of market research company Dataquest Inc., San Jose, Calif., believes rumors about the printer may be partly responsible for a recent slump in sales of other low-cost laser xerographic printers from such suppliers as Xerox Corp. and Ricoh of America Inc. Other details of the LDP-CX that have recently surfaced indicate it will employ a semiconductor laser imaging system with dry toner, come with a 120-sheet input tray for A4- or B5-sized paper, measure 475 mm. wide by 415 mm. deep by 254 mm. high (19 by 16.6 by 9.2 inches) and weigh 26 kilograms (57.2 pounds).

Breakpoints

START-UP OFFERS SUB-5¼-INCH WINCHESTER

The sub-5¼-inch Winchester market has an early start-up in Microcomputer Memories Inc., Van Nuys, Calif. The company expects to ship evaluation units of 3½-inch, 6M- and 11M-byte Winchester disk drives in January and full production units in the second quarter of 1984. Control Data Corp. and Rodime Plc. were the only other pre-Comdex entrants in the micro-Winchester arena. "Because we are targeted toward that market and the other players have not made significant shipments, we believe we'll be able to serve the market better," says Rick Eirich, marketing vice president and co-founder of Microcomputer Memories. In addition to the 3½-inch Winchesters, the company will offer 6M- and 12M-byte, half-height, 5¼-inch Winchesters for the same price as that of the 3½-inch drive.

FAIL-SAFE TECHNOLOGY OFFERS FAULT-TOLERANT COMPUTER

Fail-Safe Technology Corp., Los Angeles, expects to introduce its first commercially available fault-tolerant computer system, the Fail-Safe 86, in the first quarter of next year. Adopted from systems the company developed for military applications, the system is based on the Intel 8086 family and will be available in several configurations from a low-end iAPX-8088 to an iAPX-286 system. The Fail-Safe 86 should provide uptime greater than 99.986 percent, according to Fail-Safe vice president of engineering Gary Kravetz. The company also plans to develop the Fail-Safe 86T for applications requiring 99.999 percent uptime, which translates to a mean time to unsafe failure of more than 40,000 years. Prices will start at $10,000, and availability is scheduled for the third quarter of 1984.

MAG/BASE DBMS WILL PROVIDE MICRO-TO-MAINFRAME LINK

Following up its expected Comdex introduction of a multiuser version of the Mag/Base database software package, MAG Software Inc., Canoga Park, Calif., plans to introduce Maglink One and Maglink Two by the second quarter of 1984. Maglink One will allow users of Mag/Base to integrate its database functions with popular spreadsheet, word-processing and graphics software packages from other vendors. Maglink Two will provide a microcomputer-to-mainframe link through which Mag/Base will accept data through a number of standard communications links and integrate it via Maglink One with other application packages. Mag/Base supports CP/M, CP/M-86, Concurrent CP/M, MS-DOS and PC-DOS and should support UNIX as well by the time Maglink is introduced, says MAG Software president Greg Scott. The company expects to offer the Maglink products bundled with the full Mag/Base product for $200 more per package.

CONTROL DATA COURTS RETAILERS FOR DISK DRIVES

Control Data Corp., a veteran of OEM marketing, has plunged into the retail arena with its 5¼-inch floppy, becoming one of the first peripheral manufacturers to sell disk drives outside of a subsystem at the retail level. The company will sell its drives through nationwide ComputerLands and Sears Business System Centers. The company might add other drives, including the 3½-inch Cricket, as well as other microcomputer peripherals, to the retail channel.

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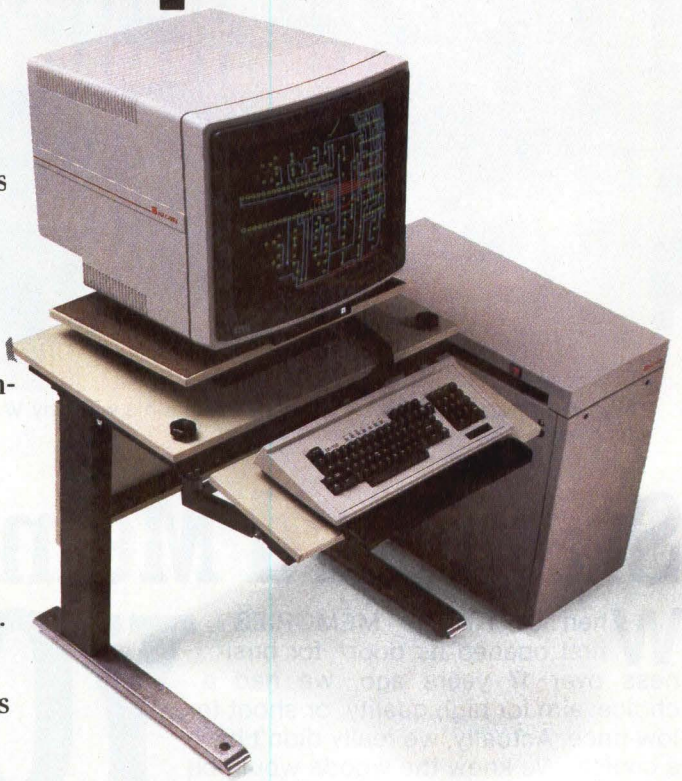

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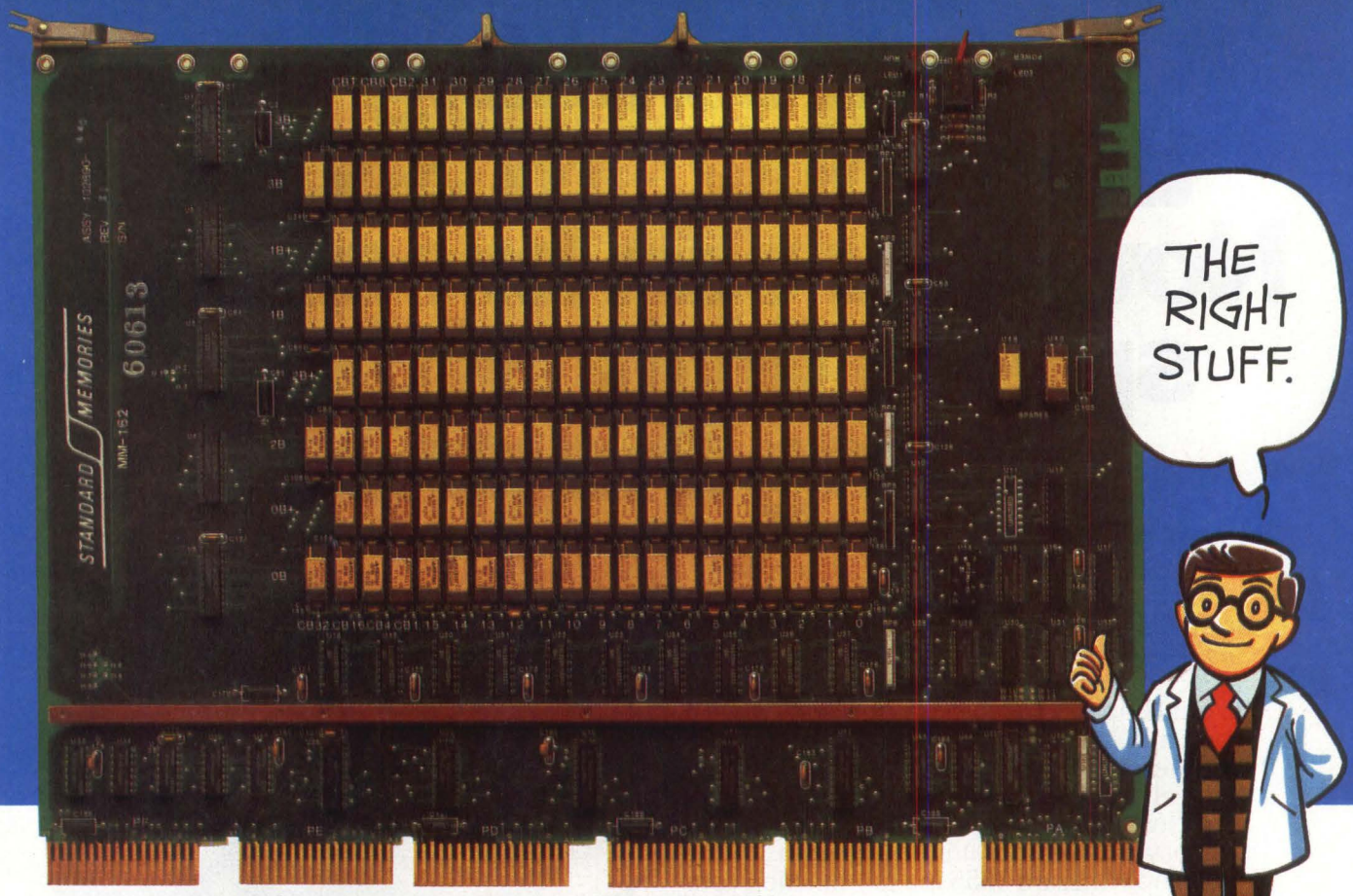

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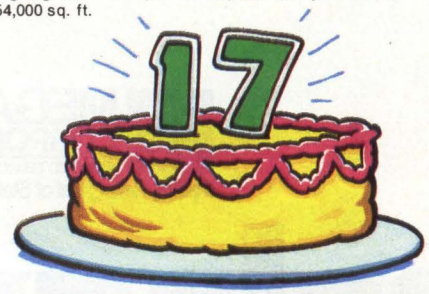

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Breakpoints

TECHFILES: A quick look at industry developments

Terminal files: Further details of the QVT-211GX, the first graphics terminal from **Qume Corp.,** San Jose, Calif., indicate retail price of the unit will be $1,295. The unit is intended for business graphics and previewing computer-aided-design/computer-aided-manufacturing work. The unit emulates Tektronix 4010/4014 commands and is compatible with Tektronix PLOT 10 and Digital Research Inc.'s GSX graphics software packages. It employs a 14-inch diagonal non-glare screen with a green or an amber phosphor, a tilt-and-swivel monitor and a low-profile, detachable keyboard. Resolution is 644 by 288 dots.

Printer files: Unconfirmed reports suggest that the source for the $175 thermal printer introduced by IBM Corp. with its PCjr home computer is Canon U.S.A. Inc. Meanwhile, Spiralux Ltd., Gillingham, England, has been identified as the manufacturer of the 10-cps daisy-wheel printer being offered as part of Coleco Industries Inc.'s Adam home computer system. Spiralux is said to be producing the printers in Skibbereen, Ireland....John R. Morrison takes over this month as president and chief operating officer of **Centronics Data Computer Corp.,** Hudson, N.H., succeeding John Tincler, who left Centronics to become president of Davox Communications Corp., Merrimack, N.H. Morrison, an 11-year Control Data Corp. veteran, was most recently president of Peripheral Components Inc., a joint venture of Control Data and Memorex Corp. Tincler's resignation was said to be unrelated to losses Centronics reported for the third quarter and first nine months of its fiscal year....Another major personnel shift occurred recently when **Ronald Huch resigned as president of Facit Data Products division,** Nashua, N.H., to become president and chief executive officer of DH Technology, Sunnyvale, Calif., a dot-matrix print-head manufacturer. DH Technology, which recently made its first public offering of common stock, is considered the largest independent supplier of dot-matrix print heads in the United States. Huch, who helped found Dataroyal Inc. before it was purchased by Facit and became the Facit Data Products division, will be replaced in Nashua by John Christman, who is now vice president of operations for the division....**Janome Sewing Machine Co.** has introduced its first printer, the CP-1 color dot-matrix unit. The printer uses a new platen technology to produce seven colors at 180 characters per second. Resolution is 120 dots per inch. Retail price of the printer is reportedly $1,055.

Random disk files: The list of licensees for **Drexler Technology Corp.'s** Drexon laser-memory card equipment technology and card-distribution rights has grown to 12. Computer Services Corp., one of Japan's largest independent software companies, is the latest to sign up for the $300,000 non-exclusive license. Others include Fujitsu Ltd., Honeywell Information Systems Inc., NCR Corp., Sharp Corp. and Wang Laboratories Inc. The non-erasable cards, which are about the size of a standard credit card, store 16M bits of data. Price of a card is $1.50. Drexon card readers are expected to sell for less than $100 in large quantities....**Seagate Technology,** which had been expected to introduce its first high-performance, 5¼-inch Winchester at Comdex, switched gears and was expected to introduce instead a very high-performance, 8-inch Winchester drive. The ST-8100 stores 102M bytes on three platters in a half-height package for multitasking, multiuser microcomputer environments. In addition, Seagate was

expected to announce the ST-9100 controller, which can control two disk drives and a ¼-inch tape drive with the company's new high-performance ST-12HP interface. A Seagate spokesman says the company believes high-performance technologies are being pushed to the limit on 5¼-inch drives storing more than 50M bytes, and, consequently, the 8-inch product's biggest advantages will be reliability, manufacturing volume and price....**Drivetec Inc. has developed a second source for its high-performance, 5¼-inch floppy disk drives—Eastman Kodak Co.** Kodak will manufacture Drivetec's 3.2M-byte floppy in "very high volume" at its U.S. Apparatus Division in Rochester, N.Y., which now makes cameras, copiers, and other photographic processing equipment. An indirect Kodak subsidiary, Data Technology Corp., Santa Clara, Calif., will market the drives. (Kodak's Atex software division owns 25 percent of Data Technology). The move is expected to give Kodak an outlet for its high-capacity 800-oersted (Oe) Isomax media, developed by its subsidiary, Spin Physics Co. The first Kodak drives, however, will use conventional 600-Oe media....**International Memories Inc.** (IMI), enjoying the benefits of a recent high-production contract with IBM Corp., discovered that manufacturing 8,000 to 10,000 drives per months isn't fun. The company discovered a glitch in a component—"not having to do with the media." The glitch forced a slowdown in production at IMI's Medford, Ore., production facility from three shifts per day to one until the problem was solved. In the interim, the company suffered in financial markets as rumors about the slowdown persisted. Company officials say production is back on track, and the source of the component, whose identity IMI does not disclose, has assured IMI that the problem is under control.

Graphics files: IBM Corp.'s Graphic Systems Divsion, White Plains, N.Y., has introduced the 5080, its first raster graphics terminal, to accompany IBM's 3250 "stroke" terminal. With a list price of less than $20,000 for monochrome and less than $25,000 for color, the 5080 is expected to compete against the Tektronix Inc. 4115 terminal in the high-performance market. Precision Visuals Inc., Boulder, Colo., has developed a software package for the 5080 that was expected to be introduced at last month's Comdex show.

Micro files: Avram Miller, former group manager of Digital Equipment Corp.'s Professional Computer program, has been promoted to president of **Franklin Computer Corp.,** a manufacturer of Apple Computer Inc.-compatible equipment in Cherry Hill, N.J. A portable computer that is both Apple and IBM PC compatible is expected from Franklin early next year. The company's initial public offering, originally scheduled for fall, was postponed until after the PCjr and Apple MacIntosh introductions....**Xerox Corp. will provide service for the IBM PC XT and DEC Rainbow personal computers and has picked up the service contract for Osborne Computer Corp.'s personal computers.** Service will be through the Xerox Service Group's Americare service program.

Mini files: Interlink Computer Sciences Inc., Fremont, Calif., has introduced the System 3711, which makes IBM 4300 and 3080 series mainframes running the MVS operating system look like nodes in a DECnet network without using the job-control language. Prices of the System 3711, including network-controller hardware and IBM host-resident software, start at $98,500.

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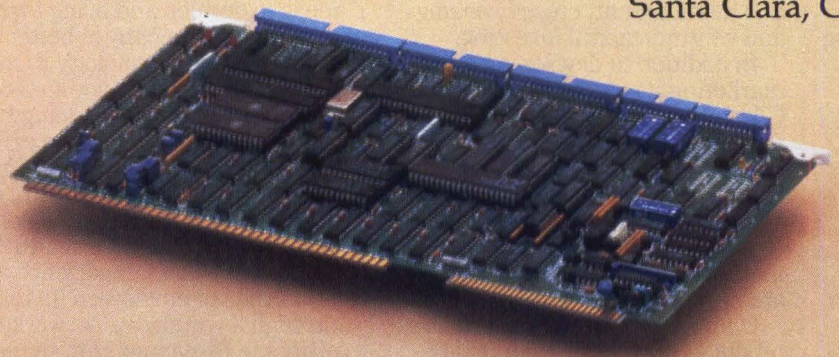

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CIRCLE NO. 14 ON INQUIRY CARD

Breakpoints

Notes from overseas: The second annual Comdex show in Europe received mixed reviews. Comdex officials claim that 15,000—double last year's number—attended the show but admit that tally includes at least 2,000 exhibitors. But industry observers may view those figures with skepticism. IBM Corp. did not exhibit, despite Comdex's assurance it would, and Digital Equipment Corp. vowed its first appearance at the show would be its last. Other exhibitors apparently had the same reaction: only 30 percent of them signed up for next year.

The site and scheduling of the next Comdex/Europe are now in question. Comdex/Europe operations vice president Richard Katzeff says exhibitors and attendees from the Netherlands stated that they would not attend the 1984 show unless the date of it is changed. It's now set for Dec. 3-6. Dec. 6 is St. Nicholas Day, an important holiday in the Netherlands. Comdex is having trouble negotiating an earlier date at Comdex headquarters, the Amsterdam Convention Center, and may have to move the show to Geneva, Switzerland, and move the date back to September. Meanwhile, **the Interface Croup has scheduled Comdex/Japan for March 1985 in Tokyo.**

The owners of **Pick Spectrum** are seeking a location for the first European Pick exhibition next year. They are considering London and Paris for the show, which could give a big push to Pick because the Pick operating system is practically unknown outside the United States. Meanwhile, officials at **Pick Computer Systems** say that months of negotiations have finally panned out—Wicat and Tau Engineering, a part of Suinomo in Japan, are Pick's newest licensees. Both have signed for an MC68000 Pick implementation.

Rexon Business Machines turned up at Comdex/Europe with the new RX200, scheduled to make its U.S. debut this month at a hospitality suite at Comdex in Las Vegas, Nev. The $15,900 12-user system fits between the RX100 and RX400 with 28M bytes of 5¼-inch Winchester storage, expandable to 56M bytes, plus 20M bytes of backup storage. Deliveries of the unit are immediate, but users will have to wait until March or April for the upcoming RX50 desktop, a four-user, entry-level system that uses 128K to 256K bytes of internal memory, 10M- and 15M-byte Winchester drives and a 1.2M-byte, 8-inch backup floppy drive. With two terminals and a printer, the RX50 should sell for less than $10,000. **Rexon is also implementing OASIS-16 to add to its proprietary RECAP and MP/M-86** operating systems. Both the RX200 and the RX50 are set to enter the United Kingdom market under a $1.5 million private-label pact with **Business Computer Systems Plc.** Comdex/Las Vegas will probably get a preview of the 8086-2 board Rexon is testing in Europe to make its RX100s, RX200s and RX400s into dual processors, increasing their speed under RECAP 30 percent to 50 percent. Meanwhile, Rexon officials say **IBM** and **Nixdorf** are evaluating backup units from Rexon's sister firm, **Wangtek, Inc.**

Victory Computer was at Comdex/Europe complaining about the non-availability of the Intel 80186. **Victory's Spirit machine, based on the 80186 chip, is one of the first acknowledged victims of Intel's failure to deliver.** At a loss of $500,000, the start-up has quietly scrubbed the Spirit, focusing instead on its MC68000-based Factor line. Victory president Roger Vass, no newcomer to the business, is highly suspicious of the IBM/Intel relationship. "There's only one cookie factory," he says, theorizing that IBM's massive buys coupled with its ownership position are stretching Intel's resources and forcing it to support some projects at the expense of others.

Breakpoints

IBM has deviated from its norm again. It's building its first company-owned European retail chain in Germany. The first three stores are in Frankfurt, Munich and Dusseldorf, West Germany, and the fourth opened last month in the annex of Karstadt's, a Macy's-style department store in Dortmund, West Germany. IBM moved its PCs, software, manuals, typewriters, salesmen and repair facilities into 100 square meters of space. It has also established a "school" in which the public can get computer instruction for $8.40 an hour. Interestingly, although Karstadt's is one of a handful of big German stores anxious to branch into computers, it won't be receiving any profits from IBM sales.

Osborne Computer Corp.'s board approved a restructuring plan to keep the company afloat. That plan still needed the bankruptcy court's go-ahead at press time. Osborne officials in Europe say they were told the rescue attempt involves additional investments from Osborne's original backers; the departure of founder Adam Osborne and president Robert Jaunich; the installation of a new management team composed of international vice president Ron Brown, international marketing head Jody MacReynolds and international service chief Dave Miller; the assumption of manufacturing by Lanpar Technologies, Toronto; and the spin-off of Osborne's subsidiaries in Germany and the United Kingdom into independent operations. Lanpar, Osborne's Canadian distributor and founder of Osborne Canada, would reportedly then try to move production offshore as soon as possible.

Start-up Massachusetts hardware supplier **Ivy Microcomputer Corp.**, another entrant in the "100 percent" IBM PC-compatible fray, launched its 3001 and 3002 portable offerings, built around the 6-MHz Intel 80186 chip, at the recent Systems show in Munich. Ivy touts its MS-DOS machines as four times faster than the IBM PC running programs such as Lotus 1-2-3. The $3,500 Ivy 3001, weighing 22 pounds, includes two half-height, 5¼-inch floppy drives, and the 25-pound, $4,500 3002 has a half-height floppy disk drive and a 10M-byte Winchester disk drive. Ivy expects to make 25,000 to 30,000 units over the next year and is looking for European distributors.

Victor's Germany subsidiary, the recently rechristened **Victor Technologies GmbH,** launched Vicki, the company's new portable model, which should make its U.S. debut this month at Comdex. The 24-pound system includes a 9-inch screen and two 1.2M byte floppy disk drives. It should sell for around $3,500 to $3,600 in the United States. Production was set to begin by the end of last month. Victor is also going to follow in Apple Computer Inc.'s footsteps and go IBM PC compatible. Victor is developing the electronics so that its 9000 can read the PC's low-level 324M-byte diskettes without sacrificing any features.

Meanwhile, the months-old contract between Victor and its biggest distributor, England's A.C.T./Sirius, giving **Victor** the right to market **A.C.T.'s** new **Apricot** machine in the United States, is being renegotiated. Victor apparently is concerned about introducing another low-end non-IBM-compatible unit. A.C.T. has set up an office in Santa Clara, Calif., put its former marketing manager Chris Buckham at the helm and begun seeking other distribution channels in the U.S. market. A.C.T. North America Inc. is scheduled to attend Comdex with its 17-pound, 8086-based portable computer that incorporates Sony Corp.'s 3½-inch floppy disk drives and runs Concurrent CP/M, MS-DOS, CP/M-86 and a proprietary database-management system with the p-System. Talks have just started between A.C.T. and Victor's European subsidiaries about Apricot's distribution in Europe.

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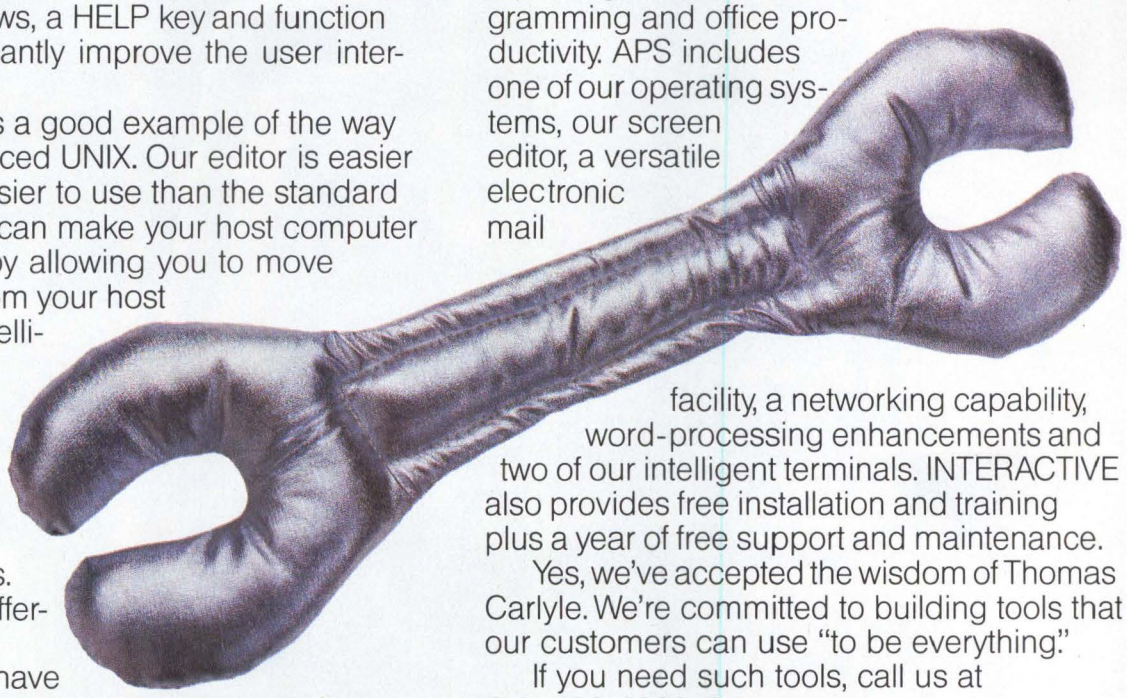

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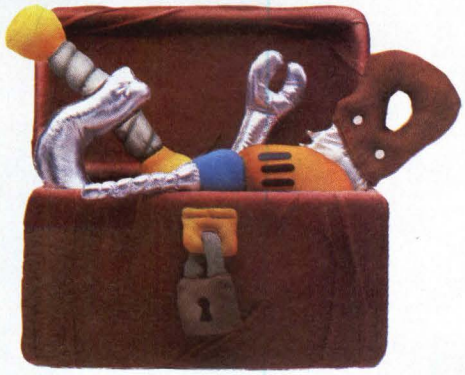

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CIRCLE NO. 16 ON INQUIRY CARD

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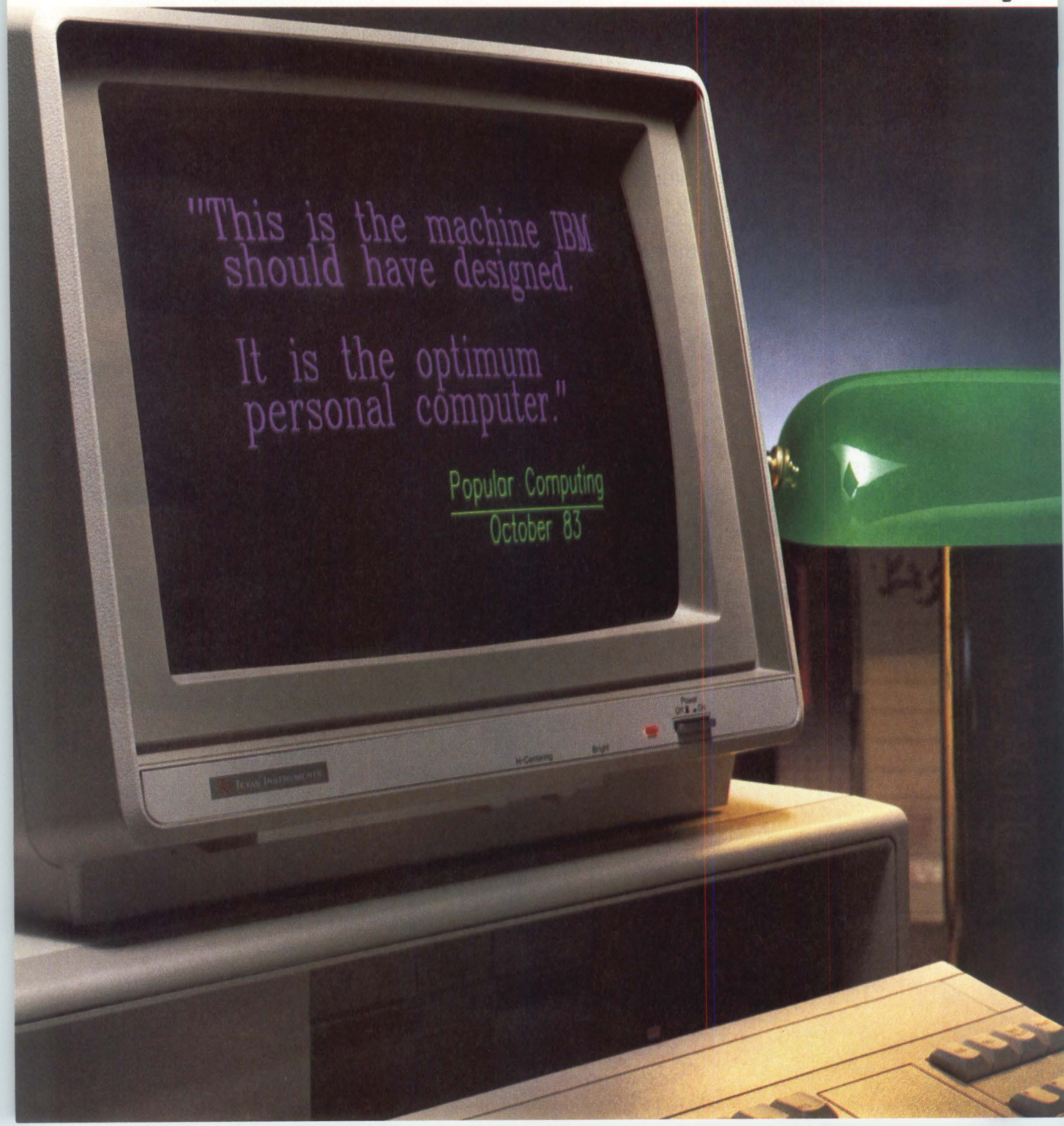

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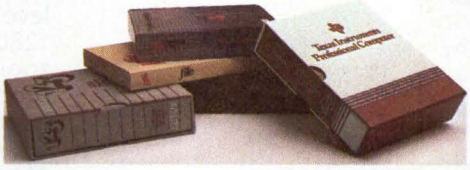

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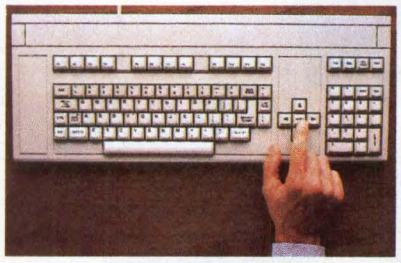

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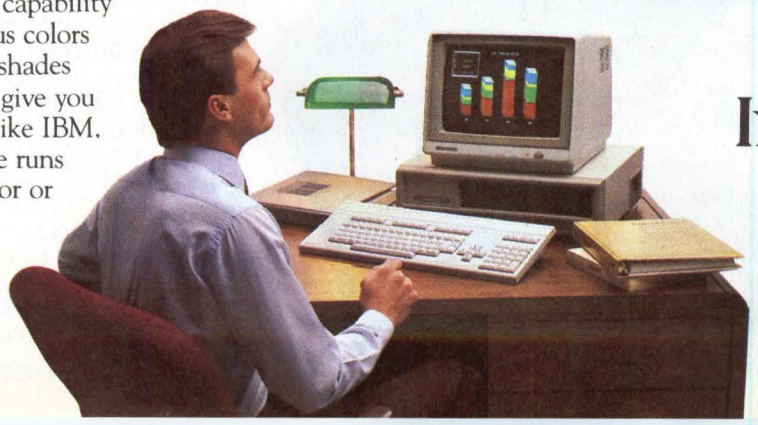

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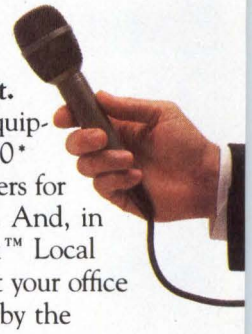

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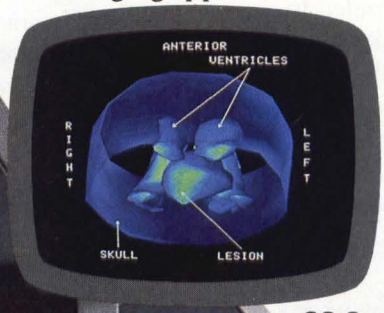

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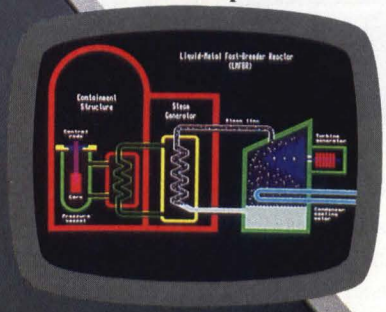

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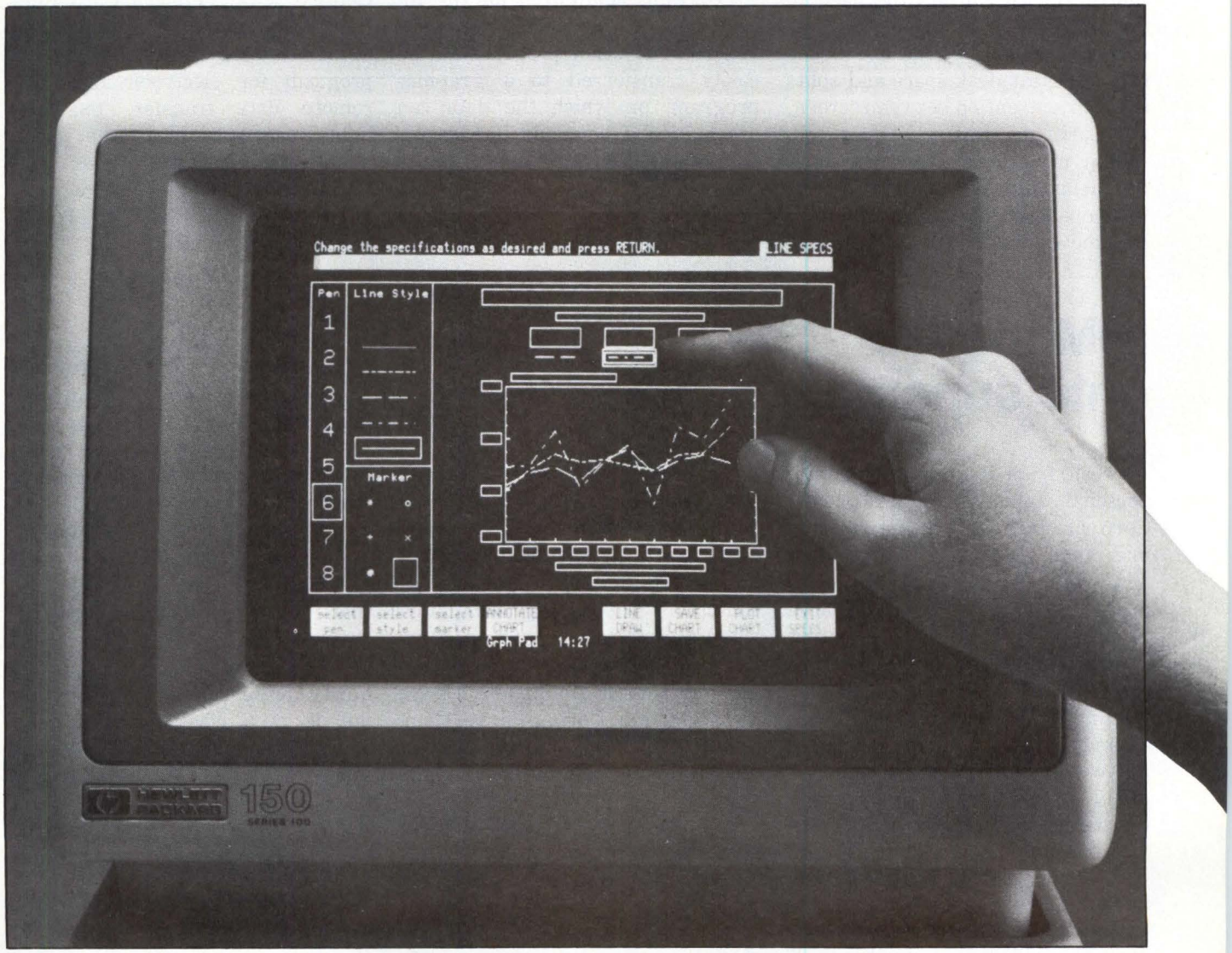
CIRCLE NO. 17 ON INQUIRY CARD

HP PC aims to touch business, consumer markets

In a major but expected shift of direction, Hewlett-Packard Co.'s personal office computer division is introducing the HP 150 touch-screen personal computer—HP's first product aimed exclusively at non-technical markets (MMS, October, Page 29). The introduction reaffirms HP's announced intention to go head-to-head against IBM Corp.'s PC and Apple Computer Inc.'s Lisa in the personal computer market.

Code-named "Magic," the 8-MHz 8088-based system, including 256K bytes of RAM expandable to 640K bytes, a 9-inch bit-mapped CRT display, a detachable keyboard with eight soft keys and a numeric keypad, two Sony Corp. 3½-inch microfloppy disk drives and three I/O ports, sells for $3,995. The I/O ports include two RS232C ports and one HP-IB interface that can support at least seven HP-IB peripherals. As many as 16 HP-IB peripherals can be daisy-chained on the system.

The most striking feature of the HP 150 is its touch screen, which uses horizontal and vertical arrays



Hewlett-Packard Co.'s HP 150 is its first personal computer aimed exclusively at non-technical markets. *Ease-of-use features include eight blocks across the bottom of the touch screen that correspond to the functions of eight soft keys across the top of the keyboard. The system is based on an 8088 processor and runs MS-DOS but is not IBM compatible because of its use of 3½-inch microfloppy disk drives.*

of infrared light-emitting diodes to locate any pointer that interrupts the invisible beams. This means the non-smear screen need not be actually touched for the sensors to be activated.

The main advantage of the touch screen is that it is menu driven, thus eliminating the need for a user to memorize complicated commands for programs. On the HP 150, HP replaces those abstract commands with functional on-screen descriptions. Although a mouse cursor-control device can also be used to drive on-screen menus, HP representatives point out that the mouse requires clear desk space and splits the user's attention between screen, keyboard and mouse. The touch-screen method, by contrast, puts the menus and the user's pointer in the same visual field.

Some of the HP 150's front-end menus use labeled icons. The eight soft keys at the top of the keyboard functionally correspond to eight labeled touch blocks at the bottom of the screen. As the labels on the touch blocks are changed, the soft keys also change function.

In a program called the Personal Card File, the screen presents the image of a rotary card file, and the user selects a card by touching the "index tab" on the screen. The user can then press a touch block labeled "dial number," and a call is placed.

Programs configured for the HP 150 can interact. Data from a WordStar or other program can be easily transferred to a graphics program, on which the data can automatically be made into a pie, bar or line chart. The graphics program resembles Lisa's chart program.

The main objectives of the integrated software/touch-screen combination are ease of use and reduced learning time. However, typists who are used to WordStar or other programs can enter commands in a traditional way.

HP and several major software houses are cooperating to convert what HP says are the most popular programs for personal computers for use on the HP 150. The system now supports MS-DOS 2.0, WordStar, MemoMaker, Microsoft BASIC, dBase II, Lotus 1-2-3, Context MBA, Personal Card File, the Condor database manager and DSN/Link, a data-communications program for electronic mail and remote data transfer. DSN/Link links HP 150s to each other or to mainframes such as the HP 3000. The HP 150 also supports programs from BPI Systems Inc. and Peachtree Software Inc.

IBM moves onto supermini turf

Fresh from its conquest of the personal computer market, IBM Corp. has turned its attention to its mid-range computer line, adding new versions of the 4300 series mainframe computer that threaten to alter the landscape of the 32-bit superminicomputer market. Like the personal computer market, in which it has chewed off an estimated 25 percent market share in two years, the superminicomputer market represents fresh territory. As one veteran IBM watcher puts it, "They can afford to do things radically where they haven't been active."

Whether the new additions to the 4300 line will represent a "radical" invasion of the superminicomputer market won't be known until deliveries begin early next year. However, one early IBM incursion occurred just as the new 4361s and 4381s were being announced: IBM had won an OEM contract at computer - aided - design/computer-aided-manufacturing systems supplier Computervision Corp., beating out Digital Equipment Corp., Data General Corp., Prime Computer Inc. and a number of other bidders comprising IBM's mainframe competition.

Another indication of IBM's intent is the positioning of the 4361. While basically an upgrade/replacement for the four-year-old 4331, the 4361 is also geared to a new market for IBM's low-end mainframe—scientific and technical users who have traditionally bought their superminicomputers from DEC, Prime and DG. The IBM 4361 includes a floating-point accelerator for high-speed number-crunching and is said to have six times the performance of its predecessor, the 4331, in scientific/engineering applications.

In the 4361 model Group 4, IBM has a scientific/engineering system that a First Boston Corp. analyst estimates will deliver a 1.15 million-whetstone throughput in FORTRAN operations, which would put it in a class with the DEC VAX-11/780. The Group 5 version will run at 1.45 whetstones. The price per whetstone is $117,000 for the 4361-4 and $128,000 for the 4361-5, compared with a list price of $139,000 per whetstone for the VAX 11/780. (The analyst adds that his estimates are based on the price of the CPU alone.) He notes that DG—at $60,000 per whetstone on its 2.5 million-whetstone MV/10000—

Some programs written for the IBM PC that do not use IBM hardware can be run with MS-DOS 2.0 in the usual keyboard-driven way, but, because of the Sony microfloppy disk drives, the level of IBM PC compatibility of the HP 150 is relatively low. "The point here is that we've made it very easy to convert software from IBM to the HP 150," says Craig Diserens, engineering project manager for the HP 150.

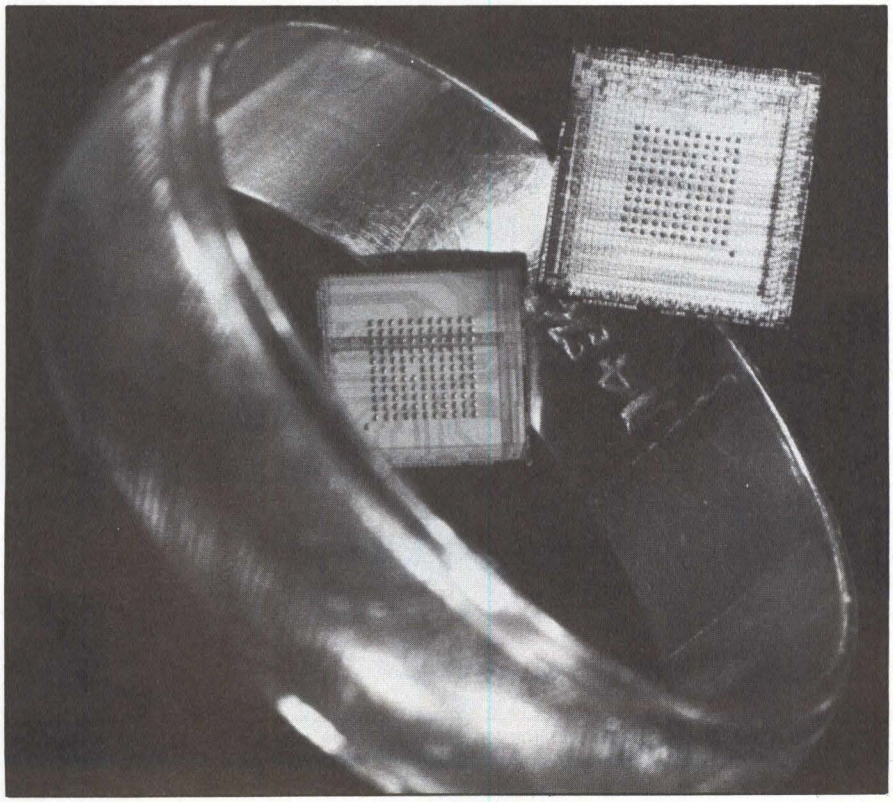
A significant departure from tradition for HP is its new thrust in sales, marketing and advertising. The company plans to begin a $15 million advertising program this fall. HP is also lengthening the amount of time a dealer can have units on its showroom floor before the dealer must pay for the machines. In addition, to encourage cooperation between its direct sales staff and dealers, HP has instituted a system whereby direct sales staff members get commissions from sales in their area even if a dealer makes the sale. HP has also set up a Dealer Advisory Council to provide feedback to dealers.

John Kiefer, senior analyst at Infocorp, Cupertino, Calif., believes that HP has the right formula. "The real significance of the HP 150 is it's the first market-driven product, as opposed to its [HP's] traditional engineering approach," he says. "This is the first product that comes out of the reorganized Personal Computer group; it's getting away from the traditional HP proprietary attitude. It adopted the 8088 and MS-DOS. HP is also working very hard to support the dealers and is opening 70 product centers across the country." He expects HP to up the capacity of the drives to 1M byte.

HP's Diserens expects the system to be successful for a variety of reasons. He cites specific patented features like the touch screen, but adds, "The key is that the 150 has the full commitment of HP throughout the company. Also, there are so many other changes for HP in advertising, marketing and dealer programs that are at least as important as the fact that we have a sharply-engineered machine."

A reputation for sharp engineering has helped make HP a giant at sales of $4.2 billion in fiscal year 1982, but the arena they have chosen pits them against two tough competitors—IBM and Apple. If HP can penetrate the business and consumer markets through its new marketing program, IBM, Apple and HP could provide onlookers with an interesting bout.

—Tom Moran



IBM's 4381 mainframe computer *employs two chips, one of which is designed to boost the system's processing power. Each chip contains 1,100 specially-wired logic circuits, making it one of IBM's densest bipolar chips.*

remains the price/performance leader in the superminicomputer arena. With the introduction of IBM 4361, IBM cut prices of 4331 and 4341 processors by 12 percent and memory prices by 25 percent to $7,500 per megabyte. List prices for the two IBM 4361 models range from $150,000 to $275,000.

While many IBM 4331 users will be able to field upgrade to the 4361-5, 4341 users will have to trade up to the 4381, the so-called Glendale, which fills the gap between the mid-range 4300s and the large scale mainframes, an area that has been successfully targeted by IBM plug-compatible system manufacturers. The 4381s will be available with conversion aids to

give users an introduction to the new VM/XA (advanced architecture) operating system that IBM has implemented on the 308X family. However, the 4381 has not been released to the IBM Value Added Remarketer (VAR) program, IBM's third-party sales channel, possibly an indication that the high-end 4300 is positioned to protect IBM turf rather than to make new advances into minicomputer markets. The 4381, which sports IBM's latest bipolar logic technology, ranges from $370,000 to $620,000.

The IBM 4361 is a value-added reseller product. In addition to Computervision, there are approximately 20 resellers authorized to repackage 4300s and sell them into vertical markets in much the same way that DEC and DG systems are sold. While the IBM 4361 can be substituted for 4331s already on order at VAR accounts, 4300 VAR support representative William H. Bozarth says there is no special program to push the new model. "The 32-bit 'supermini' market is a market we want to be in more fully, and this is a product that gives us a more competitive position there," he says. He acknowledges that IBM sees the 4361 as a powerful machine for engineering and graphics applications but declines to comment on resellers other than Computervision that might use the systems for those applications.

Even if the 4361 doesn't turn the scientific OEM community away from DEC, however, IBM still has a good chance to make its presence felt in the superminicomputer market. Bob Milligan, vice president of sales at VAR Systems Management Inc. (SMI), Rosemont, Ill., says the IBM name carries a lot of clout in the end-user market and that IBM's support programs help sell SMI versions of the 4300 which run the Pick operating system.

"It's the name on the box that counts. To the OEM community, a vendor's reputation is the most important single factor—well ahead of price and performance—in selecting hardware," asserts Aaron Goldberg, information system research manager for International Data Corp. (IDC). "It has a very important impact on the superminicomputer market, especially in light of the bad press that most of the industry has been suffering." Goldberg won't predict who will be affected most severely, but other observers suggest that it may be Prime, which relies more heavily than DEC or DG on direct sales to large end users.

Prime vice president of systems marketing Gale Aquilar says, "The announcement wasn't greeted with panic, but it wasn't greeted with giggles either. Any time IBM says it is entering a market, you've got to take them seriously." But he points out that IBM has left intact a substantial—if reduced—price differential between its systems and the superminicomputer competition. That gap was at one time 200 percent to 300 percent, depending on the application, and now has shrunk to perhaps 30 percent to 50 percent, he estimates. "I see these systems as an attempt to redress some of IBM's earlier shortcomings, but they really don't go far enough," Aquilar comments. IDC's Goldberg explains that the IBM 4331 has been criticized for its relatively slow input/output speeds and weakness in interactive processing.

One area in which IBM has not

IBM's 4381 mid-range computer *is the top of the 4300 line and is believed to be positioned as a protector product for IBM's mainframe business rather than as a scout product for the minicomputer arena.*

been noticeably competitive among superminicomputer suppliers is software. IBM still charges initial fees, monthly license charges and monthly support fees for operating systems that are often bundled into the price of the minicomputers, a Prime competitive analyst points out. As a result, minicomputer suppliers as a whole tend to offer ownership at a lower cost.

Jan Pieter Scheerder, technical products division marketing manager at DG, maintains that DG still has a 2:1 price/performance advantage over IBM, but concedes the gap is closing. Like Aquilar, Scheerder sees IBM as having continuing shortcomings—especially in the area of systems software. "Its basic operating systems are still batch oriented. There are plenty of scientific jobs that can be done in batch mode, but the world has changed, and engineers want to get instant terminal response, as they do with interactive minicomputers," he says.

Scheerder claims that DG will have an advantage in defending itself against IBM because DG's high-end MV/10000 goes beyond the VAX-11/780. He reasons that any scientific or technical customers who look at IBM's new offerings will do so only because they have outgrown their current suppliers.

A fundamental problem with the IBM 4300, suggests Bill Rosser, an analyst with the Gartner Group Inc., is the degree of complexity involved in its use and installation vs. superminicomputers in distributed-data-processing sales. While that complexity may not dissuade scientific/technical users from buying new 4300s, Rosser characterizes IBM's play for the largely DEC-dominated scientific market as "wishful thinking." He attributes the Computervision sale to DEC's slowness in topping off the VAX line and Computervision's desire to link up to IBM installations at its customers' sites.

"What is significant about the new 4300s," Rosser continues, "is the dependence on IBM to get some additional revenues from the mid-range systems. It still needs growth outside the mainframe area (and beyond the relatively insignificant —for IBM—contributions of the PC program)." Rosser concludes that, to a great extent, the 4361/81s are aimed squarely at the installed base, which Gartner estimates reached 27,000 units by the end of last year. As a result of the new additions, he expects IBM 4300 sales to hit 4,000 units next year.

—Geoff Lewis

DEC, Motorola, NSC lead joint research venture

A joint research venture, the Microelectronics and Computer Technology Corp. (MCC), backed by more than a dozen U.S. manufacturers, has been formed to meet the Japanese computer challenge (see "U.S. government programs will parallel Japanese fifth-generation AI research," Page 97). Major supporters of the venture include Digital Equipment Corp., Motorola Inc. and National Semiconductor Corp. Loosely covered by the fashionable term "fifth generation," key research areas include advanced computer architectures, knowledge-based software productivity tools and computer-aided-design (CAD) systems for advanced high-density integrated circuits.

MCC's research laboratory will be in Austin, Texas. Bobby Inman, former deputy director of the Central Intelligence Agency, is president, and Thomas Gannon, director of technical development programs at DEC, is research program director.

MCC's advanced architectures program, dubbed Alpha-Omega, will attract average funding of $18 million per year for eight to 10 years. The laboratory will investigate applications for parallel multicomputer configurations in voice and pattern recognition, expert systems, inference machines and knowledge-based systems—technologies being investigated by Japanese companies in cooperation with the government-funded Institute for New Generation Computer Technology (ICOT) (MMS, October, 1982, Page 141). Like the Japanese, the MCC will evaluate parallel architectures implemented as data-flow machines.

The software productivity program is scheduled to receive $60 million to $80 million over an eight-year period. Its main charter is to deliver an application development system (ADS) based on expert-system technology. It will be designed so that MCC members can add application-oriented knowledge databases for their own needs. The aim is for application programs to be created as a user describes problems. An accountant, for example, would build an accounts-receivable system by inputting to the ADS the same information he normally would supply to a programmer.

The eight-year CAD program will receive $11 million per year. Its goal

DEC'S APPROACH TO AI

Artificial-intelligence (AI) pioneer Edward Feigenbaum of Stanford University sees Digital Equipment Corp.'s work on AI as "very convincing." DEC has implemented several in-house expert systems programmed in the OPS language and running under VAX/VMS. Arnold Kraft, Solutions Group manager with DEC's intelligent systems group, explains that OPS, developed on the LISP AI language at Carnegie-Mellon University, is available to DEC users. Kraft adds that Carnegie-Mellon was also the source of the Schema Research Language, which DEC uses to map information flow. DEC is also employing LISP and LISP derivatives.

Three of DEC's expert systems in operation at company sites—XCON, XSEL and XSITE—assist configuration engineers, salespeople and site planners, respectively.

In prototype form are an intelligent scheduling assistant (ISA) and an intelligent project-management system (IPMS). DEC's central engineering division is using the IPMS for developing a CPU. ISA handles problems such as order cancellations, substitutions and prioritization.

Other prototype systems include the intelligent diagnostic tool, the intelligent system for refining and implementing organizational processes, the intelligent long-range planning system and the intelligent business system.

A SAMPLE DEC XCON RULE IN ENGLISH USED BY SYSTEM CONFIGURATION ENGINEERS

IF: THE CURRENT SUBTASK IS ASSIGNING DEVICES TO UNIBUS MODULES
AND THERE IS AN UNASSIGNED DUAL PORT DISK DRIVE
AND THE TYPE OF CONTROLLER IT REQUIRES IS KNOWN
AND THERE ARE TWO SUCH CONTROLLERS NEITHER OF WHICH HAS ANY DEVICES ASSIGNED TO IT
AND THE NUMBER OF DEVICES WHICH THESE CONTROLLERS CAN SUPPORT IS KNOWN

THEN: ASSIGN THE DISK DRIVE TO EACH CONTROLLER
AND NOTE THAT EACH CONTROLLER SUPPORTS ONE DEVICE

Arnold Kraft, Solutions Group manager with DEC's intelligent systems group, *reveals that DEC is using its intelligent project-management system (IPMS) prototype expert system for developing a CPU.*

is to achieve design times as low as one month for chips holding as many as 10^7 transistors. Such a prototype system is scheduled for 1988.

Because such highly complex circuits will have more I/O connections than current devices, current single-in-line and dual-in-line packaging methods must be improved. Therefore, a fourth MCC program will concentrate on packaging techniques such as tape-automated bonding, which dispenses with one-at-a-time wire bonding of a chip to the rest of a package. Tape-automated bonding can accommodate as many as 700 connections per device because it uses surface mounting rather than bulky pins.

—Keith Jones

Distributor plans to manufacture its own PC-compatible systems

With distributors and retailers throughout the United States complaining that they can't get enough IBM PCs to meet customers' demands, it is small wonder that new PC look-alikes seem to be mushrooming wherever one cares to look. It shouldn't be too surprising that some distributors are beginning to think about producing PC-compatibles themselves.

Compushack, Irvine, Calif., is perhaps the first distributor to get into the act. Compushack, which runs 20 retail outlets in the United States and abroad and has recently begun franchising, will offer three private-label PC-compatible systems called the Tava series. They're scheduled for production this month.

"Everyone is looking for IBM compatibility now. Those who have it succeed, and those who don't are

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*Scheduled availability January, 1984.

falling by the wayside," says Compushack chairman Perry Lambda. "If we sell it for 30 percent or 40 percent less than IBM does, we think a lot of our customers will be willing to do without the IBM logo."

The Tava desktop computer will come in a basic configuration with 64K bytes of memory, expandable to 256K bytes, one parallel and two serial ports, five IBM-compatible expansion slots and a keyboard for $995. Floppy disk drives and a monitor are optional. The Tava PC 1, a portable version, will have the same features as the desktop with a built-in 9-inch video monitor and two slim-line 320K-byte floppy disk drives for $1,995. The Tava Executive PC will have 256K bytes of RAM, expandable to 516K bytes, two 320K-byte floppy disk drives, a workstation and Compushack's Supernetwork built in, providing networking of 16 terminals at a base price of $2,995 per system. Operating systems on all models are MS-DOS 1.1 and 2.0 plus CP/M-86.

THE TAVA SERIES PC-COMPATIBLES

Model	BASIC Desktop	Executive PC
Memory	64K bytes, expandable to 256K bytes	256K bytes, expandable to 512K bytes
Monitor	Optional	WORKSTATION
Mass storage	Optional	Two 320K-byte floppy disk drives
Misc.	1 parallel, 2 serial ports 5 expansion slots, keyboard	SUPERNETWORK
Price	$995	$2,995

BASIC Desktop and 9-inch monitor, two 320K-byte floppy disk drives = PC1 Portable at $1,995

All three systems support MS-DOS 1.1 and 2.0, CP/M-86.

Compushack will do all final assembly, burn-ins and testing at its Irvine headquarters. Lambda is confident that his company's venture into manufacturing will be accomplished in fairly short order. "We are a small company, and we can react quickly to problems or changes in the market. We will have 200 units available by mid-November. When we get up to full production, we expect to be able to produce up to 2,000 units a month." If greater production is needed, says Lambda, the company has an arrangement with a Japanese concern to manufacture additional units. He anticipates Compushack will be introducing new products as often as every three months to keep abreast of the market.

Compushack is offering the Tava *IBM PC-compatible unit because it can't get enough PCs to meet customer demands.*

While the Tava series of computers will run most software programs intended for the IBM PC, claims Lambda, plans also call for Compushack to introduce its own bundled software for the products during the first quarter of 1984. He adds that the company also plans to set up a nationwide network of service centers through Compushack stores and selected dealers who may also carry the Tava brand.

Compushack stores have sold the IBM PC in the past, although they do not have an IBM Corp. franchise. "We will continue to sell IBM PCs if we can get them," says Lambda. "If we had an IBM franchise, we probably wouldn't even have thought of bringing out the Tava line." —*Edward S. Foster*

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AVG.POSITIONING TIME (ms)	27	18	20	70	83
TRANSFER RATE (K Bytes/s)	1,012	1,859	1,229	593 / 1,200*	625
INTERFACE	SMD	Modified SMD	SMD	SA4000	ST506/SA4000
POSITIONING METHOD	Rotary Voice-Coil	Rotary Voice-Coil	Rotary Voice-Coil	Buffered Stepper	Buffered Stepper

*48 M Bytes Configuration available only in 1200 K Bytes/s

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Roger:
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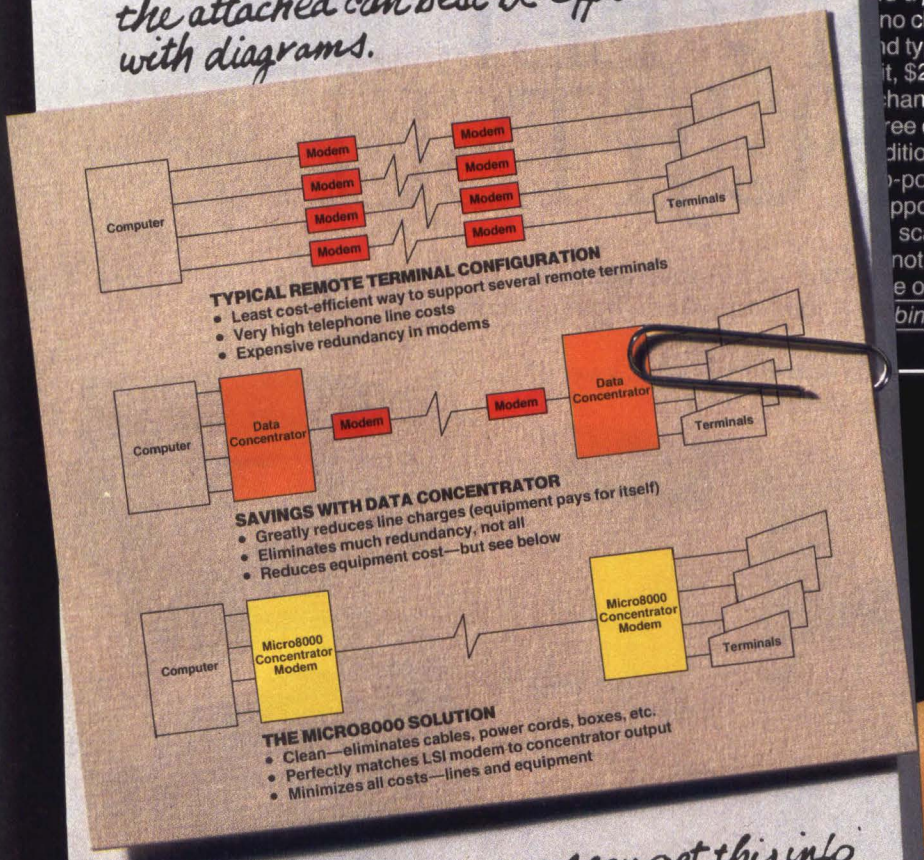

Isn't there some way we can get this info across without botching up the ads?

I doubt it! Roger

chris

e's a more cost-efficient way to support multiple remote terminals on your minicomputer—DEC, ata General, HP or any other—a way that gives ou the best of all possible worlds.

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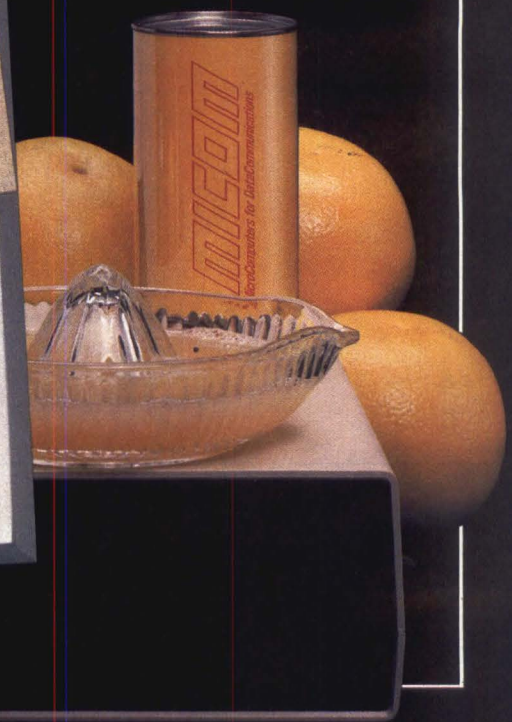

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CIRCLE NO. 20 ON INQUIRY CARD

HEARD ON THE HILL

By Stephen J. Shaw
Washington Contributing Editor

Computer crime legislation is falling into place

Designing federal legislation dealing with computer crime suffers from the same problem as fitting a square peg into a round hole, namely, how does it fit?

"At the end of [a computers and law course at Columbia Law School], many of the students, along with me, confess to ignorance of what computer crime is, what its dimensions are and what, if anything, needs to be done about it," Professor Milton R. Wessel testified before a U.S. House of Representatives subcommittee on civil and constitutional rights.

Capitol Hill lawmakers are facing the dilemma with several pieces of legislation to address the increasing use of minicomputers and microcomputers for illegal purposes.

Neal Patrick, the 17-year-old "hacker" who engineered the break-in of an unclassified computer at the Los Alamos, N.M., nuclear laboratory, testified in September at informational hearings held by the House subcommittee on science and technology. He provoked gales of laughter after being asked when he first felt any qualms about his activities. "When the FBI showed up at my door," he replied.

For others, the problem of computer piracy is far more serious. A study by the General Accounting Office pegs the total "computer-related crimes in federal programs" at $2.2 million, with an average loss per incident of $44,110. Another study estimates the annual cost of computer abuse at $300 million, with an average loss per incident of $450,000.

A Louisiana businessmen recently recounted to the House small business committee how an employee of his money-order company created phony computer accounts to divert funds. The total swindle was $100,000. The employee was eventually caught, prosecuted and convicted but not under any computer-piracy statutes. Instead, he was tried under state breaking-and-entering laws after he went back to the company at night to cover his tracks and was caught illegally entering the building.

The incident illustrates a prevalent school of thought on Capitol Hill: criminal statutes can be adequately applied to cases involving illegal computer use without the need for special federal legislation. Embezzlement is embezzlement, the thinking goes, whether it is accomplished with a pencil or a computer.

Rather than draft a bill regulating computer use, Rep. Ron Wyden, D-Ore., has introduced legislation that calls for a government/industry task force to advise small businesses on how to protect their computer-based assets from unauthorized access. The House small business committee unanimously approved H.R.3075, the Small Business Computer Crime Prevention Act, in October. The act is awaiting action.

Others advocate legislation dealing more directly with computer-related crimes. These proponents of "the-computer-as-a-gun" approach view general criminal statutes as ineffective deterrents to computer crime. "Computers are often being used like guns with the intent to cause injury," comments Dan Brooks, an attorney specializing in computer law.

Rep. Bill Nelson, D-Fla., has sponsored H.R.1092, the Federal Computer Systems Protection Act, which sets stiff penalties for illicit computer activities. Under the bill's provisions, anyone convicted of tampering with computers in federal agencies, financial institutions that are federally guaranteed or companies with interstate computer networks are subject to fines as high as double the value of the gain, or $50,000, whichever is greater, and as much as five years in jail. For criminal damage of those computers covered and for computer tampering with the intent to deny access to authorized users, the bill also calls for $50,000 penalties and five-year jail terms.

Sen. Paul Trible Jr., R-Va., has introduced an identical version of Nelson's bill in the U.S. Senate.

Two other pieces of legislation now being considered by Congress have computer piracy implications. H.R.3181 and H.R.3570, now before the House subcommittee on crime, deal with credit- and debit-card fraud. Both contain language that would make it a federal offense to produce, buy, sell or transfer a fraudulent device to access computers.

As more criminal abuses of computers come to light, federal lawmakers are under increased pressure from prosecutors, law-enforcement agencies and computer-user organizations to enact specific computer-crime legislation. At the same time, courts are growing increasingly sophisticated in applying criminal statutes to cases of computer piracy. Gradually, the round hole is being expanded to accommodate the square peg, whose edges may not be so sharp after all.

Wyse, Esprit terminal add-ons span gap between CRTs and microcomputers

Last month, Wyse Technology and Esprit Systems Inc. were scheduled to join the growing fleet of CRT terminal builders sailing into the uncharted waters between the relative calm of the traditional CRT terminal market and the maelstrom of the desktop computing market. Wyse is moving into the systems market with the WY-1000, an Intel 80186-based microcomputer attachment that will be sold with the company's WY-50 and WY-300 ASCII terminals. At $2,495 the WY 1000 package includes the WY-50 14-inch CRT terminal, dual half-height, 5¼-inch floppies, 128K bytes of RAM (expandable to 256K bytes),three ports and the MS-DOS or Concurrent CP/M-86 operating system. With the WY-300 color terminal, a color graphics personal computer workstation can be configured for $3,095.

Wyse director of marketing for systems products Jim Munro stresses that the two-year-old terminal manufacturer is not entering the personal computer market directly. Instead, Munro says, the company is offering its OEM customer base standard products and options that enable OEMs to offer their customers a variety of workstations ranging from a simple, low cost ASCII terminal to a high-end color business graphics workstation. So, while the WY-1000 uses IBM PC-format floppy disks and is offered with the IBM-like MS-DOS operating system, it is intentionally not a PC clone. For one thing, it does not support IBM PC add-in cards and, more significantly, is not headed for the retail computer stores in which it would compete with IBM and IBM-like systems. Munro also notes that a hard disk version, due in the first quarter of next year, will be carefully positioned as a high-end workstation and will not be a multiuser cluster. With that positioning, Munro points out, the system will not compete with the multiuser microcomputers that many of Wyse's OEMs sell and with which Wyse is wise not to compete. Production was set to begin late last month.

Wyse Technology's WY-1000, *based on the Intel 80186 16-bit microprocessor, provides Wyse ASCII terminals, such as the WY-50 (left), with personal computing capabilities. With the $695 WY 50, the package sells for $2,495.*

In addition to system manufacturers such as Digital Equipment Corp. and IBM Corp., which have offered add-on PC capability for VT100 and 3270 terminals, other terminal manufacturers are ready to offer products that bridge the gap between terminals and personal computers. Esprit, the spin-off of Hazeltine Corp.'s terminals division, planned to introduce a terminal at the recent Fall Comdex show. The terminal, as yet unnamed and unpriced, can be field-upgraded to a desktop computer. It reflects what Esprit president John Sasso observes as significant changes in the microcomputer business, which favors high-volume terminal manufacturers. While Hazeltine Corp., Applied Digital Data Systems (ADDS) Inc. and Beehive International all found rough going in the systems market of the mid to late 1970s, Sasso says, there is now standard hardware and operating-system software. The Esprit system uses an Intel 8088 microprocessor and MS-DOS, one such de facto standard.

Sasso also points out that Esprit's primary sales channel—industrial distributors—is clamoring for microcomputer products and would prefer to buy them from the same source from which they buy their CRT terminals. In addition to offering them a personal computer, Sasso says, Esprit will later introduce a multiuser system clus-

EMULEX TALKS DEC 8

REEL (TO REEL) ALTERNATIVE...

The new Emulex TC7000 tape coupler is more than just another emulation of DEC peripheral hardware for VAX-11/750 or 780 systems. Like every Emulex disk, tape or data communications controller, it gives you performance and cost advantages that no other product can match. Re-marketing or using a VAX-11/750 system? The TC7000 coupler allows you to move up to the higher densities and transfer rates of state-of-the-art GCR tape transports. Backing up a VAX-11/780 system? The same TC7000 gives you a choice of three tape densities—800-bpi NRZ, 1600-bpi PE or 6250-bpi GCR. In any combination. In a single tape subsystem, connected to a single plug-in board.

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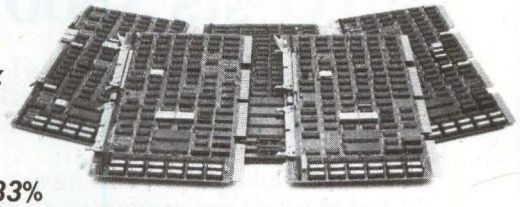

And here's good news for LSI-11 users. With your support, Emulex is now one of the country's leading suppliers of DEC-compatible hardware. With production soaring, it's time to pass along a part of the savings in production costs by reducing prices across a broad spectrum of LSI-11 disk and tape products. Price slashed 33% on the popular TC02 tape coupler. Additional savings of 21% to 32% on UC01, SC02 and SC03 controllers. Phone your nearest Emulex representative for details—and watch this space for even more good news from Emulex.

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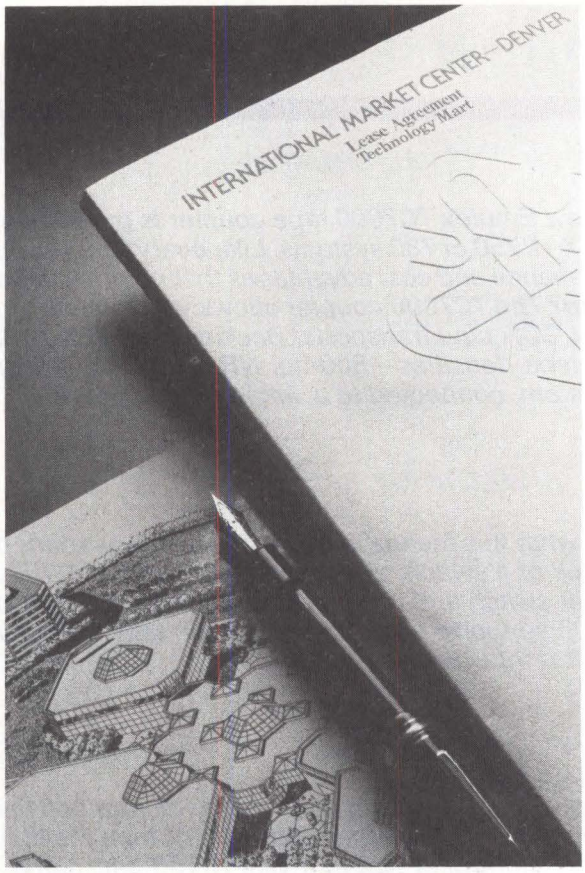

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1982	1,700	7,600	1,800
1981	1,300	5,800	1,400
1980	900	4,500	1,100
1979	319	3,800	1,000
1978	570	3,500	550
1977	39	2,750	400

Source: The Venture Capital Journal

tered around a hard disk storage system and an "industry standard" and as-yet-undetermined operating system.

While Wyse and Esprit contend their systems offerings are aggressive moves to leverage their customer bases, some observers see the moves as defensive. Dr. Egil Juliussen of Future Computing Inc., Dallas, says, "It's really a short-term strategy, a defensive measure that will work only for two or three years at most." Juliussen maintains that the CRT terminal market will eventually be overrun by personal computers and other low-end desktop systems.

—Geoff Lewis

DEI, Tandberg push QIC, try to second-guess IBM

Hoping to second-guess an anticipated move by IBM Corp. into ½-inch tape cartridges, two manufacturers of ¼-inch streaming-tape cartridge drives have completed plans for a ½-inch cartridge that will be interchangeable with ¼-inch tape cartridges. They hope to attract other manufacturers to the drive and boost momentum for the quarter-inch-cartridge (QIC) -2 and QIC-24 interface and format standards (MMS, February, Page 48).

"We hope to demonstrate the maturity of our industry by offering this cartridge design to any tape drive and media manufacturer who wants to adopt it," says Jack King, president of Data Electronics Inc. (DEI), which, along with Tandberg Data Inc., the U.S. marketing subsidiary of Tandberg Data A/S, Norway, is developing the interchangeable device.

The agreement between DEI and Tandberg calls for the two companies to cross-license each other's technology and for each company to manufacture its own drives to the new "standard." The drives will feature both the QIC-2 and QIC-24 interface standards in multiple form factors. What they are doing is setting off a backfire against IBM's expected entry into ½-inch cartridges," comments Ray Freeman, president of Freeman Associates, a Santa Barbara, Calif., market research company. "The world will no longer be divided into ¼- and ½-inch tape drives but according to the design of the cartridge. We'll need some new definitions."

Cartridge manufacturers' acceptance of the QIC-2 and QIC-24 vividly demonstrates the importance of tape drive standards. Until their adoption, streaming-tape drive manufacturers had difficulty selling their products to system integrators. Now, almost a year after the formulation of QIC-2 and QIC-24, users are assured of some interchangeability between drives from different manufacturers, and sales of streaming-tape drives are beginning to take off.

Casting a shadow over any effort to implement a standard is the ultimate direction of IBM. As is usual with an impending IBM product, the company gives no indication of when the forthcoming tape drive will be revealed. What is clear, however, is that the simple threat of an IBM design has put some system integrators into a holding pattern.

An observer at the DataStorage '83 conference in Santa Clara, Calif., noted that, in discussions of ½-inch tape drives, the emphasis was not on the many ½-inch cartridges introduced thus far—including those of Rosscomp Corp., Tandon Corp. and Mega Tape Corp.—but on the one that wasn't there. IBM reportedly declined to send a speaker on ½-inch tape products to the conference.

The DEI/Tandberg-proposed interchangeability with ¼-inch cartridges makes the standard different from other ½ inch designs. "The challenge was to find something to give us forward compatibility with an existing product and extend the cost performance of our drives," DEI's King told a news conference during DataStorage '83.

The design of the ½-inch cartridge is based on the Tandberg 8-inch disk drive, which uses a ½-inch version of the ¼-inch DEI 550 cartridge media. The ½-inch version doubles cartridge capacity. "Previously, you could increase capacity by increasing recording densities, the number of tracks per inch or the length of the tape," King notes. "By going from ¼- to ½-inch, we automatically double the avail-

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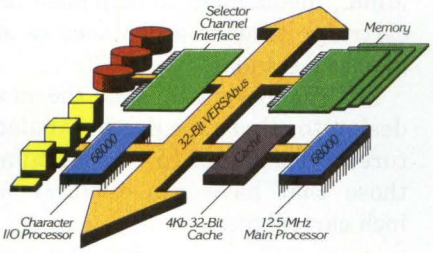
32-Bit Memory on a 32-Bit Bus

The Universe 68/05 is a true 32-bit system because it handles 32-bit data transfers in parallel on its 20Mb/sec VERSAbus, while most 68000-based machines are still limping along with 16-bit buses. With the next generation of processors (like the MC68020), a full 32-bit bus will be a requirement on *all* systems. VERSAbus is there now, and it's non-proprietary.



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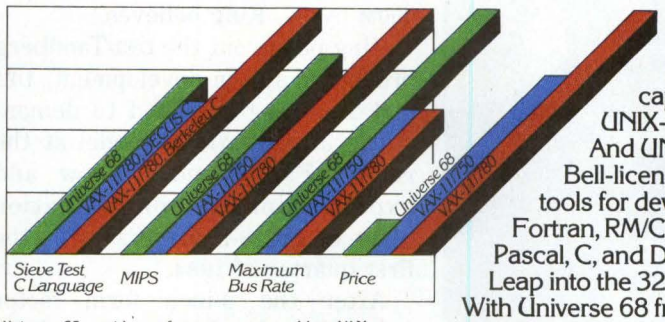

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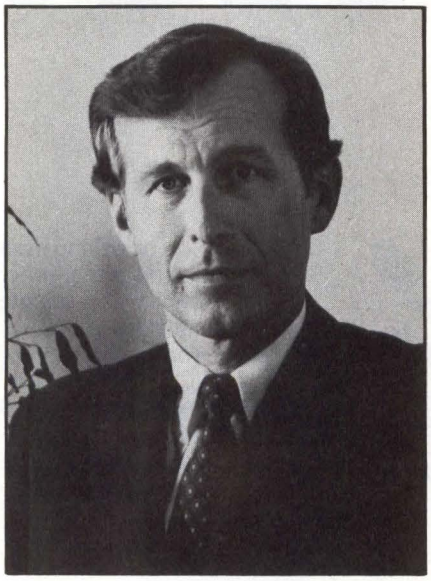

"What they [DEI and Tandberg] are doing is setting off a backfire against IBM's *expected entry into ½-inch cartridges," notes Ray Freeman, president of Freeman Associates.*

able space and, therefore, the capacity."

The DEI ¼-inch 550 cartridge can back up as much as 55M bytes of data and can ultimately back up 100M bytes. The ½-inch cartridge should ultimately record as much as 200M bytes, King believes.

King points out the DEI/Tandberg product is still in development. DEI and Tandberg expected to demonstrate an operational model at the recent Fall Comdex show and expect shipments of evaluation units of the 8-inch version in the first quarter of 1984.

After the 8-inch form factor cartridge is developed, plans call for adding a 5¼-inch drive and a half-height, 5¼-inch drive to be developed by late next year. King expects the 5¼-inch, half-height drive to dominate the market.

Jack King, Data Electronics Inc. president, *hopes to demonstrate the maturity of the industry by offering the DEI/Tandberg ½-inch streaming tape-cartridge design, which is interchangeable with ¼-inch drives, to other manufacturers to adopt.*

King says the two companies will offer the technology first to 3M, the dominant supplier of ¼-inch tape cartridges. He expects the St. Paul, Minn., media giant to help push the cartridge to wide acceptance as an industry standard.

DEI/Tandberg will offer the new design to other tape drive manufacturers in addition to 3M, including those that have non-standard ½-inch cartridges.

—Robert A. Sehr

DIGITIZING CAMERA INTERFACES WITH IBM PC

Datacopy Corp., Palo Alto, Calif., has introduced the model 610 electronic digitizing camera for entering images of photos, printed text or 3-D objects into an IBM PC without using a keyboard. The 610 has a linear array of 1,728 solid-state photosensors that scan any image focused by the camera's 35-mm. lens. The image is then organized into a matrix of 4.9 million pixels and digitized. The company claims the camera requires little illumination. Datacopy will emphasize OEM marketing, says company president Rolando Esteverena. List price of the 610 with an interface, software and accessories is $9,945.

WANG WILL INTRODUCE WIDE-AREA NETWORK

Wang Laboratories Inc., Lowell, Mass., has announced a contract with Bolt, Beranek and Newman (BB&N), Cambridge, Mass., for BB&N to design and install a wide-area network for Wang's latest packet-switching technology. Wang will initially use the network internally but will later market it.

LOTUS TO USE MICROCOM NETWORKING PROTOCOL

Microcom Inc., Norwood, Mass., has licensed Lotus Development Corp. to use the Microcom networking protocol (MNP) in integrated spreadsheet-based software programs. MNP enables personal computers to communicate with a variety of other computers supporting MNP. Other companies using MNP include VisiCorp, Apple Computer Inc., British Telecom, GTE Telenet, Systar Corp. and Comm-Pro Associates.

LOOKING AHEAD IN MMS

The coming year brings a third special issue. Slated for publication in mid-June, the **Mini-Micro Computer Digest** will prove an indispensable selection guide to minicomputers and microcomputers. It will include staff-written product/market overviews and extensive product selection tables for:

- single-board microcomputers,
- single-user microcomputers.

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Lotus 1-2-3 spawns more integrated software for IBM PC

Stimulated by the popularity of Lotus Development Corp.'s 1-2-3 and Context Management Systems' MBA, along with the promise of VisiCorp's Visi[On], more integrated decision-support software for the IBM PC is appearing. Some are completely new packages; others are enhancements of spreadsheets. Most provide at least spreadsheet, graphics and database-management functionality.

The top-selling 1-2-3 offers spreadsheet, graphics, database-management and limited text-editing capabilities. MBA has spreadsheet, graphics, word-processing, database-management and communications functions. Many of the new packages, unlike MBA, do not simultaneously show multiple applications on-screen. The most common reason given is the limited resolution of the IBM PC monitor.

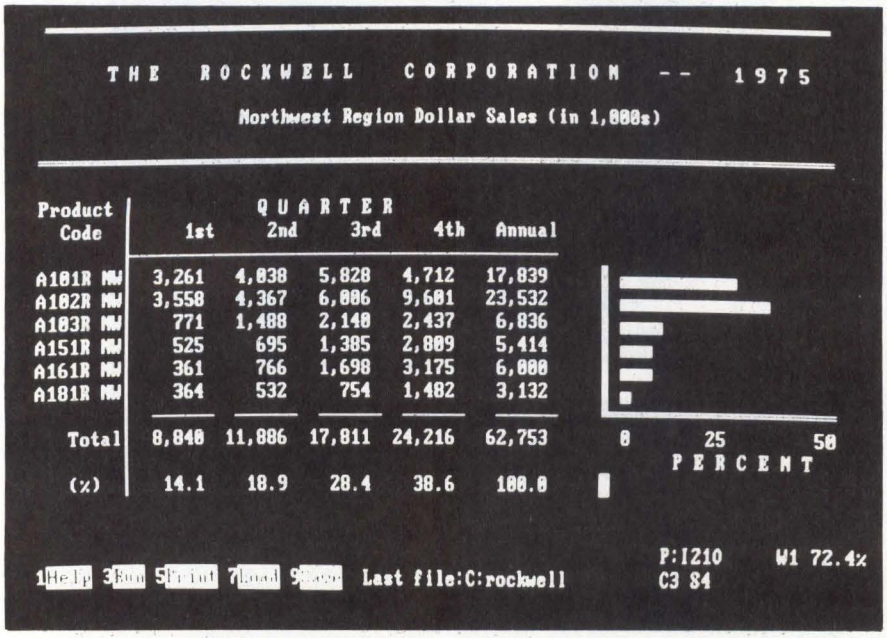
Recently introduced integrated packages include the Smart series from Innovative Software Inc., the InteSoft family from start-up Schuchardt Software Systems Inc. and SuperCalc[3] from Sorcim Corp. All run under PC-DOS, are written mostly in C and will be transported to other operating systems, particularly CP/M-86, in the future.

