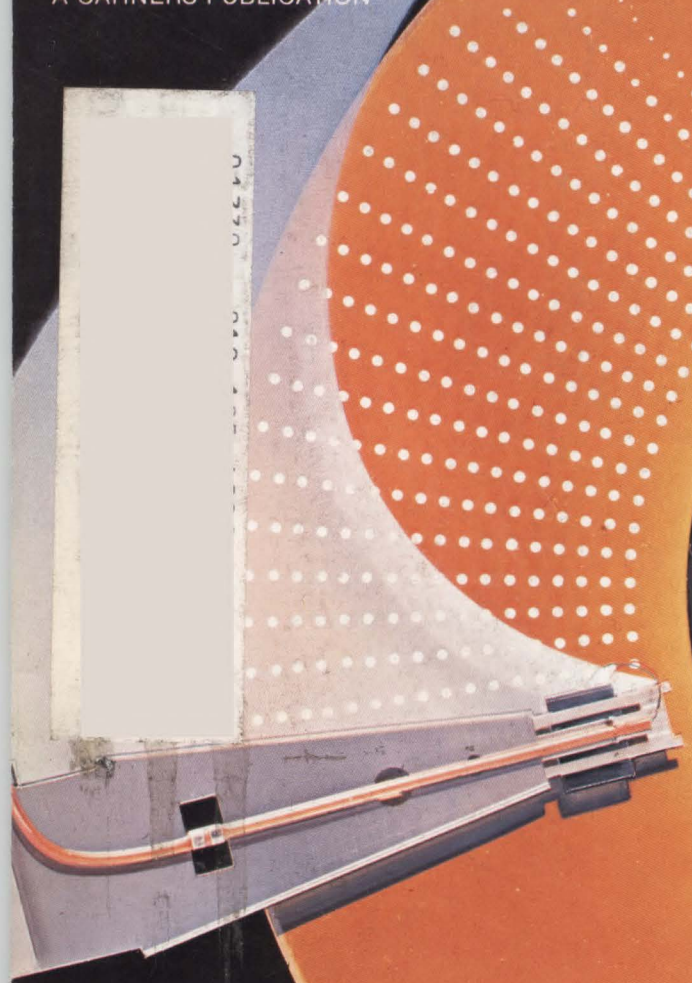
Mini-Micro Systems

A CAHNERS PUBLICATION

APRIL 1981



THE ADVENT OF THIN-FILM HEADS

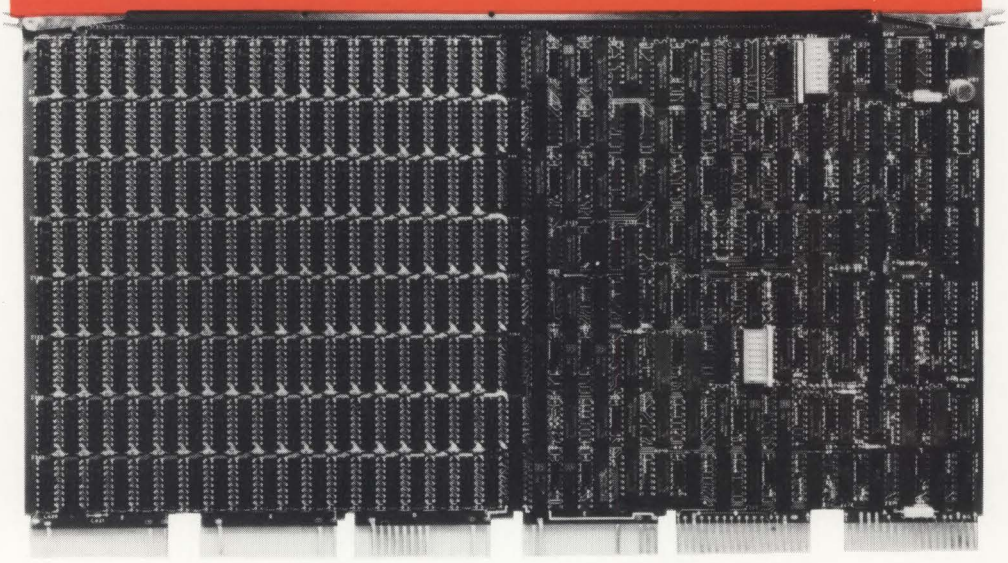
NCC 81

A session preview

Advanced work stations

ADD-ON ADD-IN

MEMORY...FROM THE LEADER



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CIRCLE NO. 1 ON INQUIRY CARD

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Lab Technologist.

Upjohn's Laboratory Procedures, Inc. delivers fast results with TI's 820 KSR.

Performing more than 80,000 clinical tests each day for physicians and hospitals, Laboratory Procedures, Inc., a wholly owned subsidiary of the Upjohn Company, needed a data terminal speedy and reliable enough to handle the workload. TI's OMNI 800* Model 820 Keyboard Send-Receive Data Terminal passed the test.

Specimens are picked up and rushed to the appropriate Upjohn laboratory where tests are performed. The lab results are entered into a host computer and transmitted to 820 KSR data terminals located in various hospital laboratories, doctors' offices and Laboratory Procedures distribution centers. The 820 KSR's clear, multiple copies are ideal for a hospital environment where patient records are maintained at the laboratory, nurse's station and physician's office.

The 820 KSR features an easy-to-use typewriter-like keyboard for simplified data access. Forms handling is quick and convenient with a 3 to 15-inch wide adjustable carriage that easily accommodates Upjohn's testing forms. And, the 820 KSR's 150 character-per-second printing provides speedy response to Upjohn's need for a cost-efficient remote data terminal.

Since installation, the 820 KSR's virtually nonstop performance has enabled Upjohn to cut communication costs by approximately 50 percent, while nearly doubling data throughput.

TI is dedicated to producing quality, innovative products like the Model 820 KSR. And TI's hundreds of thousands of data terminals shipped worldwide are backed by the technology and reliability that come from 50 years of experience.

Supporting TI's data terminals is the technical expertise of our worldwide organization of factory-trained sales and service representatives, and TI-CARE†, our nationwide automated service dispatching and field service management information system.

For more information on the Model 820 KSR, contact the TI sales office nearest you or write Texas Instruments Incorporated, P.O. Box 1444, M/S 7884, Houston, Texas 77001, or phone (713) 373-1050.

We put computing within everyone's reach.

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CIRCLE NO. 2 ON INQUIRY CARD

INTRODUCING

the DSD 880.

A DEC®-compatible disk system combining eight-inch Winchester and flexible disks.

For DEC users who need more capacity and performance than a dual RX02, the DSD 880 now offers a more cost effective alternative than a dual RL01.

- significantly lower initial and total life-cycle costs
- the reliability of a Winchester, with 7.8 Mbytes, emulating RL01
- the removability of a flexible disk, with 1 Mbyte, emulating RX02
- valuable saving in rack space (5¼" vs. 21" for dual RL01)
- unique "hyperdiagnostics" enabling fast and easy troubleshooting to the modular level
- built-in bootstrap eliminating the need for an expensive DEC bootstrap board and saving a backplane slot
- one half-quad backplane slot vs. two quad boards for the RLV11
- versatile interface card for easy integration with any LSI-11 backplane, unlike DEC's RLV11 interface that needs a special backplane and cannot be used with the VT 103 terminal

Compare for yourself and see why nothing compares to the DSD 880.

Data Systems

The Intelligent Alternative to DEC Disk Systems

See us at NCC Booth No. 5322.

To get more information on the DSD 880, call or write:

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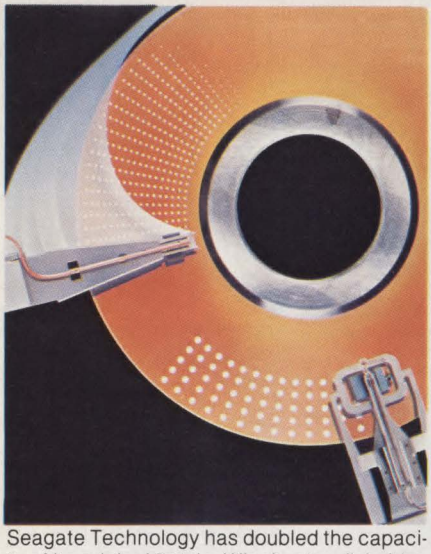
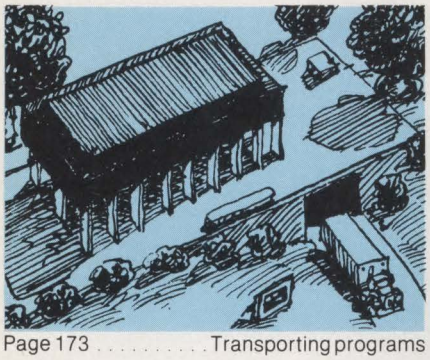
CIRCLE NO. 3 ON INQUIRY CARD



Seagate Technology has doubled the capacity of its original 5¼-in. Winchester-disk drive by using thin-film read/write heads (left). See p. 135. Cover design by Gail Tavares; airbrush art by William Ahrat; photograph by Clark Dunbar, courtesy of Seagate.



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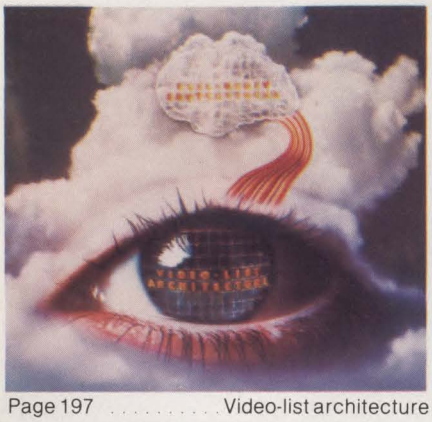

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Fastest Data On Two Reels

The winners—Model 9300 (125 ips) and 9100 (75 ips) Vacuum Column Tape Transports. They're the fastest—and most dependable in their circuit.

Speed isn't their only advantage—they handle beautifully. Data densities of 200/556 cpi or 556/800 on the 7-track unit and 800 cpi, 1600 cpi or 800/1600 cpi on the 9-track. The format is NRZ1/PE.

They're fully equipped, with features such as capacitive tape-location detectors for improved tape life, hard coated read-after-write heads to reduce tape wear, crystal controlled timing, front-accessible test panel—all the features that make Kennedy tape transports the industry standard.

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CIRCLE NO. 4 ON INQUIRY CARD

Breakpoints

DATAPOINT ANNOUNCES DIGITAL PBX

For years, Datapoint Corp. has talked about integrating voice and data information into a single comprehensive office system. This month, the San Antonio, Texas, firm took a giant step toward that goal with the introduction of a digital private branch exchange (PBX) that will link together most of the company's voice and data products, including the ARC (attached resource computer) local area network. In line with the company's distributed approach to information processing, the new system employs a dispersed switching technology—rather than one central switch—to allow switches to be located close to the equipment they control, whether on different floors within a building or in different buildings. The system will support data and word processing, electronic message services, voice communications and communications management, a company source says.

CENTRONICS MAY SHOW QUIETWRITER AT NCC

The Quietwriter—Centronics Data Computer Corp.'s long-awaited printer that pens, rather than prints, characters—is expected to highlight the company's exhibit at next month's National Computer Conference in Chicago. The Centronics exhibit is also expected to include a new dual-speed printer and a new letter-quality office printer that operates at more than 200 cps. The office printer, which uses an N × N matrix print head, will be a lower priced replacement for the company's models 700 and 701 printers, industry sources say. A company spokesperson refuses to confirm specific product introductions, but does say that several announcements are pending.

Meanwhile, Centronics reportedly continues to experience problems with its Miniprinter product line (MMS, May, 1980, p. 63), which one analyst says is still not up to the expected 1000-unit-per-day volume and has yet to show a profit. Company officials are unavailable for comment.

MILLENNIUM SOLOS IN DEVELOPMENT SYSTEM MARKET

Having severed a three-year OEM association with Tektronix in January, Millennium Systems resurfaced at the Electro show in New York this month as an independent μc development system supplier. There, the Cupertino, Calif., firm introduced the model 9700 software-development system for 8-bit processors—the first such system to bear the Milennium logo since the company began ghost-building the Tektronix 8002 system three years ago. Priced at $7500, the Z80-based system will enable users to develop software in both Pascal and C under Digital Research's MP/M multitasking operating system. Millennium will also introduce a $7500 in-circuit emulator for 8-bit processors that may be used either with the model 9700 or with a DEC PDP-11 minicomputer. Although Millennium is focusing on 8-bit processors initially, the company will add support for 16-bit machines later this year, says Dave West, Millennium's business director for laboratory products.

PRINTER MECHANISM AIDS TO LOWER PAGE PRINTING COST

High-speed, high-quality page printing—now affordable only to large-system users—could come within the price range of small-business and word-processing system users, with the development of a family of relatively low-cost page printer mechanisms by Delphax Systems, Mississauga, Canada. While many page printers now on the market are based on copier technology, the start-up firm says it has designed its printer mechanism from the ground up to eliminate the use of costly and failure-prone copier parts. As a result, a company spokesperson says, page printers based on the Delphax mechanism could sell for half the price of competitive page printers, such as Xerox 9700 and 5700, the IBM 6670 and the H-P 2680, which sell for $60,000 to $120,000. Slated for introduction in early June, the Delphax family will include 20-, 30- and 60-page-per-min. units. Delphax plans to sell the mechanisms on an OEM basis to systems houses, printer makers and large end users.

SPEECH SYNTHESIS BOARDS AVAILABLE FROM TWO SOURCES

System integrators requiring voice output will have two new board-level products from which to choose this month. Telesensory Speech Systems, Palo Alto, Calif., has introduced the

Breakpoints

Speech 1000, a single-board voice synthesizer that uses the company's proprietary PDSP speech chip set. The 8085-based Multibus-compatible board, which uses linear predictive coding techniques to analyze and compress speech for storage in memory, includes a parallel port and an RS232C serial port, with an IEEE-488 interface as an option. Single-unit price is $1200, with vocabulary generation as a separate service at a per-word price of less than $50.

A similar board will be available from Centigram Corp., Sunnyvale, Calif., this month as well. Centigram's LISA uses parametric waveform synthesis techniques to develop its vocabulary, which may be on a disk or in on-board RAM or PROM. The Z80-based device has two serial ports for connection to both a host CPU and a terminal. The LISA board sells for $1800 in single-unit quantities. A packaged version that includes LED display, audio amplifier and speaker is available for $3450. A standard 500-word vocabulary will sell for $1000; a 40-word custom library, $1000; custom words, $25 each. A voice library generation software package will be available later so that customers can generate their own vocabularies.

LOW-END 16-BIT MINI DEBUTS

A low-end companion to Point 4 Corp.'s MK V 16-bit minicomputer will appear this month in the form of the two-board MK III. The entry-level minicomputer will operate at a 600-nsec. cycle speed, which is in the LSI-11/microNova range, say company sources. Compatible with application programs running under the firm's IRIS operating system, the MK III includes a TTL processor and 64K bytes of memory on one board, and a CMD/SMD disk drive controller and four-port multiplexer on a second board. Due this summer from Point 4 is the MK VIII, a higher level machine that can operate in the 400-nsec. range and handle 32-bit instructions. Price of the MK VIII has not been established. List price for the MK III is $5500.

TI ADDS TWO BUBBLE-MEMORY TERMINALS

Moving to tap the market for data-entry devices used in large data-communications networks, Texas Instruments Inc. has added two high-end members to its Silent 700 family of bubble-memory terminals. The model 767 desk-top terminal and the model 769 portable terminal, introduced by the company's terminals and peripherals division, Houston, early this month, include facilities for the IBM 3780 protocol and data entry validation. They support host polling, downloading and broadcasting functions. the new terminals will not replace TI's current bubble-memory models, a company spokesperson says. Both house 40,000 characters of bubble memory, which can be expanded to 80,000 characters in 20,000-character increments. Prices for the desk-top and portable models are $3995 and $4295, respectively, in single-unit quantities. Each memory increment adds $500.

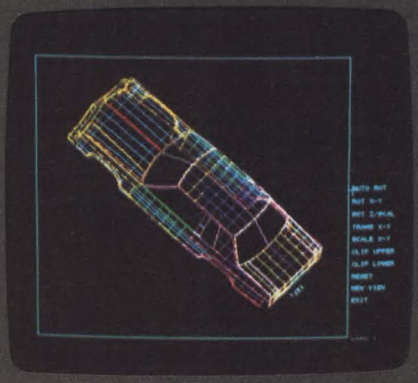
TELEVIDEO WILL SHIP LOW-COST CRT

Production versions of Televideo Systems' first dumb CRT terminal will begin this month at a price that could set off a new round of price cutting in the OEM video-terminal market. Called the model 910, Televideo's new hardware carries a $595 single-unit price tag, with substantial quantity discounts available to OEMs, says a source close to the company. The new terminal features switch-selectable communications speeds as high as 9600 bits per sec., upper- and lower-case keyboard, numeric keypad and 11 function keys as standard items. Due next month from the Sunnyvale, Calif., peripherals house is a Z80A-based stand-alone desk-top computer priced at $4295 and desginated the System I; due next quarter are two additional stand-alone systems, the Systems II and III. The former, priced at $6995, handles four work stations and includes a 5¼-in. Winchester. The latter, priced at $20,495, supports as many as 16 work stations and 92M bytes of disk storage.

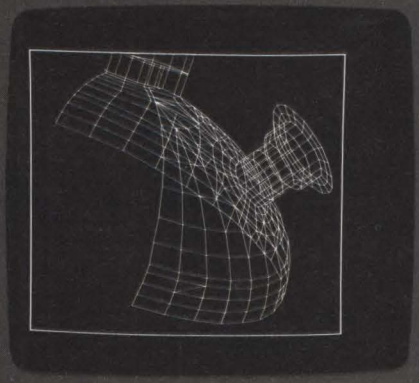
MFE CORP. DROPS FLOPPY PRODUCT LINE

Mayflower—MFE Corp.'s two-year-old venture into the floppy-disk drive business—has run aground. Citing increased competition from market leader Shugart Associates and from a host of recent domestic and Japanese entrants, the Salem, N.H., firm announced late last month its decision to withdraw from the business. "It would have required a significant

Freedom of Expression.

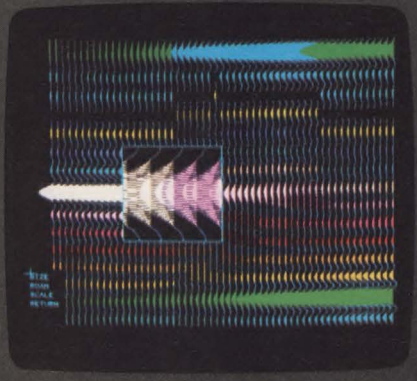


Only Megatek gives you all three, the excitement of dynamic raster color...

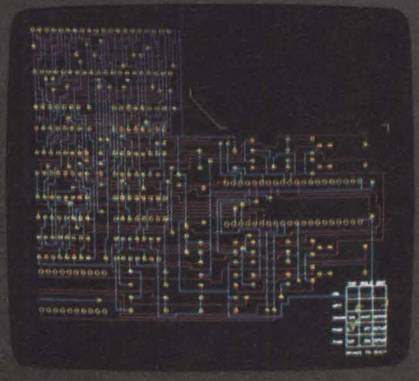


...the precision of 4096 x 4096 high resolution calligraphic Whizzard systems...

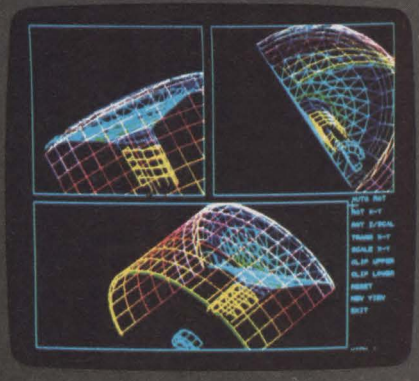
...and user-oriented software to make it easy to implement your application.



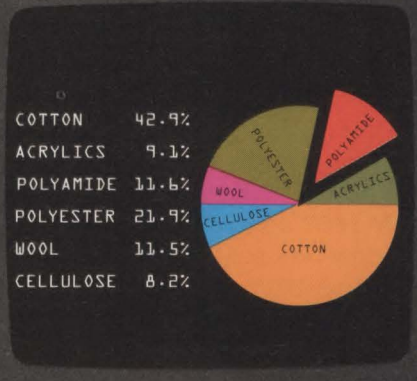
Powerful, real-time dynamics enable you to scan the display then zoom in for added detail.



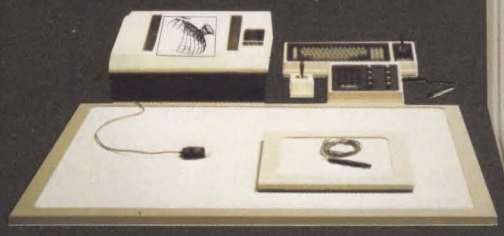
A large virtual display gives you the full picture, with the added information of up to 16 colors at a time.



Rotations mean you can view models from any angle and segment the display into multi-viewports.



It all adds up to the capabilities you need to put your ideas into pictures.



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CIRCLE NO. 5 ON INQUIRY CARD

investment for us to remain active in the market," explains MFE marketing vice president Al Vaskas, adding, "We were unwilling to make that investment." Instead, he says, MFE has decided to focus its resources on digital cassette tape drives—traditionally the mainstay of its business. Meanwhile, the company is seeking another manufacturer to buy rights to its ill-fated floppy product line, which comprised two double-sided, double-density models.

TOUCH CRT MAY DEBUT AT NCC

Touch-screen technology, now on devices such as Xerox's 5700 intelligent printers and terminals from Interaction Systems, Inc., and Carroll Manufacturing Co. (MMS, February, p. 37; March, 1980, p. 76), may debut at May's National Computer Conference in the form of an addition to Ampex Corp.'s Dialogue '80 CRTs. Which touch technology the hardware will use is uncertain, however, as are prices and availability. A spokesperson for the El Segundo, Calif., company has no comment on the reported development.

RANDOM DISK FILLINGS

Shugart Associates may be named in a legal action by **Tandon Corp.** over alleged violations of a licensing agreement between the two. The agreement allows Shugart and its assignees to manufacture Tandon's patented read/write head assemblies for use in their double-sided floppy-disk drives (MMS, May, 1980, p. 23). Shugart assignee, **Matsushita Communication Industrial Co., Ltd.,** Yokohama, is reportedly violating the agreement by selling the Tandon heads to **Canon, Inc.,** as individual components. This is prohibited by the licensing agreement. A Shugart spokesman denies any knowledge of the matter; a Tandon spokesman says only that the company "is looking into the matter." . . . Look for Exxon subsidiary **Magnex Corp.,** San Jose, Calif., to unveil its line of 3370-compatible thin-film read/write heads at the InterMag Show in Grenoble, France, next month. Magnex has shipped evaluation heads in the form of single-arm, four-slider assemblies to several vendors of plug-compatible disk drives, and the company anticipates production quantities to be available by year-end. . . . Shipments of the model 420 single-board controller for 5¼-in. Winchesters and minifloppies are slated to begin this month from **Data Technology Corp.,** Santa Clara, Calif. Also due this quarter from DTC are production version of the firm's SA1407 controllers (MMS, May, 1980, p. 5), which tie Shugart Associates' SA10 8-in. Winchesters to ¼-in. tape-cartridge drives supplied by **Data Electronics, Inc.** (DEI), and **Archive, Inc.** DTC also reportedly may build a 5¼-in. Winchester controller that will accommodate fixed/removable drives, such as the Sage 55, which is under development at **DMA Systems Corp.,** Santa Barbara, Calif. (MMS, March, p. 5). Quantitiy prices for the 520 reportedly will be approximately $700. . . . Look for **Spectra Logic Corp.,** Sunnyvale, Calif., to add a new line of multifunction disk/tape controllers this quarter. The Spectra Stream single-board hardware reportedly will interface SMD-compatible high-end Winchester-disk drives to ½-in. streaming-tape backup transports. The controllers will operate under **Digital Equipment Corp's** RSTS/E and RSX-11M operating systems, and under **Data General's** RDOS and AOS software. . . . More information is surfacing about a large-scale (100,000-per-year) request for quotations that **IBM** has placed on the merchant floppy-disk drive market for double-sided 48-tpi hardware. Some IBM watchers say the drives will be incorporated into a low-end personal computer rumored to be under development for IBM in Japan by Matsushita Communication Industrial Co., Ltd. Other observers deny these reports, pointing out that Matsushita builds its own drives under a licensing agreement with Shugart Associates and claim that the IBM group in Boca Raton, Fla., that has issued the RFQ is designing a line of intelligent terminals. . . . **Micro Peripherals, Inc.** (MPI), Chatsworth, Calif., rumored to be ready to license the 5¼-in. Winchester announced this year by **International Memories, Inc.** (MMS, February, p. 26), has opted to build its own hardware and plans to display it at next month's NCC. The new Winchesters pack 12M bytes of data on two platters.

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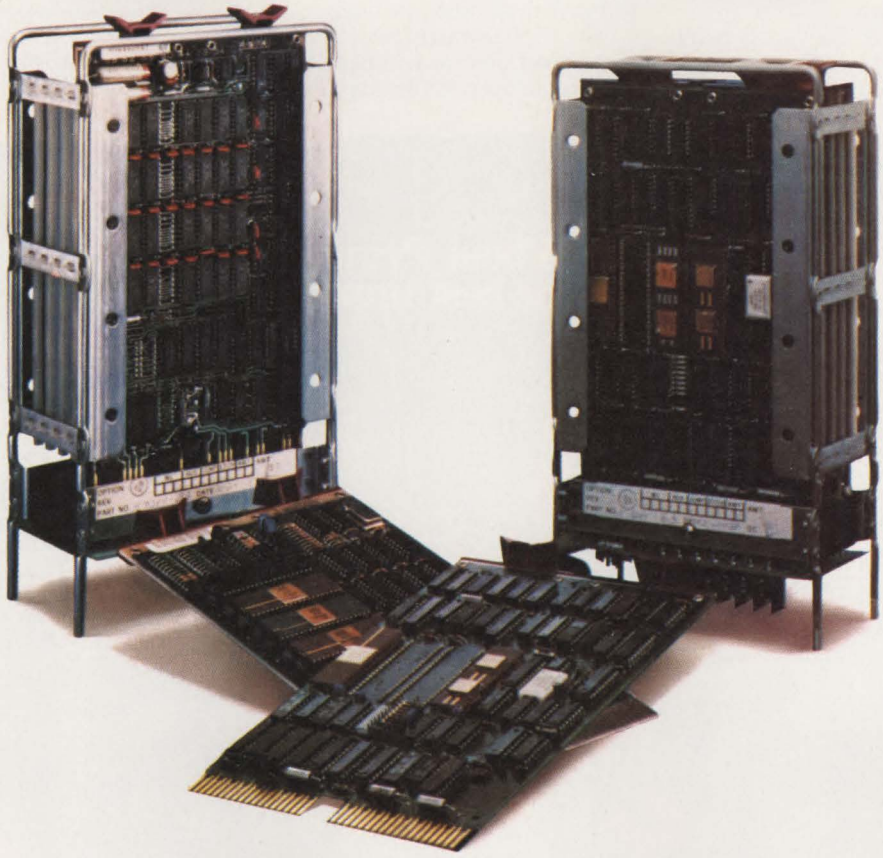

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It's available in KSR (Keyboard/Send/Receive) terminal and RO (Receive Only) printer and terminal models.

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Thanks to a simplified printing mechanism, the D-50 is extremely reliable. It's designed to operate without adjustments, lubrication or preventive maintenance (other than routine cleaning).

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Dataproducts is the world's largest independent printer manufacturer. For over 18 years, we've built printers for the biggest OEMs in the business, putting their names on our machines. These customers make sure our printers live up to some pretty tough standards.

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We manufacture the most complete family of high quality IEEE/696 S-100 mainframes on the market. Choices include three mainframes in rack-mount or table-top packages with complete board sets, to serve as the building blocks for your 8 or 16 bit system. We also provide other options ranging from complete floppy disk systems right up to our proven Pascal development system.

The $\int$ factor: one source.

No matter which option you choose, you get the benefit of working with completely integrated products ... fully assembled and tested ... under one warranty and one price structure ... leaving you free to concentrate on value-added application development and sales.

Choose from mainframe options ...

Select from three packaging options: Rack-mount, table-top or front panel models. All three feature our 20 slot S-100 motherboard with 25 amp power supply and are delivered fully assembled and tested with our Series II™ board sets. Any board configuration you choose works with any DPS-1 version, allowing you to vary your package offering, or develop on one version and market another.

- Front Panel model — a powerful development and diagnostic tool for Z-80† systems, which can be used for prototyping, servicing, debugging, and software or hardware development. Use its features to set breakpoints, trigger scopes, single step, slow step and more.
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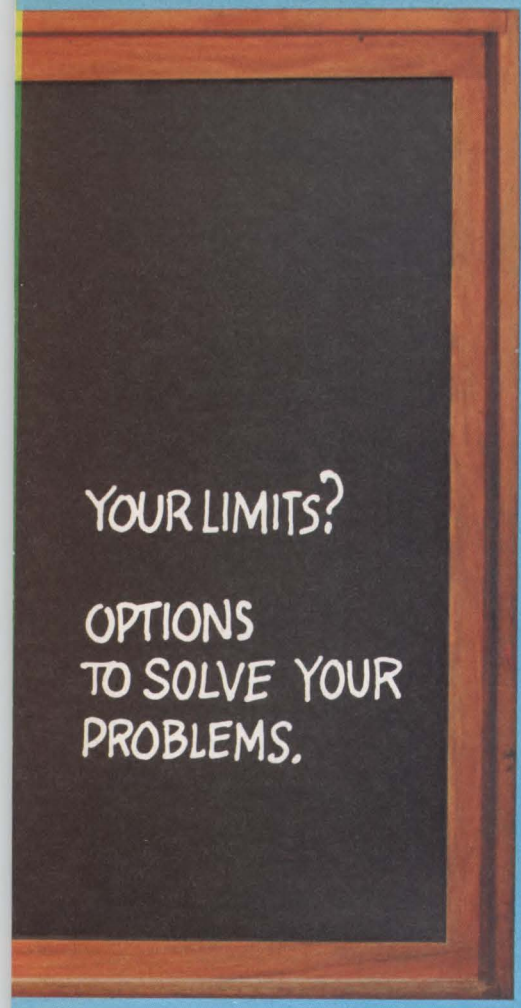
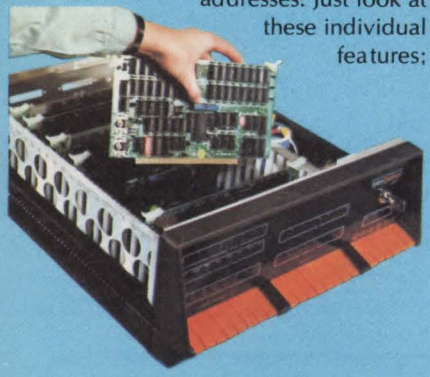
- Rack Mount version — features a heavy gauge frame designed to fit into standard 19" racks. CVT power supply for brown out immunity is standard.

*In Calculus, a fundamental statement in the definition of limit; interpreted



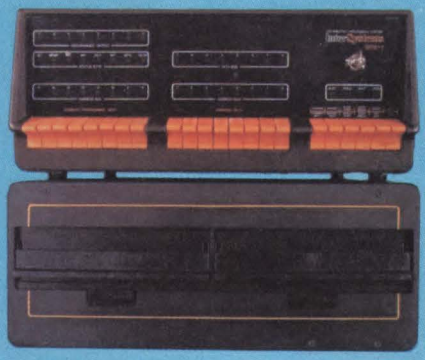
Board level options...

Intersystems mainframe packages, equipped with Series II boards, are operational in both 8 and 16 bit settings and support extended addressing in both I/O and memory space, recognizing 16 bit I/O addresses and 24 bit memory addresses. Just look at these individual features;



- MPU-80—uses a Z-80, 8 vectored interrupt lines and two 4K windows to address up to 1 Megabyte of RAM without bank select.
- 64KDR—sophisticated refresh circuitry allows unlimited DMA and absolutely reliable operation without wait states.
- 6 SI/O — six individually software-controllable serial I/O ports with optional interrupts. Each can run RS 232 at up to 19,200 BAUD, as can our VI/O board.
- VI/O—has two serial ports; two 8-bit parallel output and two 8-bit parallel input ports plus 8 individually controllable command lines and 16 levels of vectored interrupts.
- FDC II—can DMA up to a full track into 16 Megabytes of memory. Optionally generates interrupts and handles up to four 8" floppies.
- MPU-8000 — available with the non-segmented Z-8002†, which directly addresses 64K, or the segmented Z-8001†, which can directly address 8 Megabytes.

Extended systems options...



Interfacing disk drives is not a trivial matter, so when your objectives and resources dictate you spend your energy elsewhere, use our resources to perform the service for you. We can add our disk drive package to any Z-80 or Z-8000 configuration we provide ... again, fully assembled and tested and covered under one warranty.

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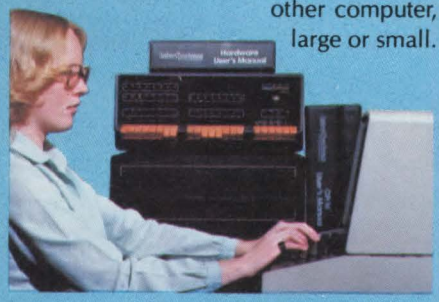
The system is versatile, too. SET program allows you to change many BIOS parameters and specify control characters to enable special features such as diagnostic output to trace program execution. It can also provide remote I/O to link your system to almost any other computer, large or small.



And it's reliable. The Cache BIOS System runs continuous memory tests when idle, and verifies with a Read after Write and Read after Read.

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CIRCLE NO. 9 ON INQUIRY CARD

Microcomputers invade financial-planning market

Financial planning in large companies was once the province of big—and costly—mainframe computers. Now that dominance is being contested by inexpensive desk-top computers that proponents claim can handle many financial-planning tasks more conveniently and at substantially lower cost, especially when they're supported by the right application software.

"Desk-top computers will revolutionize the way financial planning is done today," enthuses Dennis Brown, president of C4P Inc., a Van Nuys, Calif., software house that has developed a financial-planning package for μcs called FPL (financial planning language). "Now we can put a $7000 μc on the desk of every financial planner to perform tasks that formerly required a large time-sharing system," Brown says.

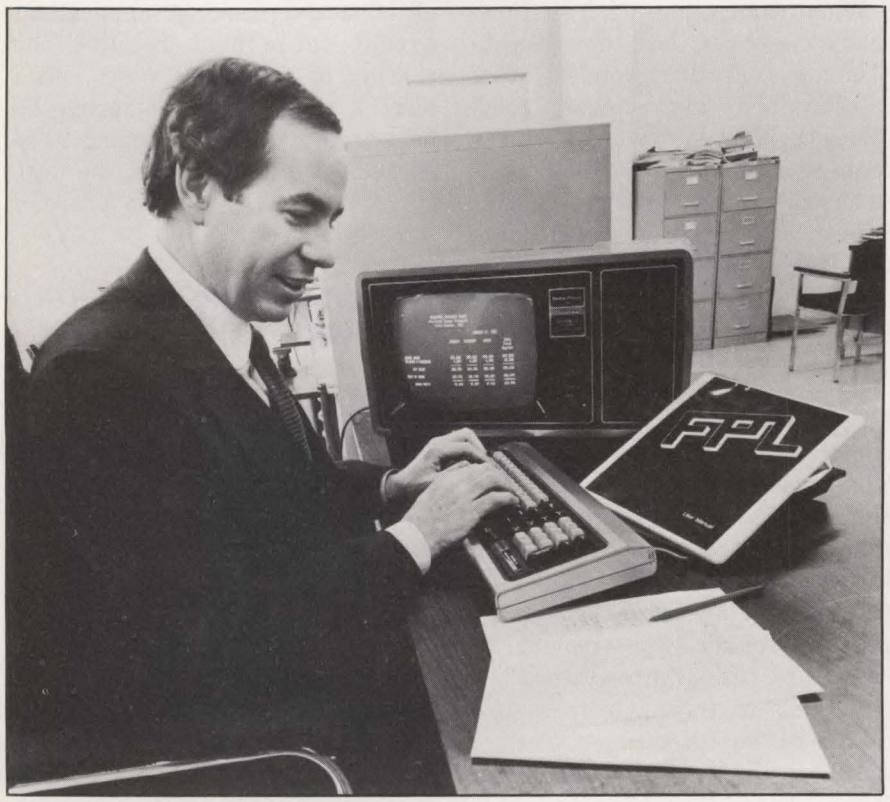
"Financial planning" is an umbrella term embracing a wide variety of specific functions from capital-allocation analysis in large corporations to mortgage evaluation in a local bank. Because a company's fortunes often depend on accurate and timely financial planning, large corporations increasingly have turned to computers to automate the process.

Indeed, automated financial-planning systems have become big business in the last decade for time-sharing services and mainframe software houses, which have been the principal caterers to this market. Time-sharing services derive one-third of their $3 billion annual revenues from financial-planning systems, estimates Brown, whose background includes marketing stints with Tymshare, Inc., and Computer Sciences Corp., two market leaders.

The market now has begun to attract the attention of μc systems and software vendors. Leading the way are a new breed of software vendors, called software publishers, that distribute low-cost μc software developed by independent authors. These firms, which depend on volume distribution to achieve profitability, are attracted by the potential of a mass market. "The desk-top market encompasses financial planners in every major corporation, bank, insurance company and brokerage firm," says Roland Joffe, marketing director at Lifeboat Associates, New York, a leading software publisher. Lifeboat recently acquired the marketing rights to Brown's FPL package, and began marketing it in February.

Lifeboat's entry into the desk-top financial-planning market was inspired by the success of another software publisher, Personal Software Inc., San Leandro, Calif., which has been marketing a generalized planning package for μcs called VisiCalc (Visible Calculator). Although not specifically aimed at financial planning, VisiCalc has been enthusiastically adopted by financial planners. PSI claims to have sold more than 50,000 copies of the package since its introduction a year ago.

Although both firms have



User demonstrates Lifeboat Associates' FPL *financial-planning language, which enables him to define question-and-answer data-entry formats and to produce finished financial reports for formal presentations.*

targeted the financial-planning market, they are aiming their products at different segments. PSI sees its market primarily as financial planners who want to use the computer as a personal tool. Lifeboat, in contrast, has aimed FPL at executives who are interested primarily in results and would prefer that subordinates program and operate the system.

The different product strategies are reflected in the firms' products. Both FPL and VisiCalc provide a computerized version of the columnar spread sheets used in manual financial planning. The systems enable a user to define the format of the spread sheet and to enter basic variables. Once the format is defined, the computer fills out the spread sheet according to user-specified calculations, such as row or column summation.

There the similarity between the two products ends. Reflecting its personal orientation, VisiCalc runs on the most popular personal computers (Apple, TRS-80, Commodore), while FPL runs on business-oriented CP/M machines, such as those made by North Star and Cromemco. With VisiCalc, spread sheet formats are defined interactively on the screen, using a cursor. With FPL, the formats are defined off-line, using a financially oriented applications language similar to those used in mainframe financial-planning systems. In addition, FPL allows a user to define question-and-answer data-entry formats and to produce finished financial reports for formal presentations—features that are lacking in VisiCalc.

"FPL is a much more sophisticated system," claims Brown. For example, he points out, FPL has logical features that enable different sets of computational rules to be applied to data, depending on the value of the data. In addition, he says that the data-entry and reporting features allow a secretary to operate the system once a financial model has been built.

But VisiCalc has virtues for personal users, points out Dan Bricklin, vice president of Software Arts, Inc., a Cambridge, Mass., software house, which developed VisiCalc. For example, VisiCalc's interactive screen orientation, which Bricklin likens to that of a word-processing system, obviates the need for a user to visualize screens as he is defining them. Moreover, he says, future versions of VisiCalc will include logical functions. But Bricklin concedes that the system lacks the prompting and report-editing features of FPL.

"FPL follows the traditional pattern of financial-planning systems where models are static, and an executive can assign one person to build the model and another to run it," Bricklin says. "VisiCalc is aimed at situations where the model is constantly changing, and the executive wants quick answers," he says.

When competing against time-sharing services, desk-top financial-planning software vendors tout convenience and lower cost. "Desk-top systems can cut a company's financial-planning costs as much as 90 percent," claims Brown, who estimates that large companies typically spend $40,000 or more a year on time-sharing costs for financial planning. Desk-top systems also offer the convenience and security of a dedicated system, he points out. Don Williams, manager of sales support at Apple Computer Inc. and author of another popular desk-top financial-planning system, called Desktop/Plan, which is distributed by PSI, says, "They allow the average guy in middle management to create and run his own system."

Officials at time-sharing companies voice skepticism about whether μcs have the power to handle the tasks involved in decision support in large companies. "We don't see desk-top systems as that serious a factor in the market," says Vincent F. Titolo, senior vice president and senior financial officer at Tymshare, Inc., Cupertino, Calif. "A large company may have to juggle 20 product lines. Microcomputers don't have the memory to accommodate that large a cost structure," he claims.

But proponents of desk-top systems disagree. "If I were directing a time-sharing service, I would not want to bet the future of my company on the hardware argument," says Williams, who points out that 16-bit μcs are approaching mainframes in memory capacity. Moreover, Williams claims, even 8-bit μc systems can handle large financial-planning applications if time is not critical. "The entire sales forecast for Apple Computer is done on two Apple computers using Desktop/Plan," he points out.

Williams sees desk-top systems replacing time-sharing services in all financial-planning applications except those that require the sharing of large data bases. "If I were a time-sharing company, I'd be scared my market is going to be sucked out from under me," he says.

—Paul Kinnucan

Intel in bubble-cassette race with 1M-bit device

Major semiconductor houses are announcing removable, portable bubble-memory cassettes, and those announcements are heating up the race to make bubble technology a popular storage medium.

Last month, Fujitsu America, Inc., introduced its 32K-bit cassette and separate controller (MMS, March, p. 49). National Semiconductor Corp. is expected to have prototypes of 120K- to 960K-bit cassettes ready within three months. Now, Intel Corp.'s Memory Systems Operation has introduced

the highest capacity device so far—a product that should be available by mid-year.

The Santa Clara, Calif., company's "Plug-A-Bubble" cassette system packs 1M bit of bubble storage and a controller into a ruggedized cast aluminum package not much larger than an eight-track stereo tape cartridge.

The cassette system, which consists of a cassette and a holder, contains Intel's 7110 1M-bit bubble component, a 7220 bubble controller and associated support circuitry. The holder accommodates interface electronics and sockets to connect the device to a processor via shielded cabling.

The company, says product marketing manager Christie Robbins, is initially aiming Plug-A-Bubble at OEMs in the machine-control market, some of whom had been developing their own bubble-cassette systems. Robbins says the device is intended to replace floppy-disk drives, especially in harsh environments or in applications requiring low maintenance and high system up-time. An optional 5¼-in. chassis, which accommodates two holders, enables the cassette system to occupy the same physical space as a 5¼-in. floppy drive or a micro-Winchester.

The cassette and holder can replace a tape cassette drive, as well, Robbins says, although the cassette holder may be too deep because Intel didn't aim the device at a particular cassette maker's product.

Although the price for a Plug-A-Bubble system—$3000 in 100-unit quantities—is higher than that of either floppies or 5¼-in. Winchesters, Robbins says reliable hardware and the nonvolatile data will be sufficient incentives for OEMs to accept the cassette. "When you consider the nature of the applications, the environments and the total cost of the systems in which the cassettes would be used, the price of the cassette is a very small percentage of the overall cost."

The price will most likely remain steady, Robbins says. She explains that component prices will drop according to the formula Intel announced last August, thus lowering the price of the components to Memory Systems Operation. But those cuts may not affect Plug-A-Bubble. "The overhead inherent in systems manufacturing—assembly and test—will keep the final price relatively stable," she says.

Logic within each holder permits as many as 16 cassettes to be daisy-chained, vastly increasing storage capacity. Cassettes can also be linked directly to a number of Intel's single-board processors (SBC family) or peripheral controllers via the SBX bus, an on-board 8080/8085 bus. With an iSBX interface card, users can hook cassettes directly to a system's main bus, Robbins says. The 2- × 7-in. iSBX interface card plugs directly into the SBC board. The bubble cassette is plugged into it via cabling. Price of the SBX interface and cabling to support two cassette holders is $300 to $400 in 100-unit quantities.

Intel expects to have prototype Plug-A-Bubbles ready by mid-year, and production volumes are planned for soon after that. —*Larry Lettieri*

Sony enters OEM market with 3½-in. floppy

Sony Corp.'s quiet entry into the U.S. OEM floppy-disk-drive market in December has not been taken seriously by some and has been ostensibly ignored by other participants in and watchers of the disk-drive industry. Behind the scenes, however, it is clear that the Japanese company intends to move strongly into the market, and industry observers are keenly anticipating that move.

Sony is not a typical fledgling in a new industry—it has already established itself as a volume producer of high-quality consumer products. The company hopes to bring that reputation with it into the computer industry.

Sony's 3½-in. microfloppy-disk drive was part of the introduction of the company's Series 35 word processor. The Series 35 incorporates two of the 3½-in. devices, which store 230 pages of text on-line. Sony's New York Office Products Division will sell the Series 35, and the company's new Data Products Division, Paramus, N.J., will sell the microfloppy.

Apart from the drive's unprecedented small size, its other features are impressive: it measures 4 × 5.1 × 2 in. and holds 437.5K bytes of information in a single-sided, double-density format. Manufacturers of 5¼-in. drives have long attempted to "slimline," or decrease the height of, their hardware (MMS, November, 1980, p. 13). The Remex

Sony's 3½-in. microfloppy-disk drive *occupies 27 percent of the volume of conventional 5¼-in. disk drives, while doubling storage capacity.*

Division of Ex-Cell-O Corp., for example, will soon offer a 2¼-in.-high drive (see "Slimline floppy saves space, boosts capacity," p. 168).

Track density of the Sony drive is 135 tracks per in., compared with 48 tpi for many single-sided 5¼-in. drives, Sony claims. The company says that the microfloppy has twice the disk-storage capacity and 1.47 times the recording density of 5¼-in. drives. But the smaller disks achieve these performance features with a volume 27 percent and a weight 56 percent that of 5¼-in. drives. The diskette is housed in a hard plastic case to improve reliability and wear.

Although there are still several loose ends in Sony's marketing approach, the company will be aggressive in addressing the 5¼-in. floppy-disk-drive market. Sab Kikuchi, general manager of the Data Products Division says, "Sony is always ambitious. Five to six years from now, we hope to take over Shugart's market share or get a big share of the floppy-disk-drive market."

Shugart says it will produce approximately 250,000 5¼-in. drives this year, and is relatively undaunted by Sony's claims. George Sollman, vice president of marketing at the Sunnyvale, Calif., company, says, "As we see the product today, it will be incremental to the (minifloppy) market as a whole. It will have minimal impact on 8- and 5¼-in. drives. This represents a new market segment Sony is trying to develop."

He admits, however, that if Sony were to become a major market participant, Shugart would have to respond. He says the 5¼-in. minifloppy is not yet complete, and more capabilities could be added. But he won't comment about speculation in the industry that Shugart is also developing a 3½-in. floppy.

Kikuchi says Sony was not satisfied with 5¼- and 8-in. floppy disk drives from either a marketing or a technical standpoint.

"The media is large to handle, and the drive size is difficult to use in compact word processors or portable personal computers." He says the main customers for

SONY TAKES RISKS WITH NEW TECHNOLOGY

There are inherent risks in creating and marketing a product that incorporates innovative technology—the risk of not being able to produce the technology in large volumes and still maintain its integrity, and the "psychological" risk of selling a nonstandard and unproven product to wary customers. Sony will face both risks when it tries to competitively market its 3½-in. microfloppy-disk drive.

"Sony wanted uniqueness and product compactness, and compactness means more benefits for the customer. The microfloppy is easy to handle and is portable," says Sab Kikuchi, general manager of Sony Corp. of America's Data Products Division, Paramus, N.J.

To achieve compactness and to develop the motor, magnetic head and magnetic media for the drive, Sony used the same technologies it has used in its commercial recording systems. For example, the 30-μm. media track head is almost identical to the one used in the company's commercial recording systems. Sony uses a single-crystal ferrite head, which it claims is lighter, harder, more stable and more reliable than the polycrystal ferrite heads used by many other manufacturers. The floppy diskettes are more rigid than standard floppies. As a result, some industry observers hesitate to call the new product "floppy." Kikuchi explains that 5¼- and 8-in. disks are easily damaged because they are too flexible. "To achieve high-density recording, you need good accuracy. The media must be kept stiff in a stable case," he says. The disks also contain a protective shutter to prevent contamination.

Kikuchi claims that the new drive's reliability is equal to or better than that of 5¼- and 8-in. disk drives. Error rates are 1 per 10^9 bits read for soft read, 1 per 10^{12} bits read for hard read and 1 per 10^6 seeks for seek errors.

MFM/FM encoding is used. Transfer rate is 500K bits per sec. in MFM and 250K bps in FM. Rotational speed is 600 rpm, recording density is 7610 bpi and track density is 135 tpi. Track-to-track access, average-access and head-loading times are 15, 365 and 35 msec., respectively.

Sony is recommending that the drive be used with IBM's 8-in. disk-drive interface, but will provide other interfaces later. The drive is not intended to fit into 5¼- and 8-in. disk-drive slots, but in products designed for its dimensions, says Kikuchi.

"The jury is still out on whether U.S. manufacturers are willing to switch," however, cautions Melody Johnson, an analyst with Kidder Peabody & Co., New York. She concedes there is a trend toward smaller drives, and Sony will have a head start on other manufacturers for that market segment.

Sony claims to have designed a product with a high number of bits per in., says George Sollman, vice president of marketing at Shugart Associates, Sunnyvale, Calif. "This requires, perhaps, pushing the magnetic head and media to their limits. Potential users will be that much more concerned when testing the product. You don't get something for nothing. Anytime you store double the information, additional risks are undertaken. You have to question whether the design takes these into consideration." Sollman says customers may find the microfloppy drives to have slower actuator speeds and lower reliability.

Some observers believe Sony can carry expertise in high-volume production for the consumer market into the computer market. "Sony can come up with the production. They won't want to bungle this type of big move into office automation," says Johnson. Another observer says, "The manufacturing cost structure they can get (with highly automated factories) and their quality orientation will make them a formidable competitor."

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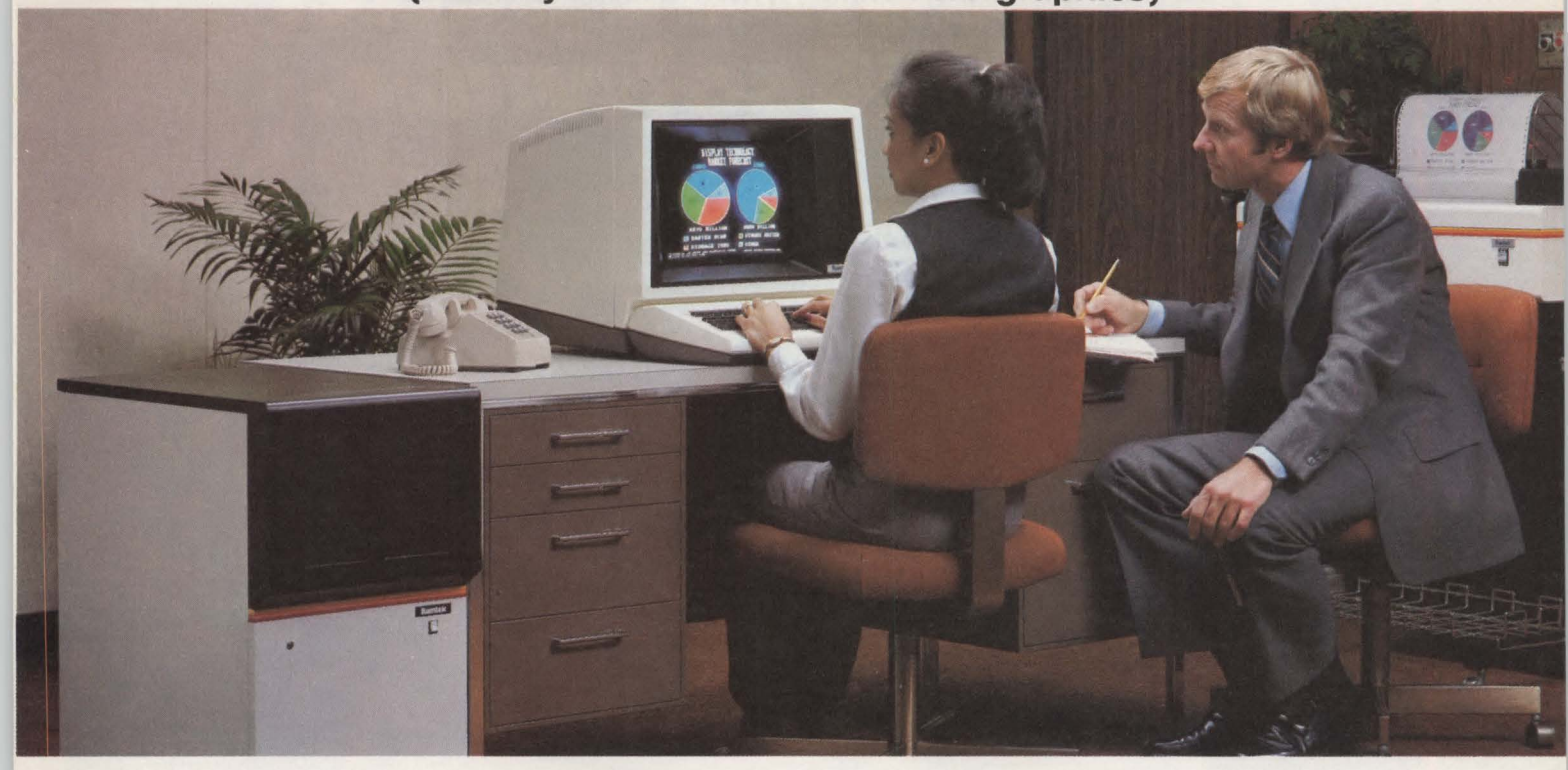

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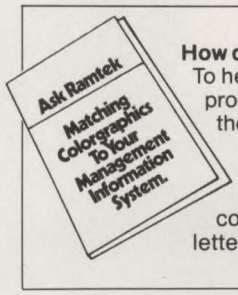

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microfloppies will be those who want to use them in future systems. "We do not want to piggyback the microfloppies in conventional disk slots," he explains. The product can also serve as a backup drive, he says.

Sollman expects Sony to receive some strong challenges in the OEM floppy-disk market. "We view the market they're entering as very competitive and heavily populated...by about 30 companies," says Sollman. "Sony is attempting to enter a brand new business sector—the OEM. They're attempting to introduce a product at the edge of technology and to develop and offer an entirely new media standard. Adding up these factors, it would appear Sony has its work cut out for it." Sollman says he would have expected a better-proven product with less technological innovation as Sony's first market entrant.

Many industry observers agree that Sony poses no threat to Shugart. "I don't think the 3½-in. drive will take the market away from the 5¼-in. drive," says James Hartke, an analyst with John Muir & Co., New York. "Shugart is not going to stand there and play dead." He believes that Sony will continue to concentrate on televisions, and computer products will take lower priority.

But analyst James Magid, of L.F. Rothschild, Unterberg, Towbin, in New York, says Sony's efforts are not to be taken lightly. "Anyplace where you are dealing with magnetic media and mechanical systems, the Japanese have proven themselves excellent," he says. He believes that Sony could become a formidable competitor if other Japanese companies adopt the 3½-in. drive and media as a de facto standard.

Sony's success is not assured in the U.S. Although the company has a strong dictation-equipment user base, it has not fared as well with other office equipment. Its Sobax four-function desk-top calculator, for example, introduced in the early 1970s, sold for $1000. But Sony withdrew that product from the market two years later when lower priced hand-held calculators swarmed into the market.

Jim Moore, of Dataquest, Inc., a Cupertino, Calif., market research firm, says Japanese companies have a lot to learn about selling in the U.S. "OEM buyers in the U.S. like to see flexibility in OEM agreements. They might want to change the basic product—for example, change a signal in an interface." Japanese firms, he says, resist this flexibility, but they must learn to accept it.

Sony's microfloppy will be marketed through direct sales and through distribution channels, says Kikuchi. The company will handle large sales directly. Sony has only two salesmen in Paramus, but it can use Sony Corp. of America's 20 nationwide regional branches as consumer-oriented distribution outlets. In addition, the Paramus division will create a distributor and service network for small customers.

Kikuchi expects the company to have more than 50 distributors and eventually to open retail stores. The company's priority, he says, is signing customers that will buy at least 500 drives per year for two years. Some observers question that number, saying it is too low to enter the OEM market. "It is not true 'OEM-ing' if you sell 500 a year," says L.F. Rothschild's Magid. "They should sell 500 per week."

Kikuchi says Sony will second-source both the media and the drive, but won't say which company would be that second source. Some observers speculate that the second source may be a Japanese company, perhaps one that Sony owns. The company intends to manufacture both products in Japan.

Some observers question Sony's ability to bring the product to volume production in the near future. But Kikuchi claims that Sony's factory near Tokyo is ready for high-volume production.

Evaluation units, which will comprise most sales this year, will be available by summer. Prices will range from $400 to $500. OEM prices will depend on the contract, Kikuchi says, but he expects the 437.5K-byte, single-sided drive to sell for $200 to $300 in 500-unit quantities. Production shipments will begin late this year.

In comparison, Shugart's 512K-byte SA410 single-sided, double-density 5¼-in. drive is priced at $285, and the SA460 double-sided, 1M-byte drive sells for $355, both in 500-unit quantities.

Many observers believe Sony's prices are too high and that its drives should sell for considerably less than 5¼-in. devices. "Sony's business is not to compete on price, but to try to put forth high quality at a high price," says John Muir's Hartke.

Some observers believe the Sony drive will make little headway in the office-automation market until a 1M-byte version is available. The company will introduce a 1M-byte, double-sided drive early next year, says Kikuchi. "That will probably be the product's first real market threat," says Melody Johnson, an analyst with Kidder Peabody & Co., New York. "It then addresses the total word-processing market and that for integrated text and data processing. Then the competition will be head-to-head against Shugart."

Dataquest's Moore says there is a significant market for the microfloppy in small-business data-processing systems and personal and desk-top computers. In the current trend of placing removable storage devices at each terminal in a distributed system, the microfloppy's size is an advantage. "There may be a trend toward trusting archiving at the systems level to

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removable hard disks. They're not appropriate now. Floppies represent a long-term interim move," says Moore.

Kikuchi also is considering entering the drive in the high-end personal-computer market. But, Sony's initial sales may be mostly through its own products, as incorporated into the Series 35. Sony is lending credibility to the drive by using it in other products, says Moore. —*L. Valigra*

Selling computer graphics in retail stores

A new concept in retail computer stores has emerged in Boston's financial district, in the form of Computer Pictures Corp. The walk-in service center, which opened in January, produces data analysis and color graphics from raw data on a "while-you-wait" or overnight basis. But the graphics service is only a small part of the business that Computer Pictures hopes to generate by selling turnkey systems like the ones it uses in the store.

The main thrust of the business, says Philip Cooper, founder and president, is selling. "It would be a mistake to portray the company as a service company," he says, although he adds that customers are first attracted to the services of the storefront operation. Once they see what the systems can do, he explains, they may be tempted to buy one.

Cooper feels that his company is unique in that it is not only a retail service center, but it also designs the systems that it sells. "Unlike a Xerox copying retail store," Cooper says, "we design and integrate the very systems that we sell, plus we provide the service. It is a way to display and market our systems."

Two basic hardware configurations are available: a low-end Intelligent Systems Corp. terminal that outputs to a camera for slides, and a Chromatics terminal that outputs to a Xerox 6500 printer for hard-copy 8½ × 11-in. color graphics.

Cooper says that the ISC Intecolor 3621 terminal has limitations in that the resolution is not as good as on the Chromatics system, but adds that the ISC system is not intended to deliver high resolution. Prices for that system, which uses a Dunn Instrument Co. or Matrix camera, start at $5000.

The Chromatics CG color-graphics terminal with the Xerox printer sells for $65,000 to $85,000.

Both systems produce bar, pie, line, area, flow- and Gantt charts, as well as scatter diagrams. Overhead transparencies are also available.

The company's turnkey systems are aimed at corporate managers who have to analyze reams of data and statistics. Customers include government institutions, Fortune 500 companies, banks and financial institutions. The company has installed 40 turnkey systems so far.

Computer Pictures Corp. also supplies system software, which is written by David Friend, formerly president of Friend Information Systems, Inc. After a merger between Computer Pictures and Friend Information, Friend became board chairman of the new company.

Cooper, a former Madison Avenue advertising executive, founded Computer Pictures because, he says, "I got tired of analyzing statistics by hand." To alleviate the drudgery, he came up with the idea behind the company.

Some of the services furnished by Computer Pictures include the production of color charts and slides of sales analyses, exponential smoothings—a method of determining long-term trends among data that has a number of variations—constant-dollar adjustments, econometric forecasting and trend lines.

Discussing the walk-in service,

Computer Pictures Corp.'s *Philip Cooper: "We design and integrate the systems that we sell, plus we provide the service."*

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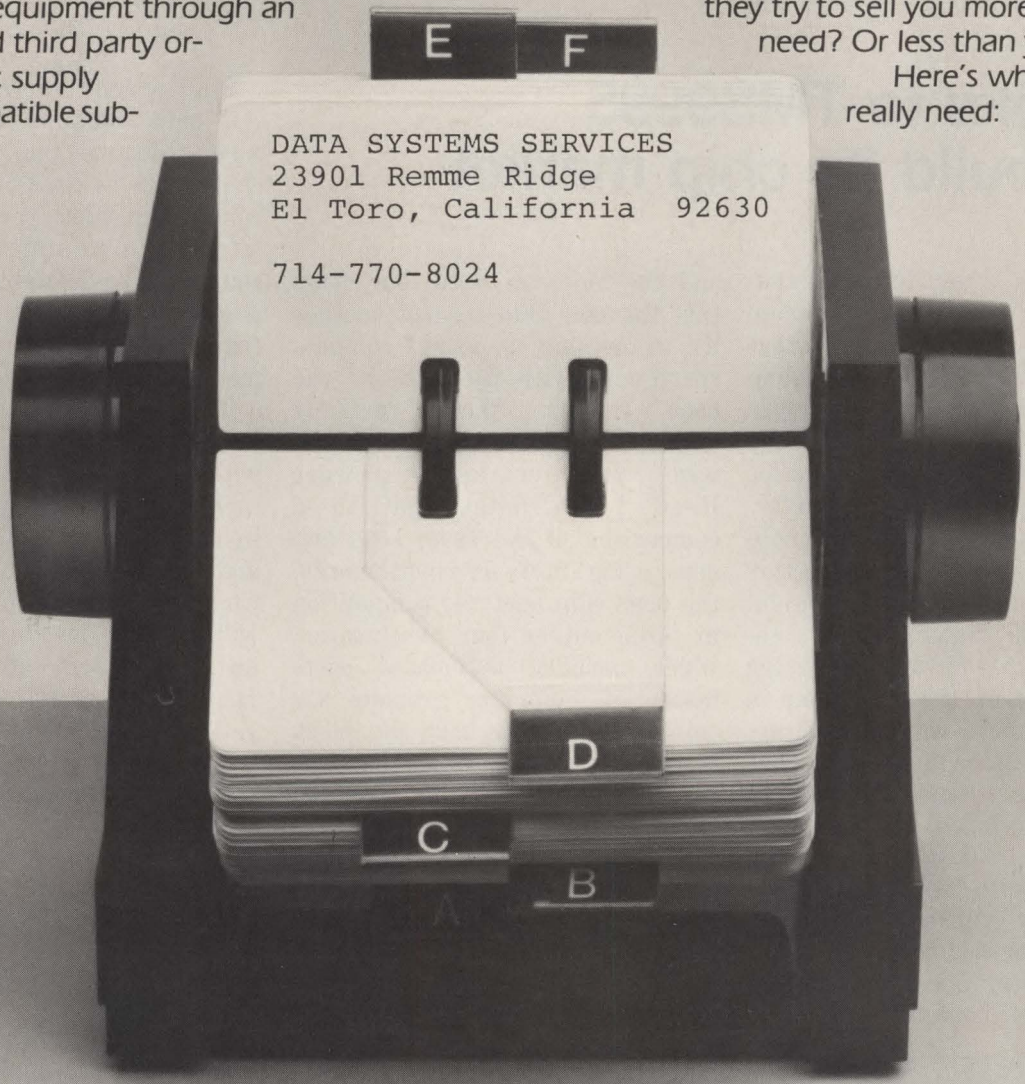

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Cooper says that only Genigraphics Corp. has a similar service, but that company is limited to making slides for graphic art departments. "Basically, those systems make pictures of what an artist draws on a screen," Cooper says. On the other hand, Cooper's systems handle both the plotting and statistical analysis of data.

Alex Ferdinand, manager of Genigraphics' Boston center, responds by saying, "We're not plotting the data out. They (Computer Pictures) make data projections; we make high-quality slides." He claims his company makes higher-resolution slides than does Computer Pictures because Genigraphics uses a higher-resolution camera with a 2000- to 4000-line scan.

"They're two different markets altogether," says Ferdinand. "That's a market we don't want to get into."

Prices for the Computer Pictures service are $20 per copy for a word-only analysis and $30 for a graphics statistical-manipulation analysis. Cooper notes that the systems perform more than 40 kinds of analytical functions.

Cooper's plans include opening stores in 20 large cities nationwide.

—Fran Granville

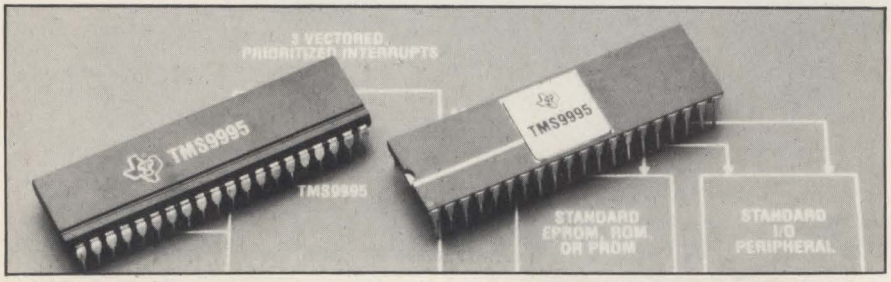
TI looks to TMS9995 to rebuild its chip market

Five years after Texas Instruments introduced the TMS9900 family of μp/μc chips—a family that failed to establish TI as a leading 16-bit chip supplier—the company is putting a new product on the market: the TMS9995, scheduled for delivery late in the second quarter.

While company sources promote the TMS9995 as offering architectural enhancements, technological advances and faster speeds compared with the TMS9900, industry observers term the new chip a stopgap measure, which, they say, will sustain TI in the chip market until a more competitive product can be developed. That "more competitive product" may be the planned 99000 16-bit chip, which the company says will be available for sampling later this year.

One industry observer lists the 9995's competition as the Intel 8088 and the Motorola 6809, but notes that the new chip "is just another hat in the ring. It doesn't compete speed-wise with the 8088 or the 6809," she says, "and it certainly doesn't compete performance-wise." Yet TI marketing manager Reed Borie notes that in a comparison of the 9995, 8088 and 6809, using Intel's own benchmarks, the 9995 chip beat the competition in three out of four benchmarks, which included automated parts inspection, computer graphics X-Y translation, bubble sort and block translation. Block translation was the only benchmark that the 9995 failed to master, according to Borie.

TI spokesmen says the 9995 chip offers system designers a minimum chip solution and that a complete system can be assembled with a single 9995 chip, an I/O peripheral and standard EPROM, ROM or PROM.



TI's 9995 chip *is built around an 8-bit data bus and contains 256 bytes of RAM, clock-generation circuitry, interrupt synchronizers and latches.*

Built around an 8-bit data bus, the 9995 contains 256 bytes of RAM—a feature that previous 9900 chips lacked—clock-generation circuitry, interrupt synchronizers and latches, a 16-unit timer/event counter, user-definable flag bits and automatic first wait-state generation, which allows matching of memory speeds to system needs.

The new chip features memory-to-memory pipeline architecture, with an access time of 120 nsec., and incorporates two new system interrupts—arithmetic overflow and macroinstruction detect (MID). Company spokesmen say the MID will allow the 9995 to execute larger instruction sets of future 9900 family processors, including the yet-to-be-released 99000.

The 9995's instruction set contains the same 69 instructions as that of the 9900, along with four new commands: signed multiply and divide, with execution speeds of 8.33 and 11 μsec., respectively; load work space pointer from memory; and load status register from general memory.

Fabricated with silicon-gate NMOS, the 9995 operates from a single +5V power supply, has a 6-MHz clock frequency and will be sold in either plastic or ceramic 40-pin dual-in-line packages. The chip is being offered in sample quantities to selected customers.

TI also plans to introduce a μc board, the TMAM6095, for evaluation of 9995 software and hardware,

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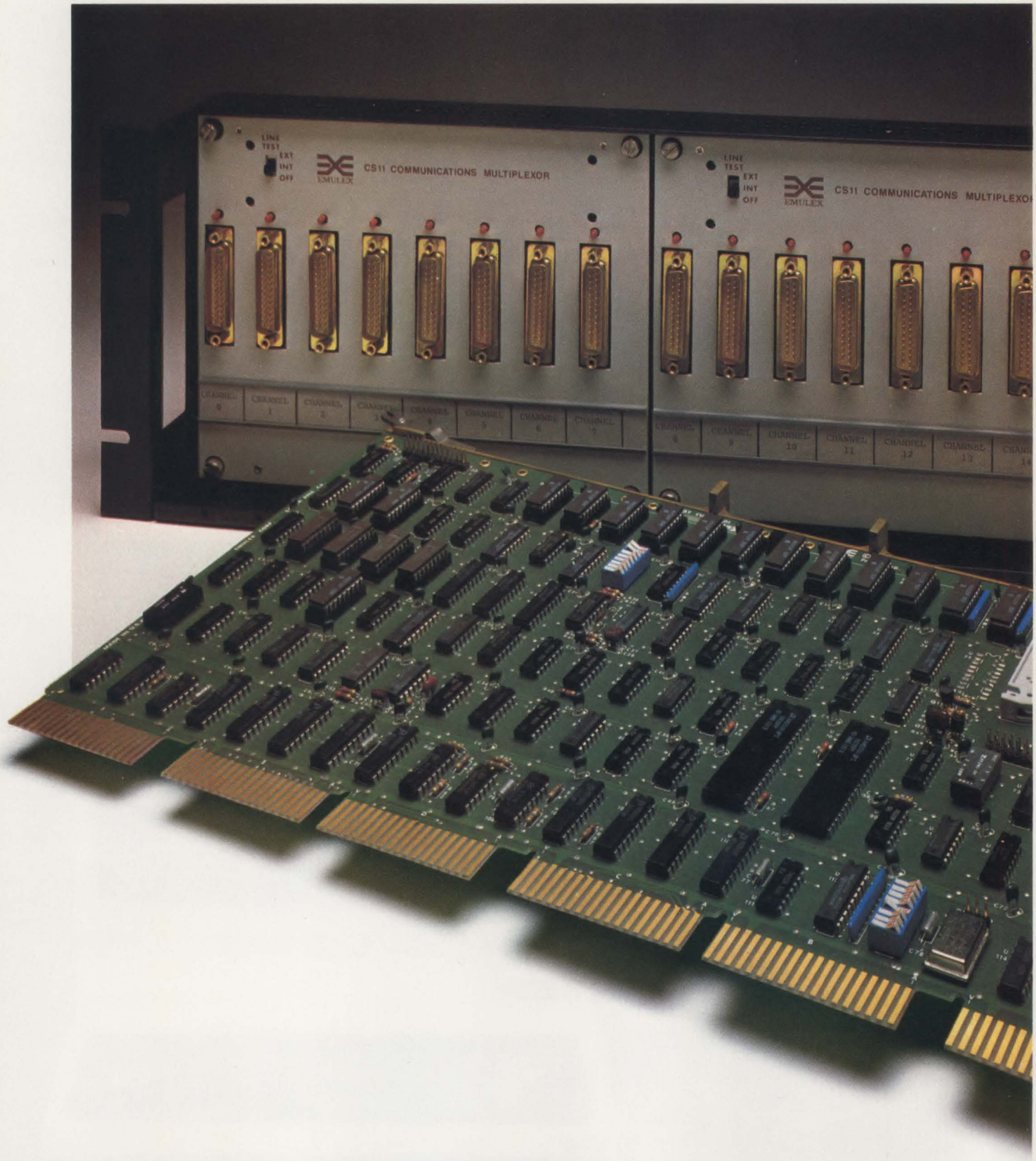

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as well as for prototyping 9995 interfaces. The board will contain a monitor for program assembly, editing and execution and a symbolic assembler for reverse assembly capability. Hardware includes two EIA data-communication links that provide for standard interfacing, 1K byte of external RAM and 6K bytes of EPROM.

The TMS9995 chip, in plastic, is priced at $40 in 100-unit quantities, and the TMAM6095 evaluation board is $800. —*Frank Catalano*

Nationwide leasing may spur small-systems market growth

Long-term equipment financing through nationwide leasing companies—a common technique in the world of mainframe processing—is starting to catch on with vendors of small-business computer systems and word processors.

Sparking the move toward small-systems leasing is the high price users must pay for the funds to buy these computers and the correspondingly high interest charges absorbed by both dealers and manufacturers to keep this hardware in inventory.

But while some dealers have leased small systems on a limited basis to their customers, full-scale programs involving both leasing companies and hardware vendors are only now being considered seriously. One such arrangement, due to be completed this month, involves Micro Five Corp., Irvine, Calif., and Greyhound Corp., Phoenix. The agreement between the two companies could serve as a model for similar deals at the small-systems level.

Under terms of the leasing agreement, Micro Five will continue its policy of direct sales to its network of independent dealers. Dealers, in turn, will resell the systems to end users. But, if an end user feels that leasing the hardware is more appealing than buying it outright, the dealer, supported by Micro Five, will resell the system to Greyhound, which, in turn, will lease it back to the dealer's customers. The presence of the leasing company in the transaction will be transparent, however. It will appear that either the dealer or Micro Five carries the lease, and Micro Five's name will appear on the lease.

Leases established under terms of the agreement will run for 60 months, and are designed for full payout. In a full-payout lease, the sale price the dealer usually charges is recovered during the term of the lease. In non-full-payout leases, the terms of the lease are not long enough to cover the sale price, and the equipment must go back on lease.

The two companies split any residual value in the system at the end of the lease term, and the lessor normally retains all investment tax credits. These credits are subject to negotiation between the lessor and lessee, however. If the leasing company retains the credit, the lease rate is reduced; if the end user wishes to retain the credit for tax purposes, monthly charges would be scaled up accordingly.

Vector Graphic, Inc.'s Lore Harp: *"$300 a month is a lot less painful to some customers than $10,000 at one shot."*

The advantages of leasing rather than purchasing can appear on an end-user's bottom line, points out Lore Harp, president of Vector Graphic, Inc., Westlake Village, Calif., a vendor of small-business computer systems. "$300 a month is a lot less painful to some customers than $10,000 at one shot, given today's interest rates," she says, adding that Vector plans to implement a leasing program for its hardware by year-end.

What form the company's plan will take is not certain, however, and won't be defined until Vector has made arrangements with a nationwide service company to handle its installed customer lease base. "This is absolutely necessary when dealing with a nationwide leasing company," Harp explains. "They want to be sure that the equipment will be serviced." The reason: customers who have complaints about service could withhold lease payments.

Mercator Business Systems, Inc., Sunnyvale, Calif., is also planning to initiate a lease program this year to expedite sales of its μc-based small-business systems. Like Micro Five, the company will handle the arrangements through a nationwide leasing company. "It's the only way to go if you're considering this type of financing," says Mercator president Herb Martin. "There's no way we could carry our own lease paper," he says. "The amount of

money needed to finance a long-term equipment lease is phenomenal, and we want to hold onto all the cash we can to grow our business."

For Martin and other vendors considering leasing, cash-flow demands dictate that previous sales-only policies to dealers will continue in force. What could happen to a company the size of Mercator if it decided to forego this policy and support its own leases? Martin answers by providing this example: "Suppose you're marketing small-business systems at $20,000 each. Your gross margins are 50 percent, and you have 50 systems out in the field. In this example, you have half a million dollars tied up in receivables."

If that hardware is classified as "sales" the vendor can expect that money back in a reasonable period of time, or he can use it as the basis of further financing, Martin points out. "But if that same quantity of hardware is tied up in a five-year lease, the picture changes dramatically. Those systems would lease for around $500 per month each, for a grand total of $25,000 income per month. That's a slow way to recover your $500,000."

Both Micro Five and Mercator also view leasing as a means of supporting their dealer networks. "Financing has always been a major problem in our industry," says Martin. "A dealer can be in business for several years, and his balance sheet may not have changed drastically." One reason, he explains, is that a dealer's worth can be measured in intangibles. "His assets consist of software, knowledge and good will," he says. "These things don't show up on a balance sheet."

Mercator's Herb Martin: *"Nationwide leasing is the only way to go if you're considering this type of financing."*

In many cases, Martin says, the only fixed asset a dealer may be carrying is a demonstration system. "Bankers used to be concerned with profit-and-loss statements," he says. "Now they're looking closely at balance sheets, and, as a result, dealers don't show up too well."

Micro Five president Ken Allen feels that his company's success also will be measured in part in terms of a strong dealer network, and he sees his firm's arrangement with Greyhound as a means of reinforcing those efforts. "In a tight capital climate, well-financed dealers can buffer the end users from the impact of high interest rates," he explains. "Our goal is to make it as painless as possible for end users to install our equipment, and we think that nationwide leasing is one of the better ways to do this."—*John Trifari*

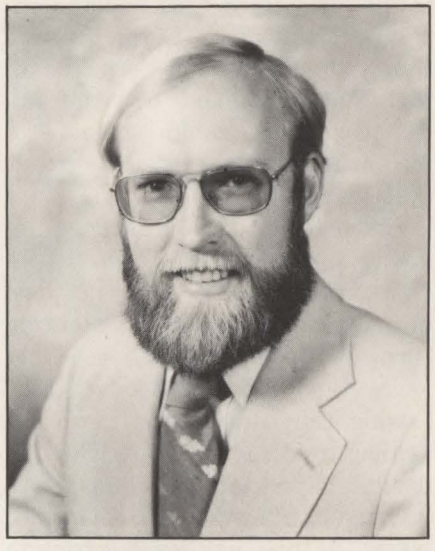
Micro Five Corp.'s Ken Allen: *"Our goal is to make it as painless as possible to acquire our equipment."*

BBN's electronic mail system is also portable

Until recently, a company that wanted to install an in-house electronic mail network had two options: buy a turnkey system from a hardware vendor, such as Wang Laboratories or Datapoint Corp., or develop its own electronic mail software to run on an in-house computer network. Now, a third alternative has emerged with the introduction of InfoMail by BBN Information Management Corp., Cambridge, Mass.

InfoMail is a software package that transforms an existing computer network into a medium for transmitting memos, reports and other office correspondence electronically. In addition, the package supports electronic filing and word-processing functions. Wang, Datapoint, IBM Corp. and several other equipment vendors offer similar software with their systems.

What differentiates InfoMail from other companies' offerings is its portability, says John M. McQuillan, BBN IMC vice president. InfoMail, he claims, can run on a variety of processors and networks, unlike competing electronic mail systems, which he says are tied to a



What differentiates InfoMail *from other electronic mail software is its portability, says BBN vice president John M. McQuillan.*

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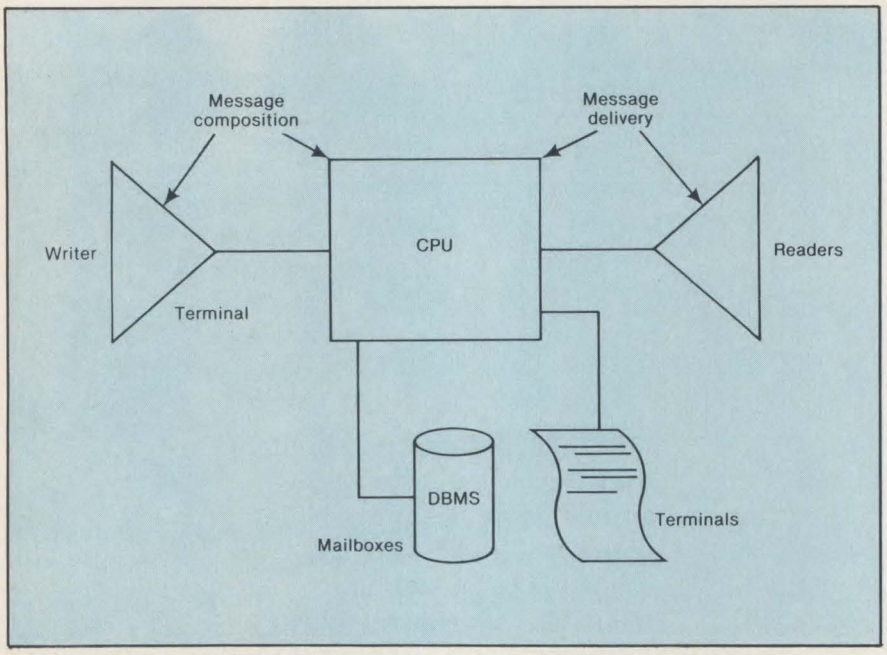

BBN's computer-based message system, *also called an electronic mail system.*

particular vendor's hardware.

The initial version of InfoMail runs on the VAX 11/780 super minicomputer made by Digital Equipment Corp. and supports asynchronous terminals. Later this year, BBN IMC plans to release an IBM mainframe version of the system, plus communications software that will enable electronic mail to be exchanged between VAX host systems. The company will also add support for synchronous as well as asynchronous display terminals.

BBN IMC has targeted the new software package at Fortune 500 companies, government agencies and other large organizations that have become interested in electronic mail as a means to boost office productivity. McQuillan expects InfoMail to find a ready market in these organizations because many of them already have computer networks that could serve as a basis for electronic mail. "With InfoMail, they get a lot of benefits for a modest cost," he says, pointing out that the $30,000 price tag on InfoMail is miniscule compared to the hardware investment in a typical corporate data network.

Moreover, McQuillan says, large companies want portable software that fits easily into the "pluralistic world" of corporate data networks, which typically comprise a variety of host processors, display terminals and network communications protocols. Indeed, he sees InfoMail as the first of a new breed of application software designed to run on networks instead of isolated systems.

InfoMail is the first product to be announced by BBN IMC, which was founded last summer to commercialize and market software developed by its parent company, Bolt Beranek and Newman, Inc., the Cambridge, Mass., acoustics and information technology research firm. As might be expected, InfoMail traces its roots to an electronic mail system, called Hermes, developed by BBN for use on ARPANET, the first packet-switching network. Hermes currently runs at 15 ARPANET installations and supports about 10,000 users.

Thus, although BBN IMC is new to the market, McQuillan counts on the company's extensive experience in electronic mail to win prospective customers. —*Paul Kinnucan*

Integrated networks: Timeplex's bold venture

For years, Timeplex, Inc., has been supplying components—mainly multiplexers—for data-communications networks. Now, the Rochelle Park, N.J., firm wants to go a step further and supply entire networks on a turnkey basis. "We intend to become the market leader by 1985," proclaims Edward Botwinick, Timeplex's brash, fast-talking president, who announced the new venture at a two-day press conference in Largo, Fla., in February.

The venture into turnkey networks is a bold move for Timeplex, and some industry observers question whether the company has the financial and organizational resources needed to carry it off. "You have to be able to put your money where your mouth is," observes John Pugh, marketing vice president at Codex Corp., which has been supplying turnkey networks since the early 1970s.

Timeplex's Series 2400 advanced intelligent modem *communicates with the Series II Microplexer to form an intelligent data-communications network. The unit operates at 1200- or 2400-bps switch-selectable baud rates.*

But Timeplex is no stranger to gambles. The firm was one of the first to tackle AT&T in the wake of the Carterfone decision in the late '60s, which opened the data-communications market to independent manufacturers. And, although many initial market entrants fell by the wayside, Timeplex grew by concentrating in a single market niche—multiplexers that allow

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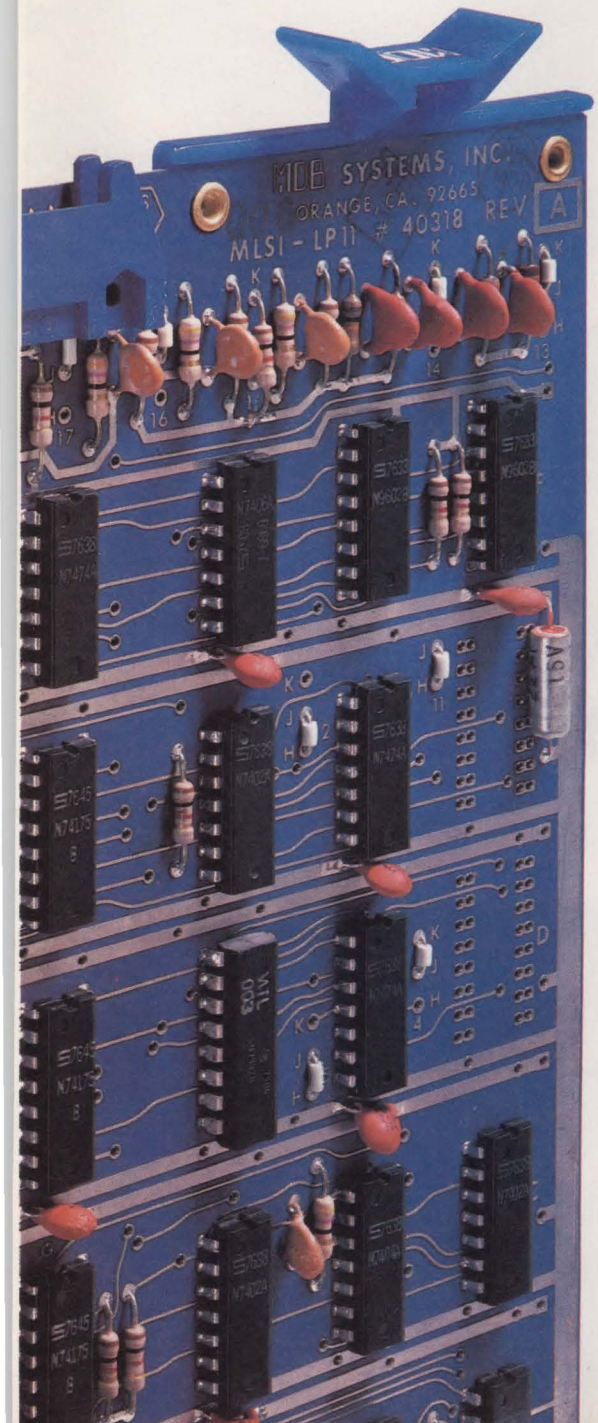

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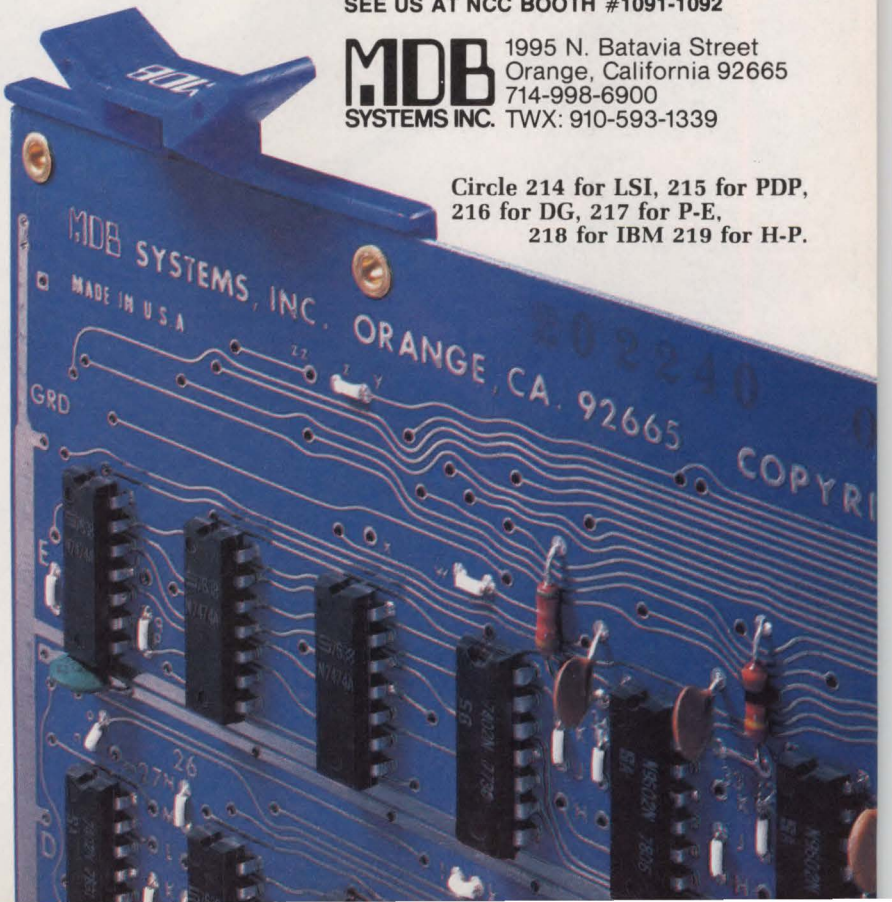

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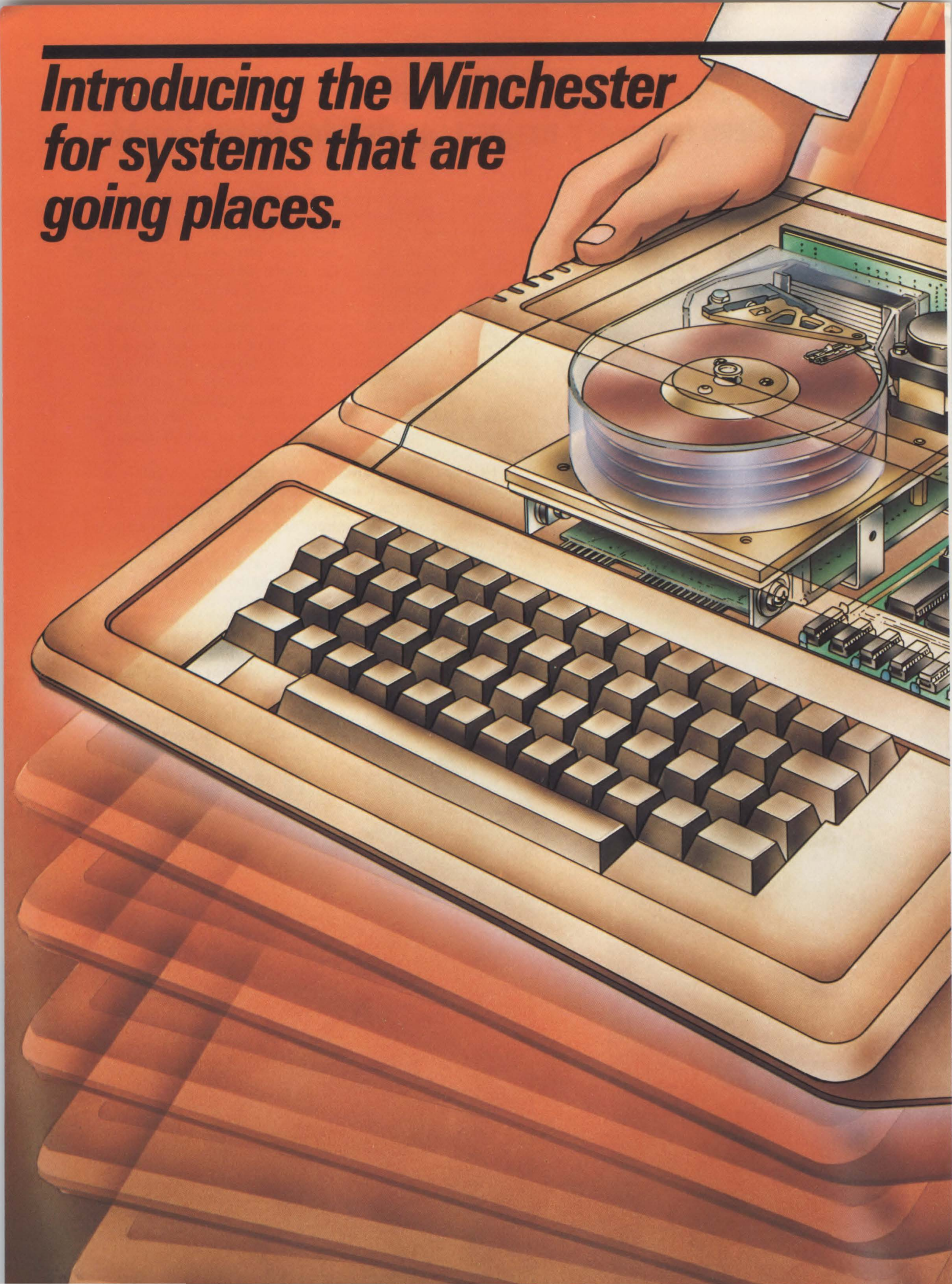

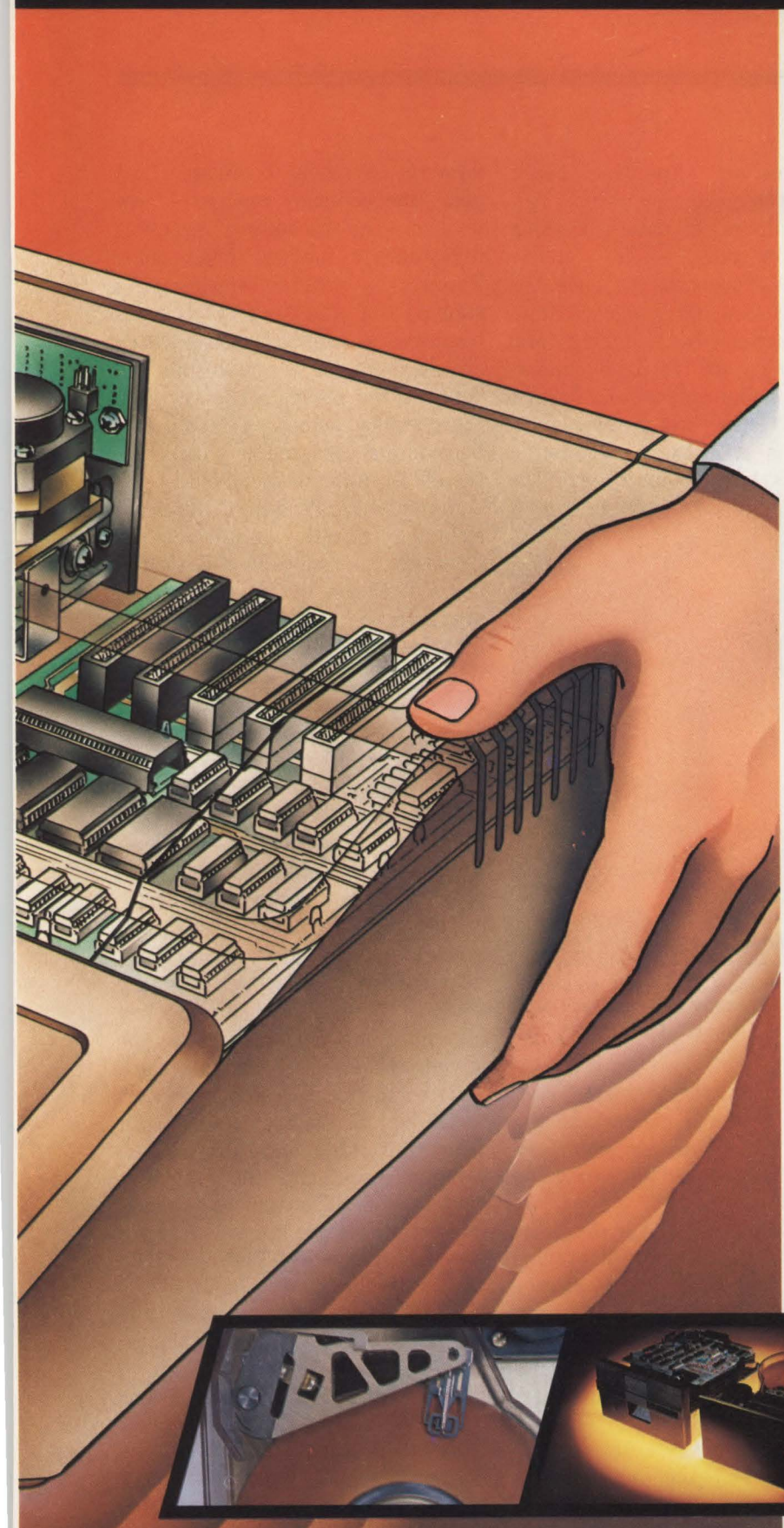

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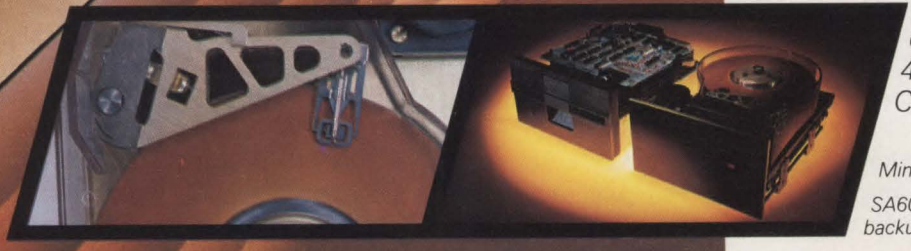

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multiple terminals to share a single data-communications line. In the process, the company has seen its revenues soar at a 40 percent average annual rate from $3 million in 1972, to $17 million in 1981.

Although Botwinick expects Timeplex's revenues to exceed $30 million in 1981, it has become increasingly clear that the company faces a crisis. The multiplexer market has become crowded with competitors, such as Codex, Infotron, Micom Systems, Inc., and Racal-Milgo. Moreover, although the market is expected to double from $50 million in 1978 to $100 million annually by 1983, according to International Data Corp., a Waltham, Mass., market research firm, that jump will not be enough to sustain the growth rate that Timeplex has historically enjoyed.

Thus, Botwinick is counting on Timeplex's new venture into integrated data networks to provide the necessary market room to sustain a high growth rate. "My gut feeling is that the latent market for turnkey communication systems could be as high as $500 million in the next five years," Botwinick says.

Spurring growth in data communications are Fortune 1000 corporations and other large private and government organizations with multiple locations. These companies have been putting terminals and distributed-processing systems in their field offices, and they need data-communications links, often spanning great distances, to connect the remote systems to central computers. "Data communications is becoming all-pervasive," says Botwinick, who likes to admonish potential customers, "If you haven't already encountered data communications, you most certainly will in the near future."

But installing a data-communications network is a ticklish business, requiring special expertise—an expertise often lacking even in big corporations that have dealt with data-processing systems for years.

Timeplex proposes to ease the pain of a customer's plunge into data communications by assuming total responsibility for the development, installation and support of a private data network, which Botwinick defines as everything between a company's host computer and the computer's remote terminals. Timeplex will design a network to the customer's specifications, configure the network and provide service on a continuing basis.

Edward Botwinick, Timeplex president: *"We intend to become the market leader by 1985."*

In addition, Botwinick says, the company is committed to supplying all the equipment used in the networks it builds for customers. "We want to be able to offer a customer the assurance of single-vendor support," Botwinick explains.

Supplying turnkey systems, plus building all the equipment on which they are based, strikes some industry observers as a tall order for a small company that has until now concentrated on only one system component.

But Timeplex has quietly been laying the groundwork for its entry into the systems business. Last year, the company created a new division—the transmission products division—in Largo, Fla., near Tampa, to provide engineering support for its turnkey systems business, as well as research and development for products that will support the company's entry into the systems business. Tampa is fast becoming recognized as a center of the data-communications industry.

Timeplex also acquired thick-film hybrid circuit manufacturer Cermetek in Sunnyvale, Calif.—the heart of Silicon Valley—as a way of starting to build a base in integrated-circuit technology, which underlies data-communications equipment.

To fill key positions at the new subsidiary, Timeplex has hired Howard Raphael and George Chou, both former National Semiconductor Corp. executives. Raphael became Cermatek's president, and Chou is marketing vice president.

The first fruits of Timeplex's investment in expanded product development appeared in February when the company announced a line of high-speed modems, called the advanced intelligent modem series, and a technical control center, which is a sophisticated patch panel for interconnecting data-communications equipment at a host computer site. Timeplex will custom build the center for its network systems customers. Both products are firsts for Timeplex, and they give the company two more key components, in addition to multiplexers and network control systems, of a data-communications network.

Gearing up for the systems market, Timeplex has also begun to beef up its sales and service organization, which has relied heavily until now on manufacturer's representatives in the U.S. and Europe. Until recently, Timeplex's products were marketed in Europe by Racal-Milgo, Ltd., under an

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exclusive distributorship agreement. In the last year, the company has doubled the size of its sales force, which has enabled it to dispense with manufacturer's representatives in all but fringe areas, says marketing vice president Vicki Brown. The company has also created a foreign subsidiary, Timplex, Ltd., to handle sales in the U.K., and has severed its long-term tie with Racal-Milgo.

(The breakup was not amicable. Timeplex recently launched legal proceedings against its former European partner, claiming that Racal-Milgo used proprietary information in the development of its recently introduced multiplexer line. Timeplex also claims that Racal-Milgo refused to honor an allegedly non-cancelable contract for $1 million worth of multiplexers. Racal-Milgo denies the claims, and the matter will be settled by arbitration, Botwinick says.)

Timeplex has also acquired land on which to build a new corporate headquarters in Woodcliff Lake, N.J. The headquarters is slated for occupancy in September, 1982. In addition, Timeplex has purchased land near its Largo division to accommodate future expansion.

All this expansion has substantially drained Timeplex's capital reserves. The company spent $2.6 million last year on land and capital equipment—a major investment for a company of that size. But Botwinick says recent ventures into the debt and equity markets, which netted $16 million, have provided the company with ample capital to continue its rapid buildup.

Industry observers point out that, in entering the turnkey systems business, Timeplex will meet some formidable competition, including major computer vendors, such as IBM and DEC, common carriers, such as AT&T and Telenet, and other data-communications equipment manufacturers, such as Codex.

Botwinick contends that competition will not be a major factor in Timeplex's success in the integrated systems market. For one thing, he claims, the market is big enough for all contenders to survive—and even thrive. Moreover, computer manufacturers and public network vendors offer different solutions to the network problem from those of Timeplex. Botwinick says these solutions will not fit all user needs. For example, he says, some customers will not want to be locked into a single computer vendor, a problem that may be involved in using a computer vendor-supplied network, such as IBM's Systems Network Architecture (SNA). Similarly, customers may want to avoid the high variable costs and lack of control that using Telenet or other public networks entails.

Such a customer is ripe for a custom-built network, and that's where Botwinick sees Timeplex concentrating its attention. In this niche, Timeplex will be relatively uncrowded. "Codex is the only company that has the equipment in its catalog to offer single-vendor custom networks," Botwinick says. "They will be a big competitor for us."

Timeplex will have to play quick game of catch-up if it hopes to match Codex in experience, product depth and financial resources. For one thing, Codex is a much bigger company. Although, as a subsidiary of Motorola Co, Codex does not reveal financial data, a company source says Codex's revenues exceeded $100 million in 1980. Moreover, Codex has been in the turnkey network since the early '70s, and has implemented more than a dozen major networks, says Codex's Pugh. Customers include the Departmenet of Defense and major international airlines, including British Airways and Air France.

Codex also has the most comprehensive data-communications product line in the industry, Pugh claims. He says this enables the company to meet almost any customer requirement. For example, Codex's product line includes not only multiplexers and modems, which Timeplex also has, but also communications processors, digital switches and intelligent terminals.

Codex also has direct access to semiconductor technology through its affiliation with Motorola.

Codex's VLSI design group, for instance, uses the design and production facilities of Motorola's semiconductor subsidiary, Phoenix.

But Botwinick professes to be unconcerned about competition from Codex. "There's room for more than one company in this market," he says. *—Paul Kinnucan*

Government accelerates shift to small computers

The federal government's shift away from mainframes and toward small computers has become even more pronounced in recent years, according to a report by the General Services Administration.

Digital Equipment Corp. is now the leading supplier of computers to the government, with 3656 units installed by the end of fiscal year 1979 (latest figures available). That represents 25 percent of all computers owned and leased by the government. Meanwhile, IBM Corp.'s share of the government inventory stands at 1284 units, only 9 percent.

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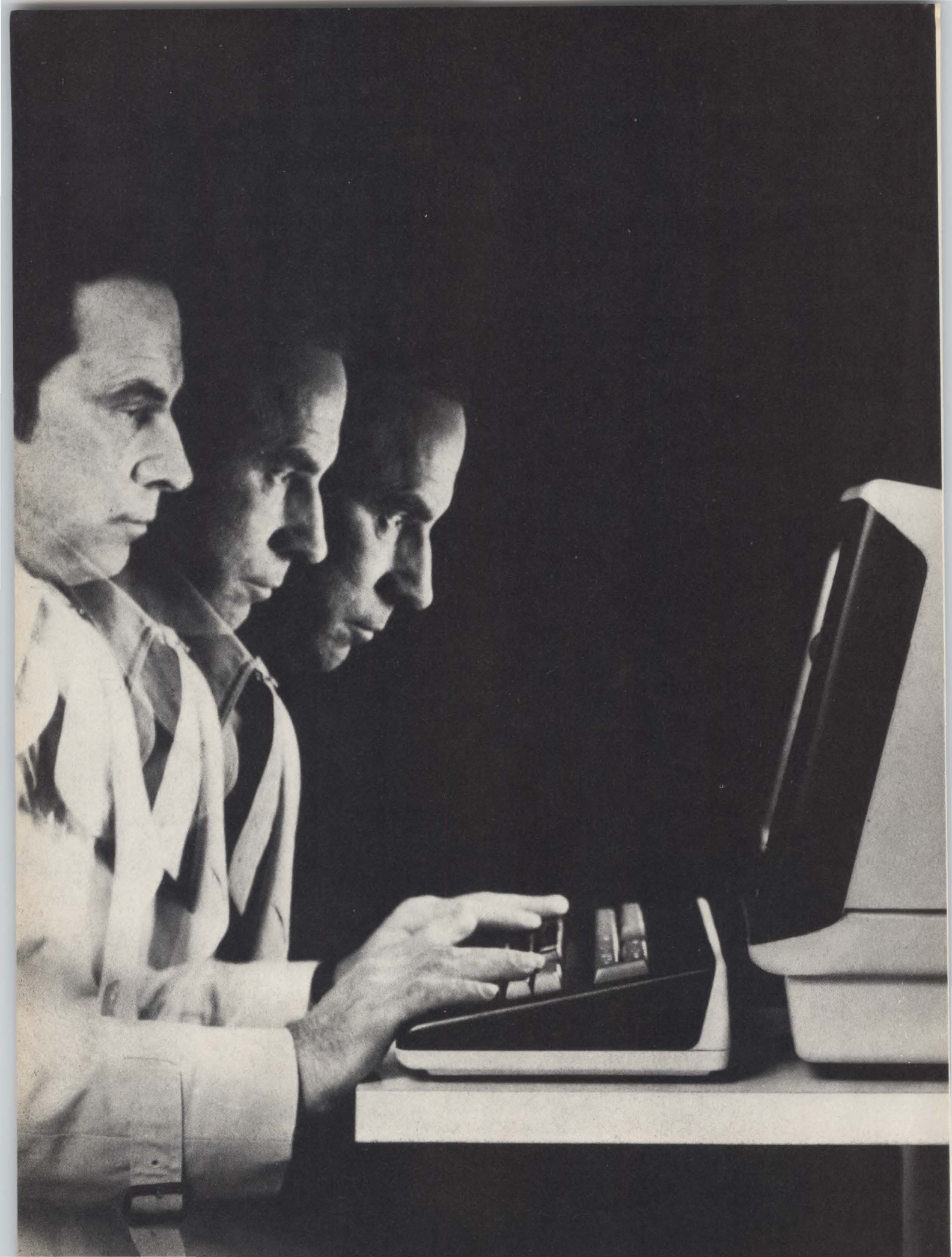
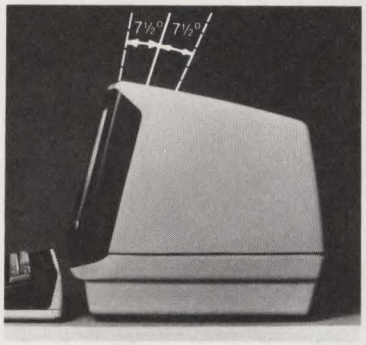


Smart moves

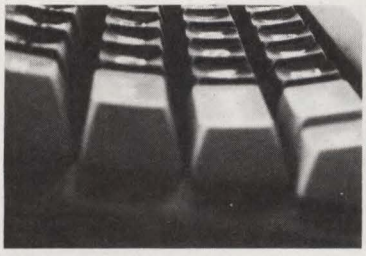
To make life easy for the operator, Hazeltine has added a few smart moves to the new Executive 80™ terminals.

The tilt feature lets you move the standard 15-inch screen to the best viewing angle. The detachable keyboard can be moved to the best orientation for the working environment. The combination helps operators work comfortably, with less physical fatigue.



Tilt screen means more comfortable viewing.

The typing position of the keys has been redesigned. The Executive 80 has a contoured, low profile keyboard where each row of keys has its own operating angle. It makes prolonged typing a lot less tiring.



Keys are precisely contoured for the most natural typing position.

Then there are smart moves you can make on the screen. You can vary the intensity, designate reverse and blinking fields, underline and even draw out forms. If you are working with full documents, you can order the 15-inch smooth scrolling monitor which lets you selectively display either 80 or 132 column formats, in normal size or double height and width. They're all features that make it easier to focus in on important data.

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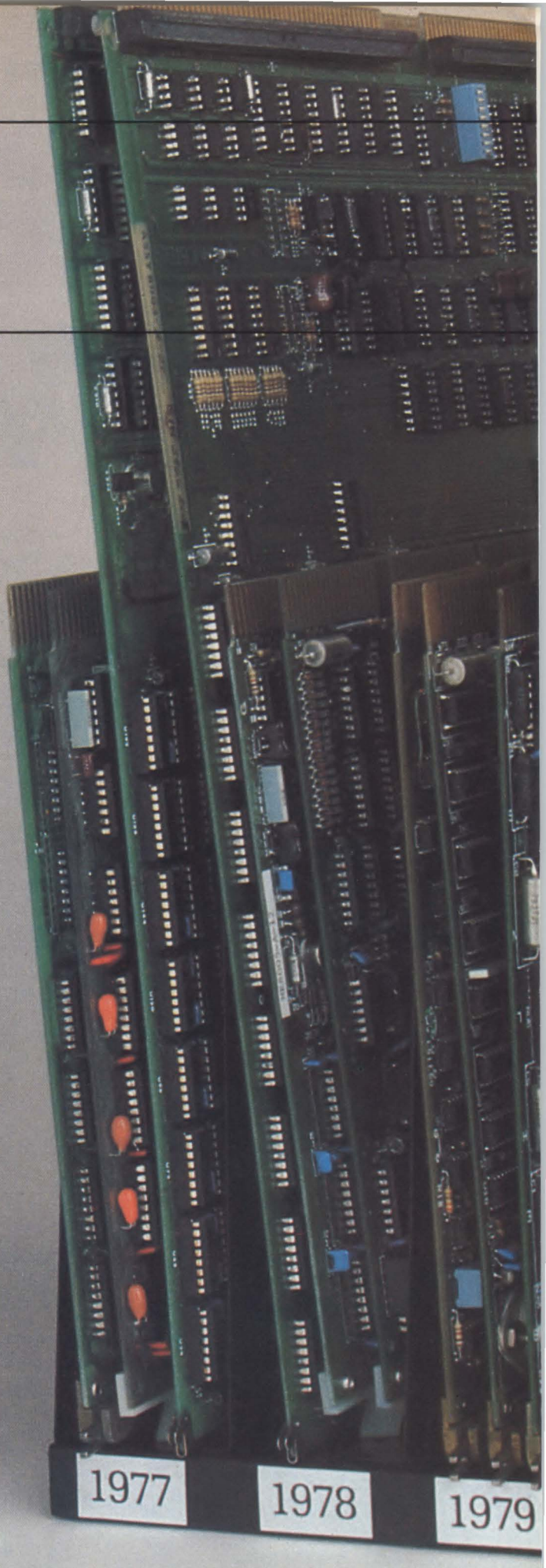

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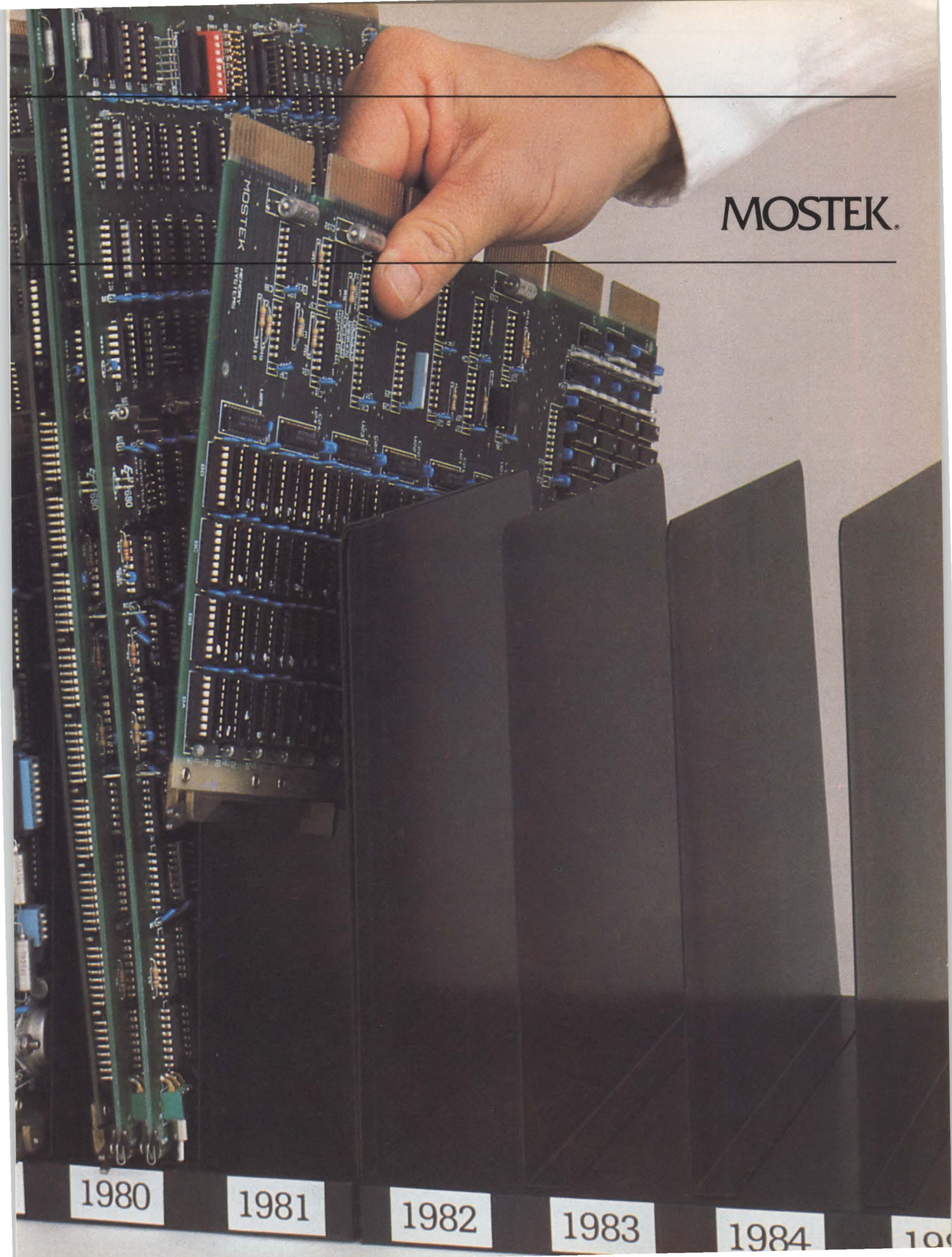
CIRCLE NO. 22 ON INQUIRY CARD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1981
1982
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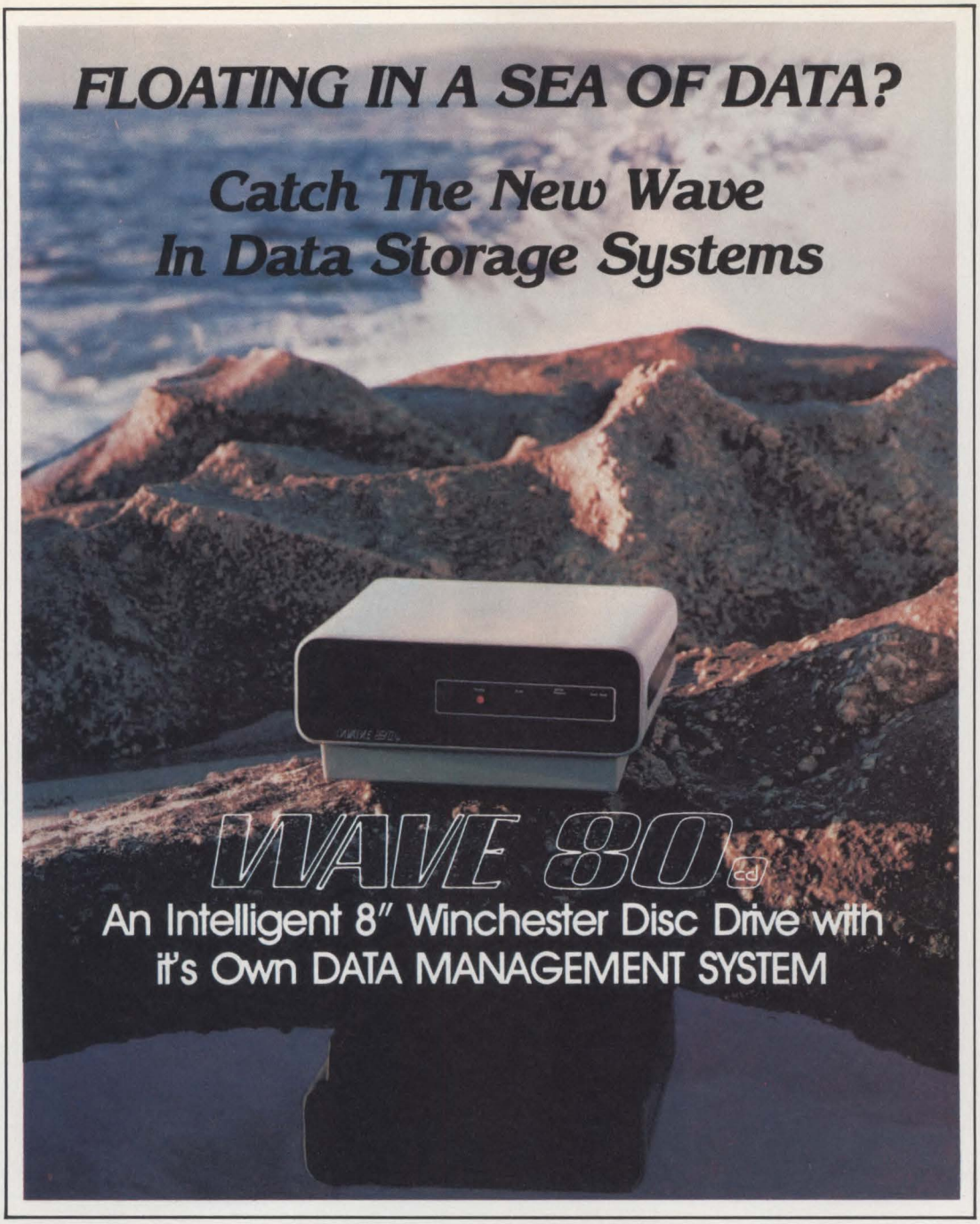

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CIRCLE NO. 23 ON INQUIRY CARD

Manufacturer	1965		1975		1979*	
	Number	Percent	Number	Percent	Number	Percent
Burroughs Corp.	161	6.7	315	3.6	303	2.1
Control Data Corp.	249	10.3	541	6.3	497	3.5
Data General	—	—	372	4.3	1052	7.3
Digital Equipment	14	0.6	1699	19.6	3656	25.5
Hewlett-Packard	—	—	361	4.2	1093	7.6
Honeywell	106	4.4	706	8.2	896	6.3
IBM Corp.	1020	42.3	1320	15.3	1284	9.0
Modular Computers	—	—	—	—	588	4.1
Sperry Univac	488	20.1	1368	15.8	1778	12.4
Xerox Corp.	14	0.6	360	4.2	297	2.0
Other	360	15.0	1607	18.5	2889	20.2
TOTAL	2412	100	8649	100	14,333	100

Sept. 30, 1979 (latest government figures available)

Table illustrates *the government's shift from mainframes to small computers.*

percent of its computers and DEC ranked third with 500 computers (9.5 percent).