Innovative was to announce the Smart series at last month's Comdex. The package includes a spreadsheet/graphics program, a word processor and a database manager. Other vendors' programs reportedly can be added to the main menu. Each Smart program can operate standalone or be integrated with the others. All three programs feature a project processor that stores a series of commands. A single keystroke initiates operations, which are performed automatically in program fashion. The command processors can be linked from spreadsheet to spreadsheet

MENU-DRIVEN SPREADSHEETS ARRIVE FROM AUSTRALIA

Imagine being able to design a spreadsheet without actually seeing the rows and columns until the model is finished. The PLANFIN and PROFIN forecasting, budgeting and financial-analysis tools for personal computers from Business Software Pty. Ltd., Chatswood, New South Wales, Australia, allow a user to model a spreadsheet through the use of menus.

With PLANFIN and PROFIN, there are no training periods and formulas to type. Selections from the menus ask for all the necessary information, such as the number of items to be included in a file, the cost of each item and annual percentage growth. When a user is finished entering and verifying the data, the results can be displayed in spreadsheet format. In addition, a menu selection changes PLANFIN and PROFIN files into the Data Interchange Format (DIF), so that they can interface with VisiCalc, SuperCalc and other spreadsheets using DIF. The programs have extra features such as a reminder to save a file before exiting. PLANFIN and PROFIN are written in Microsoft BASIC and run under CP/M-80, PC-DOS, MS-DOS and PCOS-based systems with at least 64K bytes of main memory and one disk. The PLANFIN forecasting and budget program is priced at $195, the PROFIN financial-analysis program at $295. They are available through Lifeboat Associates, New York, Softeam Inc., Culver City, Calif. and other distributors. Vector Graphic Inc., Thousand Oaks, Calif., will market the software.



The IBM PC's function keys *provide a user interface with Schuchardt Software Systems Inc.'s $295 InteCalc spreadsheet program.*

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- MUNIX from Periphere Computer Systems, a System III UNIX that runs on the PCS QU68000, and MC68000 system designed for the Qbus.
- System III from NCR, a System III UNIX that runs on Tower, a 68000 system designed for the Multibus.

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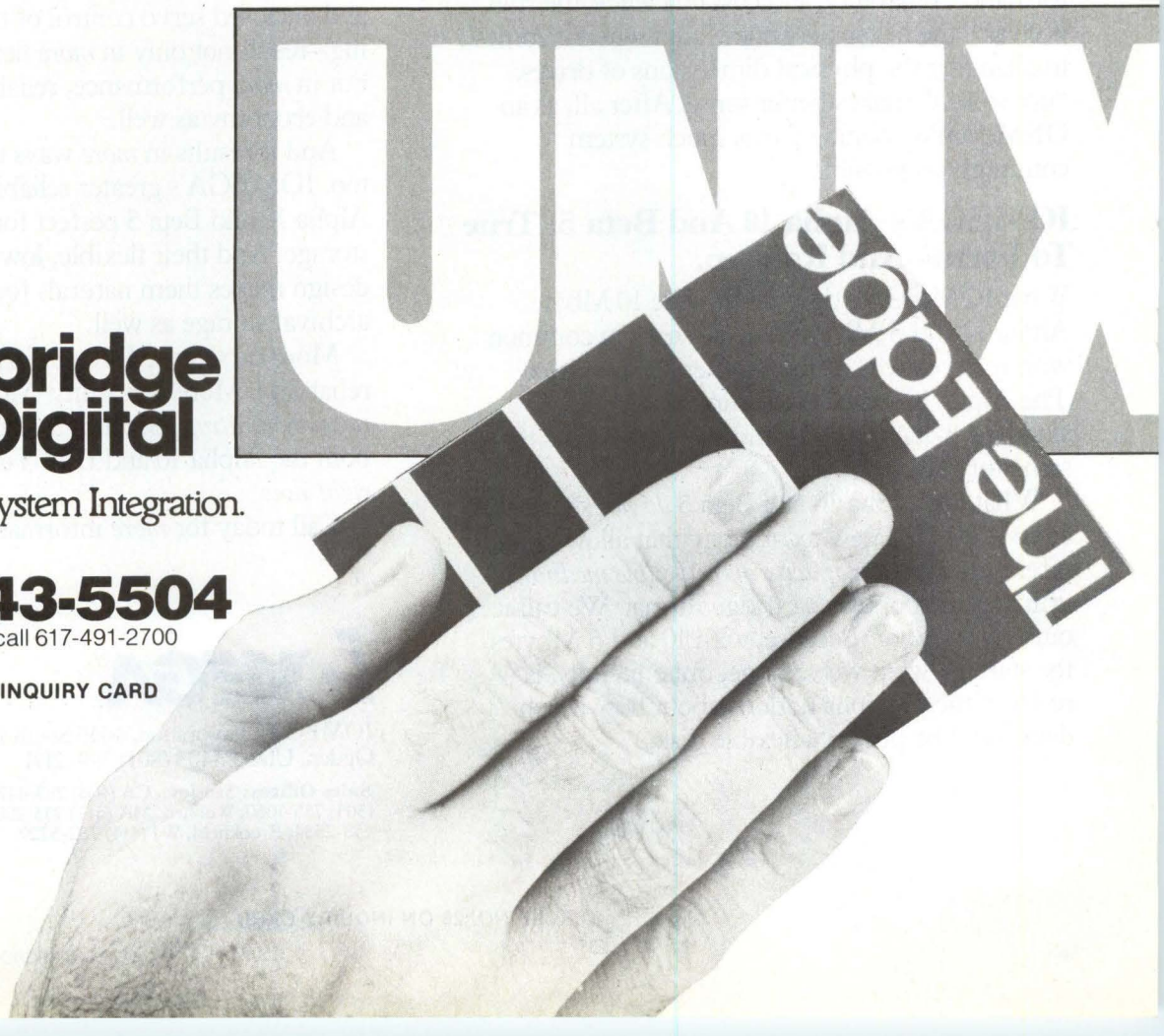

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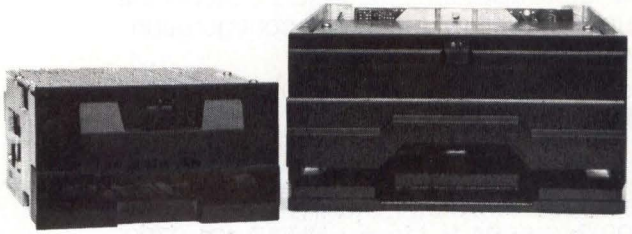
FORM FACTOR REFORM FACTOR



In the data storage business, some things change faster than others. And some things change faster than they should. When it comes to capacity, performance, reliability, and cost efficiency, the rule is clear: "the faster the better." But when it comes to changing the physical dimensions of drives, "not so fast" makes better sense. After all, as an OEM, you're looking for as much system continuity as possible.

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What IOMEGA's disk drives—the 10 Mbyte Alpha 10 and 5 Mbyte Beta 5—share in common with many others on the market is *form factor.* The Alpha 10 matches the dimensions of all standard 8-inch drives. And the Beta 5 does the same for standard 5¼'s.

What the Alpha 10 and Beta 5 *do not* share with anyone else is a new technology that allows us to offer *mass storage capacity on a flexible medium,* utilizing the popular cartridge format. We call it our *reform factor.* Because, with 10 and 5 Mbytes for starters, what we've done, quite literally, is re-form the previous notions about how much data could be put on a flexible disk.

More Than More Storage.

IOMEGA's design features—such as non-contact head-to-disk interface, high-linear bit densities, and enclosed servo control of the head positioning—result not only in *more* flexible disk capacity, but in *more* performance, reliability, versatility and economy as well.

And it results in *more* ways to use that storage, too. IOMEGA's greater reliability makes the Alpha 10 and Beta 5 perfect for primary mass storage. And their flexible, low-cost cartridge design makes them naturals for back-up and archival storage as well.

More capacity. More performance. More reliability. More versatility. More economy. *And no more waiting.* Because IOMEGA is delivering both the Alpha 10 and Beta 5 in OEM quantities *right now.*

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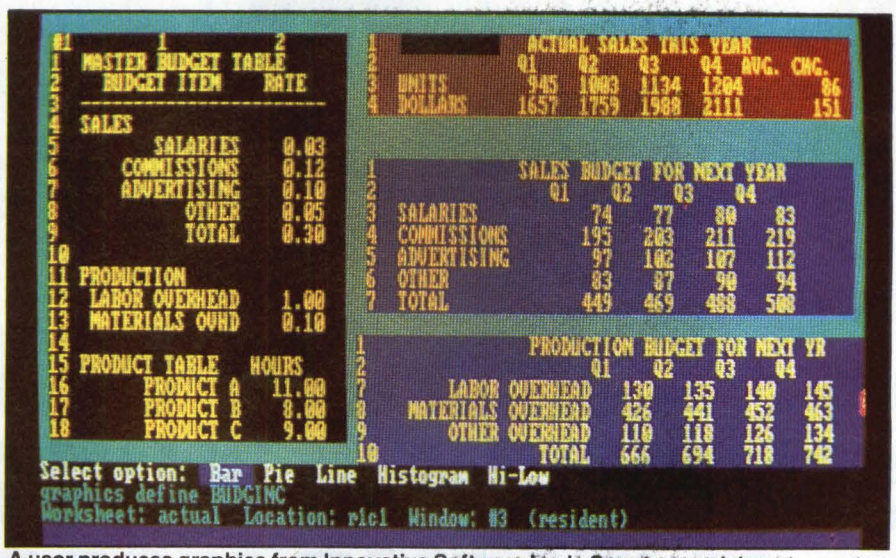
CIRCLE NO. 26 ON INQUIRY CARD

and from program to program, and each program features three confidence levels of on-screen help and prompting. A user interfaces with the programs by moving the cursor to a command list at the bottom of the screen. (A mouse cursor controller is optional.) The system supports the Intel 8087 math coprocessor.

Because the spreadsheet program uses the sparse matrix data structure, only the cells actually occupied by data are put into memory, no matter what size spreadsheet has been defined. Automatic consolidation can be performed. Graphics capability is built into the spreadsheet program, and graphs include 3-D bar charts, scatter graphs and histograms, as well as a slide-show feature. The system utilities contain a calculator that outputs in binary, hexadecimal, octal and decimal; a file directory; rename; and other file-handling commands.

Although only a single application at a time can be displayed on the screen, graphs and spreadsheet models appear in word-processed text. The word-processing program stores each character as a 2-byte integer: the lower 7 bits store the character, and the upper 9 bits store font, type size and other character attributes. System utilities such as the spreadsheet feature a calculator and file-handling functions. The word-processor program also supports the 8087 chip.

The Smart database manager uses the same parser as the spreadsheet program and the file-handling utility of the other two programs. What-if operations, sine, cosine and business functions such as net present value and interest rate of return can be performed. The program accommodates 255 fields per record, 12 field types with range checking and validation, data compaction and more than 100,000 records per file.



A user produces graphics from Innovative Software Inc.'s Smart spreadsheet *by moving the cursor to the command list at the bottom of the screen and pressing return.*

INTEGRATED SOFTWARE PACKAGES FOR THE IBM PC

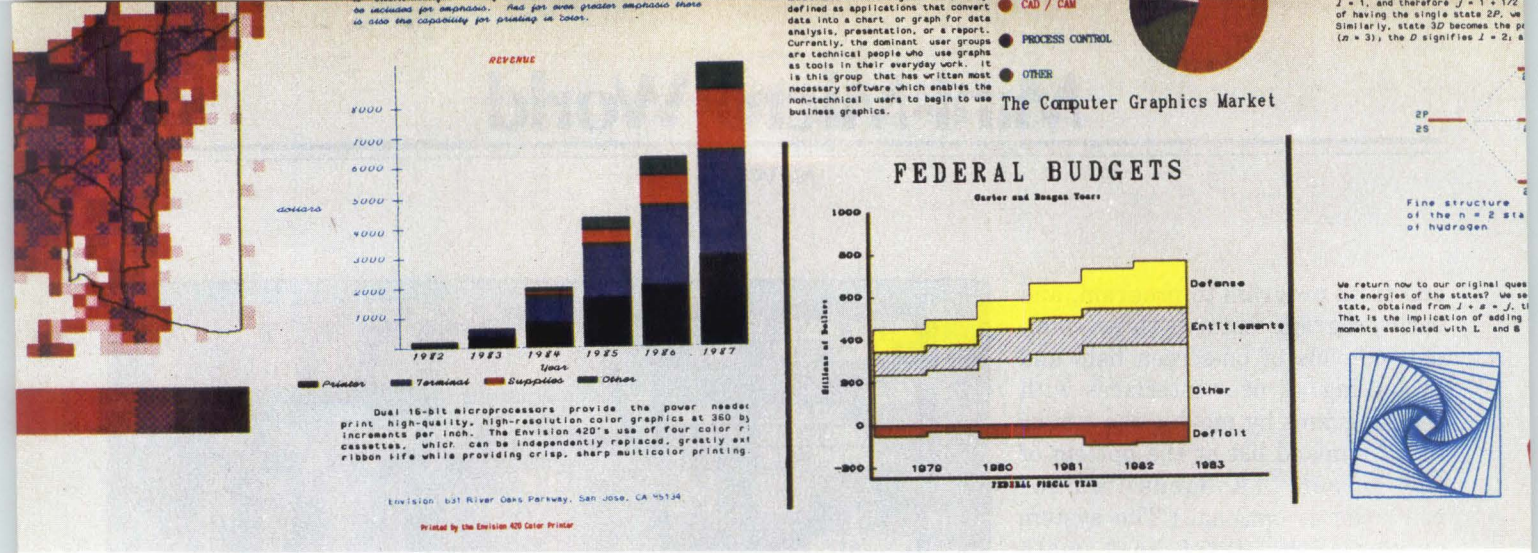
Product, Company	Components	Add other programs to menu?	Minimum memory	Price
Executive Series Innovative software Inc.	Spreadsheet/graphics/ Word processing/ Database mgt.	y	128K bytes	1595 $475 $695
1-2-3 Lotus Development Corp.	Spreadsheet/graphics/ Database mgt./limited Text-editing	n	128K bytes	$495
Intesoft Schuchardt Software Systems Inc.	Spreadsheet/ Word processing/ Database mgt./ Project mgt./ Executive time mgt.	y	128K bytes	$145-$495 each
Supercalc³ Sorcim Corp.	Spreadhseet/graphics/ Database mgt./limited Text-editing	n	128K bytes	$395

A programmer's pack, enabling a user to link other programs into the overlay, is also planned. The programs are priced at $595 for spreadsheet graphics, $695 for database management and $475 for word processing. In comparison, list price of the entire Lotus 1-2-3 package is $495 and Context Management Systems' MBA for $695. The products will be available in January, following a dealer training program, and marketed to IBM dealers and distributors.

Schuchardt president and founder Frederick H. Schuchardt was formerly president of MicroPro International Corp.'s world trade division. The company's InteSoft line includes InteCalc, InteWord, InteBase, InteMate (which provides integration), InteVate (an application generator for use with InteBase), IntePert (a project and resource allocator) and IntePlan (a time-management system). As with Innovative's Smart series, other vendors' programs can be added to InteSoft's main menu.

The program features a page-numbering scheme that allows other work sheets to be called up or referenced. Worksheets can also be viewed page by page, forward or backward. InteSoft consolidates work sheets or portions of worksheets and stores command sequences.

All seven programs were to be



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You really can't lose. Because if we can't prove our new Envision 430 Color VectorPrinter™ is more than a color printer, we'll give it to you on the spot. Free.

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What you might not know is that our new 430 has the uncanny ability to print high resolution pen plotter graphics. It can do that because we designed vector-to-raster conversion right into the printer.

And to make our 430 that much better than any other color printer you can buy, we also gave it the ability to print 100 characters per second in letter quality mode or 300 characters per second for drafts. This means our 430 gets your work done a lot faster. It also means you can print high speed drafts, letter quality text, high resolution raster graphics and plot vector graphics—on the same page! So when you buy our new 430, you're really getting four very usable talents in one very versatile printer.

A VERITABLE PARADISE OF COLOR

Even if you're not a Van Gogh, our new 430 gives you the ability to create inspired color graphics. It prints any four colors of red, green, blue, cyan, magenta, yellow or black in a single pass. You can also blend any of these colors to create an entire spectrum.

And because a one-eighth inch solid color band is printed on each pass of the 18-wire printing head, our 430 creates your masterpieces with incredible speed.

UNCOMMON VECTOR/RASTER GRAPHICS

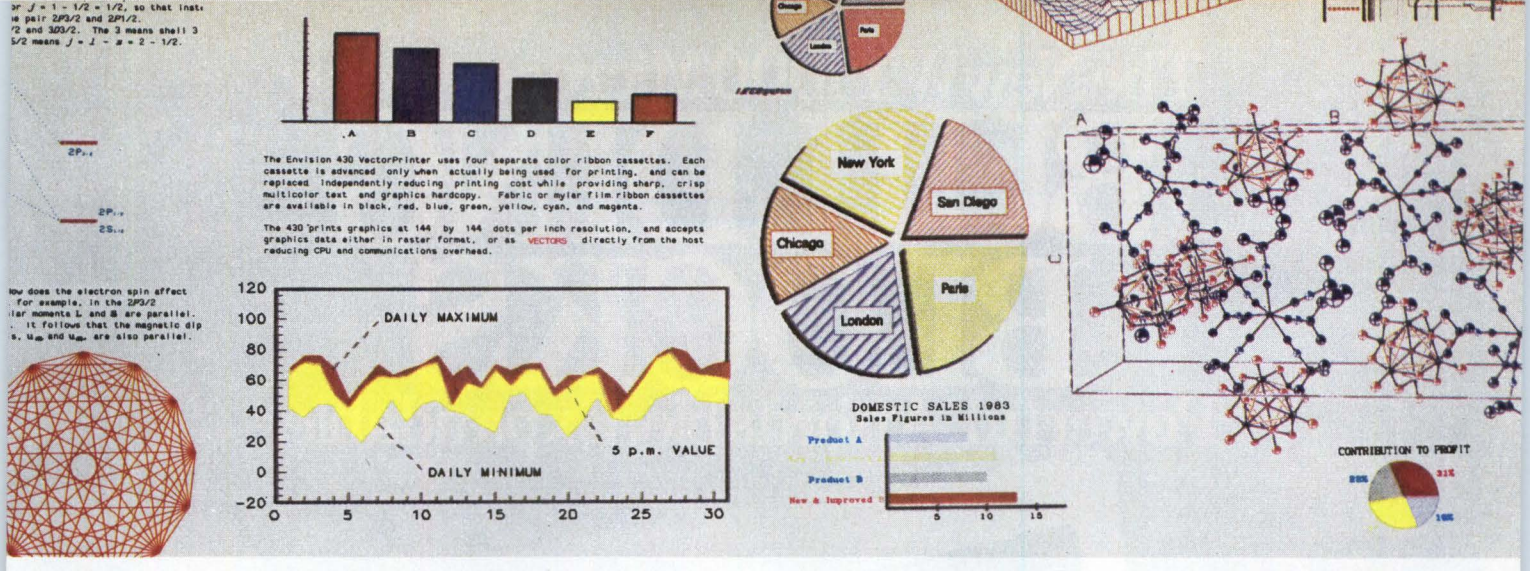
We made our 430 compatible with the Hewlett Packard 7220 pen plotter. That means it's supported by a host of business, engineering, and scientific graphics software packages. And it gives you printed quality that's nothing short of superb. As well it should. Because we designed our 430 with exceptionally accurate horizontal and vertical registration. It also prints raster graphics at 360x144 dots per inch for the highest resolution or 72x72 dots per inch for maximum speed. And to give you added flexibility, we gave our 430 the ability to print on plain paper *and transparencies*.

LETTER QUALITY MAGNA CUM LAUDE

When you begin using our 430 you'll quickly discover you don't have to be a wordsmith to create letter quality documents with punch. Any of the character fonts can be mixed or colored using host computer control.

WORDS, 4444 (characters), lines or pages CAN BE PRINTED in any of EIGHT COLORS. One letter quality font in 10, 12, and 18 PITCH and one high speed font in 10 and 12 PITCH ARE STANDARD. This means you can make MESSAGES STAND OUT. You can COLOR specific words or IDEAS.

And our 430 comes with optional letter-quality character fonts like **BOLD**, *italic, SCRIPT* and ORATOR. Plus you



can define up to 196 characters to print both text and graphics. And to add versatility to your text creations we made our 430 compatible with the **Diablo 630 ECS.** Which means it supports the most popular text and word processing packages.

NO MORE RIBBON WASTE

Another nice little benefit of our 430 you won't find in other color printers is a four-cartridge ribbon system. Our separate color cartridges advance independently as each color is used. By doing things this way you don't end up wasting ribbon or running out of the color you want just when you want it. It also means lower cost per copy for you. Plus you also have a choice of high quality mylar ribbon cartridges and longer life nylon ribbon.

YOU DON'T HAVE TO PASS UP SPEED FOR QUALITY

Our 430 has been designed with an 18-wire printing head. This means that instead of having to pass over a line more than once to achieve high quality, our 430 prints letter quality characters in a single pass. It also does this with a great deal more speed because it never has to retrace the same line.

And while we're talking about speed, you should know we built our 430 with a print control microprocessor which tracks the carriage through a unique closed-loop servo system and adjusts for carriage speed and direction during dot placement. That permits it to print *while* the carriage accelerates. Which is another reason it gets your job done a lot faster.

THE 430's UNFORGETTABLY EFFICIENT

If you tear down our 430 you'll find two 16-bit microprocessors. One of them controls the printing mechanism; the other takes care of the host interface and command interpretation.

They both share a 128K-byte bit-map memory. So while you're busily telling the 430 what to print next—it's busily printing what you told it to print last.

CIRCLE NO. 27 ON INQUIRY CARD

A RED HOT DEMO

We think you'll be impressed when you see our 430. But that's not enough to get you to pick up your telephone and call. So if we can't prove it's more than a color printer, we'll give you a 430. Free.

Show a little sporting interest and take us up on our offer. You'll get a red hot demo and a chance to buy a printer and a plotter. Send us the coupon or call. Envision, 631 River Oaks Parkway, San Jose, CA 95134, (408) 946-9755 or Telex: 176437.

Text and graphics samples courtesy of: ISSCO, Megatek, Molecular Structure Corporation, and Precision Visuals, Inc.

MM 12/83

OK, ENVISION... PROVE IT TO ME. PLEASE CONTACT ME REGARDING A DEMO.

NAME

TITLE

COMPANY

ADDRESS

CITY

STATE, ZIP

PHONE

Envision

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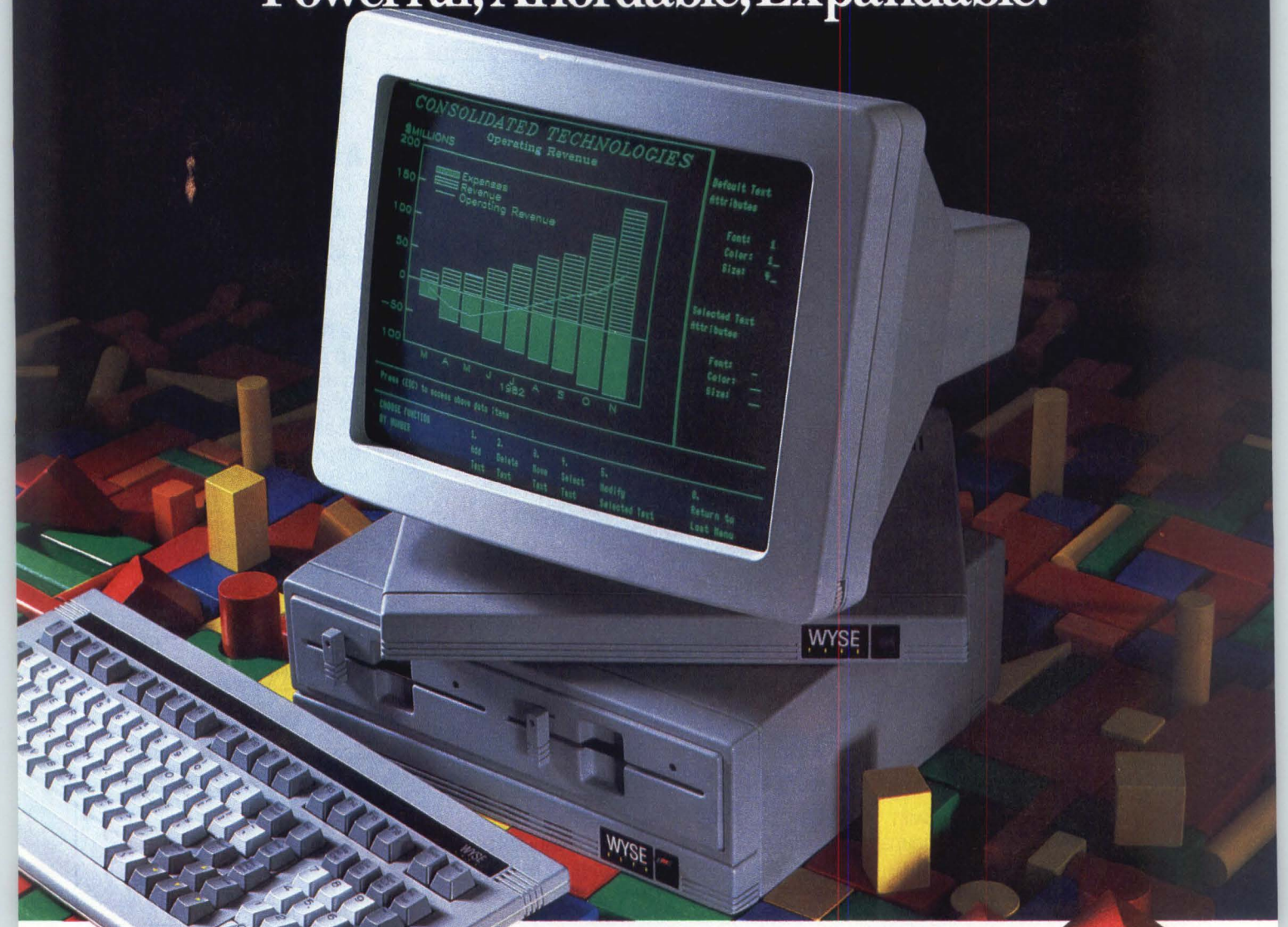

The WY1000 stacks up to be a lot of machine from a few simple pieces. By adding the WY1000 microcomputer to the good-looking, ergonomic WY50 display terminal, we created the most exciting concept in desktop workstations on the market today.

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- **Optional Graphics/Color Graphics**
- **Networking Capability**
- **CP/M™, MS-DOS™ Compatible**
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available this month, and a graphics program is scheduled to be introduced in the first quarter of 1984. InteCalc is priced at $295, InteWord at $395 and InteBase at $495; the other programs are less than $200 each.

One of the first spreadsheets for CP/M was Sorcim's SuperCalc. Like 1-2-3, SuperCalc³ has a spreadsheet, graphics, database management and limited word processing. New spreadsheet features include two-key sort and financial functions such as internal rate of return and future values of ordinary annuities. The program produces pie, line, area, bar, stacked bar, x-y and high-low graphs. List price of SuperCalc³ is $395; SuperCalc and SuperCalc² upgrades are $225 and $125, respectively.

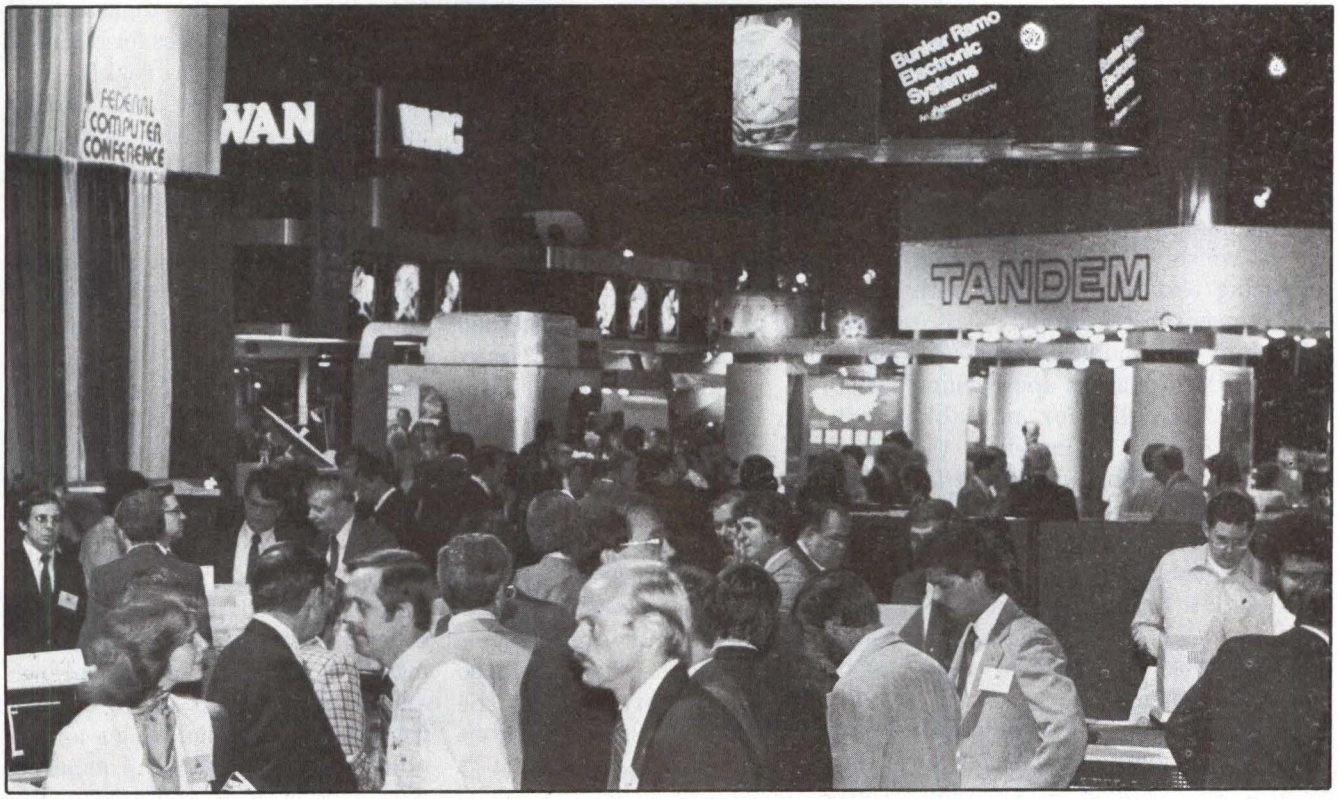
James Pelham, Sorcim's new president, says the latest offering is an example of the company's desire for greater visibility. He says that Sorcim is evolving from "an engineering-driven" to a marketing-driven company" and that future products will be more specialized as the market expands.

Lotus, Innovative and Schuchardt have all gone public recently. Pelham says Sorcim has no plans to go public as it has no debt. He does reveal that Sorcim hopes to acquire other companies soon.

—David A. Bright

Fifty new products showcased at federal conference

The 1983 Federal Computer Conference *in Washington attracted more than 250 exhibitors and 23,000 participants. Approximately 50 products were introduced.*



Billed as the largest display of computer systems and services ever held in the nation's capital, this year's Federal Computer Conference displayed an exuberance that testifies to the growing size and importance of the federal market for computer products (MMS, December 1982, Page 95).

The conference attracted more than 250 exhibitors, double the number at the 1982 show, and 23,000 participants, a 26 percent increase from last year's affair. More importantly, approximately 50 products were introduced at the show, evidence that vendors welcomed the opportunity to showcase their products before an audience comprised mainly of federal employees.

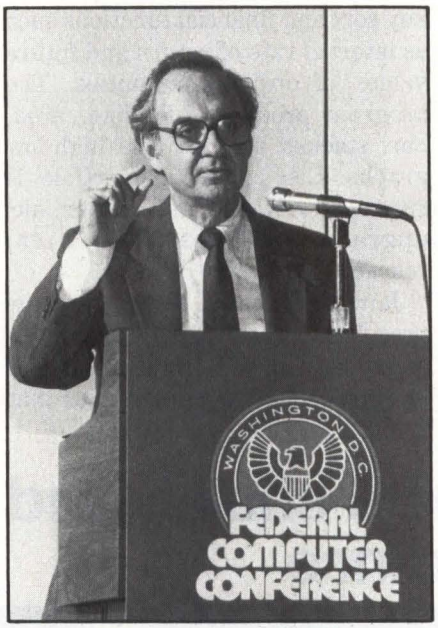
According to keynote speaker Gerald P. Carmen, administrator of the General Services Administration, suppliers have good reason to eye the federal market for computer goods and services hungrily. He estimates that the federal government uses approximately 18,000 general-purpose computers, a number that should swell to more than 500,000 by the end of the decade.

"If there's any business or any kind of institution in the United States that is more appropriately coordinated by high technology, it's us—the government," Carmen told the conference. "We can't afford [delays] in the automatic data-processing area."

Hewlett-Packard Co. led all other exhibitors in volume, with 14 new products, including the HP2628A word-processing terminal with a graphics option and several office application-software packages. HP also introduced two laser printers, one of which is a desktop model combining text and graphics with 300 dot-per-inch resolution.

Teleram Communications Corp. cited a federal market approaching $800,000 annually for portable microcomputers. It unveiled the $895 T-3620 portable disk drive for its T-3000 portable microcomputer. The T-3620 is a 5¼-inch dual-density, double-sided floppy disk drive with a formatted capacity of 320K bytes. It can transfer data from the T-3000's 128K- or 256K-byte bubble memory.

Teleram has been developing a family of portable equipment for the federal government since 1980, when it introduced the T-3000 portable weighing less than 10 pounds and priced between $2,495 and $2,995, depending on the memory configuration. The product line also includes a plug-in expansion unit that converts the T-3000 into a full desktop personal computer, a portable text-editing terminal and CP/M application-software programs. The terminals are designed for portable applications, says Teleram president Charles J. Satuloff, for field personnel, office workers and for networking applications with central databases.



Gerald P. Carmen, administrator of the General Services Administration, *expects the number of general-purpose computers in federal government use to swell to 500,000 by the end of the decade, from the current 18,000.*

Northern Telecom Inc. (NTI) unveiled a Z80A-based board that allows the company's series 400 and 500 information-processing terminals to run CP/M application-software packages. The board also permits CP/M software to be down-loaded to the company's Displayphone, a key ingredient in NTI's plans to bring expanded computer capability to its voice/data phone terminals.

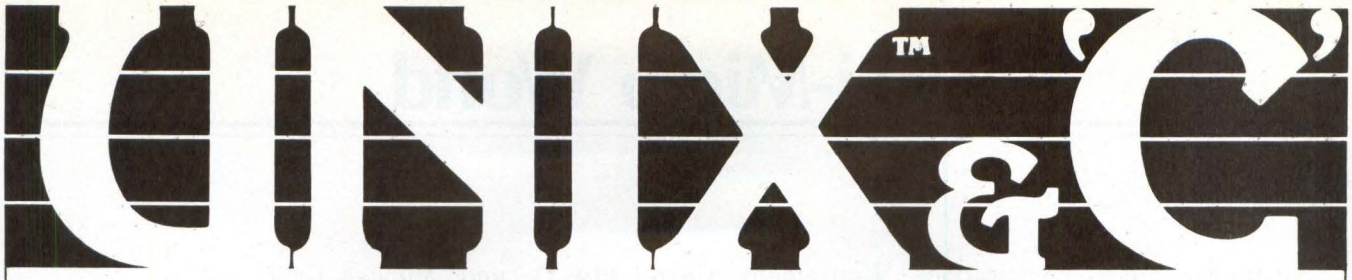
Called the "personal computing option," the board contains two operating environments—CP/M and NTI's proprietary Omnitask. Each system uses a Z80A processor and 64K bytes of RAM. Two user terminals can simultaneously employ the $1,495 board, and CP/M and Omnitask applications can share peripherals.

A "suspend" feature allows an operator to start one task, move to another and return to the first. As many as 16 tasks can be run with the suspend capability, says Robert Kill, NTI director of product management for data systems. He adds that the feature is especially suitable for any office environment in which there are frequent interruptions.

With the new board-level product, continues Kill, NTI's office information terminals can now take full advantage of the thousands of CP/M software packages for business applications. As a result, the company sees its systems moving into direct competition with the popular standalone microcomputers entering federal offices in increasing numbers. NTI's new board signals the first sally into the office microcomputer arena by a company known primarily as a supplier of telecommunications equipment. Shipments of the board will begin in the first quarter of next year.

Industry analysts view introduction of the CP/M board as evidence of NTI's long-term strategy of increased presence in the office computer market through microprocessor-based products that can be incorporated into the company's installed base of private-branch exchanges (PBXs) as a central conduit for communications among office equipment—not in competing with suppliers of end-user equipment.

"NTI's strength is telecommunications," says Harry Newton, president of the Telecom Library, New York. "What's the significance of having a phone combined with a personal computer? That's narrowing the market artificially."



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Sandra Roth, telecommunications analyst with Shearson/American Express, a Wall Street brokerage concern, sees NTI as trying to boost flagging sales of the Displayphone. The Displayphone incorporates two voice/data circuits with a small screen and keyboard for office applications such as appointment scheduling and record-keeping. "The Displayphone hasn't been very successful," she says. "Northern Telecom is de-emphasizing its role as an end-to-end office-automation supplier."

Wang Laboratories Inc., which is rumored to be developing an integrated voice/data telephone terminal, introduced the 7529T ¼-inch tape-cartridge drive storing 9M bytes. The drive is designed for government security applications and conforms to the National Security Agency TEMPEST standards for radio-frequency interference (RFI), says a Wang spokesman. Although it has not yet been formally TEMPEST-accredited, the company says it will submit the unit for government approval.

The drive, which uses serpentine recording, is priced at $6,000. Two techniques are employed to keep RFI lower than detectable levels. These include containment—coating the interior of the drive's housing with metal to block signal leakage—and suppression—electronically filtering output signals.

For non-classified applications, Wang introduced the VS-85, an entry-level, multiuser 32-bit minicomputer, and the PC-PM012, a 20-character-per-second daisy-wheel printer for use with the Wang Professional Computer workstation.

Other new product announcements at the conference include:

- the Digital Palette 1000 color graphics workstation from Automation Horizons Inc., Beltsville, Md.,
- the TFC 832 TS-11 magnetic-tape coupler, for use with Digital Equipment Corp. PDP-11 and VAX-11 products, from Aviv Corp., Woburn, Mass.,
- IBM 3270 plug-compatible display stations and cluster controllers from Printer Systems Corp., Gaithersburg, Md.,
- the 9794 315M-byte Winchester disk drive from System Industries, Milpitas, Calif.,
- the Avatar PA1000 protocol converter, which allows any ASCII terminal simultaneous access of an IBM bisynchronous or SNA/SDLC environment and an asynchronous host computer or information service, from 3R Computers, Westboro, Mass.

—Stephen J. Shaw

Stanford graphics spin-off offers real-time workstation

One of the newest players in the graphics workstation market is a spin-off of the academic world. Silicon Graphics Inc., Mountain View, Calif., began with an idea born on the campus of Stanford University in 1979. Under the direction of associate professor James H. Clark, Stanford electrical engineering students developed a "geometric" graphics engine—basically a very-large-scale-integration chip that offers high-powered, real-time graphics performance and computational ability.

The chip allows data to be moved, rotated or scaled in real time—rather than in a stored program—at the rate of 100,000 coordinates per second. In addition, the chip allows 10 million floating-point operations per second.

The proprietary geometric engine directly processes graphics data without going through the system's central processor. It unburdens the external host computer or internal general-purpose microprocessor of the routine, repetitive multiplications that alter the configuration of graphics data. It reduces the number of components while performing the same number of functions. Graphics transformations are performed in special-purpose hardware, rather than in software on general-purpose hardware.

Stanford ultimately patented the chip, and Clark took a leave of absence to raise venture capital for a practical application of the chip at Silicon Graphics. The company now has an exclusive manufacturing license for the chip and has designed a desktop workstation around it.

Just as microprocessors have reduced the cost of computing, Silicon Graphics' custom chip will lower the cost of real-time graphics systems, Clark believes. "We have an edge here because competitors would have to go to a chip maker to customize a chip like this," Clark says. "For anyone else to reverse-engineer this would cost about four times what it cost us."

A report on management workstation graphics published recently by Advanced Resources Development, Medfield, Mass., says that the business graphics market will grow from $1.3 billion in 1982 to more than $10 billion in 1987. Most of that growth will come from multifunction display systems, which include alphanumeric capabilities, rather than dedicated graphics systems.

The Silicon Graphics system sells for between $37,500 and $59,500 for a basic configuration, including 250K to 1.25M bytes of RAM and as much as 46M bytes of Winchester disk storage. All systems include a

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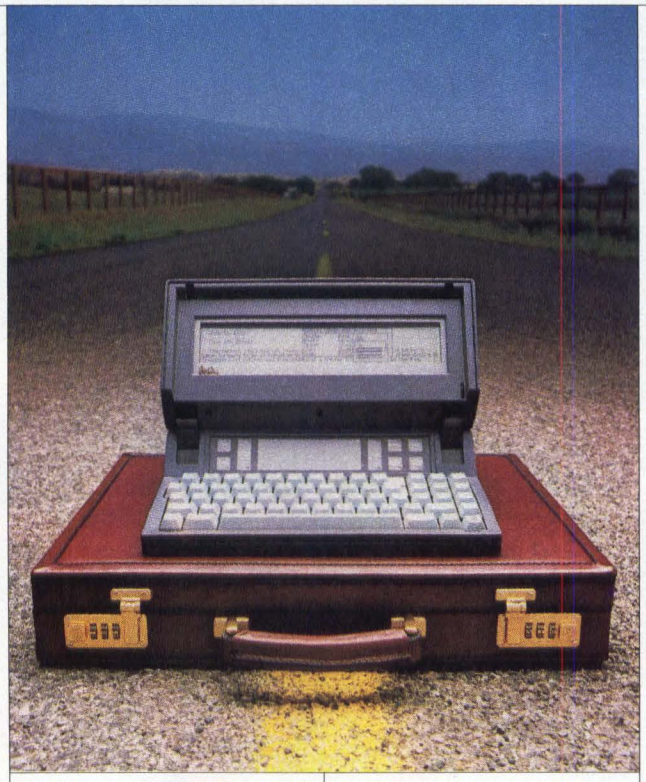

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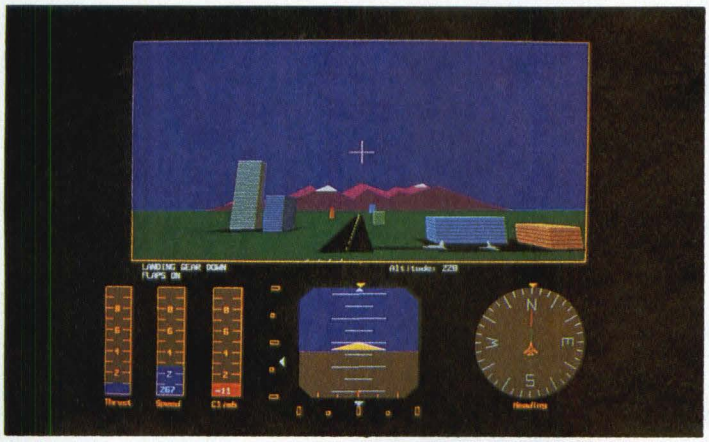
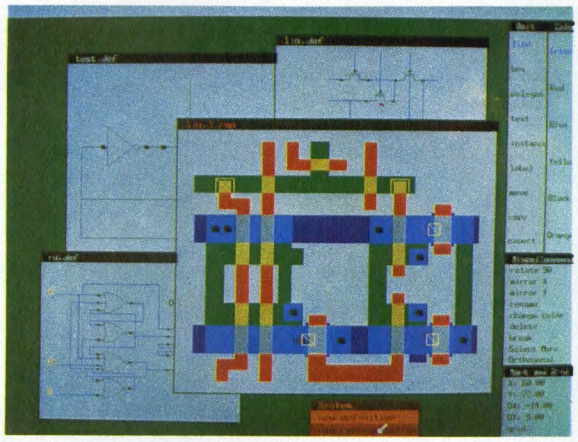


The flight-simulation program *illustrates Silicon Graphics Inc.'s systems ability at real-time graphics.*



The high-performance Silicon Graphics workstation *supports VLSI design.*

Motorola MC68000 processor, a 19-inch color monitor, a keyboard and a mouse cursor controller, an Ethernet interface and a 1,024-by-1,024-by-8 display memory.

The system is priced to compete against desktop systems from such companies as Apollo Computer Inc., Megatek Corp. and Hewlett-Packard Co. Clark believes the system will compete not only for computer-aided design/computer-aided manufacturing applications but for high-end, general-business graphics. To illustrate the system's versatility, the company has written a real-time flight simulator for demonstration purposes.

Deliveries to OEM customers will begin in early 1984. "We are not in the software business," Clark emphasizes. "We are going to leave the applications to our customers."

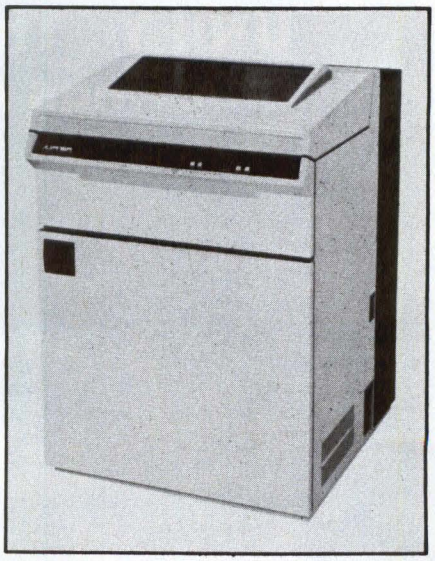
—Robert A. Sehr

Japanese printer manufacturers target high-end markets

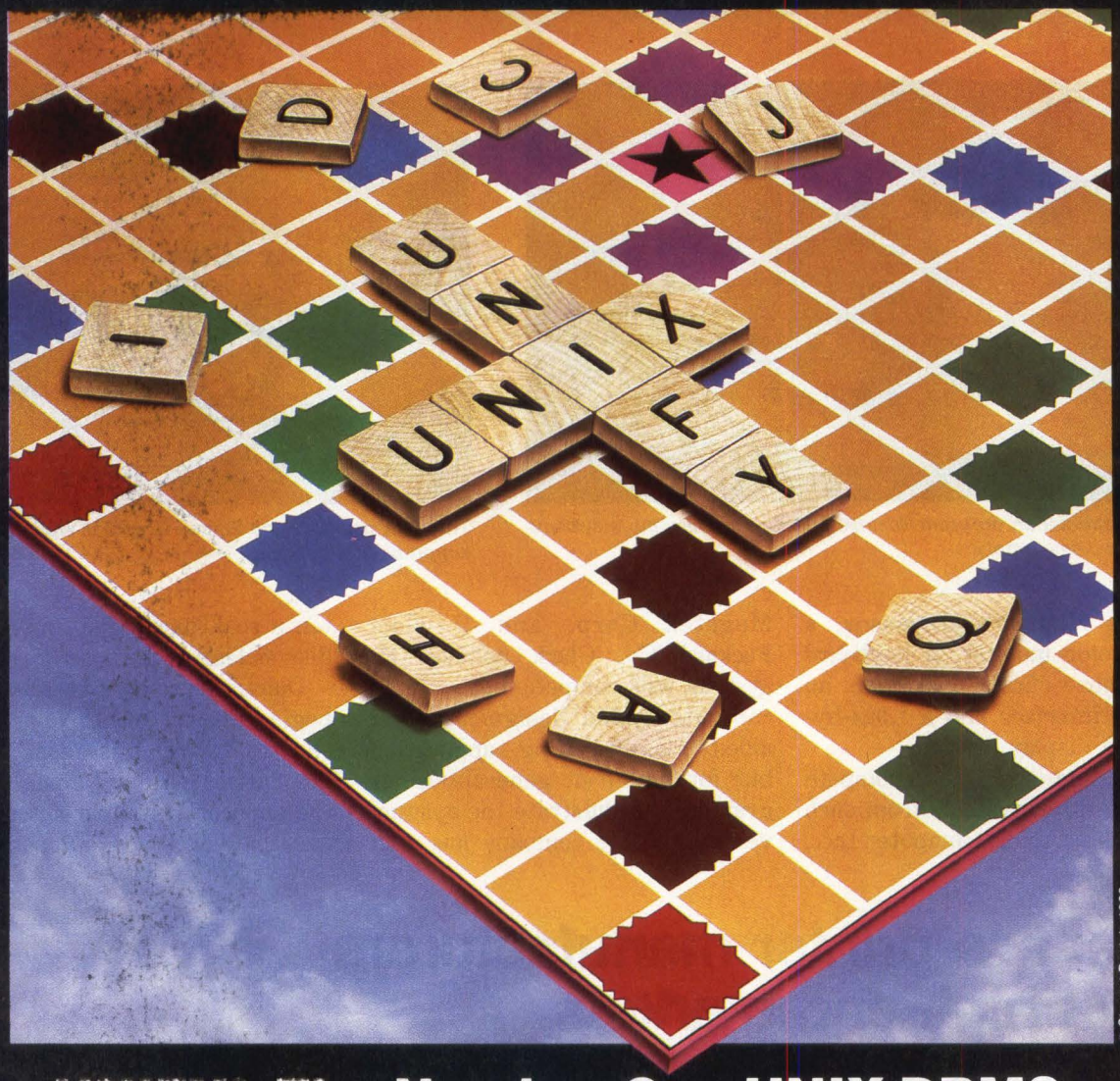
Japanese electronics firms that failed to cash in on the low-end dot-matrix market are eyeing the medium- and high-speed impact printer market with new product offerings expected to appear at this month's Comdex show. The medium- and high-speed impact printer market is one from which Japanese firms have so far been noticeably absent.

An example of the new Japanese offerings is the Jupiter series of line band printers to be marketed in the United States by Fujitsu America Inc., Santa Clara, Calif. The four printers in the series—the M3040, M3041, M3042 and M3043—print a 64-character set at 300, 600, 900 and 1,200 lines per minute (lpm), respectively. Fujitsu's priorities in designing the series, states David Steiner, Fujitsu America's president of OEM peripheral products, resulted in mean-time-between-failure (MTBF) specifications of 4,000 hours for the M3040 and M3041 and 6,000 hours for the higher-speed M3042 and M3043, as well as a noise level of 55 dBa.

As Japan's top systems manufacturer, Fujitsu Ltd. has long had a broad range of printer offerings for the Japanese and world markets, including a multimode 24-pin serial matrix printer and a thermal-transfer printer that were introduced in the United States this year and a matrix line printer marketed only in Japan. Surprisingly, although Fujitsu has products in higher-growth markets, it chose to



Fujitsu's new Jupiter series of band printers *should be introduced in 300-, 600-, 900- and 1,200-lpm versions at last month's Comdex show.*



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introduce band printers. Steiner agrees that the market for fully-formed-character line printers may not be as strong as others. But, he observes, "Line printers are a growth market, particularly as line-printer users come to the point of making decisions on replacement or expansion of their printing systems."

Fujitsu expects evaluation units of the 300- and 600-lpm versions of the Jupiter series to be available next April, with the higher speed units planned for June. The company plans to ship production units in the third quarter of next year. Prices of the Jupiter series are not firm, but Steiner expects the M3041 to sell for about $4,000 and the M3043 for $7,000, both in OEM quantities of 1,000. "The 600- and 1,200-lpm models will probably appeal most to the requirements of the market," he predicts, adding that the 300-lpm version is being offered partly to complement the line.

Many share Steiner's belief that matrix printers are impacting the market for 300-lpm printers. Fujitsu introduced the 24-pin DP124 serial matrix printer this year to compete with low-speed line printers in data-processing applications. Printers with 24-pin print heads

LOW-END PRINTER MARKET STILL ATTRACTS JAPANESE SUPPLIERS

Yet another entrant is testing the printer market's seemingly insatiable appetite for low-cost Japanese printers. That entrant is Inforunner Corp., with its Riteman personal printer.

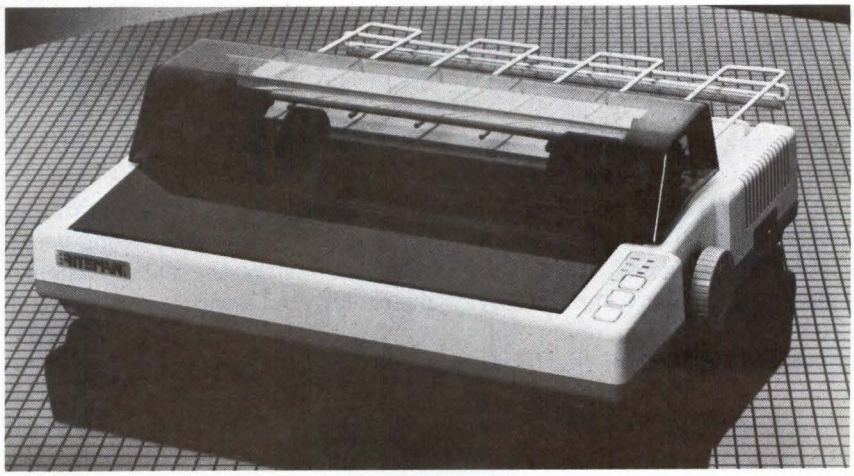
Alps Electric Co. Ltd., Tokyo, is manufacturing the 120-character-per-second (cps) dot-matrix Riteman printer for Inforunner, Santa Monica, Calif. Less than 3 inches high and weighing 11 pounds, the Riteman is one of the first 80-column dot-matrix printers that can fit into a briefcase, claims Inforunner president Masahiro Niizu. Riteman could be a harbinger of more "portable" printers from Japanese suppliers, such as C. Itoh Electronics Corp. "I'm not sure how much practical value there is in being able to put a printer in a briefcase," Niizu adds. "But I can say from showing it to dealers that it has a great deal of marketing appeal."

The Riteman printer is in a market, however, in which price is the most critical salability factor. Niizu thinks there is room for the Riteman there. With a retail price of $499, the printer is targeted at a slot in the market corresponding to the 100-cps Epson America Inc. RX-80, which has a similar suggested retail price.

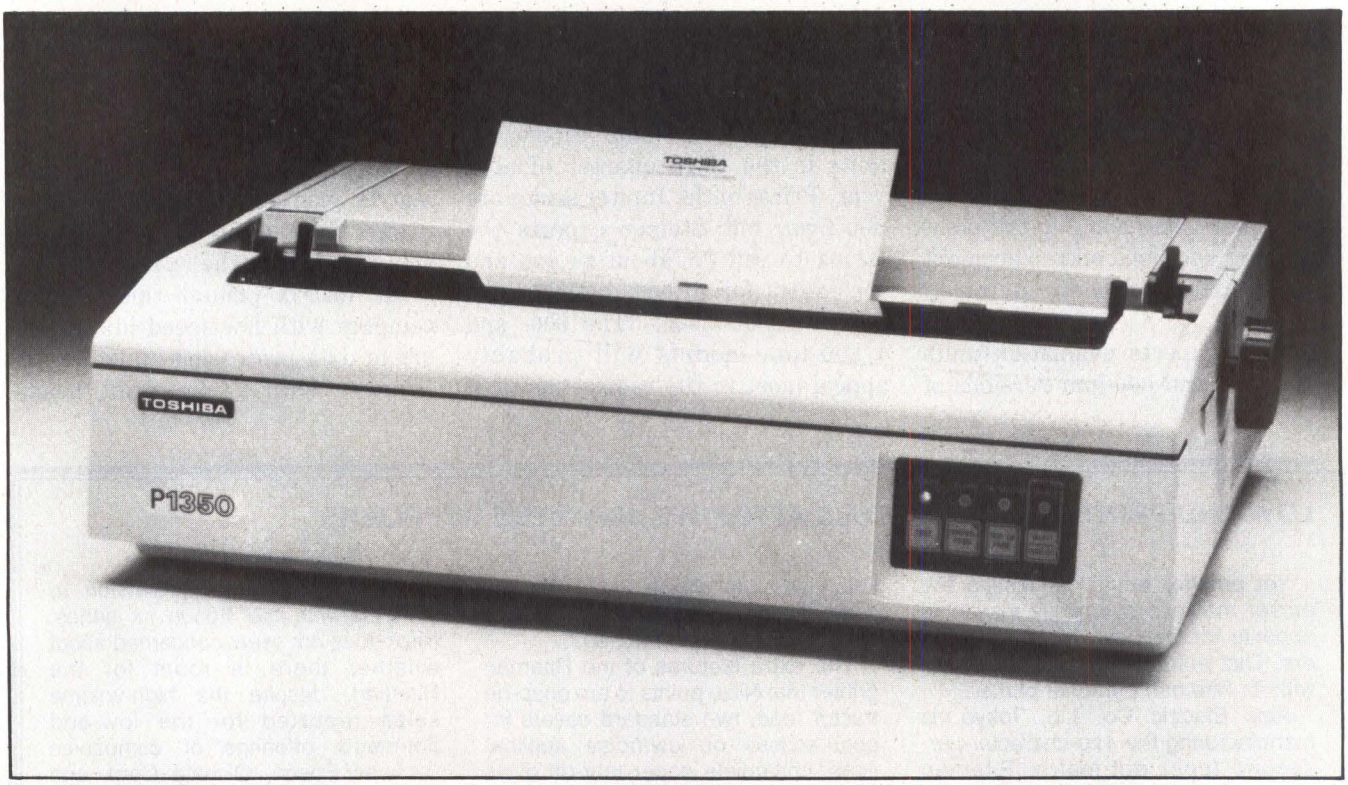
Niizu, a former Epson distributor, has a simple strategy for success in the low-end printer business. "Epson is clearly the leader, and their products set the standard," he remarks. "The ideal product should offer the same features that Epson does with perhaps a few extras such as higher speed, and it should cost a little less. It should also be as compatible as possible with software written for the Epson MX-80."

The extra features of the Riteman printer that Niizu points to are snap-on tractor feed, two standard covers for open-access or low-noise applications, immediate paper tear-off of as little as 1 inch and a "user-replaceable" print head rated at a minimum of 100 million characters. "It is not a disposable print head," Niizu emphasizes. "It can be easily replaced, but, unlike other inexpensive machines, we don't expect you to have to replace it."

Inforunner expects to introduce a number of other dot-matrix printers within a year. These include a 132-column version of the Riteman and a 150- to 160-cps version to compete with the Epson FX series. Niizu does not seem concerned about whether there is room for the Riteman, despite the high-volume sales reported for the low-end dot-matrix offerings of companies such as Epson, Okidata Corp. and Star Micronics Inc. "Our immediate target is 10,000 printers a month," he comments. "You need those kinds of volumes for the low-cost, quality-controlled type of manufacturing that a company like Alps does." Because the Japanese manufacturing base for the high-volume, low-profit-margin printers is finite, he predicts, the market will not be saturated for several years.



The Riteman printer from Inforunner *measures less than 3 inches high and could be called the first "half-height" serial dot-matrix printer.*



The P1350 from Toshiba America *is considered the first successful serial matrix printer in the United States employing a 24-pin print head. Toshiba plans to introduce an 80-column version of the printer this month.*

have long been common in Japan for Kanji (Japanese character) printing. (Fujitsu claims to have made 60,000 printers with 24-pin heads in the last five years.) But, until recently, many felt that 18 pins were adequate for English printing. However, the apparent success of Toshiba America Inc.'s 24-pin P1350 has done much to change people's minds.

The Tustin, Calif., company has gathered several major OEM accounts such as Tandy Corp.'s Radio Shack division and CPT Corp. for the P1350. Dan Crane, OEM vice president of Toshiba America, says the company now is shipping more than 600 units a year in the United States. The rapid acceptance of the 132-column printer, priced at $2,195 retail, may have caught even Toshiba by surprise. At last month's Comdex show, the company will introduce an 80-column version, the P1340. The new version will print at the same 180-by-180-dot-per-inch (dpi) resolution as the P1350. In near-letter-quality mode, however, it prints at 60 characters per second (cps) rather than the 100 cps achieved by the older model. Crane hopes the new unit will be priced at about 30 percent less than the P1350.

Crane believes the market for high-performance serial matrix printers is in small business computers. "We're addressing users who can justify the extra expense over a low-end matrix printer to get word- and data-processing [output] from the same desk space," he explains. "Word processing is the most important application, and we do see it competing with the 40-cps daisy-wheel printers in that respect." He expects graphics applications to remain secondary at least for now.

Fujitsu's Steiner agrees that many 24-pin printers will be used for word-processing applications. But he does not believe the 24-pin units will necessarily compete directly with daisy-wheel printers. Fujitsu participates in the daisy-wheel market, but Toshiba does not. "There will be some trade-offs in the marketplace and some overlap between them," asserts Steiner, "but we are certainly not de-emphasizing our daisy-wheel printer for what we see as a combination printer like the DP124." Steiner echoes Crane's belief that 24-pin models are aimed at small business system users with both data- and word-processing requirements.

—Edward S. Foster

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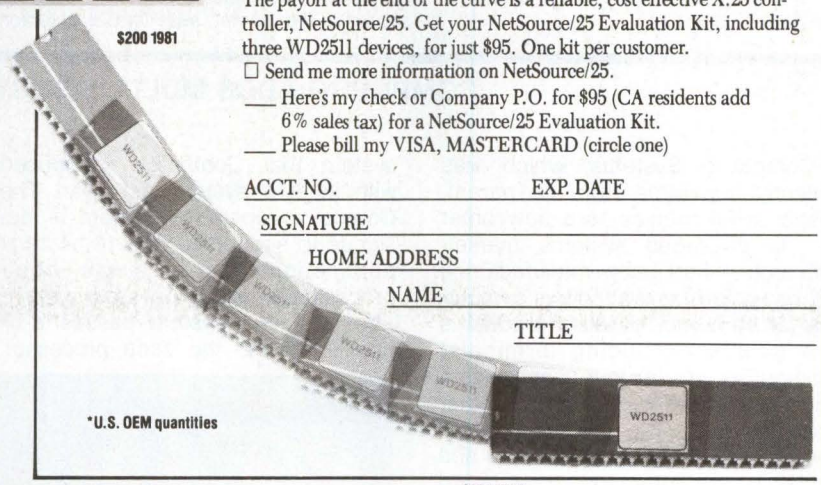

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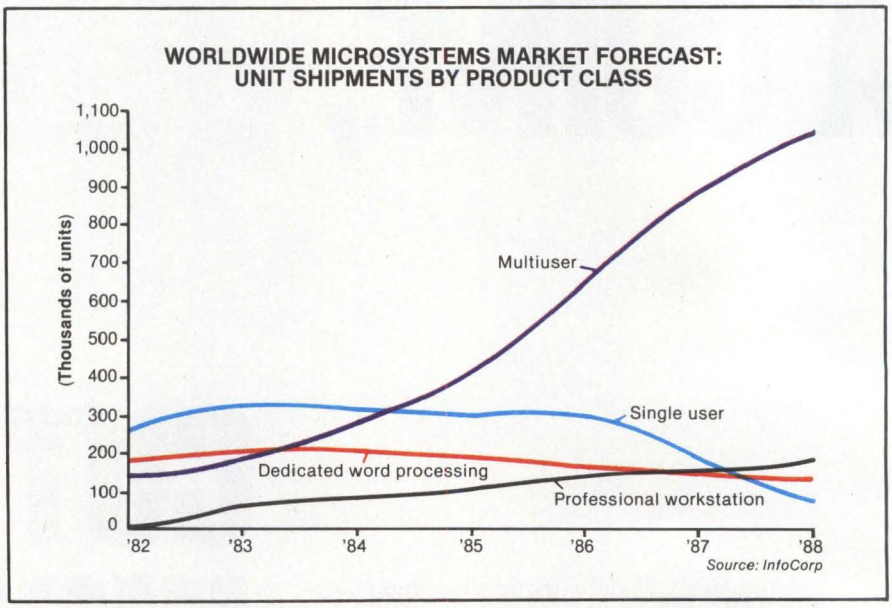
Multiprocessor microcomputers take advantage of installed CP/M base

While purveyors of 16-bit microcomputer hardware and software continue to debate which operating system—MP/M-86, OASIS-86, UNIX, XENIX, VENIX or Pick—will dominate the 16-bit multiuser microsystem market, a handful of hardware vendors are developing a thriving business with multimicroprocessor hardware that takes advantage of widely-installed 8-bit CP/M software.

Companies including Molecular Computer, TeleVideo Systems Inc., OSM Computer Corp. and CompuPro Systems have struck a responsive nerve among small business users and computer dealers who wish to upgrade to multiuser systems but want to take their 8-bit, single-user software applications with them.

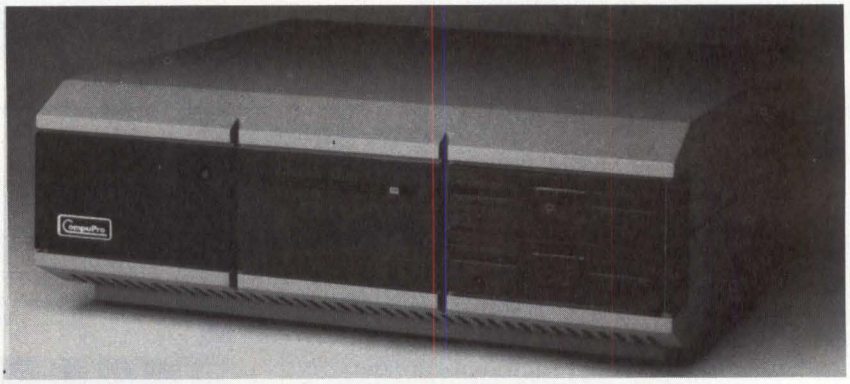


InfoCorp projects that multiuser microcomputers will be the fastest-growing section of the $6,000 to $25,000 microsystems market *through 1988, when 1.06 million such systems will be sold. Multimicroprocessor-based systems stand a good chance of gaining significant shares of the market, says InfoCorp senior analyst John Kiefer.*

COMPUPRO ADDS MULTIUSER SYSTEM

CompuPro Systems, which was recently separated from its parent, Godbout Electronics, is a newcomer to the packaged systems market, although it has been manufacturing kit, board-level and S100 bus computers for 10 years. Its latest product is the $4,995 (excluding terminals) CompuPro 10, a four-user system with a dedicated Z80B microcomputer for each user. The 8-bit processors (with their own 64K bytes of RAM and serial I/O) are arranged two per board and are housed in a 7-by-17-by-21-inch desktop cabinet with the Intel 8088 master processor and dual 5¼-inch floppy disk drives with space for an optional 40M-byte Winchester disk drive priced at $3,995. Another mass-storage option is CompuPro's M-drive/H solid-state disk emulator, which is available in 1M- or 4M-byte versions priced at $2,495 and $15,950, respectively.

The CompuPro 10 uses a version of the CP/M 8-16 proprietary operating system that CompuPro introduced with its 816 system last year. The CompuPro operating system is designed to support 8- and 16-bit CP/M applications on a single dual-processor (or multiprocessor) system. The operating system passes 8-bit applications to the Z80B processor, while the 8088 handles 16-bit operations on a timeshared basis. In addition to the operating system, the CompuPro 10 comes bundled with a spreadsheet program, a word processor and a database-management system.



CompuPro is a recent entrant in the multimicroprocessor system market with CompuPro 10, *a four-user system that combines four Z80B 8-bit processors and a shared 8088 16-bit microcomputer/controller.*

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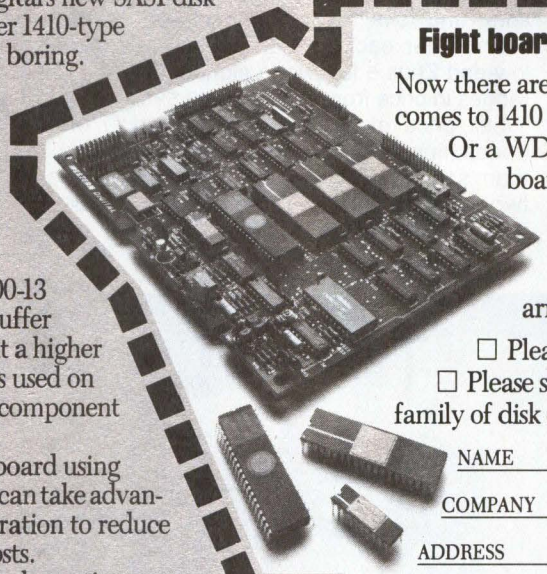

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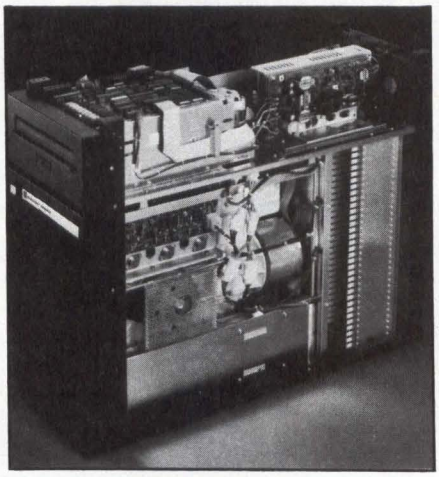
Citing what they call performance shortcomings of Digital Research Inc.'s MP/M (multiuser CP/M) operating system and the paucity of application programs supported on CP/M-86 and MP/M-86, these vendors have devised their own schemes to tie multiple 8-bit Z80 processors into single systems. The basic premise is to provide each user with a CPU and some shared memory, shared disk storage and an operating system that enables the user to run 8-bit CP/M software unaltered.

John R. Kiefer, senior analyst at market research company InfoCorp,



Molecular Computer has gained a lead in the multimicroprocessor system market with its Supermicro series. *The Supermicro 64 can be configured to support as many as 64 users.*

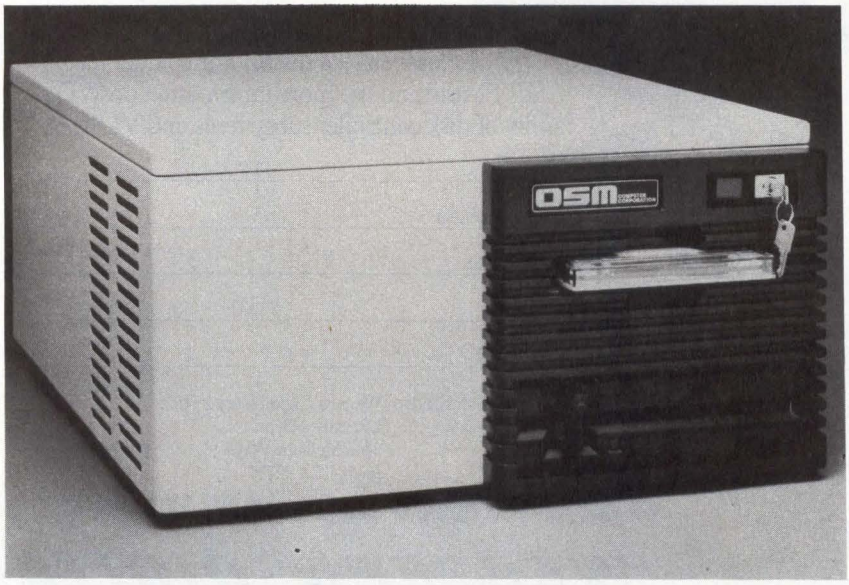
believes these vendors have found a very healthy market. Molecular's sales, for example, have mushroomed from $4.5 million on 450 units in 1982 TO $25 million estimated on 3,200 units in 1983. At the same time, TeleVideo has assumed a major role in the multiuser CP/M market with its networked and multiuser systems. Sales of TeleVideo's 806 and 816

OSM MUSE OPERATING SYSTEM MIXES CP/M, MP/M APPLICATIONS

The key element in OSM Computer Corp.'s bid for a share of the multiuser CP/M system market is its proprietary multiuser system executive (MUSE) operating system, which has been offered for three years on the company's Zeus systems.

The company has recently expanded the line with Zeus 3 and 5 models. The Zeus 3 can support as many as 32 users when configured with eight quad boards, each of which is equipped with four Z80A microprocessors and 64K bytes of dedicated memory for each of four users. The low-end Zeus 5 for two to eight users ranges in price from $5,595 to $8,595.

List price of a basic quad board (measuring 6½ by 10 inches) is less than $1,000 in a version supporting two users. A fully populated four-user version sells for about $1,900. List price of a packaged system, such as the Zeus 3, with a 12.6M-byte, 5¼-inch Winchester disk drive and a 20M-byte backup tape drive is $10,800. The Zeus 3 comes with a 10-slot expansion chassis that ties the master Z80A processor to the applications processor boards via what OSM director of marketing Nabil Baladi refers to as "a local-area network within a box." The 200K-byte-per-second channel is a parallel, synchronous, bidirectional data channel.



OSM's latest product is the Zeus 3, *which can support as many as 32 users and combines 8- and 16-bit CP/M operations under the MUSE operating system.*

Each processor card within the enclosure has two serial ports for attaching dumb CRT terminals and optional local printers. In addition, one user on each card can access a host mainframe via an IBM 3270 connection to down-load or up-load files.

MUSE consists of MUSE/Master and MUSE/User models that reside in the central controller and application processors, respectively. MUSE/Master handles file requests from MUSE/User, spools files and enforces system protection and sequential updates with record- or file-level locks. MUSE/User supports standard 8-bit CP/M and MP/M applications run by individual users. Baladi notes that the company is also planning upgrades to 16-bit capabilities in the Zeus series by adding an Intel 8086 family processor to quad board design.

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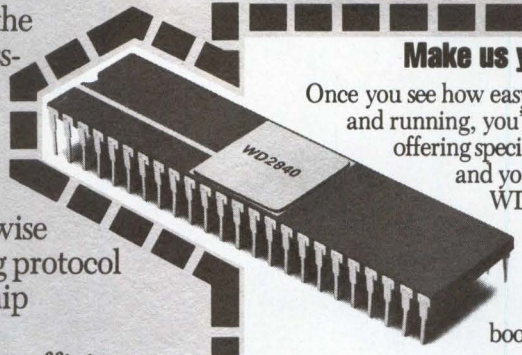

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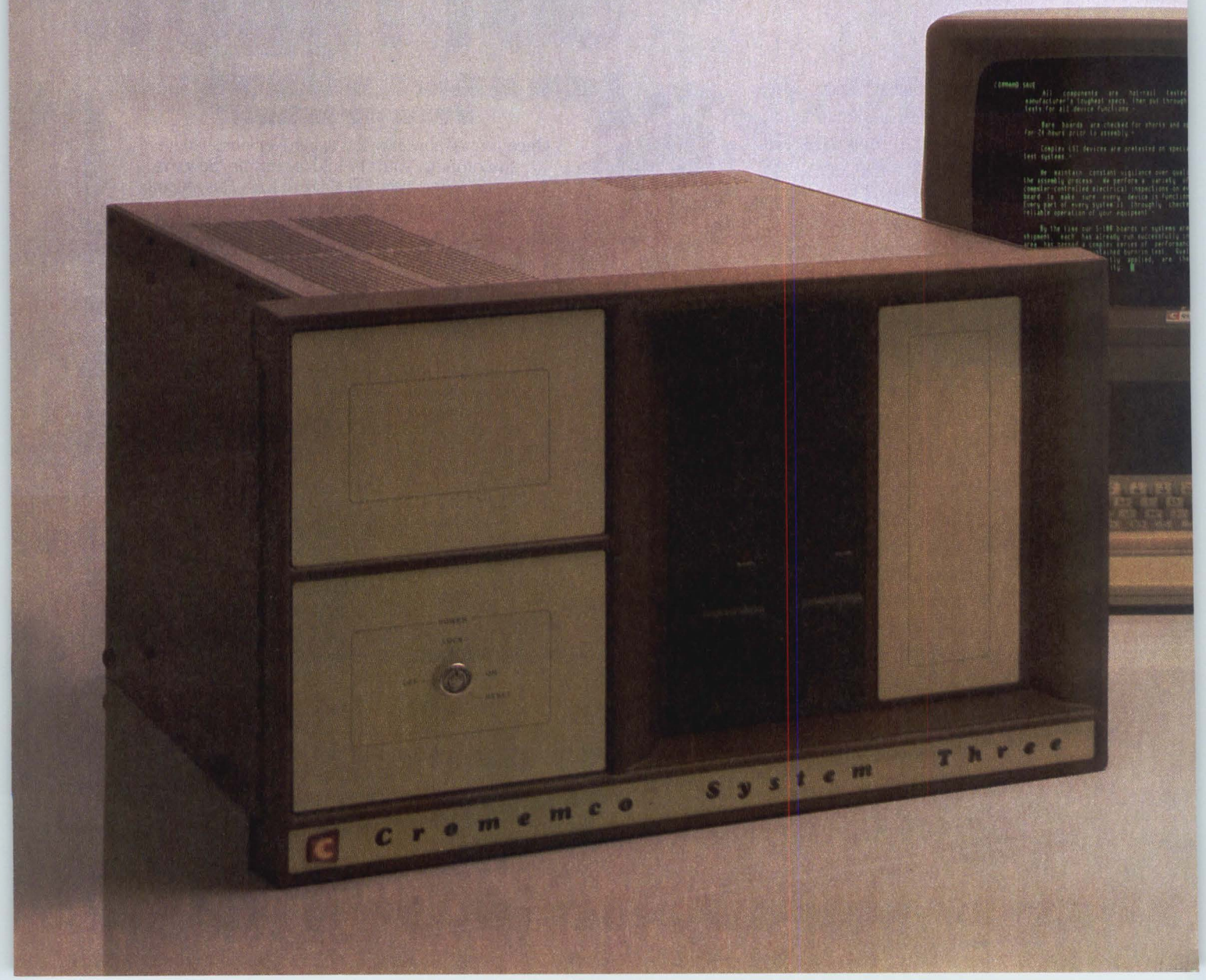
It has a lot of RAM memory to start with and plenty of room for more (up to 4MB). For disk storage, it's available with a 21M byte Winchester hard disk and a floppy disk (1.2MB), or with two floppy disks (2.4MB).

You also get more functional capability and expandability: the System Three has 21 card slots, and Cromemco offers a complete line of bus-compatible board products that can accommodate a wide



range of applications. And, of course, high-quality terminals, floppy disks and hard disks, tape drives, printers, and monitors.

What about software? We have more there, too. First, there's the CROMIX* operating system, inspired by the UNIX* system. CROMIX runs on both the 68000 and Z-80 and provides a user interface similar to UNIX, with improved file security and record level locking. But there's more. CROMIX is so flexible it lets you run your CP/M* based programs as well. And, we have high-level languages that include FORTRAN 77, COBOL, C, PASCAL, BASIC, LISP and RPG-II. Plus, graphics and communications software.

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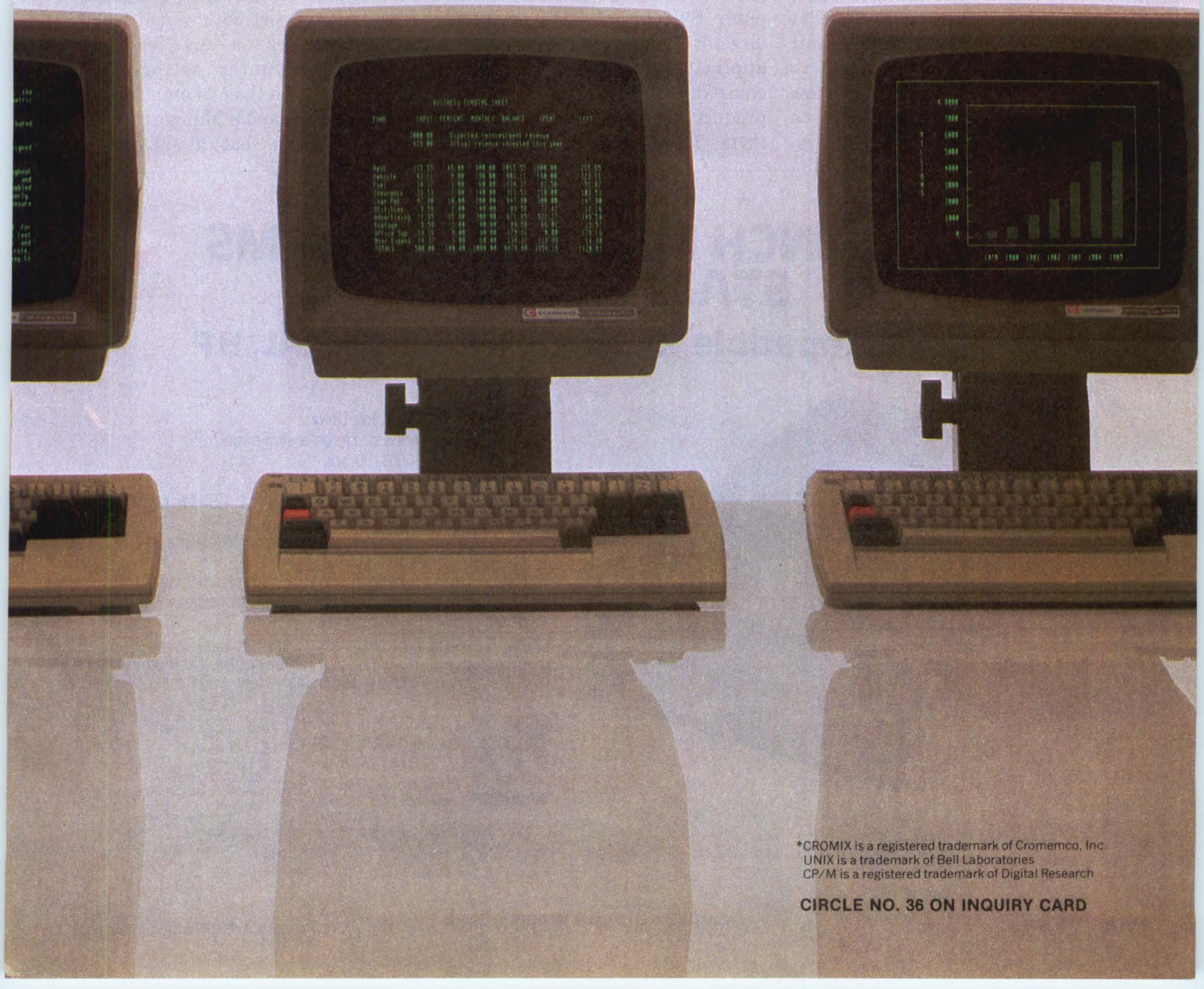

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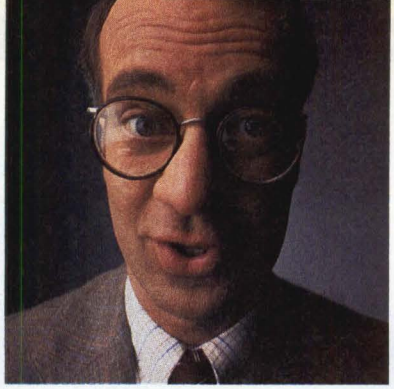
CIRCLE NO. 36 ON INQUIRY CARD

systems, its current multiuser multiprocessor lines, will have grown from 3,600 systems with 6,500 workstations in 1982 to 6,500 systems with 15,000 workstations by year-end, Kiefer states. These systems are finding a market, Kiefer notes, among the traditional 8-bit computer dealers who lack the sophistication to handle the more complex multiuser systems running proprietary operating systems or UNIX.

A recent InfoCorp study estimates that sales of multiuser microcomputer systems retailing for $6,000 to $25,000 will grow at a compound annual growth rate of 41 percent in 1983-1988 as unit shipments rise from 187,000 to approximately 1.06 million. How many of these systems will be single-processor timeshared systems such as those Altos Computer Systems manufactures and how many will be of a multimicroprocessor architecture is not known, but Kiefer points out it is "a very fragmented market with no dominant leaders." He gives companies like Molecular and OSM favorable odds for continuing their rapid growth because the distribution channel—largely dealers—is also fragmented.

Kiefer blames some confusion on a shortage of multiuser software. That lack has caused more than one company to rethink its multiuser product plans. At TeleVideo, Computer Systems division marketing director Gary Baughn says a lack of application software forced the company to postpone plans to produce a multiuser system using UNIX. The company is still gauging the volume potential of UNIX-based systems through its distribution channels (distributor-to-dealer) as well as through a growing OEM/national accounts program. Baughn says the UNIX-based system, which would use a Motorola MC68000-based CPU board, may be offered by year-end.

Meanwhile, TeleVideo will concentrate on the 1608, a replacement for the current multimicroprocessor 806/816 line. The 1608 will include an Intel 80186-based 16-bit processor as well as the Z80A used on the earlier line. A new version of TeleVideo's Mmmost operating system will support both 8- and 16-bit CP/M packages on any TeleVideo desktop computer acting as a workstation on the system. The Z80 initially will handle Mmmost executive functions, but a subsequent



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release early next year will shift those functions to the 80186. The basic system, which can support eight users, comes with a 40M-byte Winchester disk drive, a 1M-byte floppy disk drive and 256K bytes of RAM for a projected price of $7,995.

But the TeleVideo architecture is only one approach. The 806/816/1608 series are essentially single-board computers that serve as shared resource controllers for intelligent workstations with built-in microcomputers. Molecular argues that its architecture delivers lower cost by reducing workstation prices. The Molecular Supermicro series design provides one CPU card for each user but locates the card in the central controller, in which the cost of cabinetry, power supplies, disks and other peripherals can be shared, says Molecular marketing vice president Al Davis. "We see a whopping cost advantage with our architecture because, every time you do something outside of the box, you need extra power supplies and sheet metal," Davis observes. In addition, with the intelligence centralized in the CPU cabinet, Molecular can use dumb terminals that are a fraction of the price of intelligent workstations.

OSM Computer and CompuPro are using approaches similar to Molecular's (see "OSM Muse operating system mixes CP/M, MP/M applications," Page 00, and "CompuPro adds multiuser system," Page 68).

—Geoff Lewis

Advanced matrix printer heralds next generation output

Reports of dramatic advances in serial dot-matrix print quality have been circulating in the printer industry for several months. The first company to bring the next generation of dot-matrix printers to market may be Advanced Matrix Technology (AMT) Inc., a Newbury Park, Calif., start-up, which is scheduled to demonstrate its first product, the Office Printer, publicly at this month's Comdex show in Las Vegas, Nev.

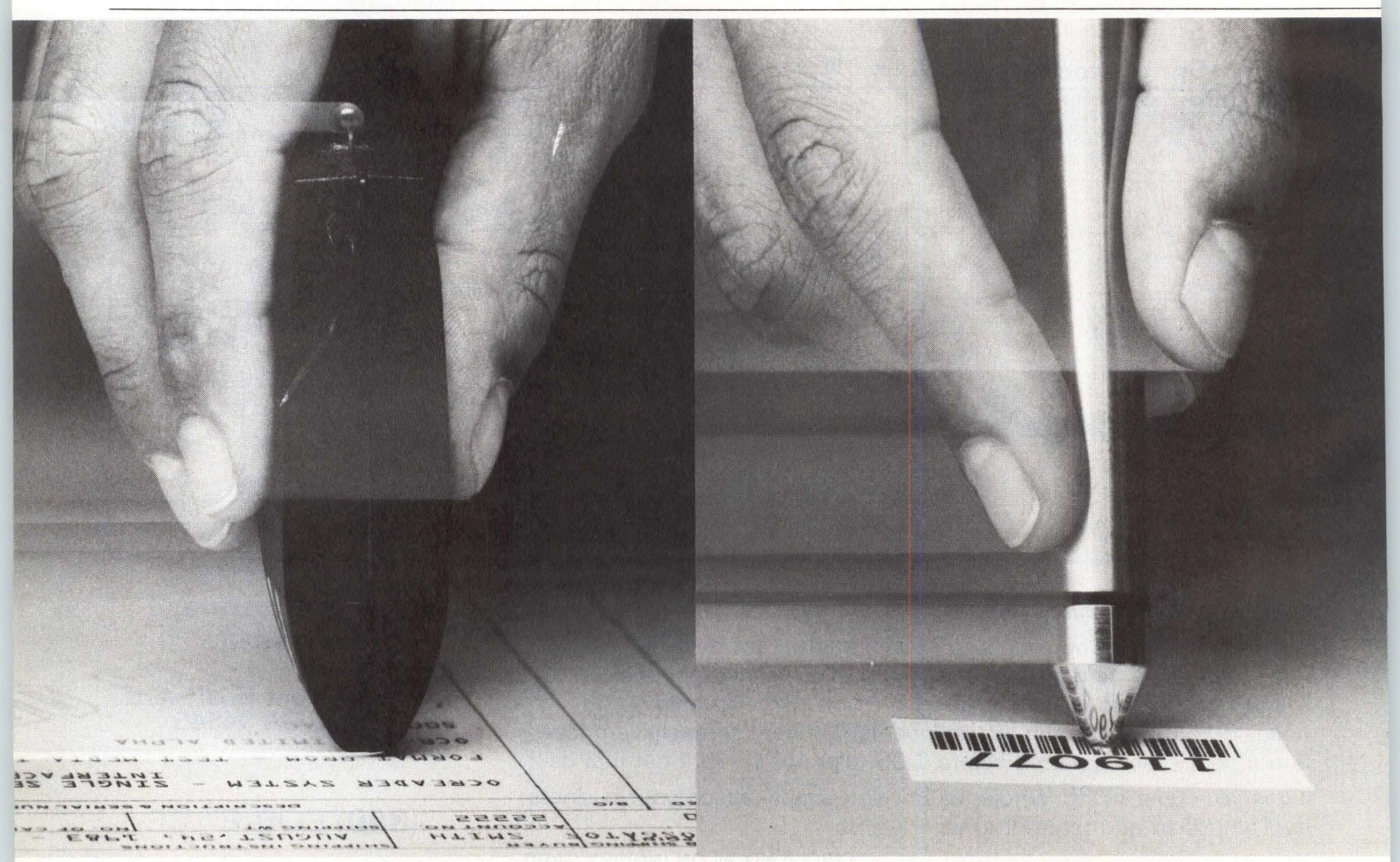
AMT's Office Printer, a serial dot-matrix printer for use with small business computer systems, is

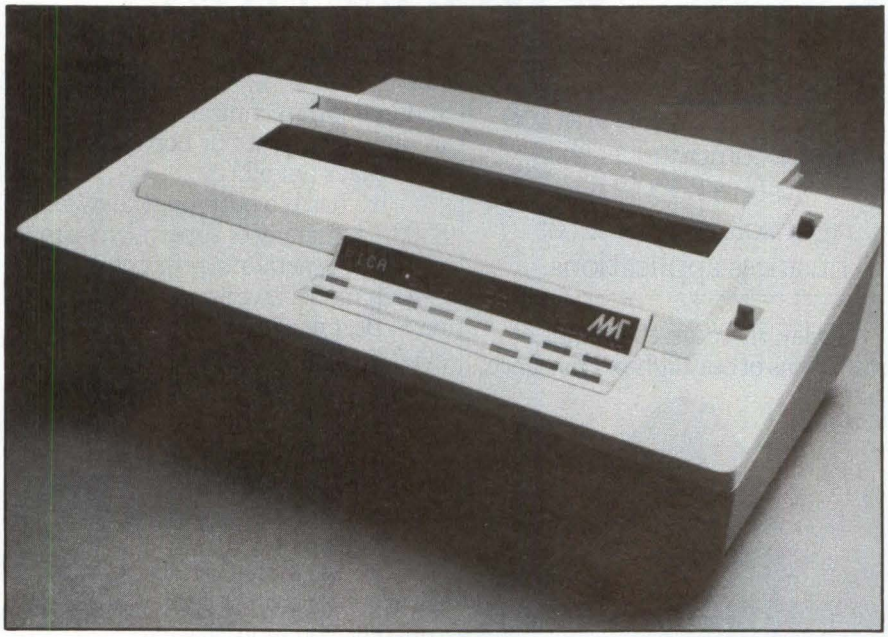
priced at $2,200 in quantities of 100. Print speed is 45 characters per second (cps) in the highest letter-quality mode, which produces characters in a 32-dot vertical by 72-dot horizontal matrix. Print speed in correspondence-quality mode is 100 cps in a 16-by-72-matrix character and 250 in the 8-by-8-matrix-character data-processing mode. For graphics applications, the Office Printer has a theoretical limit of 240 by 720 dots per inch (dpi), although AMT expects most OEM customers to use a maximum of 240 by 240 dpi for their applications.

AMT's primary marketing thrust will be through OEM sales, says vice president of marketing Bryan Doherty Jr., one of three co-founders who formed AMT after leaving now-defunct Malibu Electronics Corp. "We're emphasizing flexibility in our software to allow OEM customers to select the functions they need," he says. The printer's color capabilities are an example of the company's response to OEM requirements. "We originally planned our first product to be a monochrome-only unit," Doherty recalls, "but we found color capabilities so strongly desired that we decided to make it available right from the start."

Doherty does not credit any single technological breakthrough for the new printer's performance. Surprisingly, AMT did not develop a unique print head, choosing instead to employ a standard 18-wire head from an outside supplier. AMT's task was to improve design in other areas, Doherty states. "The key is the rigidity of the stamped-and-drawn frame we've designed," he explains. "That allows us to take advantage of improvements in electronics and software for driving the print head accurately." Another area in which AMT has concentrated is in designing its own ribbon cartridge. "The fabric weave, the density of the ink impregnated on the ribbon and the formulation of the ink itself all affect print quality more than one might expect." Doherty adds.

Many system integrators give AMT's product high marks. "We think they're the furthest along in terms of all the critical variables," comments Lee Rothstein, manager of peripherals marketing for NBI Inc., a Boulder, Colo., word-processing system company. "The print quality is superb, and it's going to look even better when more font design work is done with it. I'm





Advanced Matrix Technology Inc.'s AMT Office Printer prints at 45 cps in its highest letter-quality mode, producing 32-by-72-matrix characters. The printer also prints in correspondence, data-processing and four-color graphics modes.

particularly impressed with the printer's ability to print on transparencies."

AMT had not planned to emphasize transparency printing until potential customers requested it. Doherty sees a wide range of applications in multifunctional printing. The basic idea is "to let the user get data processing, business graphics and word processing from one printer," he emphasizes. The printer's capabilities include forms generation, spreadsheet hard copy, technical and scientific text processing and phototype simulation for proofing.

Evaluation units of the AMT Office Printer are expected to be available this month, with volume production beginning in February. Manufacturing will be done at the company's headquarters. —*Edward S. Foster*

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On a cold day in 1874, Harvard played Montreal with a slimmer, oval-shaped ball. This new ball was okay for running, but had the aerodynamics of a watermelon. It was tough to pass, and tougher to catch. The game ended in a scoreless tie. Like the personal computer, that ball was all right for individual effort, but didn't do much for teamwork.

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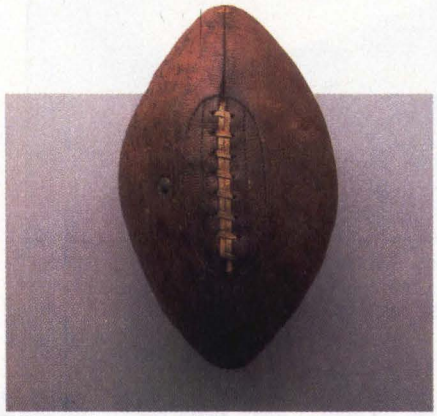

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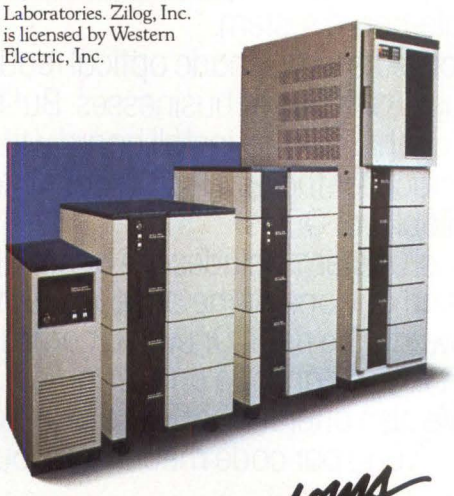

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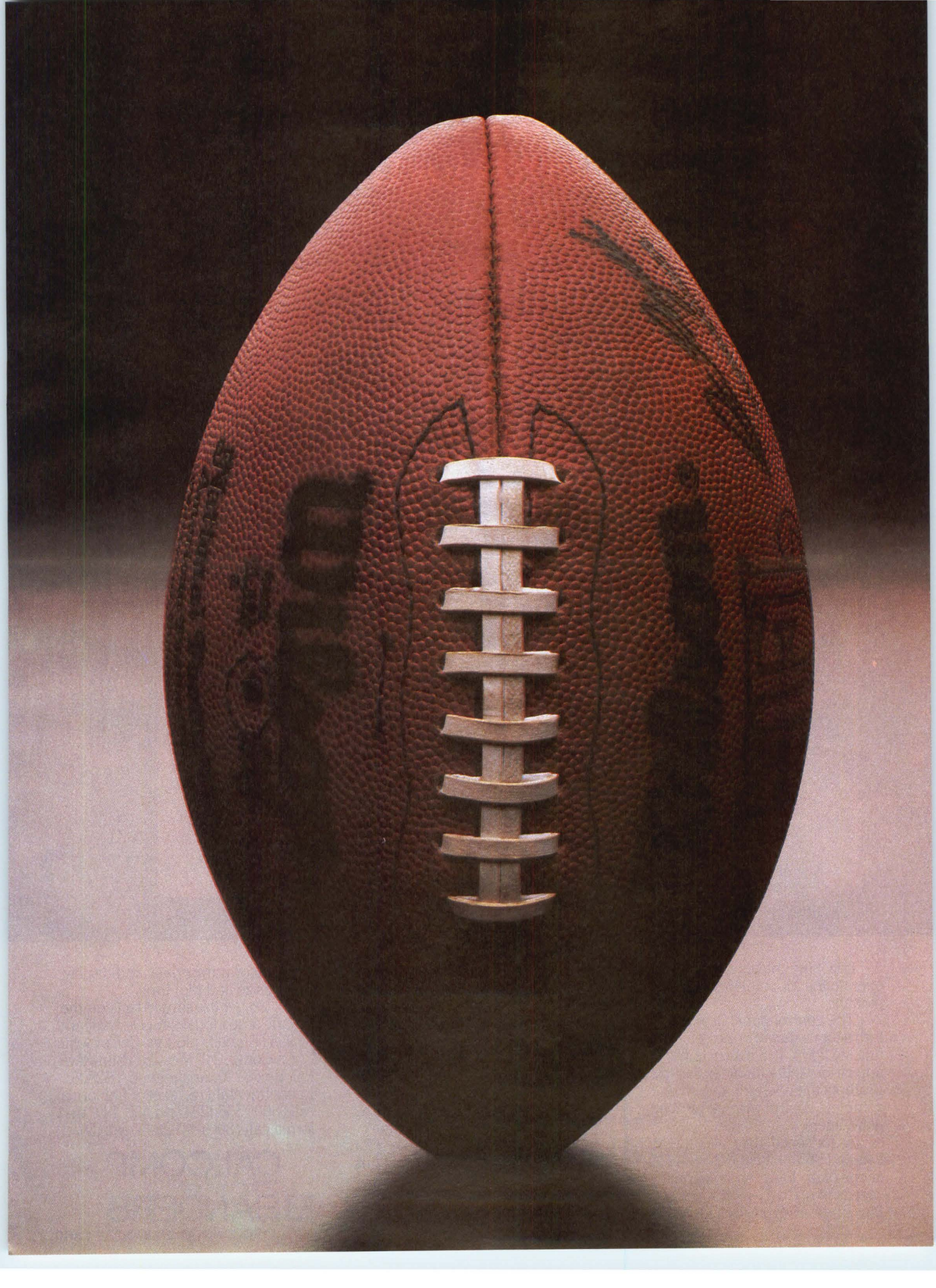

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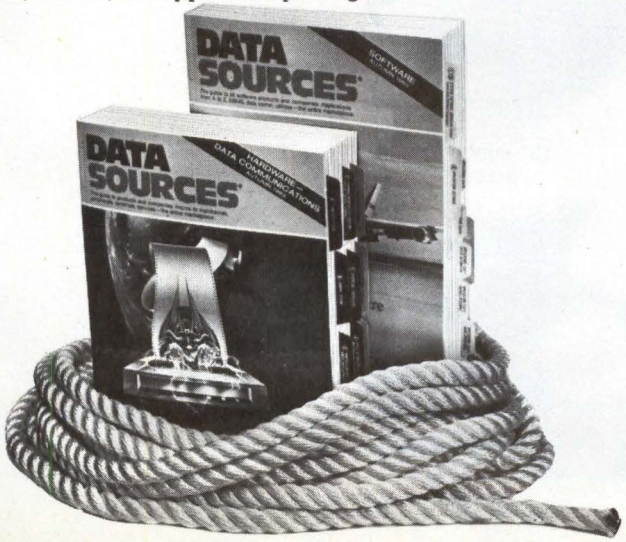

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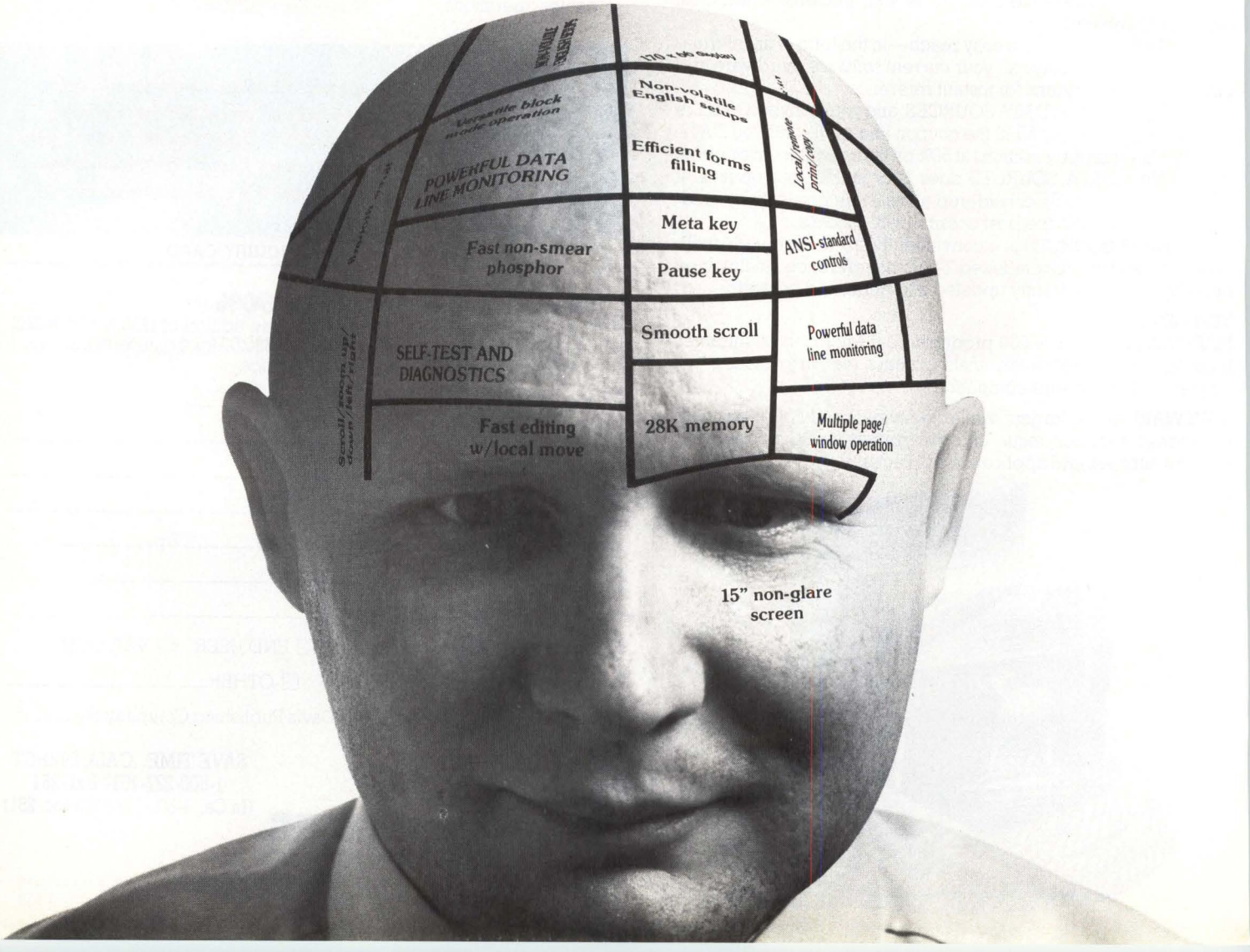


MARKET BAROMETER

A column devoted to an expert's look at an industry

Williams

Gerald Williams is executive editor of Data Sources, Cherry Hill, N.J., and has reported on the data-processing industry for six years. **Kari Fitzgerald** is an editor/analyst with *Data Sources*, a guide to hardware, software and data-communications equipment, listing more than 32,000 products.

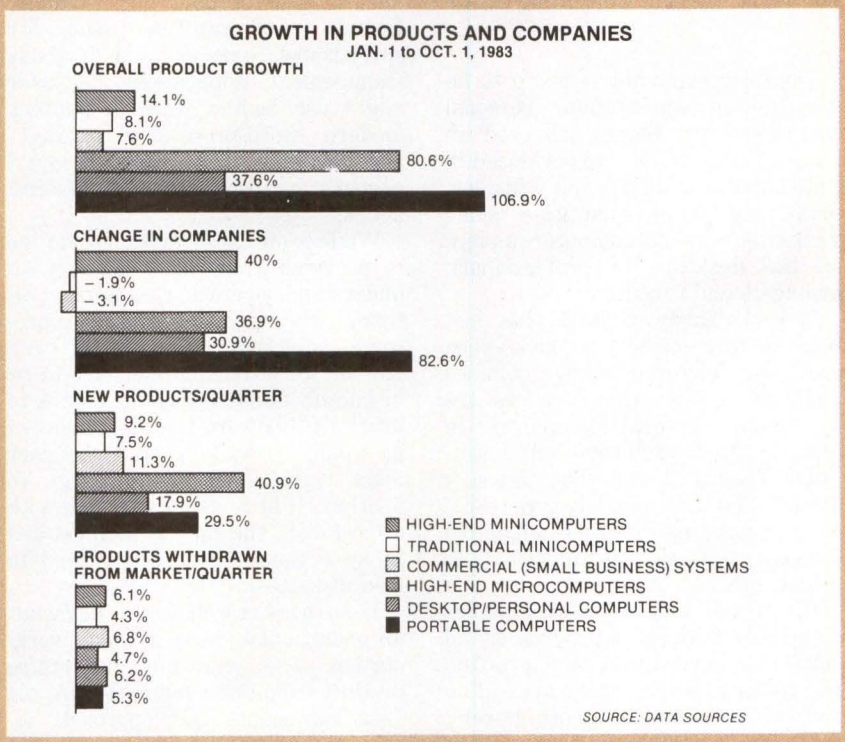
Booming 1983 micro market shows 250 new systems, 100 start-ups

By Gerald Williams
and Kari Fitzgerald
Data Sources

More than 250 new microcomputer-based systems have been introduced to an anxious audience, and more than 100 new companies have entered the microcomputer market since Jan. 1. Although one would expect this excitement to boost the minicomputer and commercial (small business) segments of the computer market, the microcomputer explosion has had a negative impact on those segments.

A prime reason for this impact is microcomputers' increasing cost/performance ratio. This has placed microcomputers and minicomputer commercial systems into direct competition with each other, forcing their vendors to redefine the market segment. The new definition is much narrower, and the growth potential of these markets is limited. In addition, this redefined market requires higher processing capabilities and expanded user support.

An analysis of the more than 2,066 computer systems and 600 vendors listed in the Data Sources database from Jan. 1 to Oct. 1, 1983, demonstrates the disparity between the microcomputer's activity and the growth of other market segments. For example, while desktop and personal computers were introduced at a 37.6 percent growth rate over that period, commercial systems grew only by 7.6 percent. Similarly, high-end microcomputers (using 16-/32-bit architecture) expanded at an 80.6 percent rate, while traditional minicomputers (those using 12-, 16- or 24-bit architecture) expanded at a much lower rate of 8.1 percent.



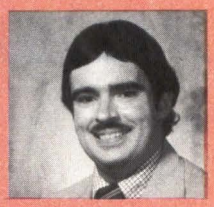
High-end minicomputers fared slightly better with a 14.1 percent increase in products.

The commercial system and minicomputer markets did not perform well in attracting new vendors. While new microcomputer vendors appeared at rates from 30.9 to 82.6 percent over the period, the number of traditional minicomputer and commercial systems vendors actually declined. In spite of low growth in other minicomputer areas, several new vendors—40 percent more—entered the high-end segment. This further demonstrates the changing market as vendors seek a niche at the high-end of the market segment.

In spite of the market problems, however, the minicomputer and commercial system vendors continue to introduce products faster than products are removed from the market. The introduction of such systems as IBM Corp.'s System/36, for example, led the commercial system market segment to post a quarterly increase of 11.3 percent. High-end minicomputers expanded at 9.2 percent per quarter, and a 7.5 percent growth in minicomputers was recorded. Although these areas demonstrate growth, they still do not compare favorably to the quarterly growth in the microcomputer segments.

GUEST FORUM

A column for guest experts to speak out



Thomas R. Billadeau *is president of The Office Systems Consulting Group Inc., Cambridge, Mass., which performs extensive market research and industry analysis. He is editor of the* Automated Office Systems *newsletter.*

The PC evolves to a useful workstation

By Thomas R. Billadeau
The Office Systems Consulting Group

The microcomputer is going to be *the* desktop workstation. Personal computers are being delivered in volumes heretofore unexperienced in the computer industry. But will a low price and large quantities alone guarantee personal computers a place on the desktops of professionals, managers and executives?

It is foolhardy to think that just because IBM PCs and PC look-alikes are being delivered in huge volumes and that a few other vendors are delivering personal computers in quantity that problems will disappear. They will not. The industry should view the expanding personal computer population as a challenge to increase systems' usefulness and usability.

Given the number of companies frantically working to produce useful software, there should be no problem in getting such software. The software must be easy to use. Surely, that's happening too. But what about the differences in operation between software packages? There are packages that have made good progress toward ease of use. For example, Lotus 1-2-3 can be used for spreadsheet, graphics and database management applications. A user might use Samna Word or another modern word-processing package, and several other packages could perhaps be used to meet vertical needs.

While using these packages, refuge is provided from less-than-easy-to-understand operating systems. Although the operating system represents something akin to a car's engine, a user should not have to be intimately familiar with the engine to drive. If this were the case, many of us would be walking. But the user must travel from one package to another. If he is using a system with a hard disk, the road is perhaps less rocky because he does not need to load diskettes.

Users have two choices if they want an operationally homogeneous workstation. They can buy the entire product from one vendor. The Apple Lisa represents this approach, although some users might not accept a user interface that forces them to tear off imaginary pieces of paper and to pretend to carry them to pictures of files, printers and wastebaskets. But at least the Lisa is consistent from one application to another. Does the user want to work with the interface the hardware or software vendor decides is best, especially if it's a baby user interface like the one on the Lisa? Can that user get all the software he needs if he locks himself into such a product?

A second choice will emerge, however, one that is more attractive. In this scenario, the user interface is another layer of software that sits between the operating system and the application program. It provides the user with a consistent way of dealing with whatever application he is running. A product that represents such an effort is DesQ from Quarterdeck, Santa Monica, Calif. I think Quarterdeck's concept is excellent, although it might be trying to do too much. DesQ is trying to allow data transfer to and from any application program. Initially limiting the number of applications might make the product available sooner, and I think that's a good idea.

LOOKING AHEAD IN MMS

The coming year brings a third special issue. Slated for publication in mid-June, the **Mini-Micro Computer Digest** will prove an indispensable selection guide to minicomputers and microcomputers. It will include staff-written product/market overviews and extensive product selection tables for:

- single-board microcomputers,
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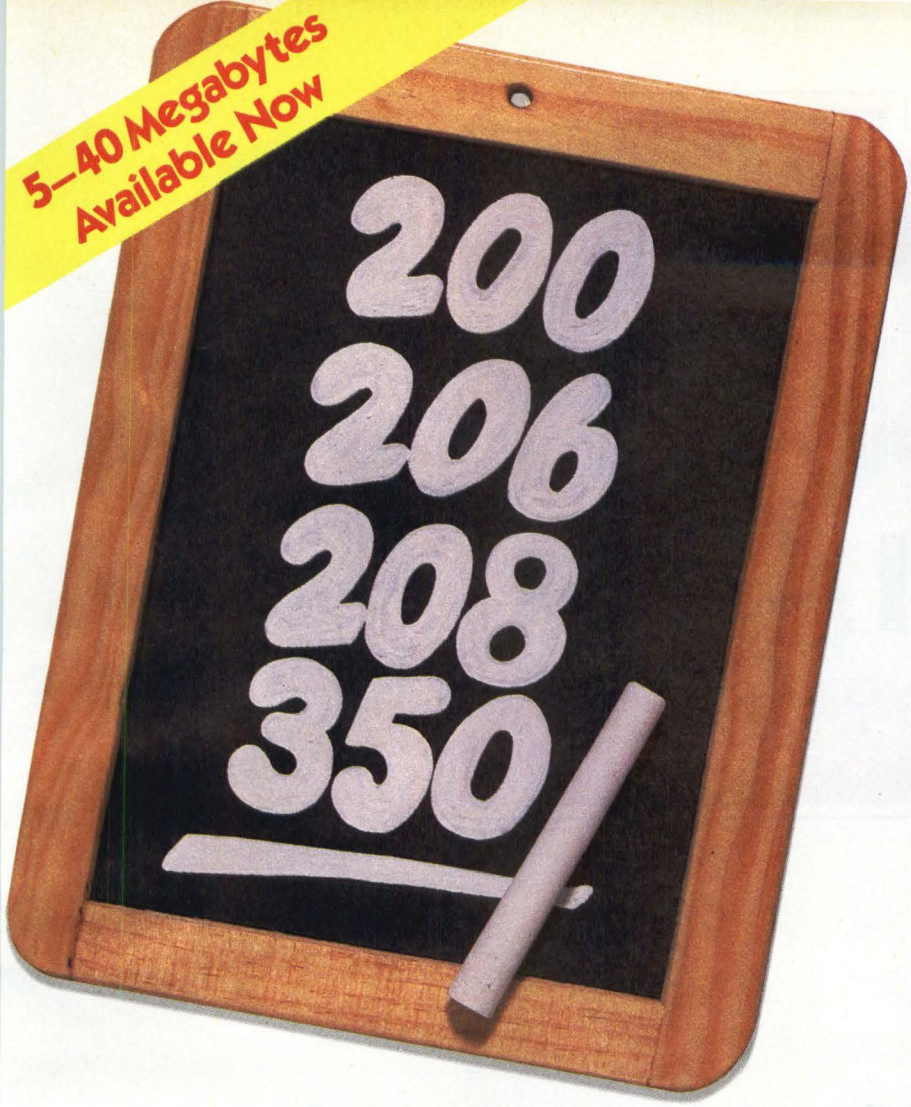

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Financings

Drivetec Inc., San Jose, Calif., has secured $5 million in its second round of venture financing, bringing the total to $8 million. Investors include Robertson, Colman & Stephens, Technology Venture Investors and the Hambro International Venture Fund. Drivetec manufactures the SuperMinifloppy 3.3M-byte, half-height, 5¼-inch floppy disk drive.

Distribution/service deals

Microcom Inc., a Norwood, Mass., manufacturer of data-communications hardware and software, has added five distributors, bringing its nationwide total to 25. Microcom is the developer of the Microcom network protocol for communications between microcomputers and larger computers....**Stearns Computer Systems Corp.**, Minneapolis, has signed a distributor for the Stearns MS-DOS-based office microcomputer in the United Kingdom and Ireland. Stearns is represented in 62 U.S. cities and nine foreign sites, including Singapore, Malaysia, Belgium, the Netherlands, Luxembourg, Australia and Norway.

Wet ink

Computer Memories Inc., Chatsworth, Calif., has signed a $7 million, two-year contract to supply 5¼-inch Winchester disk drives to Met-Chem International Corp. The drives' capacities will range from 6M to 40M bytes. Computer Memories has also increased its one-year contract with Alpha Microsystems to $10 million....Prime Computer Inc., Natick, Mass., will purchase as much as $150 million worth of equipment from **Convergent Technologies Inc.** over the next three-and-one-half years for Prime's professional workstation program. Although Convergent, Santa Clara, Calif., and Prime are not releasing details until the first half of 1984, observers speculate that Convergent's forthcoming 80186-based N-Gen modular workstation will form the nucleus of the deal. Included in the agreement is an option for Prime to purchase as many as 1.5 million shares of Convergent stock....Supermicrocomputer manufacturer **Plexus Computers Inc.**, Santa Clara, Calif., signed a three-year contract worth an estimated total of $40 million with Philips Information Systems Ltd. Philips will purchase the MC68000-based, 40-user P/35 desktop and P/60 systems....Columbia Data Products Inc. will purchase $21 million worth of 5¼-inch Winchesters, half-height Winchesters and half-height, 5¼-inch minifloppies from **Shugart Corp.**, Sunnyvale, Calif. The drives will be used in Columbia's IBM PC-compatible personal computers ....**Wang Laboratories Inc.'s** revenues continue to increase at a record-setting rate. A recent boost was a $10 million contract with Mutual Life Insurance Co., New York. The deal covers the VS and Professional computer systems.

BOX SCORE OF EARNINGS

This monthly table lists the revenues, net earnings and earnings per share in the periods indicated for companies in the computer and computer-related industries. Parentheses denote losses. Comments are from corporate summaries unless otherwise noted.

Company	Period		Revenues	Earnings	EpS
Alpha Microsystems	6 mos.	8/28/83	$23,300,000	$1,675,000	.60
	6 mos.	8/31/82	12,678,000	539,000	.20
CompuScan Inc.	3 mos.	8/31/83	5,552,000	532,000	.08
	3 mos.	8/31/82	4,709,000	1,041,000	.21
Computer Horizons Corp.	6 mos.	8/26/83	15,076,000	903,300	.38
	6 mos.	8/24/82	8,530,500	100,700	.05
Perkin-Elmer Corp.	year	7/31/83	1,015,402,000	50,242,000	1.15
	year	7/31/82	1,036,774,000	62,669,000	1.45
Rand Information Systems Inc.	24 wks.	8/14/83	6,116,788	59,422	.02
	24 wks.	8/15/82	7,172,513	222,021	.08
Software AG Systems Group Inc.	3 mos.	8/31/83	8,663,000	1,118,000	.18
	3 mos.	8/31/82	6,382,000	149,000	.02
Standard Microsystems Corp.	6 mos.	8/31/83	20,101,000	3,301,000	.33
	6 mos.	8/31/82	11,938,000	1,172,000	.14

Comments: Perkin-Elmer Corp. said semiconductor processing equipment orders were strong, and orders in other product areas continued to improve, particularly in the United States. Sales for the fourth quarter were $275 million, compared to $269 million last year. Net income was the same as a year ago—$16.5 million, or 38 cents per share. Minicomputers accounted for about 21 percent of the years sales; semiconductor processing equipment accounted for 17 percent.

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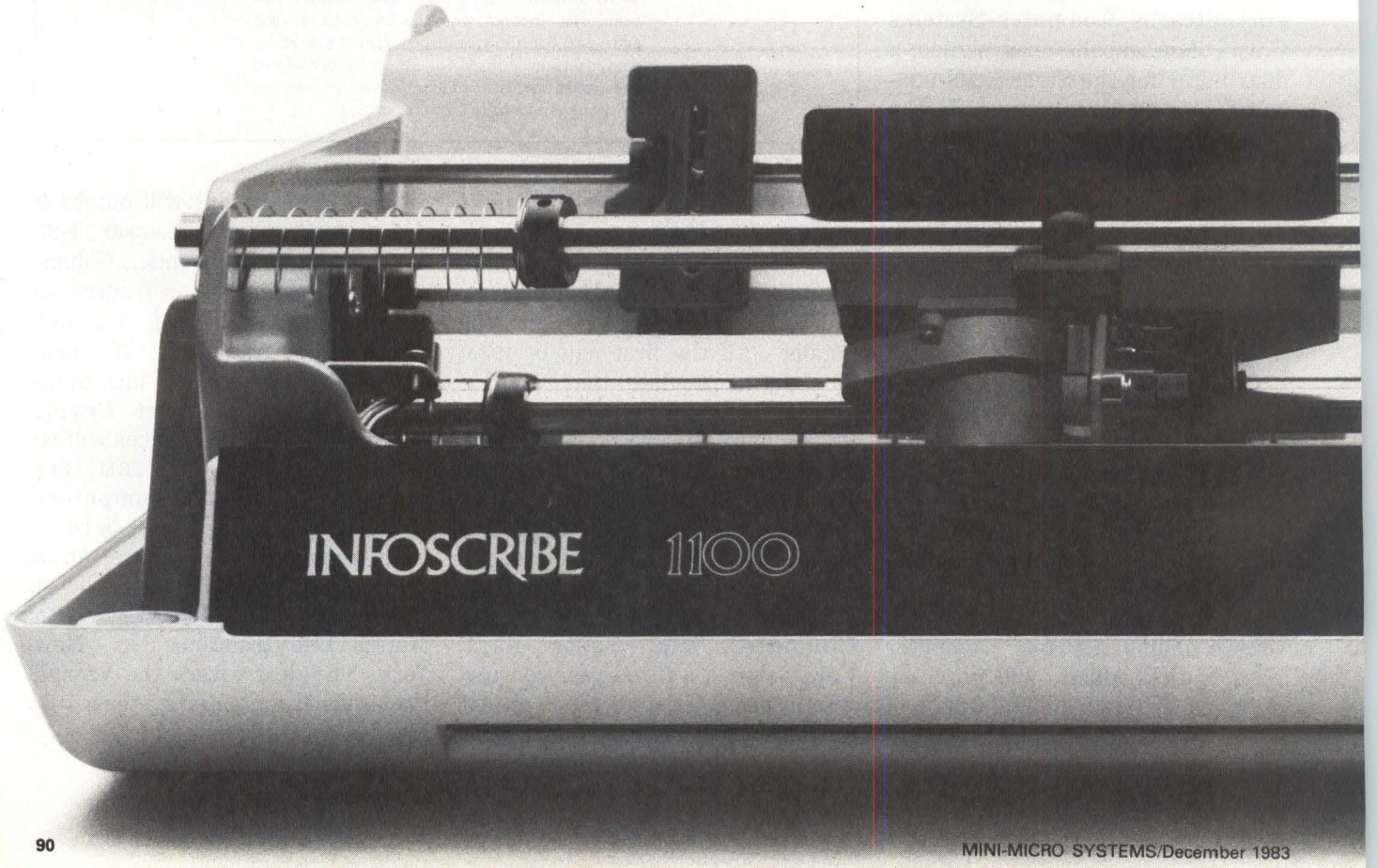

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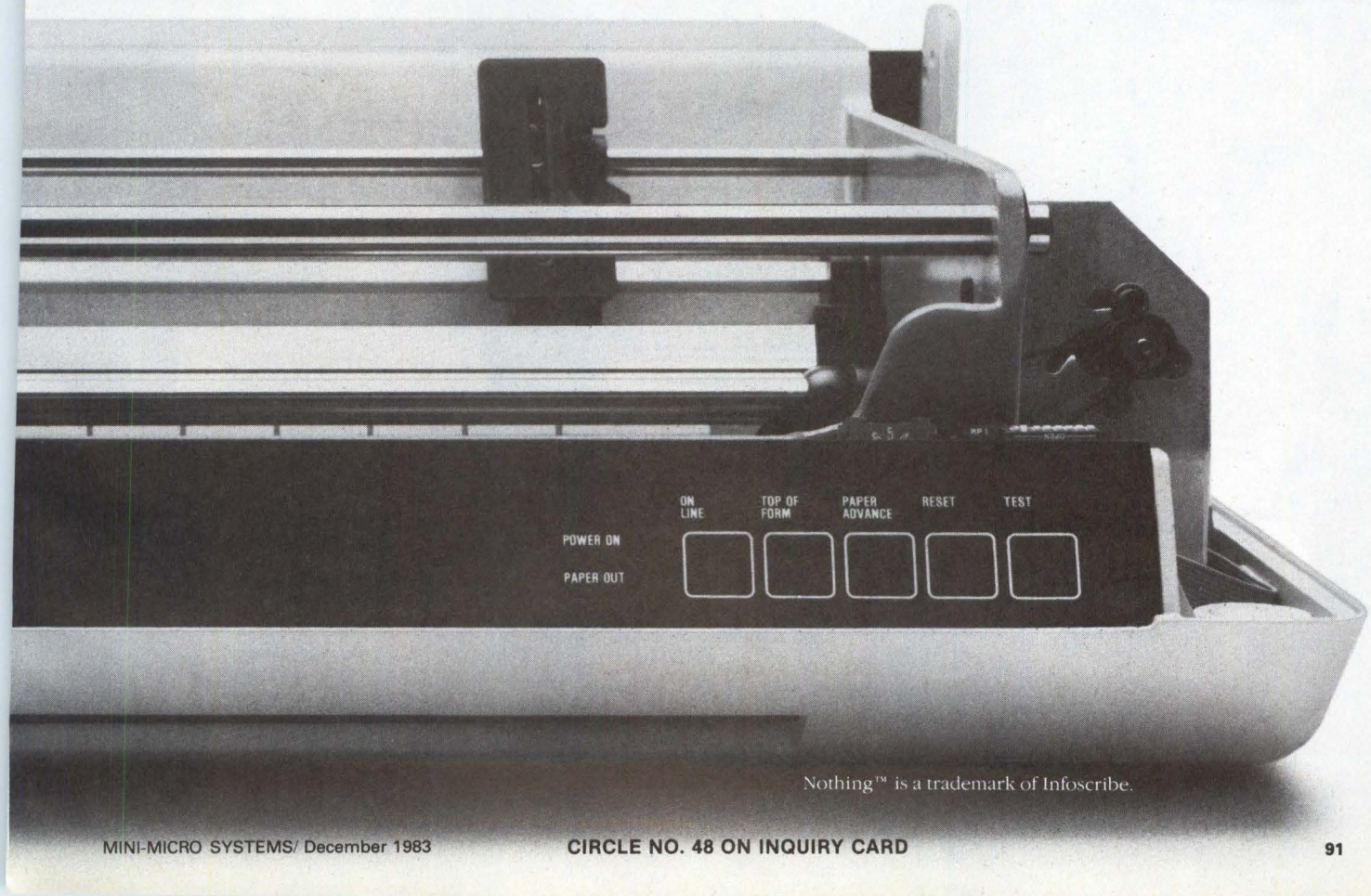

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FACIT DATA PRODUCTS

Printers, printers, and more printers.

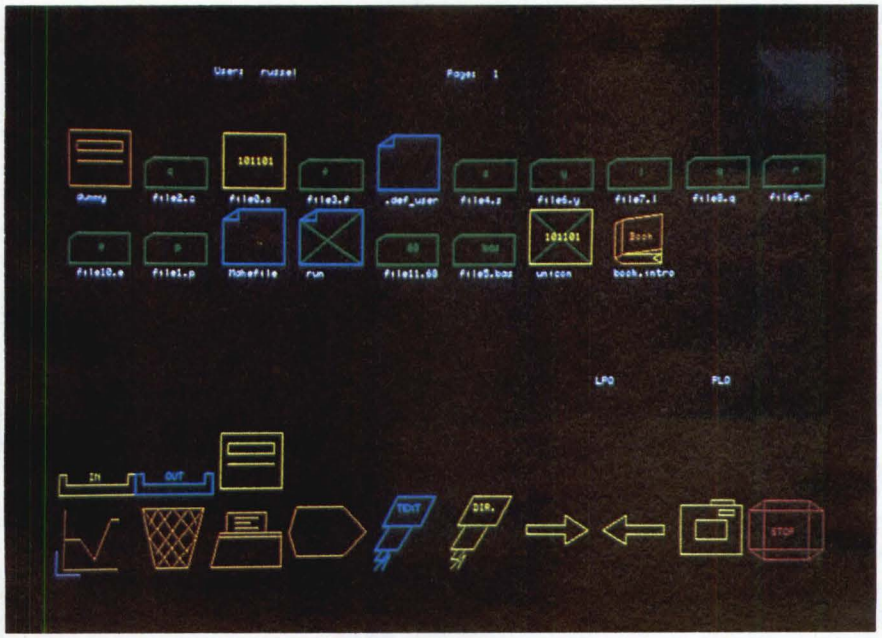
English university develops UNIX icon interface

Loughborough University of Technology, England, is seeking commercial partners to promote one of the first icon-driven end-user interfaces for UNIX. The interface, called Unicon, replaces UNIX's cryptic commands with icons that can invoke printing, displaying and deleting files and UNIX editing and mailing systems. Icons can also represent most types of user files. Users can create extra icons, as well. Unicon, mainly written in FORTRAN 77, can be tailored for other operating systems and is portable across a wide range of UNIX implementations, claim its developers.

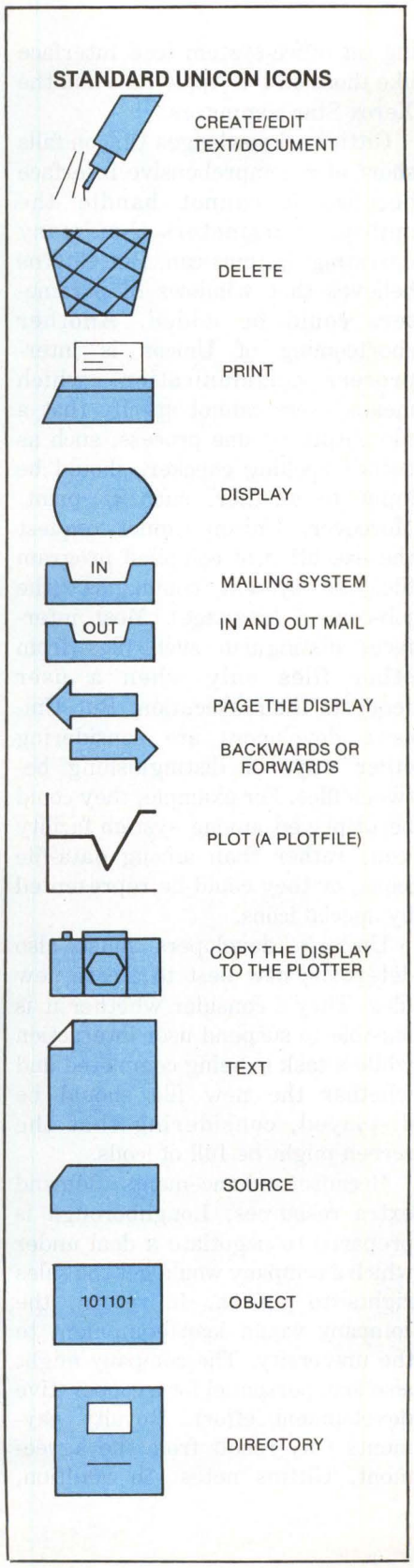
More than 20 British companies have shown interest in Unicon, says Unicon project leader David Gittins of Loughborough's computer studies school. Tektronix Inc., Beaverton, Ore., is also interested in Unicon, which includes a device driver for Tektronix's 4010 terminal, Gittins says.

UNIX market consultant Jean Yates of Yates Ventures, Los Altos, Calif., notes "a lot of interest" in icons among the U.S. UNIX community. She believes that Unicon should be well received. She knows of no commercially available icon-based interface in the United States. Existing products do, however, allow UNIX commands to be replaced by menu systems. In addition, windowing arrangements include the use of several cursor-selectable boxes, each of which holds a programmer file.

Loughborough's Gittins says academic rather than commercial motives spurred the Unicon project. The challenge of producing an icon interface for a full operating system was more problematic than develop-



A typical Unicon display has two main areas: *the upper area is for user data-file icons; the lower is for system-facility icons. The top of the display carries two text strings, one stating the current page and the other specifying the user and filestore names. The center part of the screen can be used for any textual messages, option lists and menus.*



ing an office-system icon interface like those on the Apple Lisa and the Xerox Star computers.

Gittins acknowledges Unicon falls short of a comprehensive interface because it cannot handle the multiple parameters that many operating systems can. But Gittins believes that windows of parameters could be added. Another shortcoming of Unicon is interprocess communication, which means users cannot specify that a file output by one process, such as UNIX's spelling checker, should be input to another, such as print. Moreover, Unicon cannot request the execution of compiled program files or system commands (the job-control language). Most interfaces distinguish such files from other files only when a user requests their execution. But Unicon's developers are considering other ways of distinguishing between files. For example, they could be displayed among system-facility icons rather than among data-file icons, or they could be represented by special icons.

Unicon's developers must also determine how best to create new files. They'll consider whether it is feasible to suspend user interaction while a task is being completed and whether the new file should be displayed, considering that the screen might be full of icons.

Because enhancements demand extra resources, Loughborough is prepared to negotiate a deal under which a company would get the sales rights to Unicon. In return, the company would loan equipment to the university. The company might also loan personnel for a cooperative development effort. Royalty payments may result from the agreement, Gittins notes. In addition, Loughborough may publish its findings in the academic world.

Gittins says Unicon's 2-D graphics library system could ultimately be replaced by the Graphics Kernel System (GKS) if the International Standards Organization (ISO) GKS standard becomes widely adopted. The graphics library, which accounts for more than one-half of the Unicon system, incorporates three drivers for three output devices—an HP flatbed plotter, the Tektronix 4010 and the Lundy Electronic Systems Sigma 5000 graphics display terminal.

The graphics library system is linked to UNIX via two other parts of Unicon—the control program and the host-dependent FORTRAN-UNIX interface, which is written in C. It handles functions that FORTRAN 77 cannot, such as system calls and dynamic memory allocation. Gittins says the interface is only 5 percent of the total system and is being modified for other operating systems, including Prime Computer Inc.'s Primos. The UNIX version has been implemented initially under Berkeley 4.1 UNIX on a Digital Equipment Corp. VAX-11/750 at Loughborough. Implementations on 16-bit UNIX hosts cannot run as fast because the graphics library exceeds the 64K-byte direct-address limit.

One function of the control program is to maintain a file of icon definitions. In addition to four standard data-file icons—text, source code, object code and directories—the user can define 15 icons by entering x and y coordinates of each line and forming its shape. Each icon can have as many as 15 lines. The user can also specify the color of each icon line.

—*Keith Jones*

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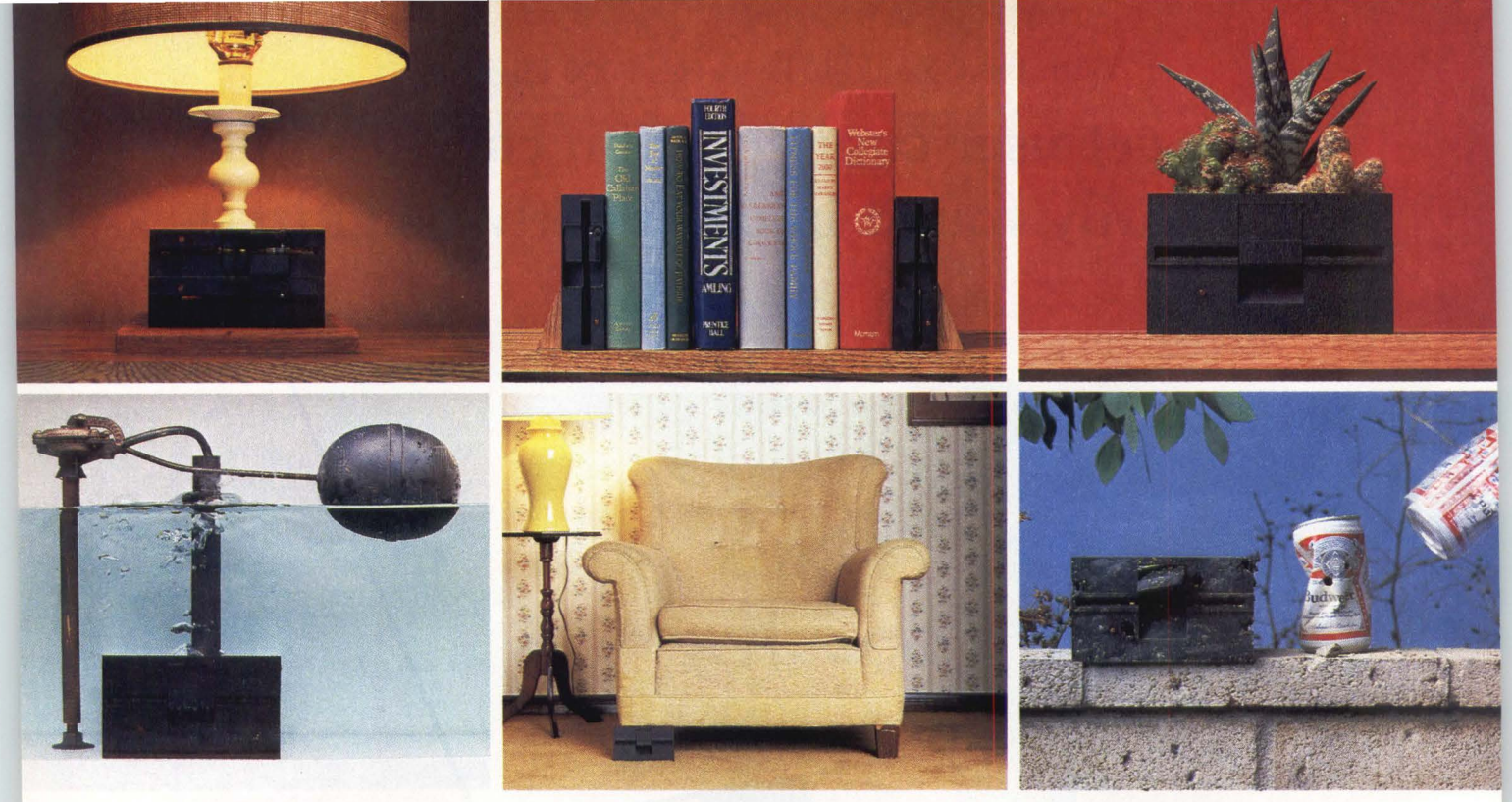

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U.S. government programs will parallel Japanese fifth-generation AI research

U.S. government projects will more closely parallel Japanese fifth-generation activities than will those of the Microelectronics and Computer Technology Corp. (MCC). So stated Stanford University artificial-intelligence (AI) pioneer Edward Feigenbaum at the recent Fifth Generation World Conference in London (see "DEC, Motorola, NSC lead joint research venture," Page 33). Feigenbaum also said the Japanese and U.S governments' programs will be most similar in applied AI and symbolic computation.

The U.S Department of Defense Advanced Research Projects Agency (ARPA) will lead U.S. fifth-generation research, stated Feigenbaum. About one-half of ARPA's $500 million worth of projects will be for military applications, including fighter pilot cognitive firing systems, autonomous weapons, image interpretation for missile homing and situation assessment and planning.

Also at the conference was Kazuhiro Fuchi, director of the Japanese government-funded Institute for New Generation Computer Technology (ICOT), who stated, "ICOT is not aiming at one huge machine. Personal computers will be more powerful in the future than today's super computers."

Kazuhiro Fuchi, director of Japan's ICOT fifth-generation project, *says his program's long-term goal is to develop a personal computer more powerful than today's super computers.*

A fundamental difference between the American and Japanese strategies is the choice of a non-procedural language to implement knowledge-based systems. Feigenbaum underlined U.S feelings that the Prolog logic-programming language favored by the Japanese is "awkward and untested." Fuchi, however, reaffirmed Japan's commitment to languages such as Prolog. Mitsubishi, one of the eight major Japanese companies working with ICOT, is building a Prolog programmable sequential inference machine called the personal sequential inference (PSI) machine. PSI is expected to be ready for testing by the middle of next year. It will employ conventional Von Neumann architecture, which is why it is called sequential. The PSI will be microcoded to host a variant of Prolog called KL0. The PSI will be linked via a 10M-byte-per-second local-area network to a relational

FRANCE, GERMANY FUND COMPUTER RESEARCH PROGRAMS

The governments of France and West Germany may soon follow Britain in funding national research programs in advanced computer technology (MMS, July, Page 81). The West German government is expected to give the green light to a program costing $40 million per year, government and industry each funding 50 percent. The French government is granting around $15 million in the first annual funding for six projects. Industry is expected to add as much.

Jean-Claude Rault, with the French government-backed Agency for Information Technology, notes the funding is on the condition that the work leads to salable products. Thus, unlike the British and German programs, the French program will not be pure research. French projects include software engineering, workstations and computer-aided design for very-large-scale integration and for general applications.

The British government is providing $300 million for its Alvey computer research program. Member companies are expected to add almost as much to each project, making the total expenditures about $500 million over five years.

Officials of the Common Market in Brussels, Belgium, expect the European Strategic Program of Research and Development in Information Technology (ESPRIT) to get fully under way in 1984. They note that the joint research institute being set up by International Computers Ltd., Siemens AG and Compagnie des Machines Bull (MMS, November, Page 89) will get a head start on other contenders when bidding for ESPRIT funds for knowledge engineering. Bidding agreements for ESPRIT programs must include members from at least two European countries.

database-management system that will support 128M bytes of semiconductor memory and 20G bytes of disk memory.

LISP remains the favorite of the AI community in the United States, says Feigenbaum. He points to Hewlett-Packard Co., LISP Machines Inc., Symbolics Inc. and Xerox Corp., which have improved price/performance ratios on their LISP-based machines (MMS, October, Page 62).

More exotic offerings could emerge from start-up Intelligent Thinking Machines, whose founders worked at the Massachusetts Institute of Technology on the ARPA-funded Connection Machine project. The LISP-based Connection Machine prototype is intended to associate facts using a network of nodal processors (MMS, October, 1982, Page 118). *—Keith Jones*

OVERHEARD OVERSEAS

By Maureen O'Gara, Contributing Editor, West Germany

Clouds over U.S. micros may slow European sales

By Maureen O'Gara,
Contributing Editor, West Germany

News of darkening clouds over California's microcomputer companies is having its impact on Europeans. English-language newspapers that otherwise ignore Silicon Valley are now reporting on the mishaps blighting Osborne Computer Corp., Victor Technologies Inc., Fortune Systems Corp. and Vector Graphic Inc. Coverage in the local and international computer press may be more balanced and informed than some of the spectacular headlines in London's *Sunday Times* and the international issues of *Business Week* and *Newsweek*, but the message is clearly the same. Often coupled with this is news of turmoil among European concerns such as Germany's Basis Microcomputer, David Daten Technik, Mercator and Dietz.

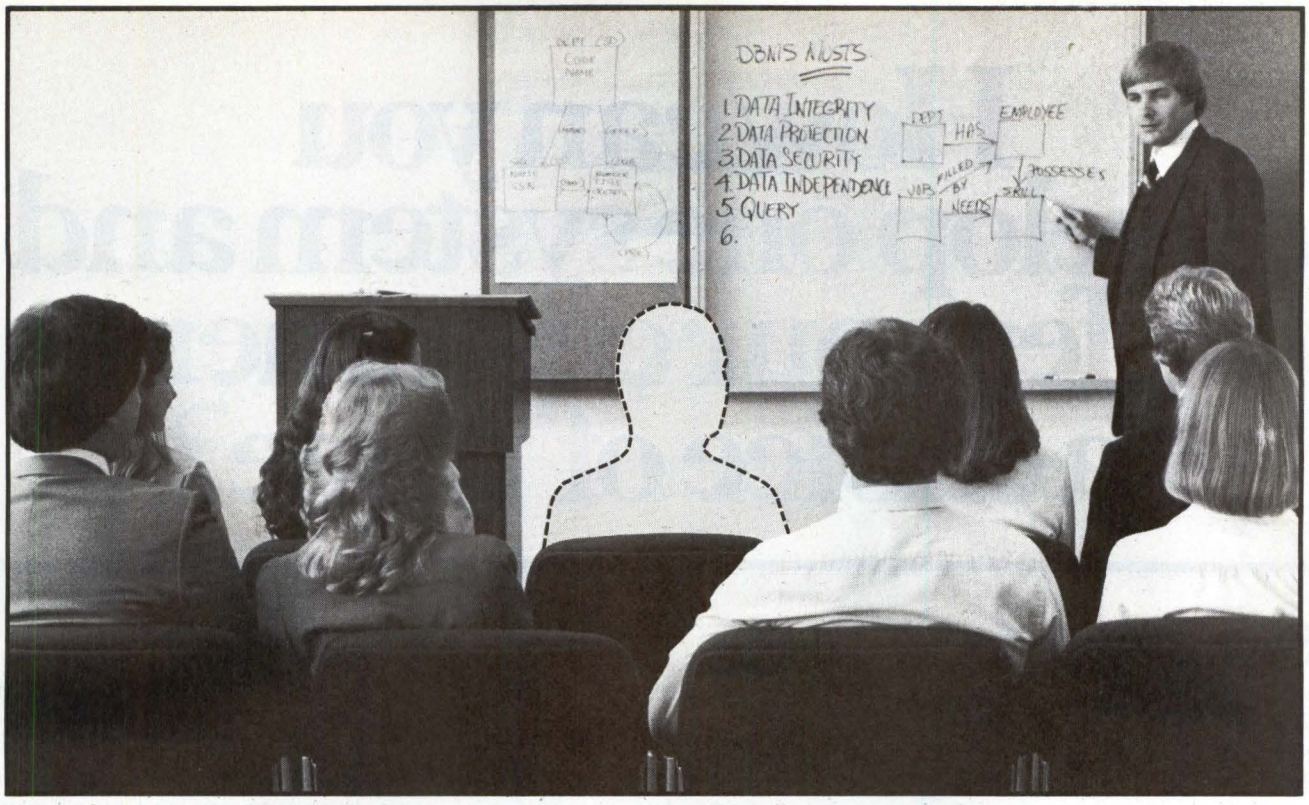
The reaction seems to be what would logically be expected of a basically conservative population not as attuned to or trusting of high tech as Americans—or as inured to high-flying start-ups and crashing failures. Initial indications are that it's going to be harder for small- and medium-sized companies in the European computer market—the vast majority of which are American-owned—to sell their wares. Even some large firms such as Burroughs Corp. may be in for a bumpy road.

European conservatism dictates that one buy from a company that is stable and reliable. Therefore, the chief beneficiary of all the bad news is likely to be IBM Corp. In Germany, for instance, Victor Technologies has had the best seller with its Sirius machine, while the IBM PC has had a slow start. Already, indications are that dealers who had not formerly queued up for IBM are grappling to find a place in line. The increased activity is probably more attributable to the general concern than the popularity of the PC.

In England's more dynamic marketplace, Gordon Skinner, head of Fortune distributor Tetra Data Systems, says he is seeing signs that IBM will capture a significant new share of market across its entire product line among U.K. mainframe users. Skinner notes that the Fortune box is not in head-to-head competition with the IBM PC. He admits, however, that competition between the Fortune and the IBM Displaywriter will probably stiffen.

Skinner thinks it is not just the failure of an Osborne or the losses of a Victor but the continued depressed earnings of Apple Computer Inc. that will critically impact the market. Apple has been catching some heat lately for its financial showing in England, where it is expected to crumble against IBM.

In Germany—which dominates Europe as a potential market—some industry watchers suggest that IBM competitors will have to become more market-driven and less product-oriented. In Apple's case, watchers say the company erred in pricing its 28,000-deutsche mark (DM) Lisa to include software vs. IBM's XT, whose 15,000-DM price tag does not include software. They say that German users didn't comprehend the reason for the difference in price. American suppliers to European markets will just have to become more aware of their audience, its limitations and sensitivities.



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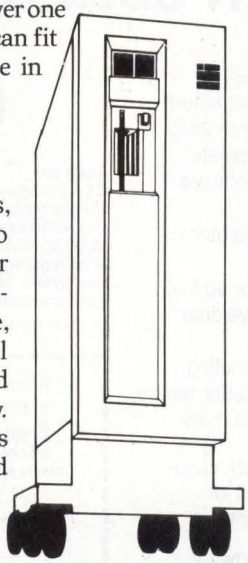

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CIRCLE NO. 53 ON INQUIRY CARD

Venture capitalists with record-setting funding seek proven management teams

By David A. Bright

Although the United States is still in a recession, venture capital firms continue to pour record amounts of money into the economy, particularly in computer and computer-related areas. Last year, an estimated total of $1.8 billion was disbursed to portfolio companies, an increase of $400 million, or 29 percent, over 1981, claims Stanley Pratt, editor and publisher of *The Venture Capital Journal*, Wellesley, Mass. Of 1982 disbursements, 42 percent went to the computer industry, and 11 percent went to the communications industry, says Pratt. He adds that venture capital commitments and disbursements this year are far ahead of 1982's rates. The total pool—the sum of moneys held by private venture capital firms, small business investment companies and subsidiaries of large corporations—is about $9 billion. That compares to $7.6 billion in 1982. Of more than 500 private venture capital firms, roughly half provide 80 percent of the funding, Pratt states.

Although venture capitalism is generally regarded as extremely risky, the rewards are enticing enough to keep financiers constantly on the prowl for new opportunities in potentially explosive markets. "Venture capitalists are looking for home-run hitters, not singles hitters," comments Pratt. Two examples of such home-run hitters that returned handsome profits to venture capitalists are Apple Computer Inc. and Apollo Computer Inc. Venture capital company Abingworth Plc. (then Abingworth Ltd.), London, invested in Apple in 1979 when the fledgling personal computer manufacturer was two years old. Although Abingworth sold some of its stock in 1980 when Apple went public, the company's remaining 500,000 shares of common stock, which originally cost $140,625, were worth nearly $26 million last May. Apollo stock purchased by venture capitalists Genstar Venture Holdings B.V., Amsterdam, the Netherlands, and Hellman, Ferri Investment Associates, Boston, in 1980 for 20 cents per share sold last August for $33.50 per share. Apollo manufactures networking workstations for OEMs in the emerging computer-aided-design/computer-aided-manufacturing (CAD/CAM)market.

In addition to the lure of high profits, changes in federal regulations offer even more incentives to venture capitalists. The venture capital industry was initially spurred by the Small Business Investment Act of 1958, which also allowed tax breaks. It received another boost in 1973 with the formation of the National Venture Capital Association, which provided a common meeting ground for venture capitalists. In 1979, pension-fund regulations were eased to allow the funds to contribute as much as 0.1 percent of their assets to venture capital. Pratt estimates U.S. pension funds to total as much as $800 billion. Another boon to venture capitalists was the drop in 1978 of the maximum federal capital-gains tax rate from 49 percent to 28 percent. In 1981, the tax rate was further reduced to 20 percent.

VENTURE CAPITAL BY YEAR
($ millions)

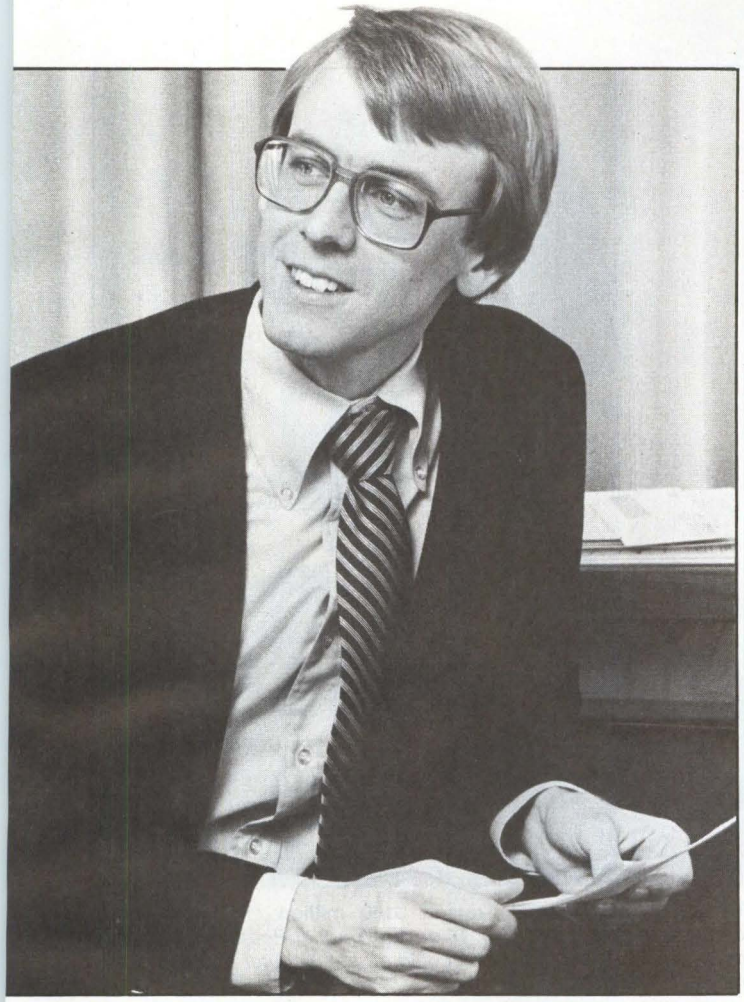
	New private capital committed to venture capital investment firms	Size of total pool	Annual estimated disbursements to portfolio companies
1982	1,700	7,600	1,800
1981	1,300	5,800	1,400
1980	900	4,500	1,100
1979	319	3,800	1,000
1978	570	3,500	550
1977	39	2,750	400

Source: The Venture Capital Journal

Despite these statistics, there are rumblings that all is not well in the venture capital industry. One rumor is that, as in the overcrowded microcomputer field, a shakeout is coming soon. Another is that the funding pattern is shifting heavily toward the later stages of financing, making it more difficult for start-ups to obtain seed money. Pratt disagrees: "Rubbish to both! The pendulum is not going to swing as widely as in the past but will continue to swing. There will always be entrepreneurs, and, as long as there are entrepreneurs, there will be venture capitalists."

Sound management is the key

Although venture capitalists take care to place their funds in companies with unique products in growth markets, often neither the product nor the market is the primary consideration when evaluating a prospect. Sound management is the key, say many venture capitalists. "We are very much sold on proven manage-



Entrepreneurs seeking venture capital who have "anything on the ball at all," *will get an introduction to a venture capitalist, says John Doerr, partner at Kleiner Perkins Caufield & Byers.*

ment," states Anthony Montagu, chairman of Abingworth, which manages capital totaling about $90 million. He says of a prospect's managers, "We look to see if they've run a good company and know what they're doing or a division of a company—an IBM, a Teradyne or whatever it happens to be." Abingworth then examines the targeted market, checks customers, looks at the product and evaluates a prospect's financial position. Approximately 50 percent of Abingworth's 60 investments are in the United States. Abingworth's portfolio covers a broad range. Besides Apple, it includes portable computer manufacturer Gavilan Computer Corp., semiconductor manufacturers Seeq Technology Inc. and Standard Microsystems Corp., complementary - metal - oxide - semiconductor (CMOS) manufacturer Telmos Inc., color terminal and dot-matrix vendor Envision Technology Inc. and Ethernet hardware and software vendor 3Com Corp.

At Kleiner Perkins Caufield & Byers, a well-known San Francisco venture capital company, partner John Doerr says there are seven key features he evaluates before investing in a company. The first three, he quips, are "the people, the people and the people." Once Kleiner Perkins is satisfied with a company's management team, it looks for technical excellence, strategic focus toward a "gaping hole" in a market, reasonable financing and "a sense of urgency." The company expects to disburse between $25 million and $30 million in investment funds this year. Key investments include Compaq Computer Corp., producer of the Compaq IBM PC-compatible portable computer, fault-tolerant computer manufacturers Tandem Computers Inc. and Parallel Computers, terminal vendor Wyse Technology, Apollo competitor Sun Microsystems and supermicrocomputer builder Plexus Computers Inc.

Last September, the John Hancock Venture Capital Fund Limited Partnership, Boston, initiated a fund of approximately $148 million. One-third will be invested in venture capital firms, and two-thirds will be invested in portfolio companies, notes investment officer William Johnston. Choosing the right investments, Johnston notes, is "not a step-by-step science—it's more of an art." The venture investor relies on his judgment of the management team, the product and the potential of the market. Potential market size must be more than just $100 million, he says. Another factor John Hancock takes into consideration is who the other investors are because the fund's policy is not to be sole investor in any venture.

How to meet a venture capitalist

How does an entrepreneur who believes his company has a strong management team coupled with a special product in a growth market meet the people who control investment money? It's rare for a venture capital company to fund entrepreneurs who send unsolicited proposals, although all proposals get reviewed, say many investors. It's not uncommon for a venture capitalist to be swamped with 1,000 proposals a year.

Faced with such intense competition, companies seeking funding must be aggressive. "If entrepreneurs have anything on the ball at all, they'll get an introduction," says Doerr at Kleiner Perkins. He believes the best way to get an introduction is to "talk to successful entrepreneurs who have built companies." A person who has succeeded in receiving venture capital can provide dispassionate advice and valuable contacts and can help set up a business plan, adds Doerr.

Lawyers, accountants and bankers who do business

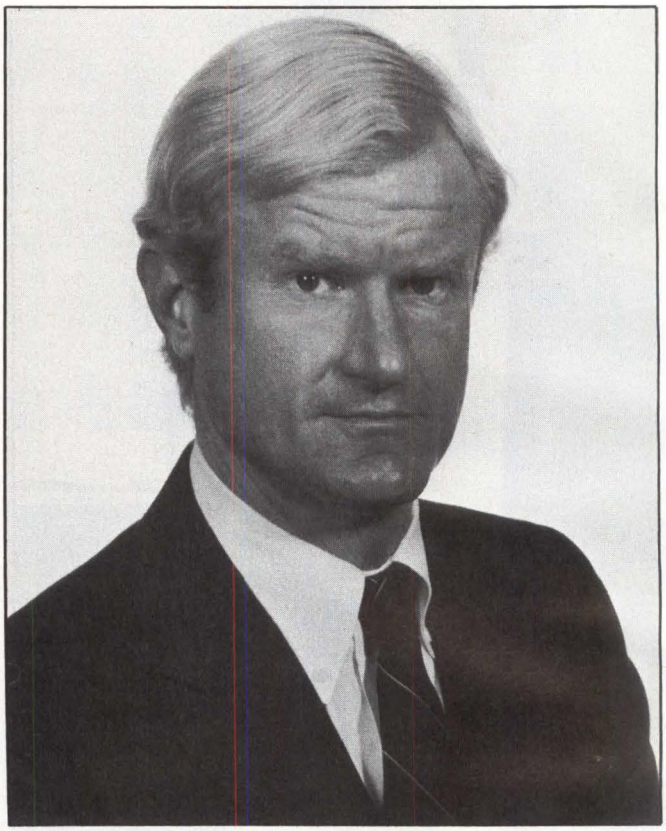
with venture capitalists and computer companies often arrange for entrepreneurs to meet investors. For example, William Chu, president of terminal manufacturer Verticom Inc., was introduced to a member of venture capital company Vanguard Associates, now Verticom's main investor, at a banker's cocktail party. That introduction led to an initial investment of $1.5 million. Verticom, a Sunnyvale, Calif., start-up, is one of the first to market color graphics terminals supporting the new North American presentation-level protocol syntax (NAPLPS) graphics standard.

Other forums for introduction are industry conferences and trade shows. Michael Hanley, president of Tabor Corp., a Westford, Mass., start-up that manufactures 3¼-inch microfloppy disk drives for portable computers, met one of the company's main investors, Oak Investment Partners, at an American Electronics Association (AEA) conference. At AEA conferences, entrepreneurs can give a short presentation to as many as 50 investors.

James Warner, president of device-independent graphics software vendor Precision Visuals Inc., Boulder, Colo., considered venture funding after starting the company with limited private funding. He met a TA Associates investment partner at the 1980 Siggraph graphics trade show, and, 18 months later, TA, Boston, became sole venture investor in Precision Visuals.

TA general partner Roe Stamps says his company's policy is to seek promising entrepreneurs aggressively. Intense competition among venture capitalists prevents his company from relying solely on introductions and presentations at trade association meetings such as those sponsored by the AEA. Stamps feels he cannot get to know an entrepreneur well enough at AEA meetings. When all the hopefuls give standard, 10-minute presentations in their pin-striped suits, they all look good, Stamps adds.

To find promising companies, TA looks for increased activity in a company. Partners read new product sections in trade magazines and help-wanted ads. TA recently raised $160 million for its Advent V partnership fund, and Stamps expects 40 percent to 50 percent of those funds to go to computer and computer-related companies. Besides Precision Visuals, other beneficiaries of TA funding are the McCormick and Dodge business software house, Digital Research Inc., producer of the popular CP/M operating system, Advanced Electronics Design Inc. and terminal manufacturer TeleVideo Systems Inc. Sometimes, after identifying a target market, "we pick up a phone, call a young company, ask who the president is and take it from there," Stamps says.



TA Associates recently raised $160 million *for its Advent V partnership investment fund. TA general partner Roe Stamps says as much as one-half of the funds could go to computer and computer-related companies.*

Richard Tadler, vice president of Investments Orange Nassau, Boston, agrees that venture capitalists are typically eager to place their money. "Our primary function is to be out in the field looking for investments," he says. In line with that strategy, Investments Orange Nassau recently opened a new office in Dallas to be closer to existing and potential investments. (Texas has been nicknamed the "Silicon Prairie.") Investments Orange Nassau is managing 70 companies and $85 million. Disk drive manufacturers Tandon Corp. and MiniScribe Corp. are in the company's stable, as is UNIX start-up Lantech Systems Inc.

Equity varies

Once a new company has captured the interest of venture capitalists, it may go through three rounds of venture capital financing before making a public offering. Early rounds are normally for research and development. The second and third rounds fund trade show appearances, other marketing and advertising functions and production.

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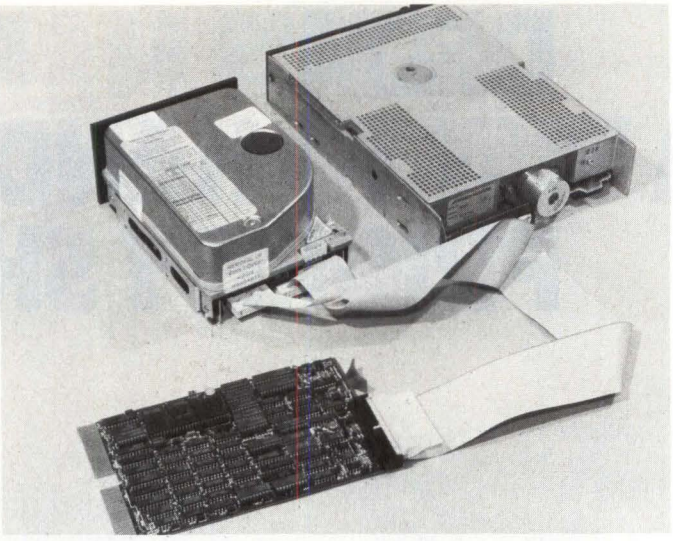

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The Interpreter

The main drawback for a company that obtains funds from venture capital investors is that the founders no longer totally own their company. Johnston of John Hancock says that, in the first round of financing, financiers may gain 40 percent to 60 percent equity in a company. After the final round, the entrepreneur's share of equity may be reduced to 10 percent to 20 percent. The primary investors usually become company board members.

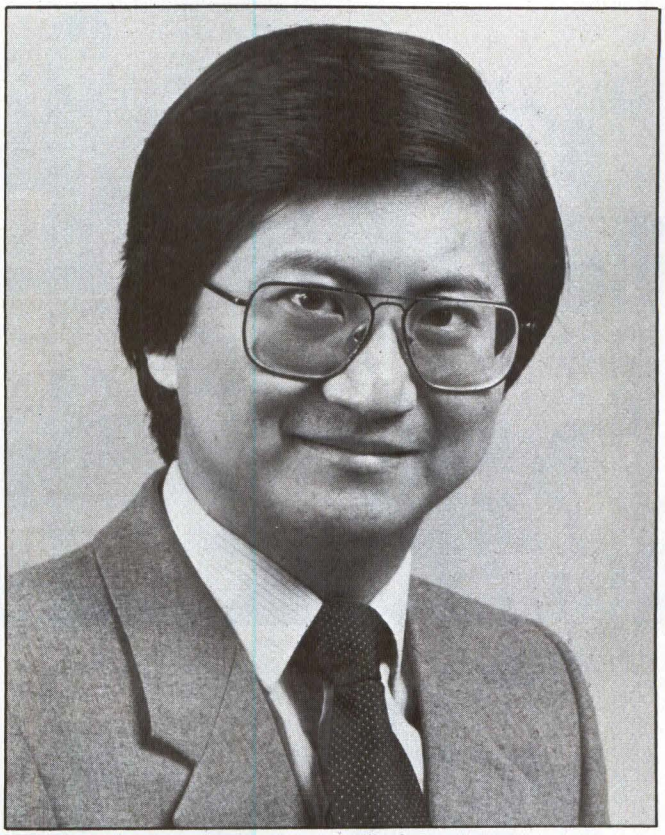
Although founders of a company may give up some control, they often receive valuable business expertise and guidance from the investors in addition to money. Chu at Verticom notes that Vanguard's connections with accountants and lawyers have been important, since "the business world *is* connections." The people at Vanguard formerly ran their own small company, and that experience is very useful to Verticom, Chu says. "That's the good thing about venture capitalists—[they] have to have deep pockets to understand what it takes to build a profitable company." Precision Visuals' Warner agrees that funding is not the only benefit. "We're getting the people as well as the money," he comments.

Each entrepreneur's interaction with an investor can vary greatly once an investment is made. In its three rounds of financing, disk drive manufacturer Tabor has taken in almost $10 million. In addition to quarterly board meetings, Hanley says, he confers with leading investors Oak Investment and J.H. Whitney at least once a week via a 10- or 15-minute phone conversation. Verticom sends a letter to its investors each month detailing progress in finances, management, production, engineering and other aspects of the business, says Chu. Verticom also has monthly board meetings.

Richard Call, president of Microbol Inc., a Longwood, Fla., microcomputer software house, says his company's arrangement is much less formal—he speaks with Venture investor Electro-Sciences Management Corp., Orlando, Fla., on the phone "every few months." Electro-Sciences' investment, however, is only $75,000, far less than many financings.

At the other end of the spectrum is Compaq with $30 million raised in three rounds of financing in less than a year. Company officials work on a daily basis with leading investors Sevin Rosen and Kleiner Perkins Caufield & Byers, says a company spokesman. Compaq also has monthly board meetings.

A company's interaction with its investor isn't the only thing that varies from company to company. Business proposals also vary widely. A standard format includes a prose section and a financial section. The prose section includes information on management, business purpose or objectives in relation to the market, company history, products and services, sales and marketing strategy, plants and facilities, labor force, administration and competition. The financial section consists of an introduction, assumptions used in preparing the projections, a profit-and-loss statement (actual and projected) a balance sheet, ratios derived from the balance sheet, capital budget, an accountant's statement and financial requirements.



Verticom Inc. president William Chu *says his company's investors have provided more than money. They've also given the new company valuable business advice and contacts.*

Even the most well-developed plans, however, are sometimes not accepted at face value. Johnston at John Hancock, for example, usually discounts the financial figures of a prospect's business plan and projects his own figures for the company. Some business plans run 200 or 300 pages; others are brief. Apollo's proposal consisted of two handwritten pages from company president William Poduska, plus VisiCalc projections. But, again, the venture capitalist's view of Poduska's impressive record as a co-founder of Prime Computer Inc. was an overriding factor. TA's Stamps cautions entrepreneurs not to be shy. "Pick up the phone and call us," he advises. □

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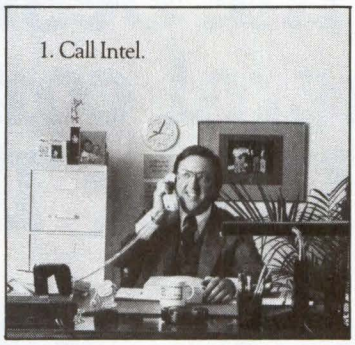

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CIRCLE NO. 55 ON INQUIRY CARD

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Computer systems can change. Your controller should have built-in flexibility, and should get on-going support from the original design group. A "one-shot" consultant may not be around when you need him.