Mainframes were even more dominant in the government inventory in 1965, when IBM alone supplied 42 percent of all government computers (see table). An estimated 80 percent of all government computers were mainframes then, but that figure has dropped to no more than 20 percent today.

That shift is demonstrated even more graphically when the GSA breaks down its computer inventory by price ranges. Its smallest computers—those priced at less than $50,000 each—represent 68 percent of all computers, but account for only 2 percent of what the government spends for computers. Meanwhile, the largest mainframes—those priced at more than $1.5 million each—make up less than 2 percent of the inventory but represent 68 percent of the government's computer expenditures.

The GSA report, which inventories all government computers—civilian and military, except for custom computers used in weapons and space systems—shows that companies that didn't even exist a few years ago are now among the government's leading suppliers. Modular Computer Systems, Inc., Fort Lauderdale, Fla., for example, hadn't shipped one computer to the government as recently as 1975, but now ranks as the seventh-leading supplier with 588 computers (4.1 percent).

Many of Modular's shipments were to the Department of Energy. Although DOE is one of the government's newest cabinet-level departments, it buys far more computers than any other nonmilitary government agency. It has 3390 computers, compared to the 1862 units owned by the National Aeronautics and Space Administration, the second-largest computer buyer in the government. The government's total inventory is about evenly split between military and nonmilitary agencies.

Two other small-computer companies that have made great strides in their sales to the government are Data General Corp. and Hewlett-Packard Co. Neither company had delivered a single computer to the government as recently as 1970, but now each accounts for more than 7 percent of the total inventory

—Peter Hayhow

DG probes graphics market with new terminal, software

In what is regarded as a timely move by some industry observers, Data General Corp. has entered the graphics market with the introduction of a terminal and graphics display software.

The company claims its new Dasher G300 monochrome raster-scan display, the first in a family of graphics products, is superior in price and performance to existing products in its class.

The Trendview chart-generation software, unveiled in February along with the terminal, enhances the capability of the G300 and can be used with any DG Advanced Operating System (AOS) or AOS/virtual storage software.

Observers note that the move will help DG prevent a sales-loss of users who might not want graphics now, but may later.

"We have taken advantage of raster technology that works with a μp to offer graphics features, such as filling in circles and plotting text, which are not possible on other

graphics terminals at this end of the market," claims Abe Hirsch, graphics product marketing manager. Hirsch says that two competing displays are the Tektronix 4025 and the Hewlett-Packard 2648. A spokesman from H-P says varied degrees of solid shading are pre-programmed into the 2648, and can be used through a series of keystrokes to solid-fill objects. A Tektronix spokesman concurs that the 4025 cannot do solid fill.

Hirsch attributes the G300's ability to handle solid shading and text plotting to the "rich" command interpreter (GCI) software loaded into RAM. Other GCI functions include lines, vectors with polar coordinates, arcs and scaling and rotation of text, enabling a variety of print sizes to be "written" on the screen at different angles.

Data General's entry into the graphics market—*the Dasher G300—is said to outperform similar-level products.*

Although the G300 is a slave device, it contains a Zilog Z80A μp that executes the GCI software. Additionally, the Z80A initiates self-test when the G300 is turned on, checking the 16K bytes of ROM, 40K bytes of RAM and keyboard operation. Although the ROM is not user-programmable, characters can be loaded into it. During program execution, the G300 can isolate command errors. The host CPU has its own system diagnostics.

The G300 is geared for applications in business and technical graphics, publication layout, visual aids, computer-aided instruction, real-time process control and low-end CAD/CAM. The 12-in. green-phosphor screen displays 1920 characters in 24 lines and 80 columns. Graphics images are plotted on a 640 × 240 pixel grid. The detached keyboard is sculptured for operator comfort.

Compatible with existing DG Dasher alphanumeric display terminals, the G300 runs all Dasher D200 software. The G300 can be used on the microNova, Nova and Eclipse computers running under RDOS, DOS, MP/OS, AOS and AOS/VS operating system software, and on most commercial systems. Asynchronous communications are performed at speeds as high as 9600 bps, and RS232 and 20-mA current-loop interfaces are standard.

Two selectable modes of operation are available. First is an abbreviated command mode, in which graphics commands are standard alphanumeric Dasher terminal control code sequences. Seven languages are included. In mnemonic command mode, graphics commands are English-like character strings, such as "line" or "circle," which are interpreted for execution. Thus, a user can define thickness of dot patterns and angles to print letters, such as italics. A user can also define company logos and other nonstandard information by using a string of commands without first having to digitize them. Hirsch explains that this process will be made easier in future systems by the addition of a utility that will define such character sets internally.

Graphics programs can be accepted in any programming language because commands are given to the G300 as text/screen. For example, the command "circle" will be given, followed by parameters such as "radius." Unlike many other graphics terminals, Hirsch explains, the G300 is not limited to FORTRAN. It can also use BASIC, Business BASIC, PL/1 and Pascal.

The G300 raster is flicker-free because each memory bit has a corresponding dot on the screen that is scanned under hardware control at a fixed rate of 30 Hz, dot by dot. Vector refresh units often flicker, even with the constant redrawing of lines several times a second, Hirsch says.

The G300 is intended for use in DG systems, but it will face some competition from other vendors when those DG systems operate in mainframe environments.

Hirsch expects competition from Tektronix's 4025 and H-P's 2648. Hirsch believes the G300 will compete favorably in price and performance with those products, although it will reach the market later than them. Price for the base Tektronix unit is $4000, with options priced separately. The H-P

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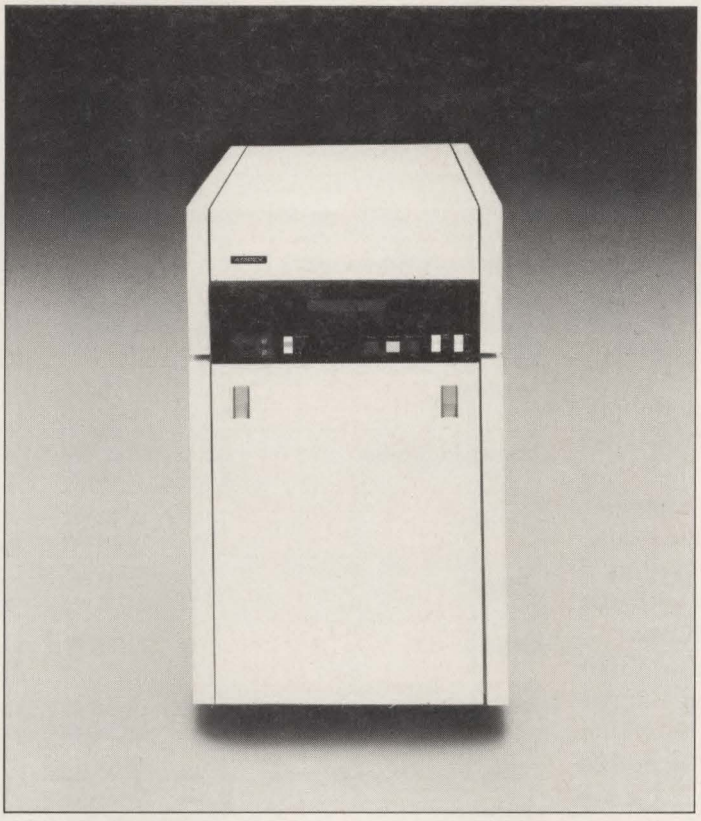

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DM-9300AQ disk pack swapping is as easy as using them. Its large front opening has been designed with the convenience of a top loader, and human engineered for minimal lifting. So even a 20-pound pack is easy to insert and remove. It's such a good idea, we're surprised somebody didn't think of it sooner.

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And the same goes for maintenance. Service requires only front, rear, or top access. Side access is eliminated, so you can arrange the units side by side. What's more, the logic chassis in the rear of the unit swings out to provide easy access to all test points and connections. And extensive use of LEDs simplifies trouble-shooting.

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The DM-9300AQ. Just one of a complete line of Ampex plug compatible disk drive memories for nearly any CPU.

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CIRCLE NO. 24 ON INQUIRY CARD

2648 is priced at $6250. Output devices for each are priced separately. The G300, including keyboard, is $3900. Initial license fee for the GCI is $500, with added terminal fees at $50. Hirsch attributes the G300's low price to DG's ability to use the high-volume production lines already in place for the Dasher D200 displays.

The G300 does not yet include an output device, but it does have a printer port, and, Hirsch says, a printer will be introduced as soon as possible.

First customer deliveries are scheduled for mid-June, and delivery schedules are 90 days. The company claims to have several orders in hand.

DG is offering Trendview software to enhance the graphics functions available on the G300 when it is used in larger computer systems. Trendview produces line, pie and bar charts. It is used on a G300 terminal in a system with AOS or AOS/VS operating software.

Trendview accepts data in three modes: interactively, from stored files or directly from an application program through an interprocess communication (IPC) port. A user can enter the chart description at the keyboard interactively, using simple, high-level commands. Chart descriptions and completed charts can be stored for future reference. Chart data are entered interactively or taken from a stored file. The second mode allows for stored chart descriptions to be used in subsequent charts.

The third mode allows the application program to directly control Trendview by communicating with it through the host-resident IPC port. Thus, a user can "front-end" an application with graphics, with Trendview acting as a subroutine. Trendview can display multiple charts simultaneously, handle curve fitting and plot linear regression trend lines. Initial license fee is $3000. —*L. Valigra*

BOX SCORE OF EARNINGS

This table, which appears every month, lists the revenues, net earnings and earnings per share in the periods indicated for companies in the computer industry and computer-related industries.

Company	Period		Revenues	Earnings	EpS
Amdahl	Yr.	12/26/80	394,400,000	15,200,000	.80
	Yr.	12/28/79	320,000,000	15,300,000	.87
Apple Computer	3 mos.	12/26/80	67,621,000	7,421,000	.14
	3 mos.	12/28/79	19,540,000	2,647,000	.06
Atlantic Research	Yr.	12/31/80	80,500,000	2,308,000	1.36
	Yr.	12/31/79	57,700,000	1,845,000	1.41
Aydin	Yr.	12/31/80	102,908,000	7,319,000	2.11
	Yr.	12/31/79	64,167,000	4,062,000	1.19
Burroughs	Yr.	12/31/80	2,902,356,000	81,972,000	1.99
	Yr.	12/31/79	2,830,976,000	305,536,000	7.45
Cullinane Database Systems	9 mos.	1/31/81	20,629,000	3,043,000	1.01
	9 mos.	1/31/80	12,738,000	1,708,000	.62
Dataproducts	9 mos.	12/27/80	195,217,000	12,628,000	1.70
	9 mos.	12/29/79	127,208,000	6,767,000	.93
Datatron	6 mos.	12/31/80	3,755,297	33,782	.04
	6 mos.	12/31/79	3,030,435	433,876	.21
Delta Data Systems	6 mos.	9/30/80	15,794,000	(797,000)	(.28)
	6 mos.	9/30/79	9,966,000	(332,000)	(.12)
Dicomed	Yr.	12/31/80	5,400,047	562,416	.93
	Yr.	12/31/79	4,101,448	355,741	.69
Docutel	Yr.	12/31/80	53,278,000	4,716,000	1.74
	Yr.	12/31/79	34,880,000	4,247,000	1.66
E.G.&G.	Yr.	12/28/80	613,093,000	26,310,000	1.93
	Yr.	12/30/79	525,798,000	20,942,000	1.57
Four-Phase Systems	Yr.	12/31/80	197,187,000	5,452,000	1.06
	Yr.	12/31/79	178,736,000	16,727,000	3.25
General DataComm Industries	3 mos.	12/31/80	15,560,000	1,273,000	.21
	3 mos.	12/31/79	11,873,000	934,000	.18
Genisco Technology	3 mos.	12/31/80	4,445,006	95,303	.08
	3 mos.	12/31/79	3,422,688	250,703	.20
GenRad	Yr.	1/3/81	167,698,000	10,322,000	1.49
	Yr.	12/29/79	119,414,000	8,512,000	1.32
Hazeltine	Yr.	12/31/80	133,799,000	4,840,000	2.37
	Yr.	12/31/79	123,333,000	5,357,000	2.63
Management Assistance	3 mos.	12/31/80	77,472,000	3,541,000	.43
	3 mos.	12/31/79	70,814,000	3,374,000	.41
MSI Data	9 mos.	12/27/80	39,763,000	2,461,000	1.06
	9 mos.	12/29/79	32,019,000	850,000	.37
Network Systems	Yr.	12/31/80	13,121,000	1,474,000	.69
	Yr.	12/31/79	8,171,000	586,000	.50
Paradyne	Yr.	12/31/80	75,907,000	8,247,000	.73
	Yr.	12/31/79	41,441,000	4,765,000	.52
Perkin-Elmer	6 mos.	1/31/81	531,349,000	36,965,000	.86
	6 mos.	1/31/80	455,661,000	30,808,000	.77
System Industries	Yr.	12/28/80	37,929,000	2,474,000	1.87
	Yr.	12/30/79	25,033,000	17,000	.12
Tandem Computers	3 mos.	12/31/80	40,609,000	4,662,000	.41
	3 mos.	12/31/79	20,826,000	2,161,000	.23
T-Bar	Yr.	12/31/80	23,563,000	1,114,000	.67
	Yr.	12/31/79	18,545,000	1,553,000	.98

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CIRCLE NO. 25 ON INQUIRY CARD

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And because bubbles pack 1 million bits of data in an area less than 100 square centimeters, they can boost the performance of a portable data logger, as well as an in-house numerical control system.

Kindle your product development

Now there's a fast, easy way for you to capture these advantages in your products: the iSBC 254 Bubble Memory Board. It puts from 128K to 512K bytes of Intel's 7110 bubble memory—complete with controller and support circuitry—on a 12 x 6.75-inch Multibus board. That's the same bubble memory and controller that's already storing data onboard ships and on factory floors. All pretested. And ready to run in your system today.

When you slip the iSBC 254 board into your Multibus-compatible chassis, it operates like any other microcomputer mass storage system. You choose from several I/O modes, including Direct Memory Access. You access data in a flash—several times faster than you can with a floppy. And move it at rates up to 50K bytes per second.

Add fuel to the fire

What's more, you can complement the performance of the iSBC 254 board in your system with any of a wide variety of Intel® Multibus boards

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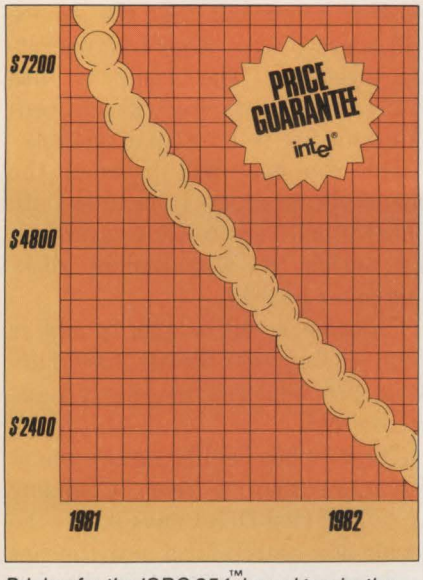

Pricing for the iSBC 254™ board tracks the downward price curve of bubble memory components.

and software products available today. From 8- and 16-bit single-board computers, to analog and digital I/O, to real-time operating systems, complete with software drivers for bubble memory. Or if you want to configure your own board, you can start with Intel's Bubble Memory Prototype Kit (BPK72). It has everything you need to tailor Intel's 1-megabit bubble memory to your product.

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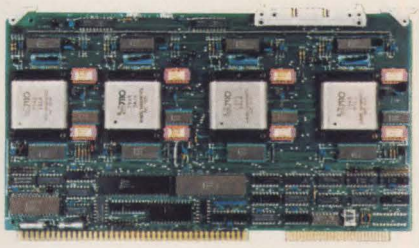

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CIRCLE NO. 26 ON INQUIRY CARD

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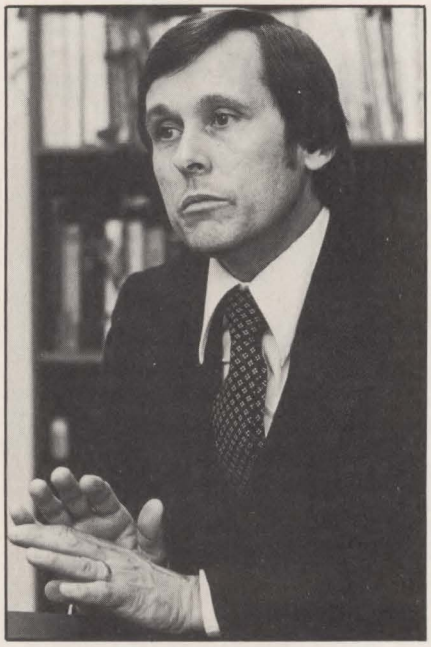
Smart disk file cache improves disk throughput

The move by disk-drive manufacturers to build intelligence into their drives could severely affect the independent disk-controller market. That's the opinion of officials at MiniComputer Technology, Palo Alto, Calif. To offset that possibility, the company is preparing to introduce a series of intelligent add-on modules for its family of emulating disk controller boards.

The firm will unveil the first of that series, the Turbo 21 disk file cache (DFC), at next month's National Computer Conference in Chicago. The single-board device contains 128K bytes of dynamic RAM supervised by an 8-bit-wide, bipolar bit-slice processor. The product is aimed at the Digital Equipment Corp. market, for which MiniComputer Technology builds the EDC21 emulating disk controller. The device enables DEC users to replace low-capacity DEC disk drives with high-capacity Winchester drives, by emulating the DEC product. When used with the controller, the company claims, the unit improves system throughput as much as 79 percent by reducing delays that result from a drive's seek time and rotational latency. The company has a patent pending on the firmware.



MiniComputer Technology *vice president Art Roshon claims the DFC has a kind of artificial intelligence.*

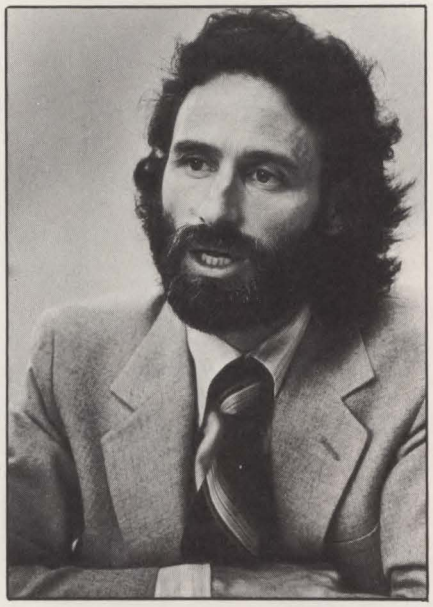
Vice president of engineering Art Roshon explains that the DFC stores the most frequently accessed data retrieved repeatedly from a disk. The DFC operates logically as follows:

The CPU issues a command for a read or write disk operation. A search of the file-management table for the requested data then takes place in the DFC. If the file is cached, the data are transferred to the controller for processing. This procedure is followed after every request for a file.

Files not found in the management table are retrieved from the disk by the process of sending the file's location information to the drive via the controller, searching for the data, and transmitting back to the processor. Once the new data are found, the least frequently used file is purged from the DFC's table, and the new file replaces it.

A "self-optimizing algorithm" performs these functions. It has a kind of artificial intelligence, Roshon claims, because it continually adjusts to incoming commands and data.

In one benchmark study, Roshon says, the system operated for 36 hours with 9.7 hours of activity on the CPU. During that time, 478,000 disk I/O requests were made—a total of 1.6 million sectors. Without the DFC, disk I/O took 5280 sec.—3968 sec. for latency and 1312 sec. for seeks, Roshon says.



Don Dilley, president, *MiniComputer Technology: "In this business, you have to come out with a new product every year, or you're dead in three years."*

The same system with a DFC saved 2966 sec. in latency and 870 sec. in seeks; or 3836 sec. better than the system without the DFC. "That's a total of 1444 sec. for disk I/O, or an improvement of 73 percent," says Roshon.

The DFC's operation is transparent to the operating system. The device runs on DEC's RSTS on PDP-11/34 to -11/70 systems. But Roshon points out that the device will operate with other DEC operating systems. The company has found that the device will add considerable life to I/O-bound systems.

The company will broaden the line of DFC products to include Data General and Perkin-Elmer systems, for which it also builds disk-controller boards.

Customers will be able to add as many as four DFC boards, each handling 256 disk sectors, for a 1000-sector total.

The DFC has been in development for more than a year. Company president Don Dilley says it was the result of a search for a new concept rather than an effort to solve a particular problem. "In this business," he claims, "you have to come

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out with a new product every year, or you're dead in three years. We will see a fall-off in our business during the next two years. The DFC is the first major step into an area that will reduce the impact of that decline."

As costs to large OEM disk-drive makers decrease, Dilley says, the practice of incorporating controllers into the drive will increase. As a result, the independent controller market will suffer. "It becomes necessary, then, to build support for your existing product line," he says.

One industry source agrees. "Historically, controller houses have gotten stiffed," he says. It will be "the clever controller houses that will survive" a downturn. The reality of LSI and single-chip controllers has sharpened the need for controller makers to stay on their toes, the source says.

He adds that the move to intelligent disk drives is occurring more slowly than expected. While integrated intelligence may be attractive to drive makers, the source says, it is also risky. "The likelihood of wiping out some markets—disk subsystem houses, for instance—is strong," he says.

Such delays will buy time for the controller houses. The source concludes, "The controller houses that can make the changes in technology and markets—those that can change their value added—are the ones that will survive."

Dilley believes the DFC will make MiniComputer Technology just such a company. He expects that products like the DFC will account for half of his firm's revenues within three years.

The Turbo 21 DFC will be priced at $6750, with OEM discounts available. The company expects deliveries to begin by the third quarter. —*Larry Lettieri*

Emulog offering alternative to DG video terminal

A small Fremont, Calif., company is shipping what it claims is the first alternative to Data General Corp.'s model 6053 video terminal, the workhorse of the minicomputer maker's terminal line.

Emulog Inc.'s Log 53 emulates the 6053 and overcomes the software and keyboard incompatibility that have excluded other video terminals from the DG market, says Jim Kurinsky, Emulog's founder and president. The dearth of DG-compatible terminals, he says, resulted from more than hardware or software problems. "Few manufacturers wanted to invest in solving the incompatibility problems simply because they had no idea how big the market for the 6053 really was," Kurinsky says.

DG ships 75,000 to 80,000 video terminals a year, with the 6053 accounting for about 85 percent. These figures cannot be confirmed, however, because the company does not release market data. Nonetheless, Kurinsky is "committed to the DG market."

Kurinsky started Emulog last summer with $120,000. Evaluation units of the Log 53 were shipped in August, and the first production models were delivered a month later. The company ships 80 to 100 terminals a month to OEMs and end users, he says.

Kurinsky believes he has hit the DG market at the right time because DG has raised the price of the 6053. The company is having difficulty delivering the device that will replace the 6053—the model D-200. "They're also having reliability problems with the D-200, Kurinsky adds, "and users are not satisfied."

Data General, however, denies trying to force the 6053 off the market and says the device is still being delivered to customers who want it. The firm also denies having delivery or reliability problems with the D-200. The company does say that not all its customers are happy with the D-200, largely because the new terminal's packaging differs from the 6053's, particularly in the keyboard's layout and operation.

The Log 53 sells for $1945 in single-unit quantities, about $600 less than the 6053, Kurinsky says.

Emulog uses a display manufactured by terminal-maker Televideo, Inc., San Jose, Calif. Kurinsky won't elaborate on the modifications that will make the basic Televideo unit emulate the 6053, except for plans to add some ICs and microcode.

The Log 53 has the full complement of 15 function keys that perform all 60 function sequences of the DG device. The Emulog unit has a 1920-character display that emulates all screen attributes—reverse video, blinking, underscore, etc.—of the 6053, providing total DG operating system and applications software compatibility. Kurinsky has added a non-glare screen and an IBM Selectric-style keyboard, features that satisfy demands for ease of use, he says.

Emulog will enter the Burroughs market this month with a TDA30 video terminal emulator. The company has designed the Burroughs look-alike from scratch—unlike the Log 53. The unit is expected to sell for less than the $3500 Burroughs terminal.

Kurinsky characterizes the Burroughs market as "more voracious than the DG market," because Burroughs has severely limited production. There's a shortage of more than 17,000 units, he claims. He expects to ship 15,000 units in 18 months when deliveries start in September. —*Larry Lettieri*

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Calendar

SHOWS & CONFERENCES

APRIL

25-26 Trenton Computer Festival, Trenton, N.J., sponsored by the Amateur Computer Group of N.J., the Philadelphia Area Computer Society, Trenton State College Computer Society, Institute of Electrical & Electronic Engineers—Princeton Section and the Department of Engineering Technology, Trenton State College. Contact: Dr. Allen Katz, Trenton State College, Hillwood Lakes, P.O. Box 940, Trenton, N.J. 08625, (609) 771-2487.

26-29 NUCON: 81, NCR Users Conference, Hollywood, Fla., sponsored by the Federation of NCR User Groups. Contact: Dennis Caldwell, Recreational Equipment Inc., 18200 Segale Park Drive 'B', Tukwila, Wash. 98188, (206) 575-4480.

26-30 Saudibusiness '81, Riyadh, Saudi Arabia, sponsored by the U.S. Commerce Department and the Business Equipment Trade Association (BETA). Contact: Donald Ryan, Project Manager, Room 3200, U.S. Department of Commerce, Washington, D.C. 20230, (202) 377-4752.

26-30 Communicaciones Expo 81, Miami, sponsored by the State of Florida, the International Center of Florida and the Data Processing Management Associations of Miami and Monterrey, Mexico. Contact: Tom Will, Comunicaciones Expo 81, Gables One Tower, 1320 S. Dixie Highway, Suite 280, Coral Gables, Fla. 33146, (305) 667-3622.

27-29 IOOC '81, Third International Conference on Integrated Optics and Optical Fiber Communications, San Francisco, sponsored by Quantum Electronics and Applications Society of the IEEE and Optical Society of America. Contact: Barbara Hicks, the Optical Society of America, 1816 Jefferson Place, N.W., Washington, D.C. 20036, (202) 223-8130.

27-30 1981 National Design Engineering Conference, Chicago. Contact: Clapp & Poliak, Inc., 245 Park Ave., New York, N.Y. 10167, (212) 661-8410.

28-29 The Greater Delaware Valley Office Systems Expo, King of Prussia, Pa., sponsored by National Trade Productions, Inc. Contact: National Trade Productions, Inc., 9301 Annapolis Rd., Suite 300, Lanham, Md. 20801, (301) 459-1815.

APRIL 29-MAY 1

American Business Equipment & Communications Trade Show, Hartford, Conn., endorsed by Administrative Management Society (AMS) Hartford Chapter. Contact: Ann D. Lazarus, Vice President, Key Productions Inc., 410 Asylum St., Hartford, Conn. 06103, (203) 247-8363.

APRIL 30-MAY 1

"An Assessment and Forecast of Computer Graphics" Conference, Saddle Brook, N.J., sponsored by Frost & Sullivan. Contact: Bob Sanzo, Director of Marketing, Frost & Sullivan, Inc., 106 Fulton St., New York, N.Y. 10028, (212) 233-1080.

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CIRCLE NO. 31 ON INQUIRY CARD

Calendar

MAY

4-7 **National Computer Conference,** Chicago, sponsored by American Federation of Information Processing Societies, Inc. Contact: Diana Snow, American Federation of Information Processing Societies, Inc., P.O. Box 9658, 1815 North Lynn St., Arlington, Va. 22209, (703) 558-3610.

5-8 **Association for Educational Data Systems 19th Annual Convention, "Exploring with Computers in Vikingland,"** Minneapolis, Minn. Contact: Association for Educational Data Systems, 1201 16th St. N.W., Washington, D.C. 20036, (202) 833-4100.

5-8 **Power Industry Computer Applications Conference,** Philadelphia, sponsored by the IEEE Power Engineering Society. Contact: W.S. Bloor, Leeds & Northrup Co., Technical Center MD 145, North Wales, Pa. 19454, (215) 643-2000 or T.A. Suman, Philadelphia Electric Co., 2301 Market St., N3-1, Philadelphia, Pa. 19101, (215) 841-6397.

6-8 **National Independent Computer Consultants' Association '81 Conference,** Las Vegas, Nev. Contact: Kenneth E. Branch, Chairman, ICCA '81, P.O. Box 772, Bartlesville, Okla. 74003, (918) 333-7371.

11-13 **Custom Integrated Circuits Conference,** Rochester, N.Y., sponsored by the Rochester Section of IEEE and the Ottawa and Kitchner/Hamilton, Ontario and Rochester and Schenectady, N.Y., Chapters of the Electron Devices Society of IEEE. Contact: Rajinder Khosla, General Chairman, Research laboratories, B-81, Eastman Kodak Co., Rochester, N.Y. 14650 722-2525.

11-13 **31st Electronic Components Conference,** Atlanta, Ga., sponsored by the Components, Hybrids and Manufacturing Technology Society of the IEEE and the Electronic Industries Association. Contact: T.G. Grau, Program Chairperson, Bell Laboratories, Whippany Road, Room 3B-312, Whippany, N.J. 07981.

11-13 **CompuFest '81,** Louisville, Ky., sponsored by the Kentucky Society of Certified Public Accountants and other professional organizations. Contact: Kathy H. Schoen, Public Relations Coordinator, Kentucky Society of Certified Public Accountants, 310 W. Liberty St., Louisville, Ky., 40202, (502) 589-9239.

11-14 **Micro City '81,** Bristol, Avon, England, sponsored by the Bristol Chamber of Commerce. Contact: Eurofairs, Ltd., 9 Park Place, Clifton, Bristol BS8 1JP U.K. (0272) 292156/7/8.

13-16 **56th International Business Show,** Tokyo, Japan. Contact: Nippon Administrative Management Association, Seikyo Kaikan Bldg., 1-13, Sendagaya 4-chome, Shibuya-ku, Tokyo, Japan 03-403-1331.

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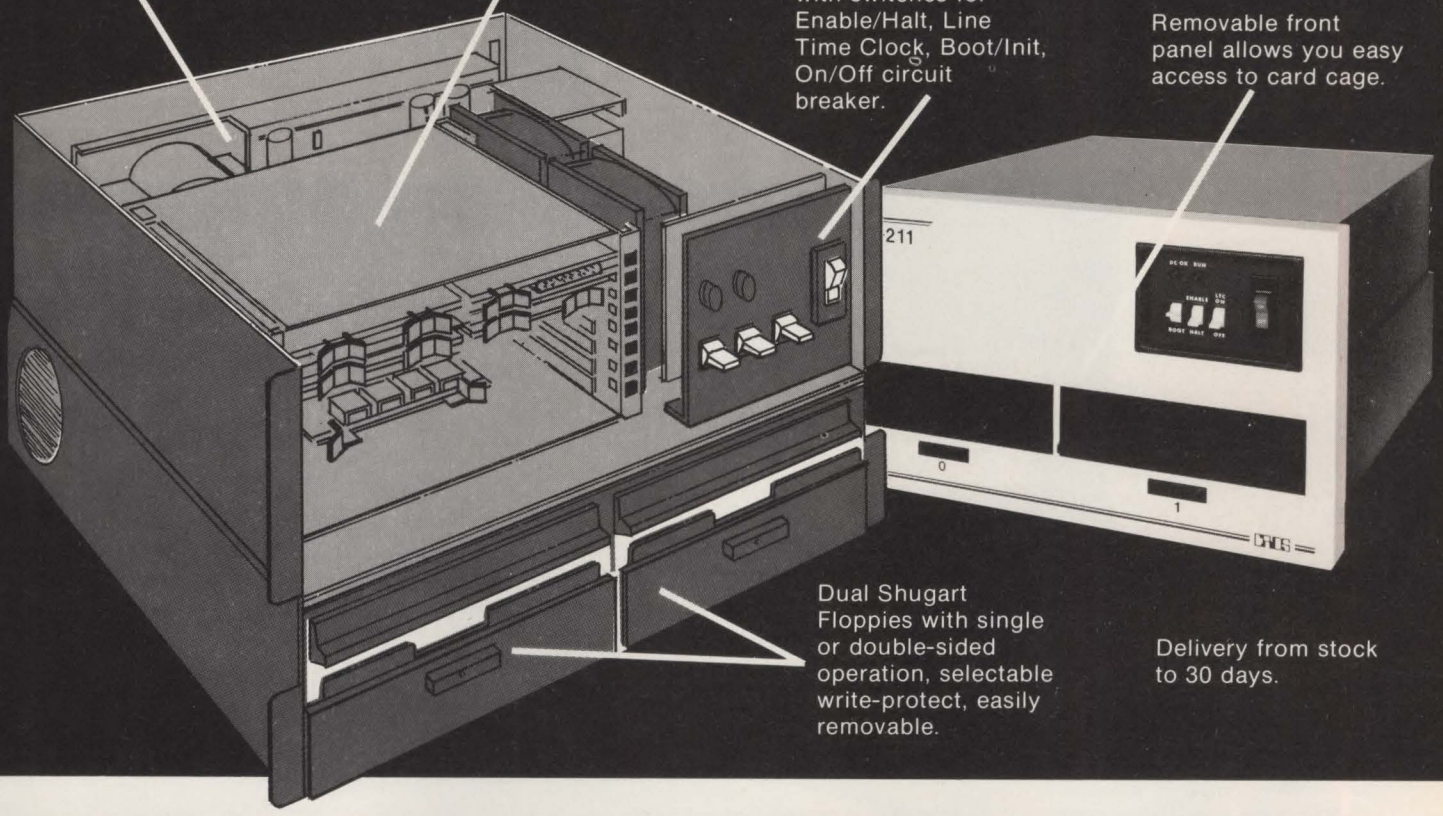

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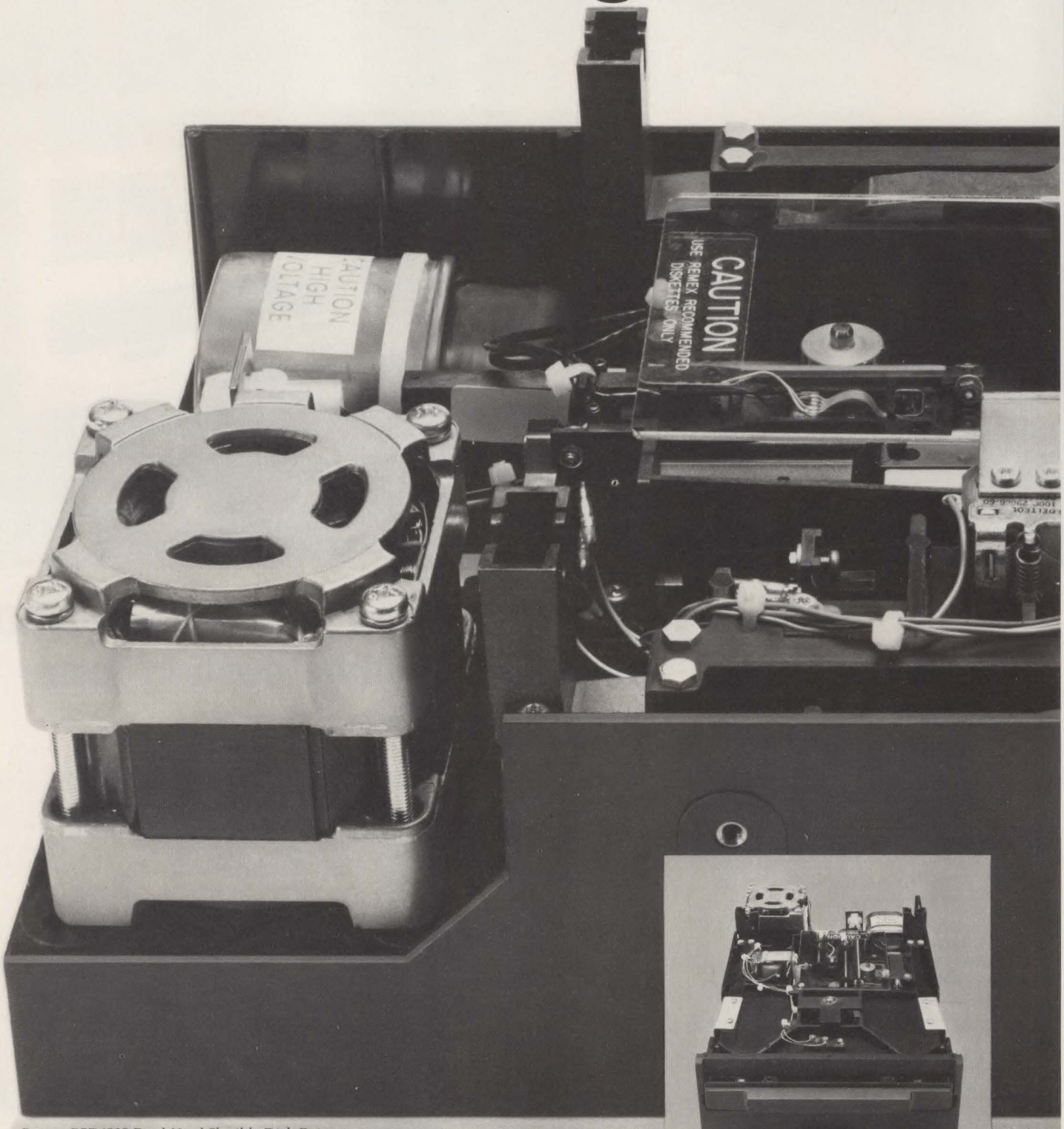

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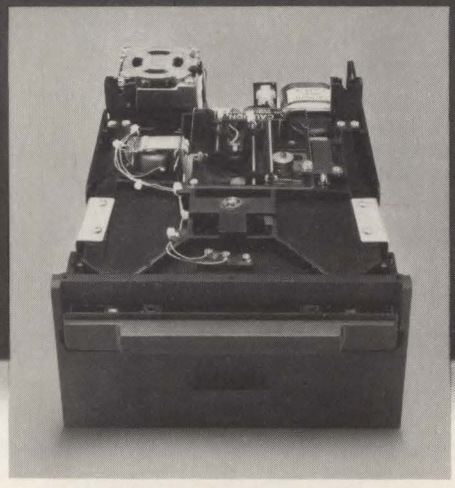

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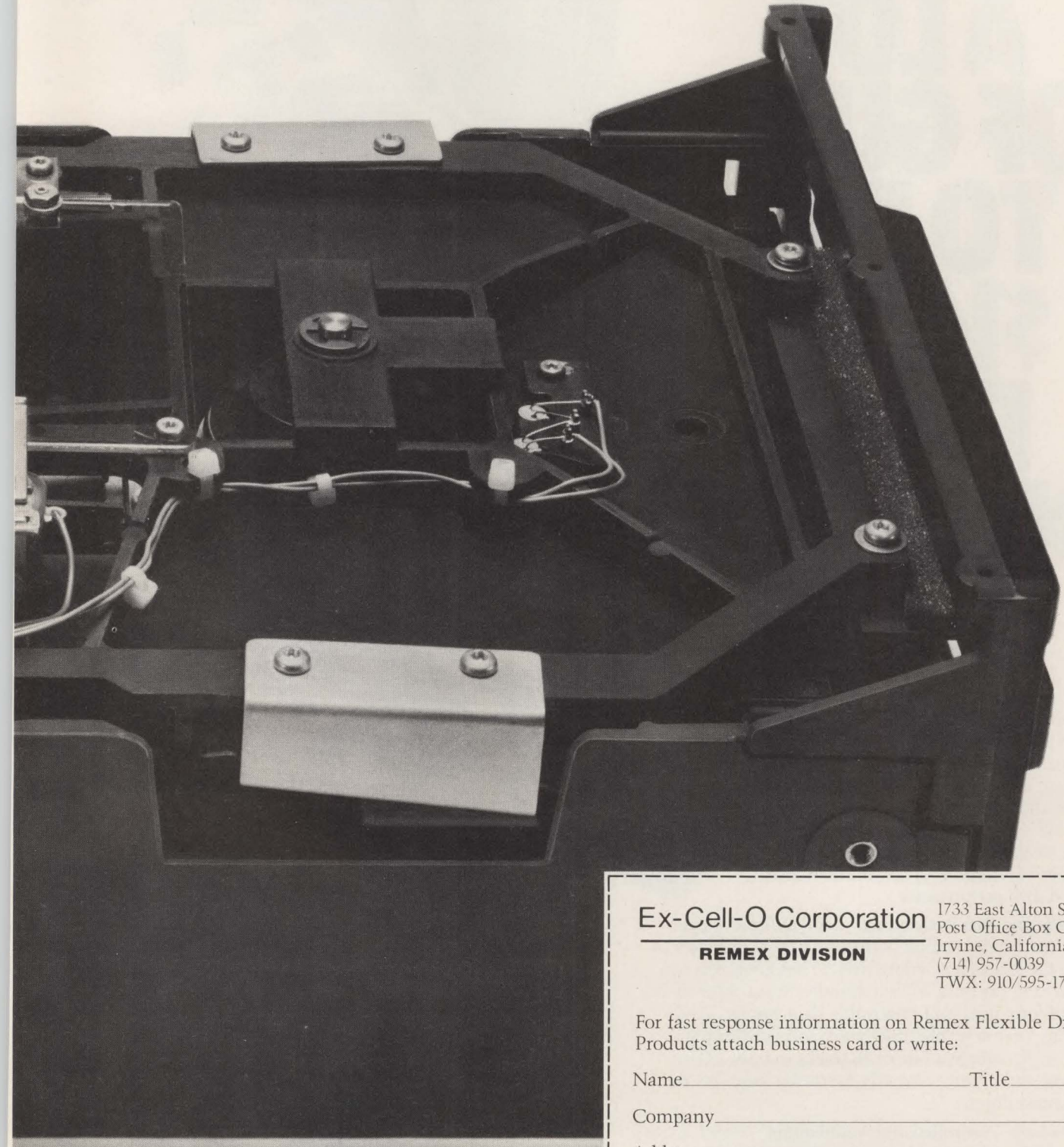

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Commodore plays catch-up in domestic market

Striving to overcome a stained reputation in the U.S. personal computer market, Commodore Computer Corp. is scouring the country for dealers in an attempt to import some of the success it has achieved in Europe.

It won't be easy, however. Apple Computer, Inc., and Radio Shack are already entrenched in the under-$5000 μc battleground, and some strong forces, including Digital Equipment Corp., Xerox, Data General Corp. and Japan's Nippon Electronic Corp., are rumored to be planning attacks.

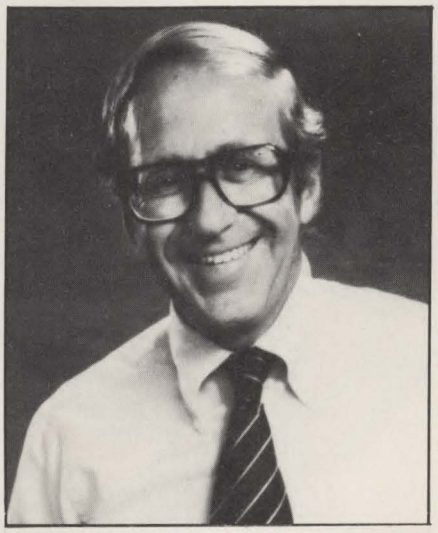
"Coming from behind with a small share of the market and trying to gain a larger share will be difficult," says Robert Wickham, president of Vantage Research, Inc., Mountain View, Calif. "Commodore will have to play catch-up, competing with companies that have established solid reputations and strong dealer and distributor bases."

Now holding a 5 percent domestic market share, Commodore has 500 dealers nationwide, compared with Apple's 1000.

One ingredient that may help the company in its effort could be its new president, James Finke, former vice president of sales for Data General's European division. Finke, who was recruited earlier this year by Commodore CEO Jack Tramiel, is engineering an all-out drive to improve Commodore's market image.

"I think our bad reputation came from overcommitting," Finke says. "Commodore hired a lot of young people who had great dreams of being able to make things happen, but they were not able to put their acts together." He adds that Commodore was "overpromising" and "underperforming," a situation he wants to reverse.

Finke's strategy focuses on dealer support and includes boosting the company's production capacity, improving its service network and beefing up advertising. As evidence of the effort, Commodore is waging a $5 million promotional campaign, which is playing up such phrases as "Commodore ate the Apple."



James Finke, *new president of Commodore Computer Corp., wants to reverse the company's past practice of "overpromising and underperforming."*

"We're getting our act together," says Finke. "I'm not sure we're doing as good a job as we'd like in convincing our dealers of that, but we're trying."

From June, 1979, to June, 1980, the company did a $20 million business in the U.S. Although slight compared with Apple's $70 million worth of sales in the fourth quarter of last year, Commodore's figures are rising. Peter Wright, an analyst with the Gartner Group, Greenwich, Conn., says Commodore is expected to increase U.S. sales 50 percent this year to as high as $35 million.

How have they managed to preserve their market position without an active marketing effort? "Their products are rated quite high by people I've talked to," says George Elling, an analyst for Bear Stearns and Co., New York. "Their prices are competitive, and their new low-end machine looks good."

Dealers agree. "Commodore products are very good systems for independent computer stores to carry as a means of competing with Tandy," says Michael McConnell of Computerland, a California-based retail chain.

Commodore markets two μc systems, and a third is scheduled for introduction this spring.

The PET portable, stand-alone system has as much as 8K bytes of memory and includes a keyboard and a built-in 40-column screen. Appealing primarily to the education market, PET sells for $995 and is usually sold with a cassette player.

The Commodore Business Machine (CBM) is aimed at small businesses. Selling for $4575, compared to a similarly equipped Apple system priced at $6900, the CBM includes 32K bytes of memory, two disk drives and an 80-column screen. An optional word-processing package is priced at $395, and a letter-quality printer sells for $1700 to $3000. Computerland's McConnell notes that software for the CBM, which is comparable to that for Apple systems, includes VisiCalc, VPI and accounting packages.

Both PET and the CBM incorporate the 6502 μp chip that is used by

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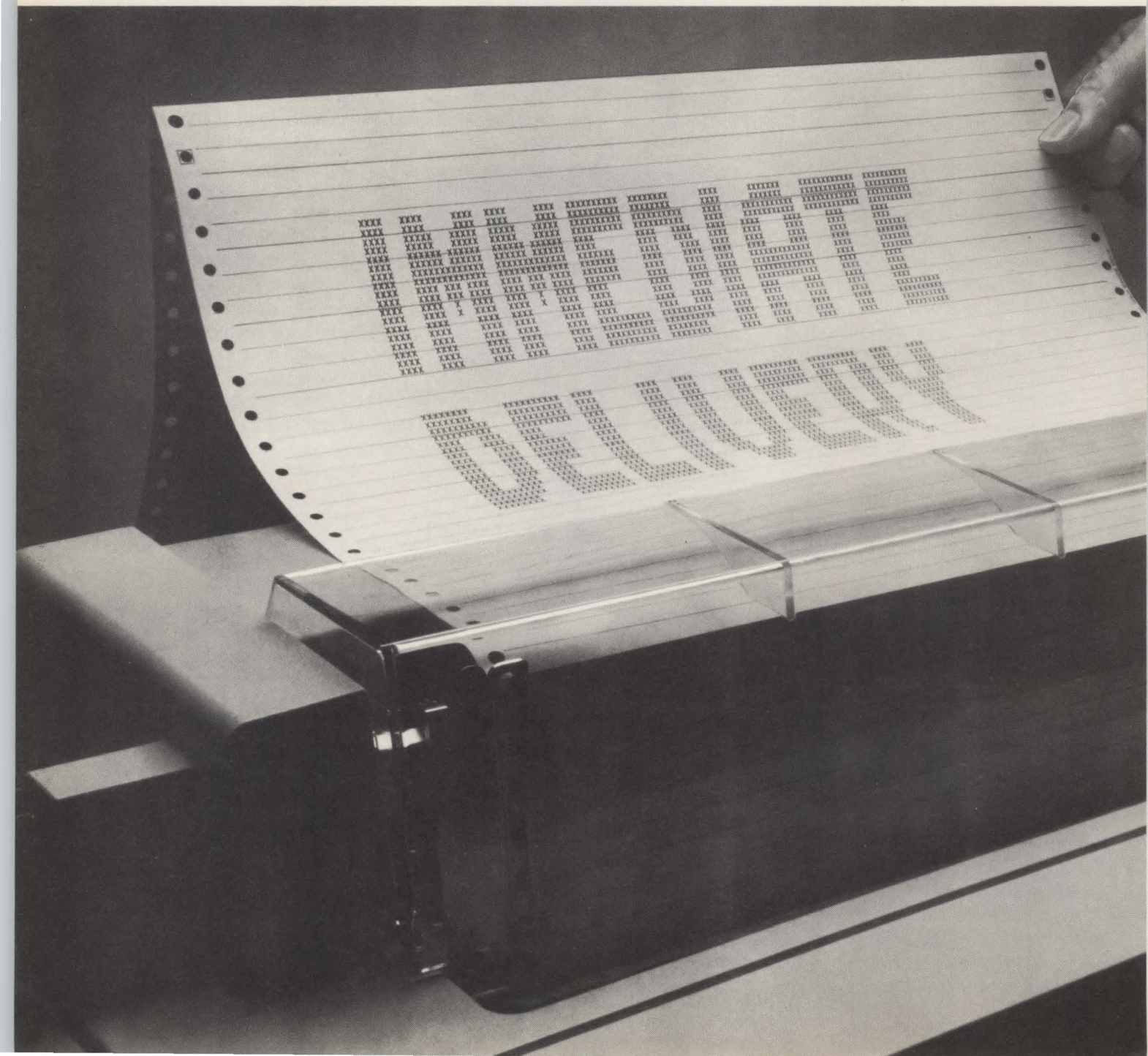

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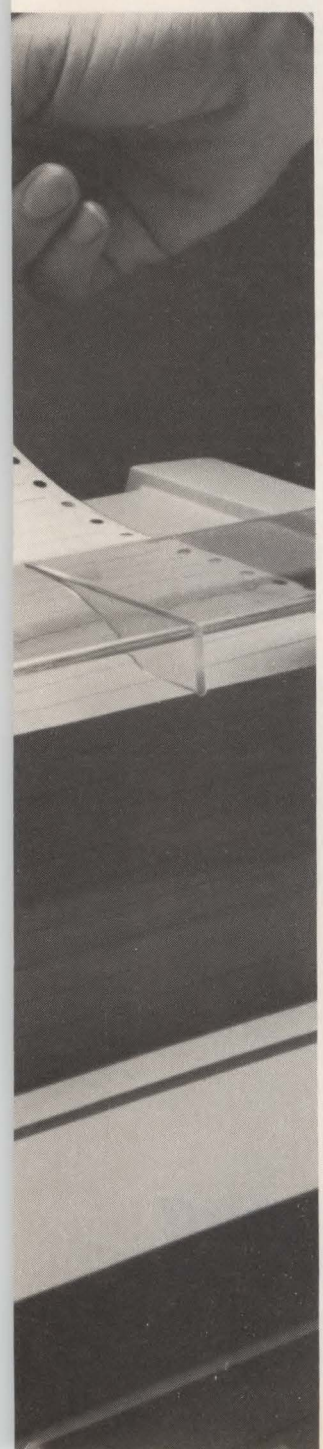

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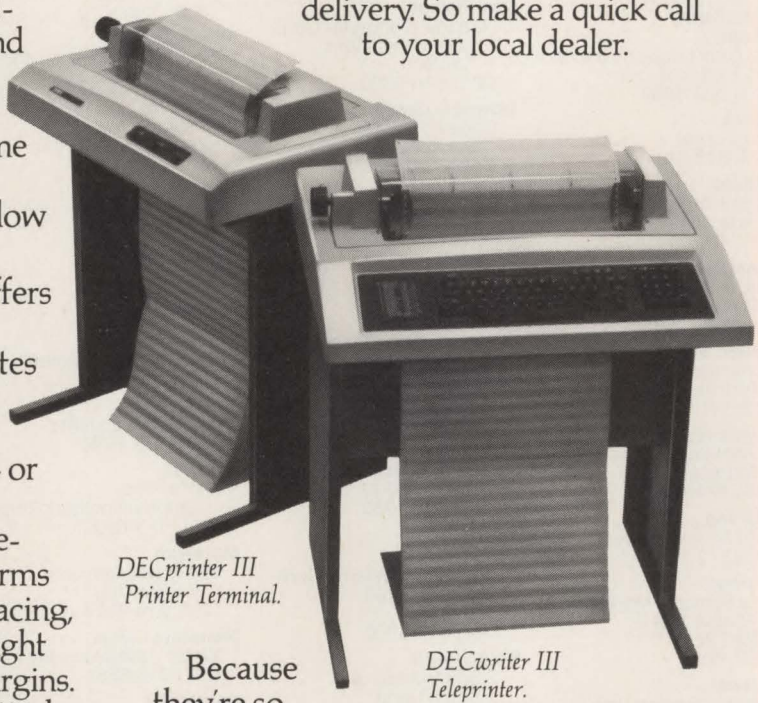

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CIRCLE NO. 38 ON INQUIRY CARD

Apple and manufactured by Commodore subsidiary, MOS Technology, Valley Forge, Pa.

A soon-to-be-released low-end system, the VIC 20, which Commodore sources say "will bridge the gap between the computer hobbyist and the home computer market," is priced at $229.95. While Apple has no comparable system, Radio Shack offers a similar model that sells for $399.

The VIC (video interface computer), built around a MOS-produced video interface chip, plugs into any black-and-white or color television set. The system contains programmable function keys, 5K bytes of memory (expandable to 32K), a full-sized keyboard and optional software and peripherals, including a single floppy-disk drive and a printer.

VIC will be sold with a learning series package, which product manager Michael Tomczyk says will include self-teaching books and plug-in cartridges.

"To be able to get into computing at a very low cost is appealing enough," says Tomczyk. "To be able to get into computing given a whole array of user-friendly software and self-teaching materials is even more appealing."

Whether Commodore's product reputation can override its dealer reputation is up for debate. "They're playing catch-up, but from our vantage point, they're making progress," comments Gartner's Wright. "Jim Finke is the big thing that could turn their domestic market around." Wright notes that Finke is personally visiting major U.S. customers as part of the effort to strengthen Commodore's dealer base. And that effort may be paying off.

Computerland, which a Commodore source says "had nothing but bad things to say about us last October," signed a $1 million contract with Commodore in December. "We're waiting to see if they come through with what they say they're going to do," says Stan Goldman, a marketing manager for Computerland. "It looks like they're serious about cleaning up their public relations with dealers. We're cautiously optimistic."

Some industry analysts, however, believe that Commodore's newly found interest in the U.S. market may have come a couple of years too late. Despite its early entry in 1977 with the PET machine, Commodore was soon outsold by industry leaders Radio Shack and Apple. Rather than duke it out domestically, the company shifted its marketing effort to Europe where it gained a 60 percent share.

Erin Goldberg, a market researcher for International Data Corp., explains that Commodore's decision to concentrate its marketing in Europe was the result of the company's production limitations. "They had a finite capability in a market that was larger than all the mass producers could satisfy," he says. A $5 million loss in the company's watch and electronic calculator division limited production capability even further, not allowing the company to expand adequately. "Rather than concentrate all their resources in the U.S.," Goldberg says, "they decided to go to Europe where there was a ready market with little competition."

But others believe that the decision had more to do with pricing. "The only reason they went to Europe was they knew they could sell their products there for twice the price they sold them for here," says one industry observer. "Their lack of interest in the U.S. market, the fact that they virtually ignored their domestic dealers and distributors, left people feeling very ambivalent about the company."

This "ambivalence" lingers as Commodore tries to make its U.S. push.

Dave Pavda of Byte Industries, a West Coast distributor of μc

COMMODORE TRIES TO IMPROVE MANAGEMENT TRACK RECORD

Commodore Computer Corp. is notorious in the personal computer industry for frequently changing top management personnel. Michael Tomczyk, product manager for Commodore's new VIC 20 μc, notes, "We're a kind of Patton's army in terms of our organization. When everyone's in the trenches, some of the generals are going to get wounded."

The company's management shifts over the past couple of years are so frequent that one dealer comments, "Commodore switchboard operators say, 'I'm sorry, but that person is no longer with the company,' more often than most operators say, 'Can you hold?'"

New Commodore president James Finke, who was recruited by the company's CEO Jack Tramiel, agrees that the company's track record of keeping executives could be improved. But he adds that the record "isn't any worse than Data General's." He says Commodore's frequent management shifts are the result of a 50 percent-a-year growth rate and that, under his leadership, the attitude among management executives is stable and "hopeful."

"I think the company has grown without sufficient discipline and administration, in as far as making sure that guys knew what their jobs were and what was expected of them," Finke says. "Tramiel's problem is that he's very tough with people. He'll say, 'That guy screwed up; fire him.' While I believe in not keeping nonperformers, I also believe in the ultimate redemption of all mankind. If a guy screws up, I help him change his performance."

Although Finke's approach in dealing with personnel differs from Tramiel's, he says he can "achieve the same results but leave fewer bodies lying around."

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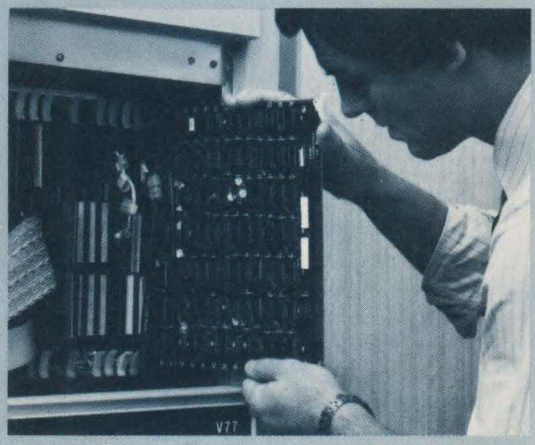

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For more information, write to Sperry Univac Mini-Computer Operations, Marketing Communications, 17900 Von Karman Avenue, Irvine, CA 92714.

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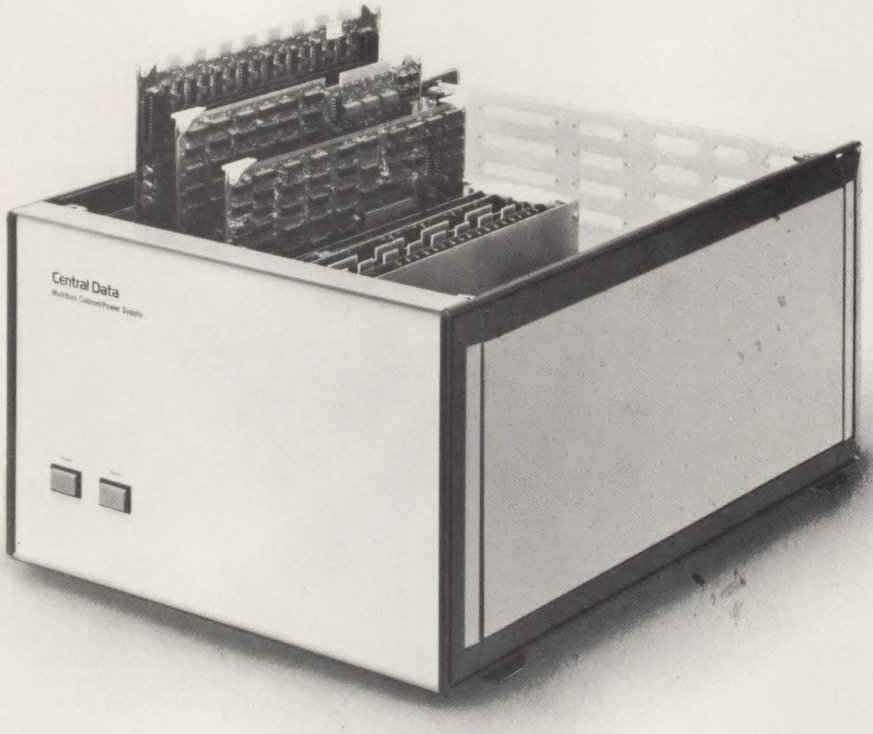

The Roloff System

Until now, the limitations of 8-bit microprocessors made the development of multi-user systems for micro-computers impractical and unattractive. The Roloff System has conquered those limitations by exploiting the performance potential of the 16-bit microprocessor. Roloff system's 16 bit zilog Z8000 processor has five to ten times the throughput of its 8-bit counterpart, giving it the extra power to handle the burden of communicating with several terminals at once. And Roloff systems put that power to work with an advanced operating system never before used in microcomputers.

The Roloff system supports from one to 32 users simultaneously, each running a different program. The system can range from 1-32 terminals or printers and 96K to 16M bytes of internal RAM. For disk storage, it can accommodate from 2M to over 250M bytes using floppy, winchester or cartridge disk interfaces.

A time-saving indexed file system efficiently stores and retrieves data using multiple keyed fields. Searching from an index instead of reading a long file saves many disk operations and allows more than one user to access the same information at once.