2 Make sure the software is compatible with your system.

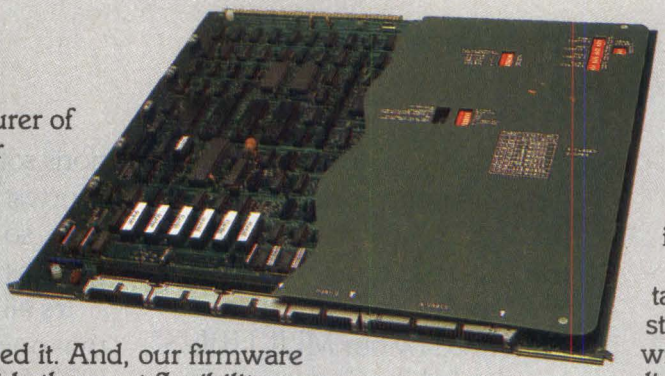
A patched-in subsystem to modify your computer's operating system is a poor alternative when true emulation is available.

3 Don't get stuck with last year's technology.

Controller technology improves all the time. Independently manufactured peripheral interfaces should not only cost less than DG's or TI's, they should do more, too.

4 Buy from a company with a proven track record.

Promises are easy to make. It pays to find out just how happy other customers have been.



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Computer marts face a tough climb toward manufacturer acceptance

By Sarah Glazer

One-stop shopping for computers? That's the idea behind computer marts, a novel concept in marketing for the information industry. Their promoters intend the marts as permanent showrooms for a variety of equipment and software, with competing suppliers lined up flank to flank. But, while the prospect of comparison shopping quickens the pulse of computer users, many manufacturers and software publishers are far from enthusiastic. Unconvinced that marts offer advantages over traditional marketing avenues—direct sales, advertising, trade shows and retail stores—many companies don't plan to participate. They'd rather watch from the sidelines, along with the many system integrators who can't afford the cost of joining a mart or who simply weren't invited.

Ken Olsen, president of Digital Equipment Corp., *says DEC, like many of the other major computer manufacturers, has no plans to participate in the computer marts. "We still haven't figured out how we will relate to the marts," he admits, articulating a wait-and-see attitude that could spell disaster for the new marketing channel.*

Despite the lukewarm reception, marts are in the works for major cities across the United States and Canada. The two largest are the Boston Computer and Communication Service Center (Boscom) and the International Information Processing Market Center (Infomart), Dallas. Promoters describe both as "national centers," each with more than 200 permanent exhibitors and with educational programs aimed at drawing prospective buyers nationwide. Boscom's tenant list as of mid-September included IBM Corp., Xerox Corp., Ask Computer Systems Inc., Corvus Systems Inc., Epson America Inc., Gould Inc., VisiCorp and Lotus Development Corp. Infomart's list at that time included AT&T Advanced Information Systems, Texas Instruments Inc., Tandy Corp. and Gavilan Computer Corp. Scaled-down regional marts are also planned for Atlanta, New York, Toronto, Miami, San Francisco and Los Angeles.

Computer marts will help manufacturers find the corporate buyers "who are invisible to them today," claims Howard C. Miller, chief executive officer of Boscom. When computers left the confines of corporate computer rooms, it became far more difficult to pinpoint who uses and buys them and for "manufacturers to identify the people who are influencing the purchase," Miller explains. He hopes to attract these buyers by presenting educational programs and conferences organized around specific computer markets such as real estate, accounting and law. Bringing groups with a common interest to the mart at one time will allow manufacturers to "make sure the people and equipment are here who can best fit that market," Miller says.

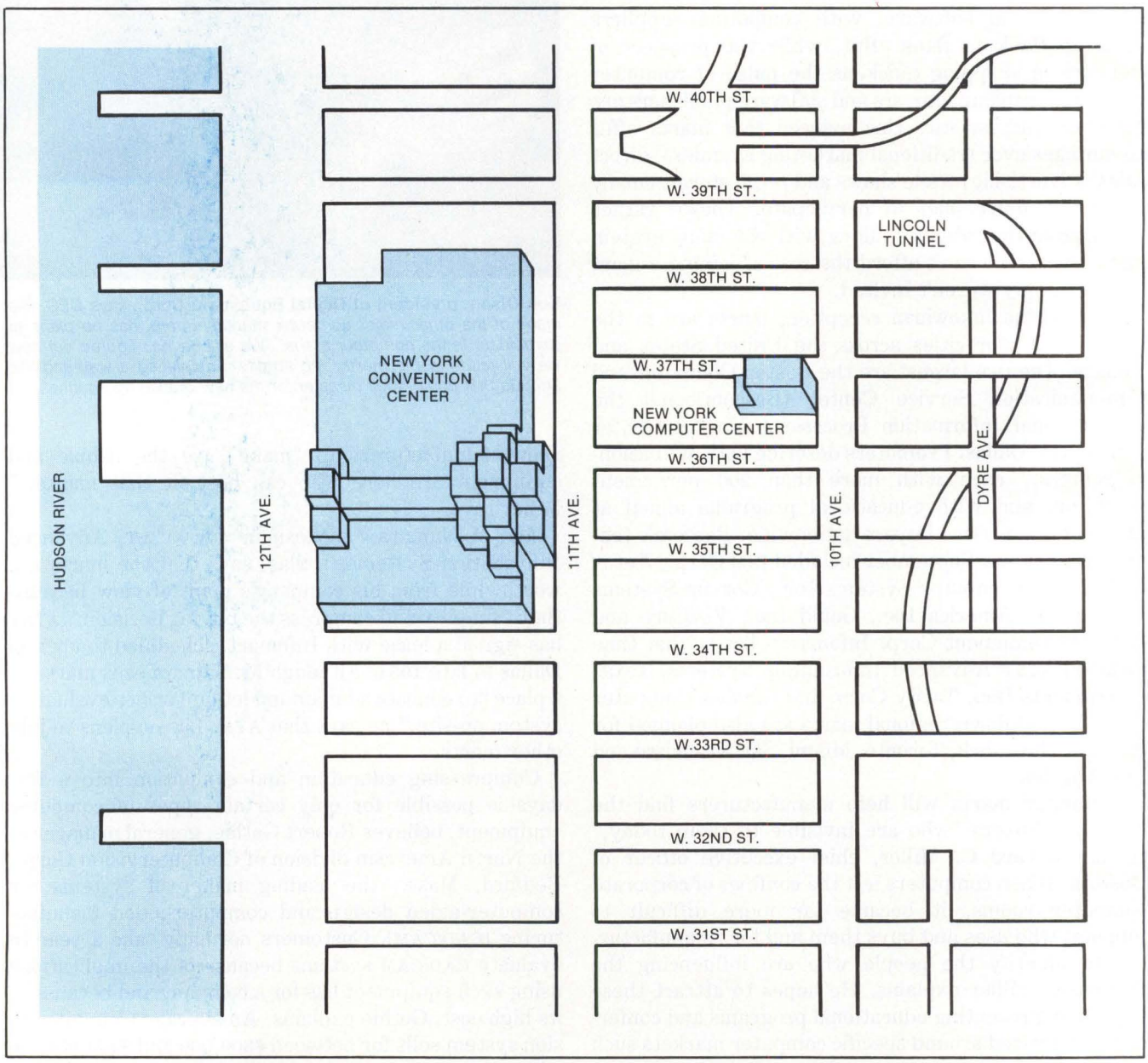
Joe McNamara, spokesman for AT&T Advanced Information Systems, Dallas, says that the marts are worthwhile from his company's point of view because they "simplify and compress the buying decision." AT&T has signed a lease with Infomart, scheduled to open in Dallas in late 1984. Although McNamara sees marts as a place "to educate a buyer and let him or her evaluate a system on-site," he says that AT&T has no plans to join other marts.

Compressing education and evaluation into a few days is possible for only certain types of computer equipment, believes Robert Gothie, general manager of the North American division of Computervision Corp., Bedford, Mass., the leading maker of systems for computer-aided design and computer-aided manufacturing (CAD/CAM). Customers normally take a year to evaluate CAD/CAM systems because of the implications using such equipment has for a company and because of its high cost, Gothie explains. An average Computervision system sells for between $300,000 and $400,000, he adds.

"Other mainframe and mini manufacturers may have

the luxury of having customers who know what they want and simply buy it," Gothie speculates. "It's not quite that short and sweet for us." Although he says Computervision had signed a letter of intent to join Boscom, management reconsidered, deciding to continue emphasizing direct sales. Not only does Gothie believe setting up in the mart is "an expensive proposition," but he also questions whether the marts "would be bringing in the right kind of people for us."

Although the marts plan to include microcomputers, minicomputers, mainframes and communication equipment, Boscom's Miller concedes that direct sales may be a more effective market channel for expensive equipment. "I think IBM can find the people who would buy the large end of its line without any help," he admits. He would like buyers at Boscom to be able to compare all types of equipment but predicts that "the emphasis will be on the intermediate end and smaller."



The New York Computer Center *is taking advantage of its location near that city's almost-completed convention center. By gearing its educational program to conventions scheduled for New York, promoters hope to attract a number of vertical markets.*

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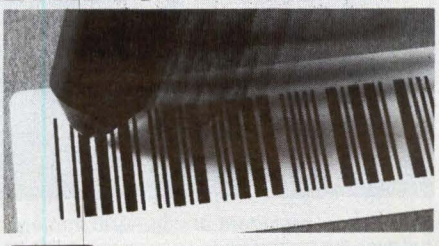

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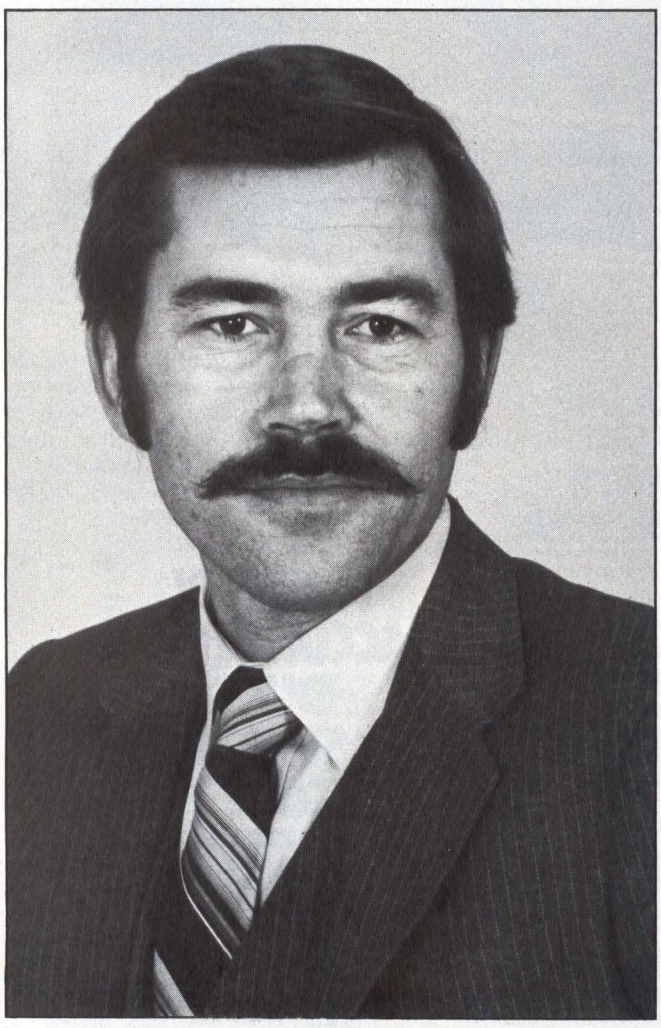
The Interpreter

Will marts squeeze distributors and OEMs?

In addition to deciding on the types of equipment to feature, mart promoters must make policies about whether the marts will be solely display areas or will allow sales. Infomart and Boscom have "display-only" policies, while most small marts will allow sales.

Infomart had originally planned to allow sales and had even signed a lease with ComputerLand, the largest U.S. chain of computer retail stores. Bill Winsor, president and general manager of Infomart, explains that manufacturers realized allowing sales in the mart would put their distributors and other local retailers at an unfair disadvantage. Instead of ringing up sales in the mart, company representatives will refer customers to regional distributors or sales offices. Manufacturers that display products in a mart with a no-sale policy are not competing with distributors but are "institutionally supporting distributors," says Winsor.



Bill Winsor, president and general manager of Infomart in Dallas, *believes the United States can support only three computer marts the size of his projected center: one on the East Coast, one on the West Coast and a third in the middle.*

He adds that "OEM's, distributors and dealers" are among those he sees as potential buyers in the marts. OEMs will also be exhibitors at times, as when a manufacturer allows them to share its display area, which Winsor says a few plan to do.

Rather than compete with existing marketing channels, some manufacturers are staying out of the marts. "It would be a duplication," says Lee Bonds, spokeswoman for Hewlett-Packard Co.'s business development group in Palo Alto, Calif. "We have sales offices with demonstration equipment, training classes and special seminars." For that reason, HP has no plans to join any of the marts, she says. "The industry gossip," Bonds adds, is that companies joining the marts are those that "feel they've got to get some exposure in a local area without having a staff of 50 or 100 or however many in that area."

A notable exception to this rationale is IBM Corp., which has signed a lease for a display area in Boscom. "This is an alternate channel of distribution to direct sales," maintains F.G.Rogers, vice president of marketing. He explains that the mart will help IBM reach its newest throng of customers, users of new products such as the PC.

One small mart, Systems Mart, Toronto, sidesteps the issue of competing with direct sales forces and distributors by letting each supplier set its own sales policy. Systems Mart project director Helen Briggs says this allows a market channel that is "sufficiently flexible to avoid expensive distribution-channel conflict." Each of the 60 expected tenants can use a showroom for either sales or demonstrations. Suppliers can also invite OEMs and independent software publishers to demonstrate their products in the showrooms during "market weeks" aimed at certain end users. These choices allow tenants to "support the optimization of existing distribution channels," she maintains.

Less wishy-washy, the New York Computer Center will encourage sales. "There's no cash and carry, but orders can be written and paid for," explains vice president of marketing Barry Segall. The New York mart, which is slated to open in February 1984 with space for more than 30 tenants, will include no dealers, only manufacturers. To avoid conflict with regional direct sales forces, Segall says, some tenants are moving their sales headquarters into the center. Some even plan to include small service areas in their space.

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CIRCLE NO. 122 ON INQUIRY CARD

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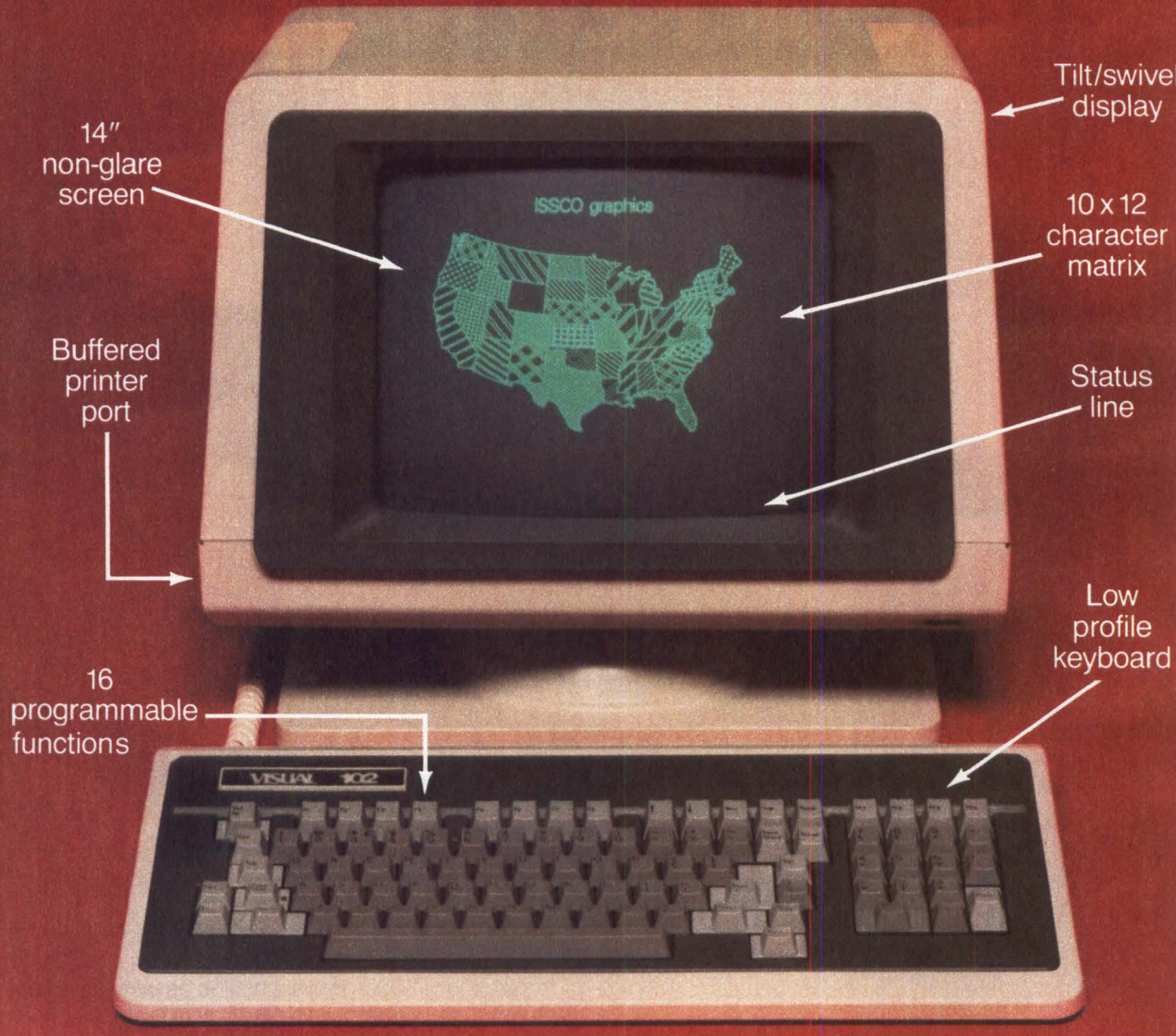

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CIRCLE NO. 57 ON INQUIRY CARD

How to reach serious buyers, avoid 'tire kickers'

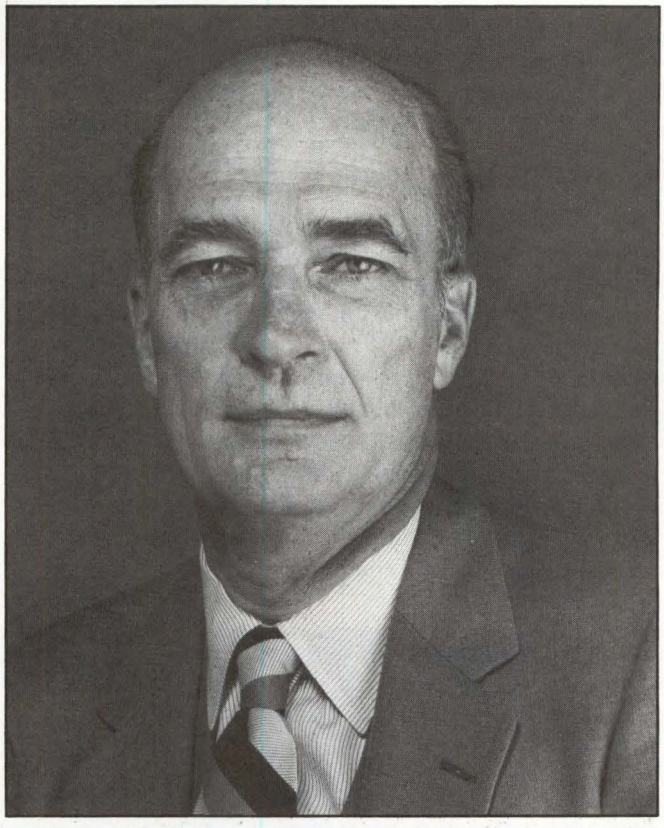
The main selling point emphasized by all the mart promoters is their promise to deliver "qualified buyers" —those who control the purse strings for their companies—and to keep out casual "tire kickers." Boscom's Miller says he learned the importance of selectivity by observing traffic through the Business Product Center in Chicago's Merchandise Mart, a small experiment in computer marts, with seven computer showrooms in operation since 1982. People pass the center to reach stores and restaurants, he recalls, and stop in the showrooms merely to browse. "It's very disruptive," he says. "Sales reps lose their train of thought with a qualified customer by being polite to somebody that walked in off the street."

Those who want to enter Boscom must be part of an "affinity group" invited to attend an educational event or be given an admission card by a tenant. The affinity groups will most often be professional organizations that Boscom invites to co-sponsor conferences, conventions and seminars about computer applications for a vertical market. Although the public won't officially be barred, Miller explains, anyone who does not have a card from a tenant or an organization must pay a fee "substantial enough" to keep the browsers from "strolling over."

New York Computer Center's Segall contends that Boscom's plan to allow professional groups to hold conventions in its facilities, which are slated to include an adjoining hotel, guarantees a substantial number of browsers. A Boscom staff member insists this won't happen, explaining that conventions will be computer related. He concedes, though, that if conference facilities aren't fully booked the mart's managers may bring in more general events. Boscom president Daniel Prigmore admits that the mart had booked only one conference by September, even though many organizations plan such events years in advance.

Small marts will depend less on creating events to bring customers from other cities. The New York Computer Center plans to take advantage of the many conventions scheduled there to reach special groups, as do projected marts in Miami, Atlanta and other cities that frequently host conventions. "We will target the top 25 groups coming to the city and have vertical market programs for them," says Segall.

However, some manufacturers believe there are better ways to reach vertical markets than any of the marts offer. "We think going to vertical market-oriented trade shows is a better investment," says Howard Steiner, manager of marketing communications for Data General Corp., Westboro, Mass. DG exhibits at shows jointly with OEMs and independent software vendors that use DG equipment, Steiner explains. He describes the show schedule as "aggressive" and as "matching very closely with our marketing objectives."



Howard Miller, chief executive officer of Boscom in Boston, *says that "it's not from a lack of effort" that his staff has been unable to sign up major New England computer manufacturers Digital Equipment Corp., Wang Laboratories Inc., Prime Computer Inc. and Data General Corp. However, he hopes to reach the "critical momentum" that will make it easier to convince companies to participate.*

Steiner believes DG will stick to its decision to stay out of the marts unless they can attract vertical application shows in which the company participates. "They need to line up an impressive list of shows to fit what we're trying to do," he maintains. He adds that Digital Equipment Corp. and Wang Laboratories Inc., other leading Boston-area companies notably absent from the marts' tenant lists, market their products similarly to DG's method—"providing solutions in concert with OEMs or software vendors." Since DEC participates in many of the same shows that DG does, Steiner speculates that DEC may have similar reasons for not joining the marts. DEC president Ken Olsen declines to specify why the company is not joining but emphasizes DEC's commitment to technical marketing.

"It's better to be technical than to sell soap," he says about DEC's marketing strategy. "And our customers want something technical."

Marts future is still murky

"It's awfully hard to tell if the marts are going to be successful," says Harry Fodon, a vice president for Arthur D. Little Inc., Cambridge, Mass., which has researched the demand for marts. Most of the companies being approached to join are still trying to evaluate them as a marketing concept and are postponing final decisions for now, he believes.

For some companies, especially small ones, the cost of setting up and staffing a showroom and of bringing in products and personnel geared to specific market groups is simply too high. "The front-end cost of setting up the display area could be from $1 million to $2 million, depending on what you do," estimates Franklyn Thiebaud, manager of market center operations (a position created in August) for Xerox Corp., Leesburg, Va. Xerox is participating in several marts, including Boscom, Infomart and Systems Mart, and expects the ongoing cost of staffing and equipment to be as much as $3 million a year, Thiebaud says.

F.G. Rogers, vice president of marketing for IBM Corp., *believes there is enough communication between competitors in the computer industry to make computer marts, somewhat cooperative ventures, successful. "One way to judge openness is to look at the openness of product architecture," he says—an ironic statement coming from the secretive computer giant, which used open architecture the first and only time for its personal computer.*

In addition to cold cash, other costs are involved in committing a company to a new marketing channel. "The major cost in our minds is management time," says Bob Bozeman, director of marketing for Altos Computers Inc., San Jose, Calif. He explains that Altos, a small company, lacks a big enough management team to take on new market channels. The cost of running a mart showroom was not the main factor in Altos' decision to stay out, Bozeman maintains. Instead, it was the realization that "our managers have to think about our regular distribution channels." This decision may be conservative," he admits, "but we're watching to see whether the marts survive."

The wait-and-see attitude adopted by many companies besides Altos spells serious trouble for the marts. "Companies operate on a herd instinct," declares Infomart's Winsor. Unless he can sign leases with a "critical mass" of companies, he believes, convincing others to join will be difficult. And, for those companies already participating, the marts could be a costly disaster if they can't be filled. "The more vendors, the better," emphasizes Xerox's Thiebaud. "And you do need major vendors."

The computer mart concept has already had one casualty—a second mart planned for Dallas called the International Information Center, which was announced in 1982. And both Boscom and Infomart have pushed their projected opening dates forward more than once. Although both were scheduled to open in 1983, Infomart now plans its debut for the second half of 1984, and Boscom has retreated to mid-1985.

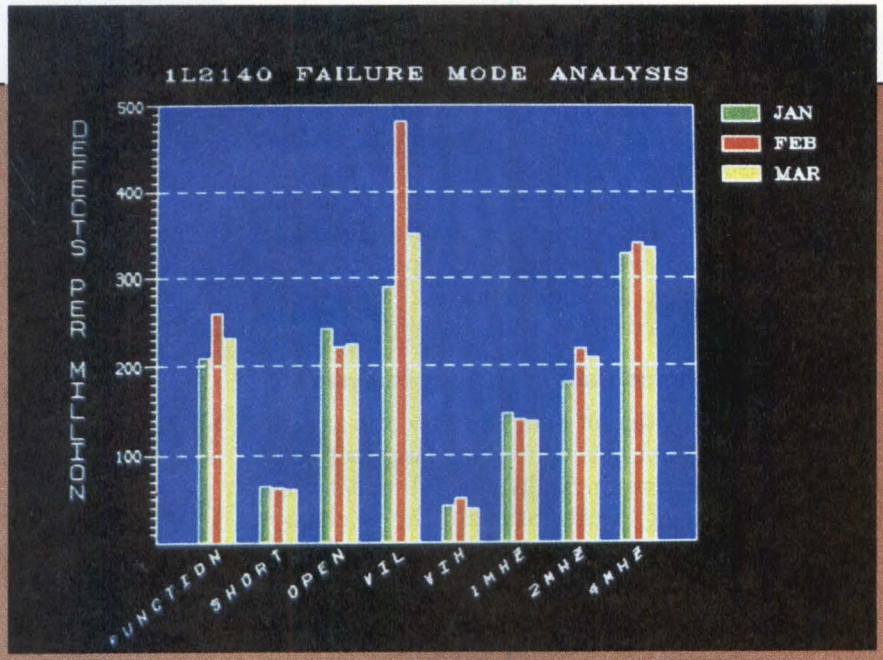
With space for more than 200 vendors, Boscom had signed leases with only 16 companies by its mid-September ground-breaking ceremony.

Despite the signs of trouble, some participants remain optimistic. The New York Computer Center's Segall says that his mart is filling up and will open on schedule in February. AT&T's McNamara answers with a resounding "Yes," when asked if the marts will succeed. And even a skeptic like DG's Steiner admits that his company's entry into the personal computer market could change its decision to stay out of the marts. "The industry is dynamic and changing," he comments. "It's something we'll review." □

Integrated software system aids factory process analysis

By Gary Legg

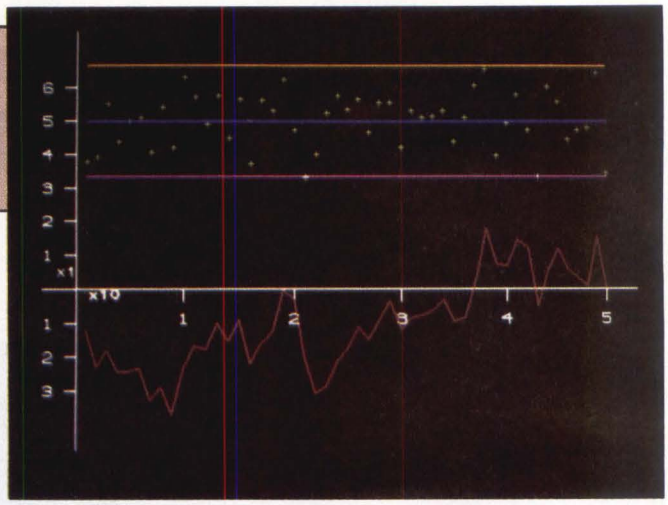
Why is productivity growth declining in the United States? Bert Moyer, president of Enhansys Inc., Cupertino, Calif., says one reason is the shortage of productivity tools for white-collar technical workers. But he claims a software package from his company can play a part in alleviating that shortage, first in the



A histogram of defects *in manufactured semiconductor devices suggests reallocation of resources to improve quality. Generation of the histogram results from Enhansys software's ability to access and analyze distributed manufacturing data.*

```
show fab_data for week < 22 and yield < mean yield

FAB_DATA IS A TABLE.

**********************************************************************
* ROW *    WEEK      LOT      WAFER         CD          YIELD    *
**********************************************************************
*   1 *   20.00    123ABC    2.000      0.2200E-01     410.0     *
*   2 *   21.00    123ADC    4.000      0.3000E-01     340.0     *
*   3 *            124AAD    2.000      0.2800E-01     443.0     *
**********************************************************************

show fab_data for week = 23

FAB_DATA IS A TABLE.

**********************************************************************
* ROW *    WEEK      LOT      WAFER         CD          YIELD    *
**********************************************************************
*   1 *   23.00    124AAE    1.000      0.3100E-01     641.0     *
*   2 *                     3.000      0.3600E-01     218.0     *
**********************************************************************
```

Simple input commands *produce automatically formatted and sorted data tables. Top table shows data for weeks in which product yield was below average; bottom table shows data for a specified week.*



Analysis and graphics capabilities *allow early detection of changes in a manufacturing process. This graph displays lines indicating mean value, upper and lower control values and a cumulative sum.*

semiconductor industry and then in other areas.

A common problem, according to Moyer, is a surfeit of data but a scarcity of useful information about ongoing factory-floor processes. His proposed solution, the $100,000 Enhansys software system, accesses and analyzes widely distributed data and presents results in easily interpreted tables and graphs. Moyer says the product is especially applicable to recipe-oriented processes used in the manufacture of products such as semiconductors, pharmaceuticals and petrochemicals. These processes involve simultaneous operations and hundreds of complex variables, making analysis by conventional methods difficult and slow.

Combining distributed data augments analysis

The broad distribution of data throughout a process plant also hinders analysis; different databases exist within corporate mainframes, distributed minicomputers and engineering workstations. The Enhansys software can access all of these environments from a single workstation, however, combining diverse data to form a coherent view of an entire manufacturing process. It also relieves users of a need to know the actual data-distribution pattern.

The software's main selling point, according to Moyer, is its combination of this distributed-data access with key features needed by analytical professionals: a natural-language interface for easy inquiry, 60 of the most useful statistical-analysis functions and tabular and graphic report generation. Furthermore, says Moyer, use of the system requires no programming knowledge.

Discussing an example of the system's capabilities, Enhansys vice president Tim Sherrod notes that a user can obtain values both for a product's average backlog and its average yield (percentage of products without defects), even though backlog data typically resides in a corporate mainframe computer and yield data might be in a separate inventory-tracking system. Users can access either database from elsewhere in the system—a UNIX workstation, say—by typing simple commands such as "show yield" or "show me the value of the average of yield." The software also permits reasonable abbreviations, allowing equivalent commands such as "show avg yield."

Output resulting from a user query can be in the form of simple statements, tables or graphs. The software automatically generates labels for displays from information in the query, and, in graphics mode, it automatically scales data to be displayed. It also identifies display-terminal characteristics—the ability to display color, for example—and can select default colors from tables.

Portability extends applications

To enable the software package to run on different systems—mainframes from IBM Corp. and minicomputers from Digital Equipment Corp. and Hewlett-Packard Co.—Enhansys wrote virtually all program code in a subset of FORTRAN-77. In addition, two major blocks of the system architecture contribute to portability.

The first block, consisting of about 30 subroutines and named Virtual Host Services, is the only part of the software that varies with the computer on which it runs; a second block, named Presentation Services, is the only section aware of peripheral devices used in a system implementation. Device-independent graphics software (DI-3000 from Precision Visuals Inc., Boulder, Colo.) allows access to numerous display devices.

Because the founders of Enhansys have backgrounds in semiconductor manufacturing, it isn't surprising that this product from the 41-person company aims at that industry. The software's first installation, on an IBM machine, was at HP's Technical Research Center; two more installations, made this fall, are an IBM implementation for Intel Corp. and a VAX version at Trilogy Systems Corp. Moyer notes that the HP installation now aids approximately 20 engineers, and he claims that just a 5 percent improvement in the engineers' productivity will justify the system's price. □

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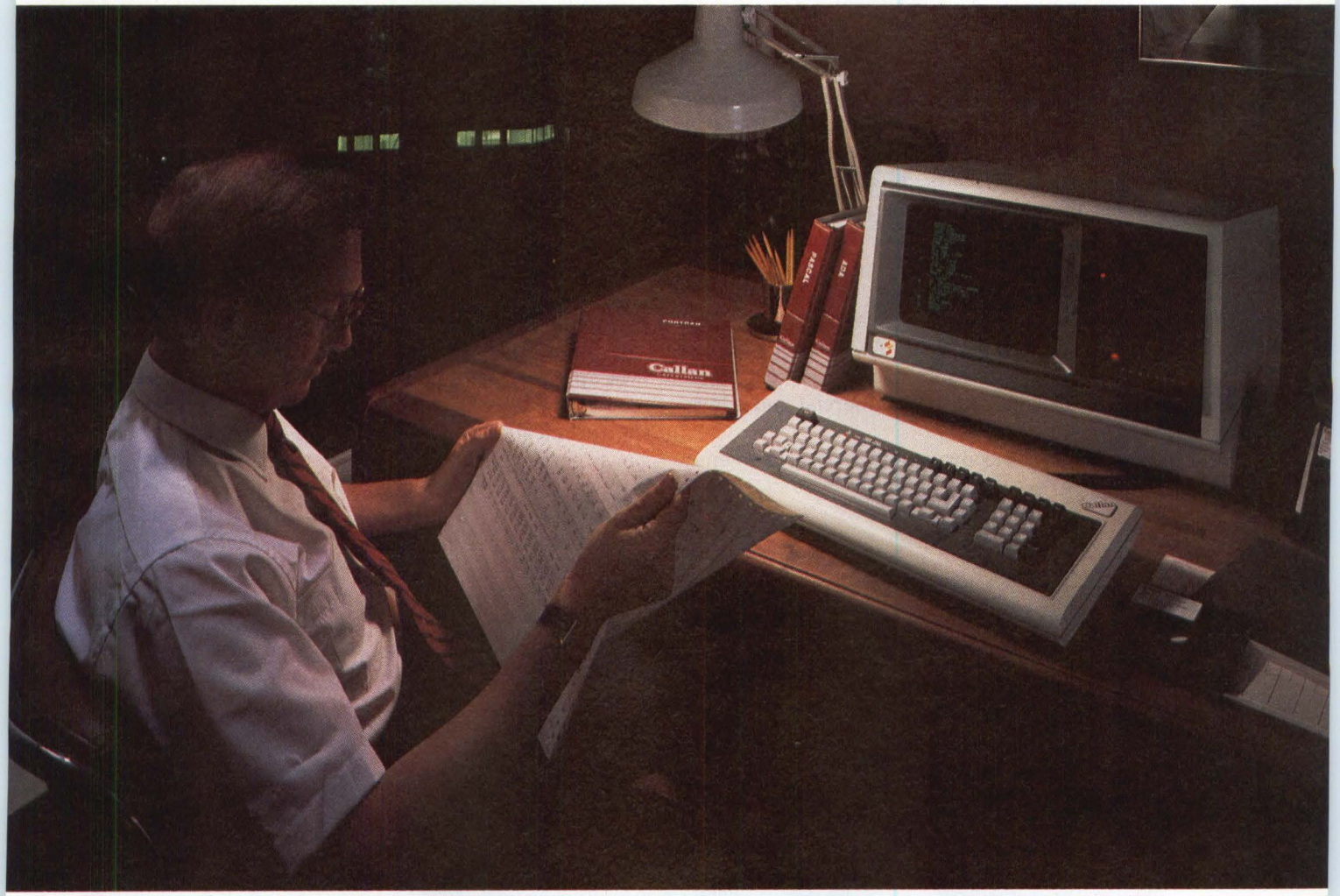

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CIRCLE NO. 123 ON INQUIRY CARD

Military-industrial cooperation advances robotics applications

By Joseph K. Corrado
Design News Magazine

Because military applications of robotics and artificial intelligence encompass far more than weapons systems, developers of industrial robotics often find the U.S. Department of Defense (DOD) to be a helpful partner. Accomplishing more than is often possible when pursuing goals individually, civilian corporations and defense agencies are teaming up to solve robotics problems.

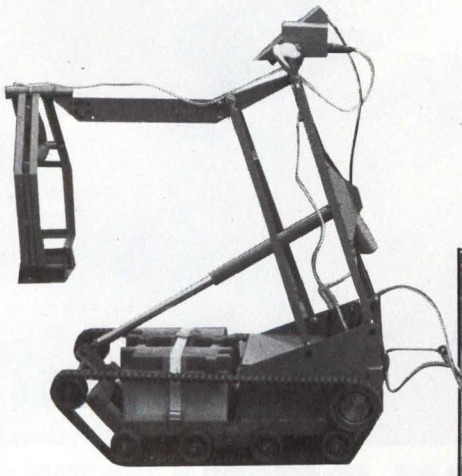
This cooperative linkage between the U.S. military complex and its industrial base is perhaps more evident in robotics than in any other field. As an integration of many high-technology disciplines, robotics programs depend on and affect numerous commercial and educational enterprises.

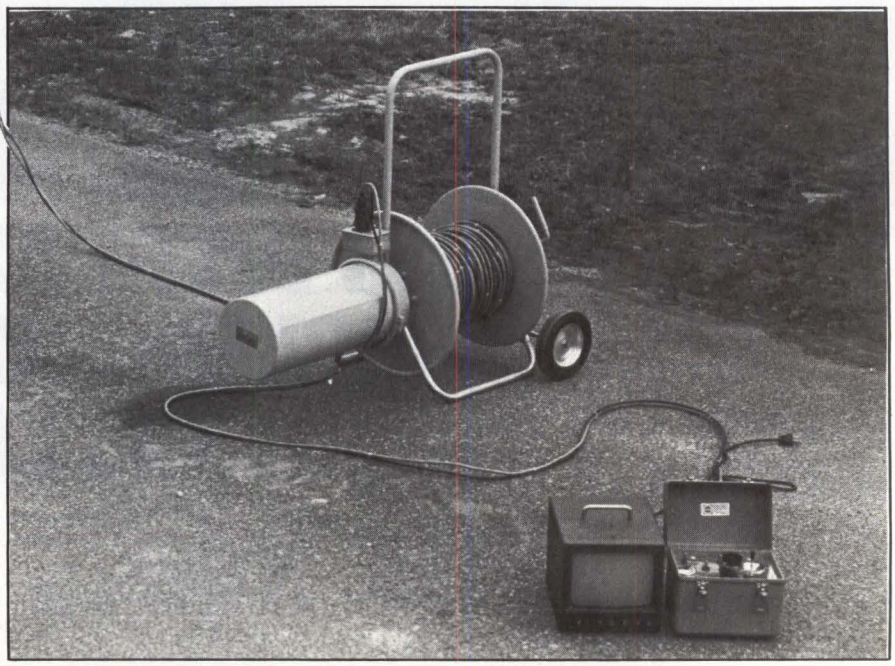
Moreover, the DOD encourages development even in areas in which the resources and application goals of companies or industries don't meet immediate military needs or interests. "Without a strong industrial base," explains Dr. Edith Martin, deputy undersecretary of defense for Research and Advanced Technology, "we simply cannot maintain our standard of living, nor, in DOD's case, can we maintain an adequate national defense."

DOD invests seed money

Certain DOD projects thus invest seed money in the first applications of new technology and then make the results available to commercial industry, reducing both the technical and financial risk of subsequent applications by the private sector. For example, Martin says, "In the industrial arena, DOD funded the original development of numerically-controlled (NC) machine tools, which have now become an international industry." She says the basic technology used in NC machines has provided the foundation for most industrial robots.

The DOD spent $26.7 million for robotics technology in fiscal year 1982 and $44 million in 1983. Of the 1983 total, $16.4 million ($2.8 million from the Army, $7.9



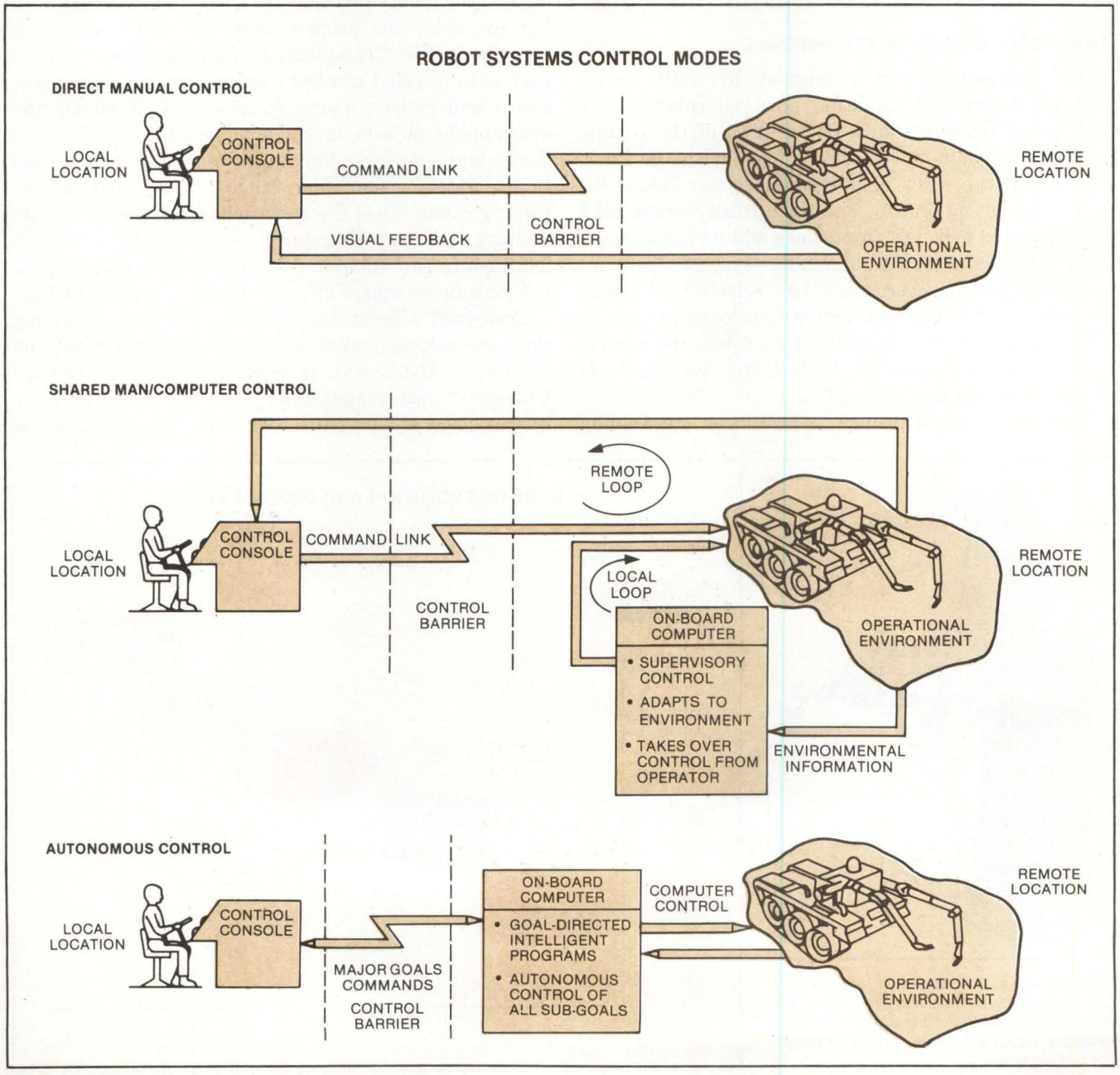


The Navy's remotely operated vehicle for emplacement and reconnaissance (ROVER) *can be operated via cable or radio link.*

million from the Navy and $5.7 million from the Air Force) went for industrial technology.

Various programs carry out the DOD's robotics objectives. The Science and Technology Program, for example, supports general robotics technology efforts that include basic research, exploratory development and some advanced development in a broad range of areas. Another program, Intelligent Task Automation (ITA), ranks and selects technological opportunities.

Other programs are in place for technology that promise more immediate use, particularly in industry. The Acquisition Management Program, for example, funds industrial applications, while Manufacturing Technology (MT) invests in advanced manufacturing. MT is now examining machine-control language, off-line programming, heuristic programming, machine vision, computer-aided-design/computer-aided-manufacturing (CAD/CAM) database programming, robot mobility and portability, workstation simulation, materials-handling systems and multipurpose effectors. MT industrial applications for these technologies include wire-harness assembly, vision-assisted arc welding, machine-tool



loading and unloading, plasma arc cutting, deburring, benching, blasting, painting, polishing, grinding and general materials handling.

The MT program isn't limited to developing new technology, however; since its inception by the DOD in 1964, it has also encouraged military adaptations of commercial products. Many MT projects are active in commercial robotics, and many more are approved or planned. Army MT projects that are approved but not yet operational include robot systems for tracked-vehicle painting, wire-harness assembly and workstation welding.

Three-robot system paints vehicles

The painting system, designed by FMC Corp., consists of three hydraulically powered robots—each with two paint guns—in a booth. Two of the robots, mounted on chain-driven tables flush with the floor, move along the sides of a vehicle; scissor tables lift them for painting on top. The third robot, located in a pit, paints the vehicle's front, back and undercarriage.

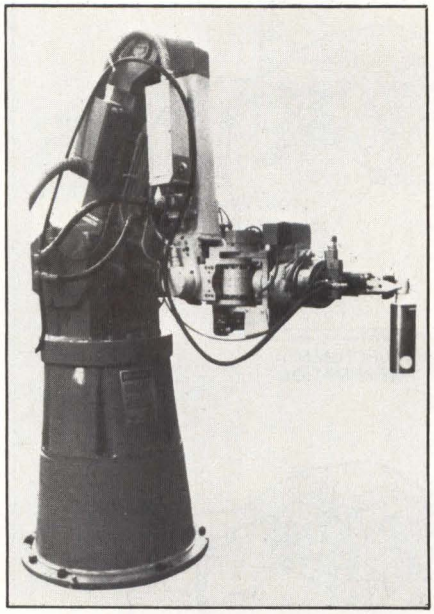
For the wire-harness-assembly system, primary contractor Boeing Aerospace has selected all major components for the equipment-development phase. Designed around an IBM model 7565 robot, the system uses a large linear-motion table being designed and built by Jade Manufacturing Co.

Work on the third project, a prototype arc-welding workstation, is progressing at Stanford Research Institute. Although the project focuses on the Navy's shipbuilding needs, it also addresses Army requirements for aluminum-alloy welding. Demonstrations of horizontal welding of thick-section fillets have been successful; future capabilities include multipass welding in relatively complex geometries.

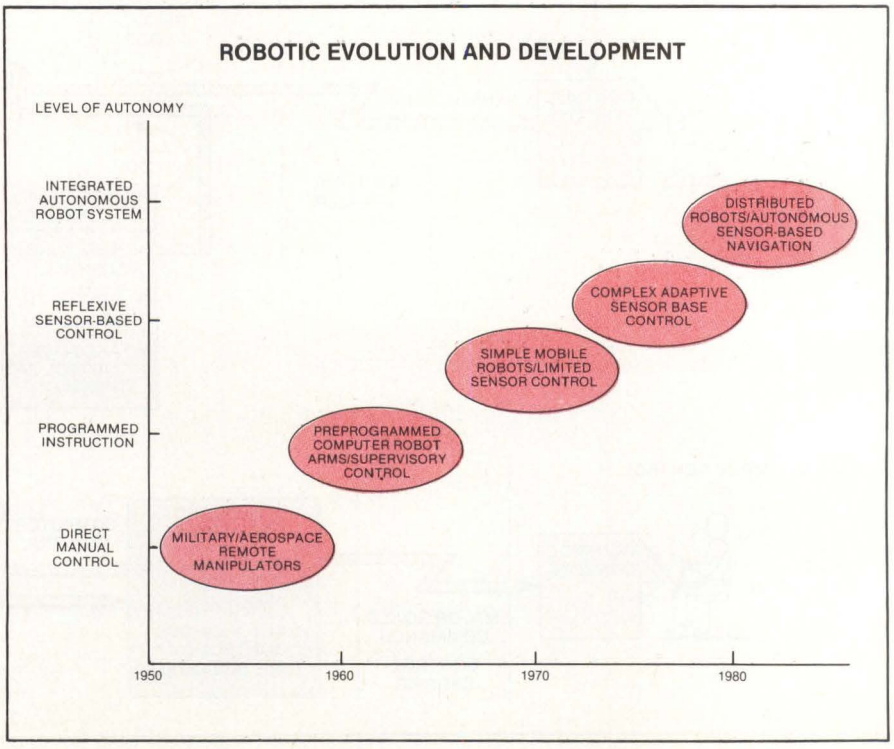
Artificial intelligence increases

DOD robotics programs are increasingly concerned with intelligent robots—those with on-board processing and the ability to organize sensed data heuristically. For example, one project under the ITA program is addressing the "tray-picking problem." The project's goal is to develop a robot system that can recognize, grasp and remove parts from a tray of mixed and overlapping objects in random orientations. Using a three-degrees-of-freedom micro-manipulator attached to its wrist; vision; and range-, force- and tactile-sensing capabilities, the robot will assemble an 18-part military switch. Ultimately, the robot's artificial-intelligence (AI) computer system will be programmable for a broad range of tray-picking assembly tasks.

Honeywell's Technology Strategy Center is directing the tray-picking project, which uses a PUMA robot and Unimation Inc.'s VAL II control language. Stanford University has responsibility for the basic robotics research and AI, and SRI International is conducting the



This six-axis, jointed-arm robot *from Cincinnati Milacron has a 9-foot reach and can handle a 225-pound load. With sensory feedback, it can achieve positional accuracy of 0.005 inches.*



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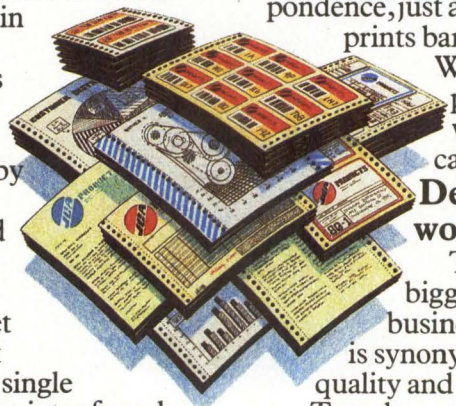

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CIRCLE NO. 60 ON INQUIRY CARD

FACT NO. 3:

80% of the microcomputers running UNIX™ and UNIX-derived operating systems use M68000 Family microprocessors.

And Motorola is the first microprocessor house to deliver System V.

Decision-makers have made the M68000 Family first choice for microcomputers running UNIX-like operating systems. The 32-bit architecture with large linear address space and regular, orthogonal instruction set make M68000 MPUs ideal for UNIX.

Research reveals that 80% of current microcomputers running UNIX or UNIX-derived operating systems use a '68000 MPU. A study by the independent Los Altos, California research organization, Yates Ventures, confirmed that the M68000 is the present microprocessor of choice in the UNIX field.

As the de facto standard for UNIX users, M68000 microprocessors become a principal asset in helping you stay abreast or ahead of the growing number of your competitors who are opting for this user-friendly operating system.

When the Bell System decided to enter the microcomputer software marketplace with UNIX, it was logical that Motorola would be selected among the first to begin joint development with Western Electric of a product derived from System V.

System V/68,™ derived from UNIX System V, M68000 version, is the first System V operating system delivered by any merchant-market microprocessor house, bringing it under a common roof with the leading MPU for its use.

As the standard UNIX-derived OS for the complete 8/16/32-bit range of the M68000 Family, System V/68 further enhances the upward-compatibility of the family MPUs.

All that's required for transporting software from one family MPU to another, no matter how powerful, is a new compiler.

Designed for high-level languages.

It's true, too, that years ago the M68000 family was designed to reduce your software development time, optimize code and hold your software costs in check by special attention to high-level language programming.

It follows that System V/68 will be available with an extensive set of programming languages, including C, FORTRAN, BASIC and Pascal, to carry these advantages forward.

User-friendly System V/68 has a compact kernel to service all programs, a powerful command shell for interactive system control and a wide range of utility programs for tasks such as program development, text processing, networking support, electronic mail and many others. And, Motorola provides comprehensive support for both source-and object-code versions of System V/68.

The kind of standardization System V/68 makes possible also ensures that a broad complement of support and applications software will be generated by independent vendors and systems integrators.

A strong M68000 software base.

The combination of this UNIX operating system and the M68000 Family is, in itself, a significant force in the microprocessor selection process. However, don't overlook the strong software base provided by the substantial array of Motorola M68000 software products already in place.

VERSAdos™ is the well-established multitasking real-time operating system designed specifically for the M68000 and '68000-based systems. Motorola's extensive software also includes debuggers, text editors, linkage editors, assemblers and more, in addition to the high-level languages and operating systems. And, it's all designed to provide the support your designers need to maintain consistent success.

Added options from independent software.

When we last counted, we knew of more than 100 producers supplying independently-written M68000 software including everything from operating systems to languages and applications. The number continues to swell, and there are still others we don't yet know of.

This rush to provide software is an additional factor that tells you a choice of the M68000 Family will be fully supported by a host of software options. It also helps explain the remarkable rate at which both your fast-track and major established contemporaries have been selecting the M68000 Family.

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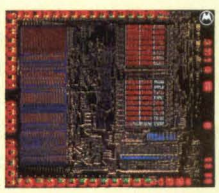

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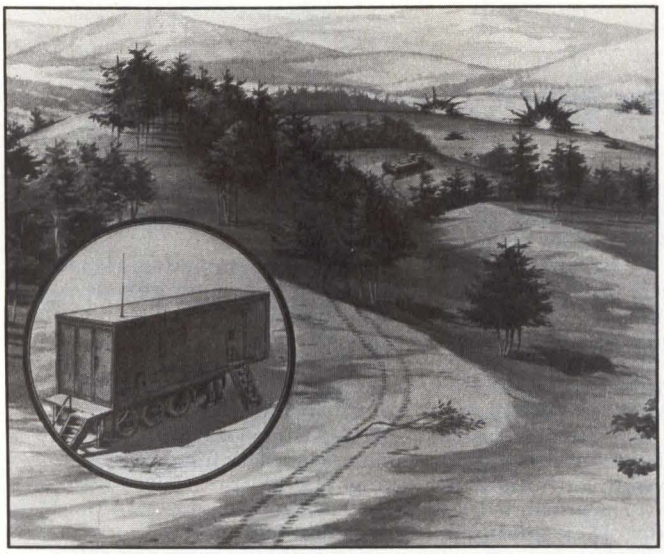
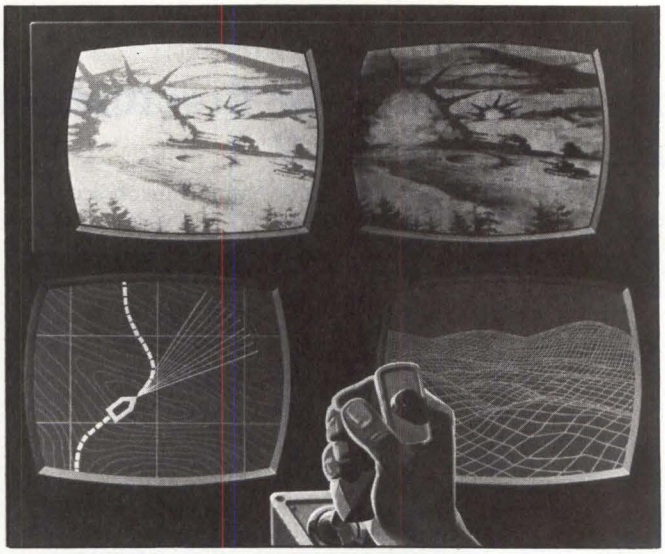


The Remote Reconnaissance Vehicle (RRV), *under development by the Army's Engineer Topographic Laboratories, receives guidance from a radio-linked control van.*



Inside the RRV's control van, *operators at two workstations control the vehicle's movement and its on-board cameras.*

applied-robotics research. Successful outcome of the program will mean an order-of-magnitude improvement in industrial-robot design, freeing the next generation of robots from needing a structured work environment.

Another ITA project, a dual-arm system using two Cincinnati Milacron T3 robots and LISP processing, is under development at Martin Marietta. Like the PUMA, the T3 is an advanced, first-generation robot; in addition to its very flexible manipulator arm, it can monitor its own operations and initiate programs for handling problems that might arise. The system's initial application will be the inspection of F-15 fighter planes' bulkheads.

AI boosts automated mapping

Investigations of robotics and AI are also under way in several government agencies. At Fort Belvoir, Va., the Engineer Topographic Laboratories (ETL) of the U.S. Army Corps of Engineers is exploring automated mapping applications. Dr. Robert Leighty, head of ETL's Center for AI, says, "The ETL approach to AI applications will be to keep the human in an interactive system and to provide AI modules, which will improve total system performance. Evolution of this system will reduce the need for human interaction and result in automated systems of the future."

One area that ETL is investigating is cartographic license—the freedom to adjust, add or omit map features within allowable limits. Such freedom is necessary to enable an intelligent digital cartographic system to perform effectively. Researchers are studying requirements and techniques for line generalization (a process of reducing superfluous detail in map lines) and feature displacement (to prevent overlap of automatically-generated map features and labels). ETL will obtain algorithms and software from universities, companies and other government agencies.

Intelligent vehicles are coming

The development of an intelligent digital cartographic system dovetails neatly with another project at ETL: the Robotic Reconnaissance Vehicle (RRV). A demonstrator version of the vehicle, which can analyze terrains, will soon be rolling out for tests at Fort Knox, Ky.

Machines such as the RRV won't likely find application in industry, but their uses of new technology, particularly on-board intelligence, could influence future applications. For example, the RRV's radio-linked control van has two digital image-processing workstations, one controlling the RRV's sensors and the other controlling its movement. This second workstation uses information from terrain-image databases and from stereo images produced by the vehicle's on-board cameras. The RRV is expected to operate semiautonomously around the end of this decade. This means it will be able to plan routes, avoid obstacles and assess situations.

In the meantime, the Navy—generally considered to be most advanced in military robotics—continues research for its own intelligent vehicles. Under the Marine Corps' Ground Surveillance Robot (GSR) project, researchers at the Naval Ocean Systems Center

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CIRCLE NO. 62 ON INQUIRY CARD

(NOSC) in San Diego are studying ways of coordinating the control and the knowledge-based components of a guidance system for autonomous, mobile robots. By late 1985, according to plans, a GSR will demonstrate modest intelligence for autonomous guidance.

Another NOSC/Marine Corps product is the Airborne Remotely Operated Device (AROD), a surveillance and reconnaissance vehicle for use in amphibious assault missions. The AROD has a television camera and can hover and move horizontally and vertically within narrow confines. Plans call for eventual distributed intelligence among several AROD vehicles; in this configuration, the ARODs would perform low-level decision making and repositioning, freeing tactical commanders for higher-level cognitive functions.

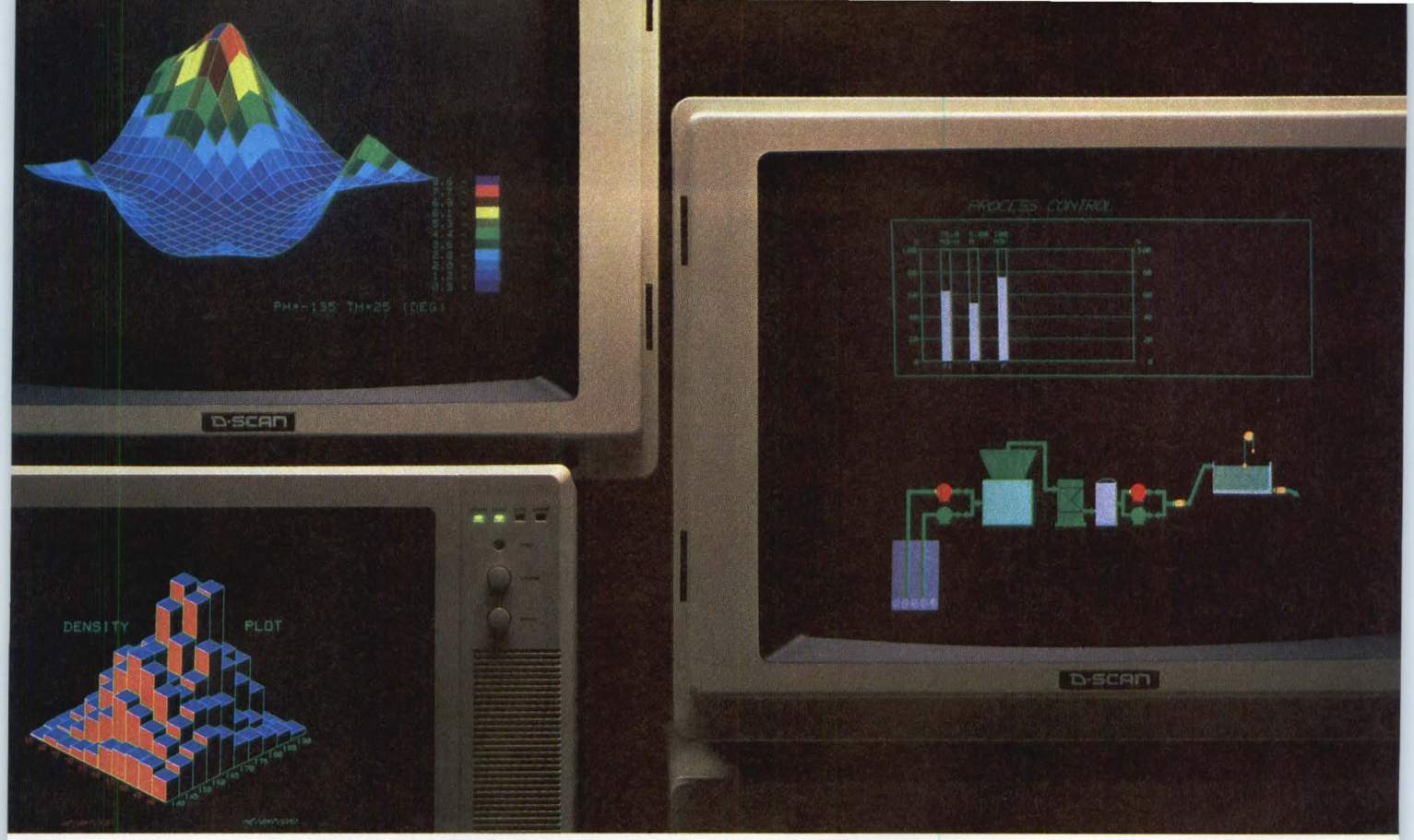
Some of the Navy's remote vehicles also find use off the battlefield, handling hazardous or heavy materials. These vehicles include the remotely-operated excavator (ROME), heavy-equipment remote-control (HERC) kits and the remotely operated vehicle for emplacement and reconnaissance (ROVER). ROVER, for disposing of explosives, is available to other military and security agencies, as well as the Navy.

DOD and industry goals are similar

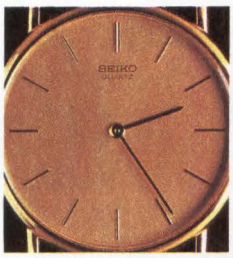
Other DOD projects include advanced hand/eye/arm manipulators, microelectronics devices and control algorithms for multiple cooperative robots working on a task, 3-D and stereo-vision sensors, image processing, acoustic sensors and waveform processing, autonomous and semiautonomous navigation systems, mobile platforms and power sources and systems for survivability and control under adverse conditions. Prototypes in AI include crisis-warning systems, situation-assessment systems, natural- (English-) language understanding, expert systems, automated computer programming and automated mission planning and scheduling.

U.S. military strategy entails a rapidly growing investment in AI and robotics for industrial and battlefield applications. The intent of the basic robotics research funded by the DOD and the various military branches is to focus and accelerate the development of advanced robots and AI and to ensure the maintenance of technological superiority. Behind the "lines"—in factories, supply depots and physical distribution facilities—the DOD envisions a robotic work force for its future industrial needs. □

Joseph K. Corrado is Western Editor of *Design News* magazine, in which a longer version of this article first appeared.



BEFORE WE MADE IT BIG IN PICTURES, WE WERE ALREADY A FAMILIAR FACE.



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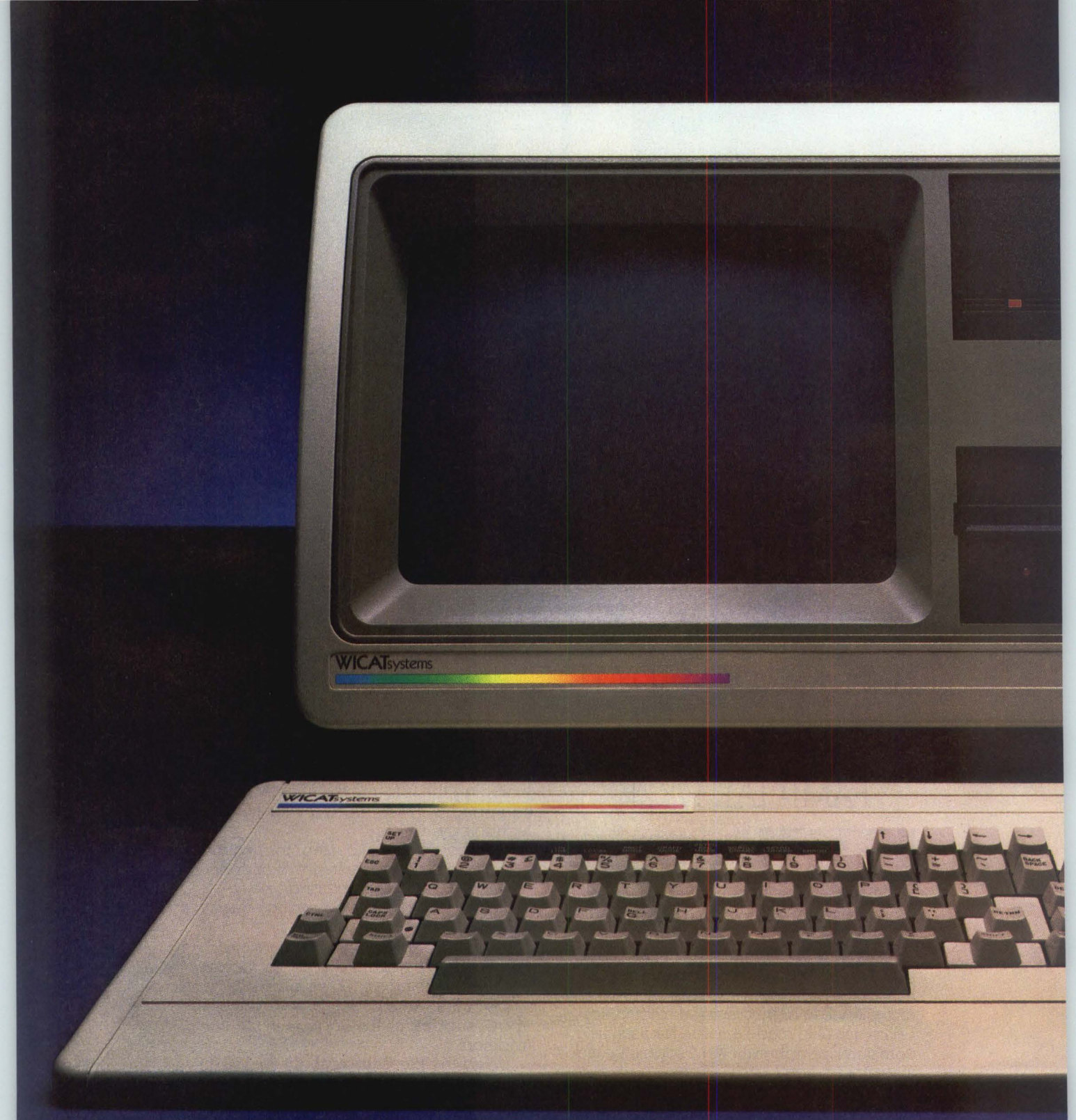

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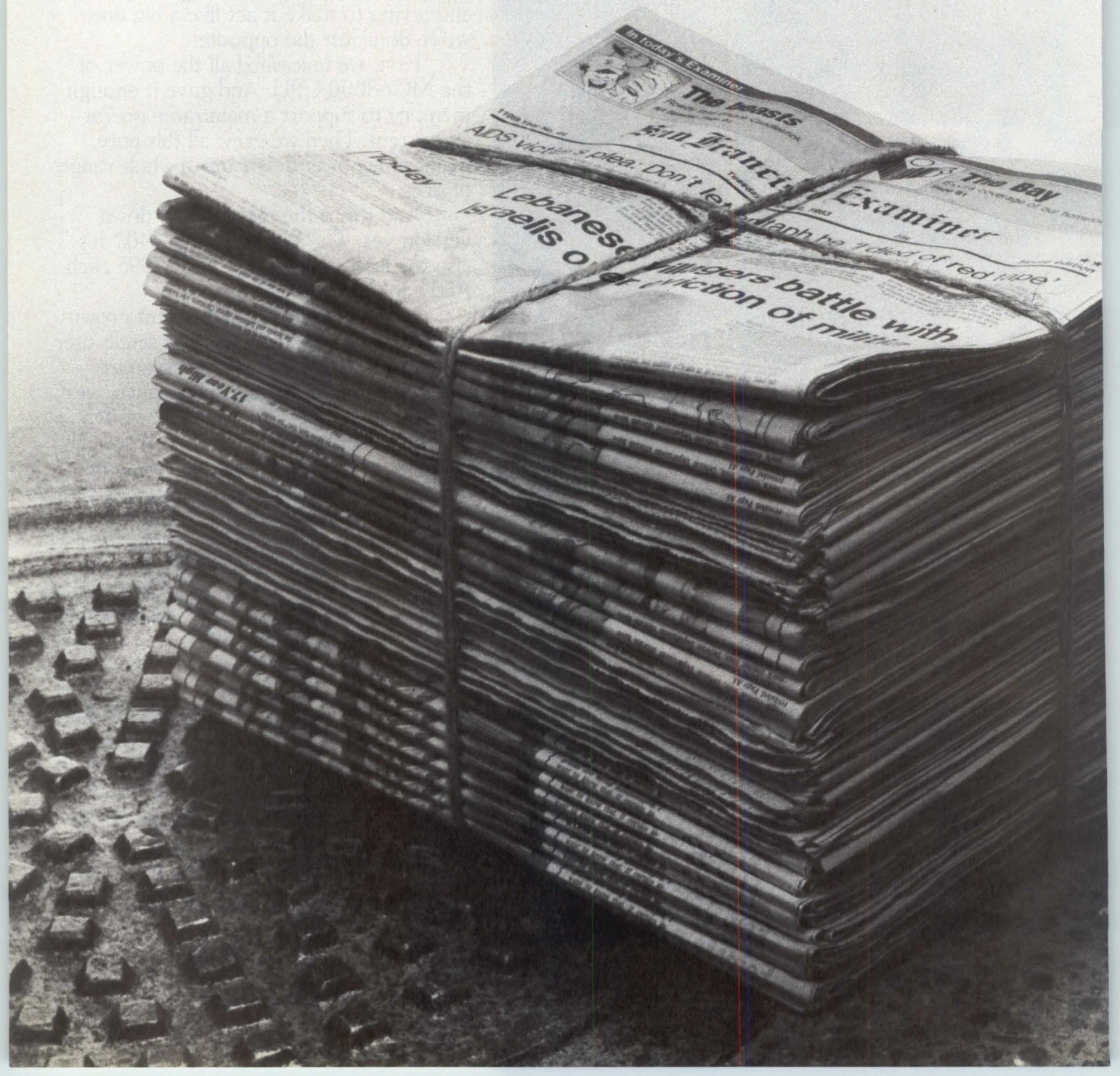

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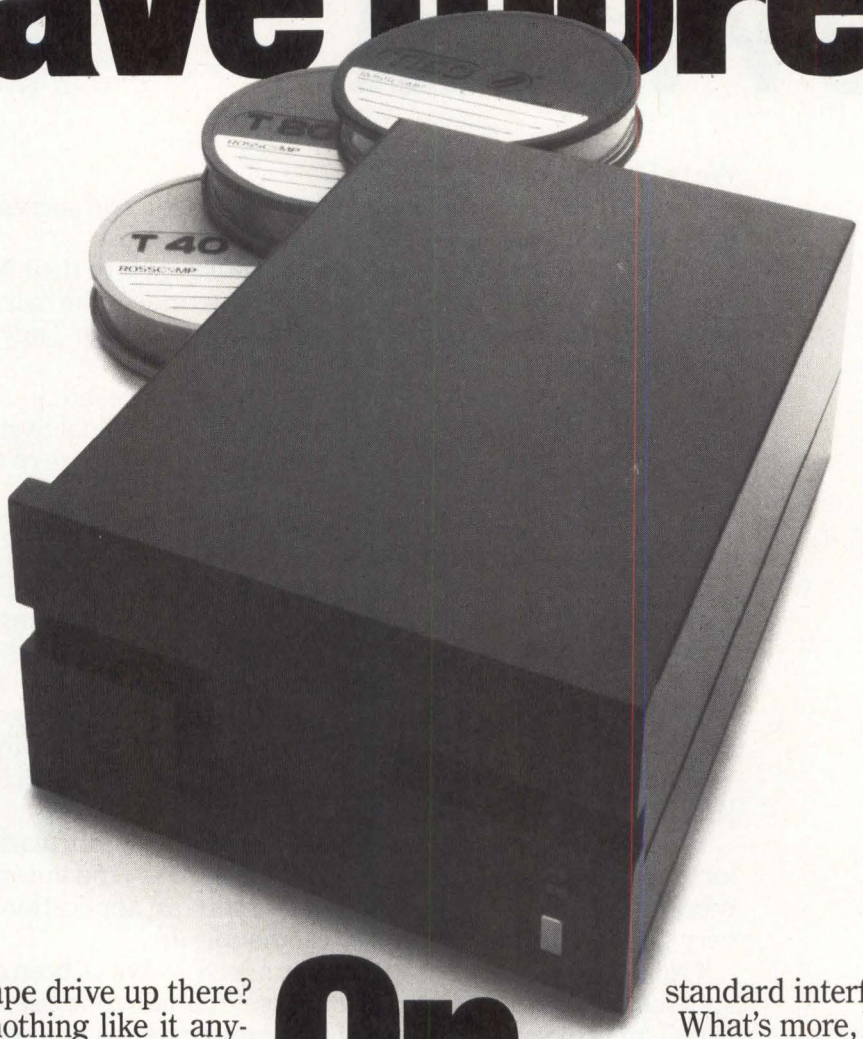

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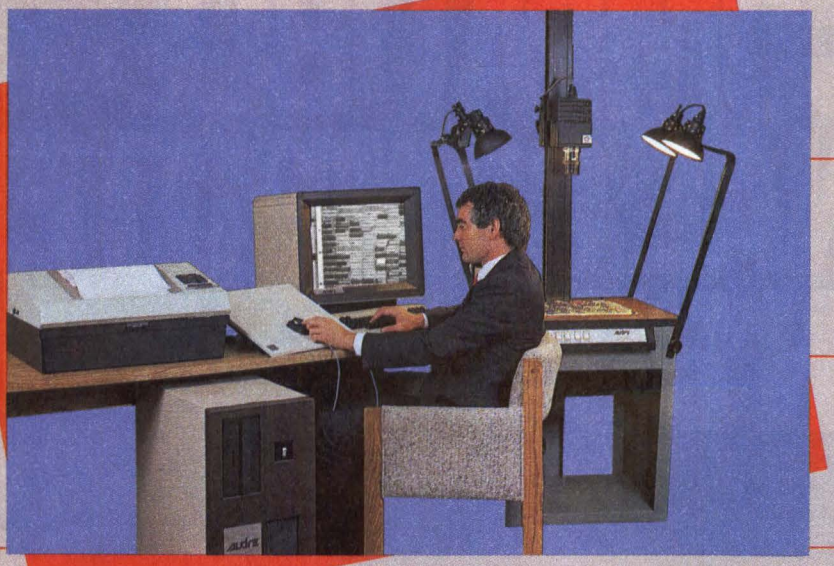

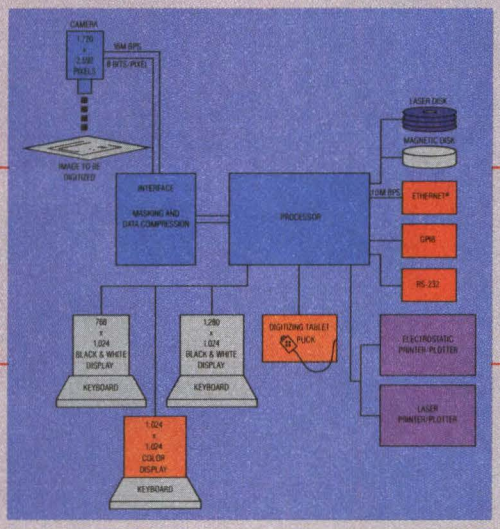

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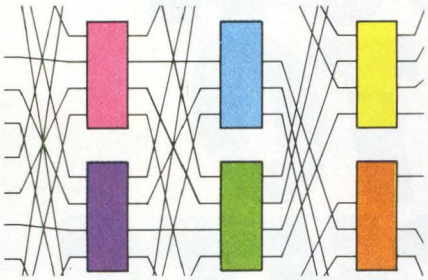
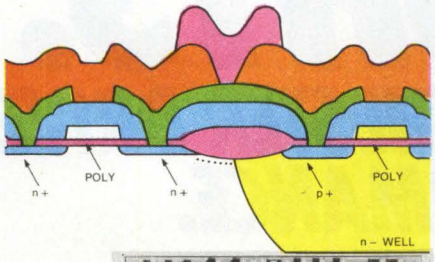
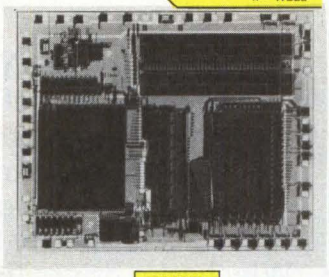
FEATURE HIGHLIGHTS



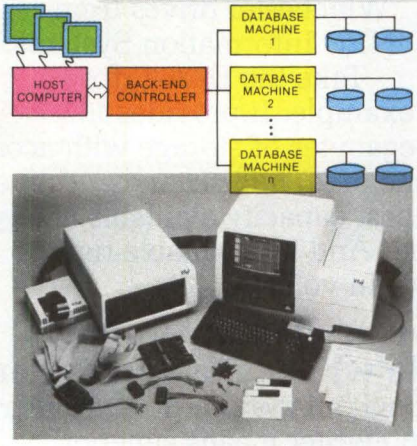
COMPUTER ARCHITECTURE: The demand for computing power is outdistancing even the newest, high-speed uniprocessors. To meet new application requirements, designers are exploring new system architectures. Six areas of multiprocessor computer architecture are described starting on p. 145: super computers, engineering networks, loosely coupled multiprocessors, fault-tolerant systems, flexible arrays and "throwaway" processors.



MICROPROCESSORS: Today's microprocessor families are still flexible and low-cost, but they now offer enough computing power to displace minicomputers in many applications. High-level architectures, compatible chip families and modular development tools are easing system design, while new fabrication and mounting techniques are moving 32-bit CPUs into CMOS technology and reducing the real estate required for VLSI circuitry devices. For more information, see p. 157.



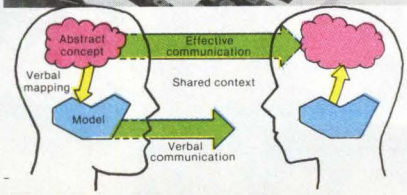
APPLICATION PROCESSORS: System designers are greeting application processors with open arms because the chips simplify programming and architectural design, providing cost-effective solutions to the demands of today's complex applications. Four of the more promising types of application processors for digital signal, speech, video display and communications applications are profiled, starting on p. 177.



DATABASE-MANAGEMENT SYSTEMS: A database-management system is a useful tool for controlling the vast amounts of data in today's business structures. DBMS vendors are meeting the need for on-line transaction processing with DBMSs that have concurrency controls and automatic-recovery capabilities. Check p. 193 to see how database machines and sophisticated management systems are opening new applications.

SOFTWARE DEVELOPMENT: 1983 saw a transformation in software development. A tremendous focus on "friendly" and "productivity-based" features and the incorporation of classic hardware tools into the software-development environment have changed the very structure of the software lab. Details appear on p. 211.

OFFICE AUTOMATION: Vendors of office-automation equipment are targeting the more than 50 million professional workers that make up the services-oriented work force. To meet increasing demands, vendors are supplying better user interfaces, increased office-automation functions and greater integration in office-automation systems and between data-processing and communications systems. Whether you are involved in this field as a vendor, user, or both, see p. 221.



ARTIFICIAL INTELLIGENCE: Applications for AI techniques are moving beyond the "toy" problems that characterized early research. The technology has now become applicable to areas as diverse as VLSI design, database query and medical diagnosis. To better understand this burgeoning field, consult p. 229.

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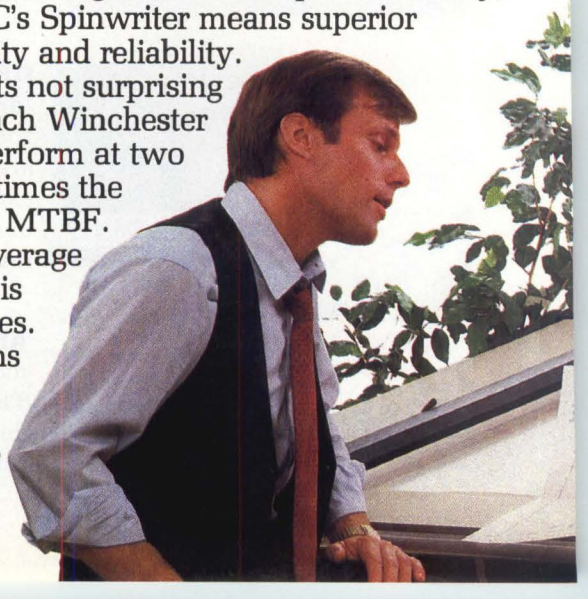

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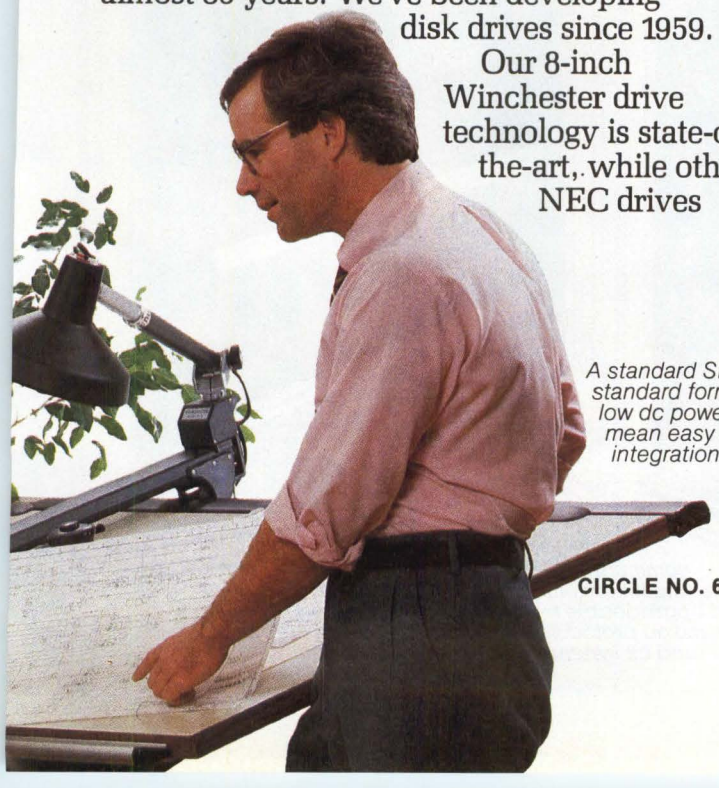

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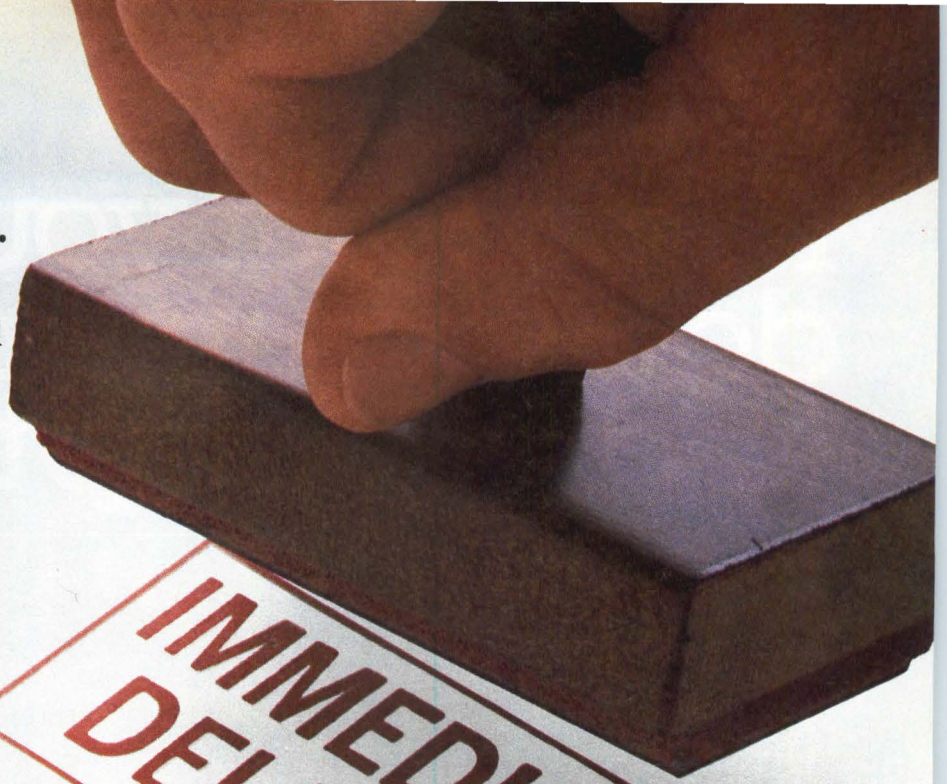

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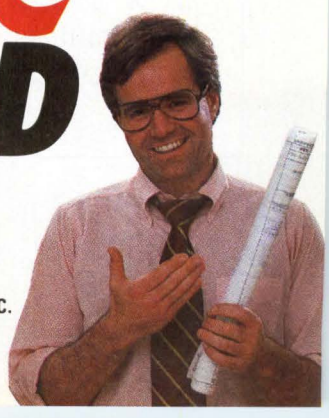

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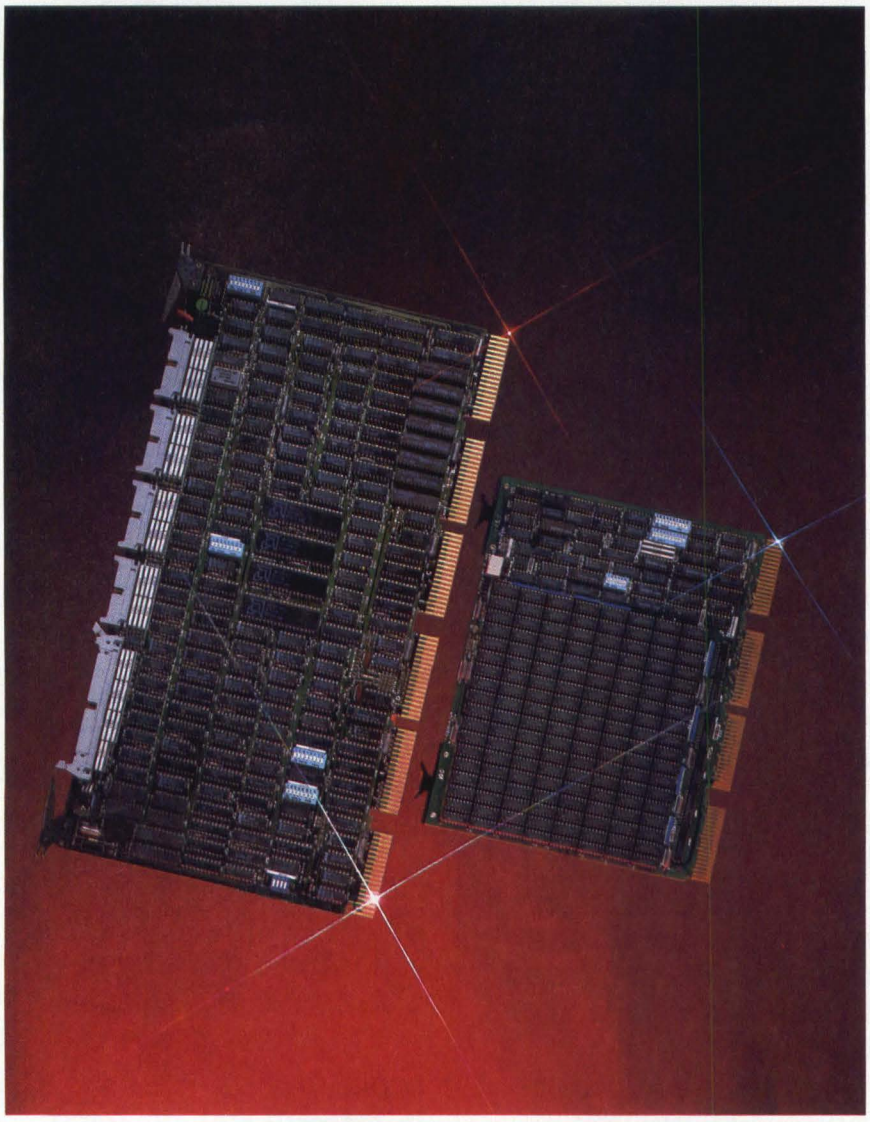

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Computer architecture

EFREM G. MALLACH, Contributing Editor

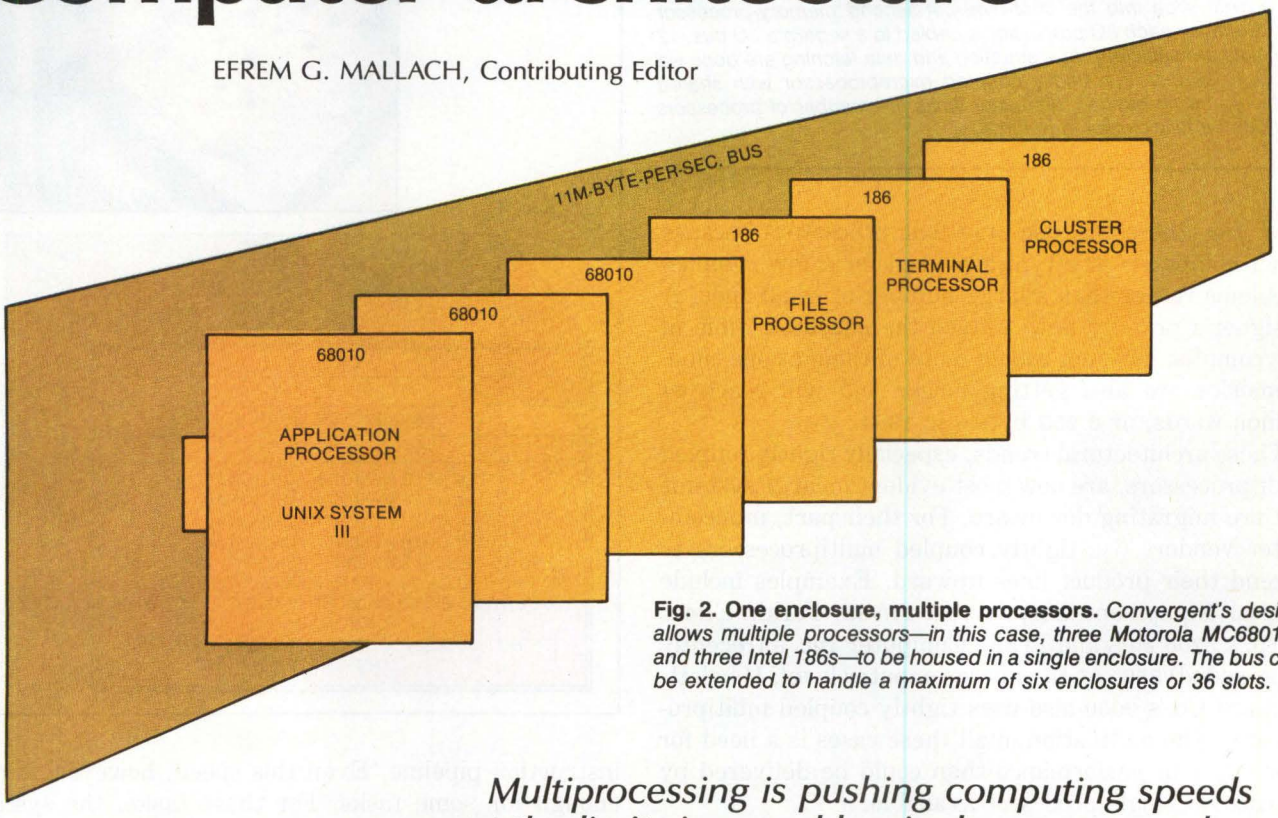

Fig. 2. One enclosure, multiple processors. *Convergent's design allows multiple processors—in this case, three Motorola MC68010s and three Intel 186s—to be housed in a single enclosure. The bus can be extended to handle a maximum of six enclosures or 36 slots.*

Multiprocessing is pushing computing speeds past the limits imposed by single-processor schemes

The days when processor speeds doubled every three years are gone. Processor speeds will increase more slowly in the future, yet the demand for computing power shows no signs of abating. Designers are coping by using more than one processor to meet their application requirements. As a result, most developments in computer architecture in the past year involve multiprocessors. Six areas of computer architecture—super computers, engineering networks, loosely coupled multiprocessors, fault-tolerant systems, flexible arrays amd throwaway processors—although superficially unrelated, all share the use of multiprocessors.

Super computers

At the super-computer level, the slowdown in processor speeds has started. Cray Research Inc., Minneapolis, the industry leader, ran the Cray I at a 12.5-nsec. clock cycle (80 MHz) in 1976. Cray's late-1983 X-MP will have a 9.5-nsec. clock. The 1985 Cray II is being designed for a 4-nsec. clock but with one-half the number of gates per path as the Cray I. Figures from other high-end manufacturers also show a lack of dramatic change. While microprocessors are not yet approaching the physical limits of super computers, they have their own set of problems. The four-orders-of-magnitude improvement—for example, from the Intel 8008 to the 286—that occurred over the past decade is not likely to be repeated in the next.

At the same time, computing power is getting less expensive, fueling demand, and this demand is growing faster than single-processor power. This is not a problem for some designs, such as home computers, since their requirements are small. When the demand for increased processing power occurs at a multiuser site, however, multiprocessors are often the answer.

Super computers are designed to deliver maximum power to solve large, complex and computation-intensive problems. To feed this demand, super-computer developers have pioneered a host of architectural advances, including pipelining with multiple parallel execution units, which arrived in the mid-'60s, and vector architectures, which have dominated the past decade. But these approaches are reaching the limits imposed by the speed of light and cooling capacity. (Cray II logic elements will be totally immersed in liquid fluorocarbon coolant.) As a result, Cray's and Control Data Corp.'s next generation will most likely be four-way tightly coupled multiproces-

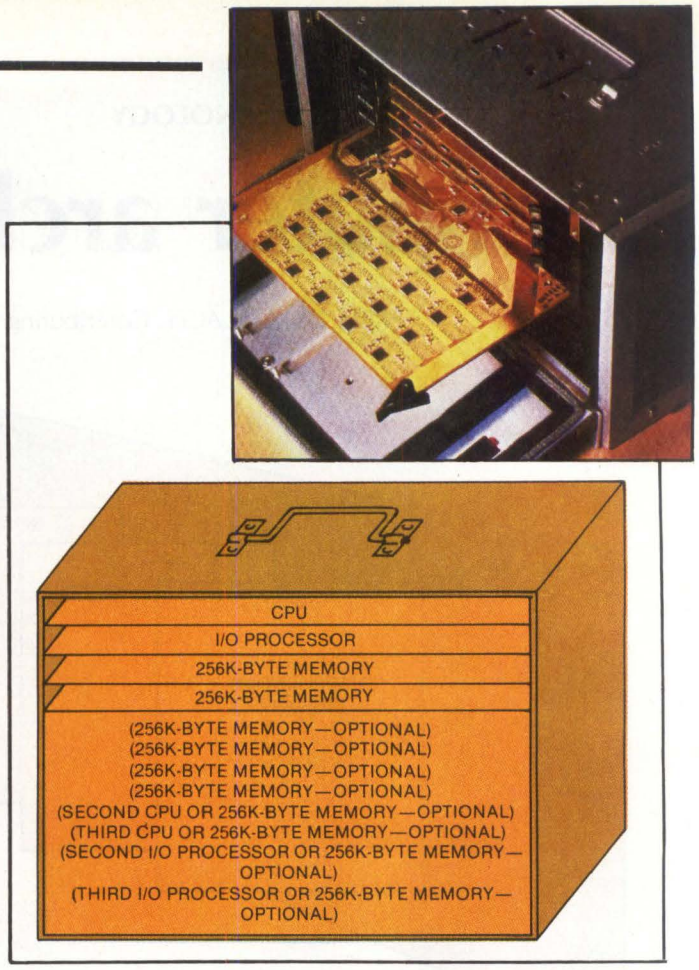

Fig. 1. "Lunchpail" logic enclosure *of the Hewlett-Packard 9000. All boards slide into the 36M-byte-per-second memory-processor bus. Because each I/O processor is cabled to a separate I/O bus, 12 bus slots are sufficient. All instruction and data fetching are done via the bus, as this is a tightly coupled microprocessor with shared memory and no cache. This factor limits the number of processors that can be fully exploited to three.*

sors. Designers will use only four processors because super computers are typically used for a few complex problems rather than a large number of small ones. A designer's priority is to reduce the execution time of one complex job—not to run more of them at one time. Memories are also getting larger and will reach 64 million words, or 0.25G bytes, in 1984.

These architectural trends, especially tightly coupled multiprocessors, are now most evident in large systems but are migrating downward. For their part, minicomputer vendors use tightly coupled multiprocessors to extend their product lines upward. Examples include Digital Equipment Corp.'s VAX-11/782, Perkin-Elmer Corp.'s 3200 MPS and Prime Computer Inc.'s (recently superseded) 850. At the microcomputer level, Hewlett-Packard Co.'s 9000 also uses tightly coupled multiprocessors. The motivation in all these cases is a need for more system performance than could be delivered by the fastest single processor available.

Engineering networks

Scientific researchers need to run huge tasks on large computers. Although engineers' computer tasks are smaller, an organization usually has many engineers who must interact with their programs as they run and share data. Traditional timesharing is one approach to this problem, but its overhead and the impact of one user's work on another's response time are drawbacks. A recent alternative is to use powerful personal engineering workstations linked in a network. Although those who equate "architecture" with instruction sets and bus designs may not see networks as computer architecture, they are, in fact, system architecture.

The first engineering network was Apollo Computer Inc.'s Domain, introduced in 1981. Domain workstations use Motorola 68000 family microprocessors. Apollo has added its own local network, memory management, floating-point processor, graphics processor and software.

HP followed Apollo in October 1982 with the HP9000 (Fig. 1), which uses HP's proprietary 32-bit microprocessor. The 450,000 transistors squeezed into the HP9000 make it a top performer in the microcomputer field. It has a 55-nsec. cycle time and uses a two-stage instruction pipeline. Even this speed, however, is not enough for some tasks. For those tasks, the system allows inserting as many as three processors into the bus. The HP-UX operating system, based on Bell Laboratories' UNIX, allocates processors to tasks. As long as there are two or more tasks to run, the extra processors yield extra speed. Besides being an engineer's personal computer, the 9000 is a key element in HP's engineering productivity network (EPN). EPN provides a data-sharing capability similar to that of Domain.

A similar offering is expected from Computervision Corp., a computer-aided-design/computer-aided-manufacturing leader that recently announced an agreement with IBM Corp., whereby IBM 4300 systems would be incorporated into Computervision products. Published reports suggest that the intent of the agreement may be to keep a shared database on the 4300. Graphics workstations would process the applications as they do in Computervision's systems. Such an approach would function much as an engineering network, with added advantages in central control, economies of scale in large disks and the use of IBM 4300 data-management facilities.

Loosely coupled multiprocessors

For many applications, multiple independent processors are a better fit than several CPUs under one "drill

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sergeant" operating system. With this in mind, the development of distributed-processing software has not gone unnoticed by computer architects. Loosely coupled multiprocessors combine distributing-processing software with high-speed inter-processor links that make close cooperation practical.

Tandem Computer Inc. and Prime offered the earliest commercial loosely coupled multiprocessors, sharing resources, but little more, in the mid- to late-1970s. The fact that these units were composed of multiple processors was still visible. The development of message-based operating-system software, however, has changed that situation. Messages can be sent to another CPU as easily as to another process. This permits building systems such as Convergent Technologies Inc.'s MegaFrame (Fig. 2), which can have as many as 16 Motorola 68010 application processors, each with its own copy of the UNIX operating-system kernel. A fully expanded system can support as many as 128 users—far more than any single commercially available microprocessor can support.

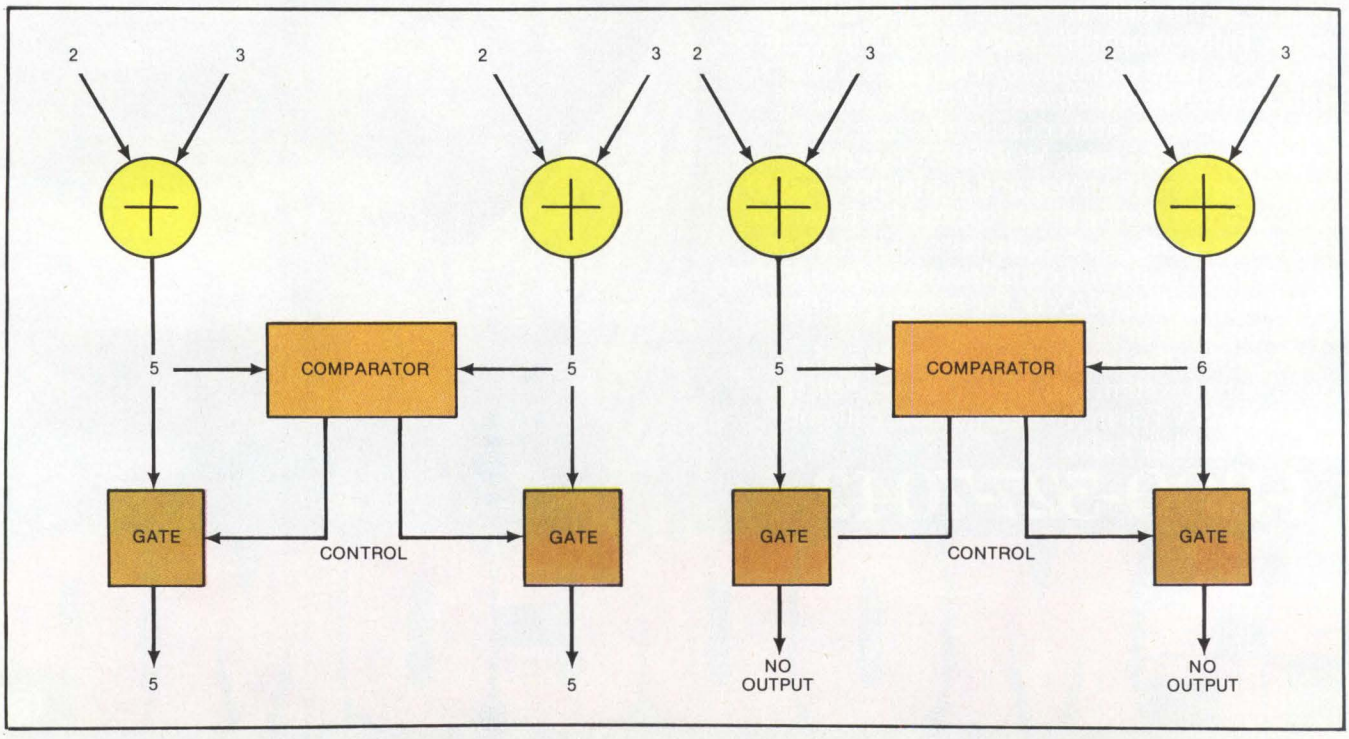
Another recent entry in this category is DEC's VAXcluster. VMS software releases do not support integrated multiprocessor operation, but indications are that they will in the future. In the meantime, the VAXcluster is more interesting for its potential than for its reality. Among other things, it could lead to the first fault-tolerant system built on a major vendor's product line.

Fault tolerance

Fault tolerance is becoming more important as a computer system attribute. When Tandem announced the first commercial fault-tolerant system in 1975, users paid a price for this feature in extra hardware, run-time overhead and programming complexity. During the past eight years, hardware costs have become less of a consideration, and software progress has reduced the impact of run-time overhead and programming complexity. The availability of low-cost, high-performance microprocessors gave this industry a real boost. Since 1980, almost two dozen firms have announced fault-tolerant products, concepts or intentions. Virtually all of them use a popular microprocessor, with as many microprocessors per system as the architecture and the desired performance level require. Some recent entrants include:

- **Stratus Computer Inc.,** Natick, Mass., is the second company to ship a fault-tolerant computer (Fig. 3). By building each user-visible processor out of four physical microprocessors, Stratus assures that failures will not be software-visible. (This assumes that a failure is repaired before another one occurs in the same area, an assumption basic to every fault-tolerant system.) The result is that the VOS operating system need not handle processor failures—a great simplification. Critical files must still be kept in duplicate, and other types of failures must be considered. Nonetheless, the processors can be treated as if they never fail.

Fig. 3. Fault tolerance in a Stratus system. *Each processor has duplicate logic (represented by the circle with the "+" inside). When the comparator sees identical results on both sides, as at the left side, it opens the gates, and two outputs proceed to the next stage. If they differ, as on the right, the gates are closed, and errors cannot contaminate the rest of the system. A backup unit takes over immediately, and the user doesn't notice the switch.*



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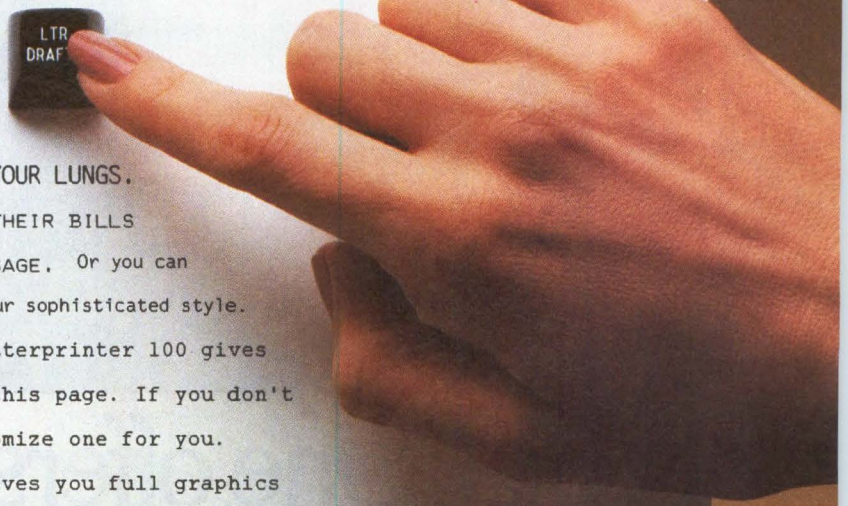

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• **Auragen Systems Inc.,** Fort Lee, N.J., has taken a different approach to the same need in its 4000 system (Fig. 4). The company uses software to track each critical process on another processor. However, Auragen's process-tracking software normally just saves messages without processing them. This keeps overhead to an acceptable level when failures don't happen, which is the normal case. However, when they do occur, the recovery information is readily available. Auragen recently began shipments to customers.

• **Synapse Computer Corp.,** Milpitas, Calif., also uses software to track task status. However, the Synapse software does not associate tasks with processors in a fixed fashion. Rather, Synapse uses a tightly coupled approach (Fig. 5), meaning processors are allocated as needed. If one fails, the task that was running on it must be restarted from the point at which it was given the processor. To do this, it is re-entered into the queue of waiting processes. The operating system continues as before, except with fewer processors. The database is unaffected because the task will

Fig. 4. The design of Auragen 4000 *makes each cluster potentially a complete system. Because the system buses operate at 16M bytes per second, inter-cluster communications do not experience significant delays.*

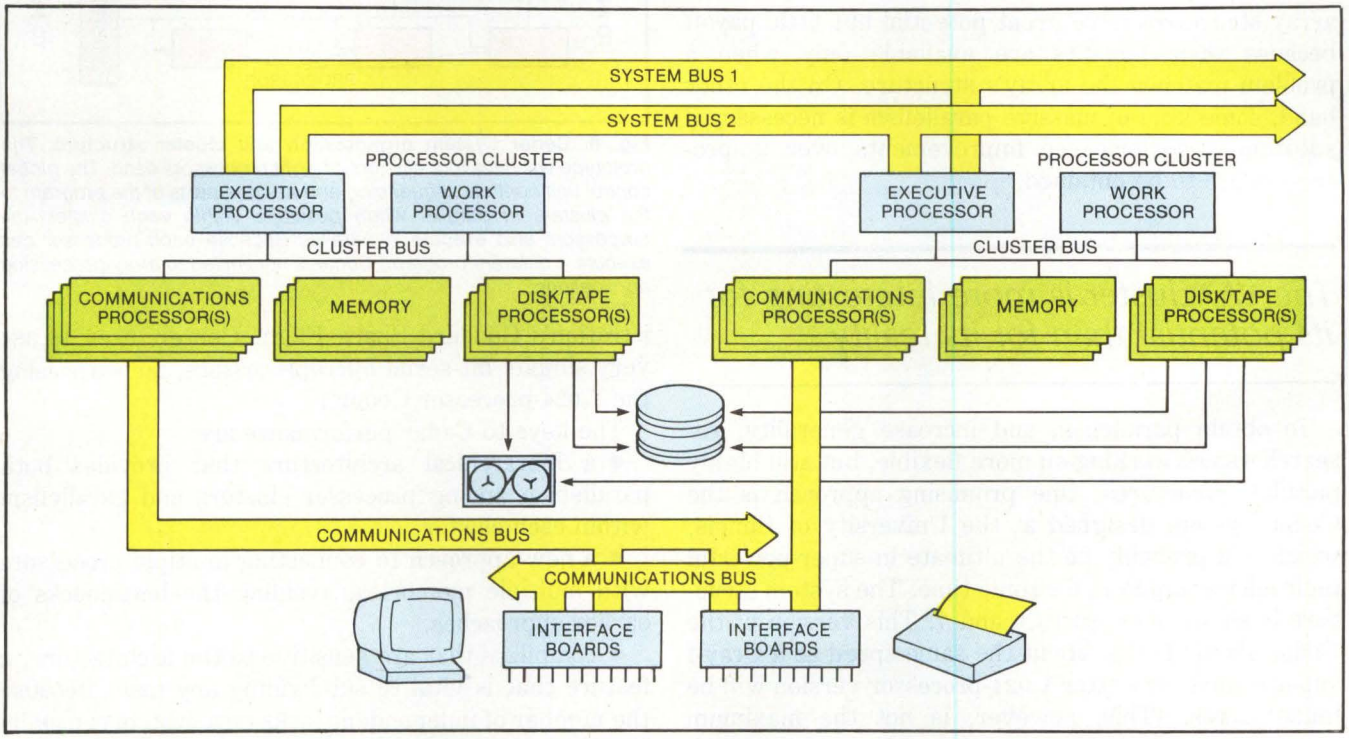
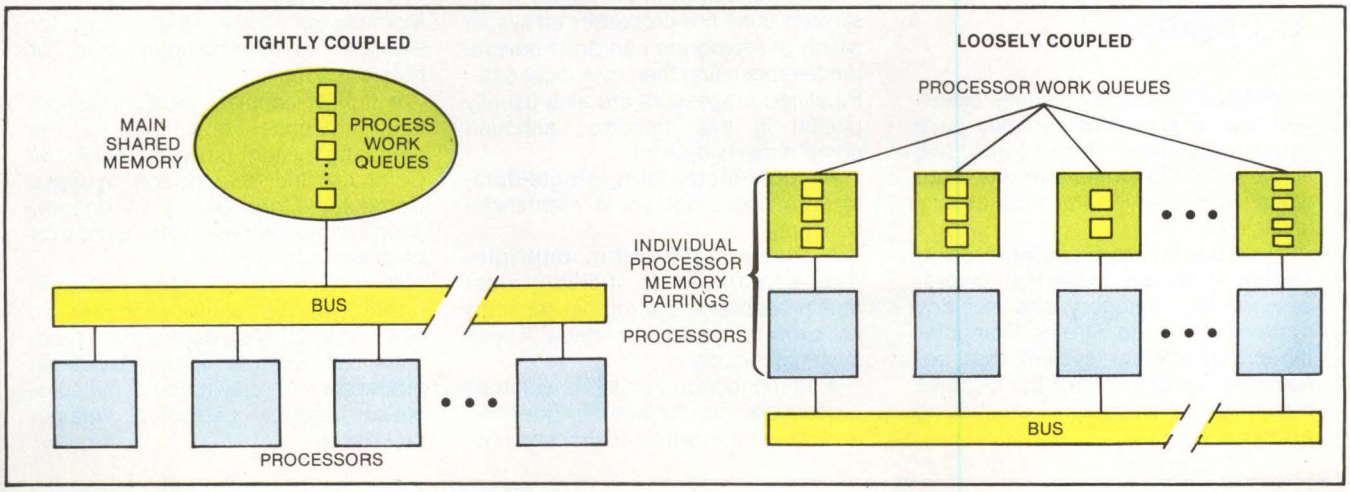


Fig. 5. Two types of processor configurations and work-queue arrangements *can be used in a transaction-processing system. Tightly coupled processors serving a single work queue, as employed in the Synapse N+1 system (left), share a common main memory and operate on a first-in-first-out basis. This arrangement allows any general-purpose processor (GPP) to serve process needs, increasing throughput by quickly emptying the work queue. Loosely coupled processors serving multiple work queues (right) have dedicated pairings of processors and memory. This arrangement requires portions of the database to be committed to a particular processor/memory pair. When a processor needs data not resident in its memory, inter-processor communications must take place.*



not have reached a "commit point." Because the incremental cost of a processor is reasonably low (Synapse uses Motorola 68000s), the configuration has more processors than an application normally needs. The result is adequate performance even with a failed processor. Synapse began customer shipments in mid-1983.

Flexible arrays

A less popular concept, the use of array structures has been experimental for more than a decade. Fixed array structures have great potential but little payoff because their benefits are available only when a problem matches the array's structure. On the other hand, some kind of massive parallelism is necessary if substantial performance improvements over uniprocessors are to be obtained.

The VAXcluster is more interesting for its potential than for its reality.

To obtain parallelism and increase generality, researchers are working on more flexible, but still highly parallel, structures. One promising approach is the Cedar System designed at the University of Illinois, which will probably be the ultimate in super-powerful multimicrocomputers for some time. The system structure is shown in Figures 6 and 7. This version of the Cedar should run at about the same speed as a Cray-1 super computer; a later 1,024-processor version will be much faster. (This, however, is not the maximum number of processors that have been used. The Goodyear Massively Parallel Processor, built in cooperation with the National Aeronautics and Space Administration's Goddard Space Flight Center, uses 16,384 very simple bit-serial microprocessors, far surpassing the 1,024-processor Cedar.)

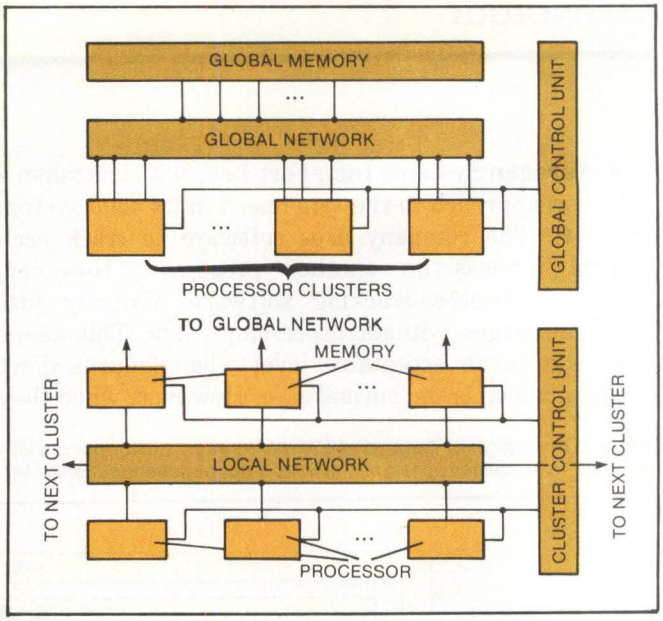


Fig. 6. Cedar system organization and cluster structure. *The prototype will have four clusters of eight processors each. The global control unit controls sequencing and assigns parts of the program to the clusters in parallel when possible. Within each cluster, the processors also execute in parallel. Because each processor can execute a different program, Cedar is not limited to array-processing applications.*

The keys to Cedar performance are:

- a hierarchical architecture that provides both parallelism among processor clusters and parallelism within each cluster,
- a new approach to connecting multiple processors with multiple memories, avoiding the bottlenecks of earlier approaches,
- compilers that are sensitive to the architecture, a feature that is vital to subdividing any task. Because the number of independent tasks on a system is usually about the same as the number of concurrent users, an approach that does not involve the compilers would be hard pressed to keep Cedar's 1,024 processors busy.

MULTIPROCESSOR GLOSSARY

Multiprocessors are usually classified according to whether they have single or multiple instructions and single or multiple data streams. Four types of systems are theoretically feasible:

Single-instruction, single-data-stream units are traditional uniprocessors. This category also includes systems similar to Stratus Computer Inc.'s fault-tolerant system that behave like uniprocessors but achieve high reliability via multiple processing elements.

Single-instruction, multiple-data-stream units are processor arrays, in which one program can drive several processors using their own local data. Pipelined processors are also usually placed in this category, although some experts dissent.

Multiple-instruction, single-data-stream units: not yet a meaningful concept.

Multiple-instruction, multiple-data-stream units include most multiprocessors. Each processor has its own program and data. These systems include:

- homogeneous units, in which all processors are functionally identical and have the same instruction set. The opposite type of system—a Motorola 68000 with an Intel 8086, for example—is non-homogeneous, or heterogeneous.
- tightly coupled multiprocessors that run under one copy of the operating system (such as the Prime Computer Inc. 850 or the Synapse Computer Corp. N+1). A loosely coupled multiprocessor has a copy for each processor.
- symmetric: a tightly coupled, homogeneous multiprocessor in which operating-system control functions can execute on any available processor. An asymmetric multiprocessor has a dedicated "master processor."

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Cedar compilers will exploit both parallelism among processor clusters and parallelism within each cluster.

Other research projects, including the Texas reconfigurable array computer (TRAC) at the University of Texas and the Blue CHiP configurable highly parallel computer at Purdue University, are looking at similar issues. A commercially available system that has similar capabilities is the HEP system built by Denelcor Inc. HEP is a multiprocessor configuration with as many as 16 pipelined "process execution modules" (PEMs) and a shared memory. Most pipelines don't operate effectively on conditional branches: everything comes to a halt, the pipelines empty, the correct path is taken, and the pipelines fill up again. The HEP PEM avoids this by running as many as eight programs in parallel in each PEM, one instruction from each program as it cycles through all eight. Consequently, the pipeline stays full, but each instruction is completed before its own successor is fetched. While the idea of rotating a processor among programs is hardly new (it goes back at least to the Honeywell 800 of about 1960), this is its first use to improve pipelining efficiency. The HEP includes several other innovations as well. Separate pipelines are used for instructions and data. "Full-empty" indicators tell the hardware when data for an instruction is available so it can be executed. Users of the few HEPs delivered so far are enthusiastic about its potential.

Throwaway processors

Efficiency considerations apply only when a user cares about the resource in question. If users had unlimited processors, what would it matter if they were not optimally used? Researchers in wafer-scale integration are asking that question, and their answer is that processor arrays can be built very inexpensively by building a large semiconductor wafer (say, 3 inches in diameter) with hundreds of microprocessors on it. Although this is a common practice, most companies then cut the individual microprocessors apart, test them and package the good ones. With wafer-scale integration, an entire wafer is tested to find the good ones. Then, a process similar to recording data in a programmable ROM is used to connect the good processors into an array. A project at the Massachusetts Institute of Technology's Lincoln Laboratory puts 352 microprocessors onto a chip but uses just 128. A chip typically has at least 128 usable microprocessors out of 352.

What next?

A conventional single processor represents a fairly rigid concept. Sharing one processing element among all users and all system functions can lead to bottlenecks that a more flexible approach could ease. Multiprocessors offer this flexibility. The use of multiprocessors has been traditionally limited because of the cost involved. With microcomputers, this is no longer a significant factor: another processor can be added to a system as easily as another terminal port—and at a comparable cost.

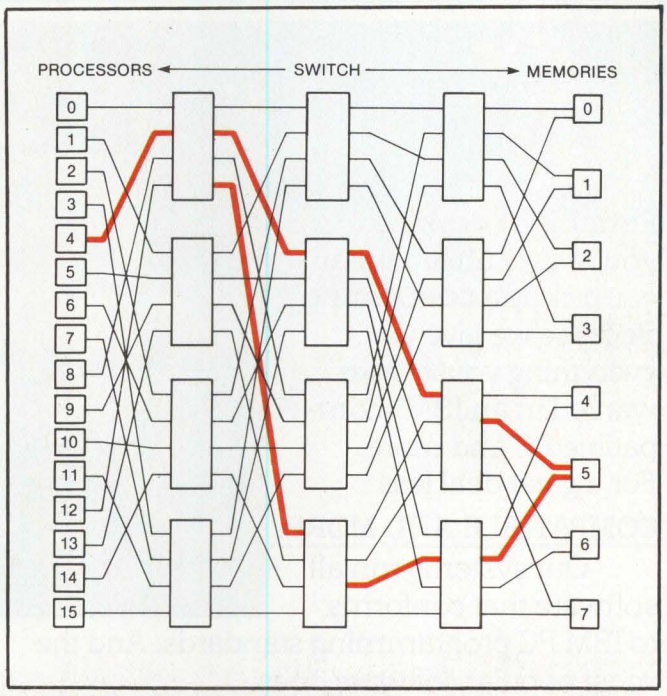

Fig. 7. Cedar system-style network *connecting 16 processors with eight memory units. Because all the switching elements are 4 by 4 but there are fewer than 16 memories, there is redundancy. Two of several possible paths from processor 4 to memory 5 are highlighted. The redundancy adds fault tolerance and improves performance by bypassing switches in use.*

Over the next few years, there will be several trends in the multimicrocomputer arena. These include:

- widely used operating systems that support multiprocessors. (UNIX has been modified to support loosely coupled multiprocessors, such as the Convergent Technologies MegaFrame and the Auragen 4000, and tightly coupled microprocessors, such as the HP9000).
- increased research into data-flow architectures. A data-flow machine divides a job into segments that can be executed on separate processors. Each segment is triggered automatically when predecessor segments supply all its inputs. A commercial offering should appear within five years.
- at least one successful massively parallel architecture. It may be a Cedar-like approach that replaces the rigid array structure of most earlier efforts with a more flexible hierarchical concept.
- the migration of fault-tolerant capability from systems handling critical data and justifying a premium price to systems in which hardware failures are mere inconveniences. □

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TECHNOLOGY

Microprocessors

RICHARD L. SANQUINI, National Semiconductor Corp.

New architectures, manufacturing processes and development tools advance microprocessors toward goals of mainframe power and software compatibility

The microprocessor has evolved far beyond its humble beginnings as a flexible, low-cost replacement for random-logic devices in simple controller applications. Today's microprocessor families are still flexible and low-cost, but they now offer enough computing power to displace minicomputers in many applications, and the mainframe-on-a-chip is just around the corner. High-level architectures, compatible chip families and modular development tools are easing system design, while new fabrication and mounting techniques are moving 32-bit CPUs into complementary-metal-oxide semiconductor (CMOS) technology and reducing the real estate required for very-large-scale-integration (VLSI) circuitry devices.

Architecture

As microprocessors progressed from 4- and 8-bit controllers to 32-bit systems, the major architectural consideration remains the space available on one silicon chip. Even with today's 70,000 to more than 100,000 transistors per chip, not all of the desired functions can be implemented on a single chip. National Semiconductor Corp.'s NS16000 family provides an example of how to resolve this problem.

The NS16000 family of four microprocessors (Fig. 1) incorporates a 32-bit arithmetic-logic unit (ALU). The most recently available member of this family is the 16032 chip, which has a 16-bit multiplexed external data path. As silicon geometries shrink, the addition of multiple data paths in and out of the ALU will permit greater system speeds without requiring redesign of the internal ALU structure. Only more buses will be required, which is a much simpler design task. This future upgrade capability is an "invisible" feature not appearing on any data sheet but one that is important for system integrators.

Silicon space also constrains the partitioning of the NS16000's processing functions. All 32-bit system-level functions are performed in the CPU, but two optional slave processors—the 16082 memory-management unit (MMU) and the 16081 floating-point unit (FPU)—are available to relieve the CPU from the complications of handling 16M-byte virtual-address spaces and performing floating-point arithmetic.

The 16082 MMU implements demand-paged virtual memory completely in hardware, rapidly swapping small pages of uniform size between main and disk memories (MMS, October, Page 259). The 16082 has eight dedicated registers to perform breakpoint and flow-trace debugging, a register file block for dynamic address translations and an associative cache memory for the last 32 pages addressed. The cache translates virtual-to-physical addresses within just one clock cycle if it contains the address being sought. The next page addressed in a program is in the cache more than 97 percent of the time.

The 16081 FPU supports 32- and 64-bit calculations with eight data registers and one status register that

stores control and error information. Options include setting the operand rounding mode and CPU traps for overflow, underflow, illegal instructions, inexact results and undefined operand.

Another important concern in microprocessor architecture is optimizing a processor for its intended applications. The NS16000 family includes special data types and instructions that are commonly used in high-level languages such as C and Pascal (Table 1). These make it possible to efficiently create and manipulate high-level structures such as arrays, records and strings.

Fabrication

Today's microprocessors are manufactured with advanced metal-oxide-semiconductor (MOS) processes that allow tens of thousands of transistors on a chip, a far cry from the bipolar microprocessors of the early 1970s that consisted of only about 1,000 transistors.

In MOS technology, a basic transistor is formed from a layer of oxide and a layer of a conducting material on top of an appropriately doped semiconductor that is usually silicon. N-channel MOS (NMOS) processes are among the more advanced MOS processes. Although NMOS is not as easily manufactured as its P-channel MOS

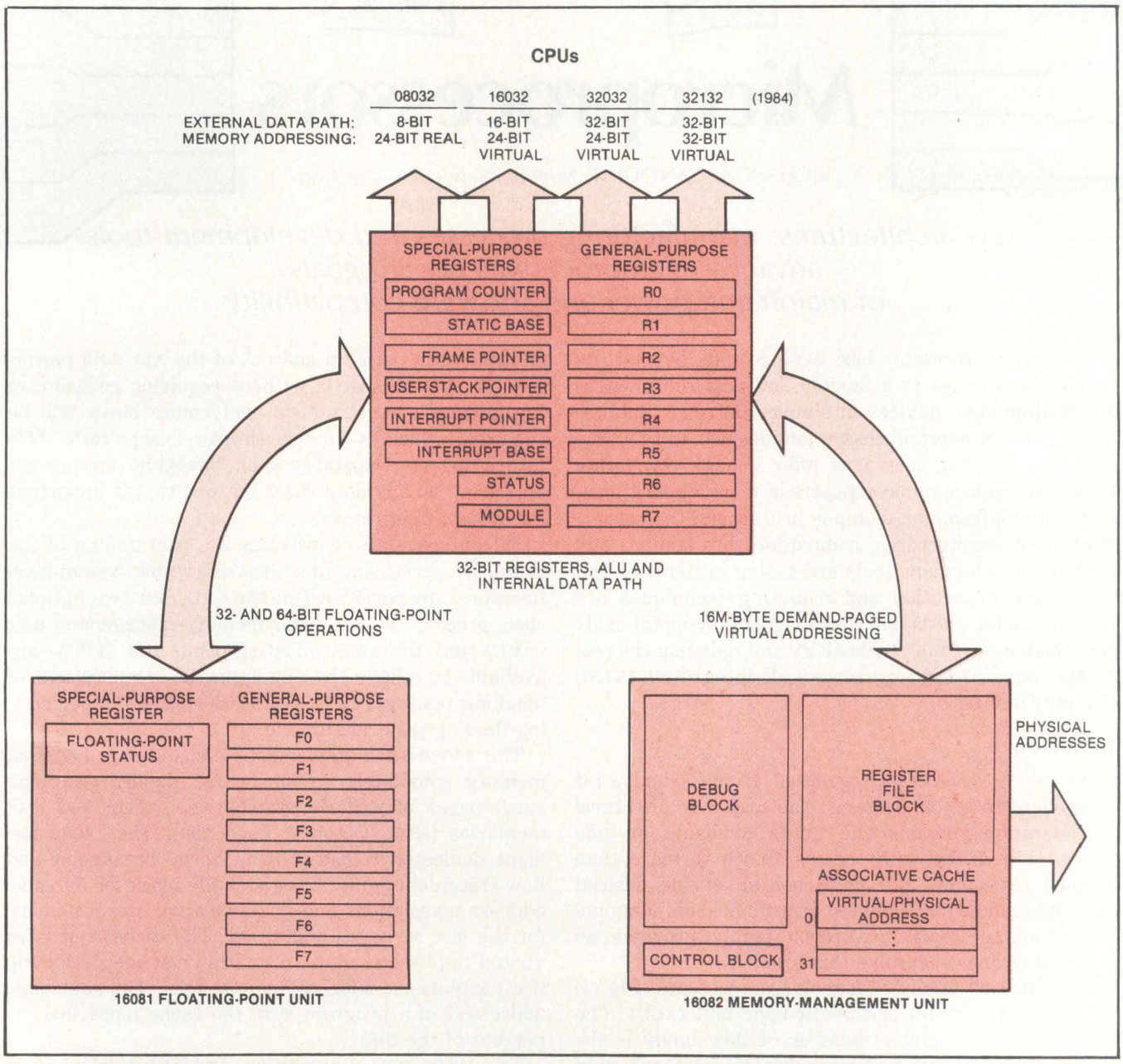

Fig. 1. The NS16000 family *represents a modern, general-purpose microprocessor architecture. The CPUs feature 32-bit internal registers, and optional floating-point and memory-management units support the CPUs.*

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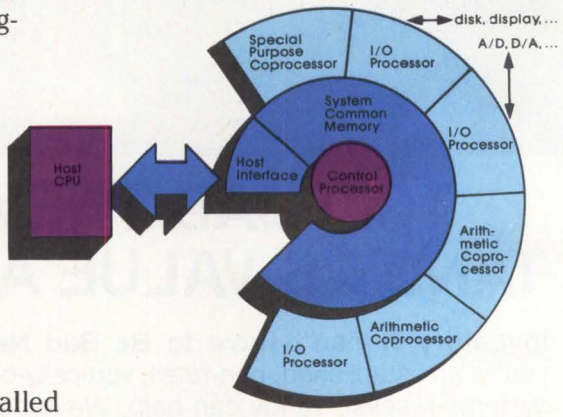
1. Demodulation/Signal Analysis	13.8 msec.	6.5 msec.	N/A	N/A
2. Tomography Preprocessing	60 sec.	25 sec.	16 sec.	12 sec.
3. Multispectral Image Classification (512 x 512 pixels 8 Bands, 4 classes)	49 sec.	25 sec.	13.3 sec.	10.5 sec.
4. 2D FFT (512 x 512 complex)	3.4 sec.	1.4 sec.	.7 sec.	.5 sec.
5. Matrix Multiply (100 x 100)	439 msec.	177 msec.	96 msec.	71 msec.

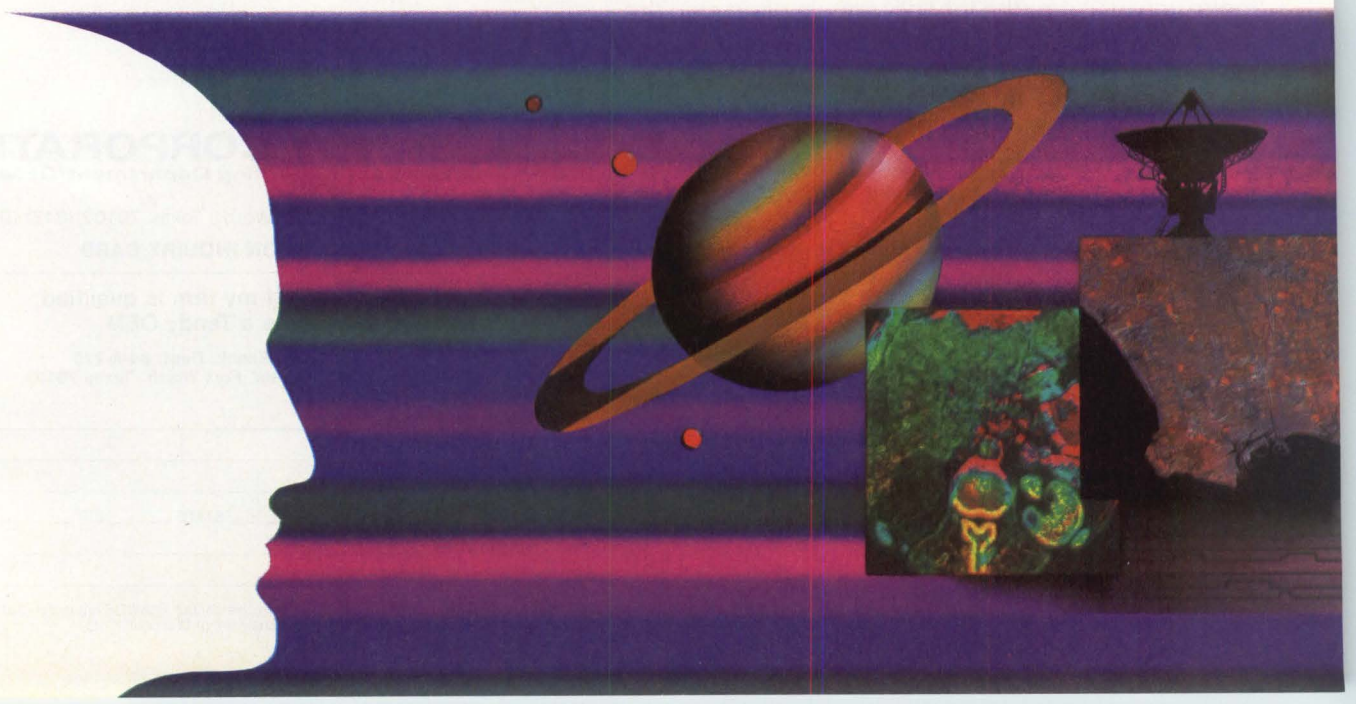
Based upon specifications subject to change.

Distributed processing architecture

The FPS-5000 Series is a distributed processing system that maximizes throughput by allocating the computational load to a set of high-performance, independent, floating-point processing elements called Arithmetic Coprocessors. Data flow is simultaneously managed

FPS-5000 Series Architecture

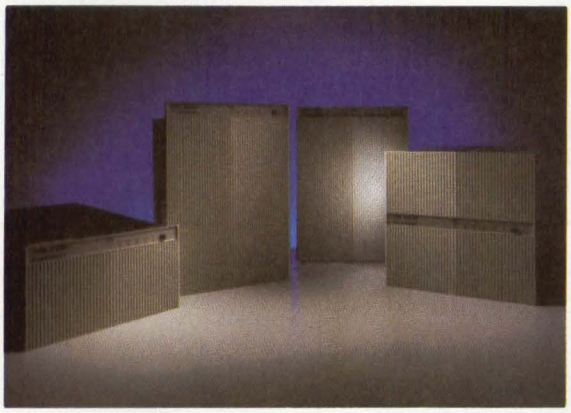




introduces the first the $2,000/MFLOP barrier.

by a combination of independent I/O Processors and the central Control Processor.

Each Arithmetic Coprocessor, with synchronous architecture to allow simple application debugging, functions as a self-contained unit.



The new Multiple Array Processor Execution Language (MAXL), based upon FORTRAN 77, allows the user to construct an integrated system environment which can be tuned to application requirements.

Increased performance can be achieved by adding Arithmetic Coprocessors as a field-installable upgrade as the user's requirements evolve.

Compatibility

The FPS-5000 Series maintains software compatibility with previous FPS 38-bit processors and is supported on a range of host computers. Thus, the extensive software support developed for FPS-100 and AP-120B products is maintained and users are able to move existing applications onto the FPS-5000 Series with minimal effort.

Quality and Reliability

The FPS-5000 Series was designed and built with the same quality standards inherent in all of the previous Floating Point Systems products—standards that have earned those products a reputation for unprecedented reliability and one of the best meantime between failure (MTBF) rates in the industry.

The Series is backed by the same outstanding worldwide support services that distinguish Floating Point Systems from other manufacturers.

For more information about how the FPS-5000 can be used in your specific application, call (800) 547-1445 or your local sales office.

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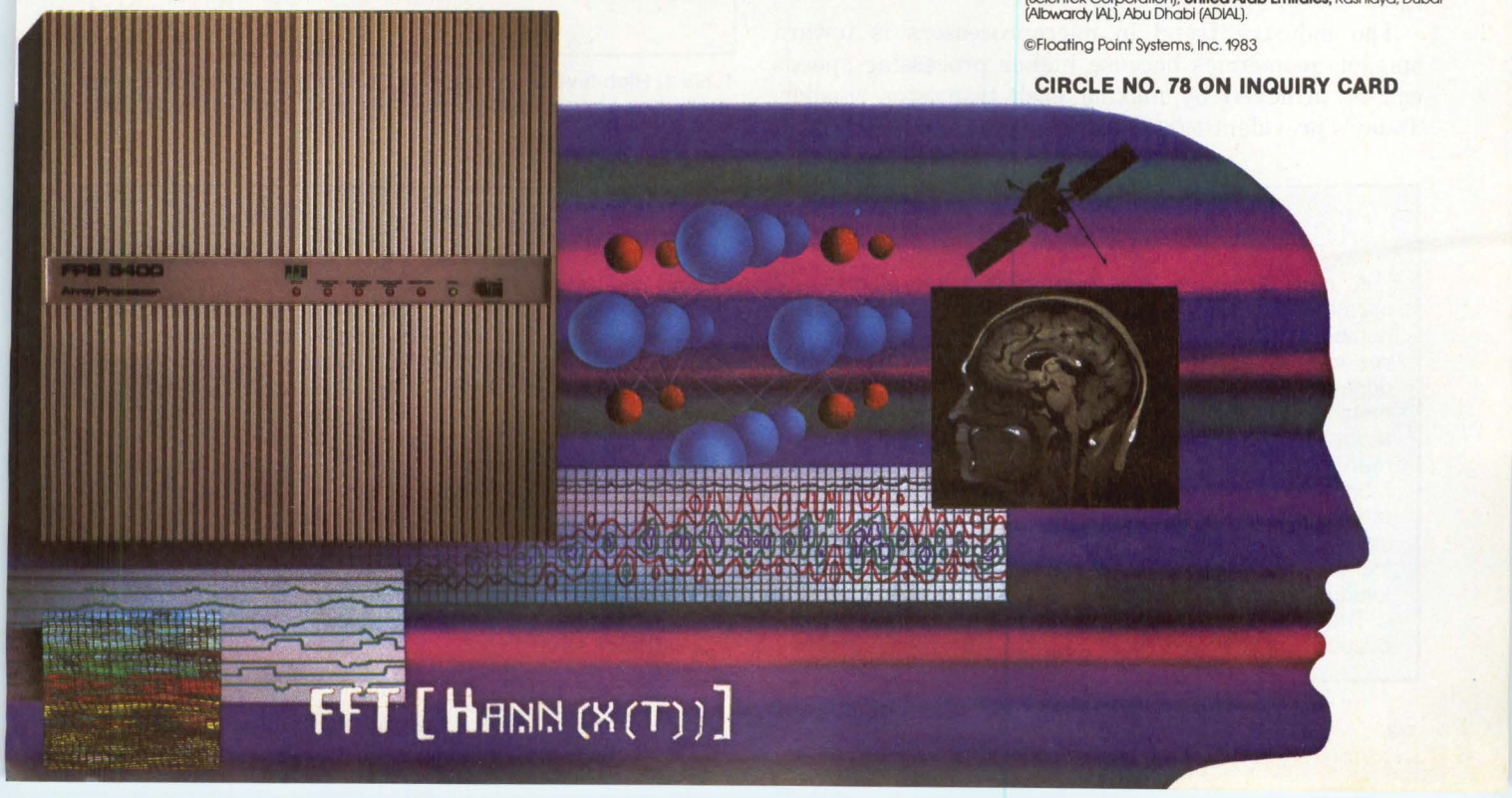


(PMOS) counterpart, it provides higher processing speeds.

CMOS technology is a strong industry trend (Fig. 2). Among its advantages are extremely low power dissipation and high reliability, making it an excellent technology for portable computers and rugged-environment applications and allowing transistors to be packed more densely without overheating. National's NSC800 family of P^2CMOS microprocessors dissipates only 5 percent of the power of comparable NMOS CPUs. Major semiconductor manufacturers are developing a double-metal process to achieve even higher processing speeds. In National's M^2-channel CMOS (M^2CMOS) process, a metal layer substitutes for the second polycrystalline silicon ("poly") conduction layer of P^2CMOS, making a total of one poly and two metal layers (see "Making CMOS, right). This increases processing speed because the sheet resistance of a typical aluminum layer is about 1,000 times less than that of a polysilicon layer. However, double-metal processes require very low manufacturing temperatures to prevent the aluminum from alloying to the surface beneath it.

Even with today's 70,000 to more than 100,000 transistors per chip, not all of the desired functions can be implemented on a single chip.

The industry trend in microprocessors is toward smaller geometries because higher processing speeds can be achieved by making each transistor smaller. Today's prevalent MOS feature size is 3 μm., compared to 5 μm. as recently as a few years ago. Many manufacturers are now making the transition to 2 μm. feature sizes, and some expect to progress to 1.5 μm. by next year. Smaller geometries will not only improve performance, but also yield smaller dies. By converting from a 3- to 2-μm. process, a circuit will occupy one-third less area.

Smaller geometries are bringing changes in production technology. For example, the main problems in photolithography are optical resolution of the small features and precise alignment of each layer of the device. Using traditional one-to-one projection aligners can cause blurring or distortion of features, especially at the edges of a wafer and can result in lower yields. Some advanced one-to-one projection aligners contain

DATA TYPE	NS16000 SUPPORT
• Integer:	Byte, word, double word
• Pointer:	Supported in memory-relative addressing modes
• Binary-coded decimal integer:	Byte, word, double word; add packed and subtract packed instructions
• Boolean:	Byte, word, double word; logical instructions, Boolean NOT and save condition code instructions
• Bit:	Test, test and set; test and clear; complement, and bit-field instructions; interlock option
• Floating point:	32- and 64-bit floating-point unit instructions
• Array:	Index and bound-check instructions; scaled and index addressing modes
• Record:	Addressing modes include final displacements of data items
• String:	Ordered arrays, especially of characters; move, compare and skip instructions; termination and translation options

Table 1. High-level language data types *are supported by special instructions and addressing modes of the NS16000 microprocessor family.*

INCREASING CPU WORD SIZE

A chip designer can improve microprocessor performance in a number of ways. Component densities can be increased, as has been done in the evolution from P-channel metal-oxide semiconductor (PMOS) to N-channel MOS (NMOS) to complementary MOS (CMOS), but chip-fabrication technology limits such advances. The classic method of improving performance has been to increase the number of bits manipulated by the CPU.

The first microprocessor, introduced more than a decade ago, was Intel Corp.'s 4-bit 4004 designed for a desk calculator, which was followed by the 8008 and 8080 8-bit processors. The commercial success of these products led others to join the 8-bit market. Newcomers included Motorola Inc.'s 6800, Zilog Inc.'s Z80 and National Semiconductor Corp.'s SC/MP. Meanwhile, Intel developed the 8085, which eliminates the system controller, external clock and three power levels required by the 8080.

With the evolution to 16-bit processors, designers had the option of retaining the standard 40-pin package (preserving current testing methods) or increasing the number of external pins (requiring new testing methods). In most 8-bit designs, eight pins are used for data, 16 for addresses, 12 for control, two for the clock and two for the power supply. To use the same 40 pins for a 16-bit design, the data bus or the address bus must be multiplexed, slowing the system. However, 64-pin packages allow 16-bit data and address transfers to occur without multiplexing, so system speed can proceed at close to the CPU rate.

high-resolution optics to minimize edge distortions. However, many manufacturers are now moving away from one-to-one projection and toward wafer-stepper technology. Instead of aligning and exposing the entire area of a wafer containing hundreds of iterations of an individual pattern, a wafer stepper aligns and exposes one tiny section at a time, repeating the basic pattern across the area of the wafer. Because each exposed area is so small, optical distortion is virtually eliminated.

Other improvements in fabrication include replacing high-temperature diffusion by ion implantation to obtain better control of dopant levels, replacing wet-chemical etching by plasma etching ("dry etching") to achieve better dimensional control of small-geometry circuit features and increased reliance on factory automation to reduce the possibility of human error and environmental contamination.

Development tools

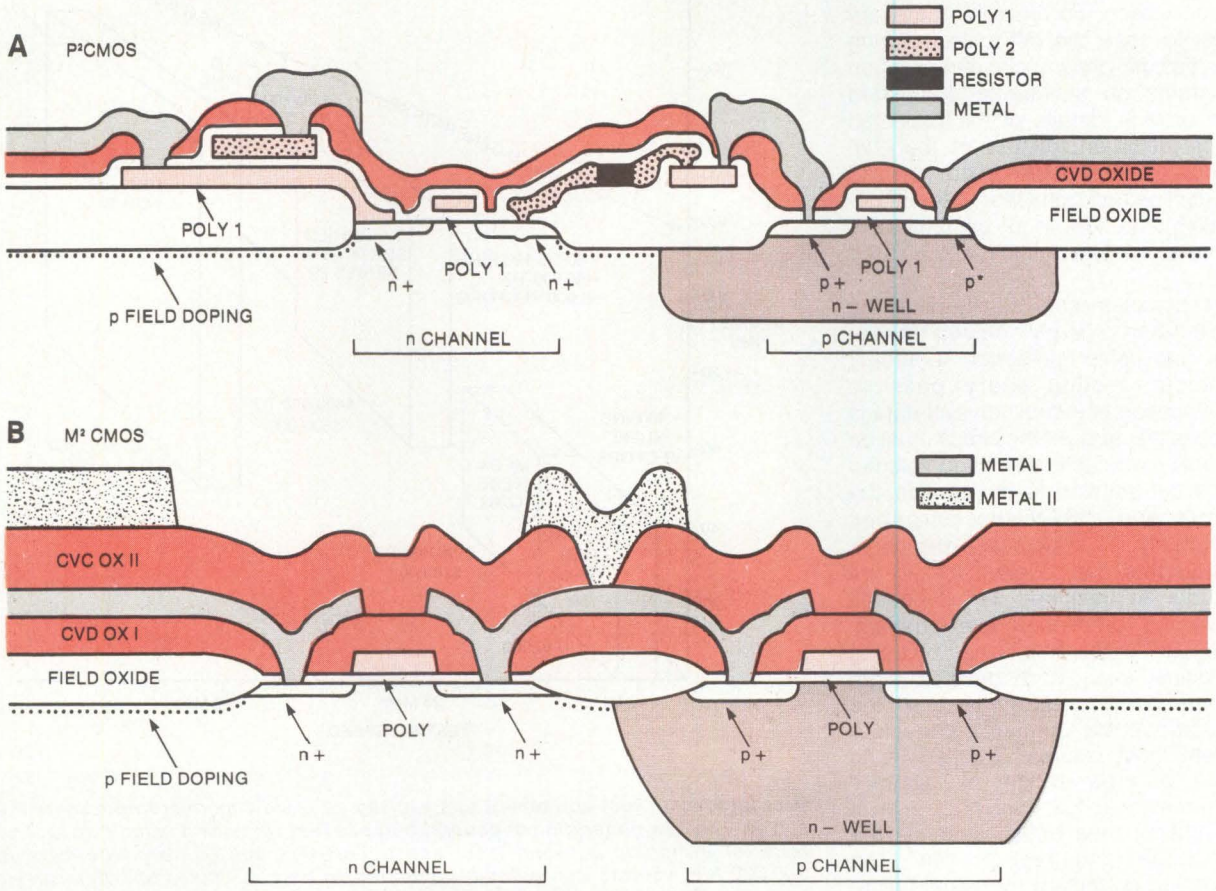
Microprocessors such as the NS16000 and Motorola Inc.'s MC68000 are being used in applications that are much more software intensive than those supported by previous generations of 8- and 8-/16-bit processors. Users of the new generation of chips are either software sophisticates or rapidly becoming so. Consequently, vendors have introduced extensive cross-development

MAKING CMOS

The complementary-metal-oxide-semiconductor (CMOS) process—either P²CMOS or M²CMOS—begins with a silicon wafer containing a "p-type dopant," which is a trace quantity of boron. Phosphorus ions are implanted in the wafer, forming "n-well" regions. Ion-implantation systems drive boron ions into the n-well, forming "p+" regions, and arsenic ions into the p-substrate, forming "n+" regions. The field and gate oxides are grown thermally. One layer of polycrystalline ("poly") silicon is chemically deposited, forming the transistor gate. A layer of insulating oxide is then grown over that. Plasma etching is used extensively in forming connections between critical layers of the circuit.

In the P²CMOS process (A), a second layer of polycrystalline silicon is deposited. Sputtered aluminum forms the metal conductor layer. National Semiconductor Corp. also uses an optional resistor in the upper poly layer.

In the M²CMOS process, which provides higher circuit speeds and packing densities, a layer of aluminum replaces the upper poly layer used in P²CMOS. This metal layer has a lower melting point than its poly counterpart, so M²CMOS manufacturing must be carried out at lower temperatures than those required by P²CMOS.



TESTING FUNCTION SHIFTS FROM END USER TO MANUFACTURER

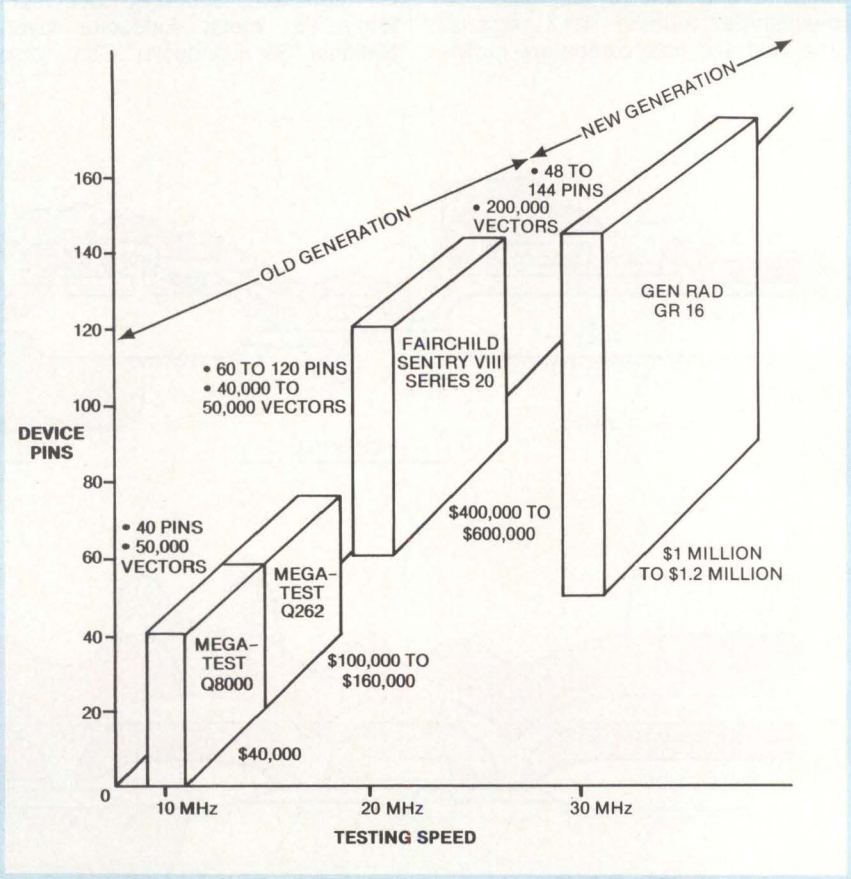
When computers were designed using medium-scale-integration components, the design task was a two-step process: an architect specified the logic, and an engineer then developed the circuit from standard logic elements. Because the electrical behavior of these standard logic elements was well-understood, circuit analysis was relatively straightforward. Once the logic of a circuit was verified, the system could be expected to conform to its specifications.

Today, when a CPU resides on a single silicon chip, there is an added layer of complexity: the silicon design must be verified for conformance to the intended logic. The electrical characteristics of the silicon geometries in each portion of the circuit must be tested to ensure that the silicon can transmit the required electrical signals. Quite often, it is not easy or even possible to implement a logical design given the physical dimensions of the silicon. Fortunately, there are tools to ease the difficulties. During the design phase, circuit-simulation programs on mainframe computers can provide details of the expected electrical characteristics of the chip layout. During the pre-production and production/test phases, very-large-scale-integration (VLSI) circuit-testers can provide data on the manufactured part.

A complex chip family like the NS16000 with nearly 100,000 transistors per chip presents a thorny problem: testing every possible combination of instruction and data is impossible, and yet the circuit must be reliably manufactured in high volume. A partial solution is to partition the circuit and debug the partitions separately. This increases the confidence that the overall circuit will operate as designed, but it doesn't solve the production test problem. The latter problem is solved by using statistical analysis to develop algorithms that functionally test the microprocessor thoroughly enough to reveal most failures. The aim is to input a wide range of stimulus patterns and to test each node in all of the critical data paths, such as the microcode and register file. The algorithm is verified by actual failure rates obtained through sampling. Typical failure rates of 100 parts per million, although higher than National's goal of 50 parts per million, are lower than traditionally accepted industry rates for medium-scale-integration (MSI) devices.

When the cost of device test equipment was in the tens or hundreds of thousands of dollars, it was possible for large end users to set up comprehensive test procedures. But today's larger VLSI testing devices require so much computing power that their prices are more than $1 million each. This makes it impractical for end users to establish their own test procedures for VLSI products; instead, they must rely on the suppliers. To meet this problem, semiconductor manufacturers are making large investments to install production-line testing systems that greatly increase quality levels. In effect, these manufacturers are transferring the cost of quality assurance from end users to themselves.

In the near future, the testing process will be further automated so that information from the design-simulation stage will be used to generate test vectors for use throughout the testing process. Advances in test equipment will reduce circuit-testing times and allow even greater levels of detail and analysis. These improvements will be needed. By the mid-1980s, devices with 500,000 transistors per chip and speeds of more than 20 MHz will be challenging even the more sophisticated of today's VLSI test systems.



Microprocessor test equipment *has evolved as rapidly as microprocessors themselves. The new generation of general-purpose test systems has logic as fast as 30 MHz for switching between tests and parameters and can produce more than 200,000 test vectors per second, compared to only 40,000 to 50,000 in previous systems. The 16032 microprocessor, which formerly required 8 seconds to be tested, can now be tested in about 1 second. Moreover, the new test provides much better "coverage" of the part in that more data paths are tested, increasing the probability of detecting an error.*

packages for users with popular software-development systems such as the Digital Equipment Corp. VAX, and most development systems support multiple users and the UNIX operating system.

Cross-development software provides a cost-effective way to use computing resources (Fig 3). Cross assemblers and high-level languages such as C and Pascal are widely available. Utilities such as linkers, librarians and symbolic debuggers make it easy to develop and debug large programs without a target system. While most cross-development software is aimed at large minicomputer installations, even 8-bit systems can be used to develop 16- and 32-bit software. When software is developed on a system other than the target machine, there is an extra step of hardware/software integration. This can be accomplished by down-loading code to a development board or an in-circuit emulator (ICE) (Fig. 4).

The ICE, an invaluable tool for microprocessor system integration, has been called the "great finger-pointer" because it allows quick troubleshooting by isolating problems to hardware or software. The consensus is that ICEs should operate in real time, provide mappable emulation memory and simultaneously emulate multiple processors. The ICE should be unbundled from the development system so that it can be used with generally available hosts.

Most development system manufacturers realize that their systems must provide greater performance than earlier single-user workstations. Newer development systems are typically expandable with Winchester disk storage, have 1M byte to 4M bytes of main memory and support two to eight users running UNIX. Although UNIX has its share of critics in the business market, it is a solid favorite among the technical community. GENIX, a Berkeley 4.1 version of UNIX used in National's SYS16 development system, provides demand-paged virtual memory with a 16M-byte address space for each user, a source-code version control system; a C shell with "pipes"; and utilities for electronic mail, text processing and program management.

While BASIC was the most frequently used language in 8-bit systems, most 16-/32-bit users prefer C and Pascal, which are supported by almost all development system manufacturers and many independent software vendors. The availability of C and Pascal combined with the underlying power of 16-/32-bit microprocessors is generating a major effort to port software from mainframes and minicomputers to microprocessors. This differs from the development of 8-bit applications, most of which were written uniquely for 8-bit systems.

The concern about software portability from 16- to 32-bit processors has been highlighted by the difficulties encountered by many manufacturers in upgrading from 8- to 16-bit systems. Because the next generation of full 32-bit microprocessors will likely overtake the

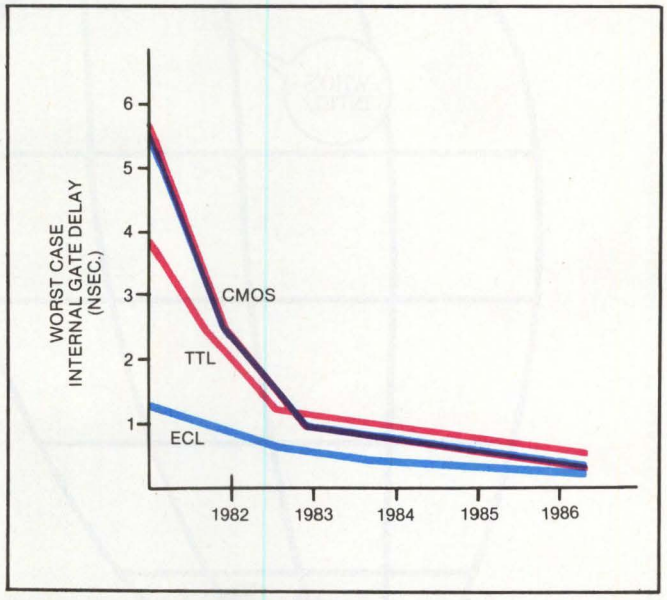


Fig. 2. CMOS performance evolution. *CMOS was once considered slow, complicated and suitable only for narrow markets, but it has benefited from intense research and development by semiconductor manufacturers. CMOS has become more attractive as VLSI pushes other fabrication technologies beyond the 1W-per-package thermal limits of low-cost plastic packaging. Moreover, NMOS processes have become more complex, so CMOS is no longer much more difficult to manufacture.*

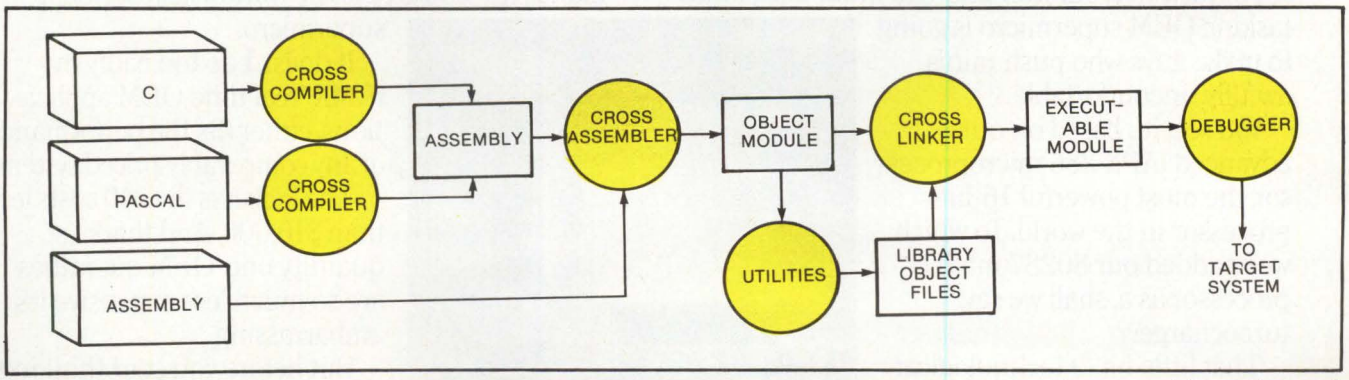
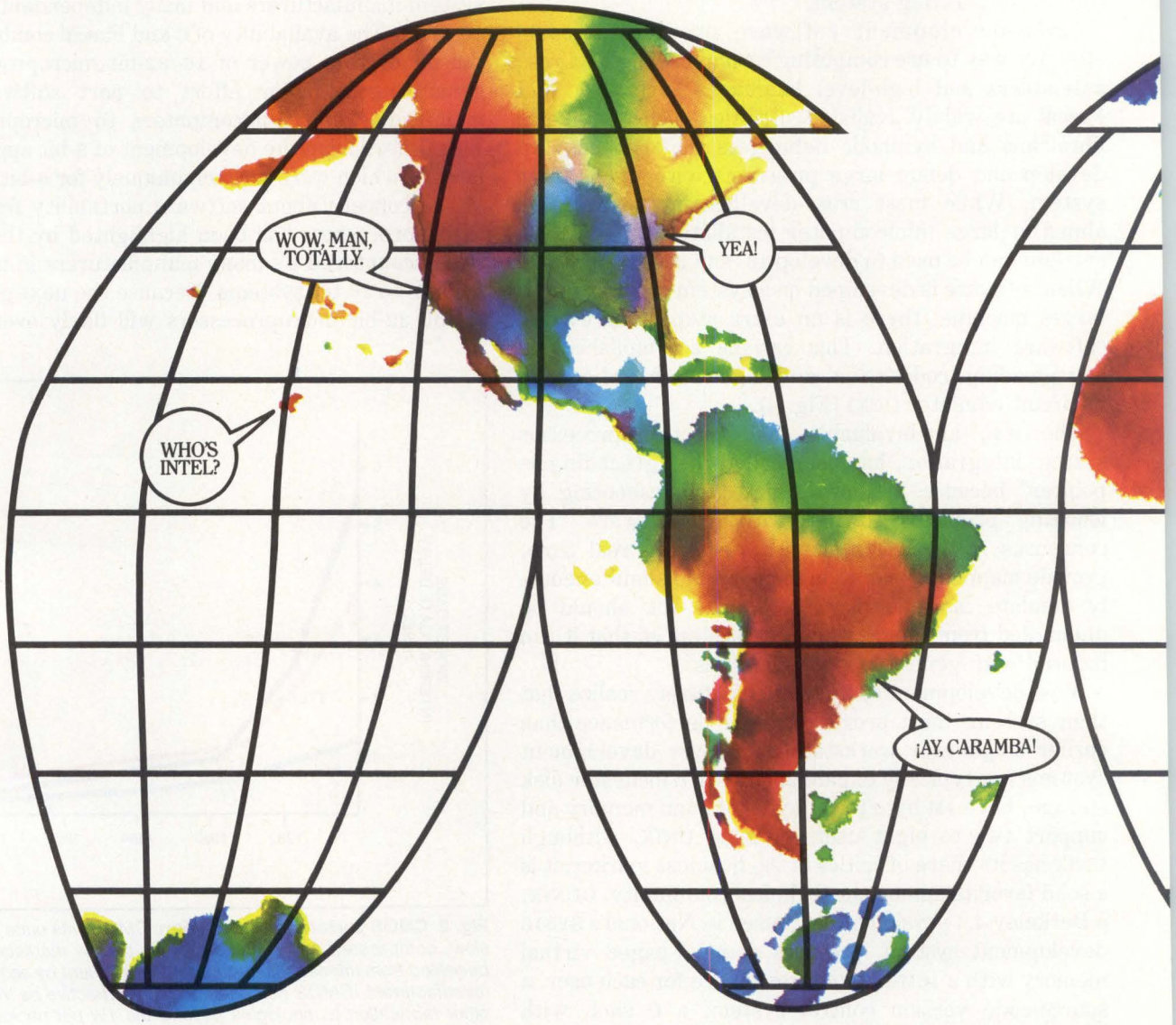


Fig. 3. Cross-development software *(yellow circles) has become a popular option for system designers because minicomputers and mainframes provide an effective environment for creating and managing large software systems written for 16-/32-bit microprocessors.*

WHEN WE INTRODUCED OUR PEOPLE HAD



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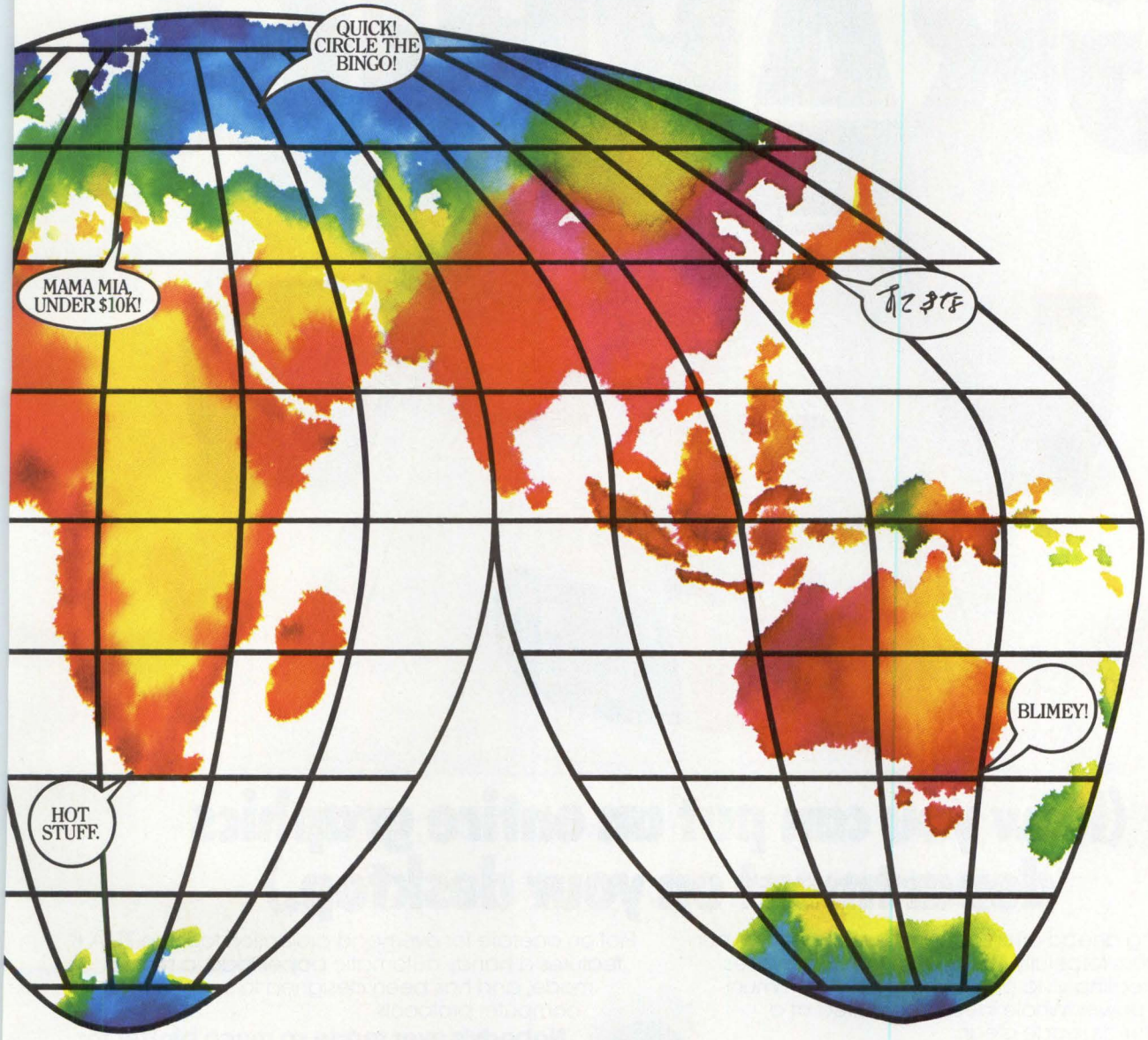

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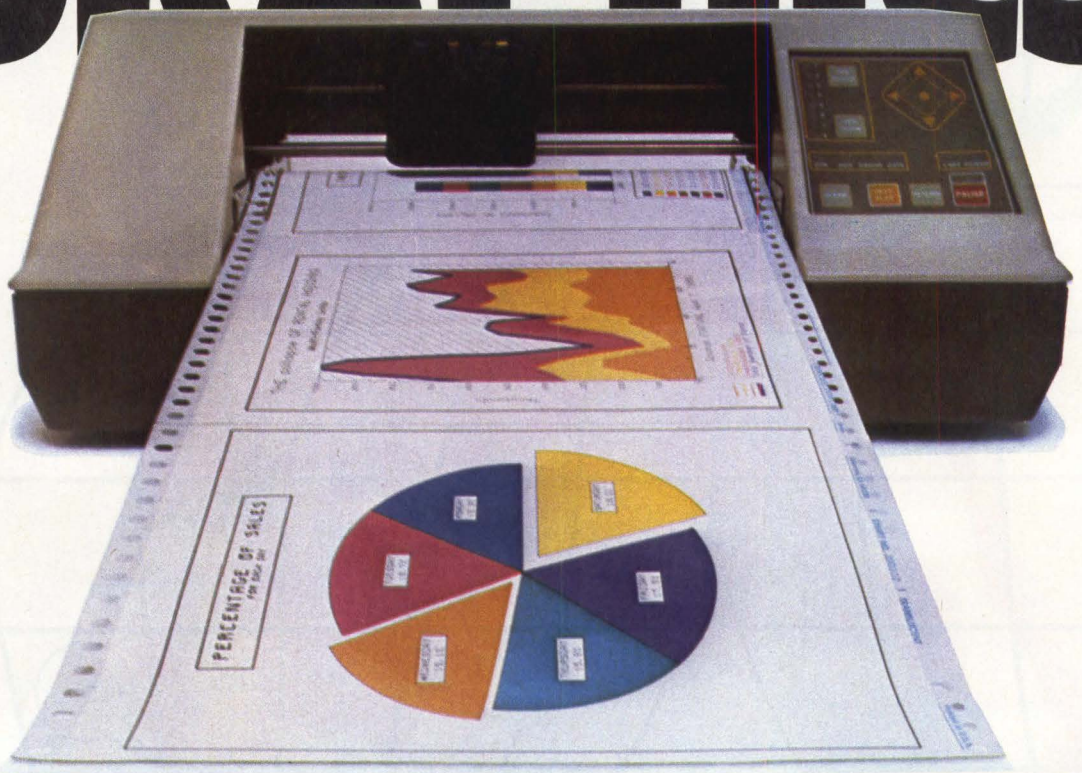

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current generation of 16-/32-bit microprocessors, system integrators should be aware of the requirements for porting today's 16-bit software to tomorrow's 32-bit machines. National designed its NS16000 family of processors and SYS16 development system to ensure full software portability from the 16032 and 08032 to the 32-bit 32032, eliminating the need for an SYS32 product.