Users can "talk" to each other through the terminals with Roloff Systems advanced communications system. Notes files, both personal and general, can be accumulated and displayed using simple commands. A special paging function enables users to conduct typed "conversations" with each other. A tone from the terminal pages the user and the two-way message is displayed on the screen.

A reliable but simple security system protects files from unauthorized access. Every file on the system can have read access or read/write access for certain individuals. Most users will not have to type any passwords once they have signed onto the system, yet all data bases are still protected from unauthorized entry.

Fast response is the benefit of Roloff Systems file cataloging. When all users leave a program, the system can catalog it for quick access later. If a user selects a program that is already being used, in most cases both users can share the program in memory.

System components are "state of the art" and go through extensive quality control tests and burn-in procedures to insure reliability. Floppy disk, Cartridge disk, winchester disk, and cartridge tape drives are available.

Options include selection of internal memory size, disk memory type, arithmetic processing units, and I/O interface boards. The versatile Intel Multibus allows the user to expand the system by purchasing boards from many different manufacturers. You can start with a small system and easily enlarge it, without making any changes in original programming.

And Roloff Systems is Central Data

Since 1975, Central Data Corporation has been designing and manufacturing an innovative line of CPU boards. Central Data's engineers have incorporated their years of experience with the heart of the system into a revolutionary multi-user system. Each system is custom-designed for the user's special requirements. For detailed information on how easily the Roloff System can go to work for you, write or call us:
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An example system might include 128K bytes of internal RAM, a 10 megabyte cartridge disk, and an interface for up to four terminals or printers. Such a system would cost $11,345.

The Roloff System

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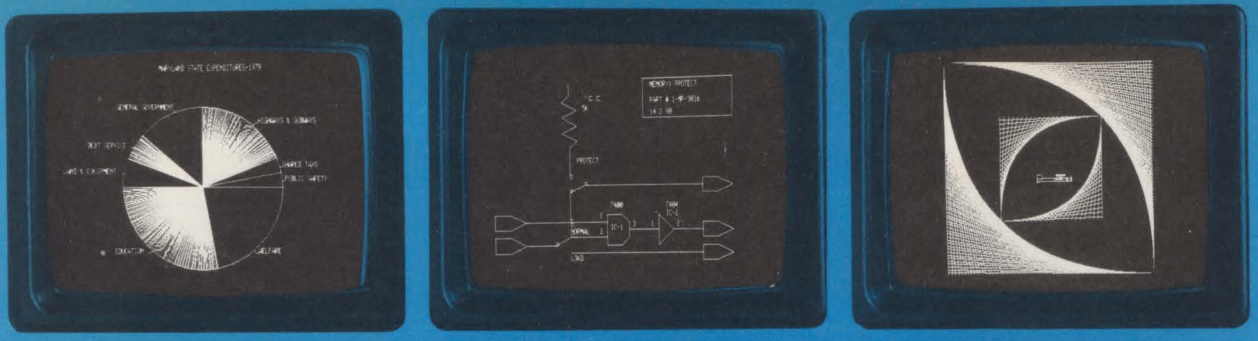
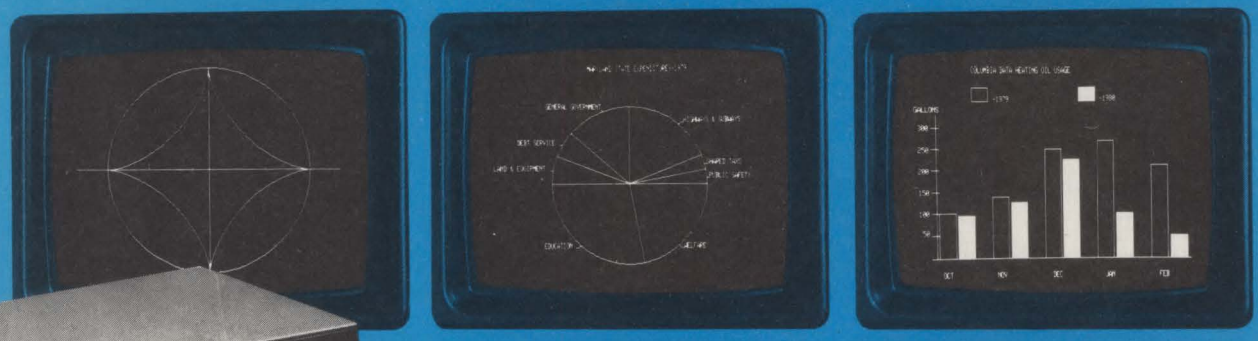
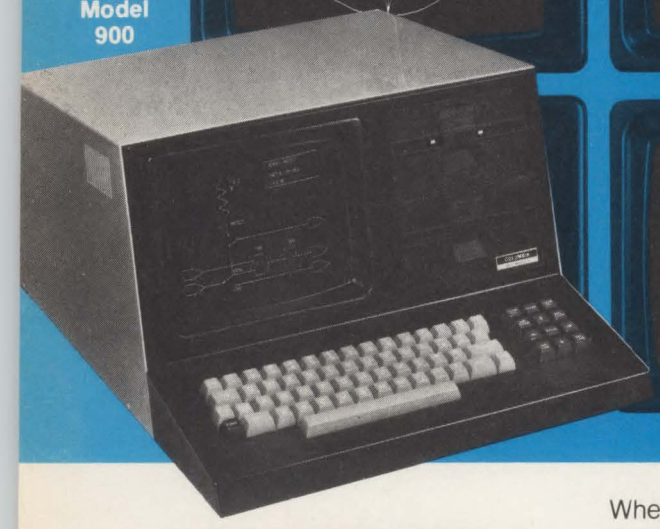




Model 900



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products, notes that his company's working relationship with Commodore was "one of the worst" he has ever experienced. Byte stopped distributing Commodore products last December, although the company was once doing a $500,000-a-month business for Commodore. "They alienated their dealers terribly," Pavda says.

Further aggravating Commodore's reputation were frequent management shifts within the company (see "Commodore tries to improve management track record," p. 69). "Every new manager who came along had a new program," Pavda says, "and every new program got overridden by another new manager, who, of course, had another new program. From a dealer's point of view, it kept going round and round, ending up nowhere."

"Cautiously optimistic" seems to be the general attitude regarding Commodore in the industry. Says one analyst, "The jury's not in yet. I won't say they're not going to be successful. They always seem to do better than I give them credit for."

—Frank Catalano

MINIBITS

BUBBLE MARKET EMERGES IN 1980

Bubble memory finally surfaced as a commercial product in 1980, with $18.4 million in shipments. By 1985, shipments are expected to reach $226 million a year, a 68 percent annual growth rate, according to a report from Venture Development Corp. The Wellesley, Mass., consulting firm says that the bubble-memory market has failed to grow as quickly as expected in the last three years because bubble prices have remained higher than RAM prices. But prices will decline as soon as bubble makers find a way to make their product in quantity within the next five years, says VDC. When this happens, the VDC report says, bubble-memory applications—now confined to specialized uses requiring compactness and durability, such as machine process control—will broaden to such general-computer applications as word processing. The leading bubble-memory producers are Texas Instruments and Intel Corp., while IBM and AT&T lead in bubble research. Recent market entrants include National Semiconductor and Motorola, while Fujitsu, Hitachi, Siemens, SAGEM, NEC and other foreign bubble makers are expected to step up competition in U.S. markets, says the report.

DATA RESOURCES BUILDING WORK STATION

Data Resources, Inc., Lexington, Mass., an econometric firm, plans to enter the systems market with an Onyx-based, UNIX-running integrated work station that will be ready for beta testing this June. DRI is reluctant to provide details on the as-yet-unannounced product, but an inside source claims that it will include 20M bytes of Winchester storage, and will support color pen plotters and as many as four video displays. The system will perform telecommunications via the company's proprietary EPS language with a strategic-planning data base and application packages.

MICRO DEVELOPMENT PUTS FLOPPY SUBSYSTEM IN A DRAWER

To expedite routine servicing and preventive maintenance, Micro Development Associates, Orange, Calif., is packaging the MD-3000 series dual-drive 8-in. floppy-disk drive subsystems into desk-drawer-like compartments. Thus, says the company's marketing head Bill Williamson, when read/write heads need to be cleaned or a pressure pad needs to be replaced, a user has only to slide the drawer-like compartment out of its integral mounting. Access to the drives is obtained via a cut-out in the compartment, and the compartment can be completely removed, if required. The need to disassemble the subsystem enclosure is eliminated, Williamson says. First subsystems incorporating dual single- or double-sided floppy-disk drives, integral power supply and power and signal cabling are now being shipped. Prices of single- and double-sided drives are $1995 and $2850, respectively. At the Comdex Show in June, the company will also introduce subsystems incorporating Shugart Associates' SA1000 8-in. Winchesters and either ¼-in. tape-cartridge or 8-in. floppy-disk drives.

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1410 (Hazeltine dumb terminal)	825	57
1420 (dumb terminal)	895	63
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Diablo 1650 KSR	2835	165
TI 743 (portable)	1190	85
TI 745 (port/built-in coupler)	1485	89
TI 763 (port/bubble memory)	2545	145
TI 765 (port/bubble/b.i. coupler)	2595	145
600 BAUD TELEPRINTERS		
TI 825 RO impact	1450	114
TI 825 KSR impact	1570	97
TI 825 RO Pkg.	1625	124
TI 825 KSR Pkg.	1795	110
1200 BAUD TELEPRINTERS		
LA 120 RO (forms pkg.)	2295	135
LA 120-AA DECwriter III (forms pkg.)	2095	135
LA 180 DECprinter I	2295	120
TI 783 (portable)	1645	100
TI 785 (port/built-in coupler)	2270	128
TI 787 (port/internal modem)	2595	143
TI 810 RO impact	1760	105
TI 810 RO Pkg.	1950	110
TI 820 KSR impact	2025	100
TI 820 RO	1850	95
TI 820 KSR Pkg.	2195	105
TI 820 RO Pkg.	2025	100
2400 BAUD		
Dataproducts M200 (2400 baud)	2595	180
DATAPRODUCTS LINE PRINTERS		
B300 (300 LPM band)	5535	407
B600 (600 LPM band)	6861	493
2230 (300 LPM drum)	7723	*
2260 (600 LPM drum)	9614	*
2290 (900 LPM drum)	12655	*
ACOUSTIC COUPLERS		
A/J A242-A (300 baud orig.)	242	13
A/J 247 (300 baud orig.)	315	17
A/J AD342 (300 baud orig./ans.)	395	20
A/J 1234 (Vadic compatible)	895	50
A/J 1245 (300/1200 Bell comp.)	695	60
MODEMS		
GDC 103A3 (300 baud Bell)	395	25
GDC 202S/T (1200 baud Bell)	565	41
GDC 212-A (300/1200 baud Bell)	850	45
A/J 1256 (Vadic compatible)	825	45
A/J 1257 (triple modem w/phone)	975	50
CASSETTE STORAGE SYSTEMS		
Techtran 816 (store/forward)	1050	70
Techtran 817 (store/for/speed up)	1295	80
Techtran 818 (editing)	1795	105
Techtran 822 (dual)	2295	140
MFE 5000 (editing)	1495	100
FLOPPY DISK SYSTEMS		
Techtran 950 (store/forward)	1395	100
Techtran 951 (editing)	1995	125

* Please call for quote

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CIRCLE NO. 42 ON INQUIRY CARD

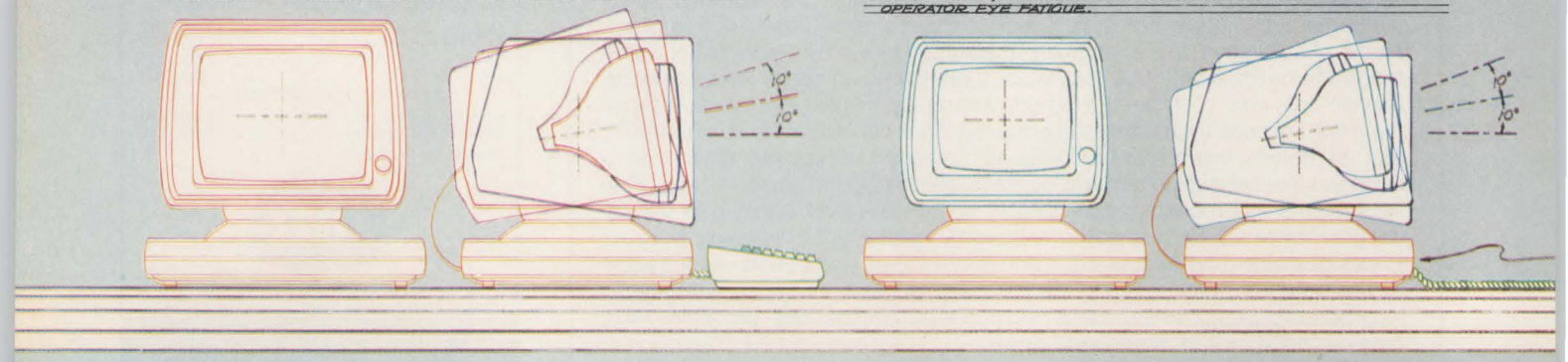
THE ZENTEC SERIES 8000 INTELLIGENT TERMINALS

The first Intelligent Terminal designed specifically for OEMs to configure and for people to use.

THE ZENTEC 8002 IS A COMPLETE INTELLIGENT TERMINAL COMPRISED OF THREE SEPARATE MODULES, THE 8201 LOGIC BOX, THE 8302 (15") VIDEO MODULE AND THE 8401 KEYBOARD.

WITH THE 8002, THE 15" CRT IS BALL-JOINT CONNECTED TO THE TOP OF THE LOGIC BOX AND PROVIDES A CONVENIENT 20° ANGLE OF TILT AND A 60° ANGLE OF SWIVEL.

THE ZENTEC 8001 IS SIMILAR TO THE 8002 WITH THE SUBSTITUTION OF A 12" VIDEO MODULE. THE NON-GLARE, HIGH RESOLUTION CRT SURFACE WITH A WHITE, GREEN OR AMBER PHOSPHOR IS OFFERED TO REDUCE OPERATOR EYE FATIGUE.



With the Series 8000, Zentec successfully re-defines the words Human Engineering. Never before has there been a more powerful, more flexible, more operator-oriented video display terminal designed expressly for OEMs and system integrators.

The first thing you see on the CRT is the almost completely glare-free surface for reduced operator eye fatigue. The single knob right up front is used to turn the system on or off and to control the level of brightness. While a P31 green phosphor is standard, white or amber phosphors may be optionally provided. Character resolution and contrast go easy on the eyes, too, and wait until you see the character size on our 15" screen!

Configurability AND Flexibility
With Zentec's unique multiple-module concept, the 8000 may be easily configured with either a 12- or 15-inch CRT with full swivel and tilt, up to three snap-in printed circuit boards in the logic box for fast MTTR, and a wide variety of detachable keyboard styles. A single PCB is standard with the 8000, and the OEM may add one or two of his own PCBs. The standard logic contains Zentec's unique mini-computer-like bus architecture under the control of a powerful microprocessor. Hardware for synchronous or asynchronous communications and printer I/O is standard. The Zentec 8000 may be configured with 16, 32, or 64KB of RAM and 4, 8, 12, or 16KB of ROM or PROM. That's flexibility!

The microprocessor-controlled detached keyboard of the 8000 is canted 11° for operator comfort and the keys may be stepped, or optionally, sculpted.

Through Zentec, all OEMs can now offer a unique private label product so finely tuned to their customers' needs that it achieves the highest level of man-machine interface. For the direct story on the Zentec 8000, call us at (408) 727-7662, or write for our brochure.

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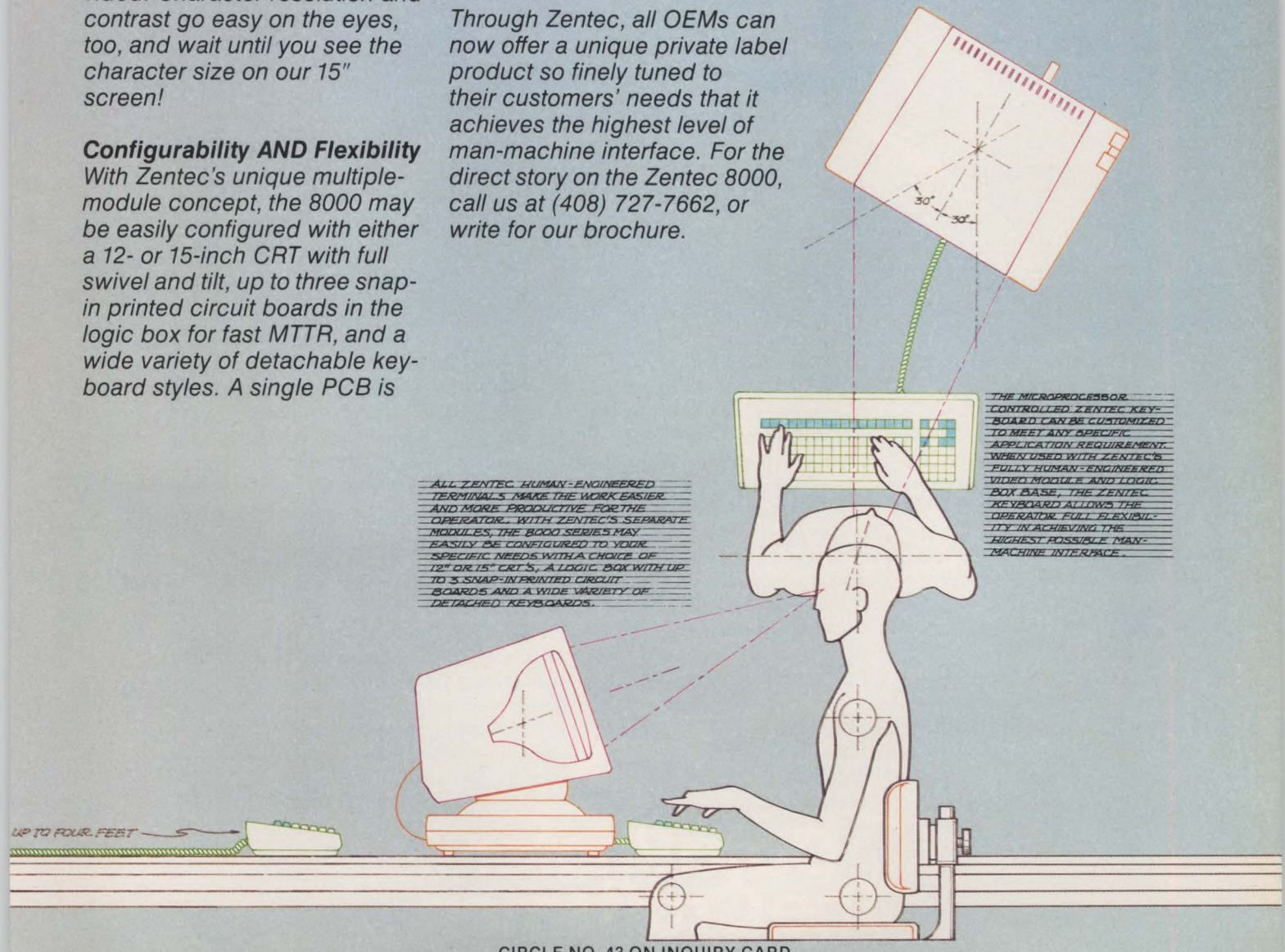
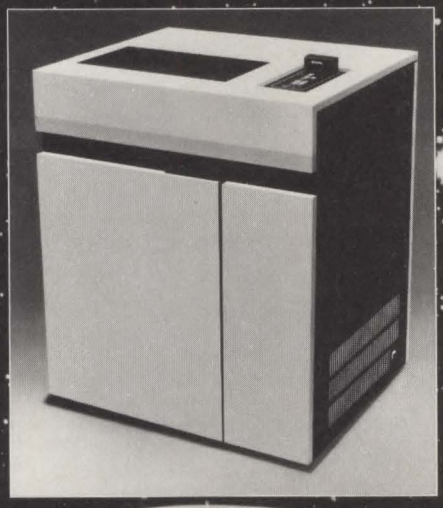


CIRCLE NO. 43 ON INQUIRY CARD

1200 LPM. $7,800*

The fastest low-cost line printer in the universe.



Introducing the best price/performance 1200 LPM printer available today. The Model 3121 band line printer. *At $7,800 in OEM quantities, it's priced at least 40% below all other competitive models. None of which offer this printer's carefully crafted combination of standard features and outstanding options.

And, it's from Data Printer, the Company that's been making high speed, high performance line printers for over a decade.

Peak Performance, Lowest Cost, Greatest Flexibility. The Model 3121 is a 132- or 136-column band line printer with over 40 digital display symbols. A full line buffer. An exceptional gravity-based paper stacker system. A spool to spool ribbon system that reduces installation and replacement time and money by at least 25% over other methods. Its operational quietness in the low 60 dBA range meets or exceeds some of the strictest U.S. and European codes. An option that allows for switch-selectable 600/1200 LPM printing means the 3121 can be used for high-speed, draft quality word processing output.

And, of course, there's flexibility to the degree you can only get from the band technology. Such as operator-interchangeable 48, 64, 94, and 128 character set bands, each with a rated life of 100,000,000 impacts per character.

The Model 3121. It's the fifth member in Data Printer's 3001 Series—a family of long-lasting, heavy duty cycle band line printers ranging in speed from 150 LPM to 1200 LPM. All sharing 95% parts commonality. All technological masterpieces of electro-mechanical engineering, marketing thought, and production craftsmanship.

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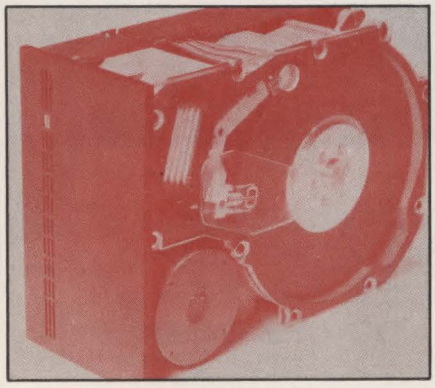
CIRCLE NO. 44 ON INQUIRY CARD

5¼-in. Winchester capacity pushed to 16M bytes

The highest capacity 5¼-in. Winchester announced so far is in final stages of development at Computer Memories, Inc. (CMI), Chatsworth, Calif. Shipments of the start-up firm's new drive—the 16M-byte, three-platter CM 5000—will begin next quarter, with production versions set to roll by year-end.

While using standard oxide-coated media, the drive is reportedly the first to incorporate manganese/zinc heads. As a result, say CMI sources, the CM 5000 operates at higher bit and track densities than similar 5¼-in. drives using conventional ferrite heads. Bit densities are set at 8650 bpi for the CMI hardware, as opposed to 7690 bpi for Seagate Technology's ST-506 and Tandon Corp.'s TM-600 series, and 7900 bpi for Shugart Associates' SA600 drives. Bit densities for Seagate's ST-512, the first 5¼-in. Winchester to use thin-film read/write heads, are set at 10,202 bpi (see "Thin-film heads appear on Winchesters," p. 135).



Computer Memories' *CM 5000—the highest capacity 5¼-in. Winchester announced so far—is in the final stages of development.*

Track density on the CM 5000 is also higher than that of established drives using ferrite heads and oxide-coated media—345 tpi—yielding a total of 256 cylinders, compared to 153 for the ST-506 and 160 for the SA600 series drives.

The CM 5000 uses DC spindle motors and rotary actuators driven by a stepper motor and split-band positioner. Also featured is an off-track capability that permits the head positioner to move slightly off track for read-margin testing. CMI's new offering is electrically compatible with controllers designed for Seagate's ST-506, and it conforms to the envelope dimensions of Shugart's SA450 5¼-in. floppy-disk drive.

The 16M-byte CM 5000 is priced at $1185 in 1000-lot quantities. A single-platter version offering 5.3M bytes is priced at $810, and a dual-platter version, with a 10.7M-byte storage capacity, sells for $995. —*John Trifari*

Fixed/removable Winchester packed in a floppy-sized box

Perkin-Elmer Corp. has joined the small club of Winchester-disk drive makers that feature both fixed and removable storage. The first offering from the firm's Memory Products Division, Garden Grove, Calif., is with an 8-in. device that combines 16M bytes of fixed storage with a 16M-byte removable disk cartridge.

Called the Vanguard 8C, the drive is the third fixed/removable 8-in. device to appear and follows Control Data Corp.'s "Lark" drive, and the Memorex 201. But it is the first to be packaged in an envelope that conforms to the mechanical dimensions of Shugart Associates' 1M-byte SA850 floppy-disk drive—the industry standard for many vendors of fixed-only 8-in. Winchesters.

Sources at Perkin-Elmer see the move to an SA850-sized drive as one that will expedite upgrades of existing small-business computer systems based on 8-in. floppies or smaller capacity Winchesters. "We're making it easy for the systems integrator to market second-generation hardware," says Don Friedman, product marketing manager for disk drives. "The same cabinetry can serve as a basis for higher capacity systems with integral backup."

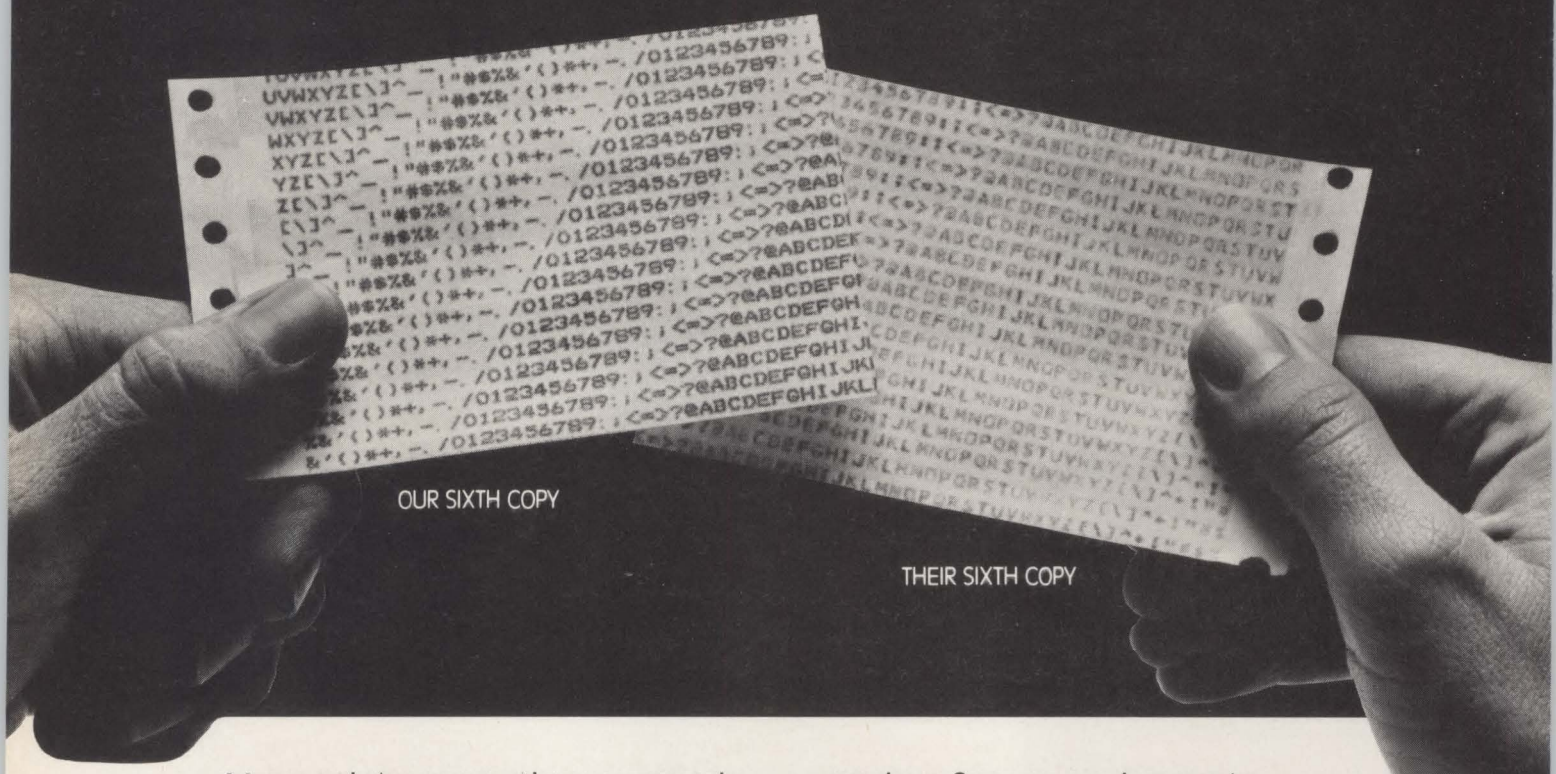
Moreover, Friedman points out, a designer can pack 16M bytes of storage and 16M bytes of backup into one drive slot. If more capacity is required and a second slot is available, a second 8C drive can be installed, or the fixed/removable device can be tied to the company's soon-to-be-announced 8F, a 64M-byte, four-platter fixed-disk version of the drive.

Perkin-Elmer's decision to use the dimensions of the SA850 required some design innovation. To provide for increased track densities in later versions, says Friedman, both the 8C and the 8F have been equipped with linear voice-coil actuators, rather than the rotary designs common to most other high-capacity 8-in. Winchesters.

Linear motors comprise a coil riding on a center core surrounded by a cylindrical permanent magnet.

See us at NCC. Booth 560

OUR QUALITY COMES IN QUANTITY.



Many printers can give you good print quality on a first copy. The real challenge is to give you that same quality, copy after copy, on multi-part forms.

Obviously, most printers can't. The further they get from the first copy, the more their quality fades. But, as you can see here, the quality of Printronix' sixth copy continues sharp and clear.

This superior quality is achieved through a simple printing mechanism quite unlike any other. It forms characters by printing one dot row at a time, overlapping rows vertically and horizontally, while maintaining uniform hammer impact energy. The result is unequalled print quality and characters that appear solid.

This same design approach also requires fewer moving parts, eliminates most bearing surfaces, and employs simple hammer drive circuits. All of which means there's less to go wrong. And that's why Printronix can give you a full one-year warranty, not the 90-day warranty typical of most other printers.

For more information on the complete line of Printronix printers, call: (714) 549-7700. Or write:

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CIRCLE NO. 81 ON INQUIRY CARD

These motors are traditionally located at the end of the two steel rails that make up an actuator's carriage way. But with the exception of Data Peripherals' DP-100 and Priam's Diskos series of 8-in. devices—both of which use compact linear voice coil actuators and are the same size as the SA850—the use of these motors has forced designers to increase the depth of the drive package.

The company's linear motor is not as compact as the Data Peripherals or Priam designs, but unique in that it is positioned not at the end of the carriage way, but within it. Thus, instead of a cylindrical permanent magnet, two semicircular magnets are used with about 1/4 –in. between them. The carriage way is positioned within these gaps, pushing the motor forward and eliminating the need for more depth.

Cartridge media for the Vanguard 8C will also follow an existing mechanical standard—the dimensions established by Data Peripherals and Dysan Corp. for the cartridge used in the former's DP-100 "Lynx" drive (MMS, October, 1980, p. 132). However, because the embedded servo information needed by the actuator mechanisms to accurately position the read/write heads is pre-written at the factories, the user cannot benefit directly. But mechanical compatibility may make it easier for other media vendors to jump into the market. 3M reportedly has expressed interest in supplying cartridges designed around the Data Peripherals/Dysan specifications.

Vanguard 8C/8F product specifications

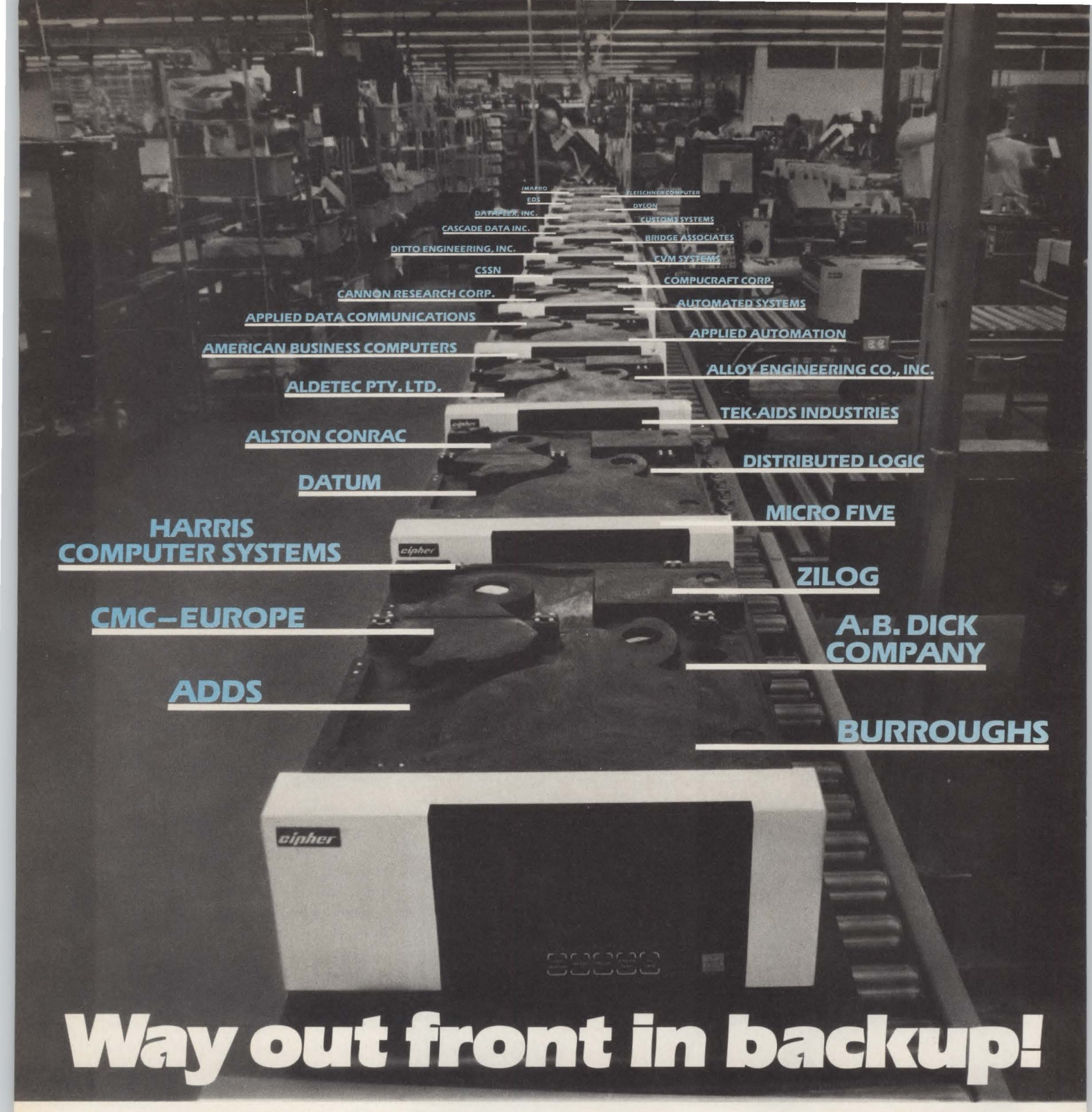
Unformatted capacities	16M/16M bytes (8C)	64M bytes (8F)
Track capacity	20,672 bytes per track	
Number of cylinders	412	
Positioning times		
Track-to-track	10 msec.	
Maximum	50 msec.	
Average	30 msec.	
Rotational speed	3600 rpm	
Data transfer rate	9.7 MHz	
Recording density		
Flux changes per in.	6774	
Bits per in.	10,116	
Tracks per in.	416	
Recording code	2, 11	
Power requirements	±5 VDC; ±24 VDC	

Evaluation versions of the 8C and 8F drives are scheduled to be shipped in the fourth quarter of this year, and quantity production is set for approximately a year from now. All drives will be equipped with an ANSI interface, a move Friedman says will expedite controller development at the OEM level. For evaluation purposes, the company will supply a separate power-supply unit with slots for the converter boards needed to attach controllers to hardware equipped with SMD-interfaces.

On-board electronics for the drive include circuits to handle a run-length limited (RLL) encoding scheme similar to that employed in the 8M-byte fixed/8M-byte removable Lark drive (MMS, April, 1980, p. 69). In a run-length code, bits per in. and flux reversals per in. are not equal. In Vanguard 8 drives, for example, bit density is 10,116 bpi, and flux density is 6774 frpi. In the Lark, these figures are 10,161 bpi and 6774 frpi, respectively.

Quantity prices for the Vanguard 8 drives have not been established, but they will be in the low-$2000 range for the disk-cartridge drive, and around $2500 for the 64M-byte fixed-disk device. —*John Trifari*

Perkin-Elmer's Don Friedman *and a disassembled Vanguard 8C 8-in. Winchester disk-cartridge drive. View of the drive is from the bottom up and shows the "pancake" DC spindle motor.*



"We can dump a 33 megabyte disk in 3.5 minutes and what's more we have instituted a verify in reverse read..." states John Jacobs—Director of Advanced Systems Development for Applied Digital Data (ADDS). Nearly 200 other companies feel they also have found the solution and have taken deliveries of our Microstreamer.™ If your company isn't among these good names—check the list. Your competition may be.

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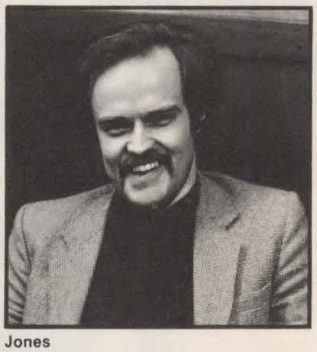
CIRCLE NO. 46 ON INQUIRY CARD

Extending our reach

We like to pause occasionally to reflect on our growth in an industry that is essentially vigorous, despite pockets of sluggishness. That vigor is certainly evident in the pages of this issue, which is the biggest in our history. But greater things are still to come from moves we're making to extend our editorial coverage.

We have added three new editors to our staff since February. Significantly, one of the three is the first staffer located outside the U.S. He is Keith Jones, who becomes our European editor, based in London, early next month. Keith comes to us from *Computer Weekly*, the oldest and best-known publication for the computer community in the United Kingdom, which is also widely read throughout Europe. For the past eight years, Keith has written on a broad range of computer-related topics, including hardware and software, political, financial and user issues. He has also traveled extensively on assisgnment in Europe, the U.S. and Japan.



Jones

Keith's background also includes experience in sales support for Recognition Equipment Corp. in the U.K., in marketing for Lever Brothers and a degree in business studies from Richmond upon Thames College in London. Keith's byline will probably first appear in *Mini-Micro Systems* in the June issue, after which he'll be contributing an important international perspective to our coverage, focusing on the U.K. and Europe.

Granville

Speaking of bylines, there are two new ones in this issue. One belongs to Frank Catalano, who joined us as assistant editor in February, and the other belongs to Fran Granville. Fran has been our chief copy editor for more than a year, and will continue in that important role, but will also begin to contribute regularly to the Mini-Micro World section. Fran has been on the editorial staff for three years, and has a B.S. in English from Boston State College.

Catalano

Frank Catalano will assist Fran on the copy desk, and also contribute to Mini-Micro World, which includes our news, product focus, corporate and financial and people sections. Frank graduated from Wittenberg University with a B.A. in biology, has an M.S. in science journalism from Boston University, and came to us from a stint as general assisgnment reporter/photographer for a weekly newspaper in New Hampshire. Frank also has writing and editing experience with *Technology Transfer Times*, a monthly magazine that traces the cross-fertilization of technologies among industry segments.

Harvey

Our third new staffer is assistant editor Fred Harvey, who will assist Alan Kaplan, executive editor, in producing the magazine's feature contributed article section. Fred has experience in writing and editing and in scientific instrumentation. He is a graduate of Northeastern University.

S. Henry Sacks
Publisher

IF YOU CAN WAIT A MINUTE, WE CAN SAVE YOU $1,000.

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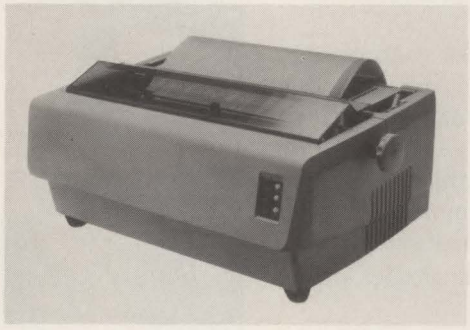

in hardware or software. It uses industry-standard ribbon cartridges, and it's "plug-in" compatible to interface with a wide variety of systems, to help lower system-integration costs.

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CIRCLE NO. 47 ON INQUIRY CARD

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Circulation Manager
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(303) 388-4511

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Susan Rapaport

Editorial Offices

Boston: 221 Columbus Ave.
Boston, MA 02116
(617) 536-7780
Paul Kinnucan

Los Angeles: 5670 Wilshire Blvd.
Los Angeles, CA 90036
(213) 933-9525
John Trifari

San Jose: Sherman Bldg., 1 Suite 1000
3031 Tisch Way
San Jose, CA 95128
(408) 296-0868
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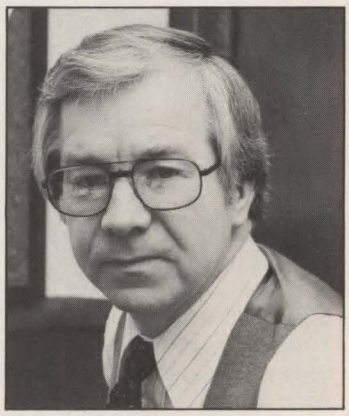
An NCC poll



At the risk of totally alienating the American Federation of Information Processing Societies, the chief sponsor of the National Computer Conference, I'm back on a well-worn soapbox this month, and asking for your opinion. I think NCC has become so large that it's subverting one of its primary purposes—that of disseminating information about new developments to those who pay to attend the show. If some portion of those who want to exhibit at NCC can't do so because there's not enough space available in the exhibit hall, those who attend won't see all the new products they could see if tighter limitations were placed on the size of each exhibit.

The way things are now, new companies with new product ideas have a difficult time getting into the show because they haven't exhibited before, while established companies soak up as much as 2000 sq. ft. of floor space. I agree with an exhibit manager from a major computer manufacturer who contends that he would much prefer a maximum limit of 30 × 30 ft. He says his company's cost to have a new exhibit designed and built every two years is now about $200,000, to say nothing of the cost to transport, house and feed the score or more people who staff the booth.

He would like to cut his costs, and if AFIPS doesn't help him by further restricting booth size, he'll pull out of NCC and have the company represented at more vertical shows, including auto industry, graphics and instrumentation conferences. I think it's time that AFIPS be shown some evidence of the restiveness among NCC exhibitors and attendees alike.

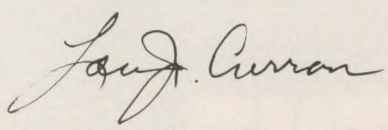
Please help us send that message by circling the appropriate numbers on the reader inquiry card at the back of this issue, indicating your thoughts about how NCC might be improved. Based on our informal sampling of exhibitors, I think the established companies would respond favorably to tighter restrictions on booth size.

If you favor reducing the maximum booth size from 2000 sq. ft. to 1200 sq. ft. (30 × 40 ft.), please circle no. 415.

If you favor a maximum booth size of 900 sq. ft. (30 × 30 ft.), please circle no 416.

If you favor having a section of exhibits set aside for minimal booths for start-up companies—those less than two years old and having no more than 100 sq. ft. (10 × 10 ft.)—please circle no. 417.

Let's hear from you.



Lawrence J. Curran
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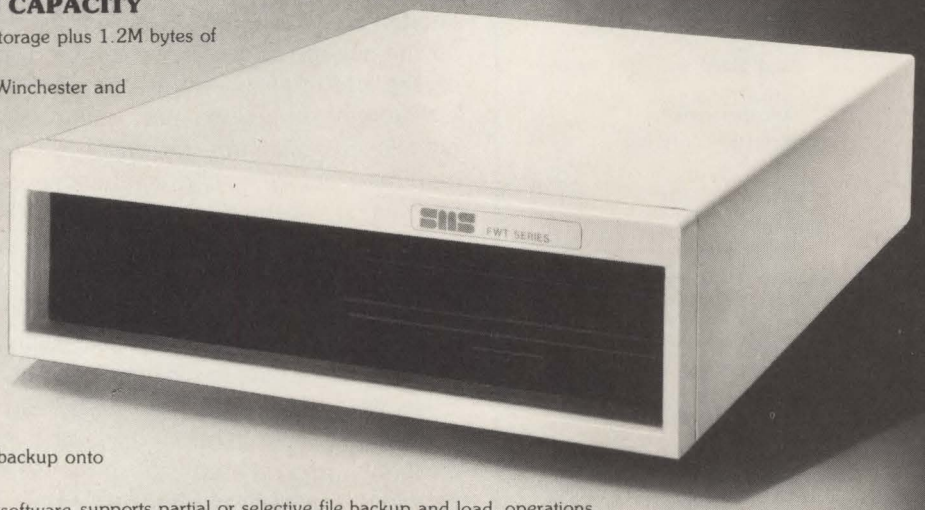
SMS Flinchester peripherals provide 8.9M bytes of 8" Winchester disk storage and 1M bytes of floppy disk storage for DEC's PDP-11 and LSI-11 computers! In only 5¼" of table top or rack space you also get the following benefits:

AVAILABLE SOON!! Look for 20M byte and 30M byte Flinchester systems in the near future.



MAXIMUM PERFORMANCE AND CAPACITY

- **8.9M bytes** of formatted Winchester disk storage plus 1.2M bytes of usable floppy disk storage.
- Fast data transfer of **427K bytes/sec** for Winchester and 63K bytes/sec for floppy.

INDUSTRY COMPATIBLE

- Automatic recognition of DEC RX01, RX02 and **IBM** diskette formats.
- Plug compatible with DEC PDP-11 Unibus and LSI-11 Q-bus.
- Increases performance of DEC's RT-11 and RSX-11M operating systems.
- Emulates DEC's RX02 floppy disk system.

CONVENIENT "MINUTE-PER-MEGABYTE" BACKUP

- Only **40 seconds** required for Winchester backup onto 1.2M byte floppy diskette.
- Standard RT-11, RSX-11M and SMS utility software supports partial or selective file backup and load operations.

UNSURPASSED RELIABILITY

- Modular construction and minimal parts count insure **long MTBF** and 15 minute MTTR.
- Off-line system and drive test.
- On-board **self test** verifies correct system operation.
- CRT initiated **super diagnostics** ease system test and fault isolation.
- **Automatic bootstrap** tests CPU, memory and DMA operation before software loading.

EXCEPTIONAL DATA INTEGRITY

- Winchester disk **flaw management** deletes permanently flawed disk areas.
- Automatic **error retry** recovers soft or temporary errors.
- **ECC (Error Correction Code)** recovers corrupted data without system shut down.
- Patented PLL circuitry requires no field adjustments and provides maximum margin for worst case bit shifted data recovery.

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(617) 246-2540

CIRCLE NO. 48 ON INQUIRY CARD

Letters

CORPORATE BLUNDER

To the editor:

The article "Surveying serial printers" (MMS, January, p. 97) incorrectly listed Olivetti Corp. of America as the vendor of the DY Series of daisy wheel printers. These printers are manufactured and marketed by Olivetti Peripheral Equipment S.p.A. (Olivetti OPE), formerly the peripherals division of Olivetti Corp. OPE was constituted as an independent company in January, 1980, specifically to serve the OEM market. Olivetti OPE manufactures a full line of daisy-wheel, dot-matrix and thermal printers, and hard- and floppy-disk drives.

Elisabeth K. Vanderbilt
Marketing Administration
Olivetti Peripheral Equipment, S.p.A.
Elmsford, N.Y.

CORRECTION

A point made in "ISI designs touch screen kit for DEC VT 103 users" (MMS, February, p. 37), has raised objections from some readers, including Arthur Carroll, president of Carroll Manufacturing Co. The article states that using infrared light beams in touch screens necessitates continued field service to keep the receptors aligned. Mini-Micro Systems erred in not checking that assertion, and we regret the oversight.

Carroll says alignment has not been a problem in either manufacturing or servicing the several thousand units the company has produced since 1975. He adds that the touch screens are durable and can withstand classroom use by children. The company has compiled millions of operational hours on its products, some of which are manufactured to stringent military specifications, including those for reliability.

Infrared technology uses LEDs and phototransistors, which are mounted on opposite sides of the CRT screen, to create about 900 intersections or "touch points." Each LED and phototransistor is mounted to a printed circuit board. Burned out LEDs are replaced simply by soldering a new LED in place.

Carroll also intends to offer Digital Equipment Corp. VT 100 and VT 103 touch kits. The kits will be introduced in September. Prices have not been set.

The success of the Cheyenne is really an inside story.

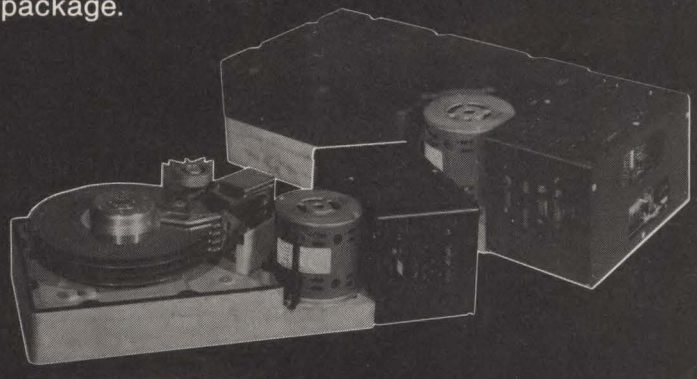
From the outside, the Cheyenne sealed disc memory tells the story of its rugged reliability. But *inside,* you can see the result of more than 15 years experience building rotating memories.

The Cheyenne features SLI's unique rotary positioner and closed-loop dedicated servo track system. Capacity is up to *51.4 megabytes,* unformatted, on 4 discs, with 7.3, 22 and 36.7 MBytes available.

Other Cheyenne features include microprocessor-based drive electronics, with built-in diagnostics; SMD interface (others available); 478 TPI and 6500 BPI.

The A/C spindle motor is standard, as is 50/60 HZ with no hardware change required.

There's more . . . inside the Cheyenne. Write or call Ray Kristiansen for the full story and our literature package.



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CIRCLE NO. 49 ON INQUIRY CARD

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Such is the case for our Commercial Systems (CS) family.

Without getting into a long, drawn-out thesis on the proven reliability and flexibility of the integrated CS systems, or Interactive COBOL, or the wide range of programmer productivity tools, or how it's all designed to grow as your customers grow, one factor well worth detailing is our new application software.

INTRODUCING GENAP™ APPLICATION SOFTWARE. WE PUT OUR RESOURCES INTO DEVELOPMENT SO YOU DON'T HAVE TO.

Based on the notion that your time should be devoted to sales and installation (where the profits are) vs. development of software from scratch, Data General has created a financial series of application software. Software which is unmatched in the industry and, needless to say, provides you with a mammoth profit opportunity.

The applications (general ledger, accounts receivable, accounts payable and payroll) were developed by Data General's software team over a period of years and include more than a million lines of code and over 350 programs. All the programming expertise was directed by in-house accountants to help make sure the products conform to accepted accounting practices and IRS codes, and offer the features your end users will need to help them run their businesses effectively.

A national firm of certified public accountants has reviewed and tested these systems and has prepared a report containing their opinion, a copy of which is available from Data General upon written request.

SERVICE AND SUPPORT TO THE N^TH DEGREE.

Data General has taken great pains to provide you with a total environment to make your end users happy: i.e., the GENAP products include not only quality application software, but also a complete series of development tools and comprehensive documentation.

Tools such as file management software supporting hierarchical data structures and a data dictionary; a flexible menu and security capability; and a series of precoded "skeleton" programs for easy coding of online transaction updating, inquiry activity and status-report programs.

And Data General provides not only GENAP technical documentation for you and your programming staff, but also comprehensive manuals to give to your end users at both executive and operational levels.

So as you customize the financial applications or write your own application software, you will spend less time and therefore considerably less money, while maintaining consistency with both the built-in standards and the user documentation.

A MYRIAD OF OTHER FACTORS.

Obviously, there are many other points we could get into, like CS's remote diagnostic feature, or the fact that Data General's percent of growth in small business systems is among the industry's highest, or Data General's unequalled delivery record, or even how our 12 successful years of dealing with OEM's have helped put us in the Fortune 500, but we won't inundate you with all that now.

For more information and then some, call your local Data General office or fill out the coupon below and we'll fill you in.

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☐ I'm in a rush. Please have a sales representative call on me.

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MMS-4-81

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CIRCLE NO. 50 ON INQUIRY CARD

"As OEMs discover the advantages of Quantum 8-inch Winchester drives, the demand grows daily. In Manufacturing, we're prepared to meet high-volume OEM commitments."

—Harold C. Medley, VP-Manufacturing, Quantum Corporation

A very manufacturable disk drive.

Quantum's 10, 20, 30 and 40-megabyte Q2000 disk drives were designed to be built in high volume at low cost.

Working as a team, Quantum design and manufacturing engineers created a drive that gives you better performance than the industry-standard Shugart SA1000, yet can be manufactured with simple, low-cost parts and fast, efficient production methods.

Low-cost, high-volume production.

To meet your low-cost, high-volume delivery requirements, we designed our manufacturing process as carefully as we designed the drive itself.

Our unique conveyorized "clean-air tunnel" combines the best of proven techniques for Winchester drive assembly. The drive is assembled on a conveyor line, so production is more efficient than with independent assembly stations. And the laminar-flow clean-air tunnel completely eliminates the need for a large, expensive "clean room," cutting production costs and increasing worker efficiency.

Specially-designed automated testing equipment thoroughly exercises each drive through all its functions, to assure highest quality while keeping labor costs down.

Every manufacturing operation is planned for easy, smooth expansion to meet growing OEM requirements.

In short, we're geared for low-cost, high-volume production of quality disk drives that we're proud to deliver to you.

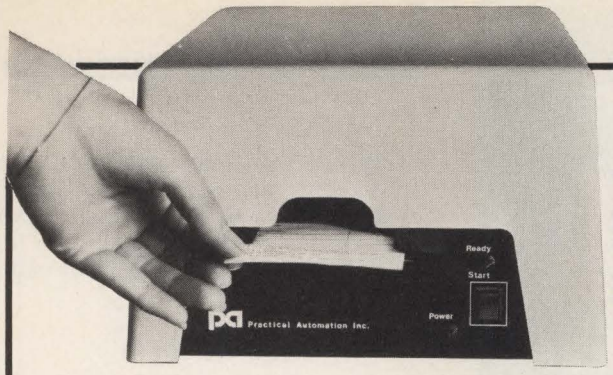
Get to know Quantum now.

From manufacturing and engineering to management and customer service, Quantum has the very best people in the disk drive industry today. People who can help you plan an affordable growth path for your small computer systems.

For details on Quantum low-cost 8-inch Winchester drives, call Bob Teal, Quantum Corporation, 2150 Bering Drive, San Jose, CA 95131, phone (408) 262-1100.

CIRCLE NO. 51 ON INQUIRY CARD

QUANTUM ***Driving down the cost of quality.***



This Ticket Printer Has The Guts To Stand Alone

Inside its free standing case, our PK-970 alphanumeric printer teams an advanced microprocessor-based controller and power supply, our long life dot matrix print head, and stepper motor that controls ticket advance, 6 lines to the inch or .110, and positioning until the message is complete. The result: a versatile standalone workhorse that can print both analog and digital data on the same card for special applications from lab to weigh station to manufacturing process control.

Print standard or enhanced characters on single-sheet cards or multi-part tickets, with or without ribbon mechanism. Program it for 30, 37 or 49 character line lengths and character density of 10, 12.4 or 16.5 characters/inch. And count on that integral controller to accept parallel, or serial data to meet your system's needs. For details write or call today.

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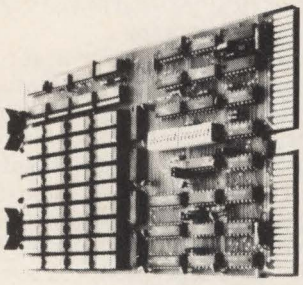
Trap Falls Road, Shelton, Conn. 06484/Tel: (203) 929-5381

CIRCLE NO. 52 ON INQUIRY CARD

STATE OF THE ART MEMORY SYSTEMS



256KB LSI 11/23® SINGLE DUAL WIDTH BOARD
The First and Only 256KB Memory on a Single Dual Board.

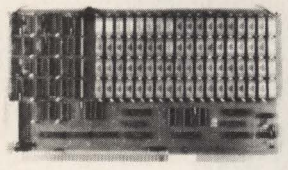
4 MEGABYTE ADDRESS FIELD — Most memories available for the DEC PDP 11/23 are only addressable to 256K bytes (18 address lines). The CI-1123 is addressable to 4 mega bytes (22 address lines) so there is no need to worry about obsolescence.

FAST ACCESS AND CYCLE TIME — With an access time of 270 NSEC and cycle time of 400 NSEC one is insured the best throughput on the PDP 11/23 system.

PARITY — The CI-1123 generates and checks parity for each byte of memory. Totally DEC compatible.

BATTERY BACKUP POWER CONSUMPTION — Power requirement for the module is only 1.2 AMP from the 5 volt supply. The CI-1123 is easily configured for battery back-up mode of operation requiring only 300MA from a single 5 V back-up supply for 256KB memory in the down state.

SINGLE QTY. PRICE: 32K x 18 **$575.** 128K x 18 **$1925**



512KB SINGLE BOARD MULTIBUS® MEMORY
State of the Art Multibus Memory Design.
First to Offer 512KB on One Board.

The CI-8086 module is compatible with both 8 or 16 bit Multibus Systems.

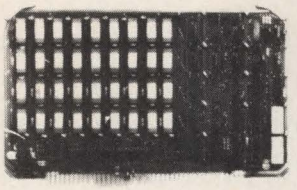
PARITY — The CI-8086 generates and checks even parity with selectable interrupt on parity error.

FAST ACCESS AND CYCLE TIME — Data access is 250 NSEC and cycle time is 375 NSEC.

16 MEGA BYTE ADDRESSING — The memory is addressable in 16K increments up to 16 mega bytes.

LOW POWER CONSUMPTION — Total power consumption is under 8 watts.

SINGLE QTY. PRICE: 128K x 9 **$1350.** 512K x 9 **$2995.**



64K x 9 EXORCISER® I SINGLE BOARD MEMORY
For Exorciser I, Exorciser II and Rockwell System 65.

FAST ACCESS AND CYCLE TIME — Data access time is 225 NSEC and cycle time is 400 NSEC, allowing the unit to work as a static RAM at clock rates in excess of 1.5 mega hertz. For 2 mega hertz operation the board can be easily configured to utilize a cycle stealing refresh operation.

ADDRESSING — On-board memory select is available in 4K increments up to 64K words of memory on either the VUA or VXA control inputs.

PARITY — On board even parity with output jumper select to the system bus as a parity error or non-maskable interrupt.

Complete board power consumption is under 7 watts.

SINGLE QTY. PRICE: 64K x 9 **$575.**

Tested and burned-in. Full year warranty.

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CIRCLE NO. 53 ON INQUIRY CARD

Letters

USER-ORIENTED SOFTWARE

To the editor:

I enjoy your magazine and appreciate your articles on operating systems and data base system evaluations. I have several applications for which I could use a μc, but I cannot find adequate software.

I need a system that is multi-user and multi-tasking and that has easy instructions to format a record definition, screen format and update or add records from the screen format. Edits to the data file are also needed, such as range checks and validation against tables, and files should be structured to have one primary key and possible secondary keys. The software needs some simple query and report-producing commands, and should sort records before displaying or printing lists or reports. Simple command-like instructions involving moves, conditional instructions and logic, plus calculating abilities to update a file, are required and the files need to be accessed from other languages, such as BASIC and COBOL.

If you are aware of software products that perform such functions, I would appreciate the names of the companies that produce them. There seems to be a lack of adequate screen formatting and data base software systems that have easy, user-oriented instructions.

Champ Overhold
Registrar and Admissions Office
University of California
San Francisco, Calif.

CRT ALTERNATIVE

To the editor:

Stephen Caswell's article, "France launches mini-CRT campaign," (MMS, November, 1980, p. 125) was interesting. But I couldn't help but wonder if it might be less expensive to have a "black box" that would enable patrons to use their TV sets as the display device.

J.E. Wurtz
Electron Tube Division
Litton Industries
San Carlos, Calif.

(The editor replies: Such "black boxes" are a viable alternative to mini-CRTs, according to Mr. Caswell, especially in small offices where mini-CRTs are unsuitable because their keyboards are not designed for word-processing or heavy-duty data-entry applications. The French, however (in reference to Mr. Caswell's article), found mini-CRTs a cost-effective alternative to television

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PUT RSTS ON OUR 11/23 BASED SYSTEM*

SYSTEM-23

Save thousands of dollars with the Advanced Digital Products System-23!