LEAD RESISTANCE (mOhm)		
	Shortest lead	**Longest lead**
DIP (40 leads)	4	7
PCC (44 leads)	3	6
LEAD-TO-LEAD CAPACITANCE (pF)		
	Adjacent shortest leads	**Adjacent longest leads**	**Across-the-corner leads**
DIP	0.1	3	0.3
PCC	0.1	0.3	0.2
LEAD INDUCTANCE (nH)		
	Shortest lead	**Longest lead**
DIP	1.4	19.1
PCC	3.2	3.5

Table 2. Electrical characteristics of DIPs and plastic chip carrier (PCC) packages. *Because the square PCC has shorter lead lengths, the resistance, lead-to-lead capacitance and lead inductance are lower. Results were obtained using the 44-pin PCC of the NSC800 microprocessor.*

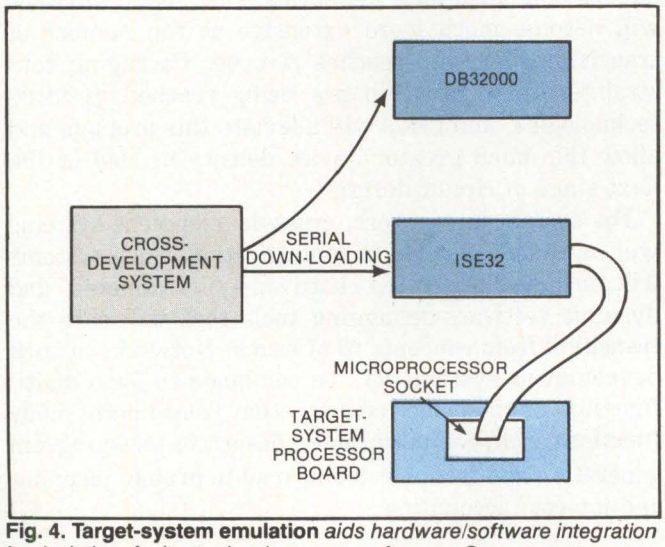

Fig. 4. Target-system emulation *aids hardware/software integration by isolating faults to hardware or software. Once target-system software has been developed, it can be down-loaded to a "development board" such as National's DB32000 for simple debugging operations or to an in-circuit emulator such as National's ICE32, which provides more extensive capabilities including real-time debugging of target-system hardware.*

Packaging

Increasing chip density with VLSI technology is forcing a major change in the way chips are packaged. For years, the standard packaging format has been a rectangular ceramic or plastic dual-in-line package (DIP). The leads coming out of the square silicon chip are carried to the edges of the rectangle and connected to sturdy legs placed 0.1 inches apart. Developed for small-scale-integration and medium-scale-integration devices with 14 or 16 pins, these rectangular packages are inefficient for mounting devices with 40 or more pins because the leads near the corners of the package must be very long to connect the silicon chip to the edge of the package. Newer square packages occupy less space and hold more connections. They have nearly equal lead lengths, providing better electrical characteristics (Table 2).

The new square package for devices with 40 or more pins is the plastic chip carrier (PCC) (Fig. 5), which can contain as many as 124 leads. Instead of the "stilt" leads of the DIP, the PCC leads curve to form a circle, and they can be spaced 0.05 inches apart. The PCC is surface mounted with solder paste instead of the "through-hole" insertion method used with the DIP. It is one-third the size of the DIP and sells for a similar price. For these reasons, the PCC is becoming the choice for packaging advanced VLSI microprocessors and their support chips.

In the future, an advanced chip carrier (ACC) package similar to the PCC will place leads only 0.025 inches apart and will provide as many as 224 leads. In instances in which feed-through holes are desired, a pin-grid array (PGA) can be used. The PGA is also square, but the leads are arranged in an array on the underside. Because of the spacing requirements of the pins, a PGA footprint can be smaller than that of PCC, although more costly to manufacture.

Future developments

The next few years will reveal greater advances in microprocessor development than the previous decade. Not only will single-chip 32-bit processors appear, performing many of today's partitioned functions on one chip, but new functions will be added to provide complete system-on-a-chip capabilities. The trend toward specialization of chip functions will continue, with specialized microprocessors being developed for bus transactions, I/O handling, communications, disk control and graphics applications.

Software support will become the critical factor in market acceptance of 32-bit processors. The lessons learned in the growth from 16- to 32-bit minicomputers and from 8- to 16-bit microprocessors have demonstrated the virtues of software compatibility.

With silicon geometries shrinking to 1.5 μm.,

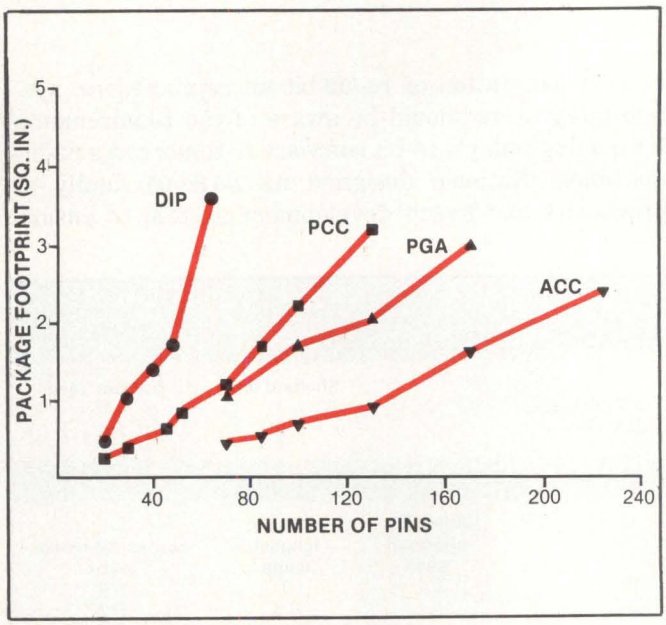

Fig. 5. Footprint size of microprocessor packages. *The square plastic chip carrier (PCC) (photo) can hold 44 pins in only 0.6 square inches vs. 40 pins in 1.4 square inches for a conventional rectangular DIP. With 64 pins, the PCC provides even greater improvement over the DIP. For a very large number of pins, the pin-grid array (PGA) is superior to the PCC. It holds 172 pins in 3 square inches. The next-generation square package is the advanced chip carrier (ACC), which is expected to hold as many as 224 pins in only 2.4 square inches.*

microprocessor designers will optimize CPU performance by adding on-chip cache in instruction-fetch queues and small local memories. Diagnostic software will become much more extensive as the number of transistors per chip reaches 500,000. Packaging constraints of 1W per chip are being reached in NMOS technologies, and CMOS will alleviate this problem and allow the much greater device density needed at the next stage of circuit design.

For system integrators, cross-development systems will continue to evolve in sophistication. Such systems will include integrated hardware instruments and dynamic software-debugging tools that will ease the transition from concepts to systems. Networks of such development systems will be combined to form multifunction engineering centers that coordinate many functions from computer-aided design to test-program generation and from electronic mail to project planning and job-cost accounting. □

Richard L. Sanquini is vice president of the Microprocessor Division at National Semiconductor Corp., Santa Clara, Calif.

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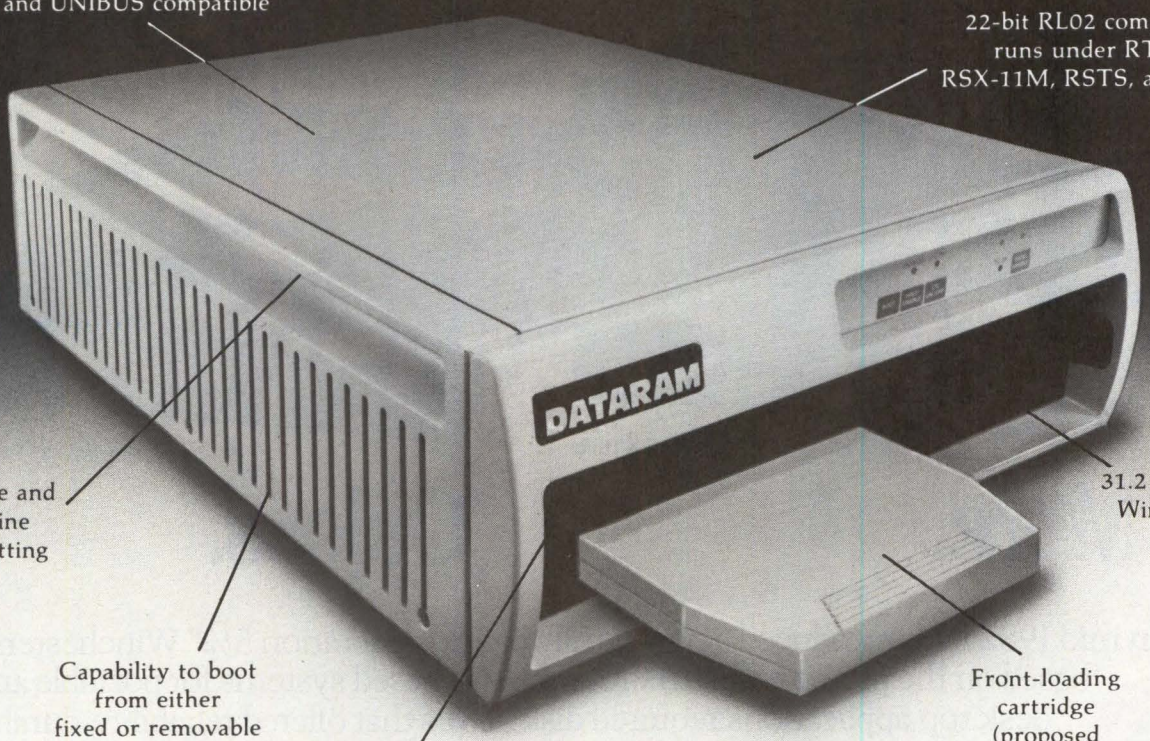

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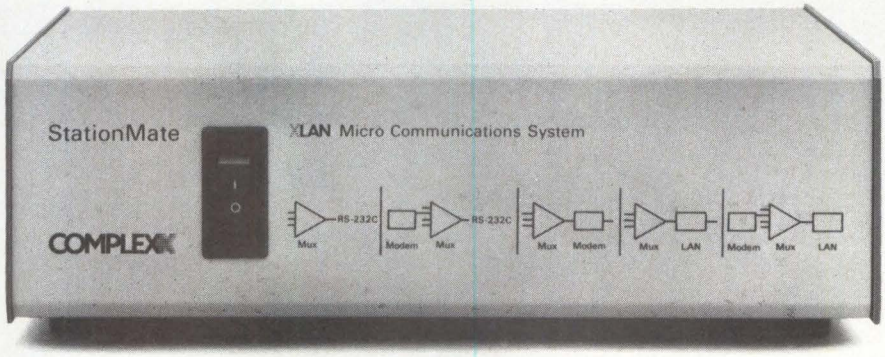

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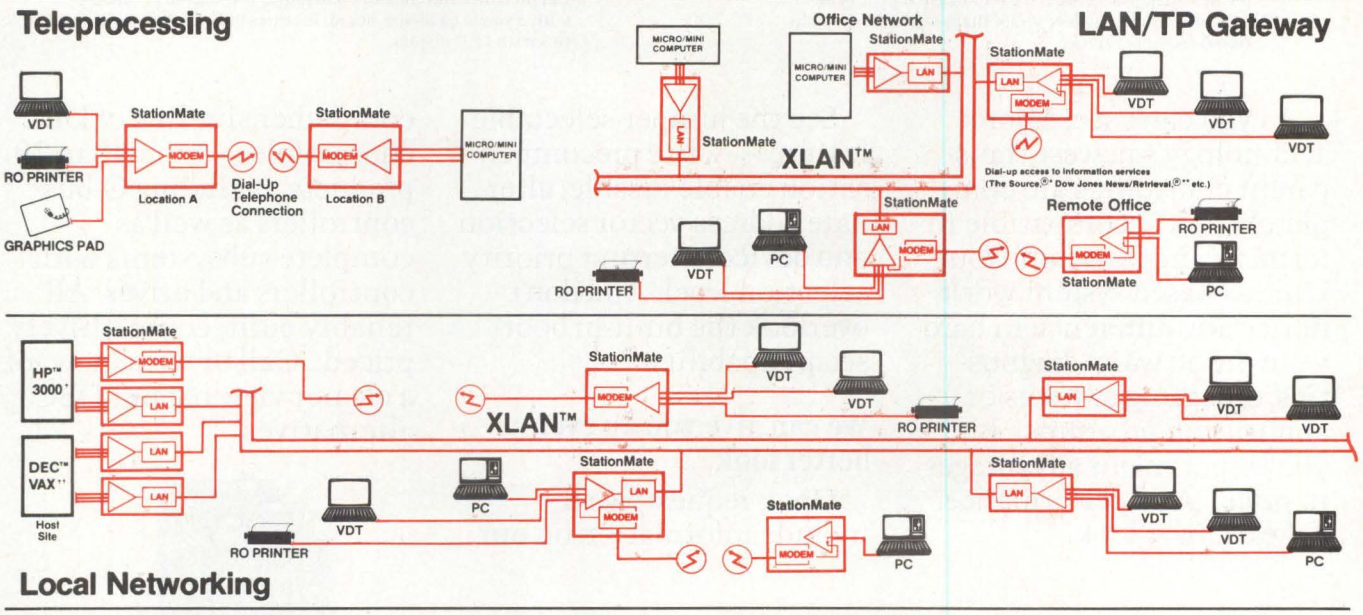

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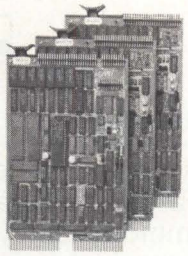

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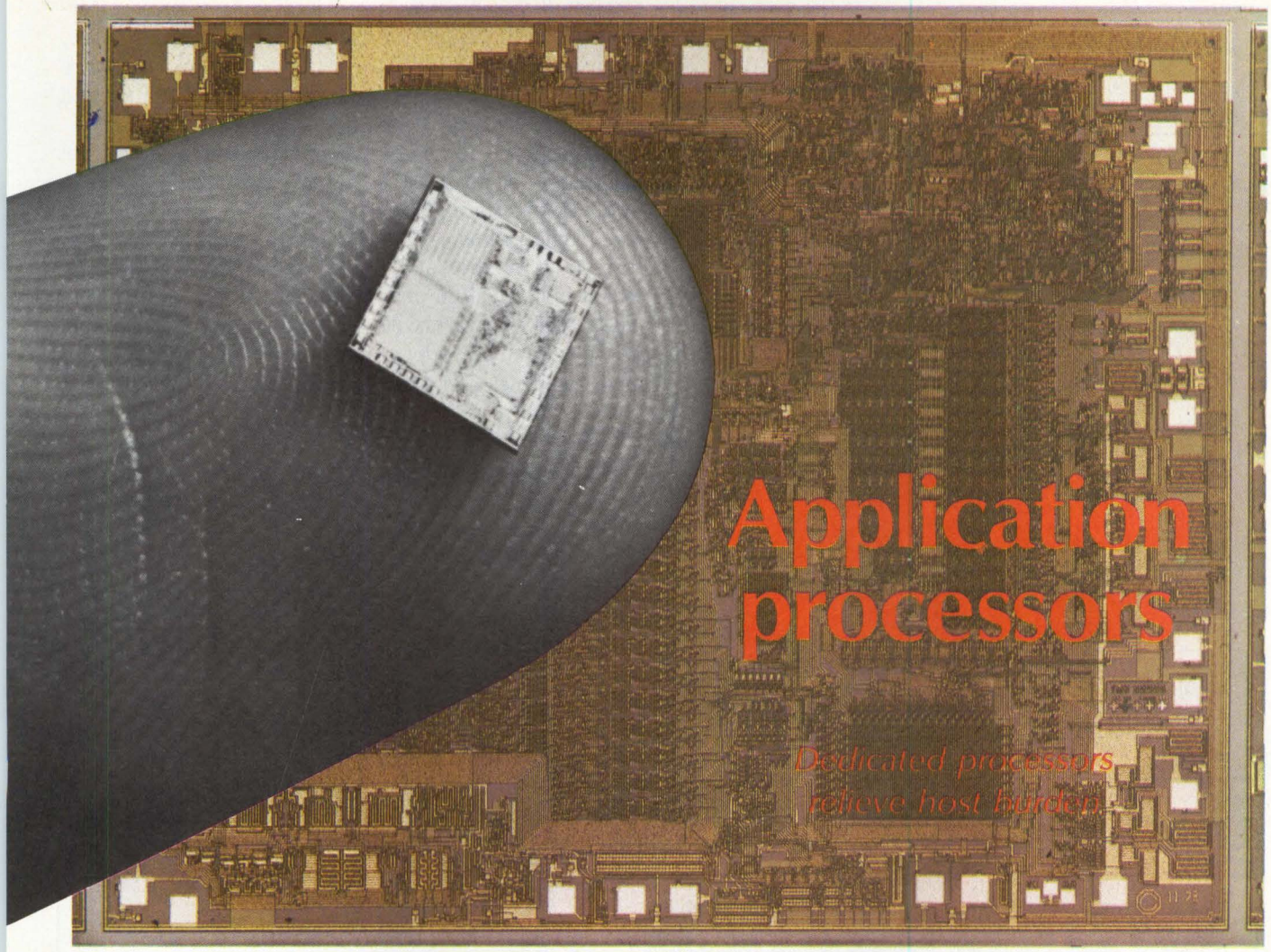


Application processors

Dedicated processors relieve host burden.

KEVIN McDONOUGH, Texas Instruments Inc.

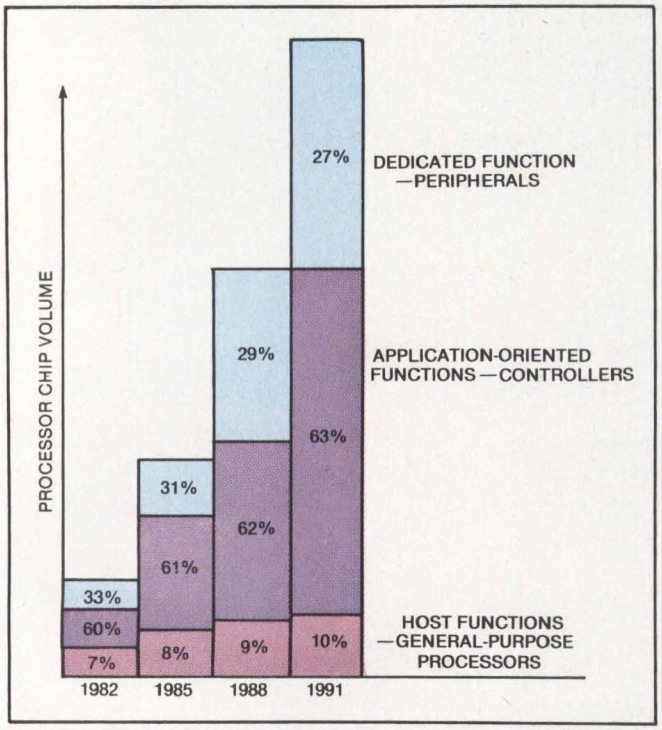
Application processors are chips dedicated to specific applications that relieve the host CPU's processing burden and increase system throughput in computation-intensive applications. System designers are greeting the new processors with open arms because the chips simplify programming and architectural design, providing cost-effective solutions to the demands of today's complex applications. Four of the more promising types of application processors—digital signal, voice synthesis, video display and modem processors—highlight this rapidly-emerging market.

Fundamentals of application processors

Application processors incorporate architectures designed for specific application requirements. Most high-performance application processors are based on Harvard architectures, which are characterized by separate program and data memories. Von Neumann architectures, characterized by a single space for programs and data, have replaced Harvard architectures in the general-purpose microprocessor market. But Harvard architecture chips are faster and thus better suited for the high-performance requirements of complex applications such as voice recognition and image processing.

To ease the problem of designing a system with multiple processors, semiconductor vendors are supplying a new generation of development-support systems. Texas Instruments Inc.'s XDS system, for example, runs with a customer's host development system to analyze several processors concurrently operating within a single system. Supporting software and hardware allow system designers to start, stop and monitor several application processors simultaneously and in parallel.

Standard interfaces are beginning to emerge—such as the International Standards Organization (ISO) standards for communications and ANSI standards for graphics (graphics kernel system, virtual device interface, North American presentation level protocol syntax)—that apply to both hardware and software, allowing application processors to communicate more



Processor functions, *expressed in percentages dedicated to each of three processing areas. Application processors account for more than half of all chips shipped.*

effectively with the rest of the system. In most cases, semiconductor manufacturers will supply these interfaces with the application processors. In other cases, semiconductor manufacturers and system software houses form third-party arrangements to produce and market the interfaces.

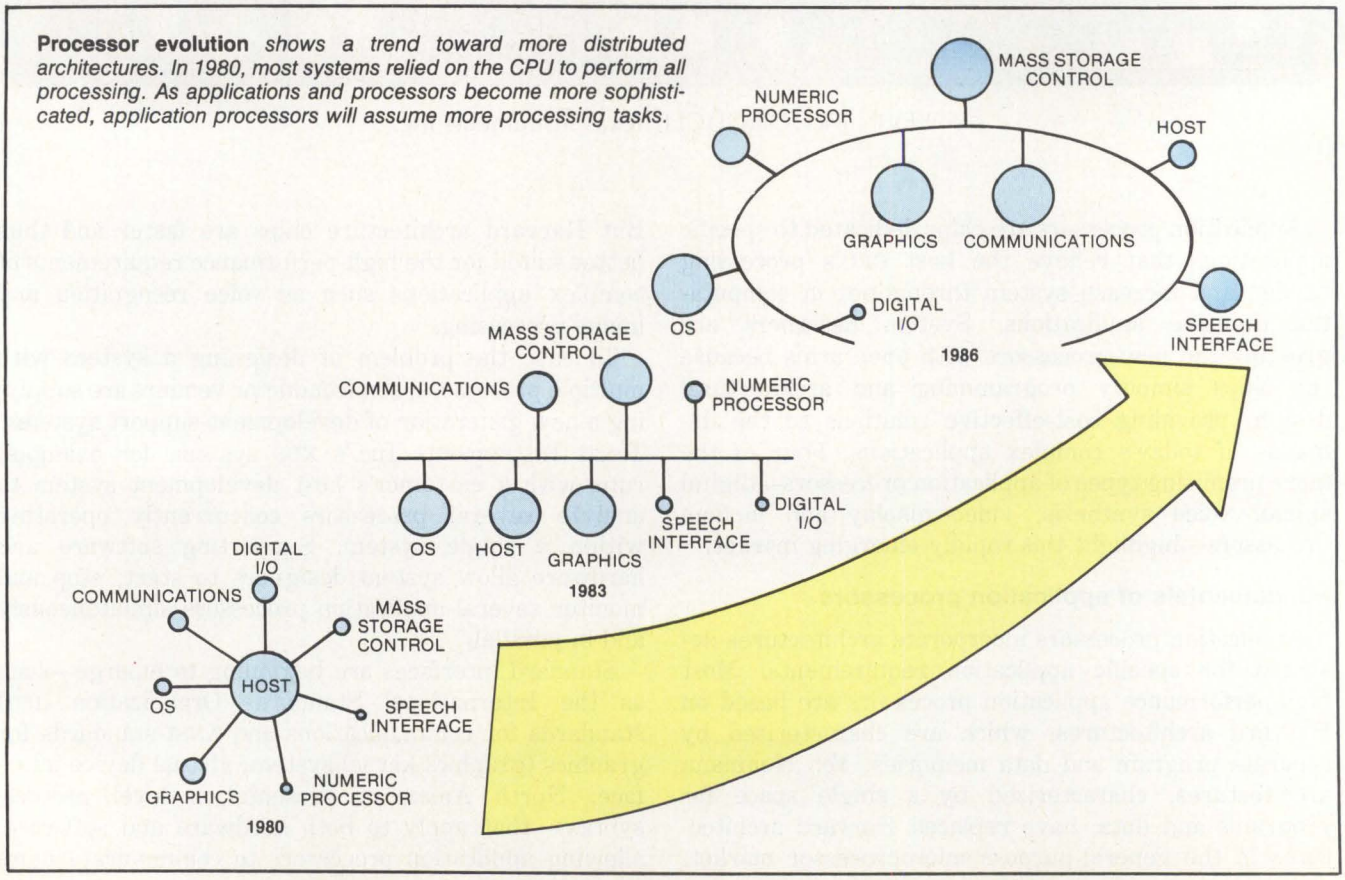
Application processors support special high-level languages such as TI's signal-processing language (SPL), currently under development, for digital signal-processing chips. Video display processors (VDPs) support a variety of languages, the most popular of which is C. System programmers will thus be able to work with software with which they are familiar, and semiconductor vendors can provide them with optimized routines and programs for special applications.

Digital signal processing

Digital signal processing (DSP) encompasses a wide variety of applications ranging from high-speed modems to speech processors. The chips are usually used in real-time, computation-intensive operations. They require elements such as parallel on-chip hardware, special I/O connections and a reduced-instruction-set-computer (RISC) instruction set. This new level of computational power is opening markets and applications that were not previously cost-effective. These include speech analysis, synthesis and recognition; high-speed modems; digital filtering; spectrum analysis; telecommunications; and image processing.

The requirements of DSP call for a Harvard architecture that permits parallel information fetching from

Processor evolution *shows a trend toward more distributed architectures. In 1980, most systems relied on the CPU to perform all processing. As applications and processors become more sophisticated, application processors will assume more processing tasks.*



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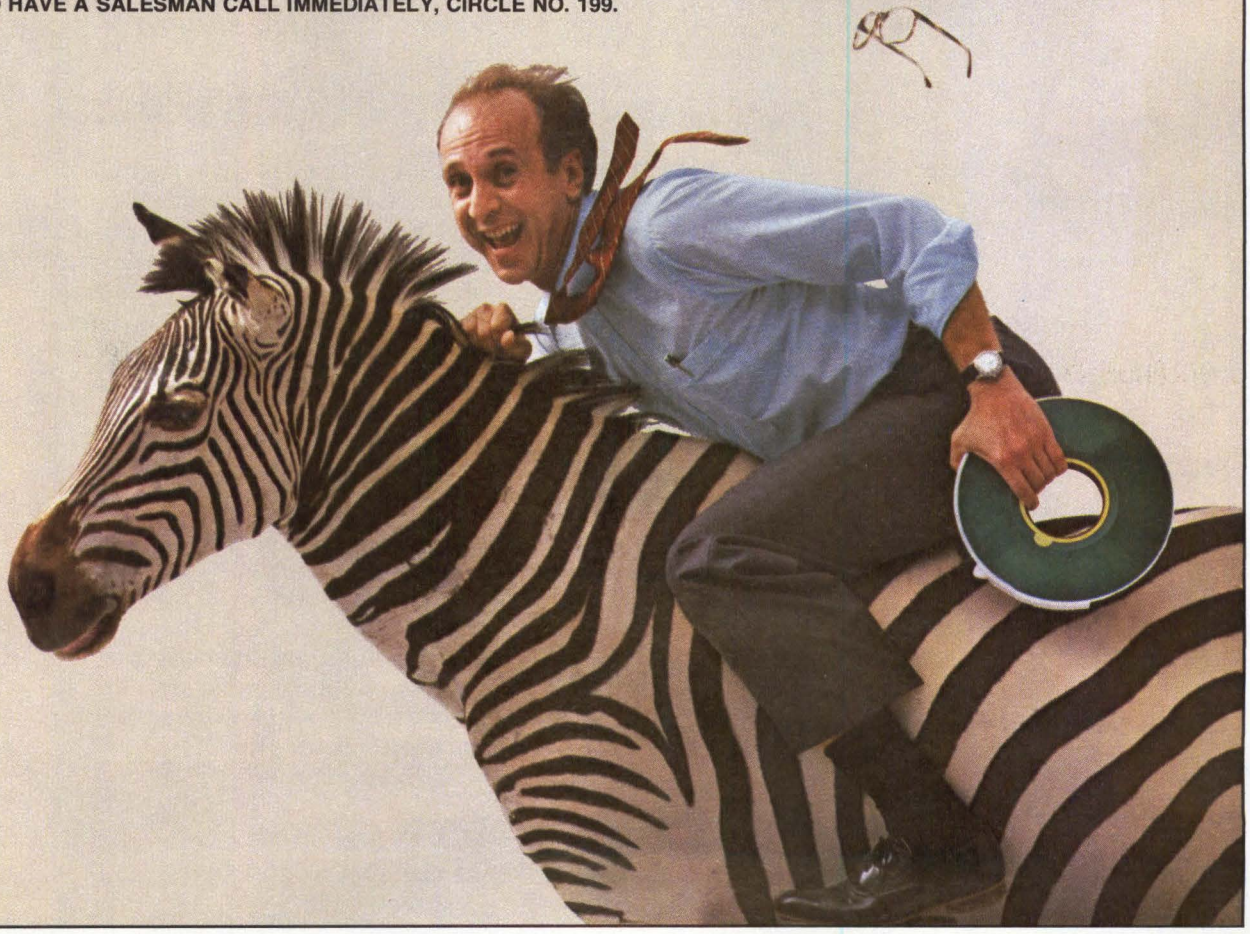

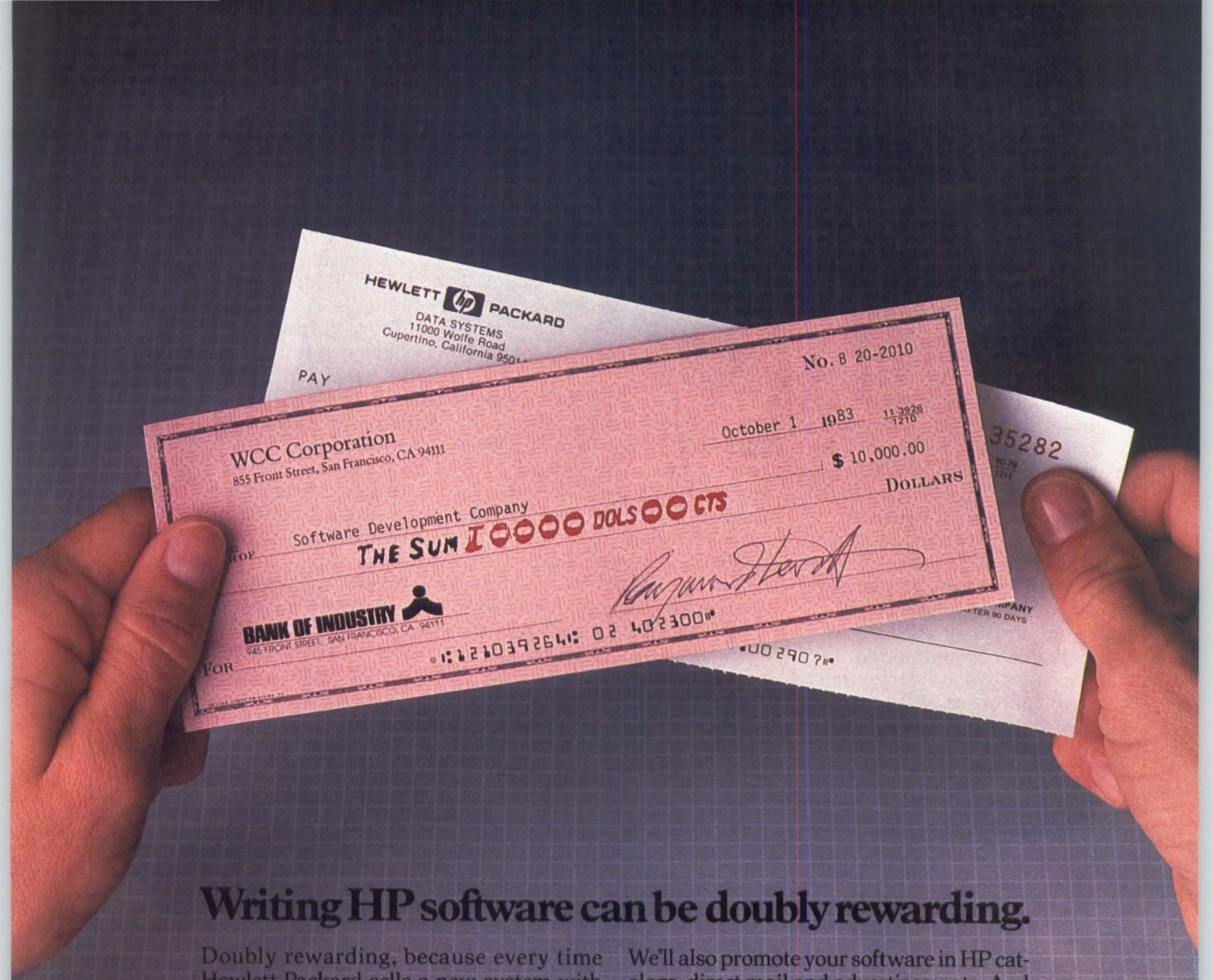

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program and data memories. An instruction's execution cycle overlaps the fetch cycle of the next instruction in a pipelined manner. A modified Harvard architecture in the TMS320 DSP chip (Fig. 1) allows crossovers between program and data memories to provide program branches based on data values from instructions and data values from constants in program segments. Therefore, even though the hardware is divided into two basic segments for handling data and program information separately, the segments are bridged in operation (Fig. 2).

Linear predictive coding (LPC) voice-synthesis processors reproduce human speech using a single-stage digital filter to execute 200,000 multiplications per second.

While many general-purpose microprocessors devote minimal space to the arithmetic-logic unit (ALU), in DSP, ALUs occupy almost a third of the chip's space. Memory is the other major consumer of chip area (Fig. 3). In the TMS320, for example, four basic arithmetic units—the multiplier, the barrel shifter (a shift register that can perform one to 15 shifts in one quarter-cycle), the ALU and the accumulator—occupy 30 percent of the silicon. The multiplier computes the product of two 16-bit inputs in one 200-nsec. cycle. Likewise, the barrel shifter can shift an operand from one to 15 positions on its way to the ALU, producing a shift and add in a single cycle.

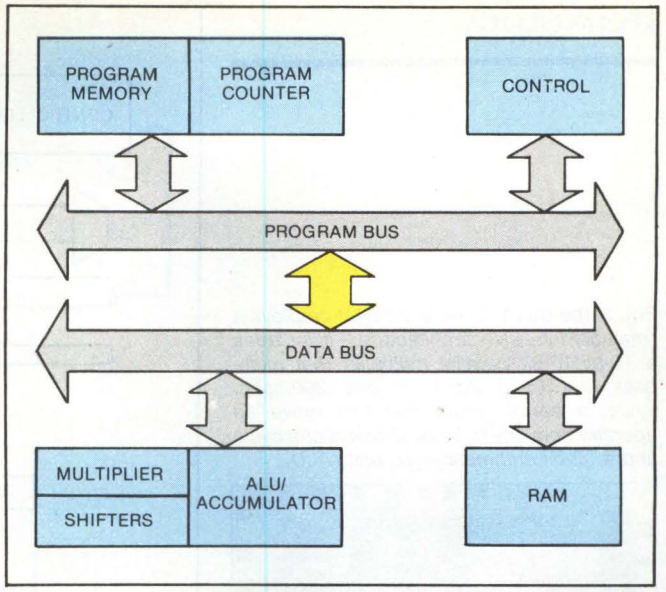


Fig. 1. The TMS320 digital signal-processing (DSP) chip *is based on a modified Harvard architecture that supports separate program and data memory spaces for parallel processing, eliminating the need for a separate ROM. This "bridge" permits crossovers between program and data memories.*

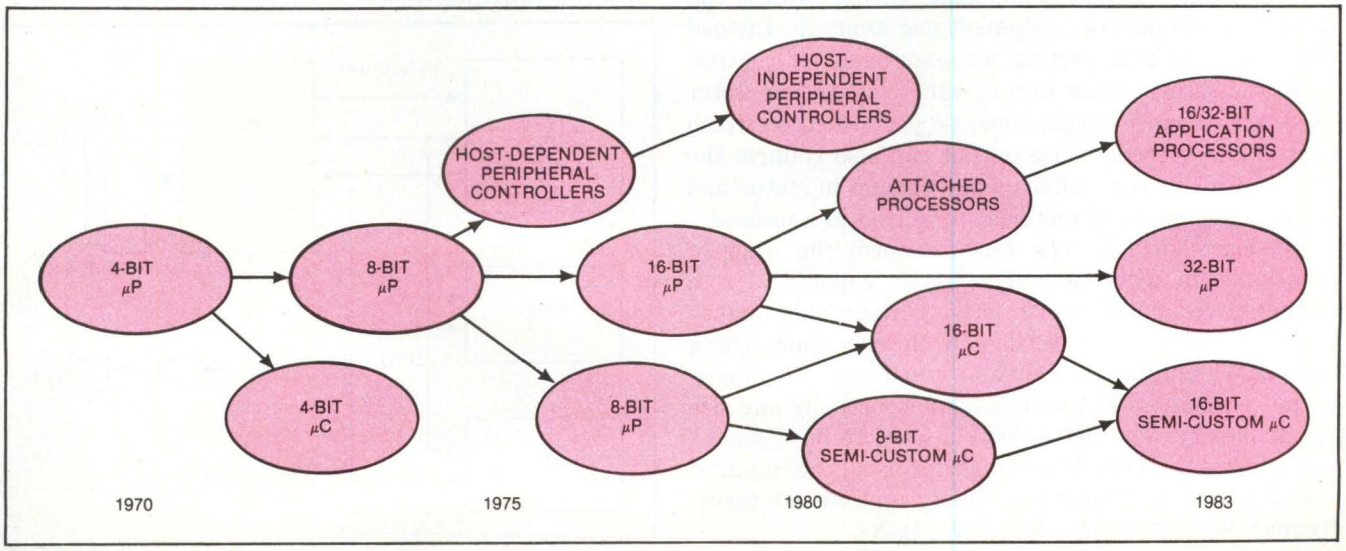
On-chip memory size plays a major role in many signal-processing applications. For example, the 3K bytes of program memory in the TMS320 also hold the linear predictive coding (LPC) algorithm for speech analysis. The 288-byte data memory allows the computation of a 64 complex-point Fast Fourier Transform (FFT) by using 256 bytes for data, leaving 32 bytes for linkage variables and temporary data storage.

The trend in DSPs is toward more parallelism, increased pipelining and lower execution times (less than 100 nsec.) The next generation of chips will accommodate more memory and more versatile system interfaces.

Voice-synthesis processors

Voice-synthesis processors (VSPs) are subsets of DSP

Evolution of microprocessors and microcontrollers. *The 4-bit microprocessors, which were invented by Texas Instruments Inc. in 1970, have evolved into full 32-bit microprocessors in less than 15 years.*



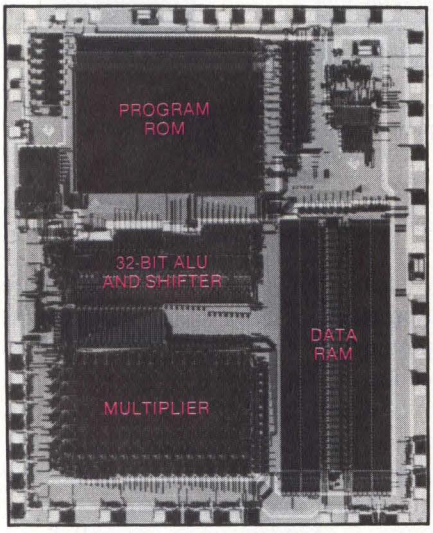


Fig. 3. (below) The TMS320 DSP *employs a "memory-intensive architecture." It includes a 16-by-16-bit parallel multiplier that multiplies two 16-bit inputs in one 200-nsec. cycle, a barrel shifter that can move an operand from one to 15 positions in one cycle and a 32-bit arithmetic-logic unit (ALU).*

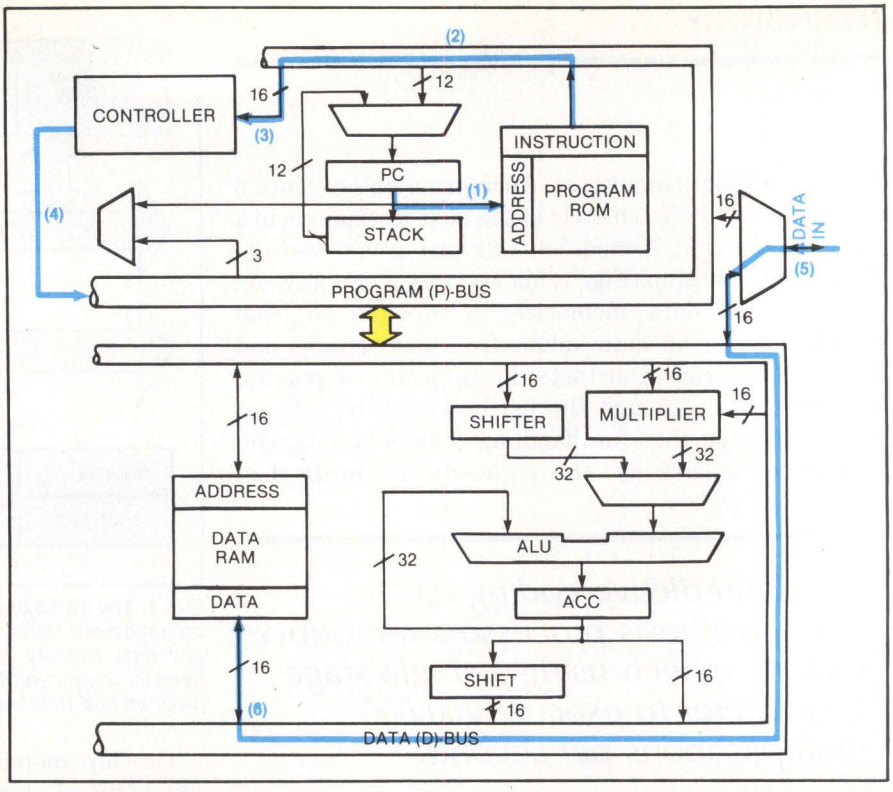


Fig. 2. (above) Information flow *in the TMS320 DSP chip occurs in six stages. (1) The updated program counter sends the address of the next instruction to the program ROM, in which the address invokes the next programmed instruction. If, for example, an INPUT instruction is activated, the ROM puts the appropriate code on the program bus (2) and sends it to the controller (3). The controller issues the timing and control signals that ensure that all processes run in sync. After decoding the IN instruction, the controller switches on the data bus (5), allowing input data into the system. The bus transmits the data to the data RAM (6), which stores it in the location addressed by the IN instruction. Digital signal-processing operation on the new data can now begin.*

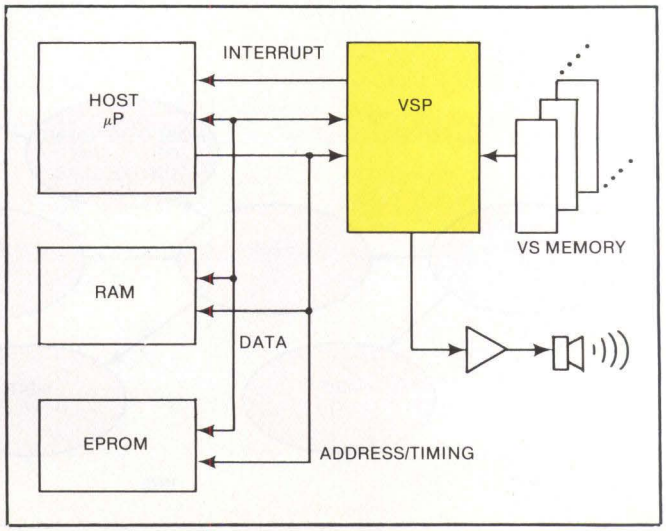
chips and form the basis of artificial-speech-output systems (Fig. 4). VSPs made their market entry through consumer products in the late 1970s. Voice output will continue to be in demand, due to new low-cost methods of generating vocabularies for commercial and industrial applications.

Voice output offers a more natural man/machine interface. In "eyes-busy" or dark environments, it can replace terminals for conveying computer-generated information. In industrial applications, voice output can be an integral part of equipment maintenance. Instead of an operator's inspecting an assortment of control-panel indicators, voice output can "tell" the operator what maintenance details must be performed on which part of the system. Voice output can also confirm the status of processes, acknowledge change in status and report the amount of materials required in a process.

VSP chips such as TI's TMS5220 form the basis of speech-output systems and range in capability from unlimited vocabularies of relatively acceptable quality to limited numbers of words and phrases approaching the quality and intelligibility of human speech. Voice-output processors fit into systems of virtually any size or complexity. The CPU selects a word to be "spoken" and informs the VSP. The VSP performs all the required data-fetching, computation, timing and output tasks, freeing the host CPU to do its own tasks.

The cost and reliability breakthroughs that have made voice output viable are directly related to (LPC) techniques. LPC reduces the data required to represent human speech by a factor of 100 and reduces speech bandwidth from 100,000 bits per second (bps) to 2,400

Fig. 4. Speech-output systems *are based on voice-synthesis processors (VSPs). The VSP produces speech output by operating on stored system vocabulary data. The host tells the VSP what words to produce, and speech output handles all data fetching, computation, timing and output tasks.*



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bps. This dramatic data compression means that system designers can use low-cost, reliable ROM to store vocabularies.

LPC techniques use linear equations to formulate a mathematical model of the human vocal tract. The model, implemented as a filter network, predicts the character of an upcoming speech sample based on previous samples. Model parameters such as filter coefficients and the source excitation frequency are calculated from analysis of human speech and are stored in memory. These coefficients control the "shape" of an electronically-simulated vocal tract.

LPC voice-synthesis processors reproduce human speech using a single-stage digital filter to execute 200,000 multiplications per second. Before development of TI's VSP chip, most vocal-tract models used a conventional 10-stage lattice filter requiring a mainframe to perform the computations.

The key to future voice-processor development is flexibility. Voice-synthesis processors will handle allophone synthesis and text-to-speech algorithms better than do today's fixed-speech vocabularies. And, with DSP technology, they will handle analysis (speech encoding), synthesis (speech reproduction) and speech recognition in real time.

Video display processors

High-end computer graphics systems, personal computers, home computers and video games incorporate VDPs. In home computer systems, a host CPU generates signals to direct the VDP, or graphics controller (Fig. 5). These CPU-issued commands manipulate graphics information stored in a memory lookup table. The resulting VDP output is a composite video signal that drives a standard TV set or monitor.

Until recently, the stumbling blocks facing graphics system designers were overburdened microprocessors that couldn't take on computing-intensive video-graphics chores and expensive RAM that wasn't suitable for graphics. Inexpensive VDPs and cost-effective memory chips have overcome these impediments. One of the new VDPs is the TI TMS9118/28/29 family (Fig. 6), aimed at video applications in which data and simple images are displayed on a color TV set or CRT monitor. The processors provide 16 colors and 256-by-192-pixel resolution.

A system designer can construct a three-chip video-graphics microsystem with one TMS 9118 chip and two TMS4416 16K by 4-bit dynamic RAMs. A designer can plug this video microsystem into virtually any microprocessor-based system using a standard interface and special application software. The VDP generates all required video, control and synchronization signals required by a TV display or CRT monitor; stores,

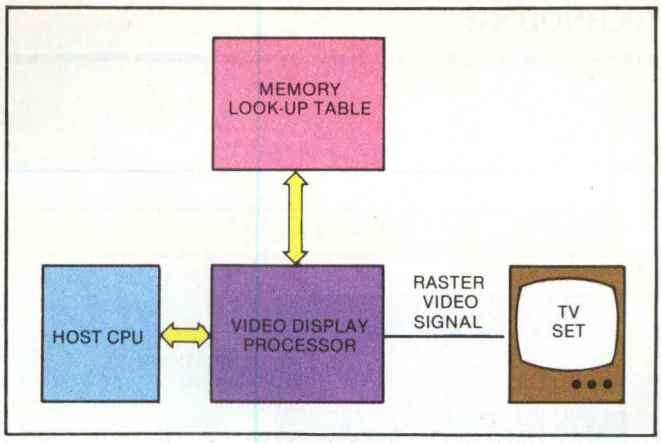


Fig. 5. Home-computer and video-game graphics systems *include a video display processor (VDP). The host CPU relays signals to the VDP, or graphics controller, which manipulates graphics data stored in a memory lookup table. The output is a composite video signal that drives the TV set or monitor.*

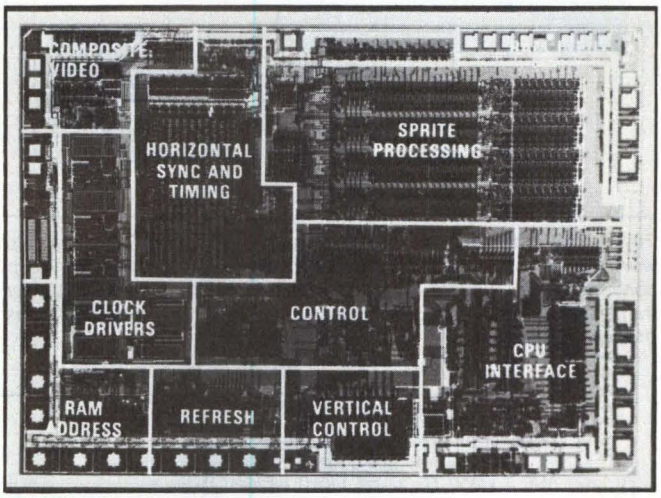


Fig. 6. TMS 9918 video display processor. *The composite video section combines color data and sync signals to produce an analog voltage that drives the monitor. Four-phase, non-overlapping clocks drive the dynamic control logic. The vertical control section includes a counter and a decoder to keep track of the generated vertical lines. Sprites, or bit-definable characters, are converted into pattern information by the sprite-processing section, which contains logic and shift registers to convert sprites into pattern information. The CPU interface causes internal VDP registers and external dynamic RAM to appear as static RAM to the host processor.*

retrieves and refreshes display data stored in system RAM; and eliminates code usually required for screen control and RAM refresh. It also manages all video memory functions, eliminating the need for a dynamic RAM controller.

In the future, another class of dense memory chips—multiport memories—will provide high-bandwidth operation for display systems requiring higher data throughput. A new generation of graphics processors will evolve to take advantage of the memory-bandwidth increase for business graphics and realistic animation.

Modem processors

Modems have evolved into low-cost application processors that work in conjunction with a host CPU (Fig. 7). Like their board and box counterparts, modems-on-

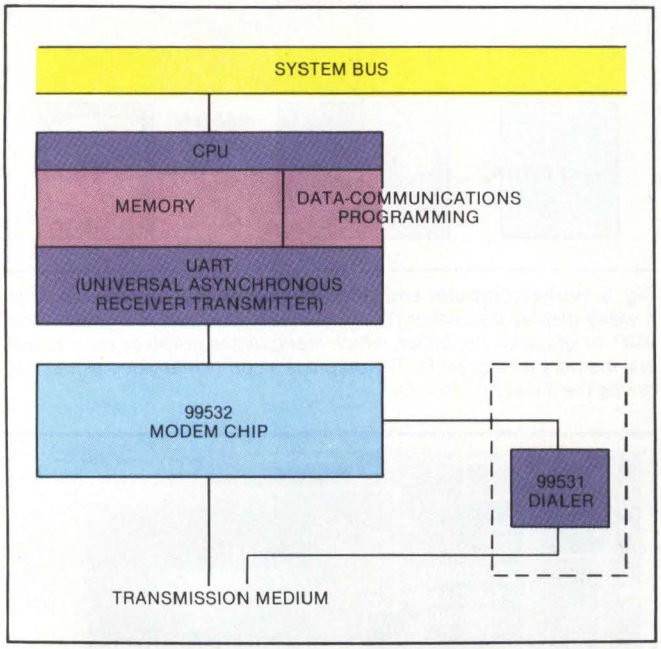


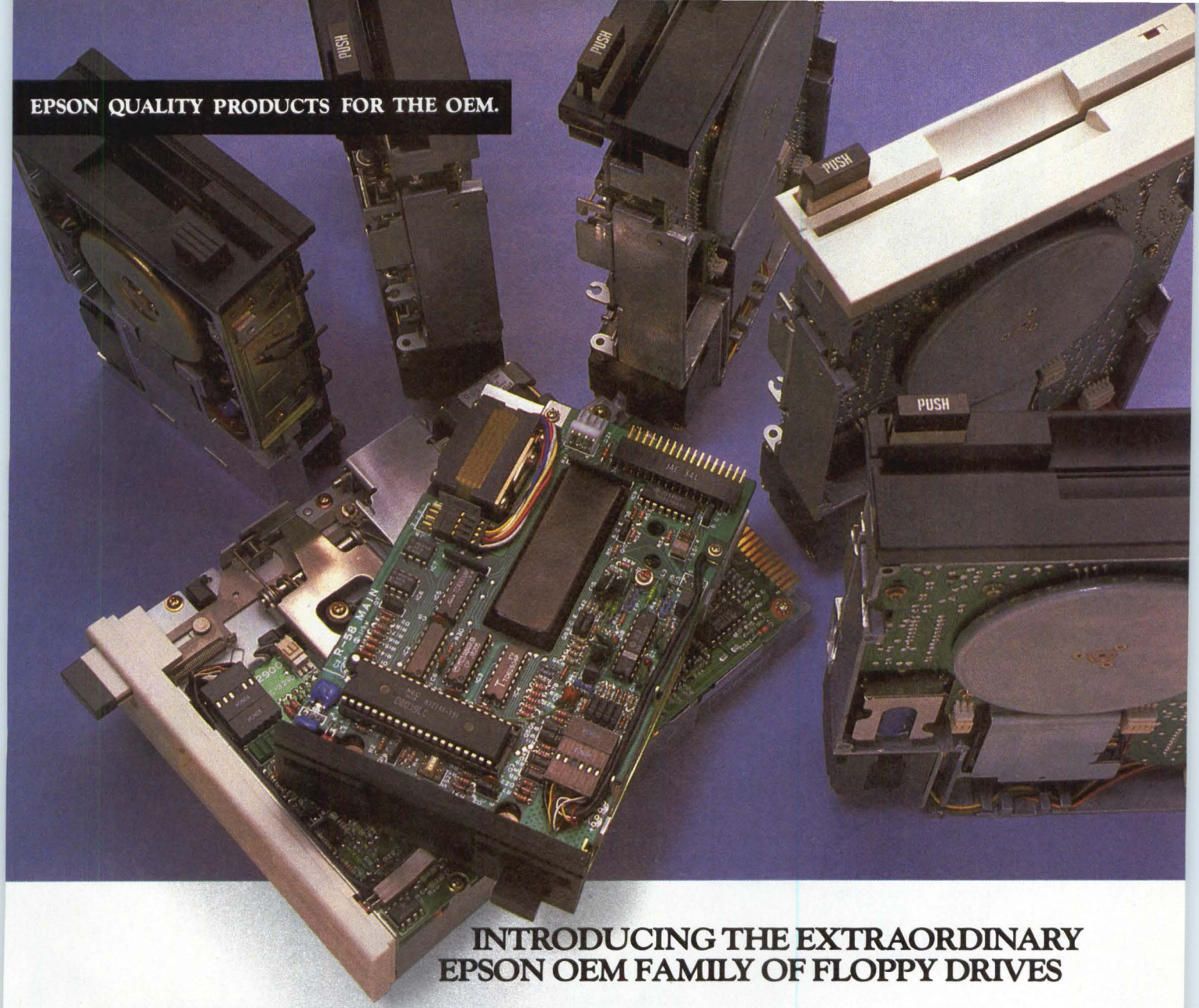
Fig. 7. The TMS99532 modem chip *and optional 99531 dialer chip work in conjunction with the host CPU. Like any modem, the chip converts digital signals at the sending end into analog signals for transmission over standard telephone lines and reverses this process at the receiving end.*

a-chip can be synchronous or asynchronous and can use several methods for modulating an analog carrier, including frequency-shift keying (FSK), phase-shift keying (PSK), amplitude modulation (AM) and various combinations of those methods. An FSK modem encodes information using separate frequencies to represent the "zero" or "one" state. For example, in a 300-baud, full-duplex modem set, the originating modem uses 1.07 and 1.27 KHz for one and zero, respectively, and the answering modem uses 2.025 and 2.225 KHz. A PSK modem encodes information relative to the phase relationship between two successive signals. AM modems encode information based on the voltage levels of the signals.

Low-speed modems that operate at 300 bps, such as TI's TMS99532 are usually asynchronous FSK devices. These modems are typically used with interactive terminals, desktop computers, point-of-sale terminals and credit-verification systems, connected to phone lines by acoustic couplers.

Single-chip modems in development will handle transmission speeds of 1,200 to 2,400 bps. For higher speeds, DSP chips are more effective. Future modems will incorporate combinations of chip sets to handle all standard transmission speeds. □

Kevin McDonough is design manager of programmable products at Texas Instruments Inc., Houston.



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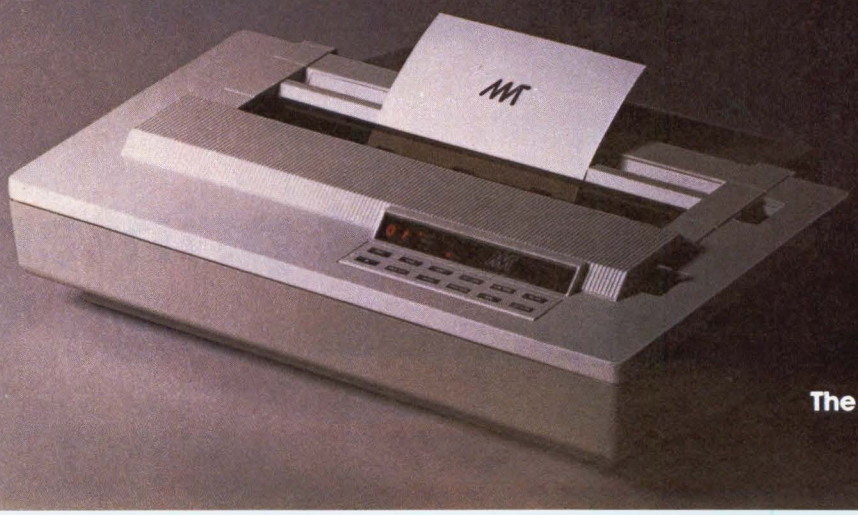

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ARMOND INSELBERG,
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Database-management systems

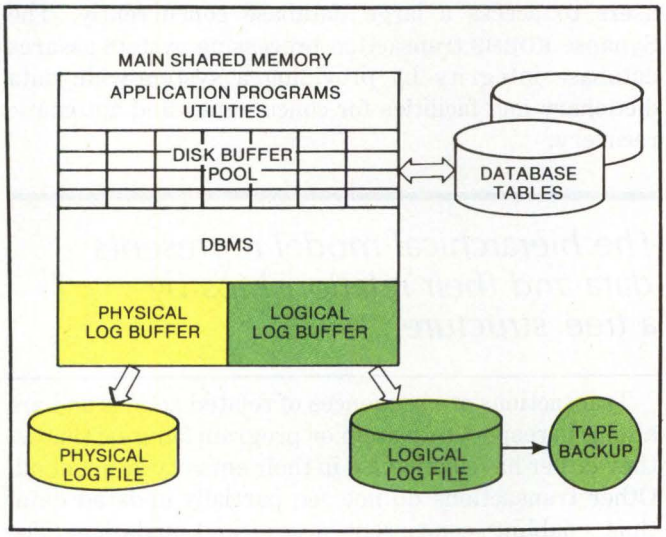


Fig. 1. The Synapse database-recovery system *uses a physical log file and a logical log file to ensure that all committed database changes are retained and all uncommitted changes are removed after a system failure. The logical log file records high-level changes, such as adding a row to a table, deleting a row or modifying a column value. The physical log file retains the "before" image of the database. To recover from a system failure, the DBMS uses the physical log file to return the database to the last global consistency point and uses the logical file to enter changes that completed after the global consistency point was recorded.*

Many corporations now realize the need for a full-scale database-management system (DBMS) that controls data flow. DBMS vendors are meeting the need for on-line transaction processing with DBMSs that have concurrency controls, automatic-recovery capabilities and central data dictionaries. Vendors are developing query languages and system interfaces to augment these systems. Another area of investigation is database machines, several of which are commercially available. In conjunction with increased DBMS sophistication, a variety of new applications, such as videotex, is becoming feasible.

Database models

A database model defines the underlying nature of a DBMS. The model determines factors such as the type of relationships in a database, methods of developing applications, the amount of storage required to store data elements and the performance level of the system. There are three prevailing database models: hierarchical, network and relational.

Although the hierarchical model of databases is the oldest, it still appears in systems such as IBM Corp.'s IMS. The hierarchical model represents the data and their relationships by a simple tree structure. A parent record type can have any number of subordinate record types, but a record type can be a subordinate to only one parent. If a user deletes a parent record from the database, all dependent records are also removed. The hierarchical model is limited in that it cannot easily represent data elements that are not hierarchically related in the real world. A second difficulty is that the model requires an application programmer to specify the data-retrieval path.

Database machines, sophisticated management systems open new applications

The Conference for Data Systems Language (CODASYL) Data Base Task Group introduced the network model in 1971. Network databases can accommodate more complex data structures than can the hierarchical model. Systems based on the network model include Intel Corp.'s System 2000. Cincom Systems Inc.'s TOTAL, Software AG's ADABAS and Cullinet Software's IDMS. A record type in the network model can have multiple parent record types. Pointers that reside in the records define relationships between record instances, enabling the system to insert and delete records easily since only the appropriate pointers need be modified. But, as in the case of the hierarchical model, a programmer must write the code to traverse various pointer chains to obtain the data.

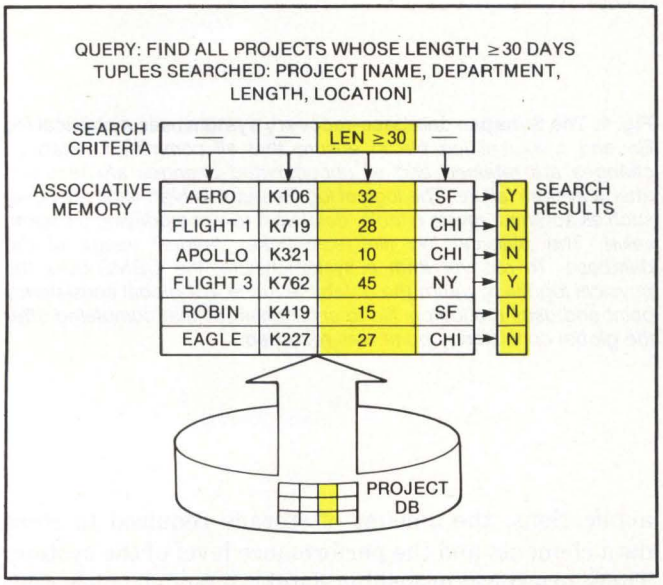


Fig. 2. Relational-model database using associative memory. *Relational models store data in tables. The column heads (NAME, DEPARTMENT, LENGTH and LOCATION) are called attributes, and the entries are called tuples. Associative memory uses non-indexed, parallel data searches and addresses data by content rather than by address.*

The relational model was introduced in 1970 but did not become commercially available until the past few years. Many relational systems now exist, including IBM's SQL/DS, Oracle Corp.'s Oracle, Relational Technology Inc.'s Ingres, Synapse Computer Corp.'s relational database management system (RDBMS) and Tandem Computers Inc.'s Encompass.

The relational model has tabular data representations. Each row of the relational table is equivalent to a record instance in a hierarchical file system. The most significant advantage of the relational model is that a programmer need reference required data only in terms of the tables because the information is represented by value instead of by location. This contrasts with hierarchical- and network-based systems that use physical connections to represent relationships.

Another benefit of the relational model is that an operator can perform various table operations that have been defined in a formal relational theory. This assures that the operations are consistent. Equally important, the results of all relational operations on tables produce subsequent tables. Because of these characteristics, virtually all planned distributed-database systems are based on the relational model.

Transaction-processing databases

An on-line transaction-processing system enables users to access a large database concurrently. The Synapse RDBMS transaction-processing system assures database integrity by providing a system-wide data dictionary and facilities for concurrency and automatic recovery.

The hierarchical model represents data and their relationships by a tree structure.

Transactions are sequences of related actions and are atomic in respect to system or program failures; that is, they either have happened in their entirety or not at all. Other transactions do not see partially-updated data, thus enabling concurrent access and updating. The completion of a transaction occurs when either a commit or a rollback command is issued. The commit message indicates that a transaction is completed, and the rollback message signifies that the transaction cannot be completed.

Database locks in transaction-processing systems ensure system integrity. The database administrator determines the locking levels when the table is defined. RDBMS detects deadlocks between transactions and rolls back the transaction that it determines to be least affected by the rollback. A deadlock occurs when each of two transactions, or all of a set of transactions, is waiting to lock an entry currently locked by the other transaction(s).

Database recovery following a system failure is essential to maintain database integrity. Most systems have more than 10 percent of the database software dedicated to recovery. Recovery capability ensures that if a system fails none of the committed database transactions are lost and that all incompleted transactions are returned to a point at which they can be reinitiated. For recovery to occur immediately, it must happen automatically, with no human intervention required.

When a system is recovered, the DBMS returns the database to a previously known system global consistency point. This is a complex process because some

transactions would have completed before system failure but after the consistency point was established. Meanwhile, other transactions were in progress at the time of system failure, though they may have begun before or after the last global consistency point.

RDBMS uses logical and physical log files in which the system enters all changes to ensure full recovery (Fig 1). The logical log file receives changes made at a high logical level, such as adding a new row to a table, deleting a row or modifying a column value in a row. The physical log file holds the "before" images (the last global consistency point) of the changed physical pages. During recovery, the system uses the pages in the physical log file to re-establish the database to the last global consistency point. RDBMS uses the logical log file to enter changes that completed after the consistency point and to remove the effects of uncompleted transactions. The RDBMS then restarts partially-completed transactions.

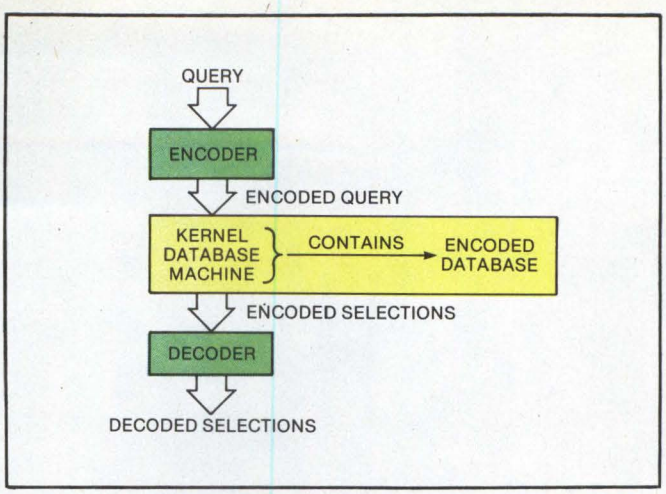


Fig. 3. Hokkaido University's data-stream database machine *incorporates an encoder, a decoder and a "kernel" database machine. The encoder converts a query's variable-length data to a fixed-length codes. The kernel database machine processes the encoded query against its encoded database.*

In associative-memory databases, the DBMS addresses data by content rather than by addresses.

A system-wide dictionary increases RDBMS performance, facilitates application development and ensures database integrity. The Synapse Application Dictionary provides central definition and cross-reference relationships of the data types, forms and programs. The compiler inserts the defined data types obtained from the dictionary into the source code at compilation time. The dictionary also facilitates automatic data validation.

Relational DBMSs typically deliver relatively low performance primarily because most such systems interpretively process each transaction after it is entered. To avoid this drawback, the Synapse RDBMS performs a binding step before a transaction's run time. Binding determines the optimal access path selection once, using this information for subsequent data accesses. Also during execution, the RDBMS evaluates the transaction's selection criteria, returning to the program only rows satisfying the criteria. This is 10 to 100 times faster than returning a row to an application program to be tested for selection.

Other important aspects of a transaction-oriented DBMS are integration of, and data-transfer rates between, different sections of system software. A "cross-sphere" call in the Synapse system transfers control between an application and the operating system in 100 μsec. Other systems, which require an inter-process call to transfer control, can require 8 to 12 msec. Integration also means that the RDBMS and the various support tools, such as the dictionary, forms editor, user profile editor and database administrator's tools are consistent in functionality and appearance, offering the programmer and end user a unified system view.

Database interfaces and languages

Application-programmer and end-user interfaces are becoming increasingly important. Programming-language extensions constitute the application programmer's primary interface. The extensions enable the programmer to read and write database records easily. End-user interfaces can consist of formatted screens in a transaction-processing environment, a query language for ad hoc inquiries or various graphics.

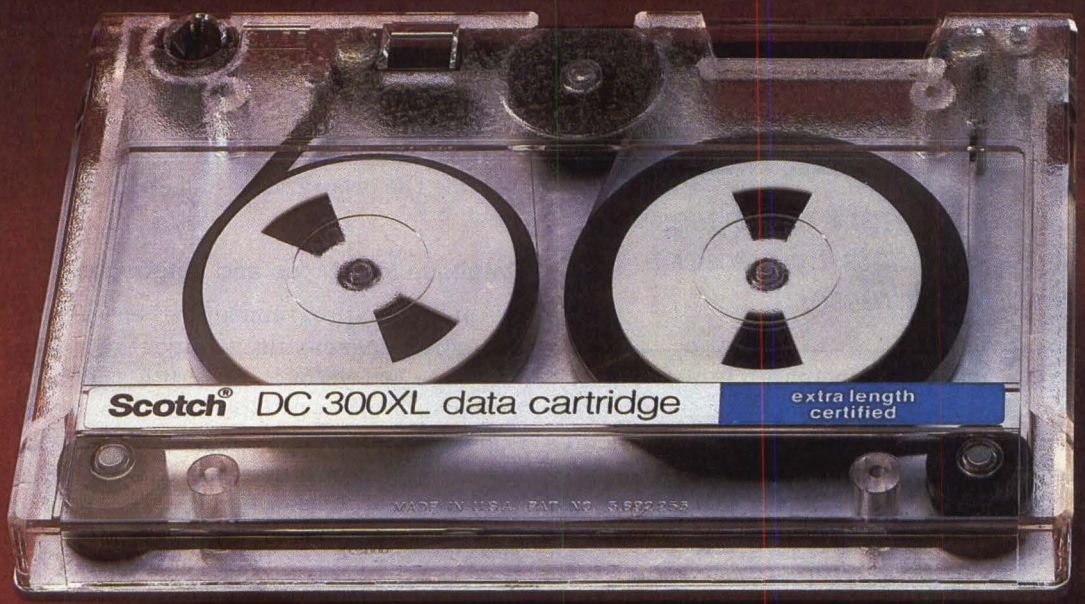
The programming-language extensions do not require a knowledge of the physical organization of the database and should be syntactically and semantically similar to file I/O statements. The scan statement is the key to the Synapse program interface. A typical example is:

```
SCAN Orders
    WHERE Date = D AND
    Price = $10,000.
    READ Orders.
```

The scan statement contains all selection criteria.

Query languages allow ad hoc investigations of database information. If a query is predictably repeated, it is probably cost-effective to define the query as a transaction. Query languages for relational databases are becoming the best known. One typical relational database language is SQL, which is designed to run on the IBM SQL/DS database system. SQL can run by itself as a user's query/update language, or a programmer can embed SQL commands in application programs. The language constructs are generally simple and of the form

```
SELECT <columns>
FROM <table name>
WHERE <selection criteria>
```



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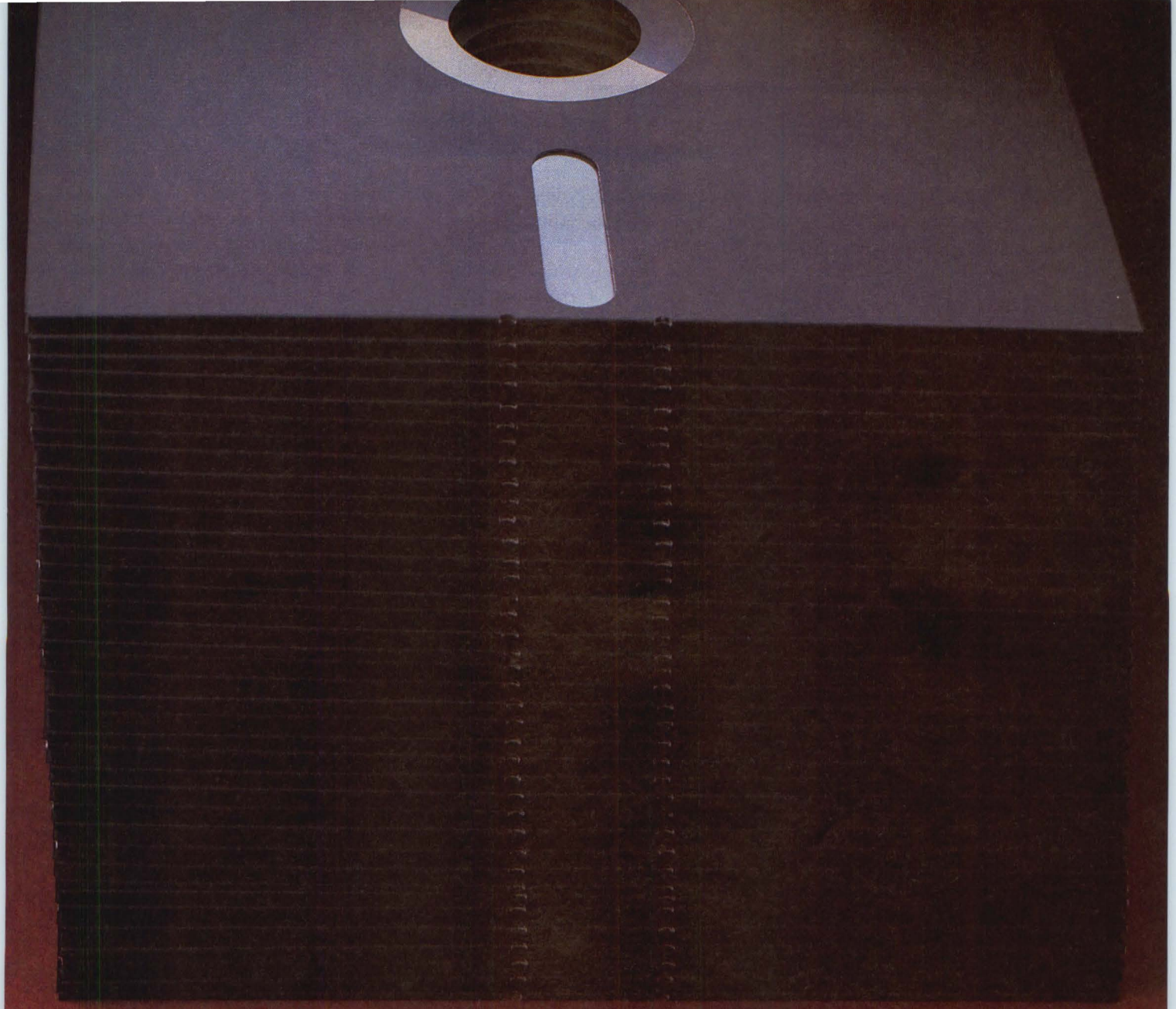

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Graphics packages are becoming a widely used form of data presentation. Graphics packages such as SAS Institute Inc.'s SAS/Graph require mainframe capability. Packages for microcomputers, however, are becoming more sophisticated. Lotus Development Corp.'s 1-2-3, Context Management Systems' MBA and Sorcim Corp.'s SuperCalc III, for example, combine spreadsheet analysis and graphics into one package.

Database machines

As database interest intensifies, database machines are receiving more attention. Although disagreement exists about what constitutes a database machine, it is generally defined as any piece of computing equipment dedicated to database activity. These machines are usually back-end processors that off-load selected database software activity from the host computer.

All commercially available database machines are based on the relational model. One of the first of these was Britton Lee Inc.'s IDM 500, introduced in 1980. The IDM 500 is a minicomputer with specialized operating-system software for database functions. The hardware includes a custom-designed emitter-coupled logic (ECL) processor (database accelerator) for doing database operations.

Other commercial database machines include Mega/-Net Distributed Machine from Digital American Computers Inc., IDBP from Intel Corp. and RDM 1100 from Amperif Corp. These systems require the host to parse and format user queries before passing them to the database machine. This enables multiple types of hosts to interface to the database machine, but it also forces some of the processing back to the host. Similarly, HDR Systems Inc.'s North query processor works in conjunction with the Britton-Lee IDM.

The most sophisticated dedicated database machines, such as Corem International's Synfobase, use associative memory techniques in conjunction with the relational model (Fig 2). The advantages of accessing data associatively have been recognized since the 1960s. Data is addressed by content rather than by address and can be searched in parallel. A system loads associative memory from a relational table stored on disk. Tuples, or entries, in the associative memory are then searched in parallel. The associative memory passes selected tuples to primary memory while receiving new tuples until the entire table has been examined.

System designers have not incorporated associative memories in commercial systems because of the high cost of the required hardware. Though memory has become significantly less expensive, it still does not appear cost-effective to use large associative memories. The Synfobase machine has 8K bytes of associative memory, which is sufficient for some applications but falls short in more sophisticated applications. Without enough associative memory, data searches require several disk transfers, which may be too time-consuming for complex applications.

Universities and research and development departments are devoting a large amount of research to database machines. NEC Corp. is developing the Information Query Computer (IQC) to off-load database functions from the host at the data-query level, similar to some commercial systems in the United States. The Naval Postgraduate School in Monterey, Calif., is investigating a multiple-back-end approach, in which a number of back-end machines use replicated software and parallel searching to improve performance over a single-back-end machine.

Hokkaido University's data-stream database machine is comprised of an encoder, a decoder and a computer, which its developers call the "kernel" database machine. (Fig 3). The encoder converts variable-length data values to fixed-length codes. The encoded databases are stored in the kernel database machine, which is optimized to process fixed-length data. The kernel database machine retrieves the coded data based on selection criteria, and the decoder converts the results back into variable-length data. A pipelined architecture reduces some overhead of encoding during updates. The system is based on the relational model but will improve performance over traditional machines by inverting files of the encoded databases.

The Naval Postgraduate School's multiback-end database system (MDBS) uses minicomputers to perform parallel processing by grouping records of one type into a cluster and then distributing the cluster across multiple back-end machines (Fig. 4). When the MDBS receives a request for a group of records, it treats the query as a request for a cluster, which can be accessed and processed in parallel over the back ends. The controller broadcasts each request received from the host computer to all back ends at once, enabling them to process the request in parallel. Each processor has a request queue, so that as soon as a back end finishes a request it can begin executing the next request in its

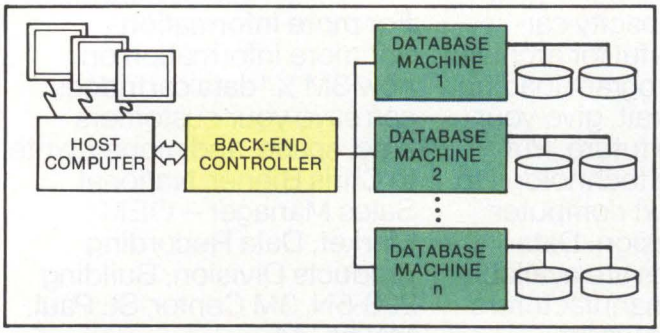

Fig. 4. Multiback-end database system. *The back-end controller groups records of a single type into a cluster and distributes the cluster over multiple back-end database machines. Each of the back ends executes the same software. The controller broadcasts each request to all of the back ends at once, enabling them to process the request in parallel.*

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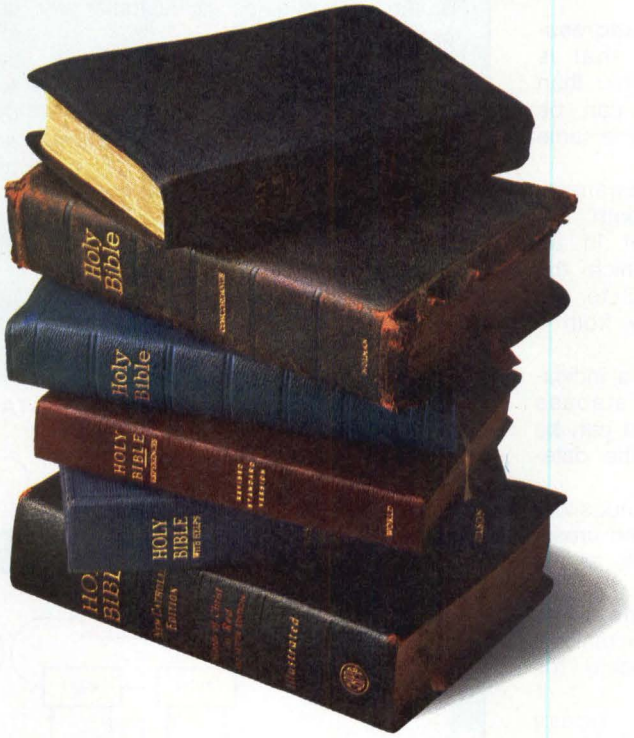

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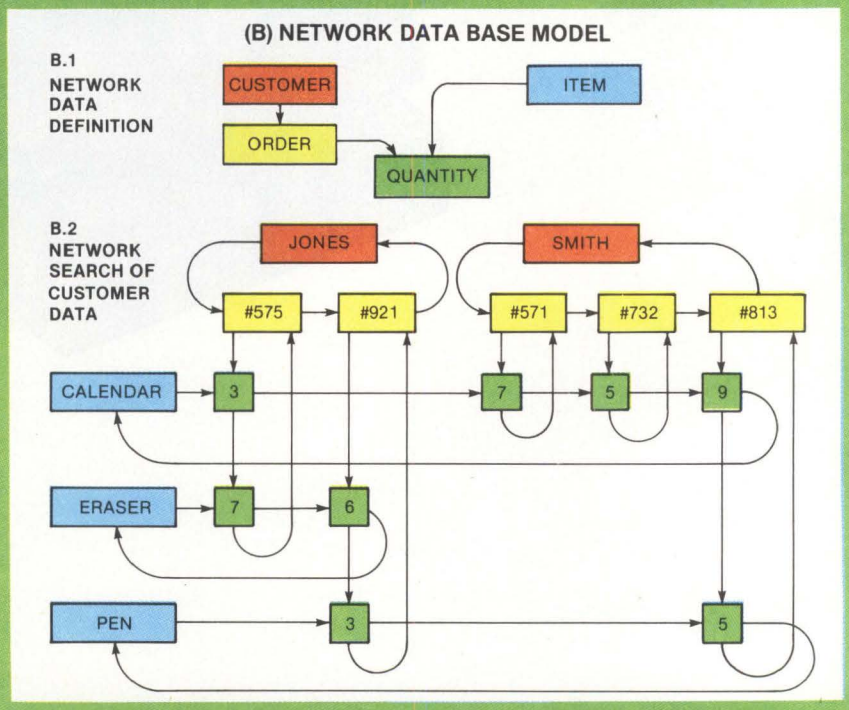
DATABASE MODELS

A data model defines the method by which a database-management system (DBMS) organizes and retrieves data. There are three basic categories of data models: hierarchical, network and relational. To compare the three models, consider an office supplier marketing manager who wishes to store in his database a list of his customers, a history of their orders and the quantity ordered for each line item. He will retrieve the information on the basis of a specific customer or product.

The hierarchical data model (Fig. A) allows the data and its relationships to obtain only tree structures (Fig. A.1). Each customer and item record is the root of an inverted tree in the database (Fig. A.2). If the item and order-quantity hierarchy is eliminated, removing the redundant data, any retrievals on the basis of a product item would be time-consuming, requiring a search of the entire database. However, the redundant data requires additional update time. The data records in a hierarchical data model are related through pointer fields contained in the records. A programmer must be aware of these physical realizations of the data relationships to retrieve the data. Thus, to retrieve all the information on "Jones," the programmer must traverse the indicated chains.

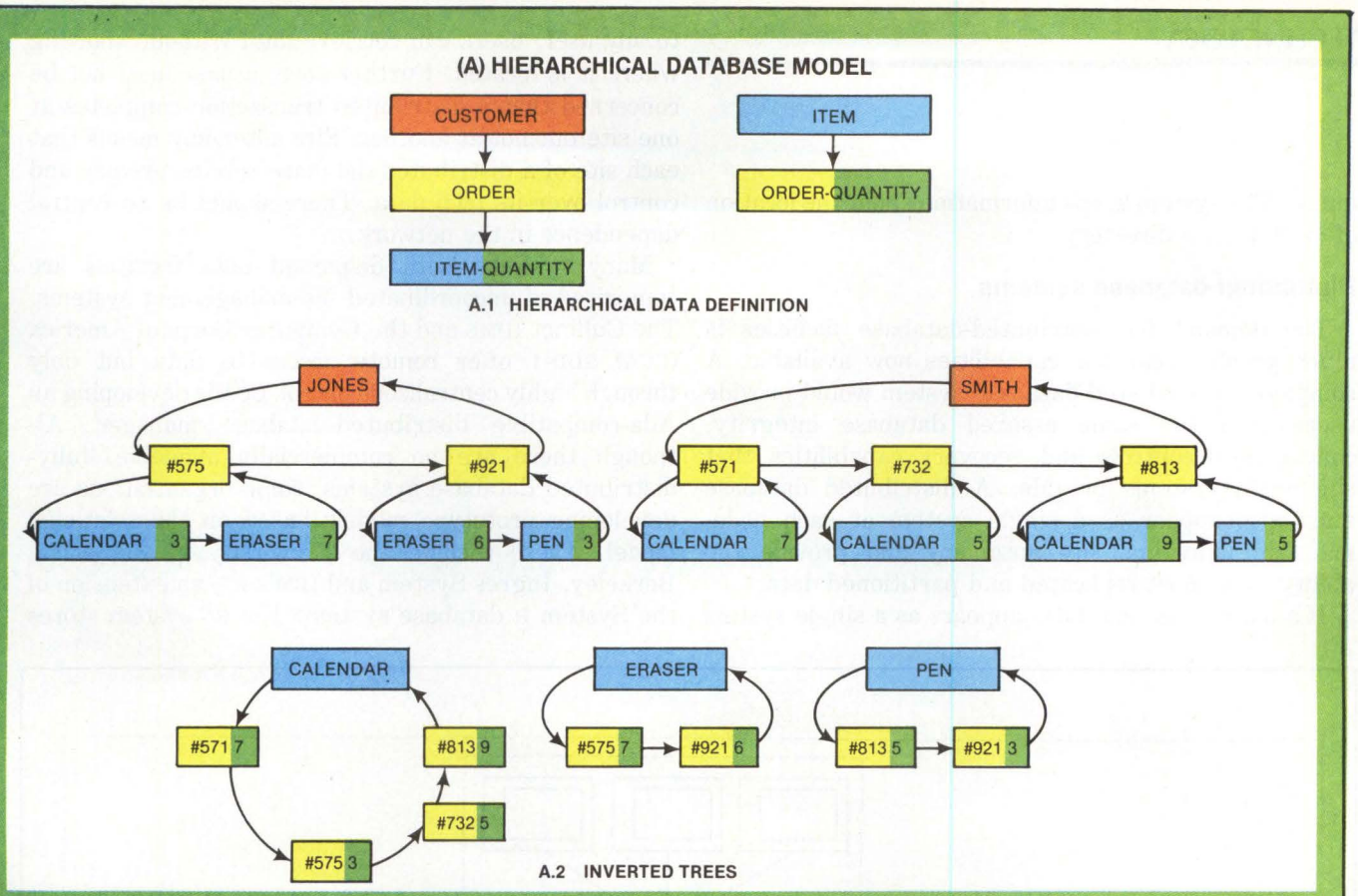
The network data model (Fig. B), allowing network data structures, enables the data definition in Fig. B.1 to be achieved. The redundant data in the hierarchical database has been eliminated by making the quantity records subordinate to both the order and item records. However, the programmer's traversal of the access paths still requires a knowledge of the pointer chains, now more complicated than for the hierarchical structure.

As shown in B.2, to obtain all the information on the "Jones" customer, after traversing downward from the Jones record to the #575 order record



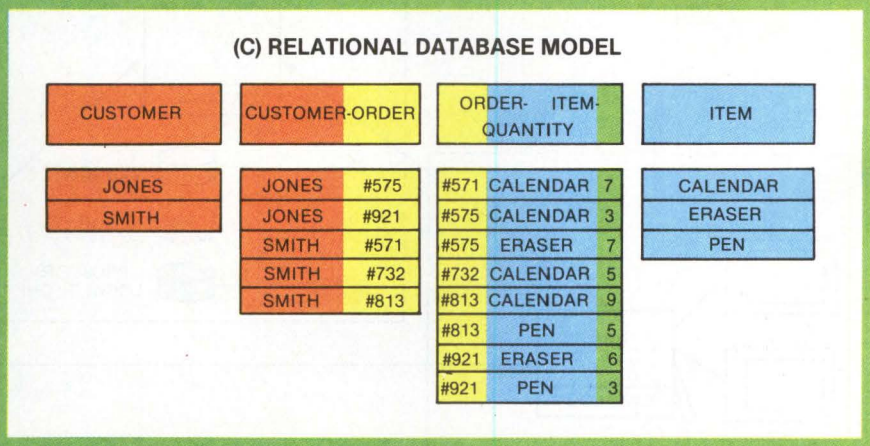
GLOSSARY

- **Ad hoc query:** a user database query that has not been pre-defined to the database-management system (DBMS)
- **Associative (content addressable) memory:** memory that is addressable by contents rather than by location; all locations can be examined simultaneously in the same cycle
- **Binding:** the linking of a transaction to its database access path
- **Checkpoint:** a point in an application program at which the DBMS automatically restarts the program following recovery from a system or program failure
- **Commit:** a transaction's indication that its pending database changes are completed and can be permanently entered into the database
- **Data dictionary:** a repository containing the definitions and cross-references of the attributes of the database elements
- **Database concurrency:** the ability of a system to allow multiple users to access and update the database simultaneously
- **Database lock:** an indicator applied to a database element, designating that the element is being processed by a transaction
- **Database-management system:** software for organizing and manipulating a collection of data accessed by many users or programs
- **Database model:** the method used by a DBMS to organize and retrieve data; the three prevailing models are hierarchical, network and relational
- **Database recovery:** the ability of a DBMS following a system failure to return the database to an accurate and consistent point
- **Deadlock:** two (or more) transactions that each require data elements to continue; the elements are locked by the other transaction
- **Global consistency point:** a point in the database history to which the DBMS can restore the database based on log files
- **Interpretive process:** a process in which each line of the transaction source code is translated to machine code every time the transaction is to be executed
- **Inverted file:** a file for which an index has been created
- **Log file:** an audit trail or journal of database changes used to perform database recovery
- **Parse:** a method to determine the syntactic structure of a language statement, whether it is a user query or program statement
- **Pipelining:** a mode of operation in which independent activities are overlapped; when one module has completed its function, the results are passed on to the next module "down the pipe," and the first module repeats its activity on new data
- **Pointer:** a record's field whose contents are the location on disk of another record



to the quantity 3 parent record, a traversal to the calendar item record must be made. The DBMS provides a "get parent" command to facilitate this request. The programmer completes the data retrieval by traversing the rest of the quantity records and their items for order #575. He then follows the order chain to the #921 order record to retrieve the remaining quantity and item information.

The relational data model (Fig. c) offers data representations in the format of a table, with each row of the table comparable to a database record. The table definitions are at the top of the figure, and their occurrences are shown below. This is a natural view of the data while retaining the ability to represent the complex structures of the network model. The relationships are now part of the tables. A request for all the information on "Jones" would be stated as a select-and-join operation over the tables. The results would be returned as a table. The relational DBMS would determine the best way to build the desired table, actually retrieving the data rows by means of indexes.



- **Rollback:** an indication to the DBMS that the transaction's pending changes will not be completed and so should not be permanently entered into the database
- **Row:** an entry in a relational table, similar to a record in a file, comprised of one or more columns, at least one of which must be defined as the primary key, and the primary key values must be unique
- **Site autonomy:** the ability of a node in a distributed network to retain privacy and control over its own database
- **Snapshot:** a materialization of a query, providing a static view of the resulting relation
- **Table:** a defined relation in a relational DBMS; comparable to a file, a table contains occurrences of data defined by a row
- **Transaction:** a sequence of database actions that either happen in their entirety or not at all; an application program is comprised of one or more transactions
- **Two-phase commit:** a protocol that guarantees that multiple nodes of a distributed database invoked by a transaction all commit or rollback the transaction in unison

queue. The system keeps information about the location of clusters in a directory.

Distributed-database systems

The demand for distributed-database facilities is much greater than the capabilities now available. A completely distributed-database system would provide users with the same assured database integrity, concurrency controls and recovery capabilities that single-site systems provide. A distributed database must also appear as a single system at each node, maintain individual site autonomy and provide the ability to support replicated and partitioned data.

If a distributed database appears as a single system to any user, users can retrieve data without knowing where it is located. Furthermore, a user need not be concerned that a distributed transaction completes at one site but not at another. Site autonomy means that each site of a distributed database retains privacy and control over its own data. There should be no central dependence in the network.

Many systems with dispersed data facilities are comprised of uncoordinated file-management systems. The Cullinet IDMS and the Computer Corp. of America (CCA) SDD-1 offer remote access to data but only through highly centralized control. CCA is developing an Ada-compatible distributed-database manager. Although there are no commercially available, fully-distributed database systems, some organizations are developing prototype models based on the relational model. These include the University of California, Berkeley, Ingres System and IBM's R*, an extension of the System R database system. The R* system stores

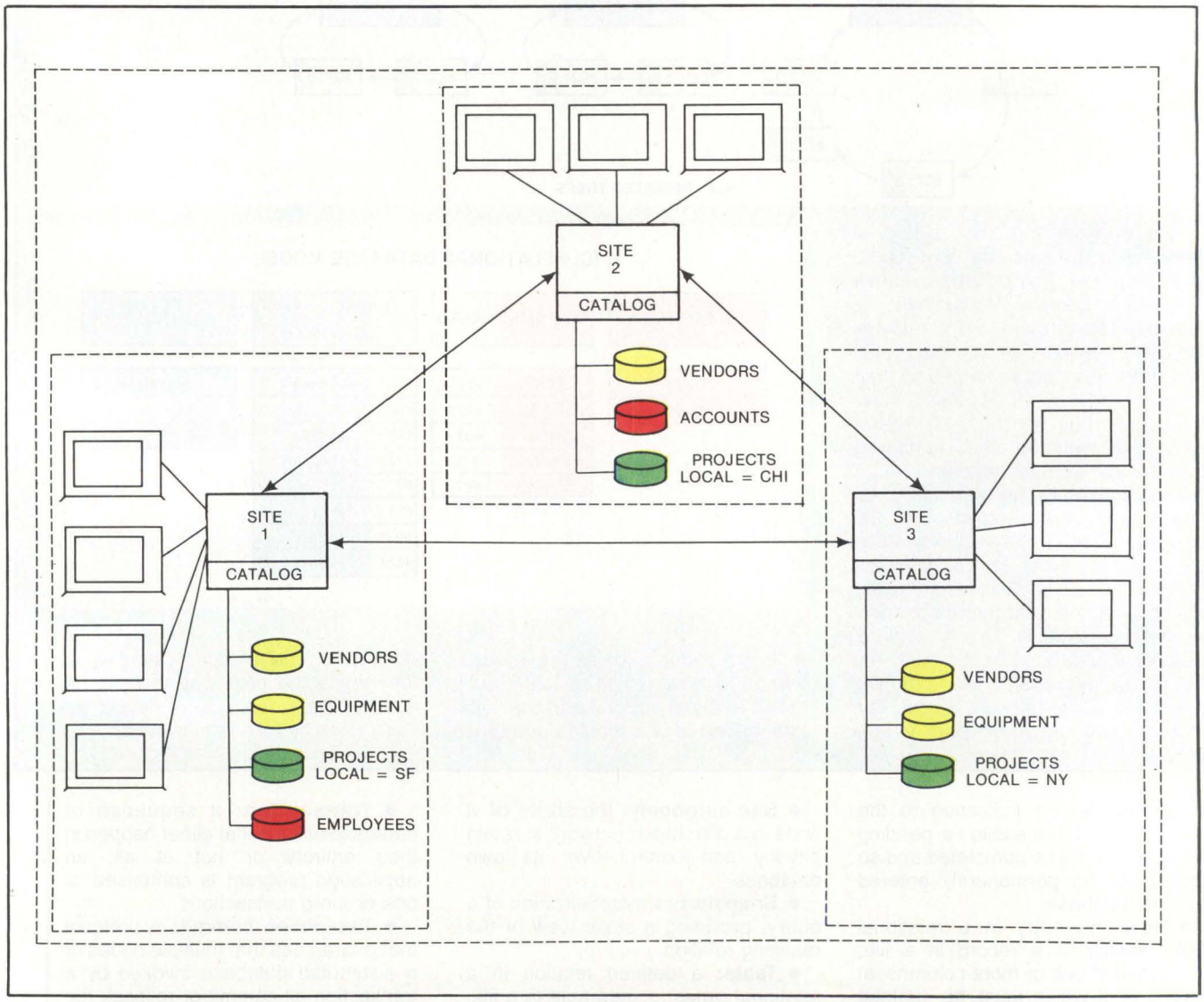


Fig. 5. A distributed-database system *should appear as a single system to a user at any site. Each site maintains autonomy by retaining privacy and control over its data. Relational tables ACCOUNTS and EMPLOYEES are dispersed data local to a single site. Tables VENDORS and EQUIPMENT are replicated data. Table PROJECT is a partitioned table; that is, it is logically one table, but parts of the table are stored at various sites.*

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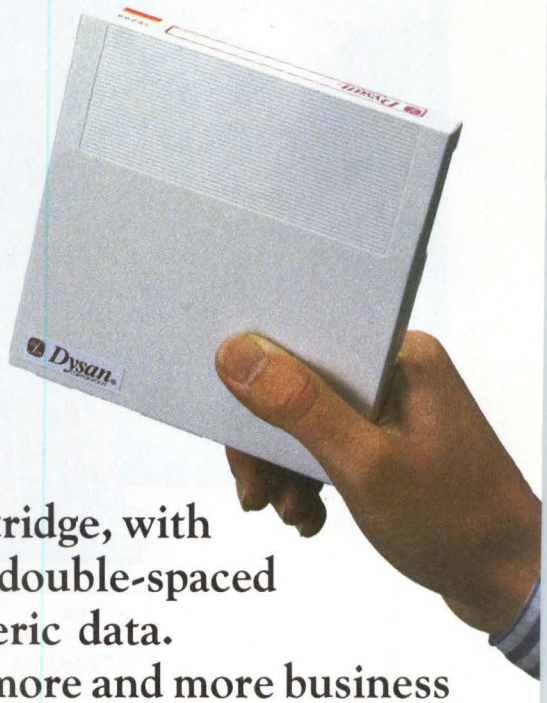

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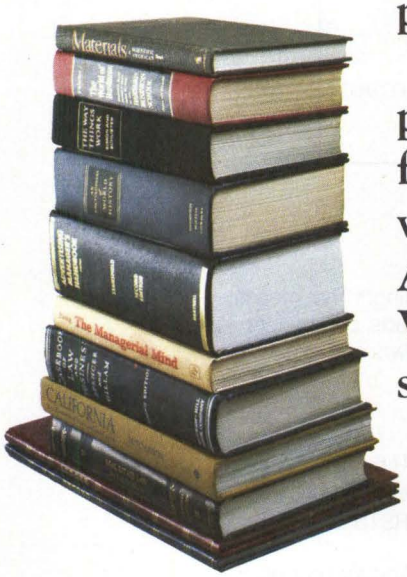

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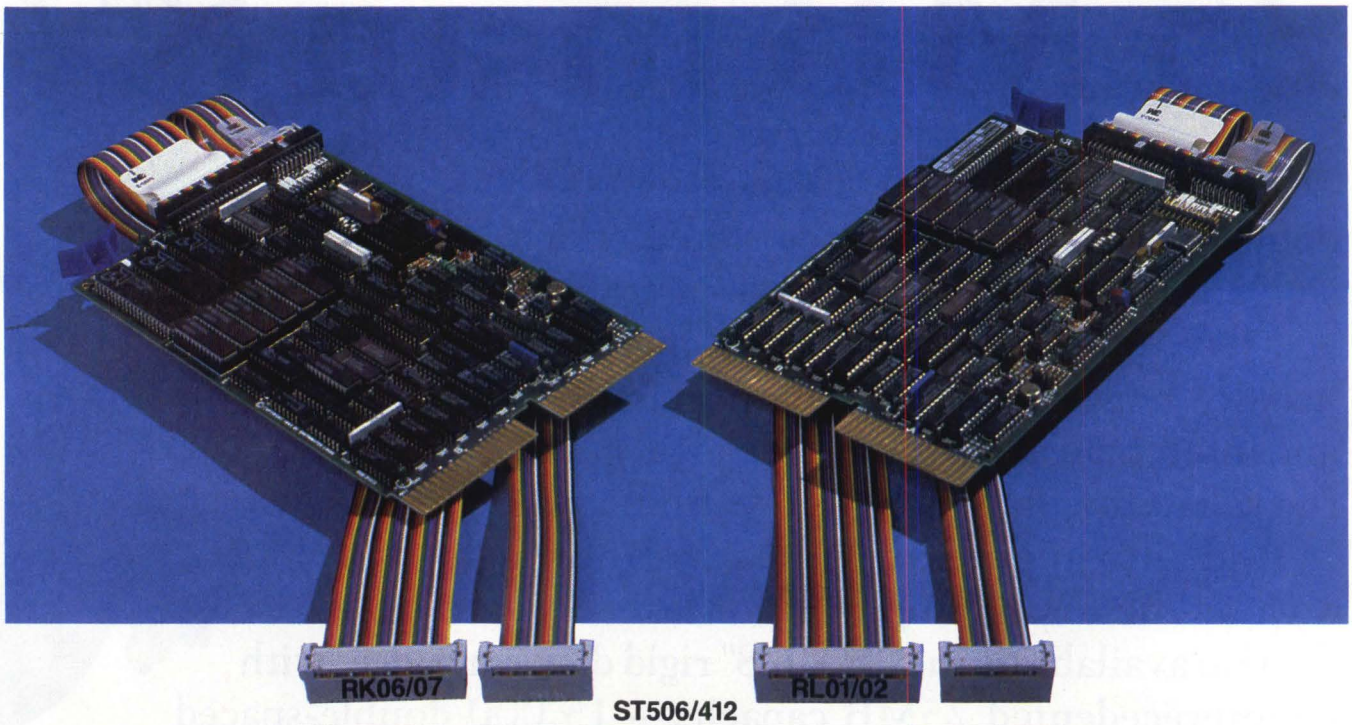

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data in relational tables that can be dispersed, replicated or partitioned. Partitioned data is logically one table, although parts of the table are stored at various sites (Fig. 5). Reassembly of partitioned tables is transparent to end users.

In distributed databases, catalogs at each site keep information about the database. The catalog at a site at which a table was created keeps information about where the table is stored. Even though tables can migrate to new sites or be distributed among several sites, the catalog entry at a table's creation site always contains enough information to allow data to be retrieved from other sites.

Database machines are usually back-end processors that off-load selected database software activity from the front-end host.

A site involved in a distributed transaction must log changes to its database as it does for a local transaction. To detect deadlocks, each site periodically examines which sites besides itself are waiting for data to be available. When a site recognizes a deadlock, it sends a request to one of the deadlocked sites to abort. The system directs the other sites involved in the aborted transactions to abort, as well.

Videotex

Videotex, a two-way approach to the widespread dissemination of textual and graphics information from centralized databases to low-cost terminals, is an important new application for databases. Teletext, one-way information dissemination, is not new, but focusing teletext databases on households is changing the market. Untrained users can selectively retrieve information on the news, weather and consumer products and can perform reservations, shopping and banking transactions. Analysts predict that 8 percent of U.S. homes will use videotex, and 33 percent to 50 percent will use teletext by 1990.

Disagreement concerning data-coding standards has delayed widespread acceptance of videotex in the United States. While the Europeans have been trying to preserve their standard European Conference of Post and Telecommunications, the Japanese appear ready to accept the proposed American National Standards Institute North American presentation-level protocol syntax (NAPLPS) de facto standard. NAPLPS capabilities include dynamically redefinable character sets, alphamosaic and alphageometric pixels and macro-picture-description instructions. Manufacturers are beginning to produce decoders based on the NAPLPS standard.

A variety of companies are accelerating videotex development. Knight-Ridder Inc., for example, is marketing the Viewtron service, which will offer more than 75,000 pages of information. This will include consumer information such as product reports from government sources, electronic shopping, banking, reference databases, airline schedules, classified ads and gateways to information in other computer databases. CBS Inc. and National Broadcasting Co. are soon expected to offer a nationwide teletext service restricted to informational-retrieval services. Times Mirror Co., in conjunction with Infomart, Toronto, will soon introduce "Grassroots," which provides 17,000 pages of farm-management information, weather and other agricultural/business tools.

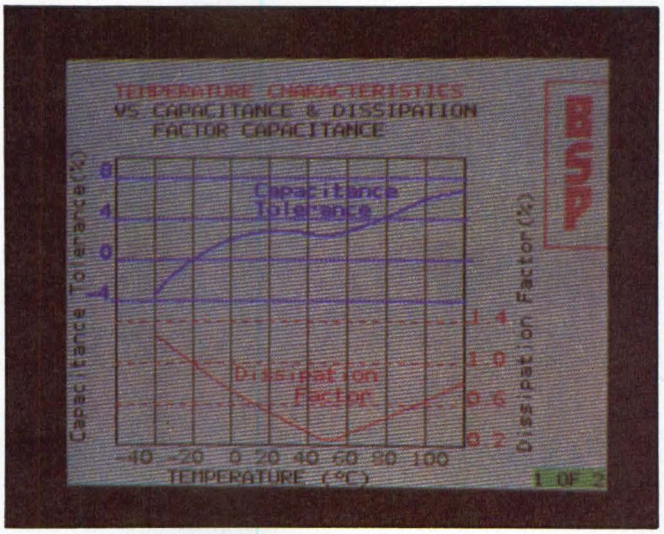
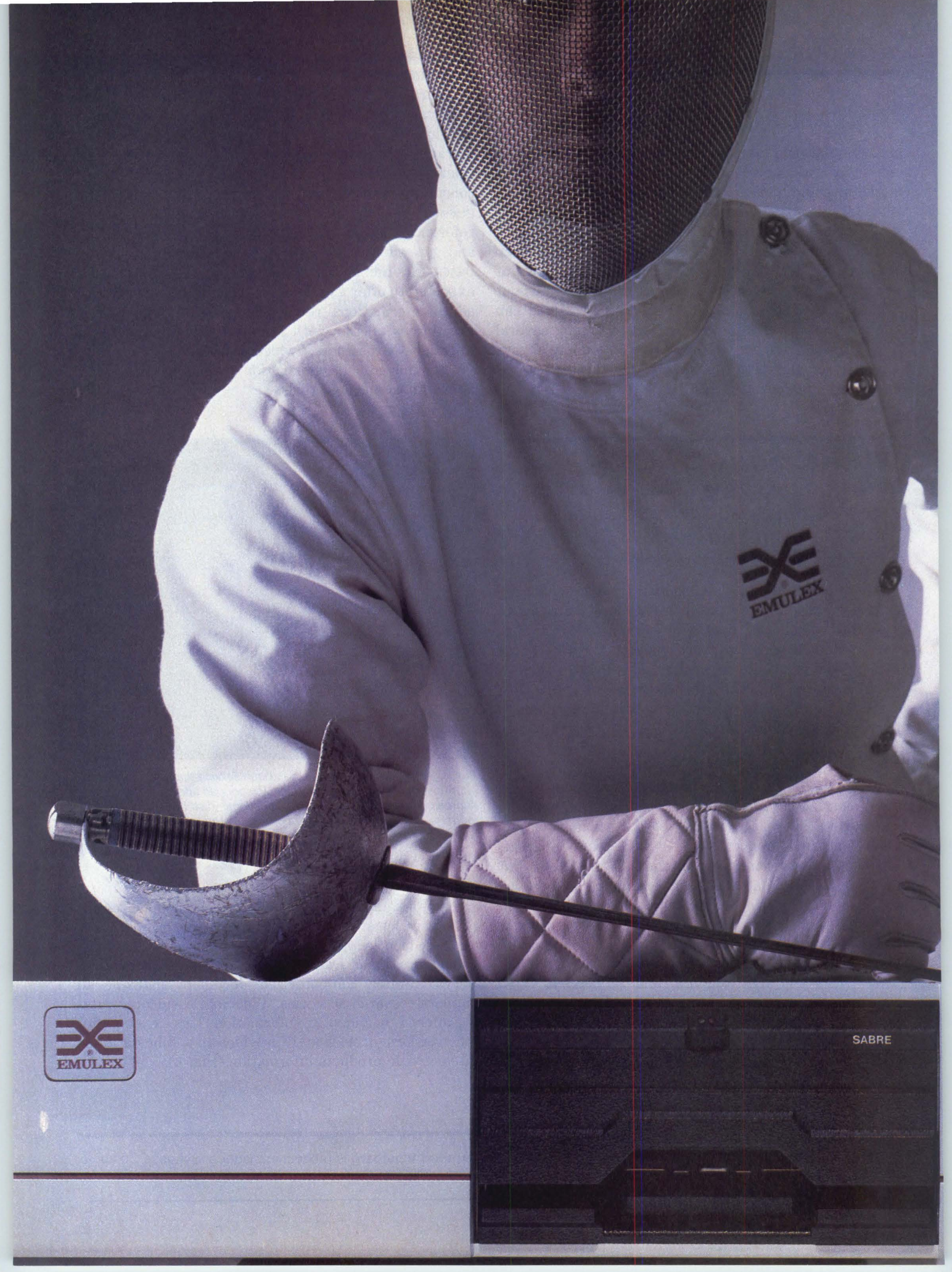


Fig. 6. Videolog *is a videotex database service that provides instant information on electronics products. Users can access a directory of sources, catalogs, product specifications, distribution information, industry news, product announcements and an on-line technical reference library.*

Early examples of videotex services include credit-rating agencies, such as Dun & Bradstreet, Equifax and TRW, which supply credit files on companies and consumers. Mead Data Central and Dialog Information Services offer computerized document indexing to support research activities. Videolog, a videotex catalog offered by Videotex Information Corp., exemplifies a newer form of service. It provides an on-line database of electronic products information (Fig. 6). □

Armond Inselberg is product manager at Synapse Computer Corp., Milpitas, Calif.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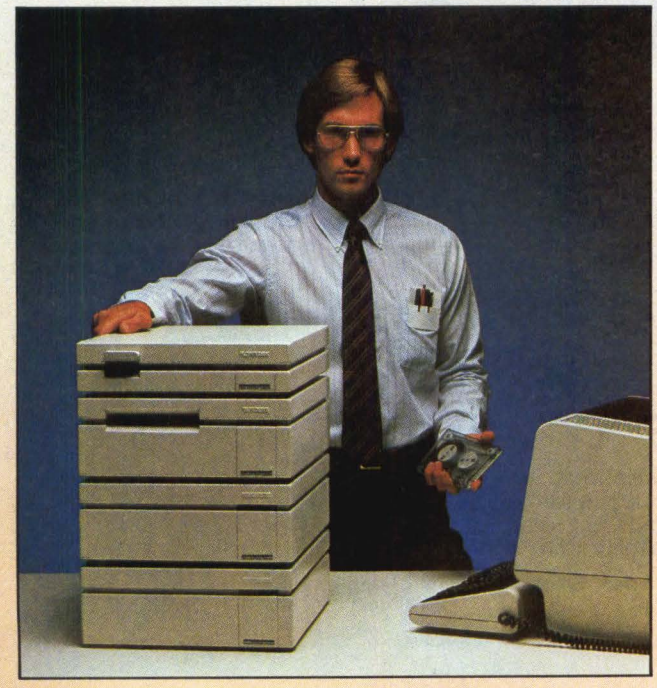

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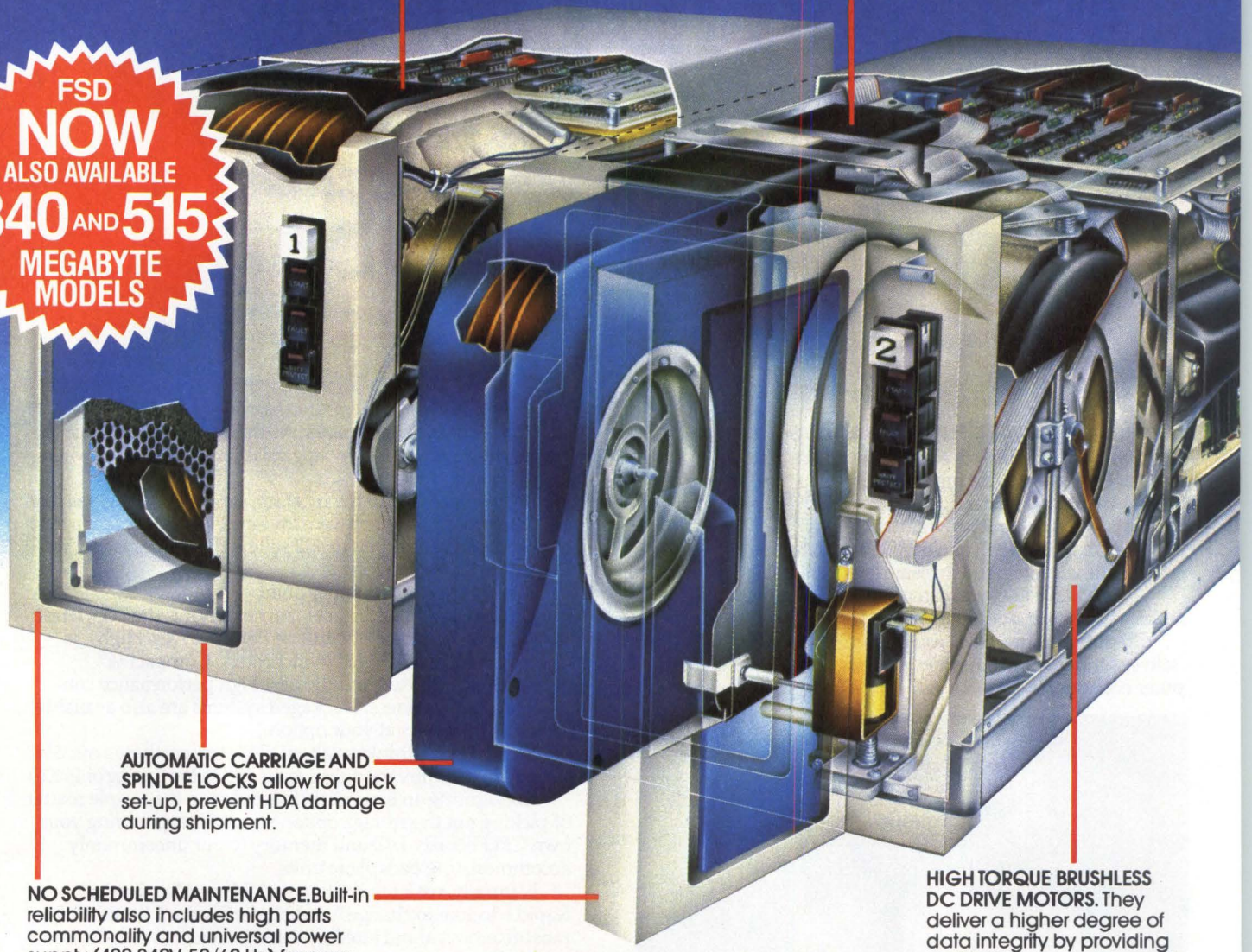

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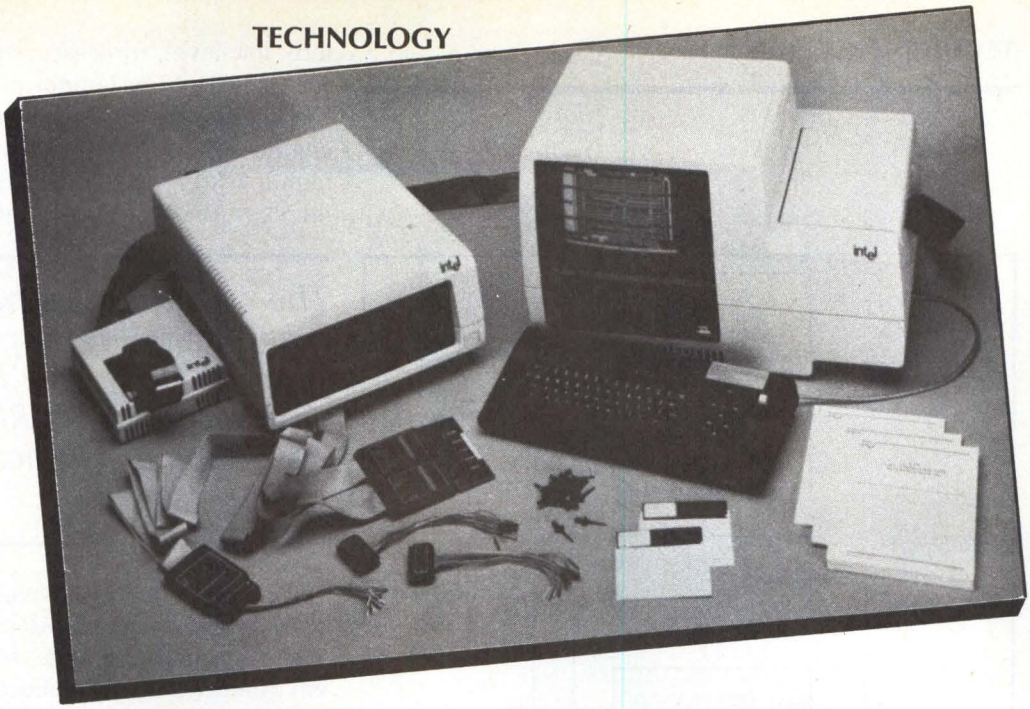

Integrated software-development instrumentation *can significantly reduce the development costs involved in bringing a product to market. The Intel I²ICE system comprises an in-circuit emulator for 16-bit microprocessors, a logic-timing and state analyzer and a high-level language debugger connected to a host development computer.*

Software development

PAUL MARITZ, Intel Corp.

New tools and approaches are boosting software-development productivity

The past year has seen a transformation in software development for microprocessor systems, involving more sophisticated processors, increased software content in the end product and a growing shortage of software talent. The integration of common human interfaces across heterogeneous systems, coupled with a tremendous focus on "friendly" and "productivity-based" features and the incorporation of classic hardware tools, such as in-circuit emulators, into the software-development environment have changed the very structure of the software lab. While in 1982 the concept of an integrated workstation combined an emulator with a logic analyzer, in 1984 an integrated workstation will combine software tools with hardware assistance to boost software productivity.

The cost to a company of a malfunctioning or poorly designed product can prove far more expensive than doubling its R&D expenditures or absorbing a significant increase in the product's cost. This is equally true for the software-development process. "Time to market is everything," and this consideration will become significantly more important over the next few years.

Increasing software productivity

During 1984, changes in computer systems will continue the evolution outlined above. Software tools will become available to guide the documentation and building of software systems, hardware will help software engineers evaluate software "completeness," and performance analysis and high-quality local-area networks (LANs) will be pervasive in every medium and large software environment. Just as logic analyzers, oscilloscopes and emulators have assisted hardware engineers, documentation aids, very high-performance distributed processing and the adaptation of emulators to software-intensive environments will lead the way to a greater measure of software productivity in the mid-1980s.

The key to software productivity lies in minimizing—or eliminating—a focus on learning to use the tools and maximizing the development and convenience of common human interfaces, high-level software tools and automated documentation and software-version control. No matter how well each individual tool works in and of itself, the effectiveness of the design aids available to the software engineer depends more on the interaction and interdependence of each tool than on any one tool's features.

The single most time-consuming task in the software-development cycle (Fig. 1) is verifying that the software works—that is, detecting and correcting bugs. One reason this process is so inefficient is that debugging is done at a low level. Most programs today are written in a high-level language. A software

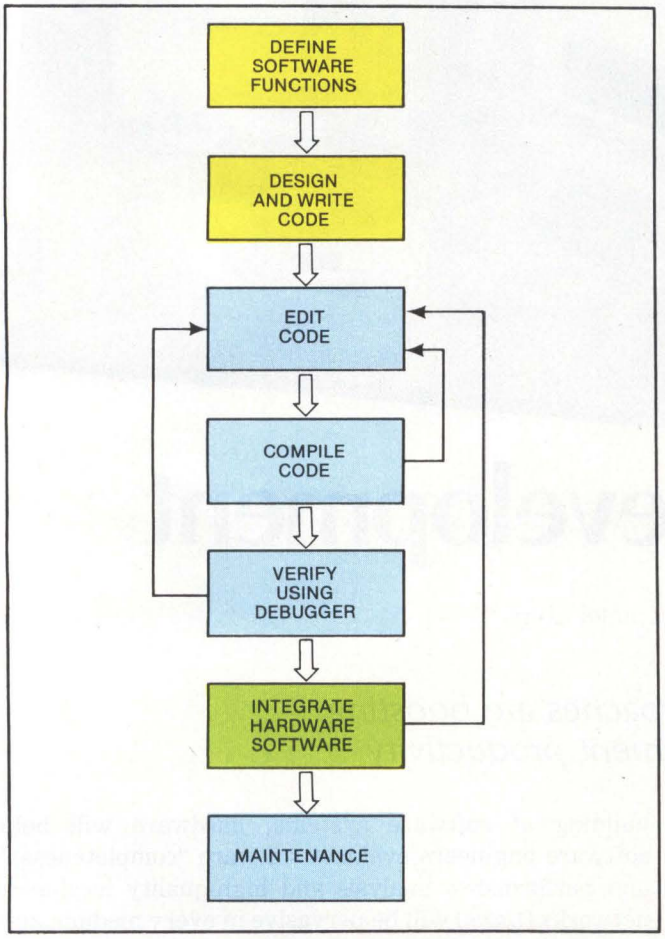

Fig. 1. In a typical software-development cycle, *problems in compiling the code, verifying it with a debugger and integrating hardware with software send a project back to the editing stage. Problems become more difficult to correct as development proceeds and particularly difficult to rectify after hardware is involved. A project that fails to use the appropriate tools throughout its life cycle risks slipping all the way back to the definition and design/writing phase.*

engineer uses a language translator that translates high-level terms and constructs that are closer to an application into low-level or processor-specific terms. For example, a programmer might write his program in Pascal, considering such entities as procedures, records and expressions. However, when he detects a bug in his program, he is forced by the available tools to operate at the processor level and to deal with such entities as hex numbers, registers and flags. Because the programmer has to translate manually back from a low level to a high level, productivity is lost.

Implementing high-level debugging

Why not, instead, have the debugging tool do a reverse translation? After all, the programmer submitted the high-level description (source code) of his program to a translator (compiler) to have it converted into low-level, processor-specific (object) code. The compiler could pass information about the program to the debugger, so that it could present the software engineer with information about the program in high-level terms (Fig. 2). This is an example of a human interface that is efficient, not just friendly.

The cost to a company of a malfunctioning or poorly designed product can prove far more expensive than doubling its R&D expenditures or absorbing a significant increase in the product's cost.

In microprocessor development, it is often necessary to complete the verification of the software by running the program in the target environment—the real-world environment of the application to be controlled. This is usually a necessary step because the interaction of the microprocessor and its external environment might be very complex and exceedingly difficult to simulate. For example, consider a microprocessor controlling a robot arm. The microprocessor must receive instructions on where to move the arm and, at the same time, monitor sensors reporting the state of the motors driving the arm. These inputs arrive in an unpredictable sequence and must be serviced within certain time limits if the robot arm is to perform as expected.

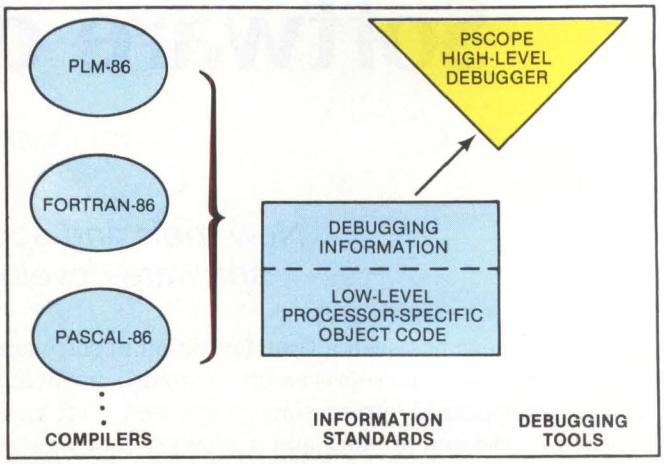

Fig. 2. Using a high-level debugger, *such as Intel Corp.'s PSCOPE, in the software-development process allows a developer to correct problems with code in a high-level language instead of in low-level, processor-specific terms. Such tools can greatly increase the efficiency of the debugging process.*

Simulating such an environment would be as much trouble as writing the target program. The ideal approach therefore involves simulating only those program modules that have a well-defined and simple input and output sequence and hence can be debugged easily in a simulated environment. The complete program, with its complex, time-dependent inter-

module relationships, can then be debugged in the actual target environment.

This two-stage approach requires two types of related debuggers: a software debugger that allows the software developer to simulate modules on his workstation and an in-circuit emulator that allows him to debug the software running in the target environment. To be most effective, these two types of debuggers should share the same human interface (Fig. 3), permitting an engineer to move easily from module-level simulation to in-target debugging without mentally shifting gears.

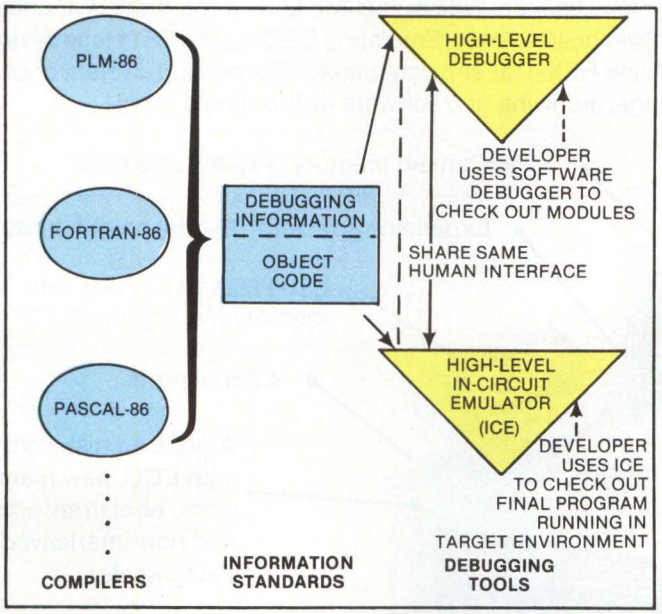

Fig. 3. High-level software and hardware debuggers *(yellow) sharing the same human interface speed software development. A developer can use a high-level debugger to exercise a software module on a workstation before all the modules of a program are available or before a prototype target system is constructed. When all modules and the prototype are ready, an in-circuit emulator, such as Intel's 12ICE, can be employed to debug the code running in real time in its real-word environment. Using a variety of compilers allows the developer to choose the optimum language for each sub-task and, in many cases, to use off-the-shelf software components written in a standard language.*

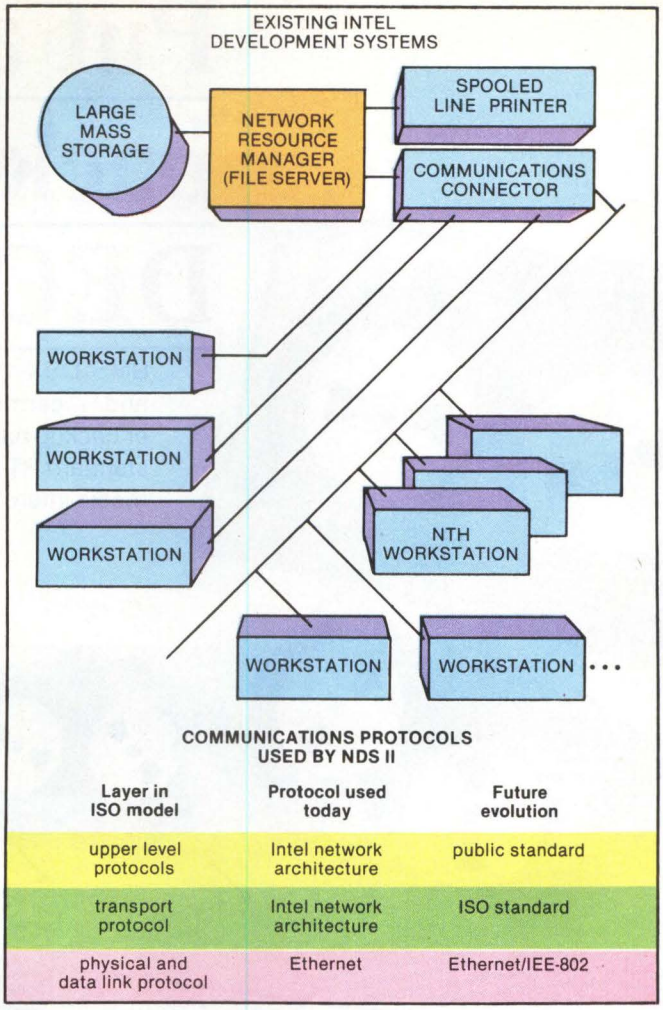

Fig. 4. An LAN can integrate shared and dedicated software-development resources. *A shared, central database allows the storage and management of project information. Dedicated, single-user workstations provide team members with processing power, large memory space and quick response. An LAN linking individual workstations furnishes communications between software developers and common access to database information through a network resource manager. An efficient LAN, such as Intel's NDS-II, will eventually be able to connect workstations from different manufacturers to serve changing software-development needs. This goal, however, requires further standardization of communications protocols, the aim of the International Standards Organization (ISO) and other groups.*

Managing software development

Typically, programmers generate at least three classes of information: documentation, source and object (processor-specific) code. More than one individual usually generates the information produced by a development project. In addition, the information usually undergoes changes over time, resulting in several different versions of the software. Furthermore, a typical project involves many variants of the information produced, such as one for floppy disks or one for Winchester disks.

On a multiengineer software-development project, the management of these different levels of information can become problematic. And, although the cause of the problems is usually simple, their effect is very costly. An engineer might waste days building a test system with an out-of-date document. Another problem that frequently arises is that of a "mysterious" change—an engineer changes a module and then fails to notify others of the modification.

Although these are simple management problems, a week lost on a 10-man engineering project because of an incorrect source file can mean $20,000 to $30,000 in direct staff costs and a serious slip in the product-development schedule.

Solving development problems

Automating software-management procedures can solve these types of problems by providing project members with a database in which to hold and control project information. It can also furnish the software-generation tools needed to build the correct software

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systems from information held in the database (see "Automating software management," below).

A project database should be able to provide:

- automatic separation of information according to type, version and variant. For example, a user must be able to extract from the database "the source associated with module X, version 2—the floppy disk variant" or "the test data for module Y, version 3."
- control of access to information. A software developer must be able to lock, or "freeze," certain versions to prevent problems arising from mysterious changes to the base information.
- a guaranteed audit trail for all information—what changes were made, by whom, why and when—making it easier to track the changes made in going from "version 2.0 to version 3.0."

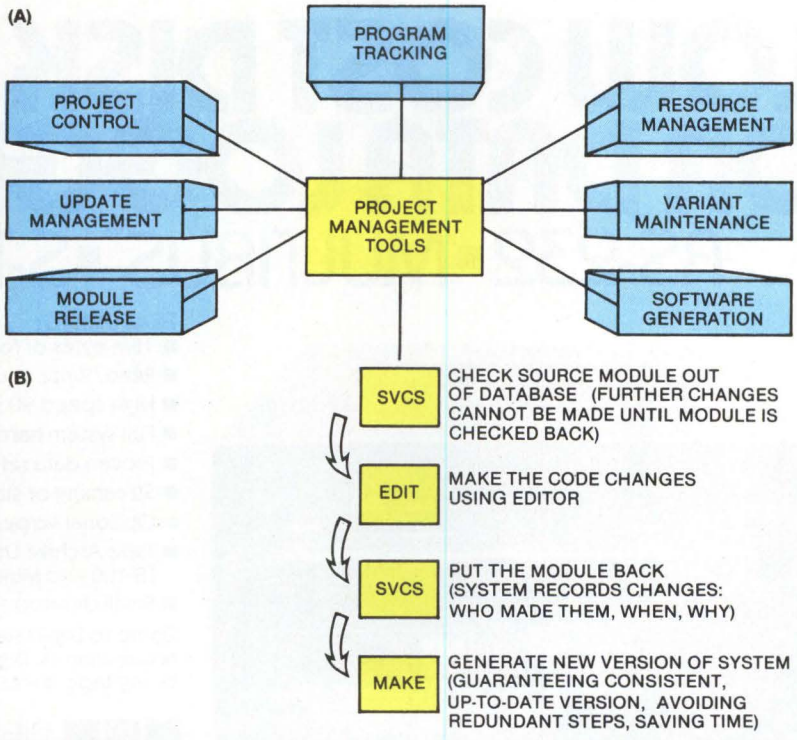
A software engineer should also be able to specify the desired software mix for the end product: the modules to be compiled and linked, the versions and variants to be used and the modules that rely on each other. From this description, a utility can extract the correct information modules out of the database and compile, assemble and link the source and object files to create up-to-date, consistent software. Ideally, the utility should be able to avoid redundant steps if the required information already exists. For example, there should be no need to recompile the source of module X as long as a good copy of the object for module X exists in the database. A single change in one module should not require the recompilation of all 60 modules in a project.

Shared resources + dedicated resources

In today's software-development environment, two conflicting requirements are placed on host systems. First, software developers must be able to communicate and *share* resources. Information-management tools typically require that members of a project share a central database in which project information is stored and managed. Software engineers must be able to communicate information, performing such functions ensure consistent, updated software and eliminate redundant steps. A programmer, for example, can use these project-management tools to alter a program module, put the module back in the system and generate a new, consistent version of the system (B).

AUTOMATING SOFTWARE MANAGEMENT

Creating a new software product is a complex, multistage process usually involving many software-development team members, three kinds of information and code (documentation, source and object code) and several versions and variants of a package. For example, developing an Intel Corp. compiler for the 8086 microprocessor involved 175 modules totaling 200K bytes of code, four engineers and 10 hours of program-generation time. Correctly managing such a project and avoiding costly mistakes increasingly requires automated project-management tools (A), such as Intel's Software Version Control System (SVCS) and MAKE. The SVCS system furnishes a database that permits project members to track and control versions and variants of the software. Database information can be protected against accidental or simultaneous changes by two or more developers. The system can also record when a change in a software module was made and the reason for and initiator of the change. The MAKE facility can determine what compiles, assembles and links must be performed on various modules to construct a software product from its constituents. The utility uses module-dependency information (what modules affect certain other modules) to



as sending and receiving electronic mail. This trend favors the use of minicomputers that let users share a database, communicate and cooperate.

Second, software developers' tools are becoming increasingly sophisticated. The price of this sophistication, however, is more powerful computing resources. These tools require *dedicated* processing power, large memory space and quick response to perform efficiently. This means newer tools will have to be hosted single-user workstations, in which software developers can be guaranteed a certain level of computing resources.

Single-user workstations connected to a local-area network (LAN) can resolve these conflicting trends (Fig. 4). Such a distributed-processing approach offers the best of both worlds. Each user has a dedicated set of computing resources in his workstation, uses a central, shared database located at the file server and can easily communicate with other users.

If the LAN architecture is correctly designed, distributed processing can offer other benefits as well. Different types of workstations can be attached to the network, according to user needs. Thus, in a software-engineering environment, most of the workstations could be optimized for software developers, with only a few reserved for hardware debugging. To meet these needs, the LAN should become the standard information bus of the software-development team.

The distributed processing afforded by an LAN will also provide a measure of protection against obsolescence. Newer stations can be added to replace older ones, as required. Now, the unit of growth for software-development systems is the workstation, not the mainframe.

The trend toward workstations connected by an LAN weighs heavily against the cost advantage of timesharing over distributed processing. The push for software productivity will therefore be the most pressing reason for the adoption of distributed processing in modern software-development environments. □

Paul Maritz is software tools planning chairman at Intel Corp.'s Development Systems Operations, Santa Clara, Calif.

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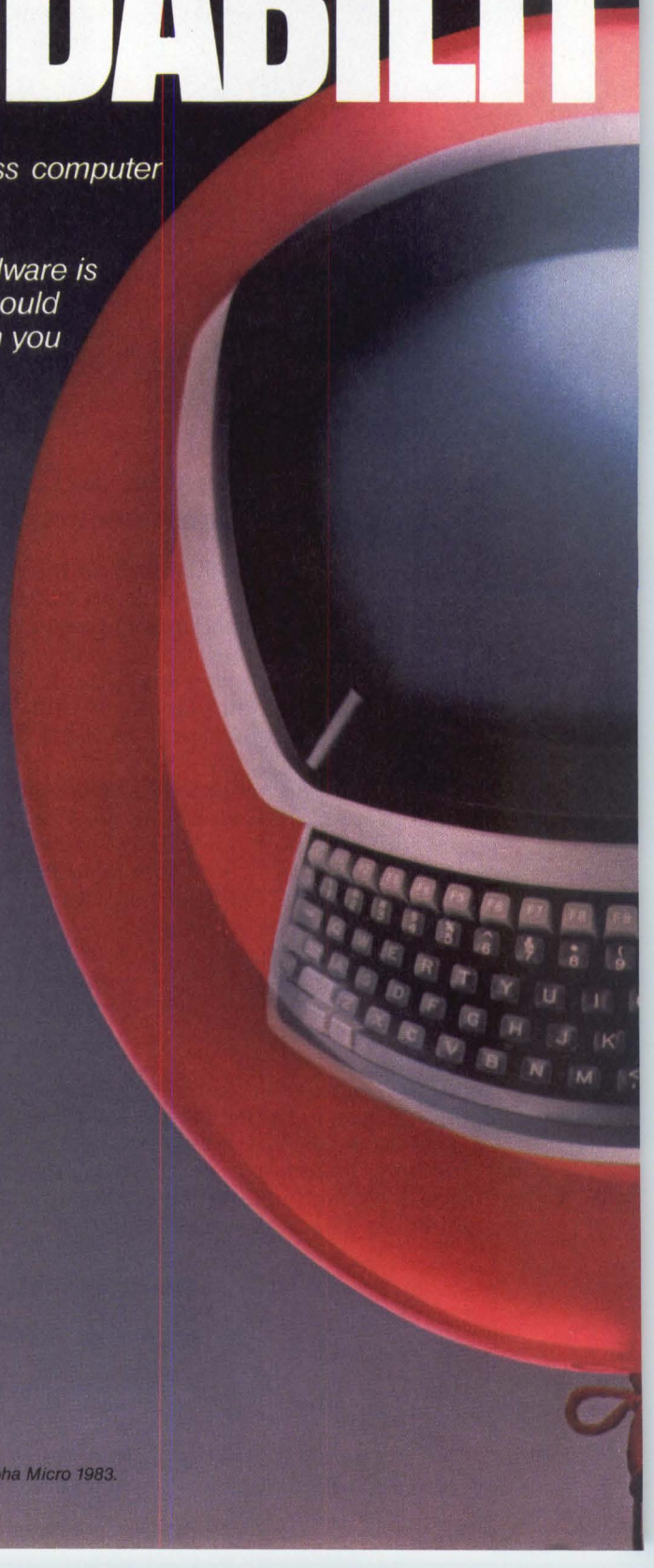

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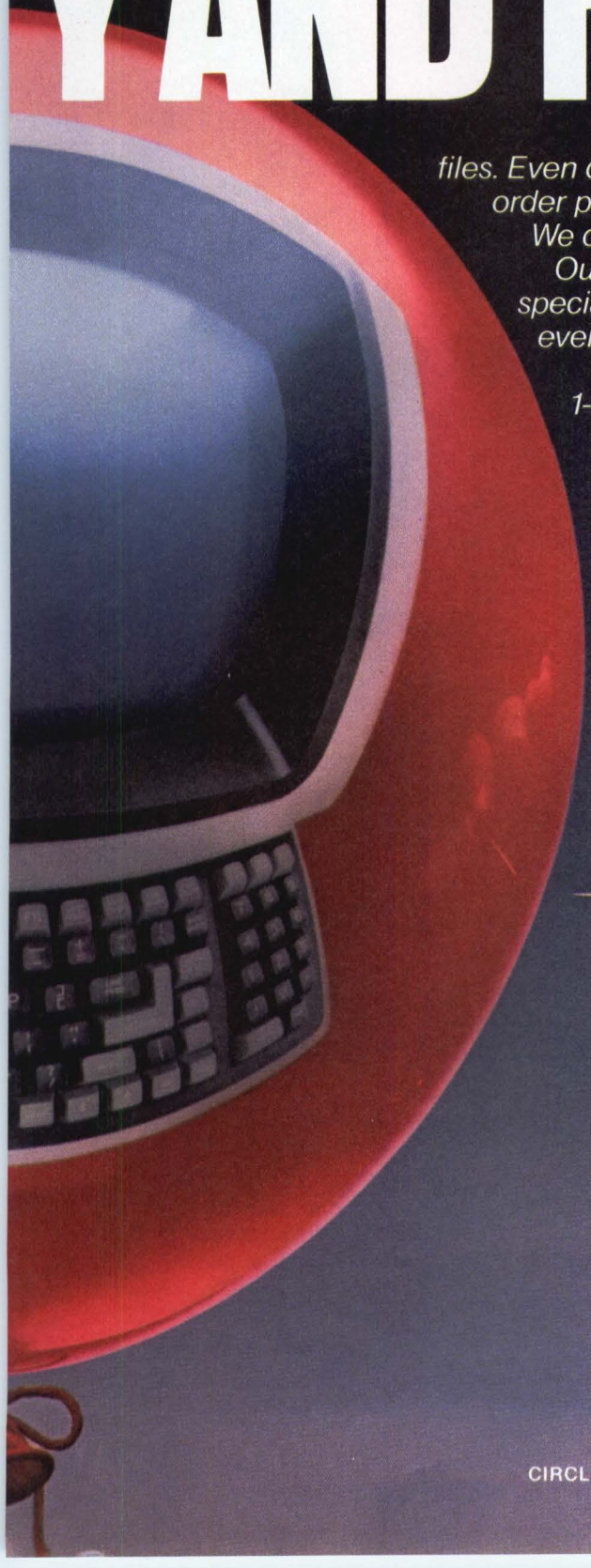

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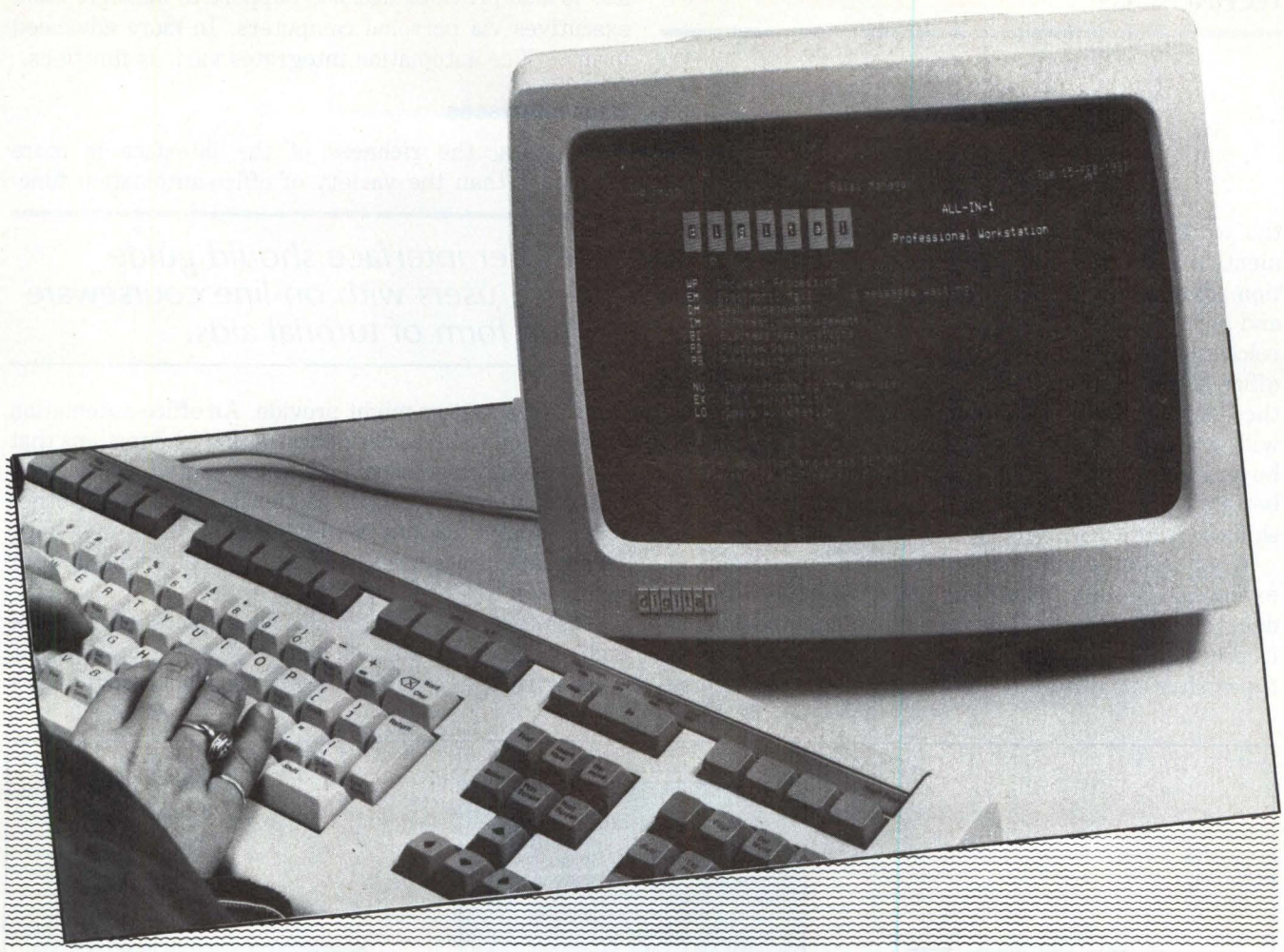


Office automation

JOHN MURPHY, Contributing Editor

Office-automation systems move toward more functions and integration

Office automation electronically enhances or replaces the paper-related aspects of typing (via word processing), message or document distribution (electronic mail), filing (mass storage), scheduling (electronic calendars) and project analysis (decision support). It also provides store-and-forward voice messaging (voice mail) and data-voice-video multiparty conferencing (teleconferencing). Vendors of office-automation equipment are targeting the more than 50 million professional workers that comprise the services-oriented work force. To meet increasing demands, vendors are supplying better user interfaces, increased office-automation functions and greater integration in office-automation systems and between data-processing and communications systems.

This professional workstation *from Digital Equipment Corp. integrates word processing, electronic mail, graphics, an electronic file cabinet and calendar and business data processing.*

Analyzing and defining office automation

Office automation is a topic that evokes a variety of reactions. To office-automation product vendors, it conjures up sugarplum visions of selling in a relatively untouched market. To corporate buyers, it evokes bottom-line images of vastly improved profit margins through increased office productivity. And to unions or worker groups, it provokes the specters of exploitation, health hazards and layoffs. Despite opinions of opponents and proponents, office automation is neither a plague nor a panacea.

However, dislocations affecting balance sheets and

the work force are bound to occur. Start-up investments to manufacture, market or apply office automation adversely influence profitability of manufacturers and buyers. There are also instances of job stagnation, relocation or even reduction during the initial stages of office-automation acceptance and implementation. But these initial ill effects are short-lived. Office automation will eventually enrich the manufacturers and the buyers with better profit margins and the users with better work tools and enhanced, transportable job skills.

What is office automation? In office operations, it extends the ability to automate paper-related text- and data-processing tasks. In single-function embodiments, it provides text processing via standalone electronic typewriters or word processors to typists and secretaries. It also provides decision support to managers and executives via personal computers. In more advanced forms, office automation integrates various functions.

User interfaces

To users, the richness of the interface is more important than the variety of office-automation functions that a system might provide. An office-automation workstation should provide workers with functions that can be easily accessed and implemented via a user-friendly interface (Fig. 1). A typical executive or other office worker is not well-versed in data-processing terms and procedures and usually has little time or inclination to learn them.

The user interface should guide novice users with on-line courseware in the form of tutorial aids.

An interface should guide novice users with on-line courseware in the form of comprehensive tutorial aids. This is to the vendor's benefit as well as the user's

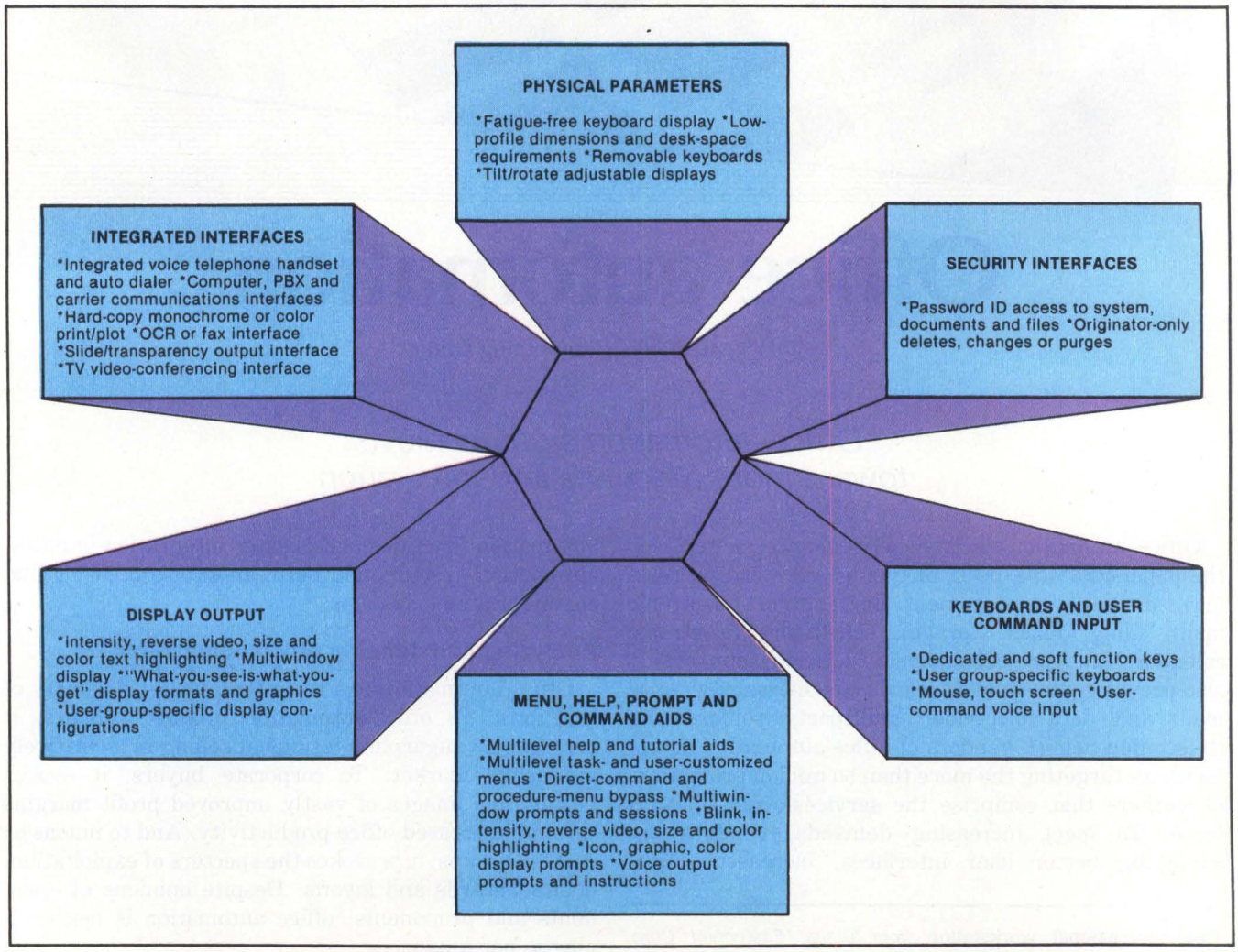


Fig. 1. User interfaces *are available in varying degrees of sophistication. Although no office-automation workstations incorporate all of these characteristics, the trend is toward systems that incorporate as many as possible within the requirements of an application.*

because it eliminates some costly handholding training sessions. The courseware and the menu structure should also be multilevel to allow users to bypass elementary aids and presentations as they gain experience. The goal is to train users via the interface and then eliminate the fundamental aids once the user acquires expertise. Most office-automation systems and workstations on the market lack multilevel capability and impose the same aids and menu structures on all users. Most systems, however, allow users to customize menu selections to their requirements. Most systems also provide stored procedures that call up a specific sub-function or task via a single-key command.

Office-automation functions

Each of the major office-automation categories provide integrated functions (Fig. 2). Almost all office-automation systems provide word processing, electronic mail and administrative or decision support. Voice mail and teleconferencing are less common. Cross-category integration is becoming increasingly important. Vendors are incorporating the text-processing functions found in word-processing systems into electronic-mail systems to construct messages and generate notebooks or diaries. The systems provide cut-and-paste-type transfers to move spreadsheets, project plans or graphics from decision-support areas to documents produced on word-processing systems and, in some cases, electronic-mail systems. Common user interfaces, menus and command structures facilitate cross-category integration.

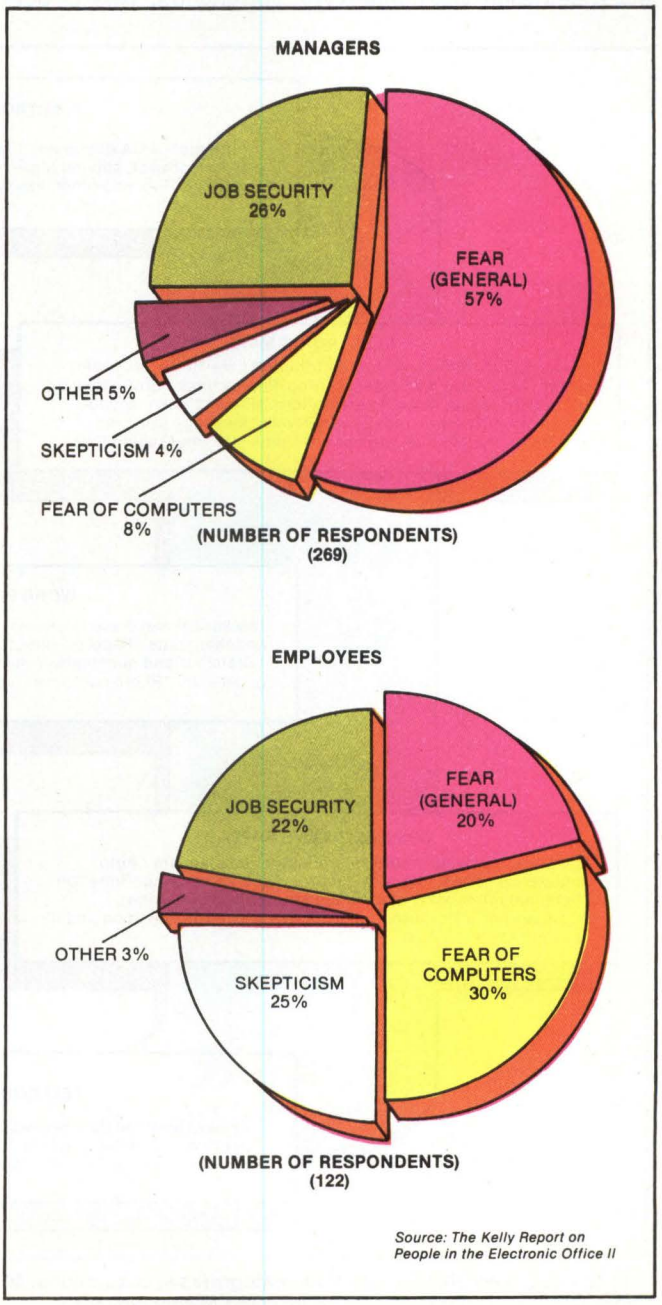
VENDOR GROUP	COMPANY
Mainframe systems	* IBM Corp. * Sperry Univac * Honeywell. Inc. * Burroughs Corp.
Minicomputer systems	* Wang Laboratories Inc. * Digital Equipment Corp. * Data General Corp. * Prime Computer Inc. * Hewlett-Packard Co. * Harris Corp.-Lanier Business Products Inc. * Basic-Four Corp. * Four Phase Systems Inc. * Computer Consoles Inc.
Office/word-processing equipment	* Xerox Corp. * Exxon Office Systems Co. * NBI Inc. * Phillips Information Systems Inc. * Syntrex Inc. * Axxa-Dimex
OEM office-a systems PBX/OA Systems	* Convergent Technologies Inc. * Sydis * American Information Systems (AT&T) * Rolm Corp.

All major vendors *of integrated office-automation systems offer systems with word-processing, electronic-mail and administrative or decision-support capabilities.*

Job-security concerns *when electronic office equipment was introduced were analyzed in a survey conducted by Research & Forecasts Inc., New York, on behalf of Kelly Services Inc., Troy, Mich., a nationwide temporary office-personnel company. While both managers and support staff reported moderate levels of apprehension about office automation in this study among U.S. and Canadian Fortune 1,000 companies, managers labeled a general fear of the unknown as the primary source of apprehension, while their employees labeled fear of computers as their primary source. After the equipment was installed, 90 percent of the support staff believed that their job situation had improved.*

In addition to the standard functions of most systems, new capabilities are adding sophistication to office-automation systems. These capabilities include:

- **Word processing:** Some word-processing systems incorporate automatic spelling-checking aids that verify spelling and suggest alternatives for uncommon words. These systems check the words against a system directory of common words and/or user-defined directories for specific areas, such as scientific, medical or legal applications. Some word-verification systems also provide thesaurus-like "find-me-an-alternative-word" capabilities. Other unique functions include automatic tables of contents and alphabetical word/term index generators for long documents or reports; grammar, style and punctuation verifiers; and font-style, point-size and page-format options presented as print-menu entries.



• **Electronic mail:** A few commercially-available electronic-mail systems incorporate TWX/Telex/E-COM messages. Others allow users to attach messages to documents or files. Another rare capability of electronic-mail systems is "pink-slip" message distribution, which uses fill-in forms and automatic addressing.

• **Voice mail:** Some office-automation systems, such as those marketed by Wang Laboratories Inc., Digital Equipment Corp., Sperry Univac, Four-Phase Systems Inc. and Sydis Corp., offer integrated voice-mail capabilities with site-wide PBX systems. Implemented via touch-tone telephone-type commands, this is perhaps the best way to introduce the power of office automation to keyboard-shy, phone-prone executives and managers. As such, it will serve as an impetus to automate and will be offered on most systems by the end of 1984.

• **Teleconferencing:** Teleconferencing has developed slowly over the past few years. Most vendors view electronic mail as a more easily-implemented and cost-effective alternative to interactive teleconferenc-

Some word-processing systems incorporate automatic spelling-checking aids that verify spelling and suggest alternatives for uncommon words.