Advanced Digital Products System-23 consist of DEC 11/23* processor with memory management, and optional floating point instruction set combined with our high performance DEC compatible peripherals such as 32, 80 & 300MB Disc Drives. Magnetic Tapes, etc.

The ADP SYSTEM 23 fully supports multi-level interrupts, and executes the PDP-11 instruction set at speeds approaching the DEC 11/34.

The system comes standard with a DEC 11/23 processor, memory management, 128KB of memory (supports up to 256KB of memory), bootstrap loader, real time clock, high speed DMA channels, 8-slot backplane, chassis, power supply, terminal interfaces and DEC compatible terminal.

Delivery and price unbeatable! Call Today!

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CIRCLE NO. 54 ON INQUIRY CARD

DataMate II

THE VERSATILE RS232 MINI FLOPPY STORE & EDIT TERMINAL FROM WTI

Let DataMate II solve your data handling problems

Data Communications
- Save on-line costs by preparing and editing data off-line then transmit stored data to your computer at speeds to 9600 bps.
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- Load operating programs into processor controlled equipment.
- Store Demo programs for exercising data terminals and equipment.

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- Store parts & address lists, sales information or any data changed or updated often.
- Perform automatic letter writing for sales letters, contracts or fund raising.

Impressive Qualifications
- Up to 328K of storage on a single diskette.
- Easy to learn—Easy to use.
- High speed string search at the rate of 10,000 characters per second.
- Global search and replace, delete, erase functions.
- Dual RS232 ports for easy insertion between your Terminal and Modem.
- 12 month factory warranty!

Send for more information, or outside California call toll free **1-800-854-7226**

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CIRCLE NO. 55 ON INQUIRY CARD

Letters

conversion for directory-assistance applications, because they hope to develop a user base for the product and encourage information providers to develop and market additional data bases.)

SURVEY SLIP

To the editor:

I enjoyed your special report on graphics systems in the December, 1980, issue ("Surveying interactive graphics systems," p. 71), but was disappointed to find that Lexidata Corp. was not mentioned as an interactive graphics systems supplier. Lexidata has been manufacturing raster-scan color displays since 1974, and is one of the industry's fastest growing companies.

Robert S. Scalea
Corporate Communications Specialist
Lexidata Corp.
Billerica, Mass.

INK JET OMISSION

To the editor:

Concerning Gerard Langeler's article in the December, 1980, issue ("Selecting hard-copy devices," p. 130), the well-written feature overlooked color-graphics ink-jet printers.

Both Applicon and PrintaColor produce non-impact color printers, which employ plain paper, not dielectrically coated. PrintaColor's IS8001 dot-matrix printer uses a piezoelectric impulse action. Ink dots are sprayed on demand by an internal μp at a resolution of 90 dots per in. The IS8001 is desk-top sized, relatively inexpensive for both equipment and copy, and generates copy in 2 to 3 min. from command to finish.

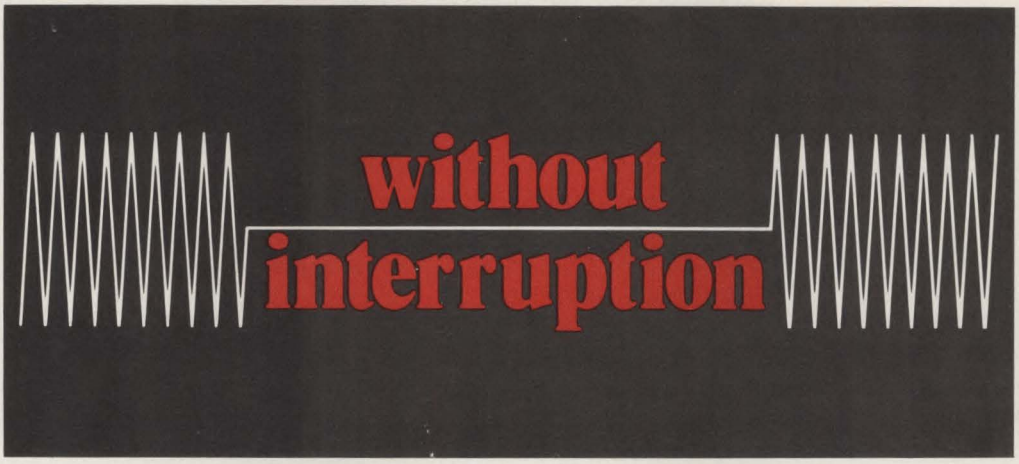
Ink-jet technology is developing rapidly, and color-graphics hard copy is increasingly in demand by business and industry.

Dan Byford
Technical Writer
PrintaColor Corp.
Norcross, Ga.

CORRECTION

The article "10½-in. Eagle challenges big Winchesters" (MMS, February, p. 111) did not carry the author's byline. The article was written by **Sam Adachi**, director of peripherals for Fujitsu America, Inc., Santa Clara, Calif.

POWER TO YOUR COMPUTER



Continental Power Systems presents a unique new design in uninterruptible power sources for all mini, small business and small/medium computers.

The PoweRotor™ UPS System keeps your computer on-line through common power problems such as momentary interruptions, erratic voltages and transient spikes. Yet the PoweRotor generator maintains absolutely constant output frequency essential to computer operation. During a utility outage, the system provides 10 to 30 seconds ride-through for orderly downsequencing or switching to back-up power.

- Installation is easy, with only small footprint area required.
- Lower installed cost than static inverter/battery systems.
- Superior ride-through over motor generator sets.
- Only UPS with 3 year warranty.

Get the complete story on the better UPS from Continental Power Systems, Inc., One Landmark Square, Stamford, CT 06901. 800-243-9145.

Continental Power Systems, Inc.

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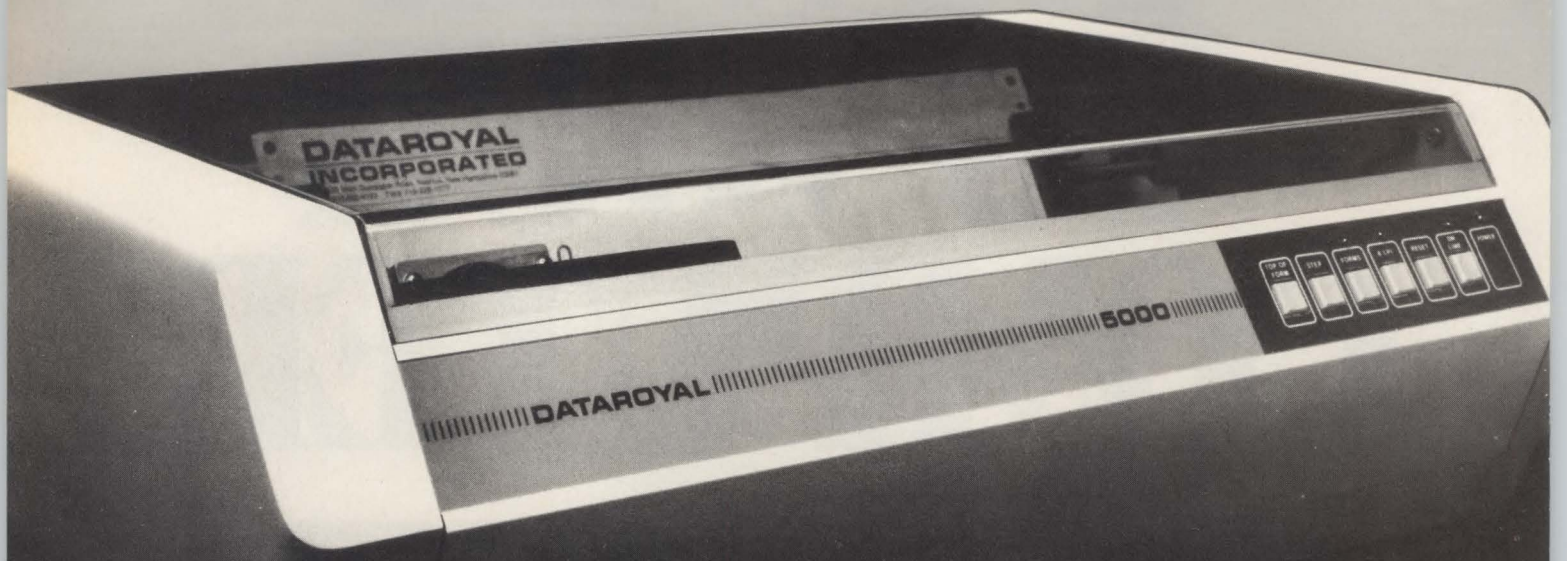
CIRCLE NO. 56 ON INQUIRY CARD

IF YOU DON'T NEED A RELIABLE PRINTER, DON'T BOTHER READING THIS AD.



The Intelligent Choice

A reliable printer means a lot to systems manufacturers, integrators and users—and not just in terms of fewer headaches. After all, if a printer doesn't break down as often, and requires less maintenance and service, you pay less for owning and operating a system.

That's why we build and test the Dataroyal IPS-5000 matrix printers for reliable operation. We make sure they can work all day, every day if needed—everywhere from offices to harsh industrial environments.

We kept the number of moving parts in our mechanism to a minimum, for fewer potential problems. And this simple design also makes it easier to maintain the printer.

The result? Dataroyal IPS-5000 printers are capable of 1500 *operating* hours MTBF at 100% duty cycles. Under normal conditions, this rating translates into two to three years between service calls. And that's one of the best marks in the printer industry.

By the way, all this reliability costs less than $1000 in OEM quantities. Get yourself an IPS-5000 —the printer selected by major systems manufacturers for reliability and quality. Visit us at N.C.C. Booth #918, or call or write us for details.

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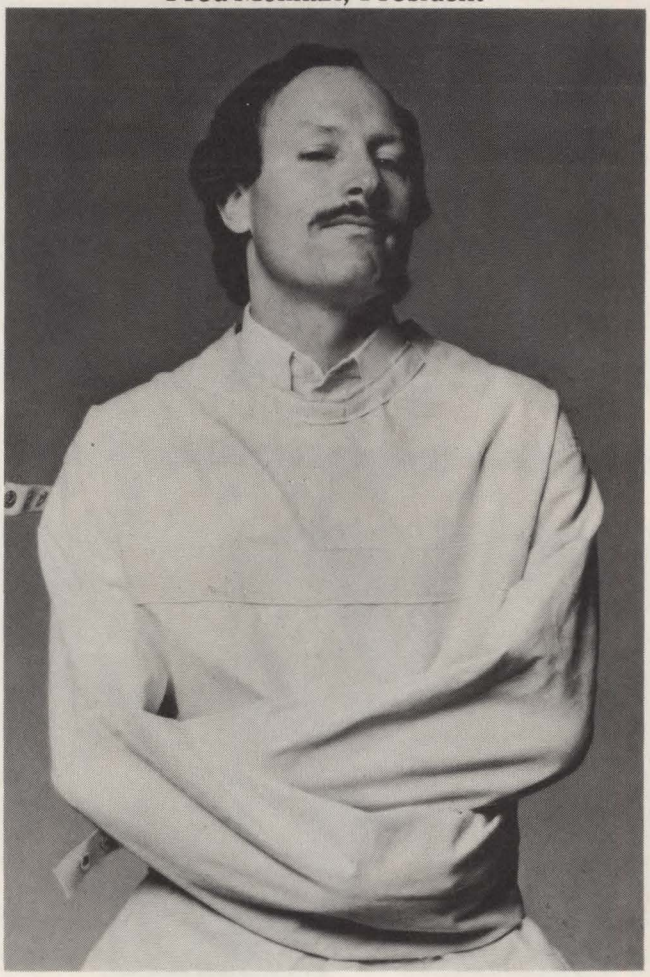
603 / 883-4157

DATAROYAL
INCORPORATED

CIRCLE NO. 57 ON INQUIRY CARD

"How did we manage to be first with intelligent analog peripherals? By working like madmen."

Fred Molinari, President



We worked days and nights, weekends and vacations to develop the intelligent analog peripheral.

It was time well spent.

Because now we can offer you a complete microcomputer data acquisition system on a single Multibus™ board.

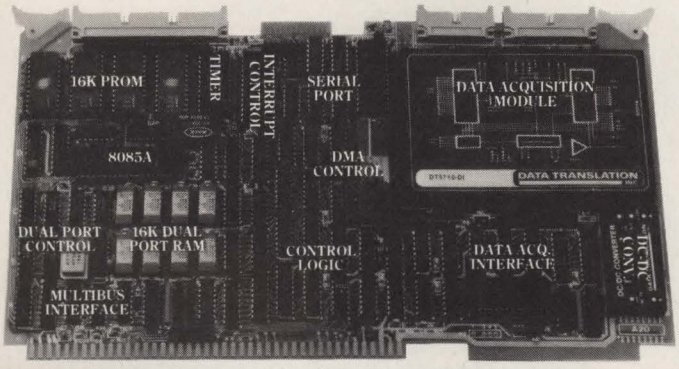
Decentralizing your computer function has finally become a practical possibility.

You see, this intelligent analog peripheral pre-processes data without involving the host CPU.

And thanks to a unique DMA controller, this peripheral also acquires analog data independently, at rates up to 125KHz.

Our new peripheral can function as an intelligent A/D slave. Or as a standalone microcomputer with A/D capabilities. Or as a remote system, transmitting data via a serial line.

Convenient? Our peripheral even includes a system monitor in preprogrammed ROM to communicate with the board, debug, and access A/D conversions.



Our intelligent analog peripheral features: A dual port memory controller. A 8085 CPU. Four PROM sockets. Two programmable timers. A baud rate generator. A complete priority interrupt controller. 12 bit A/D with 125KHz throughput to memory. A 16K byte dual-ported dynamic RAM. A self-contained four-channel multi-mode DMA controller. And quite a bit more.

In short, we have brought high-speed capability down to low-end computers. And, we might add, we are the first to do so.

Working like madmen has its advantages. We hope you'll let us work like crazy for you.

We can be reached at 100 Locke Drive, Marlboro, MA 01752. Telex: 951646. Or by phone at 617-481-3700. In Europe: Data Translation Ltd., Rockwell House, 430 Bath Road, Slough, Berkshire/England SL1 6BB. Phone(06286)3412. Telex:849862.

DATA TRANSLATION

SALES OFFICES: AZ 602-994-5400; CA 213-681-5631, 408-996-9889; CO 303-777-8071; FL 305-748-9292, 813-725-2701; GA 404-455-7222; IL 312-960-4054; IN 317-788-4296; MA 617-481-3700; MD 301-636-1151; MI 313-437-0816; MN 612-441-6190; NC 919-723-8102; NJ 609-428-6060; NM 505-292-1212, 505-524-9693; NY 516-488-2100, 607-722-9265; OH 513-253-6175, 216-659-3138; OK 405-528-6071; OR 503-297-2581; PA 412-327-8979; TX 512-451-5174, 214-661-0300, 713-780-2511, 713-988-9421; UT 801-466-6522; WA 206-455-5846; CANADA 416-625-1907.

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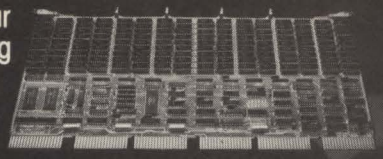

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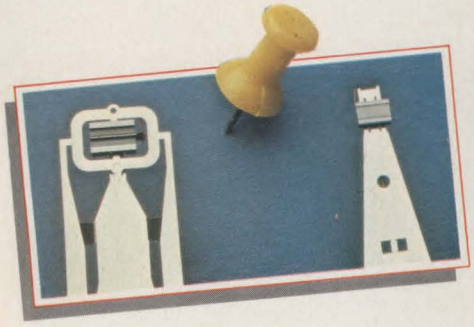
FEATURE HIGHLIGHTS

98 Personal work stations have emerged as a focal point for competition in the office-automation market. Here's a look at the dynamics that are generating the interest and at how the market is shaping up . . . For an analysis of the booming advanced work-station market—where users are taking a major hand in individualizing their systems—see p. 117 . . . And a helpful guide to selecting word-processing software for desk-top computers starts on p. 123.



135 Seagate Technology was the first to introduce a 5¼-in. Winchester-disk drive. Now it has doubled the drive's capacity by incorporating thin-film read/write heads—a technology previously limited primarily to mainframe-compatible drives.

161 The National Computer Conference will celebrate its 30th year next month in Chicago. Here's a preview of this year's professional program, where nearly half the papers and panels will address small-system issues.

208 Despite Ada's drawbacks—it is complex, somewhat verbose and lacks training aids—the Defense Department-sponsored language incorporates features that make it highly attractive for a wide range of applications. In other features this month, Data General has reorganized in an attempt to reverse its sliding profit margins, p. 141 . . . Remex is introducing the Pico, a "Slimline" floppy-disk drive that saves space and boosts capacity, p. 169 . . . Three software packages are reviewed: UNIX on p. 153, MDBS on p. 187 and TRANZ on p. 173 . . . There's also a look at video-list architecture, which allows rapid viewing of data without burdening terminals with software overhead, p. 197 . . . And scientists at the Salk Institute are using minicomputers to model brain cell reactions in hopes of understanding behavior, p. 181.

Convergent Technologies' work station *has a "landscape mode" screen with user-definable characters and is extensively human-engineered.*

INTEGRATED OFFICE SYSTEMS

Personal work stations: A concept evolves into a booming industry

SANDOR SCHOICHET, MIT Laboratory for Computer Science

Technological advances have created a new breed of office tool that soon may be more ubiquitous than the typewriter

Personal work stations have suddenly emerged as a focal point for competition in the office-automation market. Seven manufacturers have introduced personal work-station products in the last year, five of them start-ups linking their future to the success of this new concept. After such a flurry of introductions, and with at least seven more on the way, it's time to crystallize the personal work-station concept, look at the dynamics that are generating such interest and see how the market is shaping up.

The work-station concept

"The personal work station," explains Brian Rosen, a vice president at Three Rivers Computer, "is a multifunctional tool that serves the needs of one individual." This statement summarizes the two key aspects of the personal work-station concept. First, the work station has the versatility to address all of an office worker's computing needs with a single integrated system. Second, and most distinctive, it is dedicated to a single individual: instant availability and personal control elevate the role of an office worker from that of a system operator, an appendage to the equipment, to that of an autonomous tool user.

The combination of these two properties in a single product is what sets the personal work station apart from previous systems. In terms of hardware, a personal work station can be defined as a system that gives each user his own screen, processor, memory and mass storage, together with some provision for

Instant availability and personal control elevate the role of an office worker from that of a system operator, an appendage to the equipment, to that of an autonomous tool user.

resource sharing. Wang's Office Information System (OIS) series of work stations and Datapoint's 3800 series of attached processors, a part of their attached resource computing (ARC) system, both approach the personal work-station concept closely. They support both word- and data-processing applications and provide local program execution. But neither system is capable of fully independent operation. They both rely on a remote shared processor (a cluster controller for Wang, a file server for Datapoint) for program paging and file storage. Personal computers, which have been working their way up from the hobby to the office market, are also similar to the new personal work stations. The difference is really one of degree: personal work stations provide the capacity for significant business applications and are strongly oriented toward the office environment. This is most apparent in the "look" of the new equipment, which shows close attention to ergonomic and aesthetic factors.
factors.

Very broadly, the evolution of business systems architecture has already moved through two distinct stages and is now entering a third. In the 1960s and earlier, technology and economics dictated a completely centralized approach. These batch-oriented systems provided little sharing of data between applications and, from the end user's viewpoint, extremely poor responsiveness and flexibility. During the 1970s, responses to the disadvantages of batch systems took two major forms: creation of timesharing and data-base management systems (DBMS) for centralized machines, and the development of distributed data-processing (DDP) based on the availability of relatively inexpensive minicomputers. Timesharing and DBMS technology provided good resource and data sharing among a community of users, but responsiveness remained poor. Dedicated minicomputers, while they provided localized control and excellent responsiveness, disallowed sharing of data and resources and resulted in costly duplication.

Personal work stations represent the logical culmination of many recent developments, such as intelligent terminals and minicomputer networks, that were designed to overcome the disadvantages of timesharing and DDP systems. By taking the next step—distributing intelligence to the point of need, and relying on local area network (LAN) technology for resource sharing—personal work stations overcome the drawbacks of both previous approaches (Fig. 1). Gerry Stanley, vice president of marketing for Apollo Computer, talks about his company's philosophy in just these terms: "We believe we're marrying two concepts of the '70s—dedicated minis and timesharing—into the computing concept of the '80s."

Overcoming the productivity crisis

Recent economic and demographic trends are producing a productivity crisis in the office. The

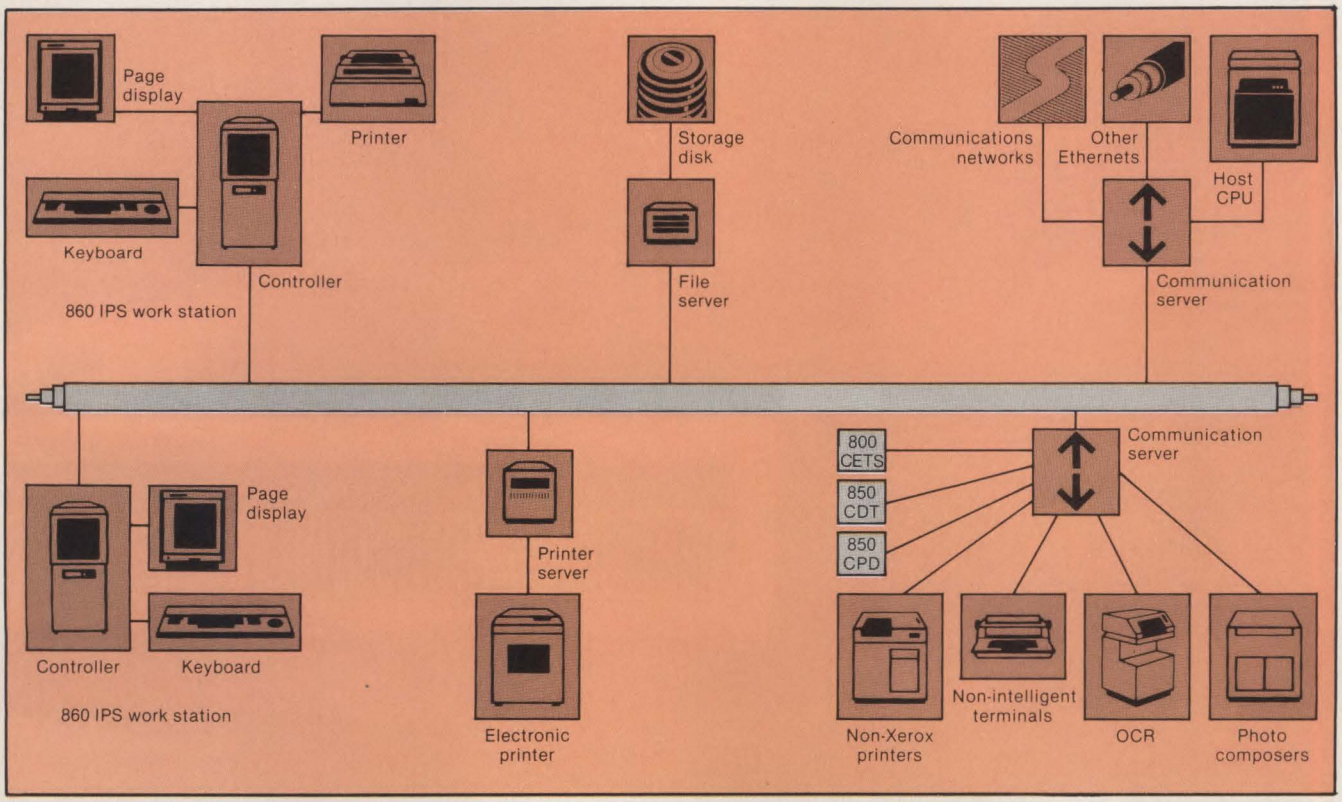


Fig. 1. Structure of distributed *work-station networks shown here is a representative Xerox 8000 schema based on the Ethernet local area communications network (dark line in center).*

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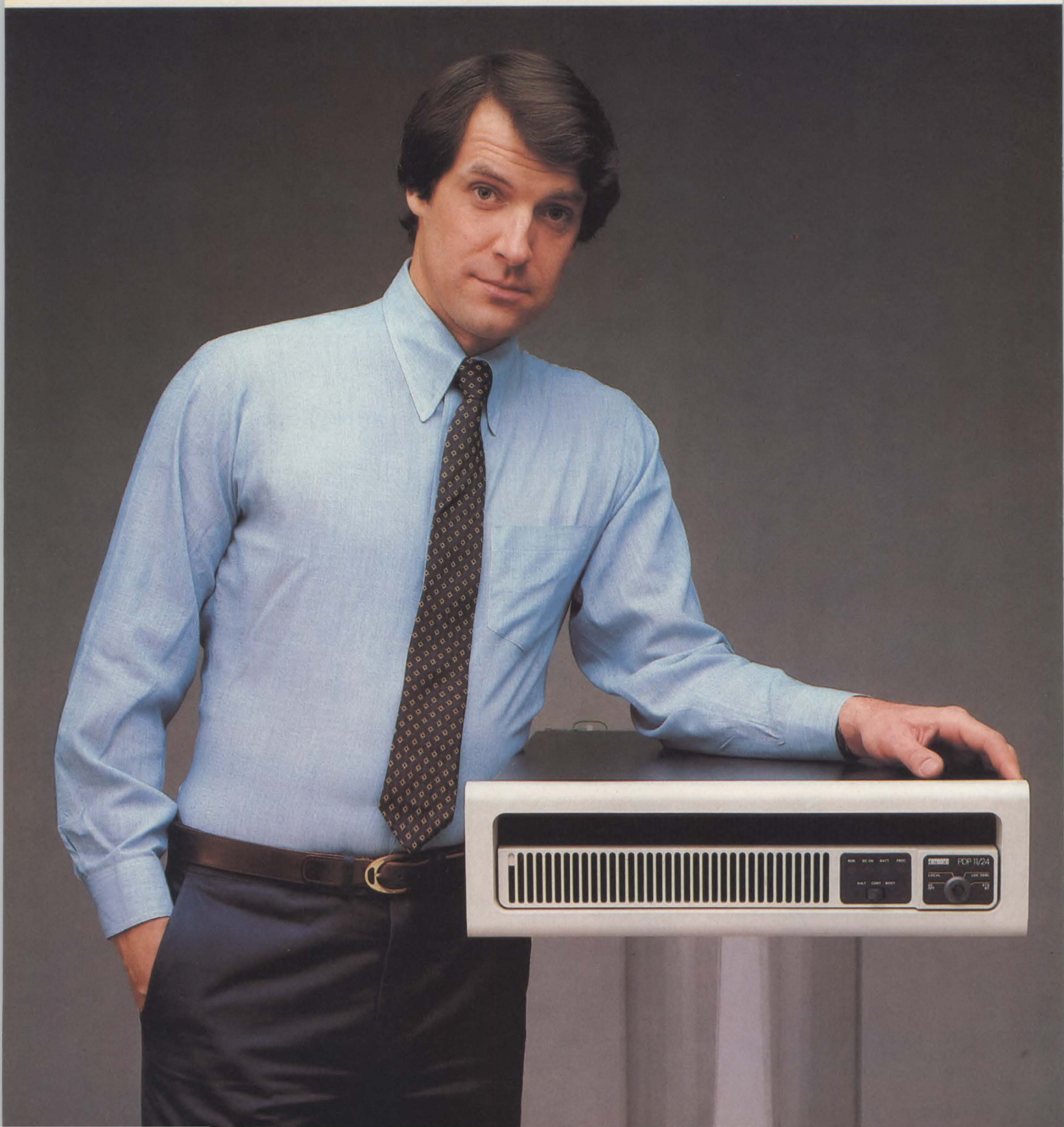

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Personal work stations represent the logical culmination of many recent developments, such as intelligent terminals and minicomputer networks, that were designed to overcome the disadvantages of timesharing systems.

response of a growing number of businesses is to follow the same strategy that has worked in the past—investing capital to provide more powerful and productive tools.

The traditionally low rate of office productivity growth, about 2.5 percent annually, together with the move toward an information- and service-based economy, has already swollen the ranks of office workers beyond 40 percent of the total U.S. working population. Growing numbers of office workers and sharply rising salaries have generated attention-catching jumps in overall staff costs. Meanwhile, the cost of computing equipment has been falling at an equally dramatic rate, from 5 percent to 20 percent yearly depending on market segment. Given the low per-capita investment in most offices today, usually on the order of $2500 versus $15,000 to $20,000 for manufacturing or agriculture, it's not hard to see the tremendous growth potential of the office-equipment market.

Concurrent with this "market pull" is an equally powerful "technological push." Technical developments in the last few years have crowded one upon the other. Microprocessors have enabled high-volume production of reliable and inexpensive computing power. High-density RAMs provide affordable space for large applications and sophisticated operating systems. The tight coupling that is possible among processors, memories and displays allows use of large, high-resolution screens that support detailed images, flexible graphics and multiple windows. High-density

Manufacturer Model	Xerox 860	AM Jacquard J500	Convergent Technologies work station	Artelonics Series 1000
Target market	Operational	Operational	OEM	OEM
Screen size	8½- x 11-in.	12-in. diag.	15-in. diagonal	15-in. diagonal
Character formation	Dense matrix / Fixed set	7 x 20 matrix / Fixed set	10 x 15 matrix / User-defined	9 x 15 matrix / Fixed set
Graphics capability	None	None	User-defined graphics characters	Standard line drawing characters or optional 864 x 512 pixel graphics memory
Interaction aids	CAT	None	None	None
CPU	16-bit Intel 8086	16-bit National IMP 16	16-bit Intel 8086	16-bit Intel 8086
Standard bus	No	No	Intel Multibus	Intel Multibus
RAM Memory (in bytes) (minimum/maximum)	128K 256K	128K 256K	64K 1M	64K 832K
Mass storage (in bytes)	Dual floppies 600K to 2.4M or 1.2M floppy and 5M or 10M Winchester	2 to 8 500K floppies and 0 to 8 12M or 24M cartridges	Various configurations to maximum 500K floppy and 58M Winchester	1 to 8 floppies to maximum 8M and 1 to 8 Winchesters to maximum 240M
Local area network	10-MHz Ethernet	No	No	No
Programming languages	BASIC, Program Mode II	Assembler, BASIC, Data-Rite	Assembler, BASIC, COBOL, FORTRAN	Pascal
Operating system features	Foreground/ background	Foreground/ background	Multiple concurrent processes, window manager, 16M-byte virtual address space	Tree-structured filing system

Table 1. Comparing the important features *of the personal work stations surveyed in this article.*

floppy-disk drives and small Winchester-disk drives can provide local storage in packages suited for the office. And, most crucially, the development of low-cost, high-bandwidth LANs has laid the groundwork for practical data and resource sharing in widely distributed systems.

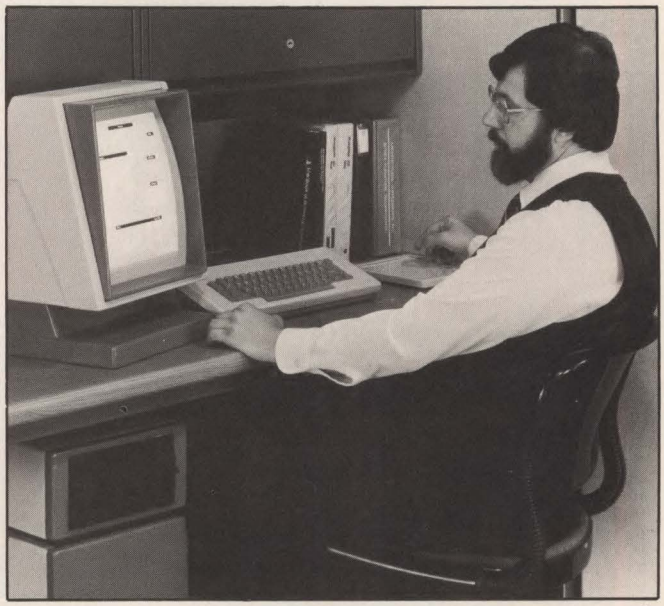
The combination of these quantitative improvements is leading to a qualitative revolution. The ability to dedicate signficant computing power economically to each individual has many implications. The simplicity and standardization inherent in personal work stations lead to lower costs and higher reliability. Dedicated nodes tied together by LANs mean systems with low incremental growth costs and unbounded size. Fast and, more importantly, consistent response times and high-resolution screens combine to create an interactive environment whose quality will extend the acceptability of computing tools to a wider range of users.

Personal work stations can be sorted into four groups based on their target market segments: operational, professional and managerial end users, and OEMs. In the current state of flux, these classifications are no more than rough guidelines, but they are still useful because the needs of each market segment emphasize the value of different capabilities (Table 1).

	Three Rivers PERQ	Apollo Computational Node	Axxa System 90
	Professional	Professional	Managerial
	8½- x 11-in.	8½- x 11-in.	8½- x 11-in.
	User-defined	User-defined	15 x 30 matrix / Fixed set
	1024 x 768 pixel screen mapped into main memory	1024 x 800 pixel screen mapped into separate graphics memory	Standard line drawing characters
	Touch-sensitive tablet	None	LED display and message lights
	16-bit microprogrammed Pascal P-code interpreter	32-bit Motorola M68000	8-bit Zilog Z80
	No	Optional Intel Multibus	No
	256K 1M	256K 1M	64K
	1M floppy and 12M or 24M Winchester	1M floppy and 33M Winchester	Optional 500K floppy and 10M fixed-removable cartridge
	10-MHz Ethernet	12-MHz ring network	Auto-dialer and 1200-baud modems
	Microprogram Assembler, Pascal	Pascal, FORTRAN	BASIC, Macro keystroke sequences
	Multiple concurrent processes, window manager, distributed file manager	Multiple concurrent processes, window manager, distributed file manager, 16M-byte virtual address space	Foreground/background, tree-structured filing

The operational end-user group includes clerks, secretaries and administrative assistants. The two machines in this group, the 860 IPS (information processing system) from Xerox and AM Jacquard's J500 work station, both focus on providing word processing, data entry, filing and other administrative activities at entry-level prices between $15,000 and $20,000. These machines are both realizations of the much-heralded merger between word and data processing: the 860 IPS is an upgrade of the earlier 850 word processor, and the J500 is a fully software-compatible single-user version of the 16-terminal J100 small business computer.

The 860's large black-and-white screen emulates a full typed page. A CAT (capacitance activated transducer) allows simple cursor control: moving a finger on the CAT causes the cursor to move in the corresponding direction on the screen. As more skin contacts the CAT surface, by pressing harder or using more than one finger, the speed of the cursor increases. The 860 IPS is configured as three separate components: a keyboard with the CAT, a tiltable screen and a floor-standing controller containing the electronics and disks. A less expensive version is also available as the 860 PDS (partial-page display) with an 8½- × 6-in. screen. The CAT is optionally available as a separate unit. Xerox offers two "generic office applications" for the 860 in addition to word processing: system activity recording, for generating automatic reports on system use, and records management. Custom applications may be developed in either BASIC or Program Mode II, a simple programming language based on the 860's math- and word-processing commands.



The window manager of the PERQ *from Three Rivers Computer allows windows to be moved around the screen, enlarged or contracted, scrolled and clipped under user control.*

Fast and consistent response times and high-resolution screens combine to create an interactive environment whose quality will extend the acceptability of computing tools to a wider range of users.

The 860 is the first component of Xerox's new 8000 network system. Marci Williams, manager of market communications for the 860, says the greatest dollar volume is still in secretarial/clerical applications, but the 8000 system lays the groundwork for extending the usefulness of the 860 into other areas. The 8000 network system is based on the Ethernet LAN technology jointly announced by Xerox, Digital Equipment Corp. and Intel. It uses a coaxial cable with a maximum length of ½ mi. to provide 10-MHz packet contention communications among a variety of office equipment. The 8000 system compromises a number of "server" devices that provide services to all users on a local network, including large disk files, high-speed laser xerographic printers and communications gateways that link multiple Ethernet systems with each other, with other computer systems and with conventional telecommunications.

The J500 provides the same powerful word-processing capabilities as the J100, which has come out on top in the DataPro user surveys for the past two years. Configured as a single desk-top unit incorporating a screen, two 8-in. 500K-byte diskettes, and all electronics, the J500 can run all of the applications software developed for the J100. This includes Data-Rite, a business programming system with facilities for file management and data-entry screen design, and Account-Rite, which comprises modules for general ledger, accounts payable and receivable and payroll. Although the J500 doesn't support local networking, AM Jacquard will introduce such a system after the IEEE has released its recommendations on LAN standards, says Roy Davis, J500 product line manager.

The professional market segment is made up of engineers, purchasing agents, bank loan officers, brokers and the like. The preponderance of office paperwork is performed on their behalf, and it is widely recognized that integrating the disparate systems that typically support their work and bringing them all under a user's direct control provides the greatest opportunities for productivity improvement. The two work stations in this category, the PERQ from Three Rivers Computer and Apollo Computer's Computational Node, reflect the needs of this user group by providing sophisticated user interfaces and powerful computational support. With entry prices of $25,000 to $35,000, both products are configured with separate high-resolution bit-mapped screens, keyboards and controller units containing all electronics, disks and high-bandwidth LAN interfaces.

PERQ (Fig. 2), a Pascal-oriented machine with a microprogrammed bit-slice CPU, directly executes Pascal P-codes at more than 1M ips. A symbolic Pascal debugger works together with the word processor to aid in developing sophisticated application systems. The 4K words of 48-bit-wide microprogram memory is

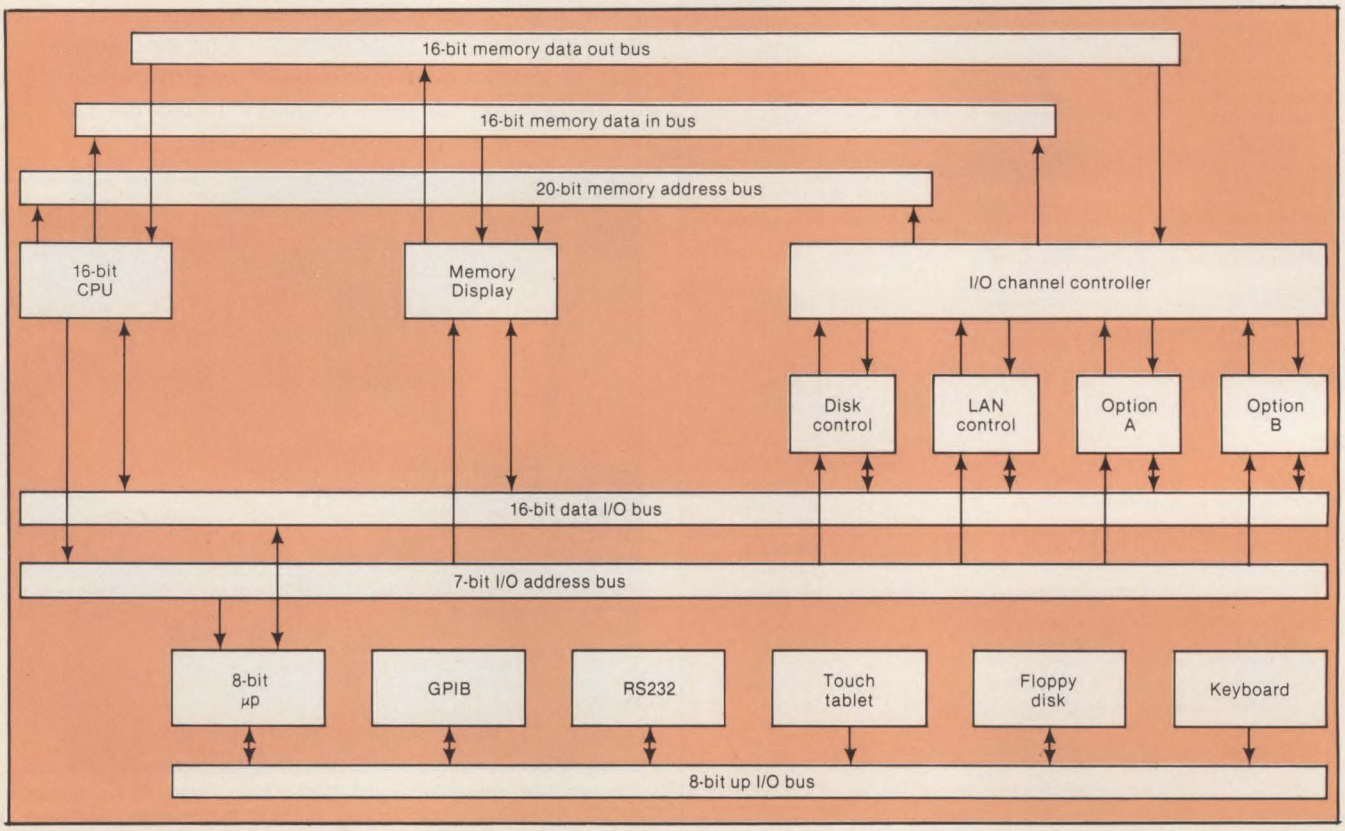


Fig. 2. Block diagram *of the Three Rivers PERQ system architecture.*

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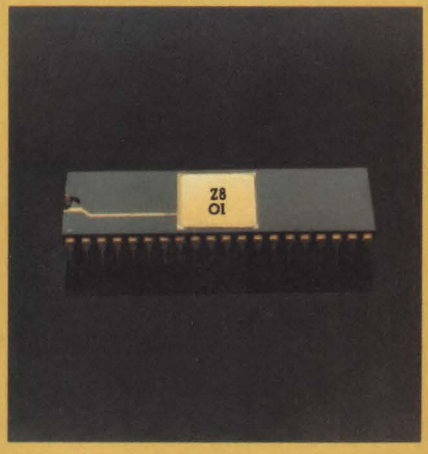

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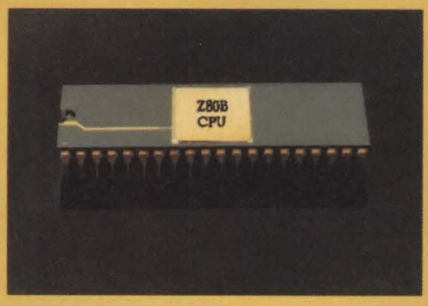

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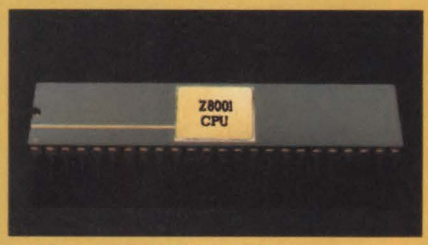

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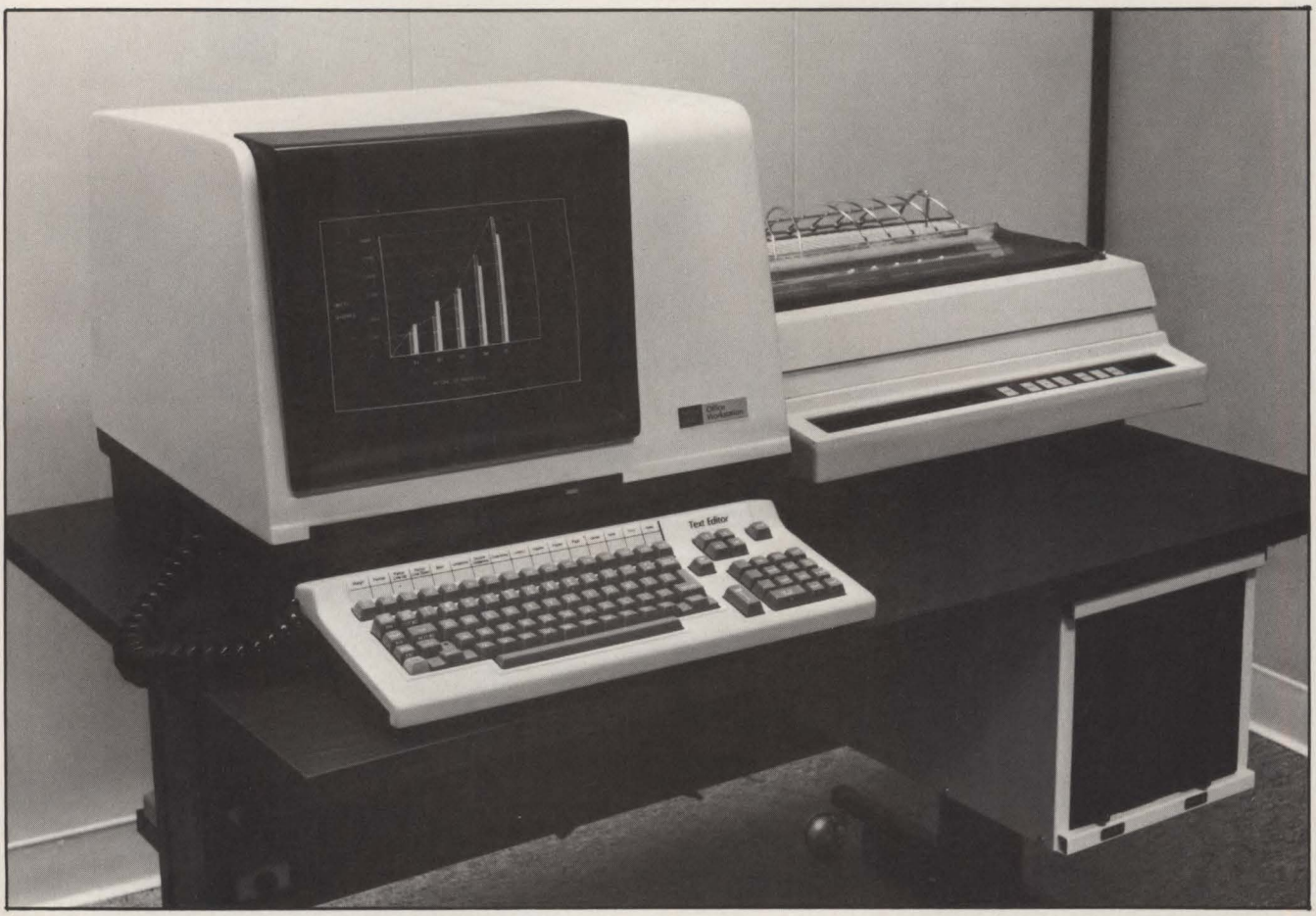
The 8000 system comprises a number of 'server' devices that provide services to all users on local networks, including large disk files.

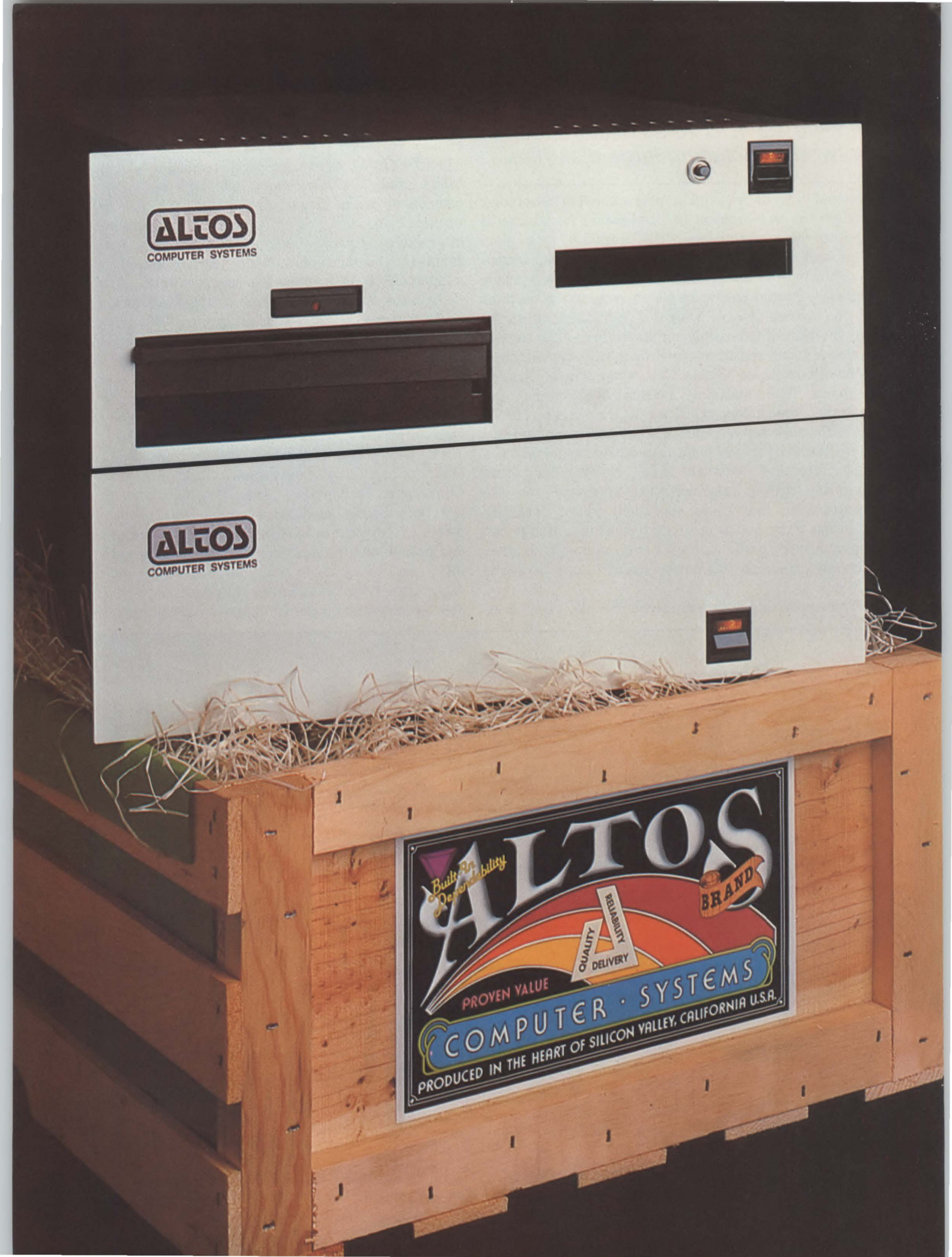
optionally writable, and a microprogram assembler enables the development of interpreters for additional programming languages. The 1024 × 768 pixel black-and-white screen is bit-mapped into main memory, allowing the use of text characters in any typeface and size. Special hardware allows rectangular sections of the screen image, which is refreshed at 60 Hz non-interlaced, to be copied or moved in a single refresh cycle. A touch-sensitive tablet facilitates user interaction with displayed objects. The PERQ operating system supports both multiple concurrent processes and multiple independent windows on the screen, one or more for each active process. This means that several projects can be spread out on the screen, and a user can shift attention between them easily. The PERQ operating system also provides a distributed file structure so that users can easily share data. By adopting Ethernet as its LAN technology, PERQs can communicate rapidly with each other and with all other Ethernet devices, including Xerox's 8000 systems servers.

The Apollo Computational Node provides capabilities similar to PERQ's, but the Node is based on a 32-bit architecture with a 16M-byte virtual address space supported by two Motorola M68000 processors. The Apollo Node maps its screen into a separate 128K-byte display memory. The Apollo is the most network-oriented of the current products; termed a "Computational Node," it is clearly intended as only one component in a larger distributed system, called DOMAIN, for distributed operating multiple-access interactive network (MMS, January, p. 14). DOMAIN connects Computational Nodes by a coaxial cable supporting a 12-MHz packet-ring network. Apollo's distributed file system creates a single network-wide name space for data and programs. The network bandwidth is the same as that of the local disk controller; there is a single block-multiplexed DMA channel shared between the local disk and the network. As a result, a user does not have to know the actual location of programs or data objects, and the Node can operate normally even without its own local disk.

The Series 1000 office work station from Artelonics (Fig. 3) and the Convergent work station from Convergent Technologies (MMS, October, 1980, p. 85) are both highly modular systems, intermediate in power and display capabilities between the operational and professional product groups. They are targeted at OEMs and could fit into any of the three end-user categories. Both systems are built around 16-bit Intel 8086 processors and the Intel Multibus, making a wide



The Series 1000 *from Artelonics, a highly modular system, is intermediate in power and display capabilities between the operational and professional product groups.*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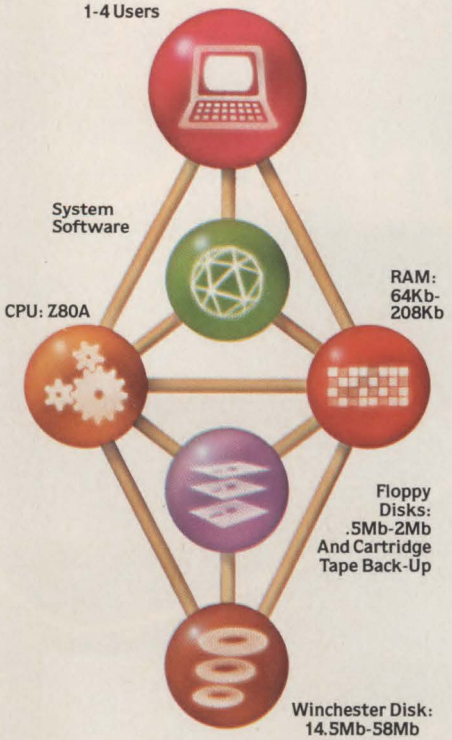
FRESH IDEAS ARE GROWING AT ALTOS

Silicon Valley, California. At one time few places in the world were as abundant with orchards. Today, no other area is as technologically fertile. And nowhere on earth is the business climate as prolific with computer innovation.

Yet within this competitive environment, one microcomputer firm continues to grow above the rest. Altos Computer Systems. Recognized as a world leader in single board microcomputer technology, Altos flourishes on its ability to produce ideas and deliver them to the market while they're still fresh and packed with price performance value.



Fresh ideas like Altos' new ACS8000-6/MTU single board microcomputer system with a DEI ¼-inch cartridge tape back-up drive, and Shugart's 8-inch floppy and 14-inch Winchester hard disk drives, with total on-line capacities from 14.5 MBytes to 58 MBytes.

The ACS8000-6/MTU joins Altos' growing family of products that branch out to a multitude of single board system configurations to serve the OEM, the business sector, and many other end users. These systems range from the ACS8000-2 with its dual 8-inch floppy disk drives, to the powerful ACS8000-5, which is upgradable to any of Altos' hard disk and multi-user systems.

Altos supports three industry standard operating systems: single/multi-user CP/M*, OASIS† and Altos' proprietary AMEX.™ Seven high level programming languages are offered which are CP/M or AMEX compatible.

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CIRCLE NO. 64 ON INQUIRY CARD

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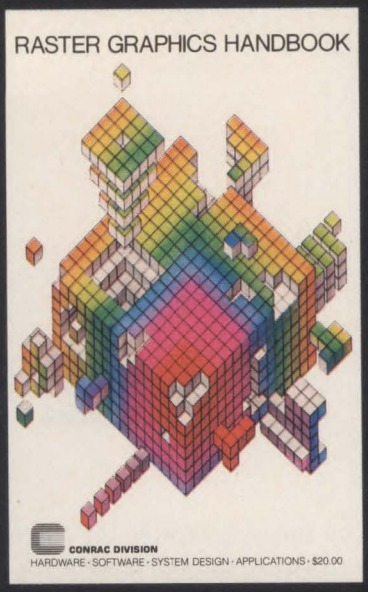

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DECISION-MAKING IMAGES

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The Apollo is the most network-oriented of the current products; it is clearly intended as only one component in a larger distributed system, called DOMAIN.

variety of off-the-shelf components available to system builders.

Artelonics sees itself as a tool manufacturer moving in the direction of a systems house, says Rick Eckland, marketing services director. The first step in this direction is a program of certifying Multibus-compatible peripherals for use with the Series 1000 and providing a modular set of operating system utilities for driving them. Configured as a desk-top unit containing a display, all electronics and a detached keyboard, the Series 1000 can be expanded to include a variety of disk drives, printer controllers and communications options. Though the standard green-on-black display provides only a fixed character set, an optional 864- × 512-pixel graphics memory can be added to allow independent manipulation of both text and graphics.

The unusual appearance of the Convergent work station is evidence of careful attention to ergonomic factors. Matt Sanders, product design engineering manager, says the user-defined green-on-black characters are large enough to be read at a comfortable distance, and that the screen can be tilted and swiveled to eliminate glare. The electronics are mounted to the side of the screen, a design that provides a convenient place to put reference documents and keeps them in the same focal plane as the screen. This eliminates another common source of eyestrain. For applications requiring more than four additional Multibus cards, or requiring a smaller desk-top unit, the electronics can be kept in a floor-standing enclosure. Although Convergent does not yet support a LAN—it is also waiting for the IEEE standards committee report—it is possible to configure a Convergent work station as a shared resource processor (SRP). One SRP can provide shared peripherals and files for as many as 16 Convergent work stations.

The proper approach for the managerial end user is still uncertain. This group is similar to the professional group in that a great deal of paperwork is performed for them. However, their primary job is working with people; this group will use the systems much less frequently, and will consequently require an extremely easy-to-use interface. The applications they require are also less computation-intensive and far more communications-oriented. Because the value of any communica-

The System 90 from Axxa *supports a manager and a secretary as a team, allowing two screens to share the same files and electronic mail address.*

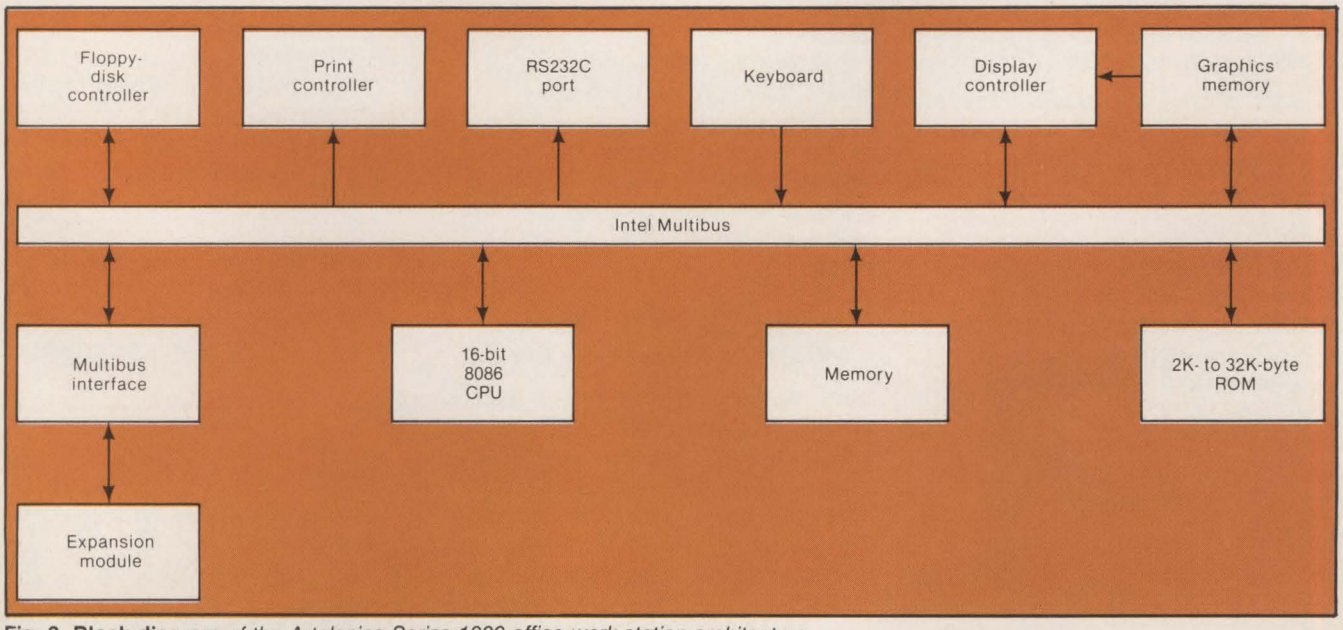
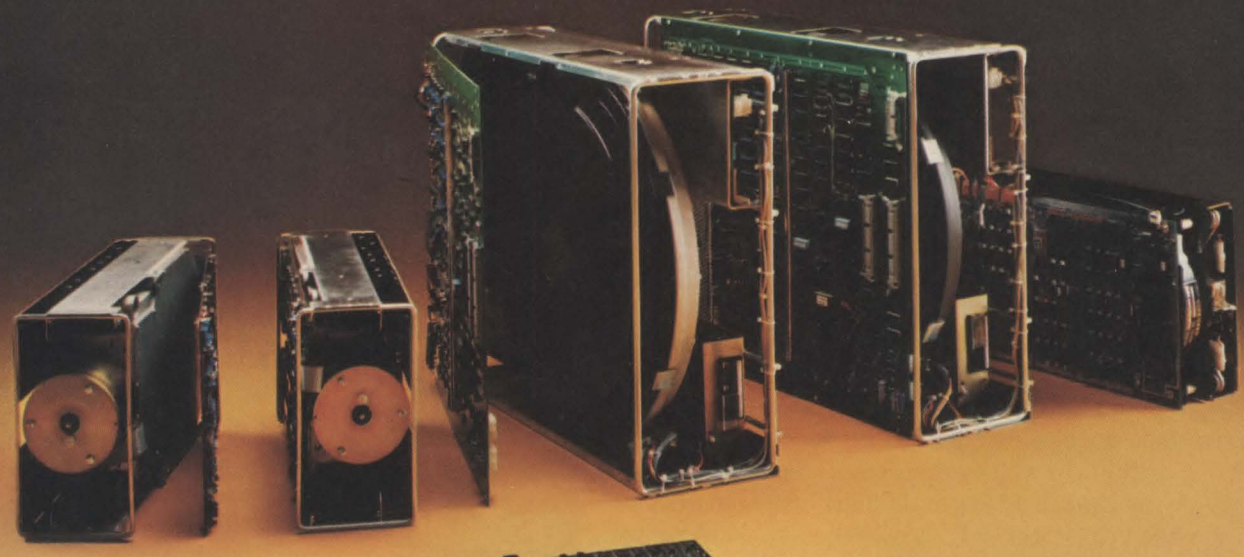


Fig. 3. Block diagram *of the Artelonics Series 1000 office work station architecture.*

THE SMART SET



Members of this exclusive circle of PRIAM Winchester disc drives have some uncommon things in common. With capacities from 10.8 to 158 Megabytes, they have the same interface. And they all connect quickly and easily to microprocessor I/O busses through PRIAM's SMART or SMART-E Interface.