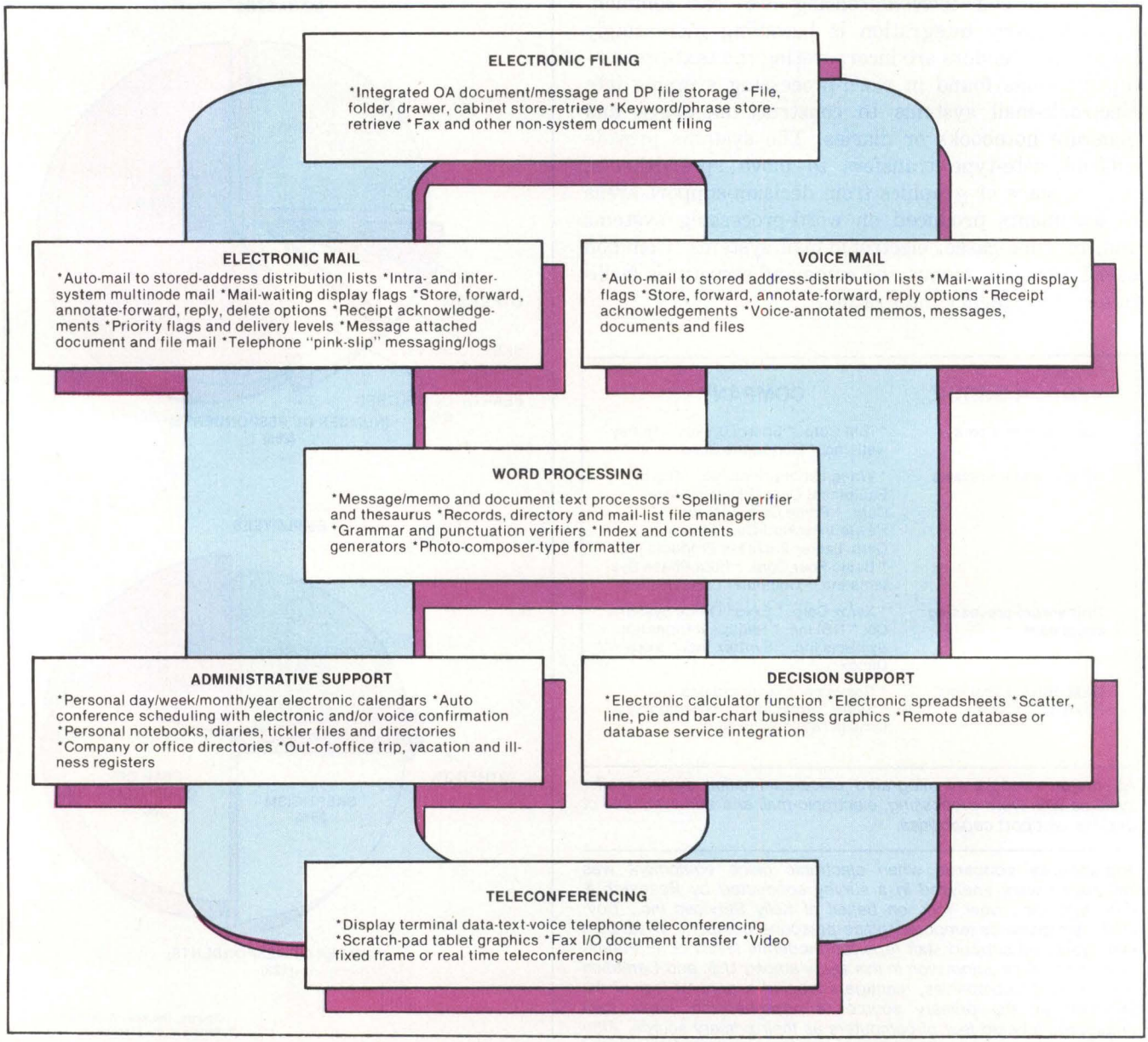


Fig. 2. Integrated office-automation categories and functions. *Most systems provide word processing, electronic mail and electronic filing, while only a few incorporate voice mail and teleconferencing.*

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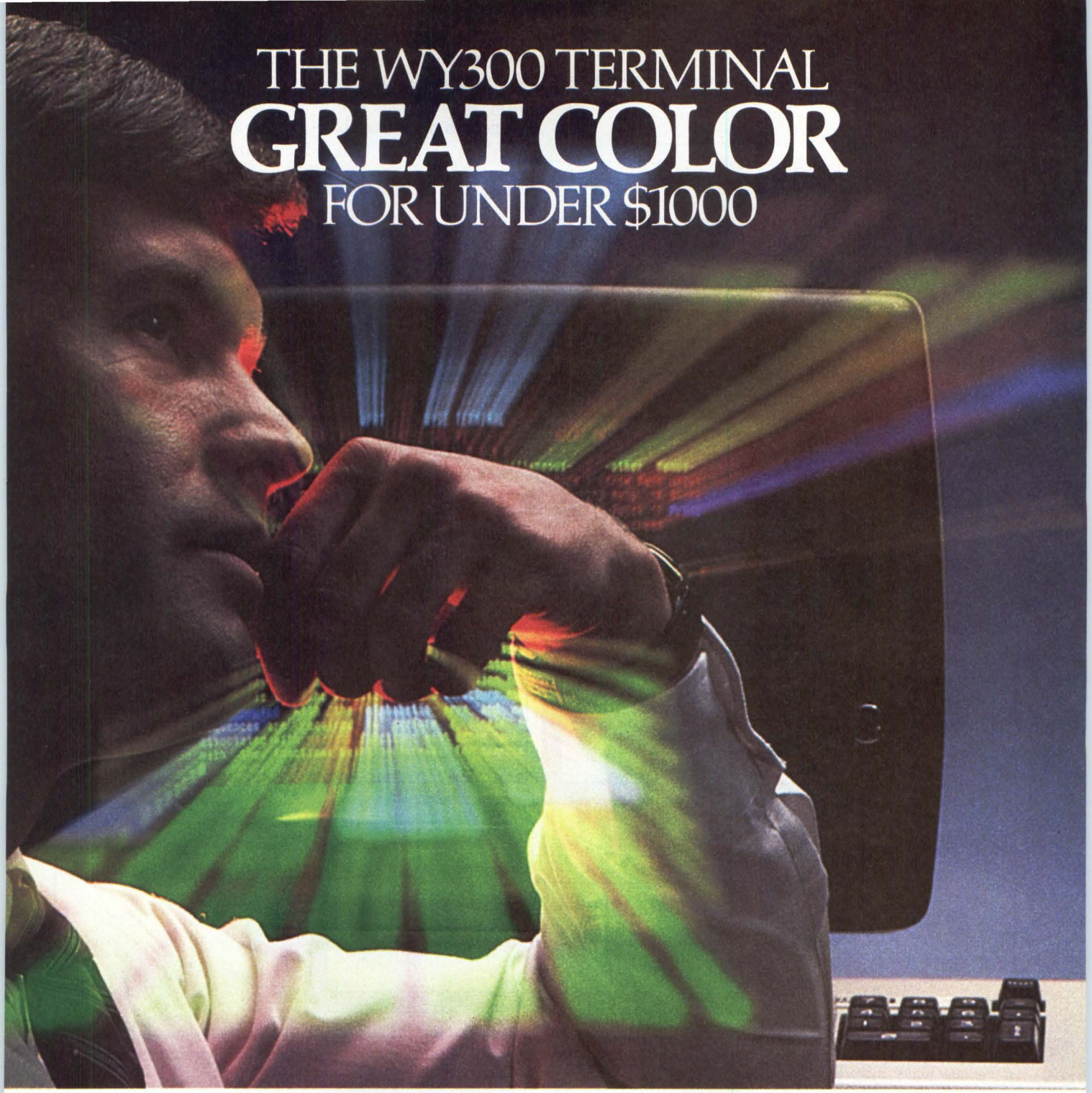

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ing. But the demand for multiparty voice-data or voice-data-video conferencing is increasing, and vendors will react accordingly over the next two to three years.

• **Electronic filing:** Electronic-filing innovations revolve around methods used to catalog a document or file. Common approaches are documents within a file folder, folders within a file drawer and drawers within a file cabinet. New systems incorporate user-attached file headers containing searchable keywords or descriptors. In addition, a few systems offer the ability to retrieve a document based on "wild-card" searches for words or terms within a document's text.

Integrated office-automation systems

Integration of office-automation functions, data processing and data and voice communications is office automation's ultimate goal. Current systems address the tasks of combining data-processing and communications functions via a separate-session, non-integrated approach. This often involves different and complex menus, commands, prompts and log-on/log-off procedures.

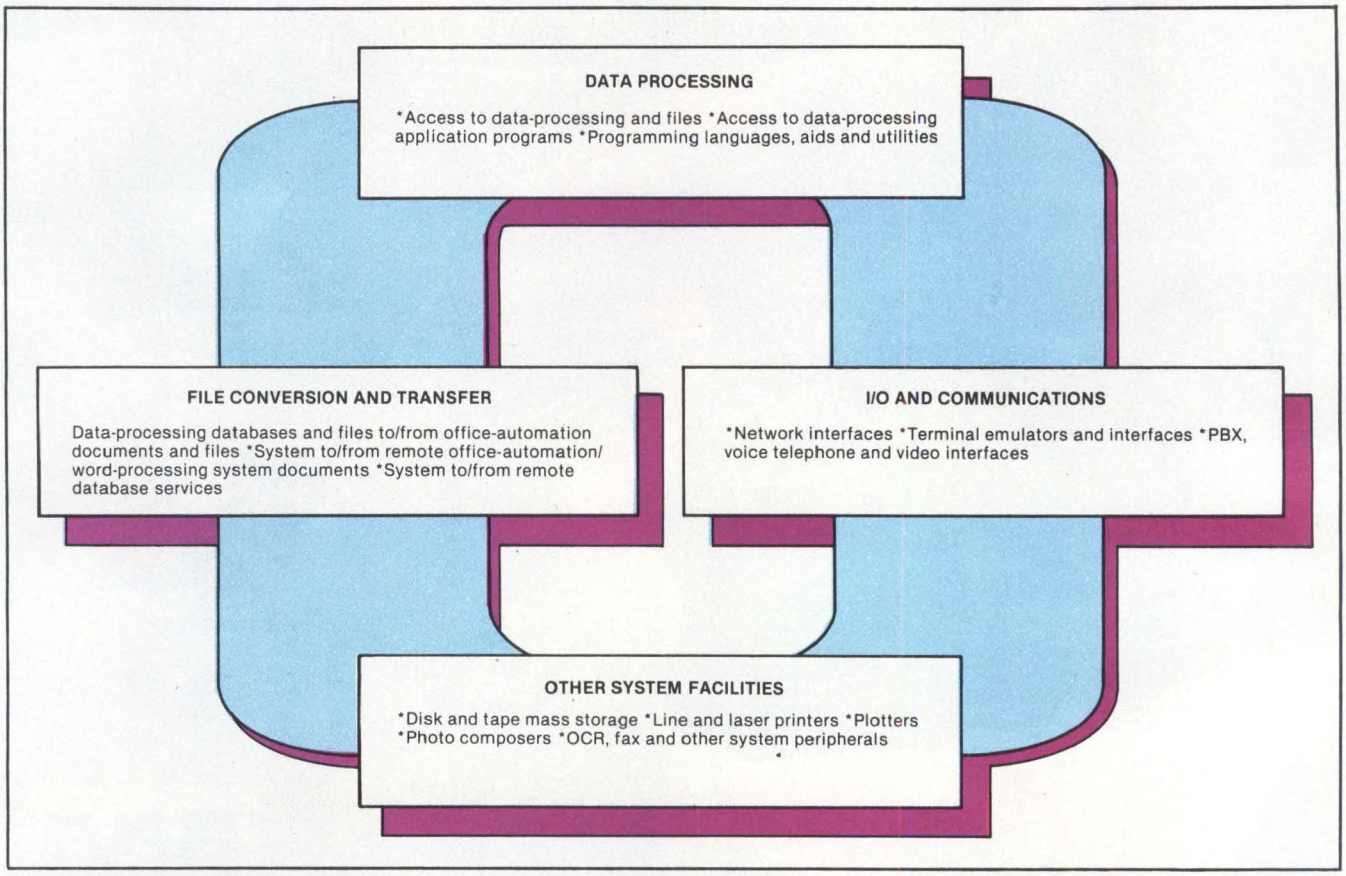


Fig. 3. A fully integrated office-automation system *includes interfaces between data processing, peripherals and communications facilities. In the near future, systems will have to accommodate information in text, graphics, voice or video forms.*

WHAT TO LOOK FOR IN THE COMING YEAR

At the interface level:

• a new generation of low-profile, small-footprint, ergonomic office-automation/data-processing workstations that include telephone handsets and autodialers;

• multilevel menus and tutorial courseware incorporated into office-automation systems;

• extended use of soft keys, pointer devices, icon graphics, multicolor, window partitions and screen-display aids;

• the advent of "speak screen" voice input/output interfaces.

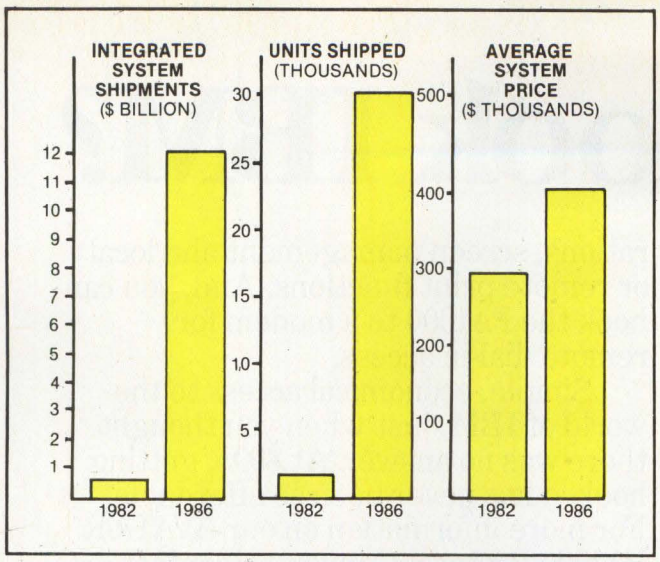
At the function level:

• voice mail integrated into more computer- or PBX-based office-automation systems;

• teleconferencing integrated on a few systems, allowing simultaneous exchange of text and voice among multiparty users;

• improved linkage-type conversion and transfer integration, supporting the interchange of files or documents between remote workstations, word-processing/office-automation/data-processing systems and electronic database services;

• non-system document (such as incoming mail, magazine articles, books) integration via facsimile-type "image" readers as an enhancement to both electronic-mail and electronic-filing functions.



The integrated office-automation system market *will grow by leaps and bounds through 1986, according to the Yankee Group, Cambridge, Mass. The value of shipments of integrated systems, which might include optical character recognition (OCR), voice input and facsimile equipment, will skyrocket from 1982's $500 million level to $12 billion in 1986. The price of an average system will rise from $290,000 to $400,000 over the period.*

One problem impeding office-automation integration is difficulty in transferring files and data between the diverse office-automation and data-processing stations. This includes problems related to transfers between data-processing database files and office-automation document files, between personal computer files and office-automation or data-processing files, between system files of sessions and remote databases or data services and between documents generated on incompatible processors. Intra- and inter-system communications and networking present similar interface problems that entail support of different protocols; incompatible local-area networks; and diverse hosts, workstations and peripherals (Fig. 3).

Most office-automation workstations operate on a dedicated basis (Fig. 4), but the trend is toward integrated facilities. Vendors will integrate voice-mail functions into office-automation systems or offer them as dial-in services over the next few years. Likewise, vendors will incorporate dedicated facsimile systems into office-automation systems. Optical-disk, document-management systems have cropped up to meet the archive storage/retrieval requirements of a variety of applications. These systems are the modern counterparts to microfilm/microfiche storage systems. To date, however, system designers have not integrated optical disks into office-automation systems because of the high cost and the read-only nature of optical media.

SYSTEM	FUNCTIONS & APPLICATIONS	PRIME USERS
Electronic typewriters	Typing and limited word processing, limited-function office-automation, system workstation, data terminal, TWX/Telex/E-Com-type terminal	Clerk-typist, secretary
Word processors	Full-document word processing, records/file processing, office-automation, system workstation, personal computer, data terminal TWX/Telex/E-Com-Type terminal	Word-processing operator, clerk-typist, secretary
Personal computers	Intermediate to full-document word processing, decision-support functions, database and file management, administrative-support functions, data terminal, office-automation, system workstation, voice telephone terminal	Manager, professional, sales/marketing, executive secretary
Executive workstations	Administrative-support functions, electronic-mail functions, Decision-support functions, voice telephone terminal, limited word processing, data terminal, office-automation system workstation	Executive, manager, professional, sales/marketing, secretary
PBX systems	Voice telephone functions, local networking, data-voice communications, electronic-mail functions, voice-mail functions, administrative-support functions, limited word processing	All groups
Office-automation/ office automation-data-processing	Full-document word processing, electronic-mail functions, voice-mail functions, electronic filing functions, administrative-support functions, decision-support functions, local networking, data communications, data processing	All groups

Fig. 4. Office-automation systems *function on a dedicated level, performing specific functions. The trend, however, is toward integrated systems.*

Innovations in office automation will focus on integrating voice functions into office-automation facilities and on teleconferencing. Wang, Four-Phase and Sperry Univac are the only vendors offering integrated voice-mail systems. Teleconferencing is available only in a two-party terminal-to-terminal mode on IBM Corp.'s PROFS system. □

John Murphy is vice president of Advanced Office Concepts Corp., a Bala Cynwyd, Pa., consulting and publishing company that specializes in office automation. He is also a contributing editor to *Mini-Micro Systems*.

NEXT MONTH IN MMS

Two profile articles are featured in the January issue of **Mini-Micro Systems.** The first outlines correspondence-quality printers and surveys solid-font impact printers, near-letter-quality matrix printers and dual-mode printers.

The second article covers operating systems. OSs have become more capable, contain more features and are more portable. More than 60 different software operating systems are profiled in an extensive list of manufacturers' offerings.

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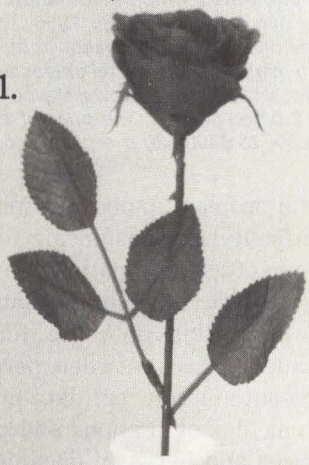

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TECHNOLOGY

Artificial intelligence

STEVEN ROBERTS, Contributing Editor

New applications raise social and legal issues

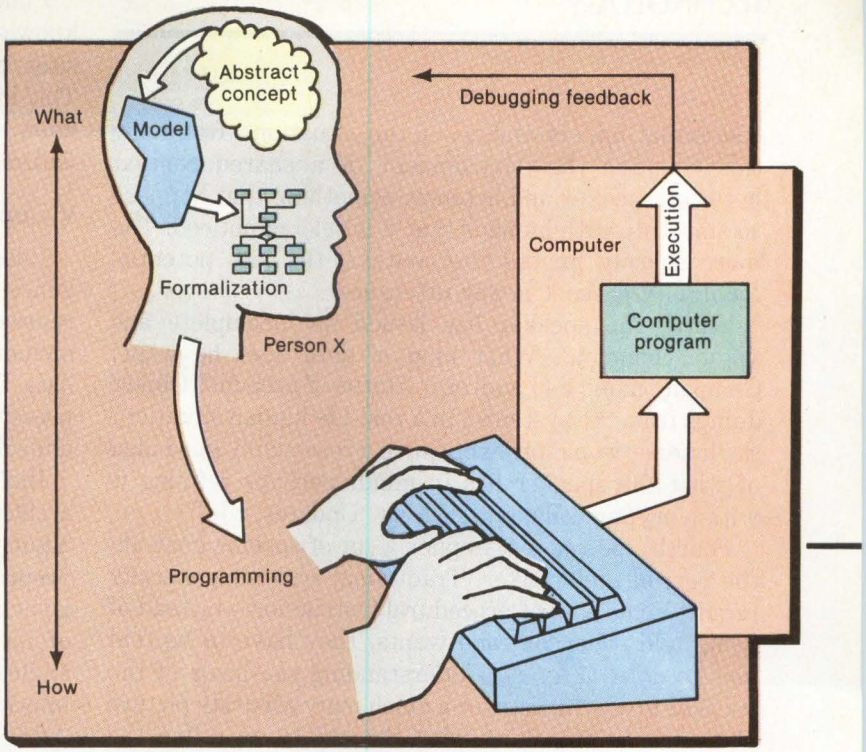


Fig. 1. The WHAT-HOW spectrum. *The object of natural-language research is a system that can interact with humans at the WHAT level ("Here's what I want you to do") rather than the HOW level, which requires translating a human's original intention into a procedure such as the code of a high-level programming language. Natural language can thus be viewed as the ultimate step in the ongoing attempt to make programming easier and more productive.*

Artificial intelligence (AI) is the subfield of computer science concerned with symbolic reasoning, inference and problem solving—all subjects that historically have required "human" intelligence. Applications for AI techniques are moving beyond the "toy" problems that characterized early research. The technology has now become applicable to areas as diverse as very-large-scale-integration (VLSI) design, database query and medical diagnosis.

AI is drawing the public eye more than ever before, largely because of the Japanese Fifth Generation Project that is causing such alarm. With the sudden influx of funding from government and industry, the AI community now finds itself with more tools, people and energy to address the complex issues of natural language, vision and expert systems. In short, the field should no longer be viewed by practicing systems engineers as an interesting but remote topic.

Natural language

Perhaps the most complex and critical problem is the need to invest computer systems with the ability to deal efficiently with "natural" human language. Natural language can help machines interact much more successfully with computer-naive users. Why should people have to become "computer literate" to take advantage of system resources? It is much more sensible to make the computer "human literate." In addition, there is a growing awareness that the representation of human knowledge by a machine requires something other than the old, reliable database techniques. In the AI community, arguments flourish in which formal logic is pitted against intuitive and "natural" paradigms as the foundation for a knowledge base. Formalisms such as predicate calculus are gradually yielding to the more flexible approaches embodied in a number of commercial products (MMS, October, Page 153).

But the problems remaining are many. Human speech is fraught with ambiguities, context dependency, unspoken "common-sense" information and the beliefs and goals of the speaker. Consider the following request that one might make to an assistant—or to a natural-language database-d query system: "Can you get me data on 370 sites using Release 3.4? I'd like them sorted by state."

This statement would be quickly understood in context by the average human listener, especially one familiar with a company's software products. But the problems facing a computer program that attempted to interpret such a command are staggering. "Can you get me data...?" A reasonable answer to this is "yes." But the speaker is politely disguising a command, not investigating the machine's capabilities, and the literal interpretation must be ignored. This requires, first of all, a general understanding of human communication style and social conventions.

Second, the request is rife with ambiguities: "...data on 370 sites...." Does the speaker want information about 370 installations, or is he interested in a type of computer? How is the software to decide without some

contextual understanding of the situation? Resolving this requires the development of a shared context between speaker and listener, something that happens so smoothly with humans that it is seldom noticed. The more sharply limited the context, the less potential ambiguity present in any utterance.

Third, the speaker has issued an incomplete and vague command. What kind of data does he want? Company name and address? Status of account? Object dumps from the systems? In a real-life human situation, the listener would probably have a reasonably good idea of what the speaker has in mind, perhaps refining it with a cryptic comment such as "Updates, too?"

Fourth, the request implies a set of specific goals on the part of the speaker. Traditional systems generally require some sort of procedural instruction—instead of being told *what* someone wants, they have to be told *how* to do it (Fig. 1). Understanding the goals of the speaker gives the listener a much more accurate picture of the situation, along with the ability to refine the results and to recover gracefully from errors.

Finally, the listener must possess a degree of common knowledge to deduce correctly that "them" refers to the sites, to discard the polite verbiage "I'd like" and so on. This kind of knowledge is not codified anywhere, yet it must become part of the basic repertoire of any natural-language system.

Vision

Like language, vision is inseparable from intelligence. It is trivial to connect a camera to a computer to represent a visual scene as an array of pixels in memory—but that's just raw data. Converting raw data into a semantic representation of the objects present in the scene requires an appreciation of the underlying complexity of human image processing.

Biological visual systems incorporate numerous hierarchical processing steps that successively strip the input field of extraneous data. After considerable preprocessing, the image is subjected to layer after layer of pattern-recognition steps—first with the intent of identifying such "primitives" as lines at various angles and later to extract culturally dependent information such as the generic shape of a human face. After all this has taken place, the information—no longer an "image" in an optical sense—is presented to

WHY LISP?

LISP is the most widely used programming language for developing artificial-intelligence systems. It differs from most programming languages in that it was designed to manipulate symbols and relationships as well as numbers, characters and bits. LISP is highly interactive, has a simple uniform syntax and usually is augmented by sophisticated editing and debugging tools. But perhaps the most striking feature of LISP is its reliance on recursive functions. For example, the LISP program shown uses recursion to compute the factorial of the positive integer N. The program employs the COND conditional function (yellow), which returns a value of 1 if N = 1 (green) and otherwise invokes a recursive call to FACTORIAL (blue) to compute the factorial of N − 1.

—*R.R.F.*

```
(FACTORIAL (N)
(COND ((EQ N 1) 1)
(T (TIMES N (FACTORIAL (SUB N 1))))))
```

The 3600 System, *from Symbolics Inc., Cambridge, Mass., has a 36-bit CPU designed to execute LISP programs. The system also features a 68000 coprocessor for keyboard and mouse control, a 1 million-pixel color display and a Multibus for peripheral expansion.*

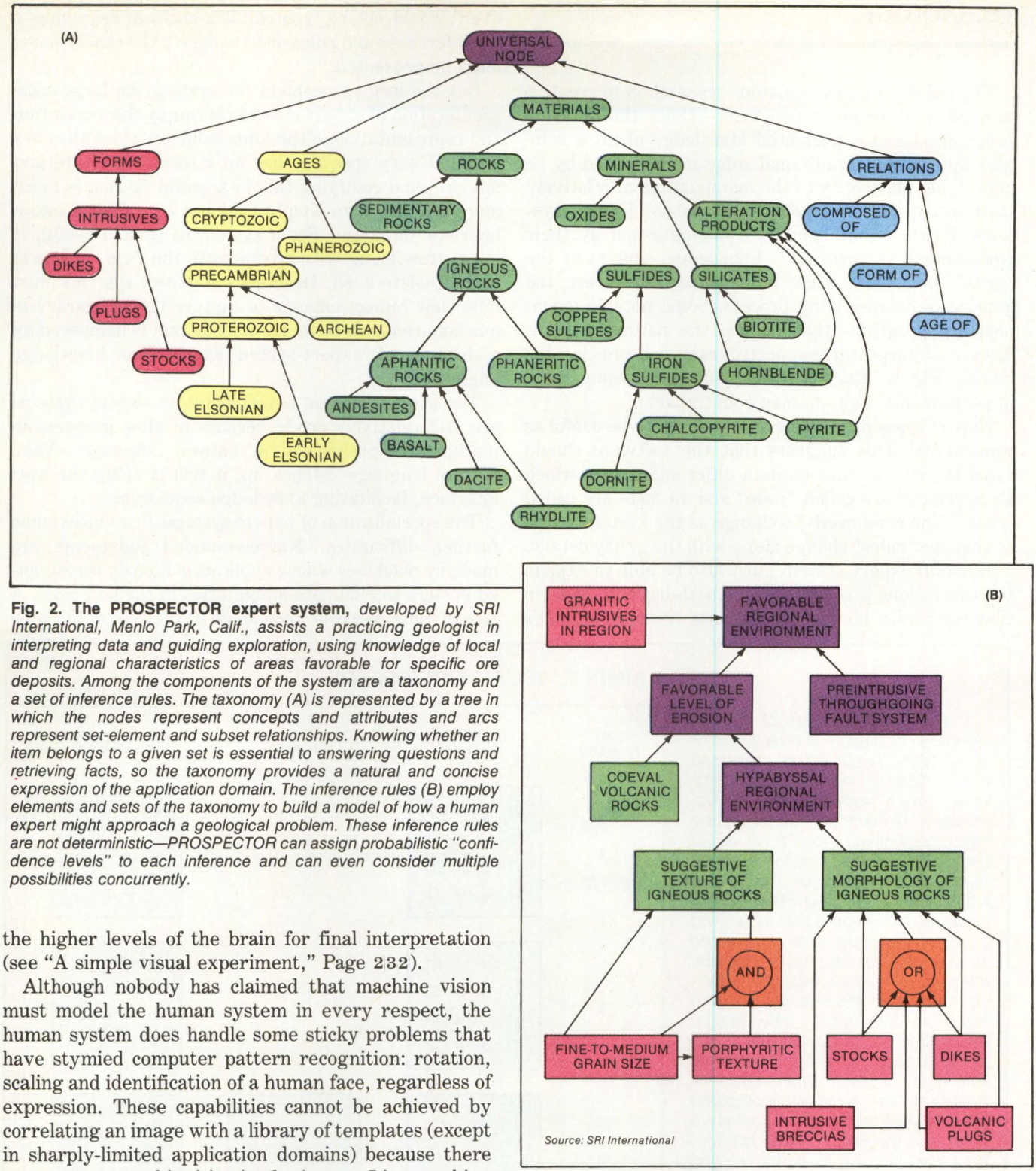


Fig. 2. The PROSPECTOR expert system, *developed by SRI International, Menlo Park, Calif., assists a practicing geologist in interpreting data and guiding exploration, using knowledge of local and regional characteristics of areas favorable for specific ore deposits. Among the components of the system are a taxonomy and a set of inference rules. The taxonomy (A) is represented by a tree in which the nodes represent concepts and attributes and arcs represent set-element and subset relationships. Knowing whether an item belongs to a given set is essential to answering questions and retrieving facts, so the taxonomy provides a natural and concise expression of the application domain. The inference rules (B) employ elements and sets of the taxonomy to build a model of how a human expert might approach a geological problem. These inference rules are not deterministic—PROSPECTOR can assign probabilistic "confidence levels" to each inference and can even consider multiple possibilities concurrently.*

the higher levels of the brain for final interpretation (see "A simple visual experiment," Page 232).

Although nobody has claimed that machine vision must model the human system in every respect, the human system does handle some sticky problems that have stymied computer pattern recognition: rotation, scaling and identification of a human face, regardless of expression. These capabilities cannot be achieved by correlating an image with a library of templates (except in sharply-limited application domains) because there are too many ambiguities in the image. Lines making up an object can be obscured by noise or uniform lighting, extra lines that don't really exist can appear as a result of pattern or texture, and objects can partially hide behind other objects, presenting a surface not explicitly defined to the system. To compound these problems, humans deal with visual data holistically—processing an entire scene—while computers do it pixel by pixel. For these reasons, a general-purpose vision system will probably elude researchers for some time to come. In the meantime, the most impressive results should be obtained in highly-specialized robotics applications such as edge detection and image irradiance.

Expert systems

The development of systems that can be put to work in a consulting capacity is another major research area in AI. Unlike natural-language systems, which deal with a wide range of human verbal expression, expert systems are defined as application-oriented machines, placing them immediately in the realm of the practical.

The object of expert-systems research is to create a new class of computer programs—those that embody judgmental and experiential knowledge about a complex application. Traditional software is limited by its underlying philosophy to the manipulation of relatively static relationships between data items. Expert systems, on the other hand, are distinguished by their embodiment of "heuristic" knowledge, and even the "meta" knowledge that humans use to direct the general problem-solving process. Some notable examples are programs that deduce the nature of plant diseases, interpret mass spectrograms and prospect for metals (Fig. 2). Each of these programs is comparable in performance to its human counterpart.

Expert systems must be able to learn to be useful as consultants. This suggests that the software should avoid the classic function-data differentiation in which all heuristics are called "code" and all facts are called "data." The code needs to change as the system learns so that the "rules" change along with the gritty details.

A useful expert system must also be able to explain the conclusions it reaches. A medical-diagnosis system that ponders a bit and then prints "remove patient's liver" would not be trusted. The chain of reasoning—the inferences and rules used to derive the conclusion—must be presented.

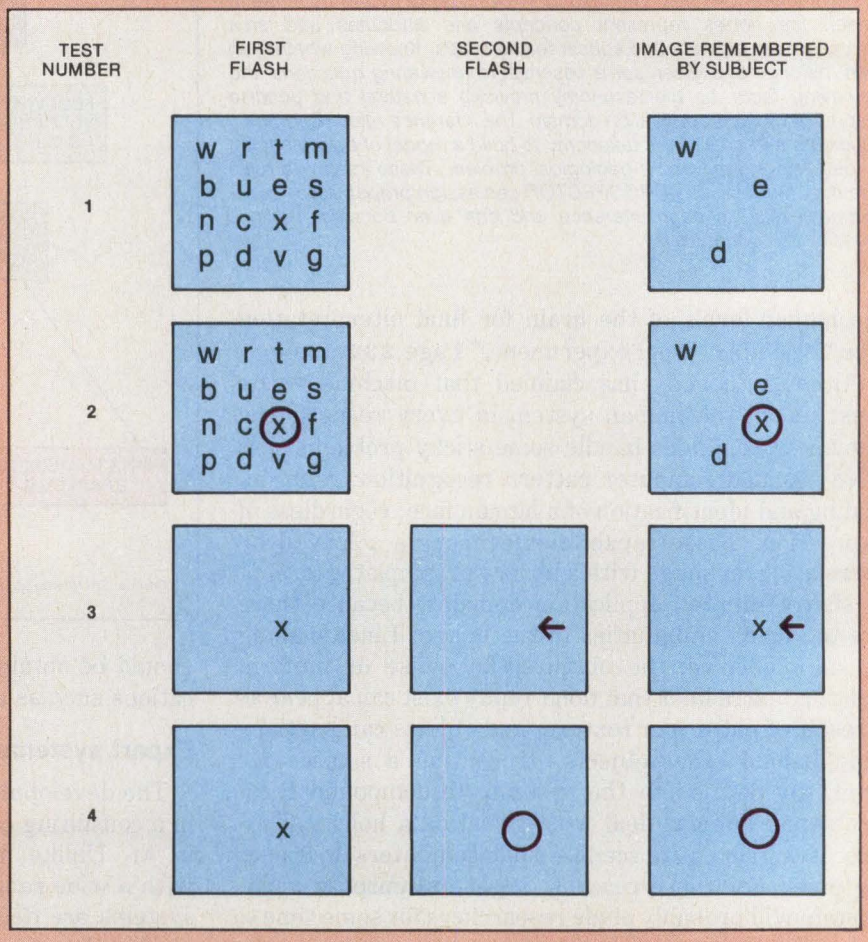
But the largest problem frustrating the large-scale proliferation of expert systems is simply the acquisition and representation of the knowledge on which they are based. Every specialty has an associated culture and folklore, and codifying this in a useful fashion is much more difficult than simply typing a set of rules into a heuristic database. For a system to remain useful, it must grow along with advances in the field, or it will soon obsolete itself. Designers of expert systems must interview human experts to capture their wizardry in machine-readable form, an activity that is hampered by a shortage of "expert-system experts," or knowledge engineers.

The user interfaces associated with expert systems are still relatively crude because of slow progress in machine comprehension of natural language. When natural language catches up, it will simplify the user interface, facilitating knowledge acquisition.

The specialization of expert systems introduces some further difficulties. Narrow-minded judgments are made by machines whose application domain is restricted enough to eliminate ambiguities in the language. A lack of general-world knowledge at the root of machine

A SIMPLE VISUAL EXPERIMENT

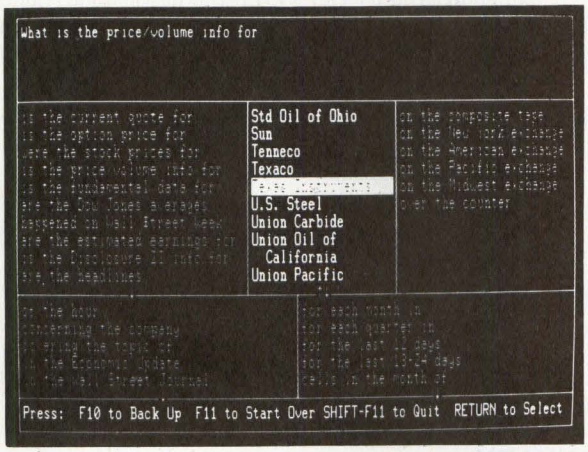
The multilevel nature of human vision can be observed by a series of visual tests. A subject is presented with a flash of light displaying 16 letters in a 4-by-4 array on an otherwise blank screen. Typically, he remembers three or four of the letters (test 1). The experiment is then repeated with one of the letters highlighted by a circle. The subject invariably remembers *that* letter (test 2). Now, the experiment is changed so that there are two flashes of light, the second flash appearing less than 15 msec. after the first. Because 15 msec. is the approximate image-decay time of the human retina, one would expect that images displayed less than 15 msec. apart would be perceived as a single composite image. When the first flash contains a letter and the second flash contains an arrow pointing to it, the subject does remember a composite image (test 3). But, when the second flash contains a circle that, if overlaid, would surround the letter shown in the first flash, the subject remembers only the circle (test 4). The circle, which the subject subconsciously recognizes as a basic visual element, erases the information—the letter from the first flash—that had been assimilated during previous levels in the visual process.



"understanding" forces them into rather limited roles.

Limitations and problems notwithstanding, expert systems are being applied to a rapidly-growing range of fields. One of the most famous is the Mead-Conway VLSI system, which embodies much of the knowledge in this complex field. Of all the research areas in AI, expert systems are the most likely to yield commercial products in the near future.

The NaturalLink program, *developed by Texas Instruments Inc., is a natural-language front end for the Dow Jones & Co. Inc. News/Retrieval service. It translates English sentences into the cryptic command syntax of the Dow Jones database (right). The program, which runs in 256K bytes of memory on the TI Professional Computer, drives a windowed display screen (above) that allows users to construct English sentences from lists of key words and phrases simply by positioning the cursor and pressing the RETURN key.*



DOW JONES COMMAND	NATURALLINK COMMAND
, ALD RJR	What is the current quote for Allied and R.J. Reynolds?
; BS 82 Q	What were the stock prices for Bethlehem Steel for each quarter in 1982?
; BS P1	What were the stock prices for Bethlehem Steel for the last 12 days?
$BA/P	What is the price/volume information for Boeing?
$TXN/F	What is the fundamental data for Texas Instruments?
. I/DJA	What are the Dow Jones averages?
//WSW	What happened on Wall Street Week?
//EARN TXN	What are the estimated earnings for Texas Instruments?
. I/HOH	What are the headlines of the hour?
. TXN O1	What are the headlines concerning the company TI?
. EDP O1	What are the headlines covering the topic of computers?
//MOVIES	What movie reviews are available?
//WTHR	What weather data is available?

Source: Texas Instruments Inc.

Social and legal issues

A question that inevitably arises when artificial intelligence is discussed outside the AI community is whether there will ever be a machine that can think. It's a sensitive issue, and one that seldom fails to spark heated controversy. Most people cling tenaciously to the last bastions of unsimulated humanity: creativity, humor, awareness and feeling. But we can expect continued advances in machine performance to permeate society more and more. Jobs that can be codified heuristically are candidates for computerization, threatening the vast community of "middle management" with the same replacement paranoia that afflicts the blue-collar population. This could backlash into an uprising against intelligent machines, raising the issue of "legal rights" for the machines.

Although barely visible, this is already occurring. As corporations become AI based, the legal distinction between company and computer could begin to blur, opening the door to the scenario in which a computer would indirectly possess the legal rights currently reserved for corporations. This boundary crossed, it would be difficult to argue that intelligent machines should not be fully enfranchised members of society. Although it sounds absurd, given the state of the art and society's historical tendency to extend rights as situations arise, it is not an unreasonable extrapolation.

Questions such as these are still largely reserved for idle musing and cocktail-party chatter, but developments in the field suggest that society should begin to think about them. Computer vision and natural language are on their way, and competent expert systems are now on the market. We must start to make room for machines that think. □

Steven Roberts is president of Words'Worth Inc., a Dublin, Ohio, consulting company, and author of *Industrial Design with Microcomputers* (Prentice-Hall) and several other books and articles about related technologies.

HOW MANY DRAWERS IN YOUR DESK?

Questions such as this one show the difference between human and computer approaches to fact retrieval. A traditional computer system, augmented by a natural-language capability, would translate the question into a database query. But, if it did not find the answer in its database, the computer would be stumped. A human, on the other hand, generally does not explicitly store such infrequently accessed data. To answer the question, a person would recall a visual image of the desk and then count the drawers in the image. Although this process is slower than querying a database, it is more "efficient" to store one image from which facts can be derived as needed than to anticipate all possible questions and store the answers explicitly.

—R.R.F.

Calendar

DECEMBER

11-15 Data Training '83 Conference & Expo, San Francisco, sponsored by *Data Training* newspaper. Contact: Loretta Wolman, Conference Manager, Data Training '83, 176 Federal St., Boston, Mass. 02110, (617) 542-0146.

12-16 "Command, Control and Communications" Course, San Diego, sponsored by the Armed Forces Communications and Electronics Association (AFCEA). Contact: AFCEA Professional Development Center, 5641 Burke Centre Parkway, Burke, Va. 22015, (703) 425-8500 or (800) 336-4583.

13-15 Automatic Testing & Test Instrumentation '83, Brighton, England, sponsored by Network Events Ltd. Contact: Network Events Ltd., Printers Mews, Market Hill, Buckingham, England, MK18 1JX, (028 0) 815226.

JANUARY

9 Invitational Computer Conference, Irvine, Calif., sponsored by B.J. Johnson & Associates Inc. Contact: B.J. Johnson & Associates Inc., 3151 Airway Ave., #C-2 Costa Mesa, Calif. 92626, (714) 957-0171. Also to be held Feb. 7 in Fort Lauderdale, Fla., Feb. 28 in Los Angeles and March 1 in Palo Alto, Calif.

10-13 "Hands-On UNIX" Workshop, San Diego, sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, Los Angeles, Calif. 90045, (213) 450-2060. Also to be held in Washington, Jan. 31-Feb. 3, Los Angeles, Feb. 28-March 2, Boston, March 27-30.

12-13 Third Annual Semiconductor Pure Water Conference, San Jose, Calif., sponsored by Westly Enterprises. Contact: Pat Westly, Westly Enterprises, 3697 South Court, Palo Alto, Calif. 94306, (415) 494-7115.

25-27 Business Telecommunications Exposition, East Rutherford, N.J., produced by TEG Inc., The Exposition Group. Contact: Michael C.J. Houston, Vice President of Sales, TEG Inc., 9128 Columbia Ave., North Bergen, N.J. 07047, (201) 662-1318.

JANUARY 31 - FEBRUARY 3

Communications Networks 1984 Conference & Exposition, Washington, managed by ICW/Conference Management Group. Contact: Louise Myerow, Registration Manager, ICN 1984, P.O. Box 880, Framingham, Mass. 01701, (617) 879-0700.

FEBRUARY

20-22 Office Automation Conference, Los Angeles, sponsored by the American Federation of Information Processing Societies (AFIPS) Inc. Contact: Ann-Marie Bartels, AFIPS Inc., 1815 N. Lynn St., Arlington, Va. 22209, (703) 558-3617.

SYSTEMS

Three new computers strengthen high end of Honeywell small system family

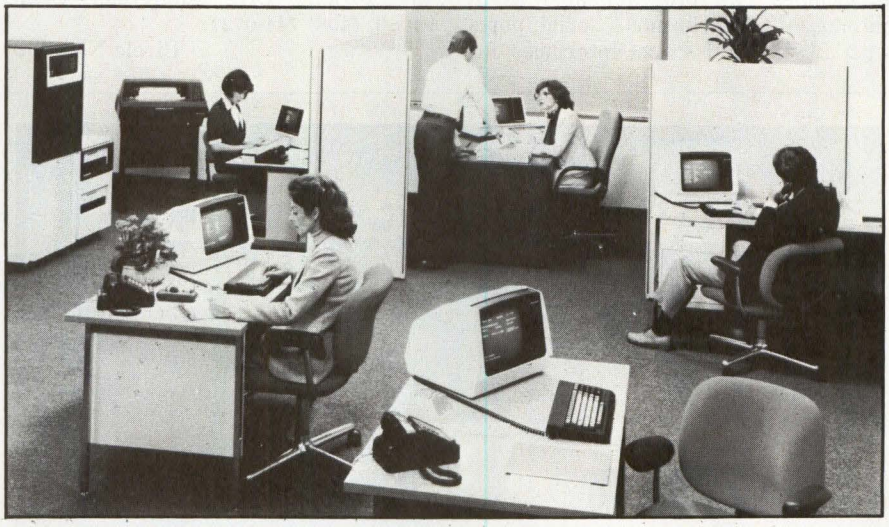
Honeywell Inc. has realigned its DPS 6 small systems product line with three high-end models. At the same time, the company introduced the TotalCare customer service program.

The new models are the 16-bit DPS 6/45 and DPS 6/75 minicomputers and the 32-bit DPS 6/95 minicomputer. They join the microSystem 6/10, microSystem 6/20 and DPS 6/40—all announced since April. The new computers augment the company's earlier DPS 6 models, which still will be marketed. All models run the GCOS 6 operating system.

The models were designed to operate primarily in interactive COBOL environments. Each is equipped with a commercial instruction processor for maximum COBOL performance. In addition, a scientific instruction processor can be added for high-performance processing in FORTRAN and Pascal.

The entry-level DPS 6/45 can be upgraded on-site to a DPS 6/75 or a DPS 6/95. On a single board, the DPS 6/45 integrates Honeywell's 16-bit Micro 6 microprocessor, 512K bytes of memory (expandable to 2M bytes), a commercial instruction processor (CIP), a memory-management unit (MMU) and a remote support facility (RSF). The basic computer also contains a multiple device controller (MDC-III) with a panel-mounted 5¼-inch floppy disk drive and a multiline communications controller (MLC-16) with four communications lines.

The DPS 6/75 delivers twice the performance of the DPS 6/45 and is the highest-performance 16-bit member of the DPS 6 line. The basic system includes the processor, the cache, CIP, RSF, MDC-III, 1M byte of memory, an MLC-16 and a user-specified mass-storage subsystem. The DPS 6/75 can be upgraded on-site to the 32-bit DPS 6/95.



Honeywell Inc.'s DPS 6/75 16-bit minicomputer *typically supports 12 to 40 users and can access 2G bytes of on-line mass storage.*

The top-of-the-line DPS 6/95 starts with 2M bytes of main memory and is priced at $40,000 less than the company's previous top-of-the-line 32-bit small system. The DPS 6/95 includes a high-speed cache, a central processor, a commercial instruction processor and a scientific instruction processor. The central processor includes both 16- and 32-bit data registers. A 32-bit disk controller on the DPS 6/95 simultaneously supports as many as three disks in seek mode while reading/writing on the fourth.

The RSF, a standard internal component on all three new models, enables Honeywell to assume remote control and operation of a user's system for problem diagnosis. Similarly, users can remotely operate and control the systems for software updates and corrections and system initialization.

The TotalCare customer-service program offers a four-hour and optional two-hour response time on service calls and a 90-day warranty that covers parts and labor.

The DPS 6/45, DPS 6/75 and DPS 6/95 are available immediately at base prices of $20,000, $35,000 and $80,000, respectively. **Honeywell Inc.,** 200 Smith St., Waltham, Mass. 02154, (617) 895-3247.

Circle No 300

Business system supports 12 users

The Poppy line of 16-bit personal business systems supports as many as 12 users in a multitasking environment. The Poppy uses a dual-processor architecture based on Intel's 80186 and 80286 microprocessors. Standard hardware features include an RS232/RS422 communications port, a parallel printer port, an asynchronous/bisynchronous/bit-synchronous communications port with RS232/RS422 line drives, a 14-in. CRT screen with tilt-and-swivel adjustment and a detached slimline keyboard. The Poppy's modular design allows flexibility in the choice and use of peripherals and add-ons, and it uses MS/DOS, CP/M-86, MP/M-86 and XENIX software operating systems. The vendor's Star BASIC business-oriented language operates under XENIX or MS/DOS. A basic Poppy, consisting of a 16-bit microprocessor with 128K bytes of RAM, two 800K-byte, 5¼-in. floppy disk drives, a CRT screen, a keyboard and the MS/DOS operating system, is priced at $4395. **Durango Systems Inc.,** 3003 N. First St., San Jose, Calif. 9513

Circle No 301

New Products

SYSTEMS

Single-board computer can be field upgraded

Starfield, a 6¾-by-12-inch single-board computer, features the Motorola MC68000 10-MHz 16-bit microprocessor. It includes two programmable asynchronous or synchronous serial ports with RS232C and RS422 interfaces for terminal or host connection. It contains 256K bytes of on-board dynamic RAM, expandable to 512K bytes. A private memory bus and an iSBX port for I/O expansion using multimodules are also supplied. $2,995. **Cosmos Systems Inc.,** 430 Toyama Dr., Sunnyvale, Calif. 94086, (408) 744-0721.

Circle No 302

Self-contained minicomputer serves OEM needs

Designed for OEM and defense markets in scientific, engineering, technical and multiuser applications, the Harris 600 minicomputer includes a CPU with 16 priority interrupts and interval timer, a 756K- or 1.5M-byte integrated memory subsystem, a communications network processor with two RS232C ports, an 11-slot chassis with power supplies, a control panel and the VOS virtual operating system. It can support as many as 32 terminals. Prices start at $38,900. Delivery is 90 to 120 days after receipt of order. **Harris Corp., Computer Systems Division,** 2101 W. Cypress Creek Rd., Fort Lauderdale, Fla. 33309, (305) 974-1700.

Circle No 303

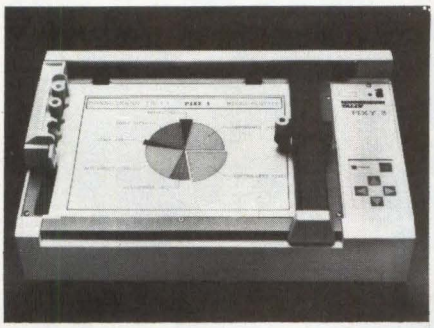
68000 development station is intended for VAX

The DVX-68 development station lets users perform off-line debugging and modification of 68000-based system code compiled on VAX systems. It consists of the vendor's SBP-68Q single-board 68000 processor, a 128K-byte SM-68 high-speed static memory board, a PPL-2 peripheral processor link for sharing as much as 64K bytes of memory with the VAX CPU, a 68000 FORTRAN cross-assembler that runs under VAX/VMS and a four-line DVL11J or equivalent serial port card. The entire subsystem is contained in a 5½-inch-high rack-mount enclosure with an eight quad-slot Q-bus backplane and a 50A power supply. $9,860. **Ranyan Computer Enhancement Systems,** 15239 Springdale St., Huntington Beach, Calif. 92649, (714) 895-5504.

Circle No 304

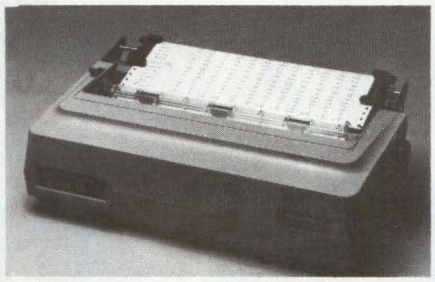
New Products

PRINTERS



Three-pen plotter produces charts, graphs

The PIXY three-pen plotter produces charts, graphs, histograms and other types of graphics displays and can be used with personal computers such as the IBM PC and the Apple II and IIe. Built-in graphics software generates circles, spirals and open or closed curves and expands or contracts one or both axes of a graph by using single commands. The PIXY plots on standard 8½-by-11-inch paper or transparencies at speeds as high as 200 mm. per sec. and resolution to 0.1 mm. It features a 96-character ASCII set, Greek, scientific and special characters and nine international language sets. $795 with parallel interface, $880 with serial interface. **Mannesmann Tally Corp.,** 8301 S. 180th St., Kent, Wash. 98032, (206) 251-5524. **Circle No** 305



Dual-mode printer suits 8-/16-bit computers

The MT 180, a wide-carriage (15 inches), serial matrix impact printer, works with 16-bit microcomputers such as the IBM PC and the DEC Rainbow and with 8-bit microcomputers such as the Apple II and IIe and the Osborne. Serial and parallel interfaces are standard. The MT 180 combines 40-cps, letter-quality printing with 132-column, 160-cps printing for spreadsheet, accounting and report preparation. Internal software integrates text and 100-by-64-dpi graphics printing in one document. The $998 MT 180I features high-speed printing only; the $1,098 MT 180L adds letter-quality printing. **Mannesmann Tally Corp.,** 8301 S. 180th St., Kent, Wash. 98032, (206) 251-5524.

Circle No 306

Graphics printer offers nine type sizes

The model 4135 microprocessor-based impact matrix graphics printer offers nine type sizes and performs character enlargement, type reversal, underlining, italicizing and simultaneous printing of text and 160-dpi resolution graphics at 160 lpm. The printer accepts

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M	Passive Components
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O	Tools and Production Equipment
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Q	Instrumentation/Test Equipment
R	Control Systems
S	Mechanical/Electronic Packaging
T	Data Communications
U	Power Sources
V	Other

graphics commands from Tektronix Plot 10 software and BASIC. The 4135 connects with RS232C and 20-mA current-loop serial interfaces and with Centronics and Dataproducts parallel interfaces. $9,500. Delivery: 60 days. **KEL Inc.,** 1 World Trade Center, Suite 4811, New York, N.Y. 10048, (212) 524-8350. **Circle No** 307

Six-pen color plotter accepts three pen types

The model VP-6801P digital six-pen color plotter uses fiber, ball-point or plastic-tipped pens in black, red, purple, blue, green and brown. It generates color impressions at 16 ips over a plotting area of 10 inches along the X axis and 7.2 inches along the Y axis. Applications include graphs, charts, diagrams and computer-assisted design graphics. The unit accepts ASCII 8-bit parallel, GP-IB and RS232C interfaces. $1,995. **Panasonic Industrial Co.,** 1 Panasonic Way, Secaucus, N.J. 07094, (201) 348-7183. **Circle No** 308

Daisy-wheel printer runs quietly

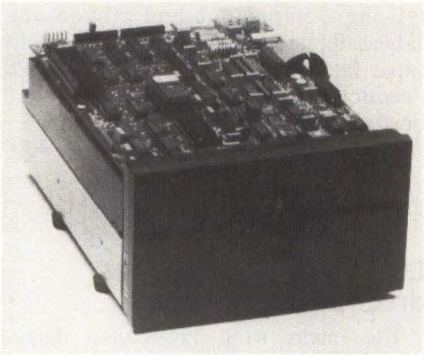
The model DI-1000 daisy-wheel printer offers letter-quality printing at 18 cps using a 96-character Qume-compatible print wheel. On paper as wide as 13 inches, it prints 120, 144 and 180 characters per line at 10, 12 and 15 cpi, respectively. The printer features a 58-dBA operating noise level. Operator controls include on-line, line-feed, set-page, paper-out and ribbon-out indicators; page advance; and adjustable paper-feed knobs. $645. **Data Impact Products Inc.,** 745 Atlantic Ave., Boston, Mass. 02111, (617) 482-4214. **Circle No** 309

Low-cost printer uses drop-in daisy wheel

The model 6100 110-column daisy-wheel printer offers letter-quality printing at 18 cps using a 100-character drop-in print wheel. It features a graphics mode and prints 82 to 220 characters per line in proportional spacing mode. The printer employs friction paper feed; a tractor form feed and a cut-sheet feeder are optional. A Centronics interface is standard; an RS232C interface is optional. $699. **Juki Industries of America Inc.,** 421 N. Midland Ave., Saddle Brook, N.J. 07662, (201) 796-8800. **Circle No** 310

New Products

DISK/TAPE



Floppy drives store 3M bytes on one diskette

This two-member family of minifloppy disk drives provides as much as 3.3M bytes of data storage capacity using both sides of 5¼-inch UHR-II diskettes. The model 1560 drive stores 3.3M bytes of unformatted capacity using double-sided recording at a density of 9,500 bpi at 170 tpi over 160 tracks. Its interface is functionally compatible with that of the Shugart Associates SA460 minifloppy drive or its equivalent, except that it has a 500K-bit-per-second data-transfer rate. The model 1860 drive stores 3.2M bytes of unformatted data using double-sided recording at a density of 9,500 bpi at 170 tpi over 154 tracks. Its interface is functionally compatible with that of the Shugart Associates SA850 maxifloppy drive or its equivalent. Its data-transfer rate is also 500K bits per second. Both drives have 88-msec. average access times. $370 each (500 units). **Amlyn Corp.,** 2450 Autumnvale Dr., San Jose, Calif. 95131, (408) 946-8616.

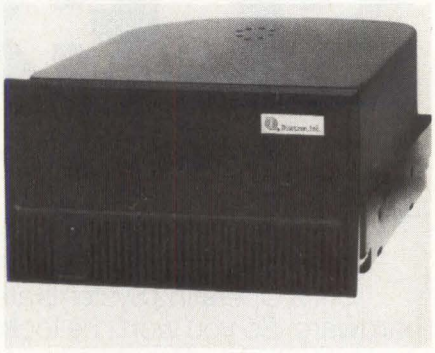
Circle No 311

Streaming tape backs up IBM PC hard disks

The Davong standalone streaming-tape drive backs up Winchester or floppy disk drives used with IBM PC and XT microcomputers. An adapter for tape backup plugs directly into an IBM PC or XT expansion slot. The tape drive copies data to a ¼-inch, 450-foot-long tape

cartridge with an 18M-byte formatted capacity. Software utilities provide for initial checkout, copying from floppy or hard disk to tape and restoring files from tape to hard disk or floppy. Under the vendor's Multi-OS control system, backup can be accomplished by volume or individual file. A 15M-byte disk can be copied in about 4 minutes. Average data-transfer rate is 28.9K bytes per second, linear speed is 90 ips, and bit density is 8,000 bpi. $2,195. **Davong Systems,** 217 Humboldt Court, Sunnyvale, Calif. 94089, (408) 734-4900.

Circle No 312



Mini-Winchester features plated media

The D-700 series of three 5¼-inch Winchester disk drives store 21.1M, 35.2M and 49.3M bytes (formatted). All three models feature mini-Winchester heads, thin-film-plated media, a linear voice-coil actuator, closed-loop servo positioning and a dedicated landing/shipping zone. Average access time is 35 msec. Data-transfer rate is 5M bits per second. The drives use standard DC voltages (+5V, +12V) and standard extended floppy interfacing (ST412). $745 to $990 (OEM quantities). **Disctron,** 1701 McCarthy Blvd., Milpitas, Calif. 95035, (408) 946-6692. **Circle No** 313

New Products

TERMINALS

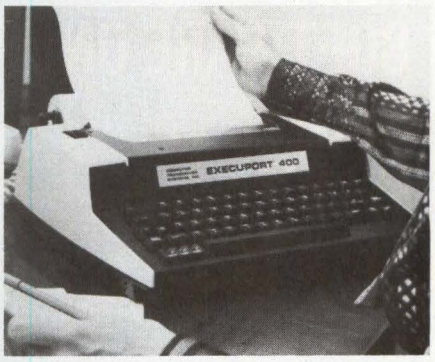
Terminal emulates DEC, Hazeltine units

The model 100/1500 terminal operates in DEC and Hazeltine environments. In ANSI mode, the terminal emulates the VT100 series (with advanced video option) except VT52 compatibility. Capabilities include a 132-column-by-24-line display, a bidirectional RS232 peripheral port, a 256-character input buffer, four smooth-scroll rates, double-height, double-width characters and an 880-character non-volatile function memory with 20 keyboard-programmable functions on dedicated keys. In Hazeltine mode, the terminal employs the same control codes and escape sequences as the 1500, 1510 and 1520 terminals and operates in character and format (block) modes. The model 100/1500 comes with 9-, 12- or 15-inch CRTs and white, green or amber CRT phosphors. 12-inch style: $1,745. **Teleray Division of Research Inc.**, P.O. Box 24064, Minneapolis, Minn. 55424, (612) 941-3300.

Circle No 314

Teleprinter has 16,000-character memory

Suited for electronic-mail and time-sharing applications, the Execuport 443 plain-paper impact printing terminal has a memory capacity of 16,384 characters. Printing speed is 80 cps at



15 cpi. Communication speed is selectable from 110 to 1,200 baud. The teleprinter is Telex I and II, International Telex and DDD compatible and operates in originate and auto-answer modes. Other features include a built-in dialer, a built-in 300-baud modem, a direct-connect plug-in for an RJ11 telephone jack and an RS232 interface. $1,795. **Computer Transceiver Systems Inc.**, P.O. Box 15, E. 66 Midland Ave., Paramus, N.J. 07652, (201) 261-6800.

Circle No 315

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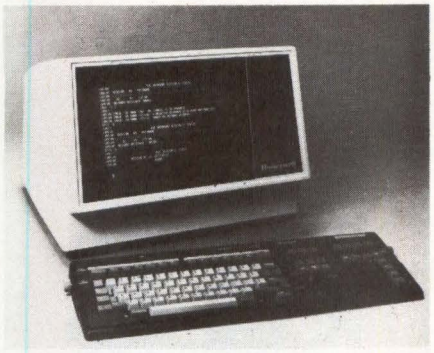
New Products

TERMINALS

Graphics terminal emulates Tektronix units

The GO-140, an integrated alphanumeric/graphics computer terminal, emulates Digital Equipment Corp.'s VT100 and the Tektronix 4010, 4012 and 4013. Its alphanumeric features include 24 lines of 80 or 132 characters, a selectable status line, 96 displayable ASCII characters and bidirectional split-screen smooth scrolling. Graphics features encompass 512-by-390-pixel bit-mapped display resolution for a 4:3 display-to-aspect ratio. The terminal is compatible with PLOT 10, Dissplа, Tell-A-Graf and DI3000/GRAFMAKER graphics software packages. It can store a screen of graphics and an alphanumeric page or four alphanumeric pages. $1,995. **GraphOn Corp.,** 2255H Martin Ave., Santa Clara, Calif. 95050, (408) 980-8500.

Circle No 317



Terminals incorporate multifunction keyboard

The VIP7305, VIP7315, VIP7325, VIP7813 and VIP7823 editing terminals feature a multifunction keyboard with application-specific overlays, allowing a user to perform both word- and data-processing tasks. The VIP7800 series offers character, line and block transmission; forms-mode editing; 72-line vertical scrolling; and a buffered printer adapter. The VIP7300 series provides character-mode transmission and right/left scrolling. The asynchronous terminals transmit data via RS232C, RS422A, 20-mA current loop or MIL STD 188C interfaces. They use a standard 24-line-by-80-character display format with a 25th status line. $2,350, VIP7800 series; $1,900, VIP7300 series. **Honeywell Inc.,** 200 Smith St., Waltham, Mass. 02154, (617) 895-6616.

Circle No 318

New Products

DATACOMM

Modem stores 52 32-digit numbers

The Info-Mate 212A 300-/1,200-baud modem automatically adapts to the host's communication parameters. The unit features auto dial, auto answer, auto-speed select, auto-parity select and auto or manual selection of pulse or tone dialing. All commands are entered from the host data terminal or computer over the RS232C interface using ASCII characters. The modem's non-volatile memory stores as many as 52 32-digit telephone numbers or log-on messages for database access. $595. **Cermetek Microelectronics Inc.** 1308 Borregas Ave., Sunnyvale, Calif. 94089, (408) 734-8150.

Circle No 319

Data-compression unit doubles line capacity

The Scotsman III data compressor doubles the throughput of a high-speed data link, allowing a 19,200-bps data stream using conventional 9,600-bps modems. The unit is compatible with asynchronous, bisynchronous, X.25, SDLC and HDLC protocols. A cyclic redundancy check detects errors between data-compression units. A self-test mode allows Scotsman III to run built-in diagnostics to test the microprocessors, RAMs, ROMs and other circuitry. The device collects statistical data including number of messages and bytes passed, compression ratio and buffer utilization. $5,000. **Racal-Vadic,** 1525 McCarthy Blvd., Milpitas, Calif. 95035, (408) 946-2227.

Circle No 321

Modem concentrates two terminals on one link

The model 2X212 MODEMplexer is a Bell 212A-compatible, full-duplex, 1,200-baud device that functions as a two-channel statistical multiplexer and a modem. It enables two remote terminals to transmit on one line. It features auto dial, auto answer, automatic redial of last number called and automatic selection of correct dialing mode. The device also provides speed dialing from memory, a stored number directory, continuous memory, dynamic buffering to 3,000 characters per port and user-programmable hang-up code. $995. **Omnitec Data Inc.,** 2405 S. 20th St., Phoenix, Ariz. 85034, 1-(800) 528-8423.

Circle No 320

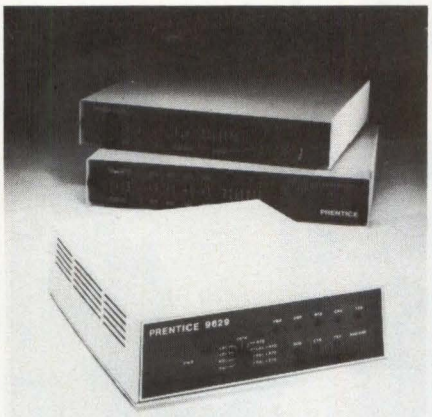
Asynchronous multiplexer plugs into dual Q-bus slot

The SCD-DZV11 dual-width asynchronous eight-line multiplexer supports RS232C terminals or remote lines and plugs directly into Digital Equipment Corp.'s LSI-11, Q-bus-based systems. This microprocessor-based multiplexer emulates the DEC unibus DZ11 eight-channel multiplexer and has jumper-selectable address and vector assignments. Other features include modem control and programmable speed for character length and stop bits. $715 (100 units). **Sigma Sales,** 6505 Serrano Ave., Anaheim, Calif. 92807, (714) 974-0166.

Circle No 322

Modem operates on unconditioned leased lines

The model 9629 synchronous, standalone modem suits operation over four-wire, 3002 unconditioned or equivalent lines in point-to-point applications. Peak operating data rate is 9,600 bps



with fallback rates of 7,200 and 4,800 bps to accommodate deteriorated line conditions. The unit features automatic adaptive equalization. Remote and local analog and digital loopback tests as well as unit self-test can be accomplished from the front panel. $2,750. **Prentice Corp.,** 266 Caspian Dr., P.O. Box 3544, Sunnyvale, Calif. 94088, (408) 734-9810.

Circle No 323

2,400-bps modem has auto-dial capability

The CDS 224 auto-dial modem operates on pulse- and tone-dialing telephone systems. It allows users to initiate telecommunications manually by dialing telephone numbers through an

asynchronous terminal keyboard or automatically through software-initiated commands. This full-duplex modem transmits at 2,400 bps in synchronous and asynchronous modes. It also features an automatic 1,200-bps, Bell 212-compatible fallback mode. Front-panel switches allow synchronous or asychronous mode selection. $1,195. **Concord Data Systems,** 303 Bear Hill Rd., Waltham, Mass. 02154, (617) 890-1394.

Circle No 324

Controller networks Apple, IBM, S-100 PCs

The 1553-NET local-area-network controller board links Apple, IBM or S-100 computers. This carrier-sensed-multiple-access controller with collision-avoidance and -detection features, provides computer network capability. It handles data-transfer rates as high as 3M bits per second and operates over coaxial cable. It features dual-channel communications for COMMAND and DATA, five levels of error protection for a 10^{-17} error rate, variable block sizes and switch-selectable network transmission rates. The board comes with a file-transfer program that runs under CP/M, CP/M-86, PC-DOS, MS-DOS and DOS 3.3. $349. **VLSI Networks Inc.,** 6214 W. Manchester Blvd., Suite 202, Los Angeles, Calif. 90045, (213) 642-0074.

Circle No 325

Software package lets users manipulate touch-sensitive interfaces

The Easel non-procedural, event-driven software facility lets users create and manipulate touch-sensitive, graphic front ends for new and existing applications. Easel interprets input from the application, the touch screen and other pointing devices. A user can execute commands, complete routines, create graphics images and charts and create files by touching the appropriate information on the screen. A user can also describe how and where an image is to be displayed, and images can be overlapped or stacked. Because Easel can support independent objects on the video display, several application programs and databases can be referenced simultaneously.

Easel's communications facility allows the passing, receiving and interpreting of data transparent to the application environment. It can connect as a front end for local applications written in C, FORTRAN, BASIC, Pascal or COBOL.

The licensing fee varies according to volume and the type of computer used. **Interactive Images Inc.,** 21 Olympia Ave., Woburn, Mass. 01901, (617) 938-8440.

Circle No 326

Source-code dictionary cross references COBOL

Robot/3000, a self-generating, self-maintaining COBOL source-code dictionary, automatically produces cross references of copy libraries and source code and provides eight displays for access to its database. Processing can be performed for source programs in a group or for those changed after a given date. The package runs on HP 3000 computers with Image, V/3000 and COBOL II software and with a V/3000-compatible terminal. Management reports can show program changes, number of changes and by whom. $5,000, including one year of maintenance. **Productive Systems Inc.,** 5617 Countryside Rd., Edina, Minn. 55436, (612) 920-3256. **Circle No 327**

Libraries process floating-point numbers

The Z80 and 8085 FPAC (single-precision)/DPAC (single and double precision) libraries process floating-point numbers in the proposed KCS IEEE formats. Library functions include arithmetic operations, integer-to-floating-point conversion, comparison of floating-point values, direct and inverse trigonometric functions, common and natural logarithms, exponentiation and conversion between ASCII and floating-point formats. Single-precision operations run at 2,000 to 4,000 floating-point operations per second on a Z80 with 6-MHz clock. FPAC, $750; DPAC, $1,250. **U.S. Software,** 5470 Innisbrook Place, Portland, Ore. 97229, (503) 645-5043.

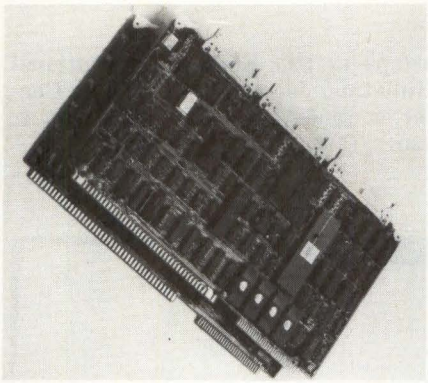
Circle No 328

Package provides data entry for VAX ISAM files

VDM is designed for interactive creation, manipulation and retrieval of indexed - sequential - access - method (ISAM) files with fixed- and variable-length records on DEC VAX-11 computers running under the VMS operating system. A file can contain multiple types of records, and multiple users can concurrently access a file, searching on full or partial keys, with selection based on the contents of any field. Each record can be indexed on several keys; information about keys and other file attributes is taken from VAX RMS file directories and headers. $2,500 to $8,500. **Viking Software Services Inc.,** 2815 E. Skelly Dr., Tulsa, Okla. 74105, (918) 745-6550. **Circle No 329**

New Products

LITERATURE



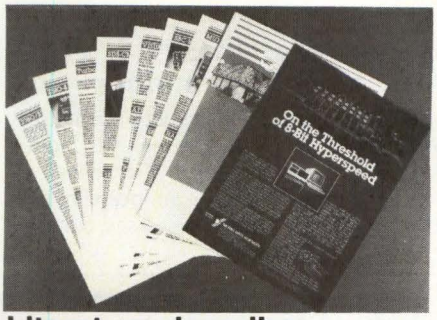
Local memory board described in brochure

The CD68K microprocessor system, which implements the Motorola 68000 microprocessor and local memory in an (IEEE)-796-compatible, two-board set, is described in a four-page, color brochure. The brochure lists the features and functions of the CPU and local memory boards including descriptions of memory management and protection, local memory interface and IEEE-796 bus interface. **Callan Data Systems,** 2637 Townsgate Rd., Westlake Village, Calif. 91361, (213) 991-9156.

Circle No 330

Guide lists packages for HP plotter, IBM PC

Graphics software packages that enable IBM PC users to produce high-quality charts and graphs on an HP 7470A graphics plotter are described in a software guide. The guide has 10 data sheets that describe software for creating pie, bar, line and text charts as well as for plotting business trends, projections and relationships. Each data sheet includes a description of the software package, sample plots to illustrate the graphics capability and a list of hardware requirements. Ordering information with suggested retail price follows each entry. Detailed information on connecting the HP 7470A to the IBM PC is provided also. **Hewlett-Packard Co.,** 1820 Embarcadero Rd., Palo Alto, Calif. 94303. **Circle No 331**



Literature describes 8-MHz S-100 products

A literature kit for S-100 product users describes the developments in high-speed, single-board-computer technology that have led to the company's 8-MHz single-board computer. Product and data sheets on all the current hardware from the company's Advanced Technologies division are included. **Sierra Data Sciences International, Advanced Technologies Division,** 25700 First St., Westlake, Ohio 44145, (216) 892-1800.

Circle No 332

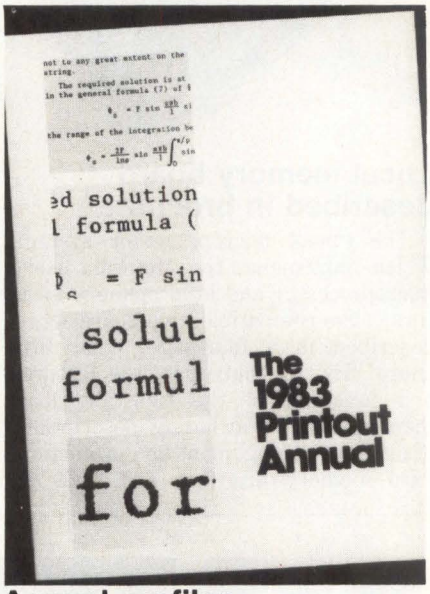
New Products

LITERATURE

Report examines Winchester technology

Addressed to technical and marketing executives in the microcomputer industry, *Winchester Disks in Microcomputers* by Jonah McLeod examines the disk memory industry and assesses current and likely future trends in disk manufacture. This research report also probes recent technological developments, such as the role of thin-film media and new solutions to interface and backup-storage problems, and surveys the major products and their suppliers. 180 pages, $95. **Elsevier International Bulletins, Journal Information Center,** 52 Vanderbilt Ave., New York, N.Y. 10017, (212) 867-9040.

Circle No 333



Annual profiles printer industry

The *1983 Printout Annual* profiles 34 printer manufacturers; lists printer products of more than 140 companies; and examines the computer printer market, printer sales through retail stores, high-density, impact matrix printers and intelligent copier/printers. More than 100 pages, $25. **Datek Information Services Inc.,** P.O. Box 68, Newtonville, Mass. 02160, (617) 244-2290.

Circle No 334

Directory is reference, buyers' guide

This guide to office-information systems equipment, software, supplies and services is designed to aid professional managers and novices. It offers product information, articles, charts and other educational tools on the latest technology for personal computers, office and word-processing systems, as well as selection tips and a glossary. $34.95 **Association of Information Systems Professionals,** 1015 N. York Rd., Willow Grove, Pa. 19090, (215) 657-6300.

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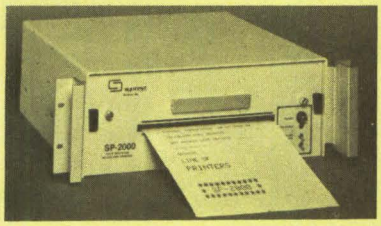

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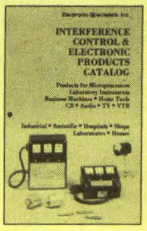

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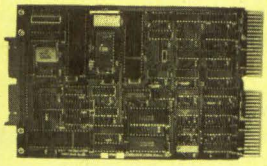

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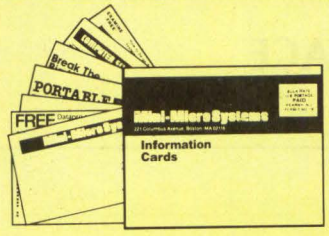

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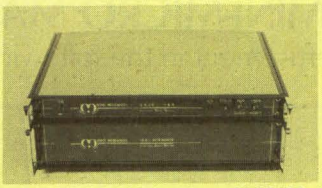

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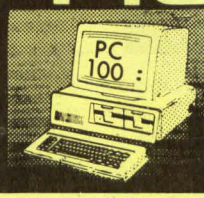

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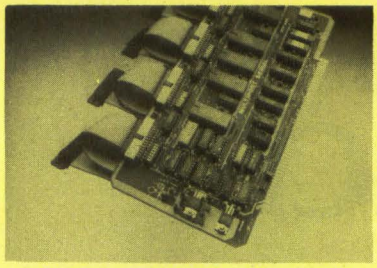

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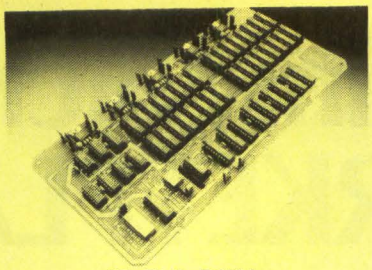

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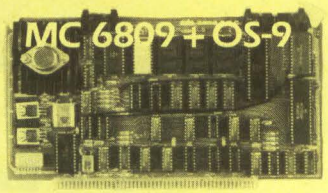

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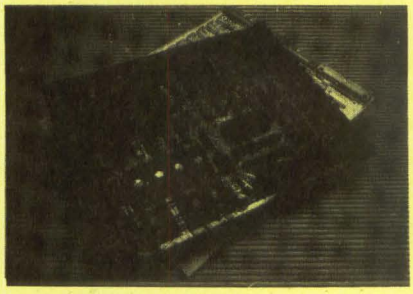

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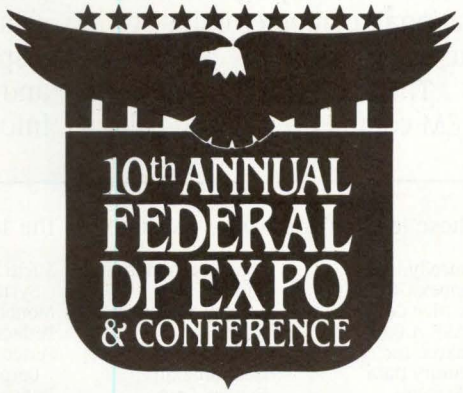

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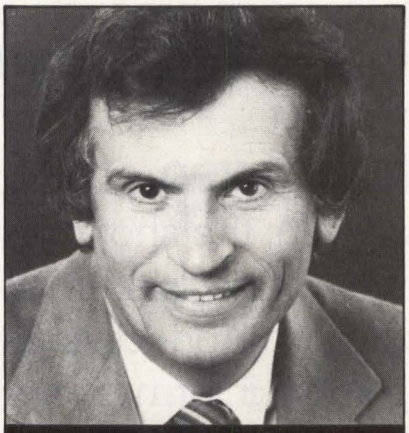

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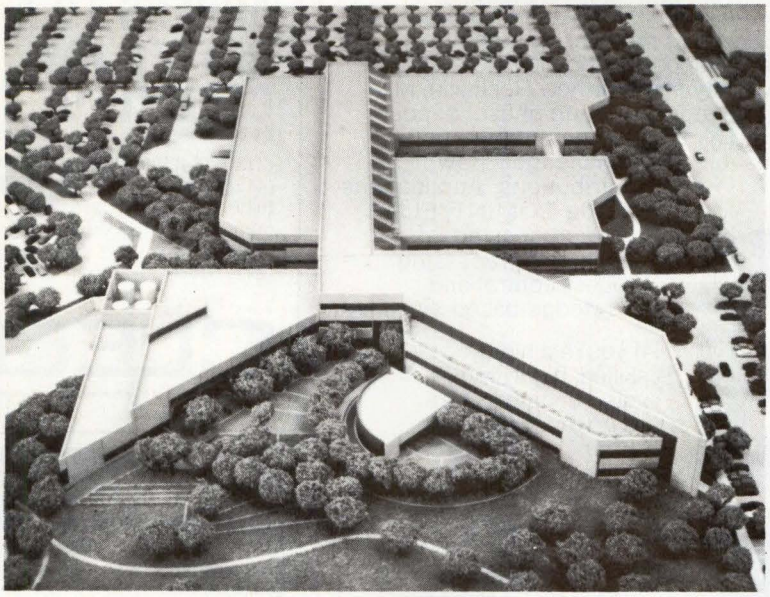

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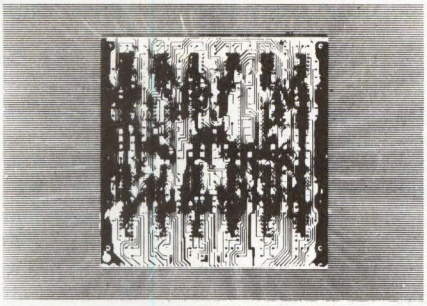

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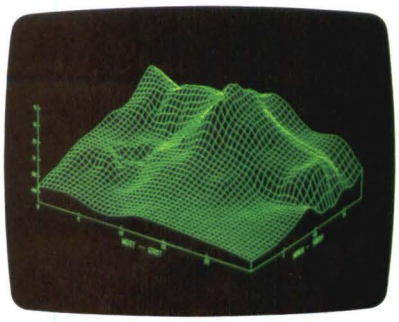

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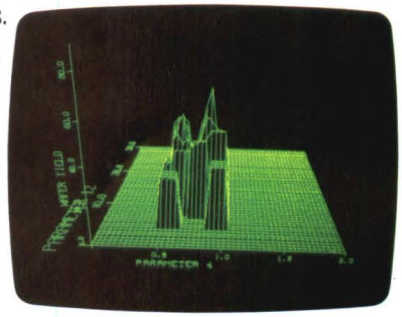

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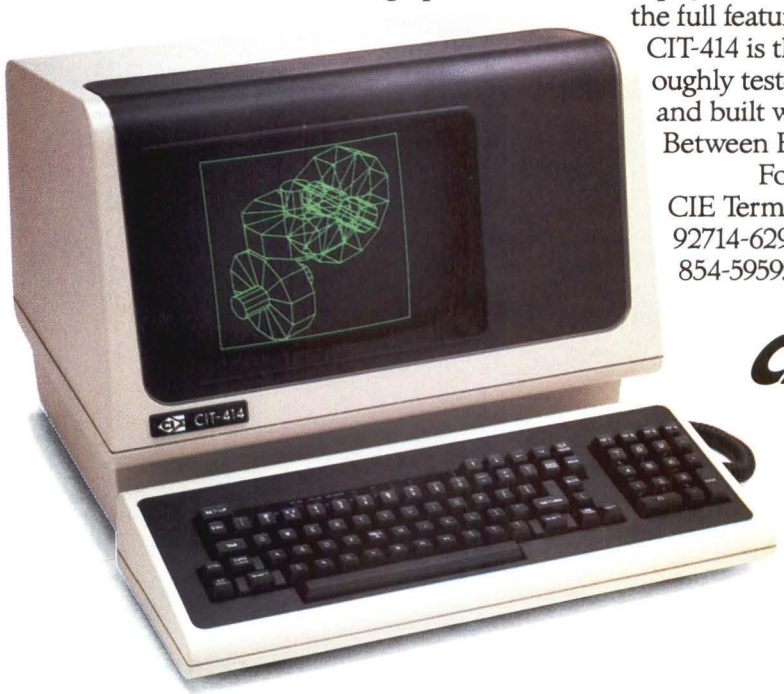

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CIRCLE NO. 2 ON INQUIRY CARD

Our IBM Protocol Converter is not the same under the skin.

MICOM's new Micro7400 is very, very different. It not only provides a Gateway for dumb asynchronous terminals to access IBM mainframe applications, but goes far beyond the basic capabilities of IBM 3270s and other protocol converters. *It's even easy to use.*

Since MICOM is the world's largest volume manufacturer of data concentrators—thanks to its Micro800/2 "Orange Box" family—it's only natural that MICOM's protocol converter should include the same features and capabilities that made the data concentrators so popular. And fortunately for asynchronous terminal users wishing they could connect to IBM mainframes, and for mainframe DP managers looking for less expensive terminals, adding concentrator features to a converter makes for a surprisingly effective hybrid.

All Standard IBM 3270 Features

Functioning as an IBM 3274 Model 51C Cluster Controller using either Bisync or SNA/SDLC protocol, the Micro7400 allows ASCII terminals (or personal computers emulating terminals) to perform as 3270s. Display terminals emulate IBM 3278s; printers emulate IBM 3287s. And special software allows printer terminals to interact with full-screen programs originally developed for crt's.

Plus Extra Functions

The Micro7400 also offers features not available in the IBM 3270 line, including dial-up access to the protocol converter, terminal-controlled diagnostics, and do-it-yourself channel configuration for setting terminal-related parameters like parity.

Support for IBM Personal Computers

IBM PCs connected to the Micro7400 can emulate IBM 3270 terminals, too, for communicating with mainframes. Diskette-based MICOM software makes it easy.

Switching Between Multiple Hosts

Users can switch between two IBM hosts, or between an IBM host and asynchronous ports on one or more minicomputers—completely under terminal control.

Command Port

Unique among protocol converters, the Micro7400's Command Port allows a network manager to dynamically alter operating parameters like priority assignment, as well as providing monitoring, diagnostic, and control facilities.

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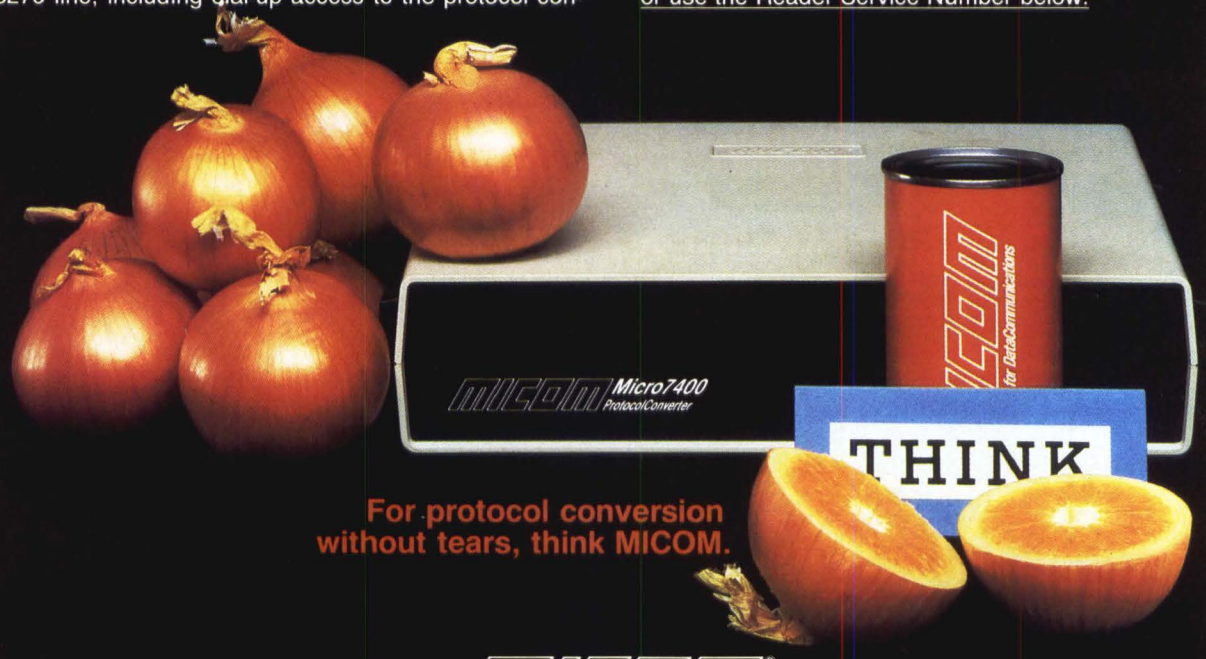

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