With a simple adapter your system can have the remarkable reliability of Winchester disc drives. And PRIAM's DISKOS drives give you the lowest cost-per-megabyte for your system database.

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With its own sophisticated preprogrammed microprocessor, PRIAM's SMART Interface gives you comprehensive disc subsystem functions, including:

- Control of any combination of one to four PRIAM Winchester disc drives.
- Automatic alternate sector assignment for disc-defect transparency to the host processor.

In addition to all SMART functions, PRIAM's new SMART-E Interface provides ECC, streamlined software, sector interleaving, a 2048-byte buffer, and logical-sector addressing. Both the SMART and SMART-E come to you on a single 8" × 14" printed circuit board that is powered from the drive. And it piggybacks on the drive or mounts separately.

Meet The Elite! PRIAM's High-Capacity, Low-Cost 14-Inch Drives

PRIAM's high-technology 14-inch disc drives have capacities of 34, 68, or 158 megabytes, and they all fit in the same 7" × 17" × 20" package, including optional power supply. Fully servoed linear-voice-coil head positioning is reliable and fast—45 ms average for the 34 and 68 megabyte drives and 40 ms for the 158 megabyte version. Track to track is 8 ms.

Brushless DC spindle motors in all PRIAM drives assure mechanical simplicity, precise disc speed control, and operation anywhere in the world without change. No relays, mechanical brakes, brushes, belts, or pulleys. Pure, reliable electronic control. Elegantly simple.

The Talk Of The Town: PRIAM Eight-Inch-Disc Drives!

Debut a Winchester disc drive in place of a floppy disc with PRIAM's DISKOS 3450 and 7050, expanding your database to 35 or 70 megabytes. Thoroughbred performance goes with their linear voice-coil positioners; seek times are only 40 ms average and 8 ms track-to-track.

If you need an even lower-cost drive, the DISKOS 1070 gives you a 10.8-megabyte capacity with stepper-motor positioning. Seek times are 73 ms average and 23 ms track-to-track. And they're just as SMART as other PRIAM drives when used with PRIAM's SMART or SMART-E Interface.

More Basic Interface Options!

To those who have their own controller plans, PRIAM offers lower-cost drive-level interfaces. PRIAM's bit-serial NRZ data interface, similar to the evolving ANSI standard, has an 8-bit bidirectional control bus for easy connection to popular 8 and 16-bit microprocessors. Data separation is included in all PRIAM drives.

And if you have a Storage Module controller, you can use it and your software with PRIAM's SMD Interface to update your system with Winchester drives quickly and inexpensively.

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CIRCLE NO. 66 ON INQUIRY CARD

Managerial end users' primary job is working with people; this group will use the systems much less frequently and will require an extremely easy-to-use interface.

tions device increases exponentially with the number of compatible units available to talk to, some people argue that a simple and low-cost system is needed, which supports electronic mail and little else.

The System 90 Electronic Office from Axxa takes a different tack. At an entry price of $30,000 to $40,000, the System 90 is aimed at the small group of users on "mahogany row"—managerial executives. It provides a very general set of communications and adminstrative features as part of its base-level software, including electronic mail, filing modeled on a file drawer and folder, word processing, a calendar and a Link program that automates the connection and logging-in processes required in communications with remote mainframe computers. The System 90 is unique in its support of a manager and secretary as a team, allowing two screens to share the same files and electronic-mail address with a special private-mail channel for coordination. The System 90's architecture employs three 8-bit Zilog Z80s as file processor, communications processor and applications processor. A fourth Z80, also an applications processor, supports the secretarial screen. Because Axxa has implemented local networking by using telephone lines and 1200-baud modems, the basic system also supports remote access to all functions by traveling executives. Because security and privacy are issues of particular concern to managerial users, Axxa writes information on both halves of its split 10M-byte fixed/removable cartridge disk to guard against disk failures. In addition, its filing system provides invisible secret files and conventional password protection.

The Xerox 860 IPS *is a multifunctional system that combines word processing with data and records processing.*

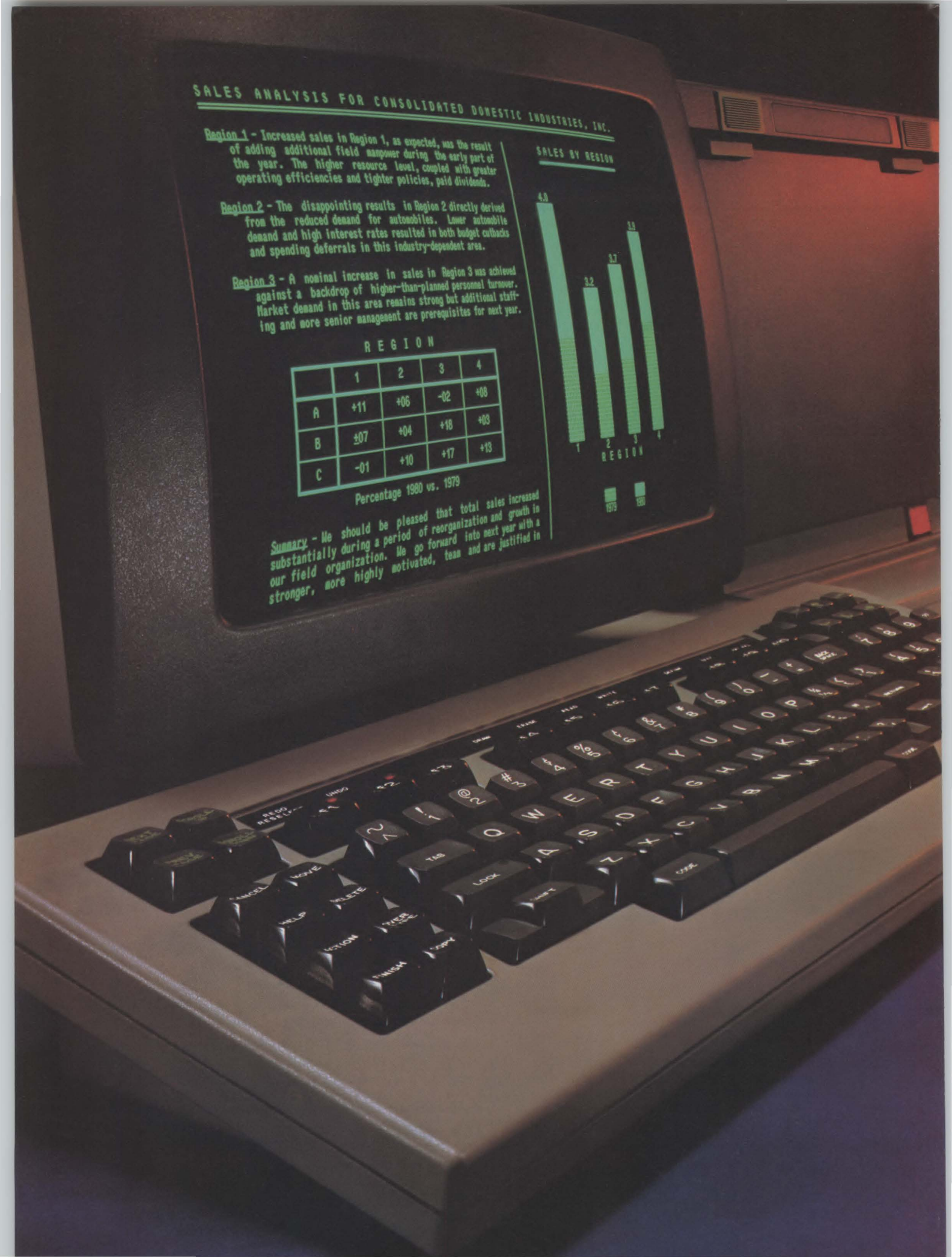
The J500 work station *from AM Jacquard supports point-to-point or remote communications with the rest of the AM product line, including their high-quality phototypesetters.*

Although all of the products discussed here are new, they didn't just emerge out of the blue. The development of next-generation computing resources in universities and corporate research groups has been proceeding in the direction of personal work stations for some time. The Alto work station developed by Xerox at its Palo Alto, Calif., research center in 1974 was the first, and it has been followed by the Dorado work station. These machines have seen rather wide use within Xerox and form the background for the 860 and the 8000 network systems. The Massachusetts Institute of Technology's Artificial Intelligence Laboratory developed the LISP machine, a powerful personal work station devoted to the LISP programming language, in 1977. A commercial version is due to appear shortly. Bolt Berenak and Newman, a research and consulting organization, has developed the Jericho work station; Stanford University is building the SUN work station; MIT's Laboratory for Computer Science has designed the Nu work station, which should also be commercialized soon, and Carnegie-Mellon University is working on the SPICE work station.

The trend toward personal work stations as key elements of office-automation systems is well-established, given the rapidly increasing amount of user experience, the education of the business community and the coming release of IEEE's LAN standards.

Before long, OEMs that have been investigating the equipment discussed here can be expected to start introducing advanced systems attacking a range of vertical markets. As qualitative changes in the relationship between man and machine allow computing tools to reach an ever-growing segment of the office work force, the personal work station will emerge as a tool with almost universal applications. ■

Sandor Schoichet, a former design engineer for Burroughs Corp. and Dataproducts Corp., is working for his doctorate in computer science as a member of the Office Automation Group in the Massachusetts Institute of Technology's Laboratory for Computer Science.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Region 1 - Increased sales in Region 1, as expected, was the result of adding additional field manpower during the early part of the year. The higher resource level, coupled with greater operating efficiencies and tighter policies, paid dividends.
Region 2 - The disappointing results in Region 2 directly derived from the reduced demand for automobiles. Lower automobile demand and high interest rates resulted in both budget cutbacks and spending deferrals in this industry-dependent area.
Region 3 - A nominal increase in sales in Region 3 was achieved against a backdrop of higher-than-planned personnel turnover. Market demand in this area remains strong but additional staffing and more senior management are prerequisites for next year.
REGION
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B ±07 +04 +18 +03
C -01 +10 +17 +13
Percentage 1980 vs. 1979
Summary - We should be pleased that total sales increased substantially during a period of reorganization and growth in our field organization. We go forward into next year with a stronger, more highly motivated, team and are justified in
SALES BY REGION
4.0
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REGION
1979
1980

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CIRCLE NO. 68 ON INQUIRY CARD

INTEGRATED
OFFICE SYSTEMS

Homing in on the advanced work-station market

HOWARD ANDERSON, The Yankee Group

A concept embracing terminals, printers and specific applications, the most important being electronic mail

The demand for advanced work stations (AWSs)—multifunctional office utilities for information processing, retrieval and communications—is enormous. The information explosion generated by the past decade's advances in computerization has catalyzed the demand for such a device. Managers and executives rely on fast access to information for decision-making, and the declining cost of processing power enables them to have personal tools for manipulating, integrating and analyzing that information. But while office automation has reached secretaries via word processing and has involved operations managers and auditors via the small business computer, it has yet to affect the vast majority of white-collar workers.

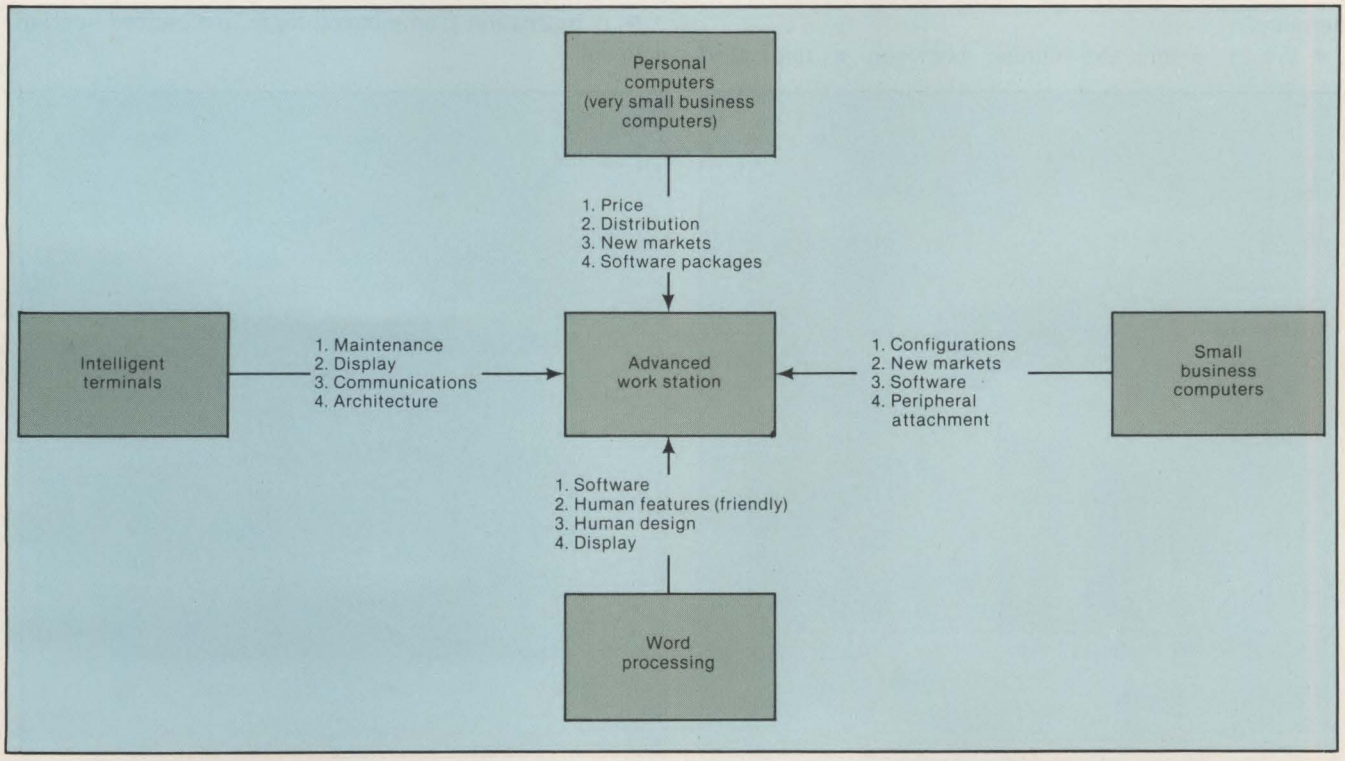

Fig. 1. Four product lines—*word processors, small business computers, personal computers and intelligent terminals—are contributing to the evaluation of the advanced work station.*

Advanced image/text processors combine copier and printer functions with telecommunications to transmit and receive information and to produce hard copy on demand, locally or remotely.

The reason? Today's systems are too generic; line managers need specially designed systems just for their needs. This can be done in hardware or software, but it must be done. And users must take a major hand in individualizing their systems.

A recent Yankee Group survey of 1300 current and potential terminal users was performed to determine the features and range of abilities desired in an AWS by management users. Eighty-two percent of those surveyed were managers and executives. The results indicated that:

- Voice output, electronic mail and calculator functions were of low priority, while stand-alone processing, easy peripheral attachment, easy access to data bases and the ability to communicate easily with a number of other devices were very important.
- Users would pay on the average 13 percent more for easy peripheral attachment, 13 percent more for stand-alone processing, 17 percent more for easy communications and 13 percent more for sophisticated data base access.
- Current users would pay on the average only 3 percent more for electronic mail, 4 percent more for calculator functions and 2 percent more for voice output.
- Potential users would pay on the average $2300 for an advanced work station (without printer and memory).
- When given the choice between a dedicated terminal and a multifunctional terminal of equal cost, 94 percent of the respondents chose a multifunctional terminal. If the multifunctional terminal cost more than the dedicated terminal, users and potential users would be willing to pay 15 percent more for the multitasking device.
- Given diagnostics and a $40 cost savings per month, 94 percent of the respondents would perform simple maintenance on their terminals.

The technologies required to meet the price/performance standards of the advanced work station are either existing or likely to emerge in the next two to four years. Four current product lines are contributing to its evolution: word processors, small business computers, personal computers and intelligent terminals (Fig. 1). In The Yankee Group's analysis, "The current word-processing market will contribute most to, and be most impacted by, the development of the advanced work station."

Word processors are used almost exclusively for text manipulation, but they are increasingly finding applications in data processing and communications. Worldwide shipments of word-processing keystations are expected to grow more than 40 percent during 1980, up from 58,000 in 1978 and from 89,000 in 1979. This rapid growth is expected to continue throughout the early 1980s with 35 percent growth in keystation shipments, and a steadily diminishing growth rate in shipment value (from 27 percent in 1980 to less than 15 percent during 1983). The cost of word-processing systems will decline 15 to 20 percent annually in the next five years. Yankee Group research indicates there are 382,500 word-processing systems installed.

The trends in word processing during the next five years will be:

- A migration from shared-logic to a shared-system concept.

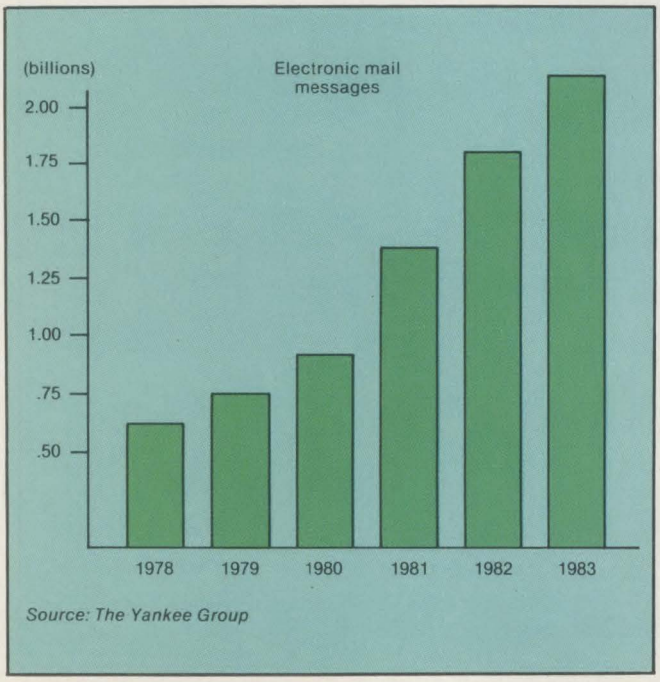

Fig. 2. Vendors are *beginning to commit large amounts of capital to marketing electronic-mail systems.*

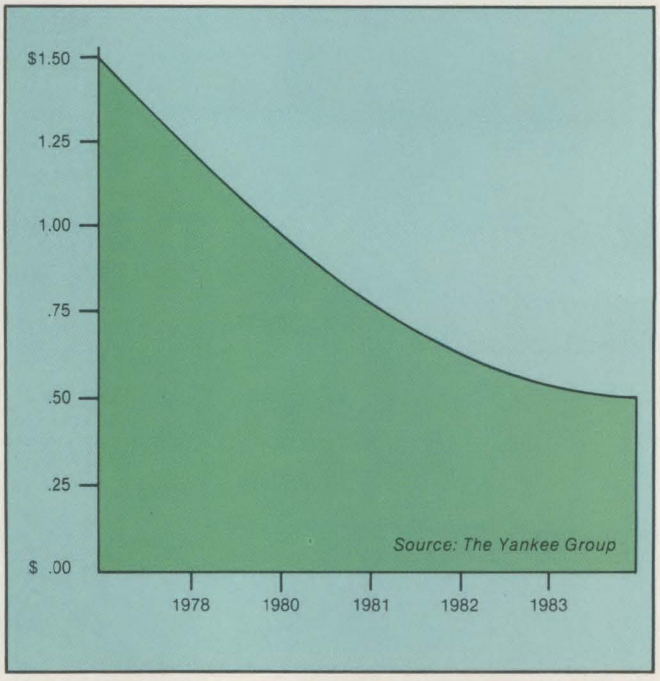

Fig. 3. Technology *is forcing down the cost of electronic mail as the cost of physical distribution climbs higher and higher.*

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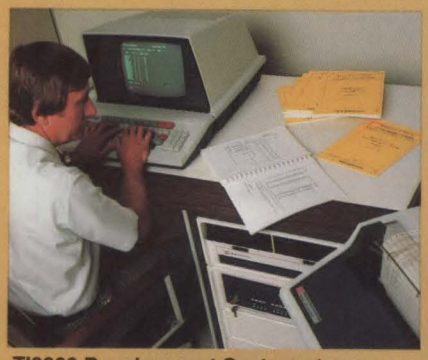

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CIRCLE NO. 69 ON INQUIRY CARD

The potential market for intelligent, multifunctional copier/printers and image/text processors is forecast to reach $200 million to $300 million in end-user sales by 1985.

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- Increased multifunctionality, including communications and increased data-processing capabilities.
- Movement from hard-wired to software-driven architecture.
- New forms of market distribution, including a dramatic increase in retail outlet sales.

The Yankee Group believes that AWSs will become a viable, cost-effective, mass-market product by the mid-1980s only if drastic changes are made in the way the devices are designed, manufactured, distributed, serviced, supported, packaged and adapted to the end-user.

Low-end terminal systems will have to be distributed through channels other than traditional high-cost direct sales. The developing strategies of Digital Equipment Corp., Tandy Corp., Texas Instruments Inc. and IBM give these companies a head start in alternative forms of product sales. The key to the new forms of distribution will be adequate training, support, maintenance and applications assistance.

In 1978, end users spent $870 million to maintain computer systems and peripherals. This figure will jump to more than $3 billion by 1986. Maintenance as a percentage of total systems cost will rise sharply in the next five years because of lower systems cost and higher transportation and labor costs.

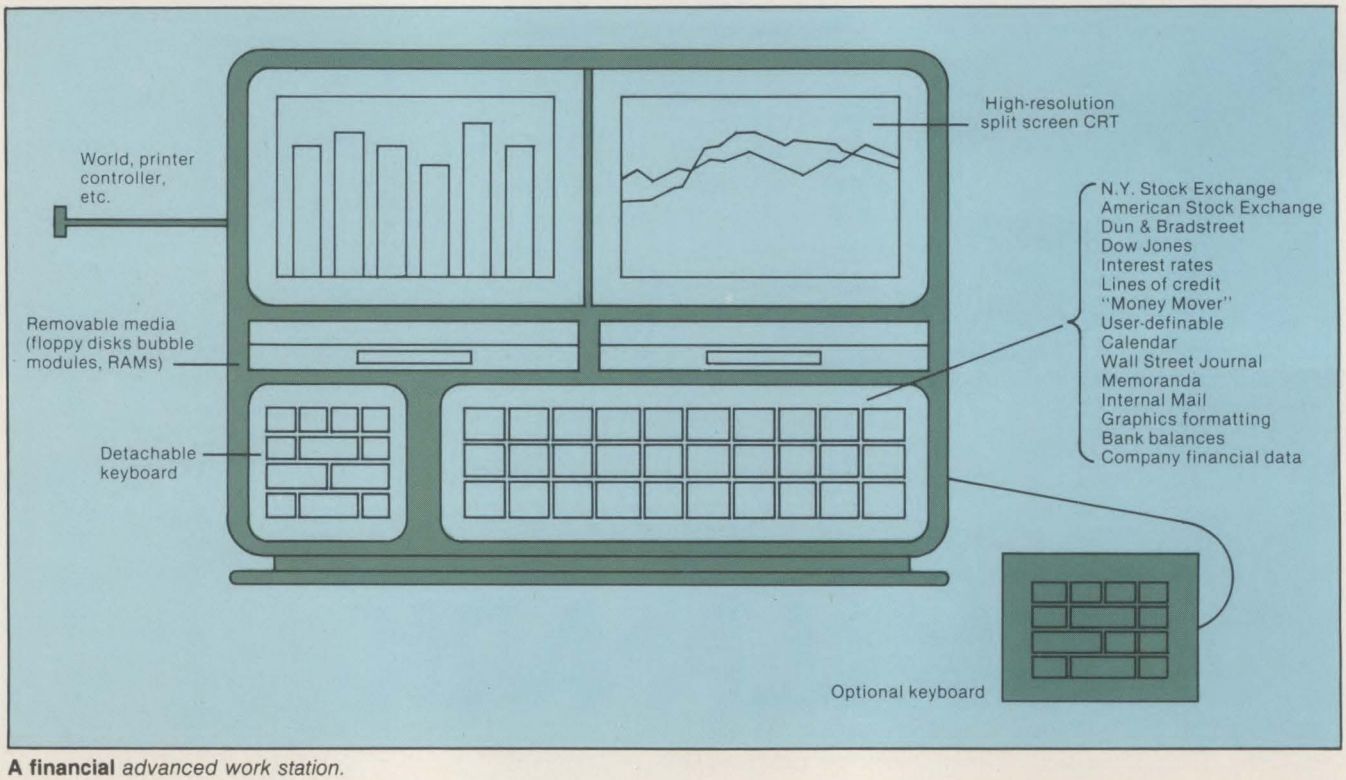
By comparison, maintenance costs of large computers will rise to 14 percent of systems cost by 1983, while maintenance costs of minicomputers and terminals will increase to 20 percent. Small business computer maintenance will amount to 24 percent of total system cost, and peripheral maintenance will reach 25 percent by 1983.

Work-station printers move away from daisy wheels

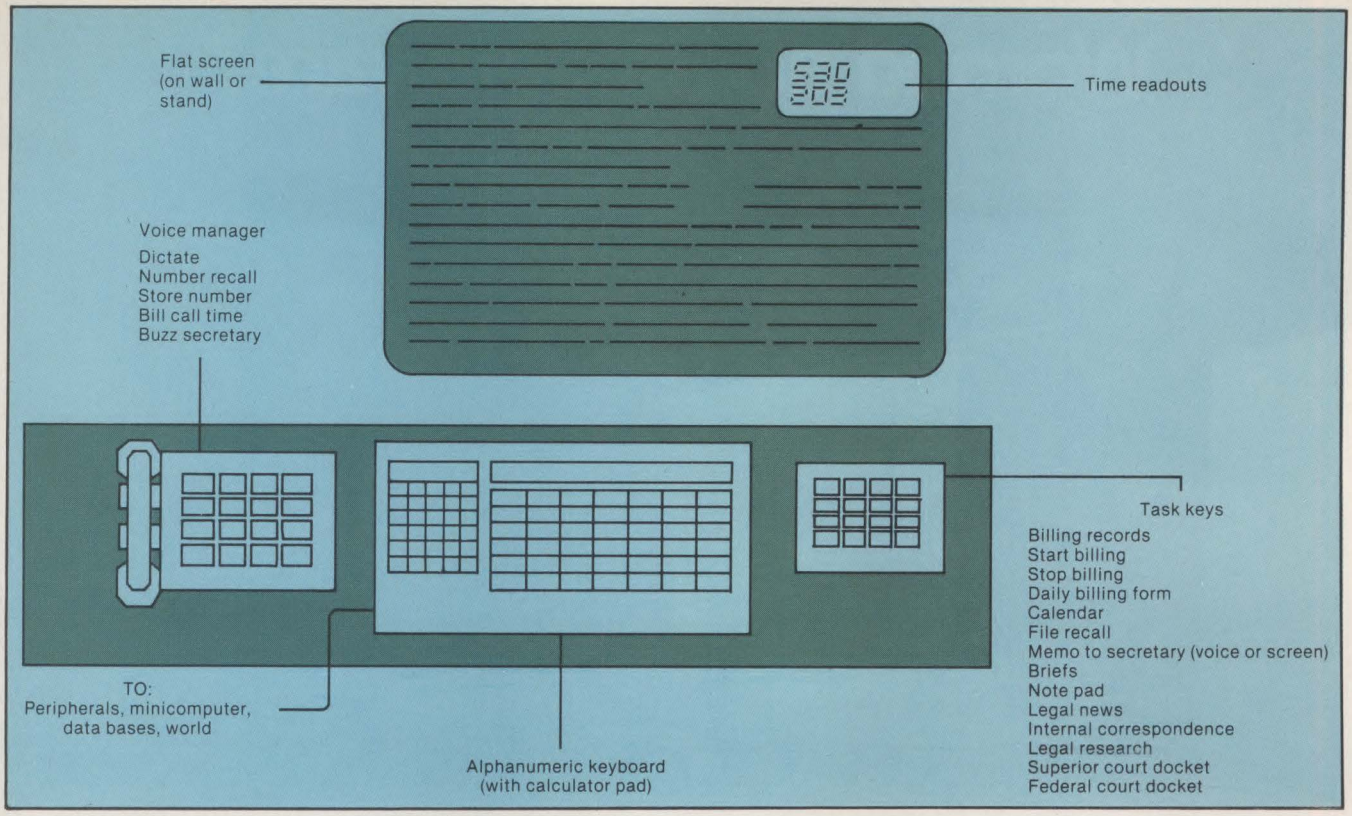
A key peripheral to the AWS is the printer. Within three to five years, newly developing "intelligent" copiers will evolve into multifunctional non-impact office printers, offering superior resolution, multiple fonts, integrated text and graphics and almost-silent operation. These devices will be shared by clusters of users and will be integral components of advanced office-information delivery systems.

The de facto standards for office hard-copy output are the daisy-wheel and Selectric-style printer because most office-information systems are typically used for reports or correspondence, and most word processing is performed by clerical or support personnel. Formed-character impact printing will continue to be sufficient for most of these applications over the next five to 10 years, guaranteeing a sizable intermediate-term market for daisy wheels, type elements and their progeny. However, a Yankee Group survey of some 1500 office printer users indicates that these formed-character impact devices are too noisy, too expensive and too limited in function for AWS applications.

Similarly, dot-matrix impact printers, which have long been used to provide high-speed text and graphics, do not offer sufficient quality for office use and produce



A financial *advanced work station.*



A legal *advanced work station.*

noise at levels that are unacceptable. The unsuitability of this technology to the office is one reason for the bankruptcy of Sanders Technology. Sanders manufactured the Media 12/7, a dot-matrix impact printer designed specifically for office use.

The solution is likely to be found in non-impact technology. New non-impact printers using lasers, ink jets, optical fibers and other imaging technologies will offer integrated text and graphics, multiple fonts, faster printing, high-quality output and virtually silent, reliable operation. Initially priced at $10,000 to $20,000, these printers will become price-competitive with today's daisy wheels over the next three to five years.

The Yankee Group believes that users will flock to these new printers, using them as foundations for new office imaging systems. Many users are willing to configure their systems to justify the printers' high initial prices. More than 75 percent of The Yankee Group's respondents, of whom more than one-half were "white-collar decision makers," would be willing to share a printer with at least three work stations, and nearly 50 percent would be satisfied sharing such a printer with four or more work stations.

Consequently, The Yankee Group believes there are two office printer markets. Less expensive daisy wheels and dot-matrix impact devices will be used primarily for internal correspondence and simple information access. As prices of these devices decrease, the printers will be justifiable as "personal" desk-top printers for immediate, local hard-copy output. The more costly imagers with multiple fonts, graphics and higher speeds will be shared by a number of users for information processing, report generation, external correspondence, customized forms and other specialized hard-copy requirements.

Image/text processors combine several functions

The logical next step will be the integration of developing imaging technologies with optical character recognition and image scanning, on-line communications capabilities and bulk electronic storage to produce what The Yankee Group calls "advanced image/text processors." These processors combine copier and printer functions with telecommunications to transmit and receive information and to produce hard copy on demand, locally or remotely. First-generation image/text processors include the IBM 6670 Information Distributor, the Wang Intelligent Image Printer and Toshiba's DF-2000, marketed in Japan.

The Yankee Group estimates the potential market for intelligent, multifunctional copier/printers and image/text processors to be between $200 million and $300 million in end-user sales by 1985. The group further estimates that Xerox and Japan will initially dominate this market, with IBM, Wang and others close behind.

Having made the transition from buzzword to reality (Fig. 2), vendors are beginning to commit large amounts of capital to marketing electromechanical systems, and users are devoting significant resources to its consideration and implementation. Technology is forcing down the cost of electronic mail (Fig. 3), as the cost of physical distribution climbs. ■

Howard Anderson is president of The Yankee Group, a Cambridge, Mass., consulting and market research firm.

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SOFTWARE

Evaluating word-processing software

GEORGE W. CHERRY,
Language Automation Associates

Some good products are available, but better ones are sorely needed

Word processing is one of the most important functions that μcs perform for business, professionals and students. Word-processing programs have sold more μcs to businesses and professionals than any other kind of program. Therefore, word-processing programs play an essential role in marketing and buying minicomputer and μc systems.

But evaluating and choosing a word-processing program is not getting any easier. It's getting harder, although potentially more gratifying. When I bought my first word-processing program and μc about three years ago, my choice was easy: Electric Pencil II and one of the few μcs that could support it at that time. There was little else to choose from then, and I would not experience the many deficiencies of Pencil II until several hundred pages later in the textbook I was writing.

It takes weeks or months for a purchaser to find out whether he has bought high productivity or appalling inconvenience. If he's a casual user, he probably won't mind—or may never discover—the serious limitations and drawbacks. For example, some casual users like Pencil II, but they did not use it, as I did, to write a 314-page book and prepare camera-ready copy for a publisher. Some of Pencil's limitations are files limited to available RAM (smaller than most of my chapters), slow editing and lost keystrokes when working on the earlier parts of long files (at least on my system), inability to print certain characters because Pencil usurps them for print commands (a particular nuisance in my computer science text book), inability to print page numbers beyond 255 (because the 8080 is an 8-bit CPU and 8 bits hold only 255 decimals), inability to print page numbers anywhere except the upper-right hand corner of the page prefixed with "PAGE," inability to

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Editor's Note:

Desk-top computers are not integrated work stations, but they can and have been made into them. A necessary step in this process is selecting word-processing software.

This article was written at our request by a man with direct experience in selecting-word-processing software for low-cost, desk-top computers. It is a personal account by a knowledgeable user who describes not only his experiences with various packages, but also his considered opinions on what they should provide.

The vendors provided the descriptions of word-processing packages on p.126. Only those vendors who responded to our request for written information—about half of those contacted—were included. It would, however, be incorrect to assume that all independent suppliers were contacted. Invariably, we learn of some suppliers too late to mention more than their names. We also received some completed questionnaires too late. A list on p.278 names those independent suppliers whose products—for one or another of these reasons—are not described in the table.

Almost all manufacturers of desk-top computers directly supply one or more word-processing packages. Such packages are not within the scope of this survey, which considers only independently offered word-processing packages for desk-top systems.

While there has been significant improvement in word-processing software, there's still plenty of opportunity for advancement and integration.

preview what a printed page will look like (which made me lose considerable time and money on the camera-ready phase of my publishing contract), a line-justification technique that justifies lines by distributing white space between words and between characters, but without any provision for hyphenation (which results in some lines in which words seem to be falling apart) and an unfriendly interface with CP/M (that can make you lose your text in RAM if you forget to insert your diskette in the drive when you try to save your text). Some of these limitations may not be a nuisance the first week a user owns the program, but why opt for limitations that may evenutally cost time and money?

Don't expect to evaluate a word-processor program in a few hours in a store or at a distributor. If you're not a word-processor user, don't expect to evaluate word-processing programs at all. Talk to knowledgeable users or hire a consultant. Don't try to write your own software unless you have an extremely experienced programming staff.

While there has been significant improvement in word-processing software (for example, the improvements from Electric Pencil I to Electric Pencil II to WordStar software for the popular 8080, 8085 and Z80 μps), there's still plenty of opportunity for advancement and integration. There's a need for higher quality output: more aesthetic line justification, true proportional spacing and accommodation of devices with a larger variety of typefaces and type sizes. There's also a need for a human-engineered interface and for integration with the other functions of communications: electronic mail, list processing, graphics and computer-aided writing. Integration with other functions of the electronic desk—financial calcuations, project management programs, appointment programs and statistical packages—is also required. Use of high-level languages rather than assembly language by software originators is also needed. This will enable originators to sell more

Jay Author and his marvelous μp-based, amber-character, mouse-controlled, spelling-checking, synonym-suggesting, multi-font, telecommunicating electronic desk

Jay Author finished breakfast, poured another cup of coffee and pushed away from the breakfast table. He had a busy day ahead: correspondence with an editor, completing an article for a magazine, printing out camera-ready copy for another article and teleconferring with co-authors on a book. He picked up his cup of coffee and moved into his home office, where he turned on his electronic desk, which responded with the date and time in lucent amber letters on a two-page, dark-green background.

With μp speed, Jay could view his appointment calendar, his electronic mail or any other stored documents or reports. On a conventional desk, one can view several documents simultaneously, as one could on Jay's electronic desk. Jay could refer to one document on the left side of his video screen while scrolling through and revising a second document on the right side. He could electronically "cut" text from the document on the left page of his screen and designate where he wanted it "pasted" on the right-hand page.

Jay wanted to check his day's schedule. Using the "mouse" input device, the fastest way of controlling the cursor on a text-editing screen, he moved the amber cursor to designate "appointments" on the menu displayed below the date. Appointments reminded him that he was scheduled to call a consulting client today. Using the mouse again, he designated "telephone." Using the only editor he had needed to learn, Jay typed in the time for the telephone call and then a few notes to remind him of points he wanted to discuss with his client. At the designated time, the computer would automatically dial the client and display Jay's notes, allowing him to make additional notes during the conversation.

Jay designated "mail" on the menu and read a message from the editor who had the copyedited version of his manuscript. Using the screen's smooth scroll, he quickly surveyed the copy. The suggested changes and queries appeared in bold red. There were few changes. He quickly scanned the copy again, and assented to changes, modified them or inserted short notes in response to queries. There were no spelling errors in Jay's manuscript. because he had installed a spelling checker. He hadn't had a spelling error in the nine months since installing the system. Jay's choice of words had also improved because he had installed a synonym suggester. Jay designated "electronic mail" with the mouse and sent the final copy back to the editor. Total turnaround time was less than 30 min.

Jay's next client wanted camera-ready copy. Jay designated the document-edit mode and surveyed the pages he would print. The screen depicted all the line-endings, hyphenations and page breaks. It did not portray the type style, type size, character spacing or line length because an engineer had convinced Jay that this would be too expensive. Jay knew that his laser printer's character spacing and line justification would be attractive and professional because his system's software accurately controlled them according to the type style and type size he had chosen. When Jay didn't like the aesthetics of a line ending or page break, he changed the text directly on the screen and received immediate feedback. He spotted a one-word line on page 6, called back page 5, tightened up a sentence or two, and the word popped back on page 5, where it belonged.

Jay finished previewing the document and sent it to a printer, designating that he wanted three copies. For a few minutes, he watched the rapid deposition of the elegant, perfectly spaced characters and words on the perfectly justified lines. Then he turned back to his electronic desk to work on his new article, while the printer hummed softly in the background. By 11:30 a.m., Jay had finished the first draft of his new article and the camera-ready copy was stacked in three neat piles. Jay appraised the morning's effort—a day's work in three and a half hours.

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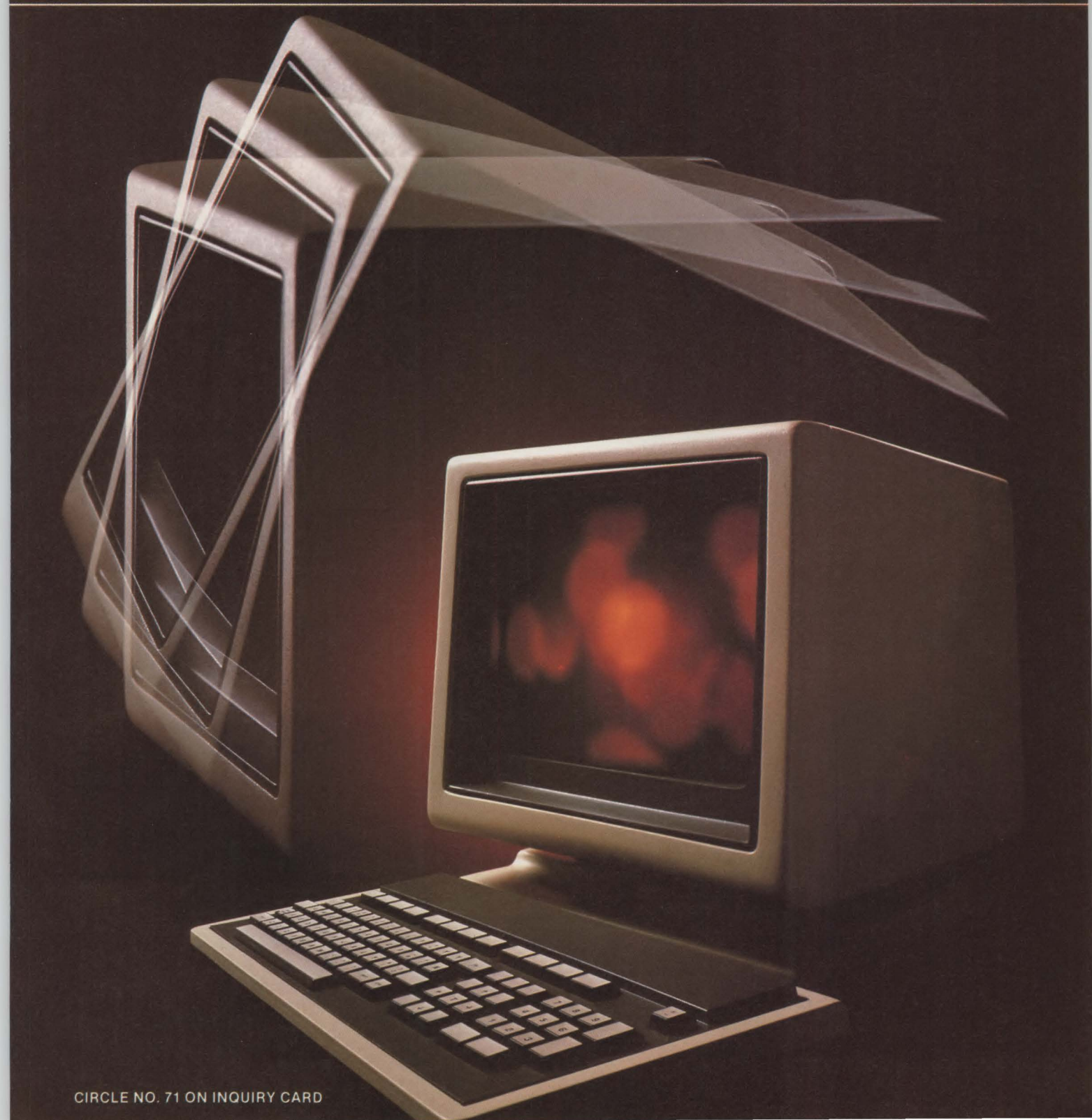


CIRCLE NO. 71 ON INQUIRY CARD

CP/M is hardly a human-engineered interface because its skills are difficult for computer laymen to acquire.

sophisticated products to greater numbers of computer owners, decreasing prices and increasing profits.

What can a user buy for an electronic desk today? The survey table (below) will suggest some wares to examine. For example, if you want to prepare fairly long documents, such as instruction manuals or catalogs, buy a program that allows you to preview pages before you print them. A system that does not provide a page-previewing feature will cost considerable labor in blindly repairing bad page breaks. Except for Electric Pencil II, all the packages listed provide at least some degree of on-screen page preview and modification.

If an application demands typographical excellence, choose a system that offers automatic or semi-automatic hyphenation. Some originators and vendors of word-processing programs are particularly ignorant about typography. For example, one vendor responded to my question about justification method by stating, "We do not believe in the vulgar practice of hypenation" [sic]. Their user's guide exhibited its own brand of vulgarity—some lines justified by means of ½-in. inter-word gaps. Check out the offerings of those vendors that promise true proportional spacing, which allocates less horizontal space for a narrow character than a wide character. (For example, should a "." be allocated as much space as a "w"?) But beware: Magic Wand, for example, offers true proportional spacing, but its character spacing is sometimes off-target.

Editors greatly affect the productivity of the keyboarder, especially productivity during modifying, correcting and rewriting text. Research at Xerox's Palo Alto, Calif., research center and at Carnegie-Mellon

Package and Supplier	Computers supported	Operating system (RAM required) • Programming Language	Terminals supported • CRT screen capacity
BAS text formatter Business Application Systems, Inc. Raleigh, N.C.	TI 771, DS 990 models 1 through 30	TI DX10 (14K-byte and operating system) and TPL (64K bytes, including operating system) • Pascal (for DX10)	DX10: TI 911 and 915, ADDS Regent, ADM 3, Televideo 912, Infotron I 100. TPL: TI 771 and 990 models • 24 x 80
Copywriter, Copywriter + Digital Marketing, Walnut Creek, Calif.	North Star, Super Brain, TRS-80 model II, Vector Graphics	CP/M (54K bytes) • Pascal/M	ADDS, Hazeltine 1500, Soroc 140, Televideo 920, ADM 3A/31/42, P-E 150, Beehive, etc. • 24 x 80, scrolling to 132 lines
Electric Pencil II Michael Shrayer Software, Inc. Glendale, Calif.	S-100 systems, Radio Shack TRS-80 models I and II	CP/M or TRSDOS (32K) • 8080 Assembly	Imsai VIO, Sol VDM-1 Polymorphic VII, SSM VB-1B, Vector Graphics video interface, TRS-80 models I and II • 16 x 64 or 24 x 80
Magic Wand Small Business Applications, Inc. Houston	All	CP/M (14K bytes for EDIT, 22K bytes for PRINT) • 8080 Assembly	RS232C and most video boards • 16 x 64 or 24 x 80
Super-Text II Muse Software Baltimore	Apple II or Apple II plus	Apple II or Apple II plus (48K bytes) • 6502 Assembly	Supports 32 x 40 monitor only
VEDIT/DPS Andromeda Systems, Inc. Panorama City, Calif.	DEC PDP-11 and LSI-11 systems (e.g., Heath-Zenith H-11)	RT-11 and RSX-11 M (minimum 40K bytes recommended) • TECO 11 (VEDIT), FORTRAN and MACRO 11 (DPS)	ADM 3A, Hazeltine 1500, DEC VT52 and VT100 • 24 x 80 (14 x 132 on VT100)
VTS-80 Kmega Microsoftware Sunnyvale, Calif.	Altos, Superbrain, Apple, North Star, Cromemco	CP/M and MP/M (48K bytes minimum, 64K bytes preferred) • PL/M	Standard RS232C • 24 x 80
Word Star MicroPro International Corp. San Rafael, Calif.	Almost any 8080/8085 or Z80 running under CP/M or CP/M derivative	CP/M, CDOS, IMDOS (50K bytes) • 8080 Assembly	ADM 3A or 31, TEC 571, Hazeltine 1500, IMSAI V10-C, Televideo 912/920, Microterm Act IV or V, etc. • 16 x 64 to 48 x 80
WORD-SYST Information Access Systems, Inc. Rockaway, N.J.	DEC PDP-11, LSI-11	DIBEX RT-11 (12K bytes) • DIBOL	Supports terminals through specification file • 24 x 80
Wp Daisy InfoSoft Systems Inc. Westport, Conn.	North Star, TRS-80 model II, Intellec MDS	I/OS or CP/M (18K bytes) • 8080 Assembly	ACT-IV, ADM 3A, P-E Bantam and Fox, Hazeltine 1400 and 1500, Soroc IQ 120, Heath H-19, Televideo 912, Cops 10 and memory-mapped video • Variable via configuration dialog
WP Saturn Saturn Systems Inc. Hopkins, Minn.	DEC PDP-11, LSI-11 and VAX 11	RT-11, RSX11, RSTS (12K bytes) • MACRO-11	VT52, VT100, IQ120, Hazeltine 1500, 1510, Terak, Regent, ADM42, TVI 920, Microterm MIME • 24 x 80 or 24 x 132
WP 6502 (V.1.3) Dwo Quong Fok Lok Sow New York	All Ohio Scientific models	OS65D, OS65U (8K bytes) • 6502 Assembly	Ohio Scientific polled-video and all ASCII-RS232C • user-defined

University has shown that some editing systems have as much as three times the throughput of others. The editors in our survey do not have that much variation, but they differ in productivity and convenience. Most are character-oriented and, thus, suited to screen editing. The most inefficient editors are line-oriented, originally developed for hard-copy terminals and sometimes adapted for CRT terminals.

Some features to watch for in editors include the ability to make large cursor movements efficiently, to set tabs and margins easily, to view alignment with nonprinting control characters suppressed and to make convenient and safe global searches and replacements.

The most efficient way to make large cursor movements is with a "mouse" input device. This interface should be provided on μc-based word processors, but it is often neglected. The next best approach is WordStar's, which is effective because it's spatially logical and, therefore, easy for the user to conceptualize. The keys in this diamond

E
SD
X

on the keyboard make single-line or single-column movements. Ctrl-S moves the cursor one column left, Ctrl-D, one column right, Ctrl-E, one line up, and Ctrl-X, one line down. By prefixing these commands with Ctrl-Q, a user can amplify each movement. Ctrl-Q,S moves the cursor to the extreme left of the text, Ctrl-Q,D, to the extreme right, Ctrl-Q,E, to the top of the currently displayed text, and Ctrl-Q,X, to the bottom of the currently displayed text. One does not type a hyphen or comma for these commands, but simply presses the Ctrl key and Q simultaneously and then presses S, D, E or X. WordStar also presses additional keys into service to supplement the S, D, E and X commands

E R
A S D F
X C

Ctrl-A moves the cursor left one word. Ctrl-F moves the cursor right one word. (These are amplifications of the Ctrl-S and Ctrl-D effects.)

Ctrl-R moves the cursor up a whole screen. Ctrl-C moves the cursor down a whole screen. The Ctrl-Q prefix can be used to amplify these movements. Ctrl-Q,R moves the cursor to the very beginning of the text, Ctrl-Q,C, to the very end. After four or five hours of keyboarding, these commands become habits, because logical structure makes them easy to learn.

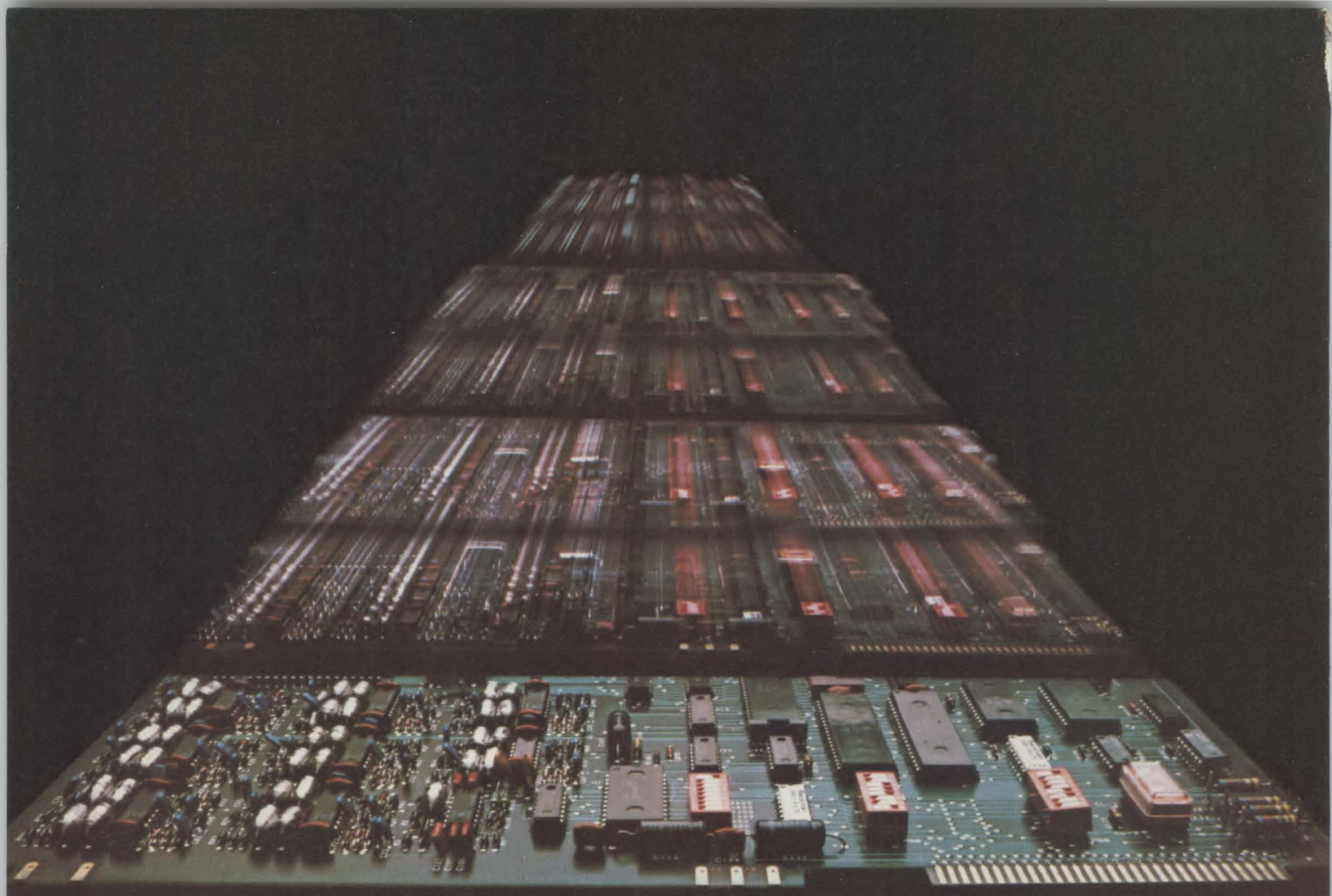
An efficient keyboarder sets and uses margins and tabs effectively. An efficient editor facilitates the setting and use of margins and tabs. Tabs are especially useful in creating tables and columnar material and in writing computer programs in a structured, indented style. WordStar is nearly exemplary in respect to setting and recalling margin and tab patterns. WordStar allows one to set up nonprinting ruler lines in one's text. A rule line is a sequence of hyphens, exclamation points and crosshatches. For example,

```
!-----!-----!-----!-----!-----!-----!-----!-----!
```

is a typical ruler line. The exclamation points indicate tab positions. The hyphens indicate non-tab positions. The left end of the ruler line is the left margin, and the right end of the ruler line is the right margin. A user can have as many ruler lines as he wants in his text. To activate a ruler line, he simply places the cursor anywhere on the ruler line and then types Ctrl-O,F. The active ruler line also appears at the top of screen along with the cursor's page, line and column number. A crosshatch (#) indicates a decimal type. A decimal tab allows one to key in a decimal number, while the software aligns the number's decimal point on the crosshatch's tab position.

How can a novice learn these sophisticated features and associate commands with keys? WordStar provides a menu, but the menu clutters the screen and intimidates novices. Many word-processor manufacturers provide dedicated function keys and engraved key

Printers supported • Printing features • Justification technique	Disk drives supported • Storage method • Length of files
TI 810, Diablo, Qume, NEC, etc. • Underline, subscript and superscript, boldface • Word and letter spacing, manual hyphenation	TI FD800, FD1000; Control Data drives, including 96M-byte hard disk • Manual • 400 lines of English text (DX10); 32,767 lines (TPL)
Diablo, NEC, Qume, etc. • Underline, subscript and superscript, boldface • Word spacing and character spacing, user-assisted hyphenation	8-in. single-density, soft-sectored IBM format, Micropolis model II • Auto buffering, manual for named file • Disk capacity
Diablo, NEC, Qume, etc. • Underline and boldface (BF command symbol not printable) • Word spacing plus character spacing	Helios, North Star, Micropolis and other CP/M systems; TRS-80 model I and II • Amount of free RAM
Diablo, NEC, Qume, etc. • Underline subscript and superscript, boldface • Word spacing, character spacing	Micropolis, Apple (softcard) 13- and 16-sector, North Star, Superbrain, OSI, and CP/M 8-in. • Manual • Search/replace commands operate on text in RAM (to as much as 48K bytes), otherwise, disk capacity
Any with Apple interface • Underline, subscript and superscript, boldface • Word spacing only	Apple II disk • Manual at any time; automatic during automatic file linkage • 20,049 characters (unlimited for find, find and replace, preview and print operations in automatic file linkage).
RS232C daisy-wheel and all standard DEC printers • Underline, subscript and superscript, boldface • Word spacing	All DEC PDP-11 mass storage peripherals • Manual at any time, automatic at end of session • Disk capacity
NEC 5510/5515 daisy-wheel and compatibles • Subscript and superscript, boldface • Soft hyphen	8-in. single-density, IBM format, Apple, Cromemco, Superbrain • N.A. • as many as 65,000 lines
OEM versions of Diablo, NEC, Qume printers with MicroPro I/O Master • Underline ,subscripts and superscripts, boldface, strike out • Word spacing, character spacing and user-assisted hyphenation	8-in. IBM single-density, North Star single- or double-density, Dynabyte 5-in., Micropolis model II, Heath H-89 • Manual during session and return, or automatic at end of session • Disk capacity
RS232C; parallel • Underline only • Word and character spacing	RX01, RX02, WH-27 Winchesters • Automatic • Disk capacity
Standard character-serial • Underline, subscript and superscript, boldface • Word spacing, character spacing and phantom hyphenation	Micropolis model II, IBM 8-in. standard, CDC hard disks, other CP/M disk systems • Manual • Disk capacity
Diablo,NEC, Qume, Line printer • Underline, subscript and superscript, boldface • Word spacing, automatic hyphenation	All disks usable on RT-11, RSX-11 and RSTS • Automatic on exit from editor • Disk capacity
Centronics, Diablo, NEC, Qume, etc. • Underline boldface, super boldface • Word and letter spacing, no hyphenation	All OSI drives including 12M-, 23M- and 74M- byte hard disks • Manual • RAM capacity



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CIRCLE NO. 72 ON INQUIRY CARD

Some features to watch for in editors include the ability to make large cursor movements efficiently, to set tabs and margins easily and to make convenient global searches.

caps. Even frequent users would appreciate engraved key caps for those functions that are used too infrequently to remember.

Training and documentation

Training is one area is which manufacturers of dedicated word-processing systems badly beat the suppliers covered here. IBM, Xerox, Wang, Vydec, NBI, etc. not only design easy-to-use systems, but also teach their customers how to use those systems. The professional teaching period requires several days. Typical computer stores lack the personnel, time, place, equipment or profit margins to match that training.

Consequently, a new purchaser carts his μc and word-processing program to his office or home and then relies heavily on the user's guide. If there's one class of product that requires good user documentation, it's third-party-supplied word-processing programs. Evaluate documentation carefully. You might want to pay for documentation before buying the whole package, but I don't believe you can evaluate either a program or a user's guide separately.

Anyone who designs, maintains or markets word-processing software should write a guide for it. I applaud Shrayer and WordStar for writing their user's guides with their own software and WordStar for providing many examples to illustrate the use of the system. But I'm suspicious of Magic Wand, which has its manual typeset. If Magic Wand isn't good enough for the company that sells it, why should I expect it to be good enough for me?

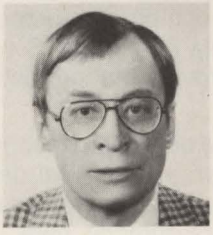
Word processing and operating systems

The survey indicates the operating systems under which the word-processing programs operate. CP/M—the "software bus"—is a potent factor. It's hard to overestimate the degree to which CP/M has allowed software suppliers to address a very large market of potential users. Other operating systems simply cannot boast a similar offering of reasonably priced, competent word-processing wares. I have been checking out word-processing programs for the Apple for two years, and was overjoyed when Microsoft brought the Z80 "Softcard" and CP/M to the Apple, allowing us to run WordStar on that machine. (I am also evaluating Magic Wand on the Apple.) None of the word-processing packages for the Apple II's 6502 can compare to WordStar.

CP/M and the way in which word-processing programs interface with it yields good and bad features. CP/M is hardly a human-engineered interface for word-processing users because its skills are difficult for computer laymen to acquire. Some word-processing programs are too trigger-happy to write BDOS error on the screen and dump the user back into CP/M, causing a loss of possibly precious text.

Consider WordStar. It is awesomely powerful; hence, a user must learn a great deal in order to master all it offers. But learning can't stop with the WordStar commands: a user must also learn several CP/M skills, including FORMAT, COPY and STAT. Given the clarity of CP/M documentation, that's very difficult for nontechnical users. The WordStar program permits users to copy single files and even to run CP/M programs, but the problems of mastering the necessary CP/M skills are hardly mitigated by these amenities. Nontechnical users must learn a great deal about diskette capacity and STAT to avoid DISK-FULL errors. DISK FULL is particularly appalling to a writer who wants to save an irreproducible product. The WordStar user's guide offers several suggestions for recovering from a DISK-FULL error, but those suggestions are problematical. Therefore, WordStar counsels users to check file sizes and disk space frequently with the system STAT command and keep extra space on each diskette. This is not an ideal user interface. There are similar problems in interfacing other word-processing programs with system software.

The survey table indicates that many word-processing programs are written in assembly language—an unfortunate choice because it limits a program to a single CPU (although the 8080, 8085, Z80 family provides scope). Pascal and C are excellent languages for word-processing programs because they have high-level capabilities and portability, which strongly recommend them as means to develop software faster, for a wider market of machines. If you don't believe that Pascal can hack it for word-processing programs, consider UCSD Pascal, which is written in Pascal. The screen-oriented editor in UCSD Pascal equals or surpasses the editor in many word-processing programs. With respect to C, consider UNIX NROFF and TROFF programs written in C. The Pascal version of Don Knuth's TEX typesetting program will soon be running on about six machines. Digital Marketing, whose offering is written in Pascal, plans to beat its assembly-language competition onto the 8086, 8088, Z8000 and MC-68000. ■



George W. Cherry is technical director of Language Automation Associates, Reston, Va. He also lectures on computer science at George Washington University and on algorithm methods and high-level languages at IBM's Federal Systems Division. He is the author of *Pascal Programming Structures* (Reston Publishing) and more than 20 articles on technology and management. His new book, *Ada Programming Structures* (Reston Publishing), is in press.

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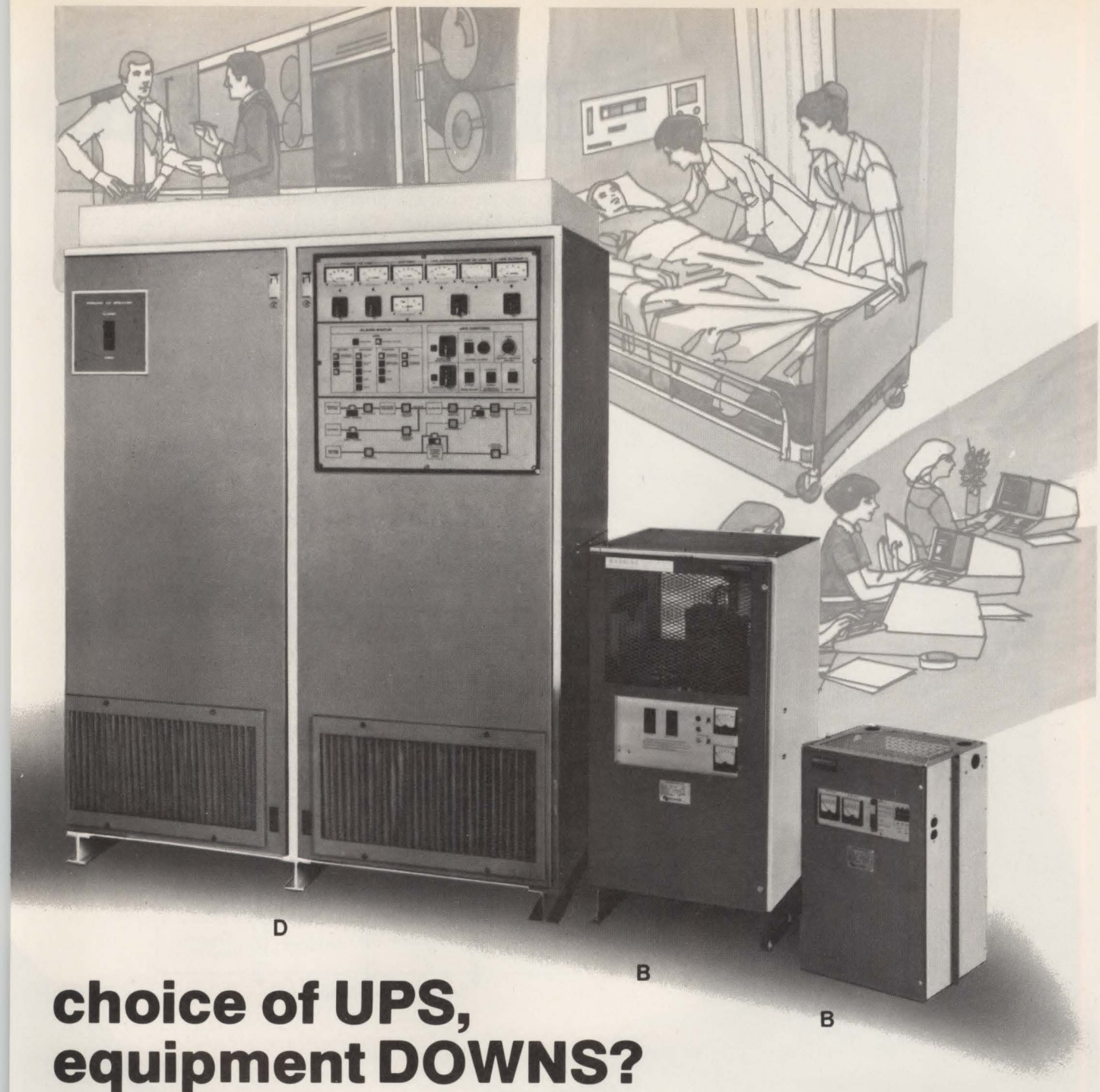

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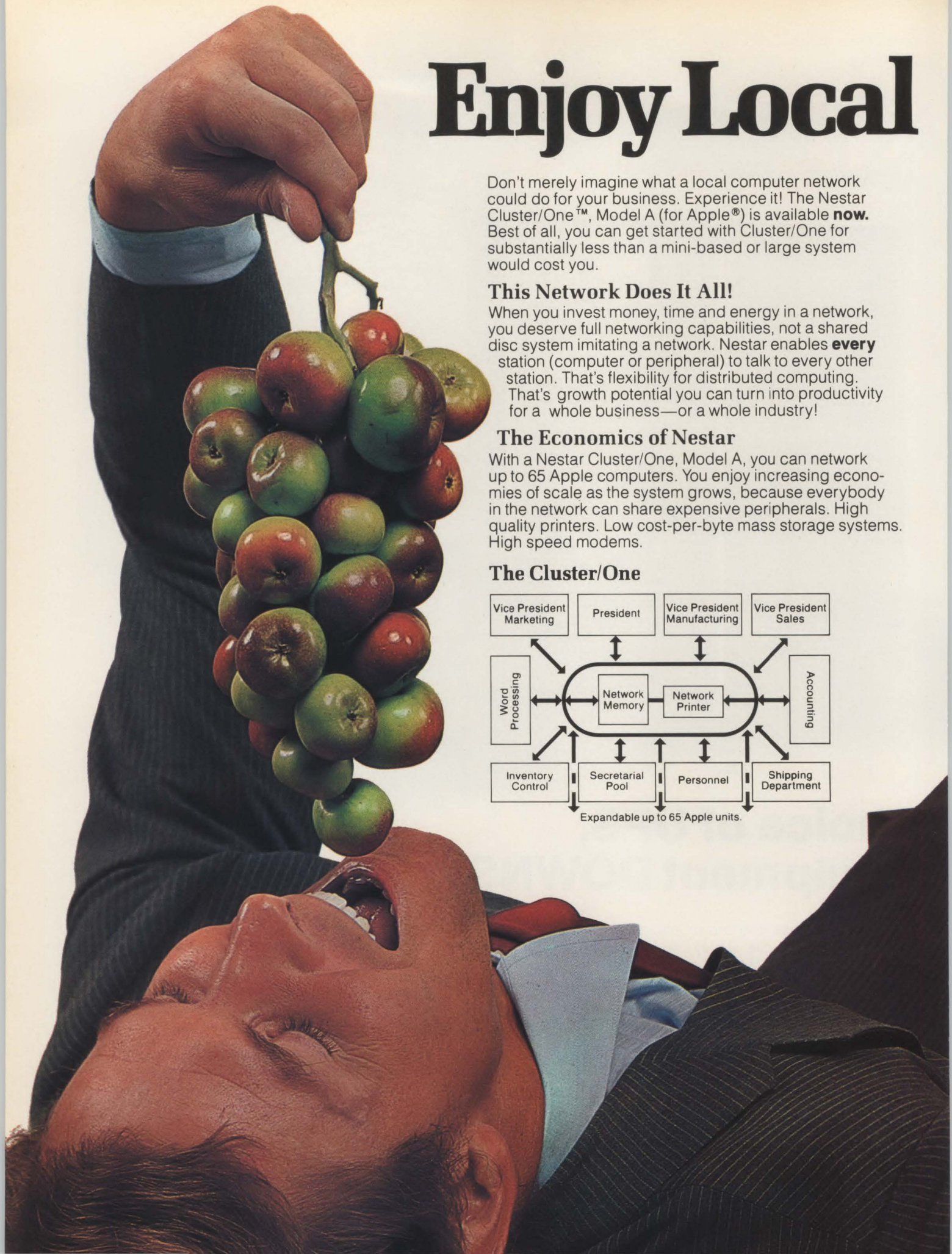

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Dual-rail thin-film read/write head *(right) used on Seagate's ST-512, compared to conventional Winchester component on the ST-506. Wires from the end of the arm assembly attach to a coil fabricated into the thin-film slider using a semicondcutor process.*

DISK DRIVES

Thin-film heads appear on 5¼-in. Winchesters

JOHN TRIFARI, West Coast Editor

Thin-film head technology enables Seagate to double the capacity it provides in the ST-506, the industry's first micro-Winchester

Thin-film read/write head technology—so far limited to mainframe-compatible disk drives such as IBM's 3370 and 3380, and in the OEM market to Dastek Corp.'s 14-in. 407M-byte 4830—is now being used by one hardware vendor to boost the storage capacities of 5¼-in. Winchesters.

Scheduled to be announced next month at the National Computer Conference in Chicago is Seagate Technology's ST-512, a two-platter 5¼-in. fixed-disk drive with a capacity of 12.76M bytes—exactly double the capacity of the company's 3350-technology (ferrite head) ST-506, the first 5¼-in. Winchester to be announced (MMS, February, 1980, p. 61), and the first to be offered in production quantities.

In addition to increased storage capacities, the ST-512 will set a pattern for product development at the Scotts Valley, Calif., peripherals house, says executive vice president and co-founder Finis Conner. "The future of this company is with thin-film head technology," he says. "There will be no further performance upgrades to the 6M-byte ST-506."

Conner stresses, however, that the company's decision to incorporate a newer head technology at the same time that it begins cranking out lower-capacity 5¼-in. Winchesters in high volume will not affect product planning at customer sites. "Other than the heads themselves, the ST-512 is the same drive we're producing now," he explains. "Both drives will use the same interfaces, and both will operate at the same data rates."

These two points are critical to designers anticipating systems upgrades, Conner adds. "We can't do anything that will force people to change their controllers, and we feel that controllers already designed for the ST-506 will be adequate for thin-film versions operating at capacities as high as 30M bytes."

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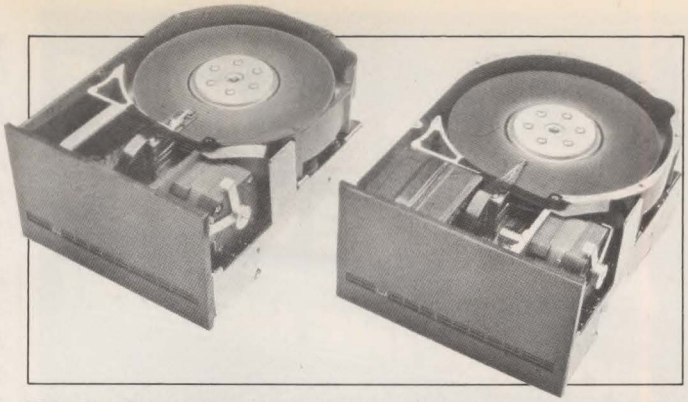
Bit densities on the new drive have been increased by almost one-third—to 10,202 bpi.



Thin-film ST-512 5¼-in. Winchester *(right) stores more than 12M bytes of data compared to the 6M-byte capacity of the ST-506. With the exception of thin-film heads and arm assembly, both drives are essentially identical.*

How thin-film heads enable Seagate to boost capacities without making other significant mechanical or electrical changes is demonstrated by the use of this technology with the 512. First, bit densities on the new drive have been increased by almost one-third—to 10,202 bpi. In addition, the number of tracks per surface (hence, the number of cylinders) has been doubled from 153 to 306 tracks.

Track density, one determinant of the type of actuator incorporated into the drive, remains essentially unchanged (255 tpi on the ST-506 and 270 tpi on the 512). As a result, Seagate has retained the same stepper-motor/split-band positioning combination first designed into the ST-506.

Future capacity increases will be in the form of increased track densities and the incorporation of a third platter into the drive. The last step will be an increase in bit densities.

Thin-film read/write heads for the ST-512 are being supplied by Dastek Corp., Los Gatos, Calif., under an exclusive arrangement between the two companies, covering a semi-custom-designed product that differs in two areas from the heads Dastek has designed for larger capacity 14-in. drives. First, the heads built for Seagate are designed to handle a wider track width; second, they incorporate a larger air-bearing pad to compensate for the slower rotational speed of the 5¼-in. drive. "Dastek will meet our requirements through 1982," Conner says, adding that his company is also considering second-source head vendors.

Media for the new drive will be supplied by Dysan Corp., Santa Clara, Calif. Dysan owns a minority

A LOOK AT THIN-FILM HEADS

Thin-film read/write heads, such as those used in Seagate's ST-512, are high-performance components incorporating photo-lithographic techniques similar to those used by memory circuit and μp vendors.

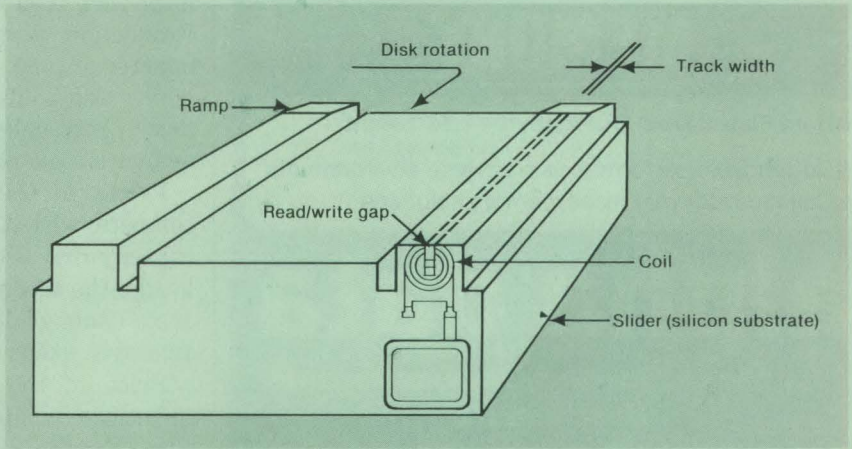
Conventional Winchester-disk-drive heads comprise a small coil wound around a gapped ferrite core that is attached to one end of a "slider," a three-rail aerodynamic pad. A thin-film head has a series of spiral conductors and a permalloy core, which are sputtered or deposited onto the outside edges of a two-rail silicon substrate that becomes an integral slider.

From a vendor's viewpoint, manufacturing thin-film heads enables the application of semiconductor-like optical techniques to the problem of controlling head geometry as read/write gaps shrink to the 1-micron range, and track widths are reduced to less than 35 microns. This technology also permits simultaneous batch processing of a large number of these heads on one substrate or wafer.

Thin-film heads offer performance that is superior to that of conventional ferrite components, although no drive exists that takes full advantage of ferrite technology. Ferrite heads are theoretically limited to approximately 10,000 flux changes per in., but Winchesters now on the market do not operate at that density. Flux densities on 3350-technology drives are typically 6400 fcpi, corresponding to 6400 bits per in., unless a special encoding scheme is used. IBM's 3310 Piccolo drive operates at roughly 8500 fcpi.

A number of sources say thin-film heads can operate at approximately 15,000 fcpi. But like their lower-capacity cousins, capacities are higher in theory than in practice. IBM's 3370, the first thin-film-head drive, operates at 8128 fcpi/bpi. Dastek's 14-in., 407M-byte 4830, the first thin-film OEM drive, and Seagate's ST-512 both operate at approximately 10,000 fcpi.

Five thin-film-technology disk drives have been announced by domestic vendors: Dastek's 4830; Seagate's ST-512; and IBM's 3370, its 800M-byte 3375 and its 1.2G-byte 3380. But a number of other vendors are expected to announce hardware with thin-film heads throughout this year and next.



Thin-film technology head: *Inverted view of two-rail thin-film device shows coil and gap at rear of slider. Device is made using a semiconductor process that integrates the metallic windings and core directly into a silicon substrate.*

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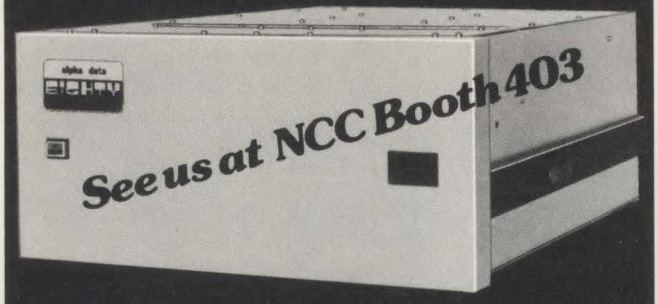

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Despite Seagate's enthusiasm for thin-film technology hardware, production of the 6M-byte ST-506 will not be impacted.

interest in Seagate and three-quarters of Dastek.

Despite Seagate's enthusiasm for thin-film technology hardware, however, Conner says, production of the company's 6M-byte ST-506 will not be impacted. More than 1000 have been delivered since the announcement of the 512, and Conner anticipates that 50,000 units will be delivered by the end of 1981.

"There will always be applications that will demand less than 10M bytes of storage," Conner says, referring to the market for low-end desk-top computers, word processors and intelligent terminals. The 506 will also find wide application as an entry-level storage device for systems that will be expanded after installation. "There will be a tremendous market for higher capacity disk upgrades," he says. "We anticipate that many customers will start at 6M bytes and then move up."

These customers may have to change their thinking about file backup, however, Conner concedes. As capacities pass the 10M-byte range, he says, high-capacity minifloppy-disk drives, now commonly found on systems incorporating Seagate's ST-506 hardware, will give way to tape-cartridge drives.

The first such drive, aimed at meeting the needs of higher-capacity 5¼-in. Winchesters, may be an unnamed offering from Archive, Inc., Costa Mesa, Calif. The new device will be based on either a Phillips cassette or a 0.15-in. DC-100 tape cartridge and will complement the firm's ¼-in. "Sidewinder" tape-cartridge hardware first announced last spring (MMS, July, 1980, p. 28). Archive's drive will be designed to fit into the slot provided for a 5¼-in. minifloppy, and evaluation quantities could be ready by the fourth quarter, say sources close to the company.

Evaluation versions of the ST-512 may be shipped by mid-1981, and Conner says his company plans to deliver more than 1000 12M-byte devices by the end of the year. Production versions will be available in the first quarter of 1982. At that time, Texas Instruments Inc., which also holds a second-source license of the ST-506 (MMS, September, 1980 p. 13), may begin shipping evaluation quantities of its version of the ST-512.

Prices of the Seagate thin-film drive are set to compete with three other recently announced high-capacity drives equipped with conventional read/write heads: the model 512 from Rotating Memory Systems Inc., Sunnyvale, Calif., and Shugart Associates' 10M-byte SA606.

Price of the Seagate drive is $1150 in 500-unit quantities, compared with $1200 for the RMS entry, and $1190 for the Shugart drive. The 10M-byte model 510 announced last fall by Irwin International, Inc., which incorporates an integral tape-cartridge backup drive, is priced at $1500 in 500-unit quantities. ■

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COMPANY FOCUS

Data General struggles to control its growth

L. VALIGRA, Associate Editor

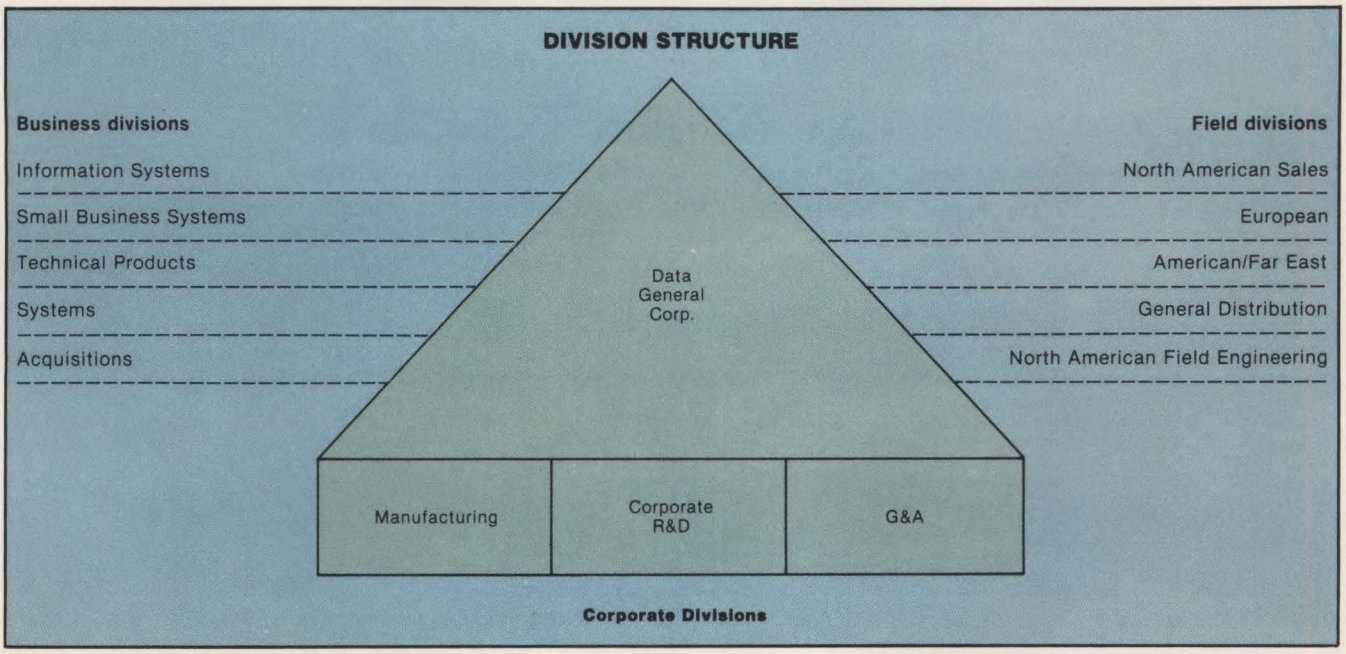
The third-ranking minicomputer manufacturer reorganizes in an attempt to curb its declining profits

From the moment the starting gate burst open in the late 1960s to unleash a field of more than 50 minicomputer start-ups, Data General Corp. bounded down the track virtually unbridled, establishing breakneck growth rates to become the fifth largest minicomputer manufacturer in only two years. That pace continued almost unabated for the next 11 years, so that DG has eclipsed all those '60s start-ups to command the third ranking in the minicomputer business, with fiscal 1980 revenues of $654 million, an employee roster near 15,000 and, historically, the most enviable operating income margins (18 to 20 percent) in the minicomputer business.

But the Westboro, Mass., company is now pulling tight its own reins in an attempt to get better control of its growth. Three new business divisions and a corporate R & D group were established in late February. The new divisional structure came amidst mounting criticism that company president Edson D. de Castro personally directed too much of the company's activities—and may have retarded its growth (see "Management remedies may heal some wounds, open others," p. 146).

The move has not quieted skeptical industry analysts, many of whom believe the changes came late and aren't significant. Yet most agree the reorganization is a step in the right direction.

De Castro seems to be preparing DG watchers for less lofty financial results, especially lower operating margins (pretax profit from operations), until the company fully digests its recent reorganization. "For a little while," says de Castro, "we will be very



Data General has decentralized, *adding three new business divisions that will operate autonomously.*

De Castro seems to be preparing DG watchers for less lofty financial results, especially operating margins, until the company fully digests its recent organization.

long-term-oriented. We've embarked on a program that's transitional," he adds of the restructuring—a move that decentralized DG's management.

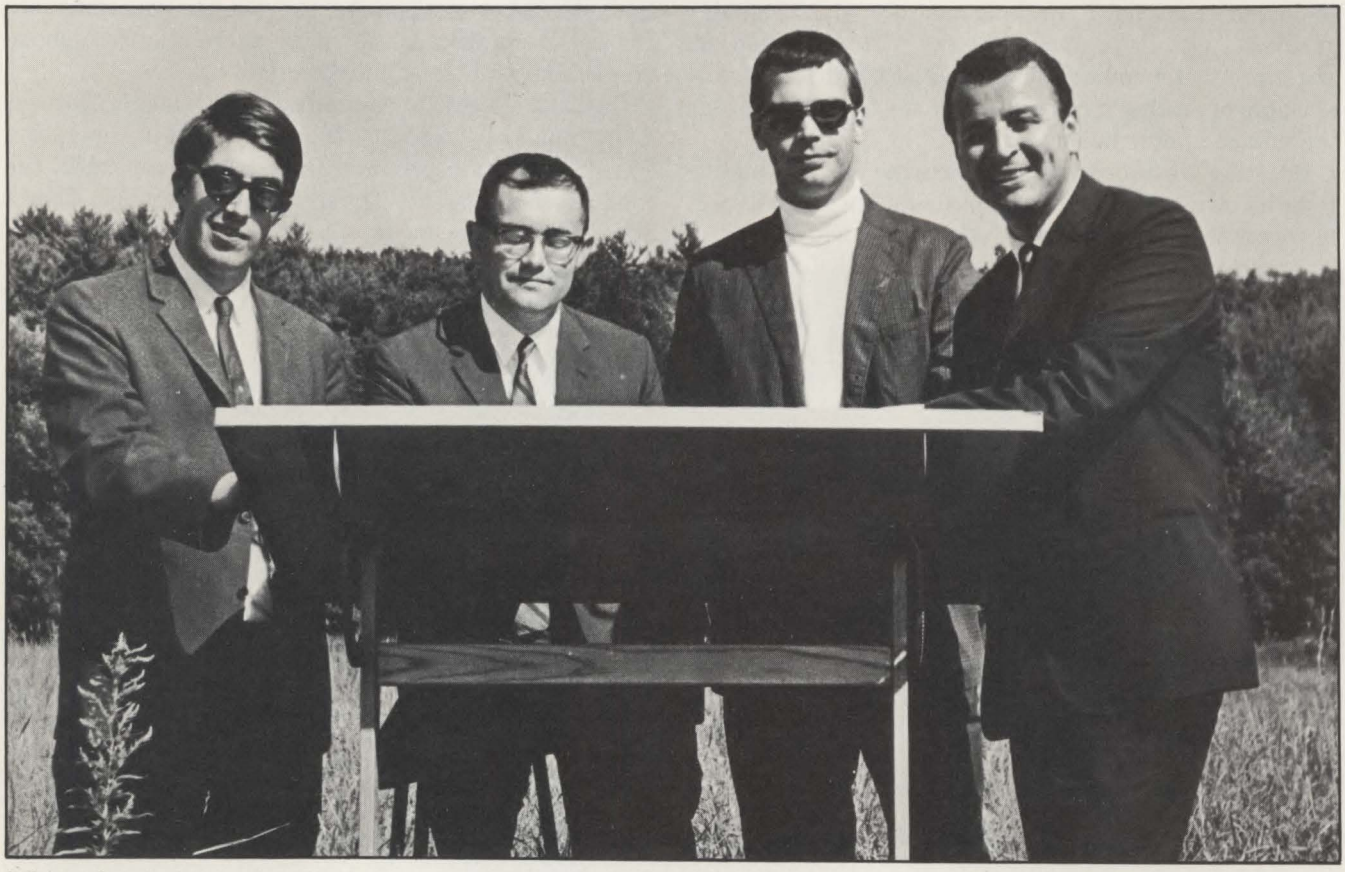
For his part, de Castro recognizes that growth for the company also means growth for employees. "We must assign increasing authority and responsibility to outstanding people throughout the company and encourage them to run portions of the company's business. This process of delegation by profit center (each new business area) is as essential to...career satisfaction as it is to our customers," he comments. De Castro expects the divisional structure to be fleshed out by next month, but predicts even more fine tuning of the new organization will be required over the next several months.

Reorganization follows profit decline

February's reorganization came after more than a year of declining profits, culminating earlier this year in what perhaps were the company's most disappointing quarterly results to date (MMS, March, p. 50), which included operating margins of 13.1 percent on revenues of $156 million—well below the operating margins of 18 percent to 21 percent from 1976 to 1979.

The company attributes that first-quarter disappointment to a depressed economy compounded by a softness in OEM market demand for the company's lower priced systems. De Castro concedes there have been some "deferrals" of orders for low-end hardware, but he's ready neither to step down as the chief executive nor to become overly concerned with short-term phenomena, such as a depressed stock price or lower operating margins. "We're not doing all that badly, except when you compare us with our earlier selves," he asserts, adding that the company has $100 million in cash available to finance its growth. Even so, the slowdown in orders contributed to another casualty for DG in mid-March: The company laid off 230 of its 900 employees at its Westbrook, Maine, plant, which manufactures subassemblies for computer systems. DG says the action will help reduce expensive computer inventories and bring production in line with market demand. No further layoffs are expected throughout the company, a spokesman says.

The three divisions set up during the winter are the Information Systems Division (ISD), which handles computers for large businesses and scientific applications; the Small Business Systems Division (SBSD), for small business computer sales to companies with revenues of less than $25 million; and the Technical Products Division (TPD), which markets the company's bread-and-butter products to technical OEMs and



DG founders *look over plans for the company's first major facility in Southboro, Mass. From the left are Henry Burkhardt III, now a board member; Edson D. de Castro, company president; Richard D. Sogge, who has since left the company; and Herbert J. Richman, new executive vice president.*

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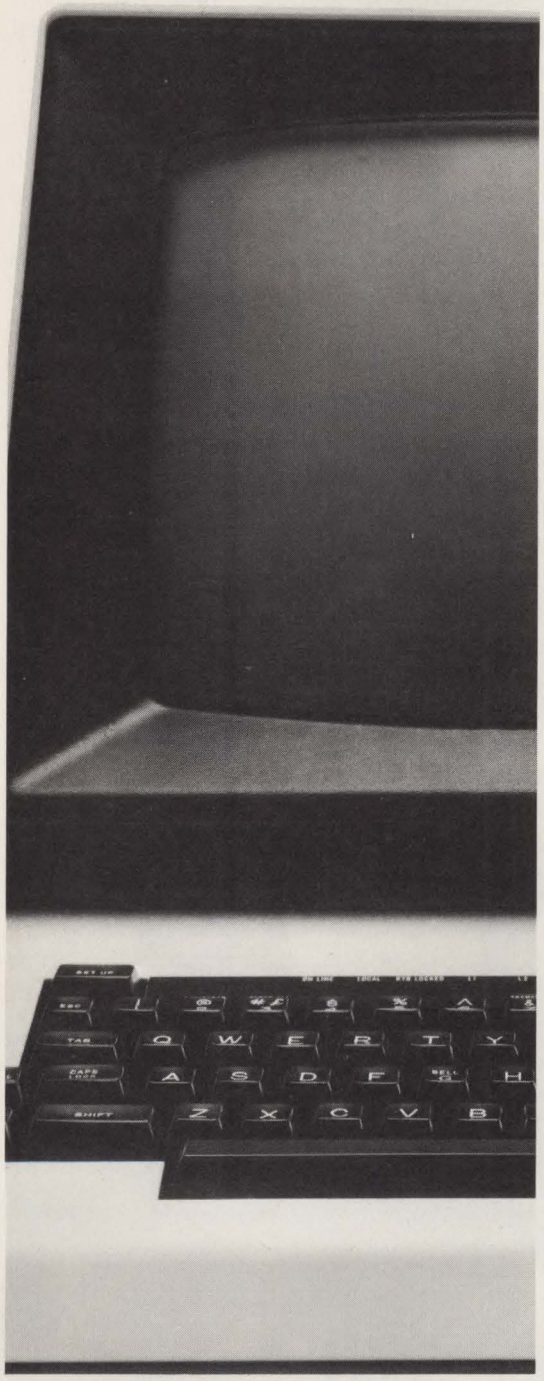

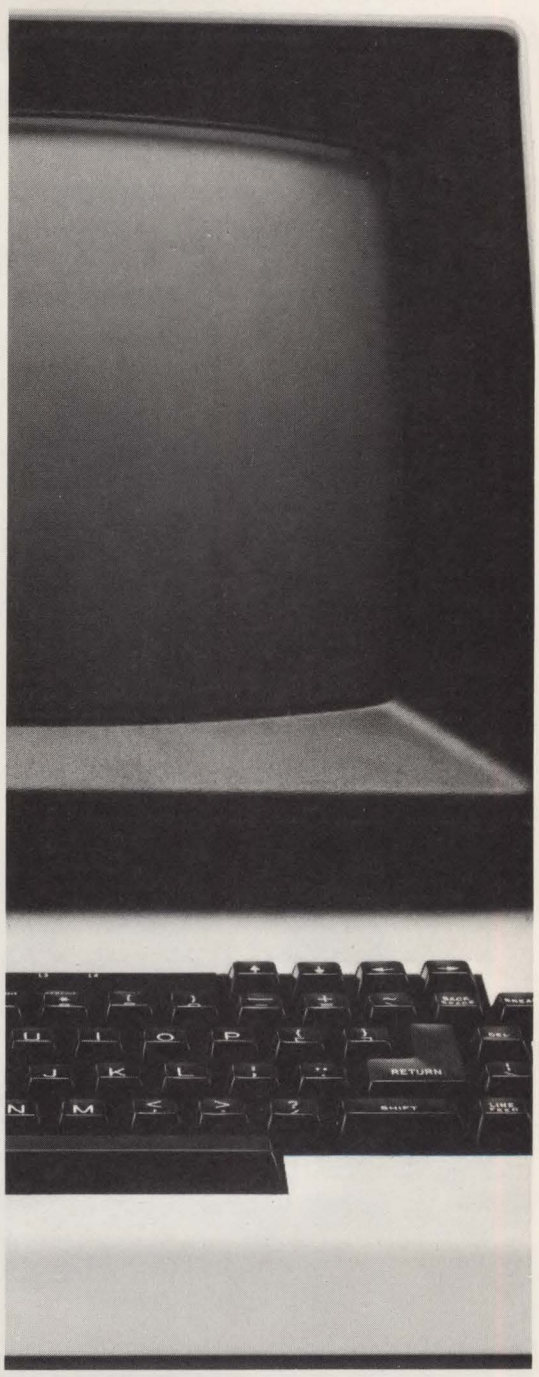

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system builders. Each will develop, maintain and market products oriented toward specific markets, and their managers will have profit-and-loss accountability.

The three divisions report to Herbert J. Richman, new executive vice president. Richman previously headed the sales divisions as vice president for marketing. He will continue to direct the sales organization, and is also acting head of the company's General Distribution Division, a position vacated by William Jobe before the reorganization. Jobe resigned to join a start-up company.

Richman reports to de Castro, who will continue to preside over manufacturing and field service. De Castro will be acting head of the new corporate R & D group, a position that was offered to Jeffrey Kalb, former vice president of engineering. Kalb also has resigned from the company. All products will continue to be sold and serviced by DG's sales and field-engineering groups.

De Castro admits that as the company grew, it was difficult for any one person to "optimize" its performance. He concedes that the three new divisions, as well as the 32-bit MV/8000 supermini, probably should have emerged earlier. Yet he does not consider the company's growth problems to be extraordinary. "The organizational changes will not have dramatic short-term effects. I don't believe a company of this size can make dramatic things happen overnight," he cautions.

The divisional managers are excited, however, about making a go of their new responsibilities. "We needed better business planning. You don't have 13.1 percent operating margins and not know what's happening," says Larry Seligman, a 12-year company veteran who is vice president and general manager of the Small Business Systems Division. Seligman is pleased that the company has mechanisms to motivate employees. "Employees now see tangible goals and the resources available to meet them," he says. "Each individual gains more visibility and sees the effect of his contribution" in the divisional setup.

Business plans tailored to markets

Seligman also views the changes as making SBSD's products more competitive. Some of those products suffered from softened small OEM orders during the sluggish economy. The market-oriented divisions "eliminate some of the averaging (of performance specifications and marketing of multi-market products) that was formerly done. We can develop a business plan more tailored to our market," Seligman says. "One plan does not have to include both scientific and commercial products." A major product for Seligman's division will be the forthcoming Tiny Business System, which is expected to sell for about $2000 in dealer and

The new DG management team. *From the left are Barry Fidelman (ISD), Larry Seligman (SBSD), Michael Schneider (TPD) and executive vice president Herb Richman. At right is Steve Gaal, head of R & D in the Information Systems Division.*

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February's reorganization came after more than a year of declining profits, culminating earlier this year in what perhaps were the company's most disappointing quarterly results.

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Michael Schneider, vice president and general manager of the Technical Products Division, agrees that averaging of product requirements has been a problem. "The TPD market requires a lot of R & D. Technical OEMs do not need as much field service," he says. If such a product is marketed alongside a high-end product that may require less R & D than field service monies, the marketing approach can be ineffective, he explains. Schneider says that although the business plans of each division may differ, a product must still meet the needs of other divisions that might use it. "I must satisfy Seligman's desires in developing microNovas, because they are also sold in the SBSD."

Schneider will remain the head of the Systems Division, which develops custom-made products. He says there is considerable overlap in hardware between his two groups. He will not disclose the amount of operating funds initially available for his division, and he won't comment on the future profitability of each.

The group that may prove to be the quickest new growth unit for DG is the Information Systems Division, which will sell systems to companies with more than $25 million in revenues. Products include the Eclipse and MV/8000 minicomputers, advanced operating system software and communications and networking products. Competitors include Wang Laboratories, Tandem Computer, Digital Equipment Corp. and IBM's

MANAGEMENT REMEDIES MAY HEAL SOME WOUNDS, OPEN OTHERS

A major reorganization of a company's management is expected to cure some ailments and to cause some casualties, but it's difficult to predict how potent a remedy it will be. The clues in the case of Data General Corp. lie in the key executives, say company observers. Two questions have been raised: Why was Herb Richman chosen as executive vice president, and what is president Edson D. de Castro's new role?

The restructuring has been viewed by some observers as merely a lengthening in reporting lines. Analyst Harry Edelson, Edelson Technology, New York, believes this is the case, and says the staff was merely reshuffled. Although he finds the management changes encouraging, he had expected more of a top-level shake-up and, perhaps, a new president. "In many businesses, it is considered good practice to change the top management every seven years. The top guy (begins to) lack enthusiasm, and his best ideas have already been put forth." Nonetheless, Edelson believes de Castro is a good executive.

De Castro has no plans to step out of the picture. "I want to be active and implement changes. I enjoy it," he says. More than half of DG's 15,000 employees are still under de Castro's direction—field engineering and manufacturing report to him. De Castro is also acting head of the corporate R & D group. In working with the divisions, he intends to concentrate on using common products, such as peripherals, among them. Richman, he says, will focus on marketing.

Richman's appointment has baffled many observers. "It is very surprising to see a salesman put in charge of most of the business, given DG's historical preoccupation with technology," says Donald H. Brown, director of small systems analysis at the Gartner Group, Greenwich, Conn.

Richman admits, "I am somewhat limited in making technology decisions (for the divisions). But I can tell them what is required to be successful in the market." Richman will have three sources for technical advice. First, he will form a technical advisory committee, comprised of people from each division, to ensure there will be no scramble for products among the divisions. "I want competition between the divisions, but not contention," Richman says. He will also hire a technical "adviser" to assist him. The third valuable technical resource, in Richman's opinion, is de Castro, who designed Digital Equipment Corp.'s PDP-8 minicomputer before founding DG.

"I have no intention of running the divisions ad hoc," claims Richman. He says that division heads and de Castro will initially help set division goals. A key part of Richman's role is to keep entrepreneurial engineers satisfied, while limiting them to tighter profit-and-loss constraints, say sources close to the company. One source says Richman has a good rapport with engineers, and he believes so himself.

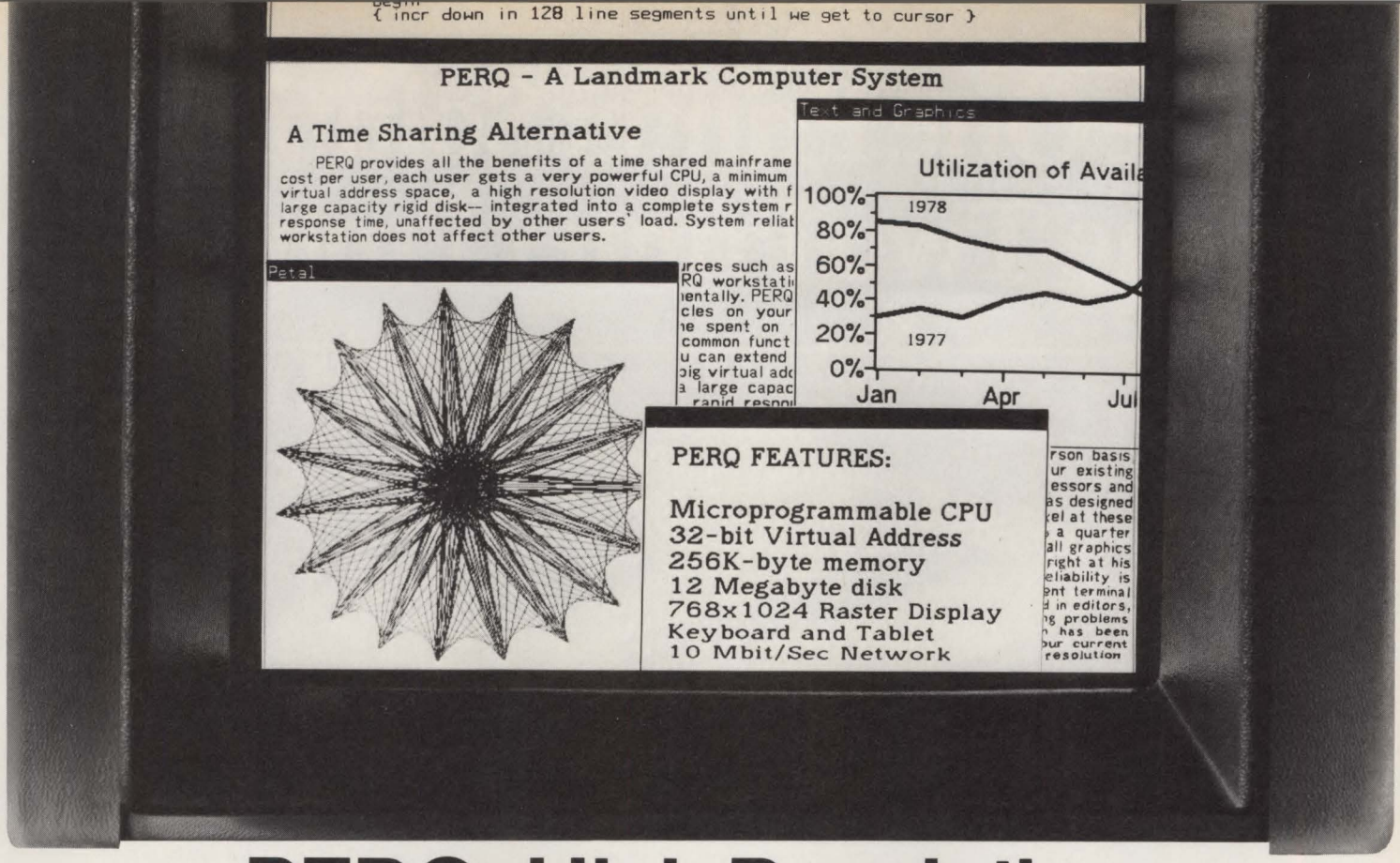
De Castro, who knows how to motivate engineers, remains the pivotal figure for DG, some observers contend. "The key to everything is the president, who is obviously an extraordinary individual," says John Kotter, associate professor in Harvard Business School's Organizational Behavior department. He says that, while de Castro may have caused some problems by retaining too much control in the past, he is also the chief asset in the company's growth. Kotter believes the main question is whether de Castro can adapt to the changing needs of the company.

Kotter, a consultant to some computer companies in Massachusetts, points out that it is rare for a company to grow as fast as DG has. "It is almost impossible for mortal human beings to understand what de Castro went through for the past 13 years with growth from zero to $600 million. The nature of his job in a $5-million company versus a $600-million company is completely different. Not many people can adapt to changes of such magnitude."

Although the ever-understated de Castro does not appear to be exhilarated about his company's successful growth, he says, "Not many companies have grown like us in 13 years, so I can't feel bad."

In comparison, DEC reached $600 million in revenues about midway through its 20th year, and Wang Laboratories, Inc., expects to reach that level this year—its 30th. Wang's greatest growth period has occurred since 1970, when revenues were $26.9 million. Intel Corp. probably best approximates DG's growth, having surpassed $600 million in revenues in 1979—its 11th year.

Despite some problems and delayed decisions, DG is solid financially, says J. Brad Stroup, DG's director of investor relations and public affairs. The company has more than $100 million in cash and can finance its own growth. "DG has been walking on water so long that when it gets its feet wet, everyone catches cold," says Stroup.



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Although the business plans of each division may differ, a product must still meet the needs of other divisions that might use it.

data processing division. DG's entry into mainframe competition will probably be its multiple-processor FHP computer (MMS, February, p. 5). Division general manager Barry Fidelman wants to get a large share of the high-end minicomputer market.

Stephen J. Gaal, former vice president of software development for all products, will direct the division's R & D activities. He will handle hardware and communications for all high-end systems, including those being developed at the company's North Carolina R & D facility. Steve Wallach, one of the architects of the MV/8000 will work under Gaal, and Edward J. Zander, former director of marketing for Eclipse and MV/8000 products, will handle marketing.

The MV/8000 holds the promise of attaining a significant share of the high-end market. Although late in entering the market (MMS, May, 1980, p. 11), the product is doing well and is being accepted by customers, Fidelman says. He admits, however, that DG lost sales to DEC's VAX supermini, which was a bitter pill to swallow. "At first, our sales people didn't believe we had a competing product. They hadn't had the experience of winning with a product because we had no product for a while. Every salesman believes we have a competitive product now," he says.

'Criticism was overblown'

Zander believes that criticism of DG's management is overblown and would not have surfaced if the MV/8000 had been introduced earlier. "I guarantee that if we had had a 32-bit machine two years ago, we'd be sitting here today telling you how well-managed we are," he says.

"We were hit at a bad recession time," Zander says of the low profit margins and criticisms of management. "We had a product-line imbalance because of too much emphasis on low-end products."

To sell to large customers, DG realizes it will have to do some "image repairing." "We had a reputation of being tough, hard to do business with and not being service- or customer-oriented," says Richman in summarizing the results of customer-satisfaction surveys. During the 1970s, when the company sold a narrow product line into broad markets, says Richman, "All we had to do was design terrific products and sell the hell out of them. We did that well." MV/8000 marketing director Zander adds, "We were brash and tough and went after DEC's base. We hired aggressive salesmen."

As a result of this approach, the transition from OEM to end-user sales was difficult. Some industry observers questioned the company's one-price strategy. DG won't haggle over prices, as do some competitors and as customers might like. "We're a single-price house and proud of it. As long as we can deliver value, this is the way to be," says Frank Keaney, vice president of North American sales. Keaney further defends DG's strategy by pointing out that IBM has a similar policy.

Richman knew that DG had to invest more money to get a larger field-service force to sell to end users effectively, as IBM does. Last-quarter 1979 profits suffered when DG formed that service group two years ago.

Not surprisingly, DG chose an ex-IBMer to direct field service. The investment is paying off as customer surveys show the company's continued improvement.

A quarterly survey of more than 10,000 contract customers is weighted once a year, explains Tom Cook, vice president of field engineering. Cook, who worked in IBM's field-service operations for 16 years, joined DG 3½ years ago to organize its field service effort. The first survey he completed in 1978 rated the company as a 6 on a scale of 1 to 10, which is unsatisfactory. That has improved over the last couple of years, nearing IBM's goal of 7.5. Cook hopes to equal IBM's rating within a year. The North American sales force, still settling after a reorganization last summer, is also attempting to improve its survey ratings. "We're serious about becoming a full-service company with support. We are intent on on-site service for almost every product in the future," Cook says. DG will break ground this month at a Milford, Mass., facility, which will include approximately 150,000 sq. ft. as a warehouse depot, and 60,000 sq. ft. as offices for adminstrative personnel. The company is also training field engineers, stocking inventories, creating nationwide service channels and hiring specialists. The company now has service channels at more than 130 locations.

Building a new image

That may be why Fidelman says the company's

In more profitable days: *DG president Edson de Castro (right) and board member Henry Burkhardt III are all smiles as one of the company's first Novas rolls off the production line.*

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DG does not yet offer 32-bit COBOL, which some industry observers claim is keeping it out of the mainstream of supermini competition.

hard-nosed reputation is more perception than fact. "We want to attract (Fortune 1000) customers, and we do have something to offer them. We must do an effective job of changing that perception," he says, although he has not planned his strategy.

But that image is not the only one haunting the company. Many industry observers say DG has a history of standing in DEC's shadow. "This company has ridden the coattails of DEC all its life. DEC is making this more difficult now. It has developed systems (with capabilities) beyond those of DG," says Peter Lieu, an analyst with Arnholdt & S. Bleischroder, New York. He explains that DG does not offer word-processing capabilities, nor does it have a well-fleshed-out 32-bit minicomputer.

The MV/8000 is more compatible with earlier products than was the VAX 11/780 at its introduction, but DG does not yet offer 32-bit COBOL, which some industry observers claim is keeping it out of the mainstream of supermini competition.

Zander counters that DG has had many firsts for a minicomputer company, including a 16-bit minicomputer on a chip, an in-house 14-in. Winchester-disk drive on a small system, interactive COBOL on a minicomputer, CODASYL DBMS, early endorsement of X.25 and microcode in alterable ROM on the MV/8000 supermini. He adds that the company will have a full product line based on the Eclipse architecture, from the forthcoming microEclipse (a full Eclipse architecture on a chip), priced at about $500, to the $500,000 MV/8000. Compatibility is a strategy DG considers critical, Zander says. Start-ups using new technologies, such as the Motorola 68000 μp, will also have to contend with compatibility in follow-up products, he says. De Castro proudly cites the company's 1972 decision to build a semiconductor facility, a first for a mini maker.

The company will continue to face fierce competition as it grows. "The company will have to stay in the mainstream of EDP...and not keep its head in the sand with minicomputers," comments Harry Edelson, an analyst with Edelson Technology, New York.

Edelson says that part of the recent problems DG has faced is a cyclical down in a dog-eat-dog business. Minicomputer manufacturers are more subject to fluctuations in demand because they sell rather than lease their products. "The death knell has not sounded for DG," he says. He explains that the company's problems are accentuated because DEC is now riding the crest of high orders. Many industry observers suggest that because DEC has decreased leadtimes, companies such as DG and Prime Computer, Inc., are beginning to feel the full impact of competition with DEC. ■

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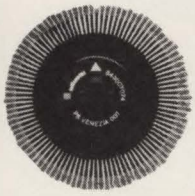

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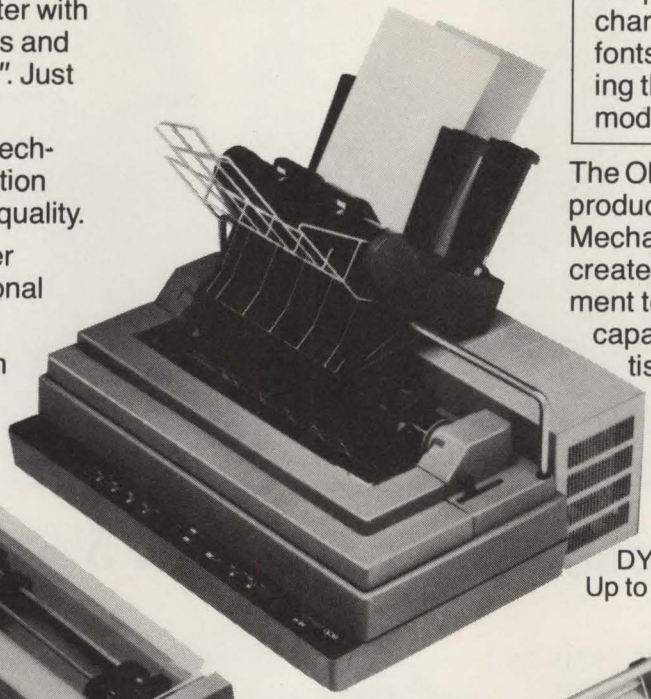

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Some users call the UNIX operating system "the best software this side of heaven;" others see it becoming the standard μc operating system of the future. Brian Kernighan and P.J. Plauger, in their preface to *Software Tools*, state, "Of all the operating systems we have used, 'UNIX' is the only one that has been a positive help in getting a job done instead of an obstacle to be overcome."

UNIX is not the answer to all problems; and some of its limitations are described in this article. Nevertheless, it satisfies the wishes of many people for a convenient, portable operating system that provides a pleasant, uniform programming environment on a wide range of mainframes, minicomputers and μcs. Witness the number of UNIX and UNIX-like operating systems now available or in development (see Tables 1 and 2). Western Electric licenses versions that are compiled from Bell Labs' source code, originally written for the DEC PDP-11 in the C language; other versions imitate only some of the structure of UNIX.

A fundamental reason for the success of UNIX is its original design goal: user convenience. Its authors, Ken Thompson and Dennis Ritchie, had no plans for anyone else to use it, so marketing considerations did not control the design. No pressure was exerted to add features that someone might want, or to consider compatibility, efficiency or marketability. The result was an unusually portable and reasonably efficient system that has attracted users and vendors alike.

Companies authorized to sell UNIX object code sub-licenses

Microsoft, Inc.
Suite 506
Bellevue, Wash. 98004
(206) 454-1315
XENIX

Onyx Systems, Inc.
73 E. Trimble
San Jose, Calif. 95131
(408) 946-6330
ONIX

Zilog, Inc.
10340 Bubb Rd.
Cupertino, Calif. 95014
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Sunnyvale, Calif. 94086
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Robert Marsh and Kip Myers
c/o Prism Computers, Incx.
4960 Hamilton Ave., Suite 201
San Jose, Calif. 95130
(408) 866-8126

Wollongong Group
652 Bear Island Rd.
Redwood City, Calif. 94062
(415) 493-3698

Table 1. Companies authorized *to sell UNIX sub-licenses.*

UNIX's most significant deficiency is lack of a standard accounting package, although existing data-base management systems could be used to develop these applications.

Universities use UNIX

Microsoft is among the companies working on languages that run under UNIX; many software houses offer other system and application software. For example, Unidot, Sunnyvale, Calif., has translated TEX, a sophisticated computer typesetting program written by Prof. Donald Knuth of Stanford University, from Stanford Artificial Intelligence Language to C, and plans to convert the METAFONT typographical design program that goes with TEX. Other UNIX applications include text-editing and word-processing systems relational data-base management systems and computer network software.

UNIX's most significant deficiency is lack of a standard accounting package, although existing data base managment systems could be used to develop this application.

One reason for this activity is that UNIX is available to educational institutions for $150, and has been maintained at several hundred universities, creating thousands of UNIX system and application student-programmers. The universities also generate a lot of software under UNIX that attracts commercial interest. As the user community grew, the universities started the first UNIX users group, called USENIX, which functions as an information and software exchange (see Table 3). Last year, a commercial users group started under the name /usr/group (pronounced "slash user slash group") to promote the spread of UNIX, disseminate information about available software to go with it and help create portability and compatibility standards for UNIX. At least one other group will form when Microsoft's version of UNIX is released, for end users with object-code sub-licenses.

Software components

The structure of UNIX encourages the philosophy of tool building—the creation of interactive data-manipulation programs, specialized for various functions that can be combined to create larger programs. Language processors include a compiler-compiler for users who need to generate their own languages. Text processors furnish editing, formatting and pattern-matching functions. Utilities provide for file-format conversion, sorting and merging. An on-line user's manual is available. A tutorial program called LEARN has computer-aided instruction scripts that teach the use of the most-often-used UNIX facilities (files, editing, formatting, C).

An extended version of UNIX, called the Programmer's Work Bench, provides still more development facilities. Its combination of text processing, pre-

SYSTEMS MODELED ON UNIX

Debbie Scherrer, Coordinator
Software Tools Users Group
Lawrence Berkeley Laboratory
University of California
Berkeley, Calif. 94720
(415) 486-4000
LBL software tools package

Ira D. Baxter
Software Dynamics
2111 W. Crescent, Suite G
Anaheim, Calif. 92801
(714) 635-4760
SDOS; 6800

John White
Software Labs
735 Loma Verde
Palo Alto, Calif. 94303
(415) 493-8186
OS-1; Z80; CP/M compatible

Microware Systems Corp.
P.O. Box 4865
Des Moines, Iowa 50304
(515) 279-8844
OS-9, OS-9 Level Two; 6809

Mary Elizabeth Kroening
Computer Systems Design Group
3632 Governor Dr.
San Diego, Calif. 92122
CHAOS II; 8080

Scott Guthrey
Yourdon Software Products Group
1133 Avenue of the Americas
New York, N.Y. 10036
(212) 730-5840

Whitesmiths, Ltd.
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New York, N.Y. 10023
(212) 799-1200
IDRIS (functional equivalent of UNIX version 6); PDP-11

Ithaca Intersystems, Inc.
1650 Hanshaw Rd.
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(415) 524-2101
UNIX

Table 2. Systems *modeled on UNIX.*

compilers (including syntax checkers), file conversion, program librarian and a catalog of JCL procedures, makes it the system of choice for developing IBM 370 software at Bell Laboratories.

The file system

The foundation of UNIX is a hierarchically structured file system, with multiple directories for different users and projects. There are no required access methods; the operating system handles the physical aspects of file management (device, track, sector, etc.) so that a file appears to a program as a sequence of bytes, upon which any desired structure may be imposed.

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The foundation of UNIX is a hierarchically structured file system, with multiple directories for different users and projects.

Necessary distinctions among files and users are made, using access permissions (stored with the file) in conjunction with user IDs. Access bits are given for the file owner and for all other users to indicate permission to read, write or execute the file; another bit allows a program to change the user ID temporarily to the file owner ID. This enables setting up a file that can be accessed by anyone, within the limits set by the programs. The operating system controls creation of directories, so that only authorized system programs can write to them. A variety of protection systems can be programmed with these facilities.

Languages

UNIX is written in C, which was specifically developed for it. C is the primary language for tool building at Bell Labs' UNIX installations. The UNIX system includes a C compiler for production and a portable C compiler with fixed lexical-analysis and parsing sections and a modifiable code-generation section. Zilog has turned the portable C compiler into a PDP-11-to-Z8000 cross-compiler.

Bell Labs has dozens of other languages running under UNIX, including APL, BASIC, ALGOL 68, Pascal and SNOBOL4, but does not license many of them. Commercially available utilities allow programs from other operating systems to run under UNIX; almost all RT-11 programs and languages run under UNIX on a PDP-11 using RT-EMT, supplied by Human Computing Resources Corp. of Toronto. OS-1 and CROMIX, UNIX imitators for the Z80, offer a CP/M emulator that allows versions of more than a dozen major languages to run.

Microsoft plans to convert its languages (BASIC, COBOL, FORTRAN) and any that they introduce in the future (including APL) to run under UNIX. Ultimately, the company intends to write its compilers and interpreters in C for total portability.

The UNIX command interpreter, called the Shell, provides a uniform interface between the programmer and all programs, files and hardware facilities, including main memory. It is not, however, part of the operating system. If a different interpreter is desired, the Shell can be replaced, like any other application program.

The Shell reads and writes files (which include all I/O devices, main memory and file directories, plus data and program files), and calls programs, passing arguments and command files and setting up files for input and output or redirecting I/O between programs. Output from one program can be passed directly to another program, creating what is known as a pipeline. Looping, conditional execution and concurrency are also provided.

The Shell also handles file protection, multiprogramming and other functions and can be used interactively or through command file scripts. It is a very high-level language, which handles files and programs as easily as other languages handle numbers and arrays. The Shell is the major programming language on Bell Labs' UNIX systems, measured by number of program files and number of invocations. Many jobs can be handled by invoking the appropriate tools in simple Shell programs, frequently one line in length. With the Shell's I/O redirection capability, it is not necessary to include printer formatting in any application program. Compatible formatters include a typesetting program that can be given the output of any program and command files to specify any transformations that are needed. It is worthwhile to consider how much programming time can be saved by this feature. We usually think of programmer productivity under UNIX in terms of code that need never be written, rather than in terms of quantity of code produced.

UNIX USERS GROUPS

USENIX
(Scientific / educational UNIX users group)
Box 8
Rockefeller University
1230 York Ave.
New York, N.Y. 10021
(212) 360-1182

/usr/group
(Commercial UNIX users group)
Box 8570
Stanford, Calif. 94305

Table 3. UNIX *users groups.*

Moving between systems

UNIX is unequaled in the area of portability. First implemented on a PDP-7 in machine language, it was moved to a PDP-9 and a PDP-11, and was then rewritten, mostly in C. Versions in C have been installed on Perkin-Elmer/Interdata, Univac, Amdahl and Onyx computers and on Digital Equipment Corp.'s VAX-11 systems.

Microsoft is working on versions for Zilog Z8000, Intel 8086 and Motorola 68000 processors, and is considering still other 16-bit or larger processors. Microsoft hopes to make UNIX a standard in the μc industry, to compete with operating systems from the semiconductor manufacturers and with such offerings as CP/M and MP/M from Digital Research.

Moving UNIX is relatively easy, but not trivial. A C compiler must be modified to generate code for the new machine; the UNIX kernel and device drivers must be written in machine language. Most difficult is the harmonizing of UNIX with the interrupt and memory-management structures of the new machine; the rest is compilation.

An APL or BASIC interpreter written in C or any other portable language running under UNIX can be recom-

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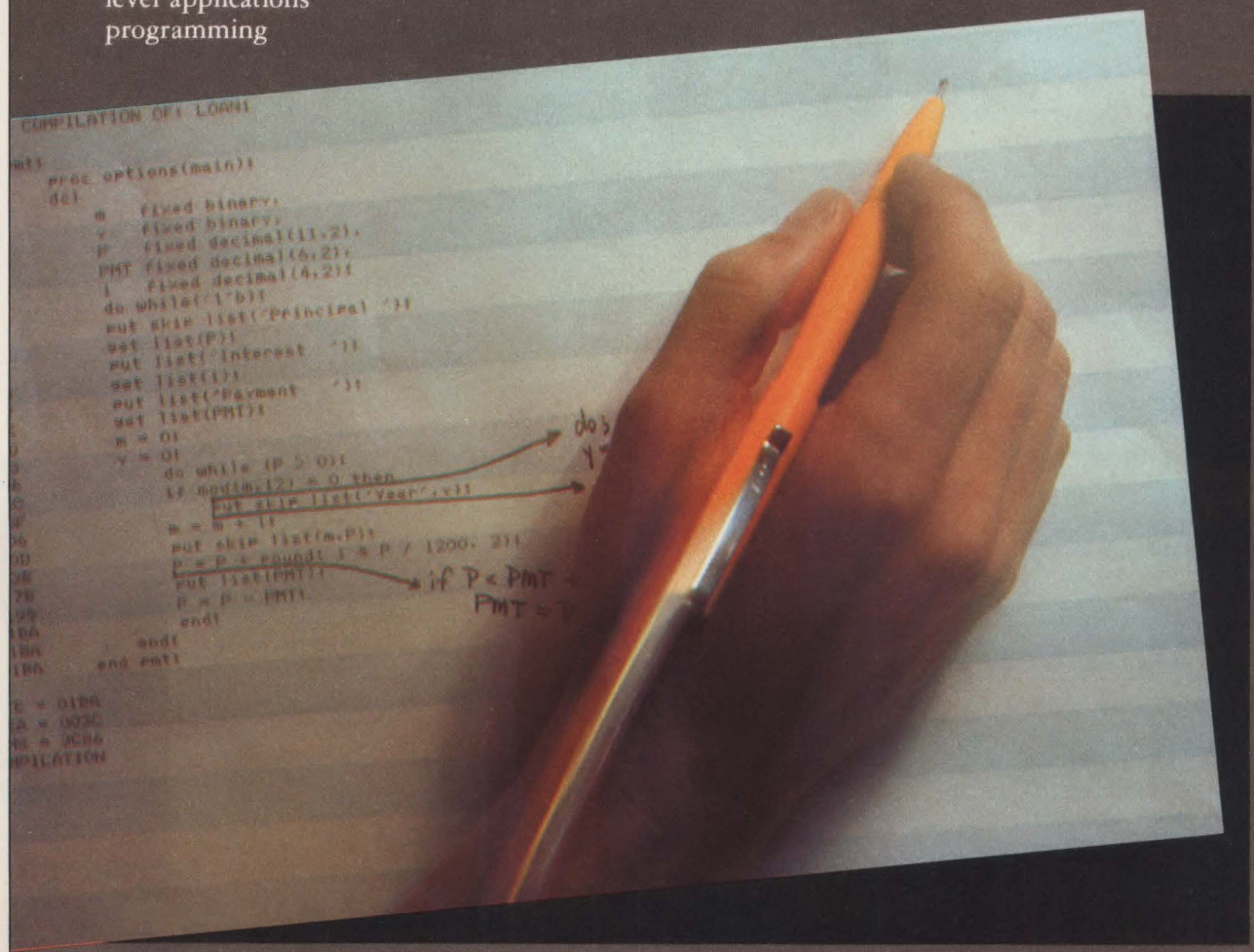

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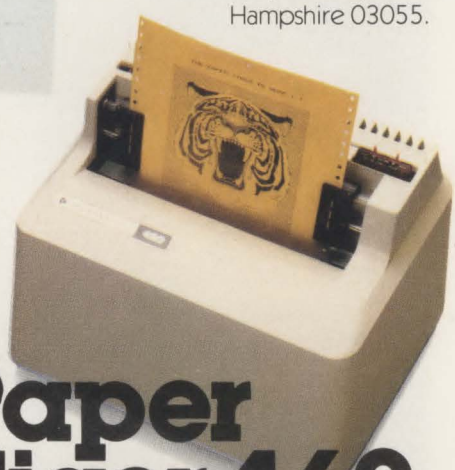

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The capabilities of UNIX-like operating systems for 8-bit μps are limited by storage space: a 64K-byte address space in main memory, and a 150K- to 2M-byte space in floppy-disk systems.

piled once for each system; then programs written in these languages become totally portable. For compiler languages, the code generation section is rewritten for each new machine; alternatively, a high-level language-to-C translator could be used. Such compilers should work on any UNIX system, so that special cross-compilers are not necessary. The LINT program, a syntax checker for C programs is particularly valuable here. It identifies parts of a program that are illegal, in bad style or not portable to other machines.

Imitators

UNIX has served as a model for various μc operating systems, on 8080, Z80, 6800 and 6809 processors (Table 3). In some cases, only part of the file system was copied, with the I/O redirection capability. Other systems include more Shell facilities, such as multiprogramming and pipes. Some provide all UNIX features and incorporate extensions such as file protection. Whitesmiths, Ltd. offers an operating system called IDRIS that is claimed to be functionally identical to UNIX Version 6, but does not use Western Electric's code.

The capabilities of UNIX-like operating systems for 8-bit μps are limited by storage space: 64K-byte address space in main memory, and 150K- to 2M-byte space in floppy-disk systems. Full UNIX on a PDP-11 needs at least 48K bytes of main memory; 8M bytes of disk is needed for the applications, utilities, games and other programs that come with it; file space is extra. Onyx eliminates nonessentials on its 10M-byte disk system, reducing the disk requirement to 4M bytes. For a while, the Yourdon Software Products Group offered OMNIX, taking 32K bytes for the kernel and 16K bytes per user; it was practical only on systems with bank-switched memory. Software Labs' OS-1 for the Z80 processor, the first in a series, omits multitasking and some other features and fits into 12K bytes. Later versions for 16-bit processors will offer considerably more capability and require more room.

The Software Tools Users Group (STUG) at Lawrence Berkeley Laboratory has taken a completely different approach. Using UNIX as a model and methods specified in *Software Tools*, STUG has created what it calls a "virtual operating system." Users of STUG packages are almost totally insulated from the peculiarities of the operating system. For example, if an operating system requires files to be read in fixed-sized blocks in a certain format, the STUG file handlers buffer input, so that a user sees only a sequence of bytes; the command interpreter handles generating, or looking up, any necessary job-control statements. The full STUG package runs under six operating systems; subsets of the system are running under at least 59 operating systems on at least 42 machines, including CP/M on an Intel 8080, UNIX and several other operating systems on PDP-11s, five operating systems for IBM 370s and Cray CPSS.

Licensing

Western Electric offers no support with a UNIX source code license. In the words of licensing manager Larry Isley; "For $20,000, you get a tape, a stack of manuals and our best wishes." Western allows source code licensees to sub-license object code, and to offer the sub-licensees support, enhancements and applications. Object code license fees were quite stiff until a new fee structure was announced last year.

By paying $50,000 to start (treated as an advance to Western on royalties), a company can offer sub-licenses starting at $750 for a single user, plus, $250 for each additional user. As the total amount paid reaches certain levels, the rates for more licenses decrease in steps; after total payments of $2.5 million the incremental charge is just $40 for a single user, plus $10 for each additional user. To reach this point, a licensee must sell 15,000 to 20,000 copies. Several μc operating systems have already passed that level of sales.

In the years ahead, UNIX will remain in competition with operating systems provided by CPU manufacturers. In many cases, UNIX will prevail because of its two major advantages; its portability and its vast storehouse of high-quality data-manipulation software. ■

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"The UNIX Timesharing System," Dennis M. Ritchie and Ken Thompson, Communications of the ACM, Vol. 17, No. 7 (July, 1974), p. 365-375.

Bell System Technical Journal, July-August, 1978, Vol. 57, No. 6, Part 2 (special issue on UNIX).

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Edward Cherlin is director of micro systems development for APL Business Consultants, Inc., Newark, N.J.

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The National Computer Conference, which traces its roots to the Spring and Fall Joint Computer Conferences, will celebrate its 30th year May 4-7 in Chicago's McCormick Place. This year's conference will feature more than 525 exhibitors in some 2300 booths, plus 100 program sessions and 21 professional development seminars.

NCC has become a mammoth forum for information exchange since the first JCC was held in Philadelphia in 1951, the same year that UNIVAC-I, the first commercial computer, was delivered to the U.S. Census Bureau.

In 1973, the American Federation of Information Processing Societies, chief sponsor of the conference, consolidated the Spring and Fall Joint Conferences into the National Computer Conference, which drew 32,500, and attendance has been growing ever since. Last year's show in Anaheim, Calif., was attended by more than 80,000.

AFIPS is cautious about forecasting attendance this year, officially estimating the number at about 60,000 because Chicago is not in the heart of a computer enclave. There is still a waiting list of some 125 potential exhibitors, despite the fact that 230,000 sq. ft. of space is available at McCormick Place.

A personal computing festival has been organized for microcomputer buffs. The festival will feature 30 sessions covering such topics as robotics, business applications, languages and the use of personal computers in the classroom.

This year's professional program is organized along eight so-called tracks. Nearly half of the papers and panels will be devoted to small-system issues. For more details on the program and its importance to minicomputer and microcomputer users and designers, please see the story that follows.

Logo Design by Robert J. Tabor

Previewing the National Computer Conference

MALCOLM L. STIEFEL, Contributing Editor

Minicomputer and μc users and designers will find a rich mixture of interesting topics and exhibits at this year's show

The NCC has always been a haven for large systems. In the technical sessions, attendees could reasonably expect to hear presentations about the techniques of managing development of multi-mega-instruction software systems, design approaches for multi-gigabyte data base management systems or architectures for multi-millions-of-floating-point-operations-per-sec. processors. That sort of big-league stuff will be on hand again this year, as the attendees and exhibitors gather in Chicago's 230,000-sq.-ft. McCormick Place on May 4 to 7.

Almost half the papers and panels, however, will be devoted to small-system issues, including how to program and microprogram them, how to connect them in distributed systems and networks and how to apply them in office-automation and other applications. Meanwhile, the concurrent Personal Computing Festival, an NCC tradition, will also be conducted.

In all, minicomputer and μc users and designers will find a rich mixture of interesting topics and exhibits. For the price of admission—$60 in advance, $75 at the door for the four days—attendees will get a bargain-basement education and insight into what's happening in the industry. For $25 more (half day) or $65 more (full day), registrants can attend professional development seminars on such topics as managing word processing and office automation in the '80s. Registration fee for the Personal Computing Festival is $30.

A word of caution: Do not try to substitute perusal of the conference proceedings for attendance at the show. Many sessions will be conducted in a panel-only format—speakers provide slides or view-graphs, but do not submit formal papers for publication.

Dr. Alex Orden, of the Graduate School of Business at the University of Chicago, and chairman of the NCC program committee, points out that the NCC is a hybrid gathering of commercial and scientific/engineering (that is, academic) practitioners. Thus, the ideal mixture, he says, would be to have half of the speakers—those from universities—with papers and the other half—those from industry—without. As it stands, about a third of the participants submit papers in advance that are referred and published in the conference proceedings. Thus, some of the most interesting and informative material in the conference never appears in the proceedings. The sessions are recorded on tapes that are available for a nominal fee.

This year's conference is structured along eight principal tracks: hardware and architecture; network technology and capacity/performance analysis; software; information-processing management; educational and societal issues; office-automation applications and computers at work; data base systems; and voice, vision and artificial intelligence. Several of these tracks are of special interest to small-system designers and users.

Dr. Anthony Wojcik, chairman of the computer

Stephen S. Yau *of Northwestern University Technological Institute will lead a program on software maintenance.*

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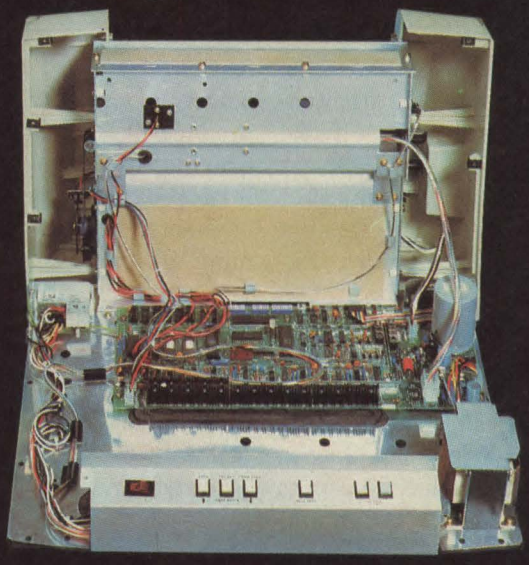

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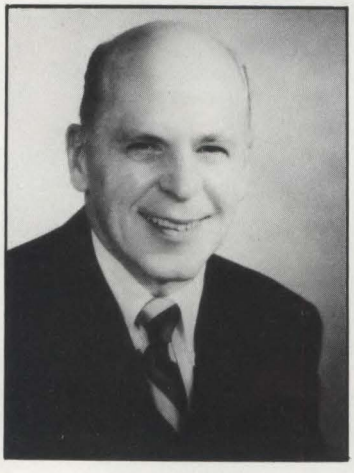
Fault-tolerant systems that operate despite component failures will be the subject of two sessions.

science department at the Illinois Institute of Technology, is NCC's vice chairman for hardware and architecture. He is also chairman of the IEEE technical committee on fault-tolerant computing, so it is not surprising that fault-tolerant systems are the subject of two sessions. Representatives of IBM Corp., Tandem Computers, August Computing Co., Stanford Research Institute, the University of California at Los Angeles and the Massachusetts Institute of Technology will discuss systems that continue to run in the face of component failures. Wojcik characterizes the sessions as informational rather than theoretical. The discussion will attract users who are considering installing a system for round-the-clock applications, such as process-control, patient-monitoring or bank-transaction. The discussion covers both small and large systems.

Two full-day sessions devoted to microprogramming may be of much broader interest. The sessions will reflect a need to simplify microprogramming as designers strive to increase execution speed of system-control and application functions. One session, for example, will discuss high-level microprogramming language. This probably signals a new breed of real-time systems that will be programmed in traditional high-level procedural languages, such as FORTRAN or Pascal. These systems' compilers will invoke powerful microprogrammed routines to achieve throughput, replacing assembly language programming, the time-honored tool of real-time programming and microprogramming. The idea that anyone would write microprograms to define machine instructions in a high-level language is mind-boggling.

In another session, representatives of U.S. and Japanese industries will discuss mutual interests and competitive positions. The session—called "μp architectures, what next?"—should interest hardware designers planning forthcoming generations of equipment.



Albert K. Hawkes *of Sargent & Lundy Engineers is conference chairman for this year's NCC.*

Small-system users are represented at almost every station of the software track, says Dr. Howard Morgan of the Wharton School at the University of Pennsylvania and the vice chairman for software. The sessions will emphasize productivity and reliability. For example, one session deals exclusively with the Smalltalk language, created at the Xerox Research Center. The language is said to be "user-friendly" and to promote productivity. Smalltalk has a procedural segment and a graphics-manipulation segment that allows users with little programming background to play with graphics elements, compose music and perform other programming tasks.

A session on software reliability in real-time programs will deal with techniques for automatic validation of real-time programs. Debugging real-time programs has always been more difficult than debugging batch programs, because it is often difficult to replicate the precise sequence of events that cause a program to err.

Pascal, the language that has perhaps stirred the greatest amount of interest in recent years, particularly in μp-based systems, is being standardized—a sure sign of respectability. A session on Pascal standardization will provide a status report and will probably stimulate audience and panel comment. Standardization is an emotional issue in every part of the computer industry. For example, the recent brouhaha about COBOL, and the long-running battle about I/O channel standards are both emotionally charged issues. Changes in, or adoption of, standards cause these battles, because such changes cost some people a lot of money, while they make a bundle for others. The wounded ones, who are forced to make wholesale changes to their products to adhere to the standard, roar their disapproval, while those who are already compatible with it shake their heads and remark how much better off vendors and users alike will be once a new standard is implemented. Look at all the fun Congress is having with an outraged, suspicious public on one hand, and the Postal Service on the other, as it wrestles with the proposed nine-digit zip code.

Integrating office-automation equipment

Office automation, a major small-system market in the next decade, will have its own track in NCC '81. Topics include the problems of marrying office automation and data processing and the integration of diverse information systems for data, text and graphics manipulation in offices. A pair of sessions will speculate on the future of office-automation technology.

A related topic—business conmunications security and vulnerability—will be covered in the voice, vision and artificial intelligence track, although the subject is relevant to the office environment. In a similar fashion, the sessions on microprogramming noted above ride on the software track as easily as on the hardware.

The components of office automation—word processing, data processing and, in a more limited way, picture processing do not have their own sessions because the

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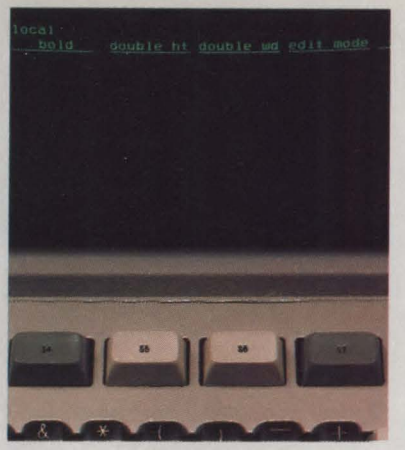

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CIRCLE NO. 94 ON INQUIRY CARD

Office automation, a major small-system market in the '80s, will have its own track in NCC '81.

integration of these elements and the interactions among them are more important than the separate components. These elements have been elevated into mature, well-understood disciplines. The spotlight will be on interfacing techniques, which the data-processing industry has not, after three decades, successfully developed. Thus, there is a strong interest in standards in general, and in interconnection standards in particular, to connect distributed systems that perform diverse, but related, functions.

Standardizing distributed systems

Distributed systems were not given their own segment in this year's NCC, probably because buzzwords do not merit their own segments. Nevertheless, specific sessions will cover them. In particular, Harold Uhrbach of DBD Systems, Inc. Rockville Centre, N.Y. is chairing a panel on architectural considerations in distributed data base management systems. The speakers will deal with standardization and the creation and maintenance of distributed data bases. Uhrbach predicts that a user at any site will one day be able to request data from a data base without any knowledge of where (in a distributed system) the information is located, and without regard to the hardware and protocol in use at the user's site. That is, the network will transform the request into a standard format for transmission along the network connecting all nodes, and transform the message again at the receiving node into a format that the receiver can recognize. The inverse process will occur when the response is transmitted back to the requester.

The ANSI.SPARC study group, of which Uhrbach is a member, has a charter to provide an architecture for a distributed data base management system environment, covering such concerns as heterogeneous environments, data-dictionary standards, software-control procedures, security and recovery. The group will present a proposal at the session.

The International Standards Organization (ISO), which also has a data base standards activity under way, says that the SPARC proposal is compatible with Level 1 of its protocol. Meanwhile, CODASYL has its own group studying the same problem. Attendees at the session should get a good idea of the status and relationships of these efforts.

Problems still exist: currency and integrity of data and data base administration in a distributed environment. Bits and pieces of the problems are being solved, but progress is slow. For example, it is now possible to support multiple data base management systems at one site with user programs able to communicate with all of them. Thus, a user could store some data via a hierarchical DBMS, and other data via a relational DBMS on the same machine, and manipulate both data bases at once.

The problem of security in distributed data base management systems has been "intellectually" solved, Uhrbach says, and implementing the solutions is not far off. These issues will be discussed at the session. Small-system designers and users, major beneficiaries of the new distributed DBMS technology, are likely to have much interest in the topic.

The distributed system is the way to get computing power into the hands of the user in a convenient and economical form. It allows small systems to interact with one another as well as with mainframes. The question is: How will these units be connected? The answer is: with networks. Given the concern in the other tracks with integrating systems, it is not surprising that a separate track is dedicated to the design, development—and standardization—of remote networks that connect users in geographically separate locations and local networks that tie users within a building, or within a few miles.

Here again, the emphasis will be on standardization. A report will show the status of various cooperative and competing protocol development efforts.

Greg Hopkins of Mitre Corp. will lead a double session introducing local networking and the Ethernet approach. The speakers will describe the attributes of local networks; review the products offered; and discuss standardization activities at ANSI, IEEE, ISO, the EIA and others. The speakers will also examine word-processing, graphics, electronic-mail, file-transfer and data-base access applications—all of which will be covered in the other tracks. These sessions will offer an overview of where the industry is heading in the next five years, because networking influences so many other segments of the business.

In the past, NCC has been criticized for being too academically oriented and out of touch with the needs of the commercial-user community. It has also been dismissed as a large-systems conference. Neither claim is valid. The technical sessions at NCC will address issues that are of vital concern to users and will be of concern in the immediate future. Far from having a strictly large-system flavor, it will deal in depth with small-system issues.

As in the past, it will be crowded, noisy and exhausting, but exhilirating and educational at the same time. ■

Malcolm L. Stiefel, now a group leader at Mitre Corp., has worked as a systems analyst, systems engineer and programmer on military command-and-control, hospital administration, investment securities and municipal information systems.

DISK DRIVES

Slimline floppy saves space, boosts capacity

WAI SZETO, Remex Division, Ex-Cell-O Corp.

Remex's Pico—a 5¼-in. floppy-disk drive—is the first to combine low profile and high capacity

The demand by floppy-disk drive users for maximum data capacity in the smallest possible space is inspiring a new generation of floppy-disk drives. The industry is seeing the birth of slimline minis—drives using available 5¼-in. media, but in low-profile, ultra-slimline drive housings. At the same time, manufacturers are increasing track density on 5¼-in. drives to boost data capacity.

The first floppy-disk drive in which these two trends—low profile and increased tracks per in. (tpi)—have been combined is the new offering from the Remex Division of Ex-Cell-O Corp. The drive will be introduced next month at the National Computer Conference in Chicago. Remex's Pico is a 5¼-in.-media, dual-head drive that measures only 2¼ in. high at the bezel in standard configuration (a 3.4-in., "standard"-sized bezel is available to buyers that don't require the small size, but want the drive's other advantages). In addition, the drive writes and reads 96 tpi or 48 tpi on two surfaces, thus increasing unformatted data capacity to 1M byte.

The small-sized, high-capacity combination, however, is only one of the advances in the Pico drive. Improved design features are directed at reducing or

eliminating the industry's on-going head-loading problems, reducing drive wear, improving data reliability to accommodate higher track densities and to decrease power consumption.

The Pico is ANSI-compatible, compatible with Shugart's 5¼-in. drives and interchangeable with BASF's low-profile-sized drives—the only other "mini-mini" on the market (but without double-tpi capability).

Direct drive DC is smoother, simpler

While one or two advanced-design 8-in. disk drives have been equipped with direct-drive spindle motors, the Remex Pico is the first 5¼-in. drive to offer brushless direct-drive advantages. Pico causes no brush wear, resulting in longer motor life. And, because it is direct-drive, improper belt seating is nonexistent, eliminating variations in speed and side loading. Side loading places undue friction on the motor and causes bearing wear in belt drive motors. The mean time between failures (MTBF) of the motor is rated at 30,000 hours, versus approximately 3000 for most brush-type motors.

The motor's closed-loop servo regulates speed to 1 percent versus 2¼ percent for other small drives. This assures that media can be interchanged between Remex drives, unlike other drives in which speed varies between systems, even of the same manufacturer, causing read/write errors when a disk written in one drive is read in another.

The drive's speed control also simplifies control design and may save the OEM time and money. One typically demanding aspect of a drive controller's design is the phase lock loop (PLL), which controls jitter in decoding the data stream. Improved speed control stabilizes the data stream and reduces jitter, thus improving data-recovery reliability.

No head-loading solenoids

One of the most significant user advantages of the Pico drive is that it lacks a head-loading solenoid, which in most drives is associated with head-loading ("tap-tap") problems and resulting media damage. The Pico loads the head directly onto the media when the drive door is closed. Continuous wear has been demonstrated

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CIRCLE NO. 95 ON INQUIRY CARD

One of the most significant user advantages of the Pico drive is that it lacks a head-loading solenoid, which in most drives is associated with media damage.

to cause less stress to the media than "tap-tap" wear. With the drive's very low head force, media wear incurred by having the head in contact is minimal compared to the wear and damage caused by the loading and unloading of many read/write heads. For long periods of read/write inactivity, the drive spindle motor is simply shut off and can be reactivated when required. The entire stop/start process requires less than 200 msec.

Elimination of the solenoid tends to improve read/write data reliability. In standard drives, magnetic leakage from the solenoid, when it's positioned close to the read/write head, frequently causes data errors. The Pico has no such leakage.

Clutch and spindle design protects media

Remex has altered the clutch and spindle assembly of the Pico drive from that of other 5¼-in. floppies (Fig. 1). Other small drives and many 8-in. drives have short clutch-and-spindle assemblies with limited track for travel. The result has often been poor media-to-spindle registration, causing the clutch to crash into the media surface or distort the diskette hole. Data is lost as a consequence. The Remex design saves space by altering the bearing surface, enabling the use of a longer clutch with a greater tapering angle and longer travel, even in the small drive space. With this design, the clutch adjusts the media, and the spindle is seated with virtually no possibility of collision with the diskette surface.

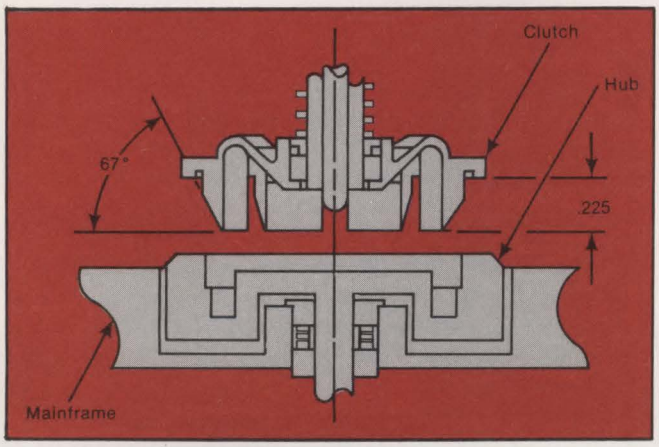
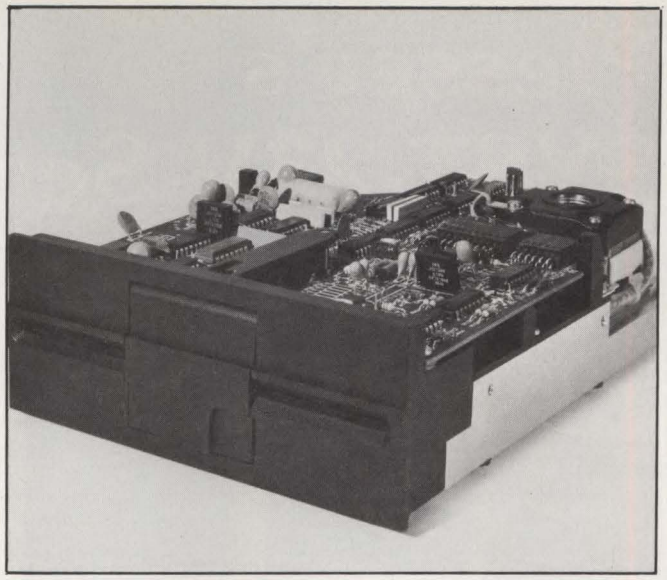


Fig. 1. Remex has altered *the clutch and spindle assembly of the Pico drive from that of other 5¼-in. floppies.*

The Pico's electronics can optimize the current of the read/write heads for a given media, improving data reliability. Most other drives have a single selected current for all read/write heads and media.

Remex's 5¼-in. drive also includes electronic damping of the stepper motor, rather than the mechanical damping found on other drives. Damping corrects overshoot and unwanted motion at the end of a seek so the carriage can "settle" quickly. Electronic damping also shortens settling time and substantially decreases hysteresis over mechanical damping techniques, thereby increasing the accuracy of the final position.



Remex's Pico *is the first floppy-disk drive to combine low profile and increased capacity.*

The Pico drive contains optical rather than mechanical sensors, so there are no moving parts to wear and require replacement.

The customary write-protect sensor of most floppies is implemented uniquely in the Pico. An optical write-control sensor indicates the presence of a diskette in the drive. Protection of written data is a controller function, and an OEM designer can choose whether to implement that function. Therefore, write protect is not required in systems where there is no danger of operator error.

Reduced friction reduces power load

Many elements of the Pico design reduce operating friction. The drive's positioning mechanism is composed of reinforced fiberglass molded by a proprietary technique to improve the bearing surface on all parts and to reduce friction. This material enables the use of electronic damping without loss of positioning and settling speed.

The drive has been configured to facilitate interfacing. Four reserve lines are set aside for user implementation of special features. For example, an extra drive select line can be designated.

And because of its high degree of compatibility, the drive can be used with a number of standard controllers, including products from Western Digital Corp. and NEC Information Systems, Inc. ■

Wai Szeto is project manager at the Remex Division of Ex-Cell-O Corp., Irvine, Calif.

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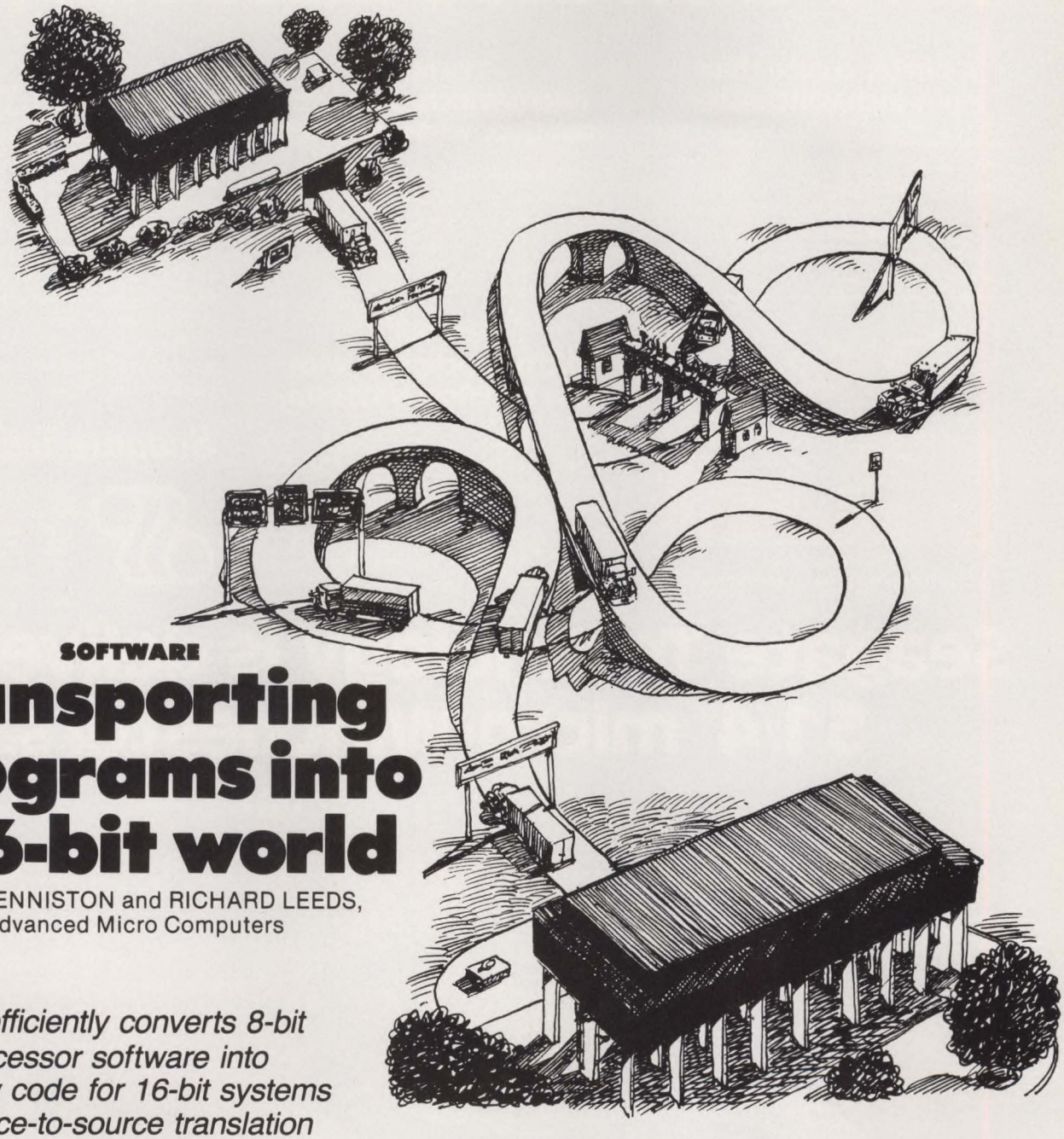

SOFTWARE

Transporting programs into a 16-bit world

BRAD DENNISTON and RICHARD LEEDS,
Advanced Micro Computers

TRANZ efficiently converts 8-bit microprocessor software into assembly code for 16-bit systems with source-to-source translation

The advent of 16-bit μps has provided users of 8-bit devices a more powerful CPU, but the newer processors aren't always software-compatible with the earlier ones. Until the recent introduction of high-level languages for μps, most programs for 8-bit machines were written in assembly language, which must be translated in order to transport those programs into a 16-bit world. The need for such a translator was recognized at Advanced Micro Computers, which has developed TRANZ, an assembly-language-to-assembly-language translator written for the AMSYS8/8 development system. TRANZ is intended to overcome the obstacles to upward migration posed by other techniques, which often compromise the 16-bit processor's execution efficiency or entail substantial support costs.

Within a CPU family, it is often possible to execute programs developed for low-end machines directly on high-end machines. For example, the IBM 370 can execute 360 code; Digital Equipment Corp.'s VAX-11/780 can execute in PDP-11 emulation mode; the programs written for a Data General Nova can execute on an Eclipse; and those written for an Eclipse can execute on an MV/8000. But the support costs of such examples of upward compatibility are reflected in hardware limitations on the larger machine that reduce its efficiency. As a result, upward compatibility can mean saddling new hardware with old problems.

Another solution to the problem of transporting software has been to use standardized high-level languages, which provide compatiblity by recompiling the

Illustration by Jon McIntosh

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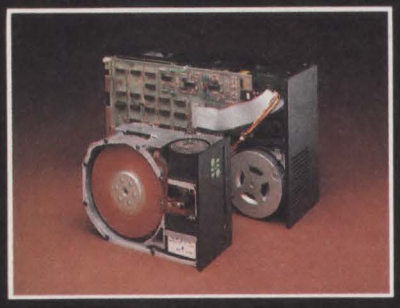

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CIRCLE NO. 97 ON INQUIRY CARD

Transporting assembly language programs to a high-performance but non-compatible machine poses new questions.

program to be transported. For example, the PORT mathematical subroutine library from Bell Laboratories is written in a subset of ANSI standard FORTRAN ('66) and has been recompiled for a variety of machines with little modification. The drawback of high-level language, however, is a loss in efficiency compared with the same program written in assembly language.

Obstacles to transporting assembly programs

But transporting assembly language programs to a high-performance but non-compatible machine poses new questions. Emulation of the original CPU can be inefficient, and programs written in assembly language can't take advantage of a new compiler or assembler. Language translators can help by generating efficient code for the new CPU with little programming effort, but a source-to-object translator produces an object program without source notation, making it difficult to optimize, enhance or debug. Use of a source-to-source rather than a source-to-object code language translator permits portability while allowing the user to optimize a program for the upgraded environment, which is what TRANZ offers. Source output contains the keys to producing a maintainable software product—the user's original labels, comments and structure.

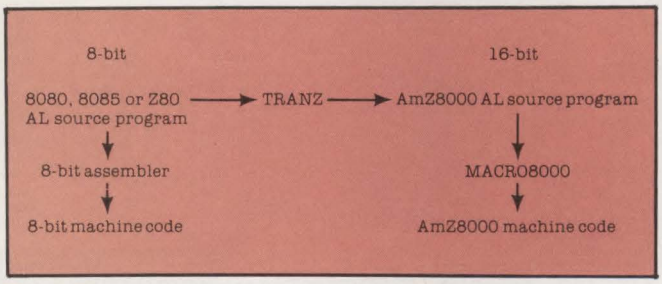

Fig. 1. Basic *8- and 16-bit assembly procedures.*

A	ACTION CLASS COMMANDS
T	TRANSLATE SOURCE
C	COPY SOURCE
R	REPLACE SOURCE
D	DELETE SOURCE
X	EXECUTE STORE (stored command 40 bytes)
M	MODE SETTING CLASS COMMANDS
L	LIST TRANSLATION QUALITIES
Q	QUIT

Fig. 2a. Action *class options.*

M	MODE SETTING CLASS COMMANDS
L	LIST TRANSLATION QUALITIES
C	CARE
D	DON'T CARE
T	TERMINAL DISPLAY SELECTION
O	OBJECT SELECTION
I	INPUT COLUMN SELECTION
S	STORE COMMAND (stored command 40 bytes)
A	ACTION CLASS COMMANDS

Fig. 2b. Mode-setting *class options.*

		Default Setting*
1.	C - Carry flag bit	C
2.	Z - Zero flag bit	C
3.	S - Sign flag bit	C
4.	P - Parity (parity/overflow) flag bit	D
5.	A - Auxiliary (half) carry flag bit	D
6.	F - FCW flag-bit ordering	D
7.	D - Decimal adjust flag bit	D
8.	B - Byte ordering in memory	D
9.	K - Byte ordering on stack	D

* D = Don't care
C = Care

Fig. 3. User-specifiable *translation qualities.*

Advanced Micro Computers *developed TRANZ, an assembly-language-to-assembly-language translator.*

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Applications for the 80's

Besides the traditional areas of Landsat interpretation and enhancement as major applications for the 80's, there are several new emerging applications that are already taking advantage of digital image processing techniques.

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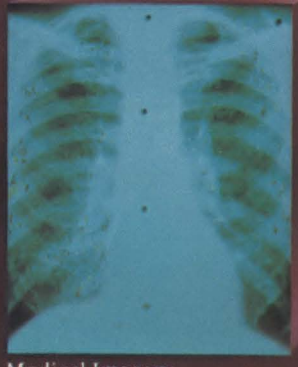

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The Z8000 requires a language translator to execute programs written for the 8080, 8085 and Z80, and that's where TRANZ enters the picture.

Most 8-bit μp software runs on the 8080, 8085 or Z80. All three have evolved into two 16-bit μps—Intel Corp.'s 8086 and Zilog Inc.'s Z8000. The 8086 is generally compatible with the 8080, but the Z8000 has acheived greater efficiency than the Z80 at the cost of some compatibility. The Z8000, therefore, requires a language translator to execute programs written for the 8080, 8085 and Z80, and that's where TRANZ enters the picture. It's an assembly language-to-assembly language translator for the AmSYS8/8 development system that translates 8080, 8085 and Z80 (8-bit) assembly source code to AmZ8002 (16-bit) assembly source code, allowing a program originally written for an 8-bit μp to run AMC's 8000. The translator writing system on which the current implementation of TRANZ is based could also be used for Motorola 6800-to-68000 translation, with addition of the proper translation tables. Output from TRANZ is assembled using AMC's MACRO8000 assembler and may be linked with other assembly language modules (Fig. 1).

```
NOTES:
   * MAXIMUM FIXUP NOT PERFORMED
   * ADDRESS EXPRESSION CORRECTED
   * ADDRESS-RELATIVE FIXUP SUSPENDED
     ACROSS THIS INSTRUCTION
WARNINGS:
  ** WORD BOUNDARY ERROR-BYTE INSERTED
  ** EXPRESSION NOT EVALUATED
  ** ILLEGAL SYMBOL
  ** ABSOLUTE REFERENCE MADE (PCHL, RST
     OR NUMERIC ADDRESS)
  ** RESERVED WORD USED
SOURCE ERRORS:
 *** SYNTAX UNACCEPTABLE, NO TRANSLATION
     MADE
 *** UNDEFINED OPCODE OR MACRO
     ENCOUNTERED
 *** UNTRANSLATED OPCODE ENCOUNTERED
```

Fig. 4. Diagnostic *messages.*

AMC's translator is a flexible, table-driven program, which is implemented on a general-purpose translator-writing system comprised of a user interface combined with translation table drivers, a translation table entry program and a translation table compiler. An implementer using the translator-writing system enters a translation table for each language translation desired, and may modify the table using an ASCII editor. The translation table can represent LR (1) grammars. The table must be converted by the translation table compiler before it can be used with the user interface and translation table drivers for interactive translation. Scanner declarations, production equations and code generation definitions are defined within the table.

Three translation tables are supplied with TRANZ on the AmSYS8/8: 8080 to AmZ8000, 8085 to AmZ8000 and Z80 to AmZ8000. These tables allow the AmZ8000 to simulate a superset of the 8080, 8085 and Z80 instructions, excluding interrupt handling. This exact simulation requires from one to 10 instructions for each 8-bit instruction.

A software system may be efficiently transported to the AmZ8000 without operator intervention using TRANZ. Users can achieve further improvement in

Translate Until specifies the condition under which translation of the source assembler language statements is to terminate.

ACTION (T,C,R,D,X,M,L,H): TRANSLATE UNTIL (E,S,'WD',#):__

A command delimiter results in translation of one line of input file source code, and processing of the specified output; i.e., terminal and object output as defined in the mode setting.

. . . TRANSLATE UNTIL (E,S,'WD',#): END OF FILE

An E response results in translation of the entire file, using selected mode-setting options.

. . . TRANSLATE UNTIL (E,S,'WD',#). SEVERITY (N,W,Z): __

An S response results in translation of the file until a problem of the selected severity is encountered, where

N = translate until a source line is encountered that cannot be fully translated (possibly due to translation quality selections) or until translator address recalculation must be done. Note that entering a command delimiter at this point has the same effect as an N response.

W = translate until a source line is encountered for which a fix routine is not available.

Z = translate until a source line is encountered that cannot be translated, or until a command error is encountered.

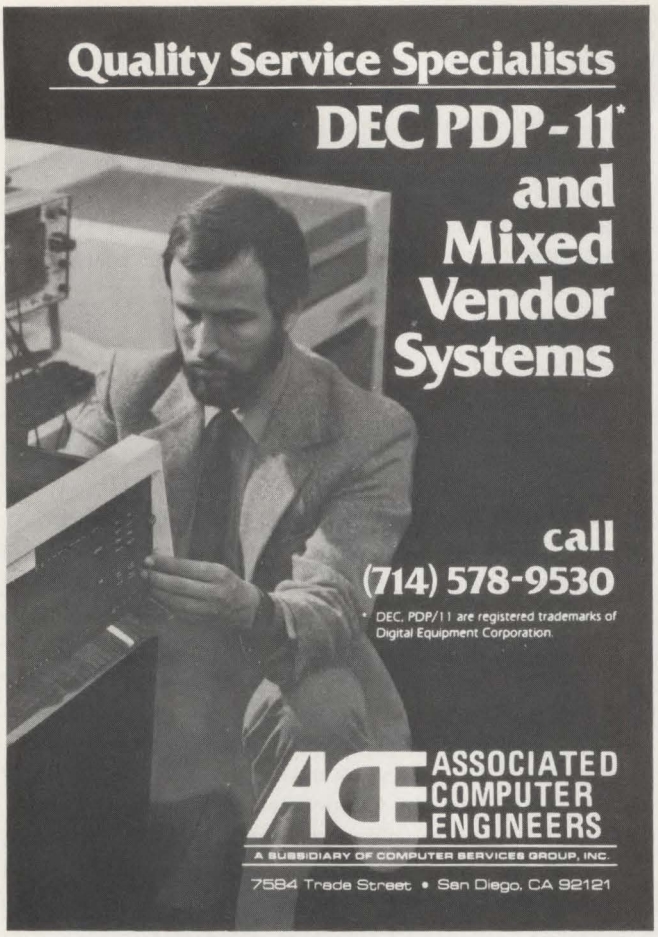
. . . TRANSLATE UNTIL (E,S,'WD',#): 'string'

Selection of 'WD' (keyword) is in the form of a string of up to 16 characters, bounded with single quotes. (Note that the code 'WD' need not be entered.) When the specified string is encountered in the source line, TRANZ halts and prompts with the ACTION display for user intervention.

. . . TRANSLATE UNTIL (E,S,'WD',#): n

Selection of # is in the form of an integer value n. (Note that the code # need not be entered.) TRANZ processes n source lines, halts and prompts with the ACTION display for user intervention.

Fig. 5. Translate *termination options.*



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An average AmZ8002 program written in assembly language might execute in 60 to 80 percent of the time and occupy 80 to 90 percent as much code space as a comparable 8080 program.

efficiency by reprogramming selected portions of the source code output. In a typical program, 10 percent of the code, consisting of frequently used routines and inner loops, is executed 90 percent of the time. Little more than this 10 percent needs to be optimized to gain a substantial improvement in efficiency.

An easily used interactive interface allows users to simulate 8080 and Z80 CPU flags and features selectively in the AmZ8000 code produced by the translator. This is possible because an exact simulation of 8080 or Z80 instructions is seldom necessary. For example, the 8080 CPU flag P (parity) can be exactly simulated on the AmZ8000 by following any AmZ8000 instruction that does not set the parity flag (for example, ADDB sets the AmZ8000 P/V flag for overflow, not parity) with the instruction TESTB. The user can specify the quality of the translation as follows: carry, zero, sign, parity, auxiliary (half) carry and decimal adjust flags, the flag and control word bit ordering and the byte ordering in memory and on the stack (Fig. 3).

User commands specify either actions or mode settings. Actions include translate, copy, replace and delete. Mode settings include setting "care" translation qualities, setting "don't care" translation qualitites and selecting terminal display and object file output options (Figs. 2a and 2b). Action and mode setting commands (that is, translation and specification of translation qualities) can be performed in batch or interactive operations. For batch operation, commands are placed in the source file; for interactive operation, TRANZ will prompt for the next command.

Users may choose the line at which an action, such as translate, is to stop to allow user intervention (Fig. 5). Using this interactive, source-to-source translator, a software engineer can produce a look-alike AmZ8000 system for a working 8080, 8085 or Z80 system, which executes at 80 to 200 percent of 8080 time and occupies approximately 2½ to 4 times the code space. ■

Denniston

Leeds

Brad Denniston is a systems product marketing manager at Advanced Micro Computers, Santa Clara, Calif., and **Richard Leeds,** who was a software engineer in the Language Products Development Group and author of the TRANZ product, is now a consultant.

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SIZE Height	8.5"	8.2"	8.5"	8.5"
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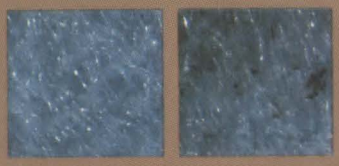

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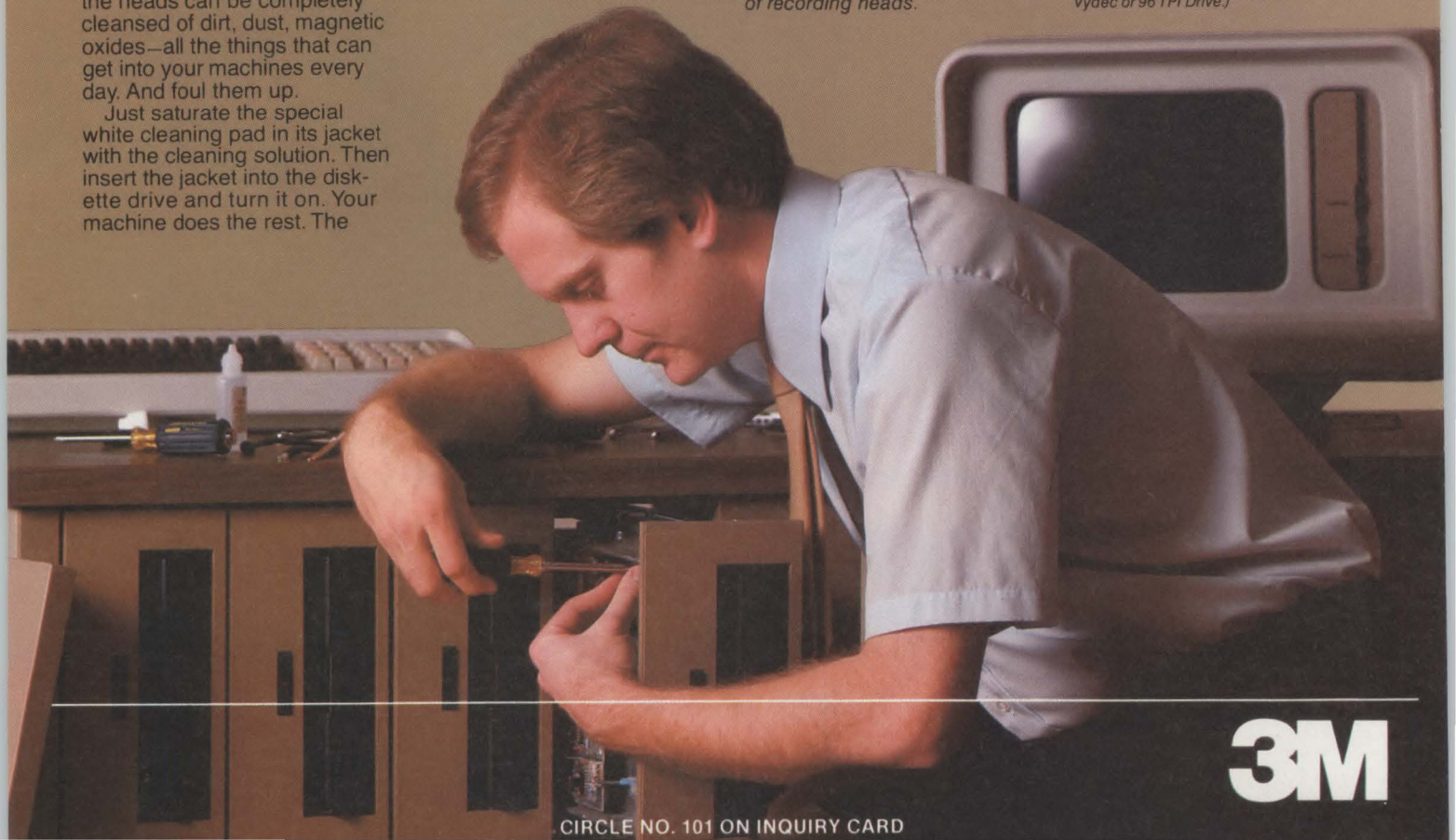

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APPLICATIONS

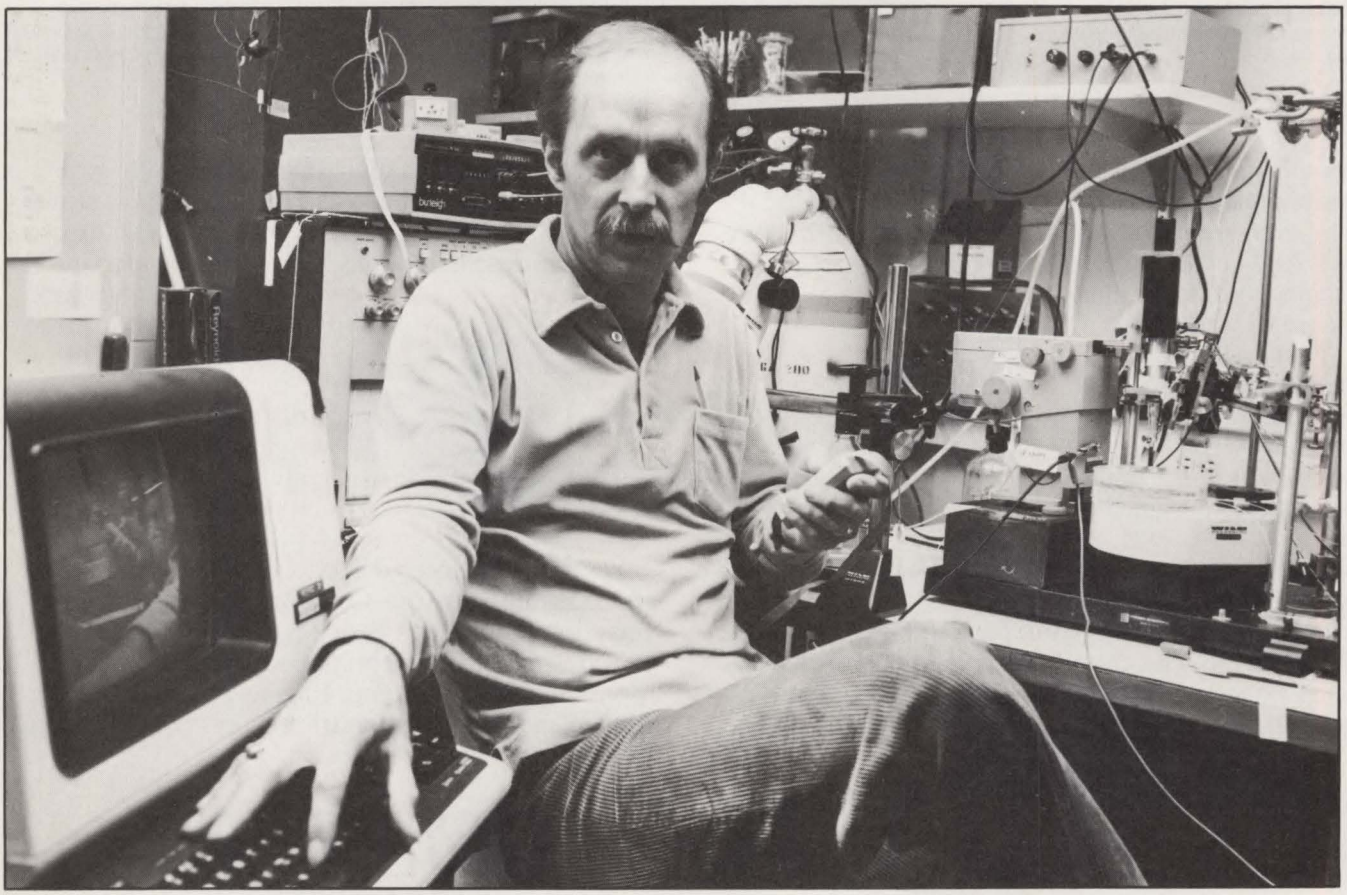
Unlocking the brain

Scientists at the Salk Institute are using minicomputers to model brain cell reactions in hopes of understanding behavior

Amid a tangle of wires, tubes, pipettes, beakers and computer terminals, scientists at the Salk Institute in San Diego are working painstakingly to unravel Earth's most complex logic system—the human brain. They hope the research will point the way to understanding the biological mechanisms associated with alcohol and drug abuse, brain development, memory, aging, malnutrition and the biochemical reasons for mania and depression.

"The problem is complicated because there are more than 15 billion cells in the human brain," says George Siggins, associate director of the Arthur Vining Davis Center for Behavioral Neurobiology. "Each cell is not a binary-state memory element, but a complex system of its own." Brain cells may have thousands of inputs and hundreds of outputs, related by processes not yet fully understood.

"It's like trying to troubleshoot a sophisticated



George Siggins, associate director of the Davis Center *for Behavioral Neurobiology at the Salk Institute, demonstrates Digital Equipment MINC laboratory data-processing system.*

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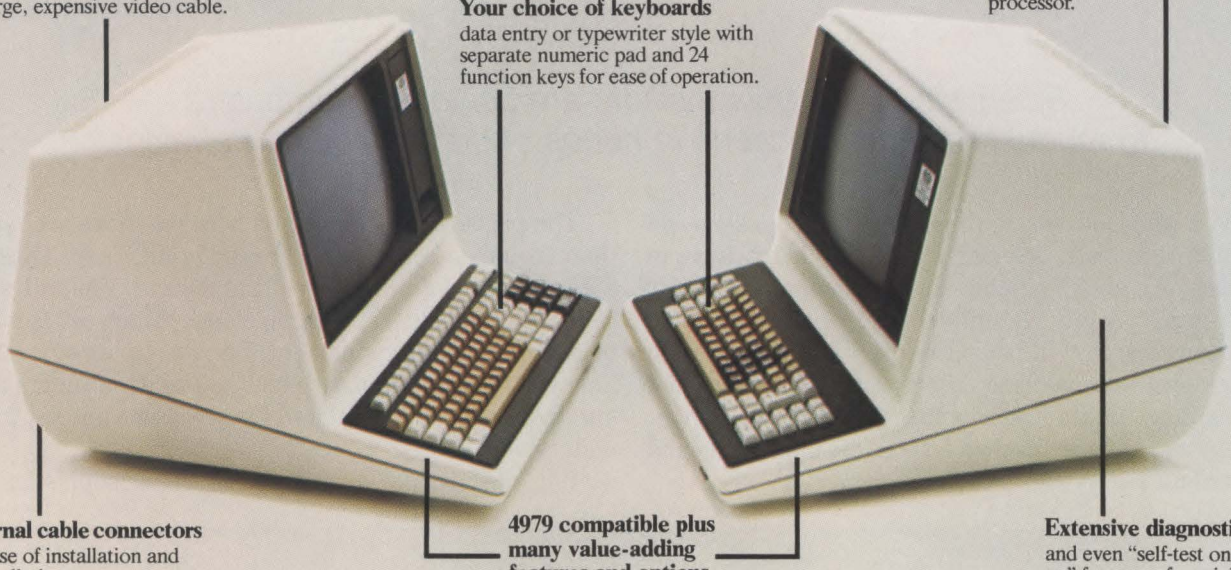

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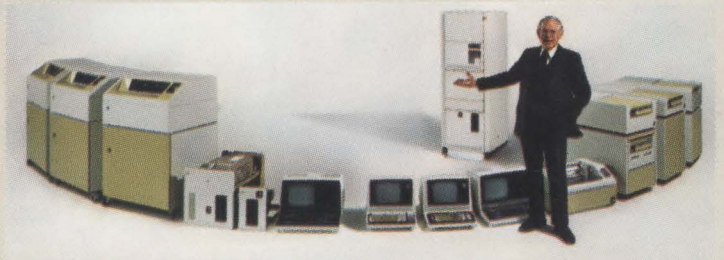

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The MINC automatically counts the spikes, along with their associated intervals, and produces histograms that graphically depict the responses.

computer without schematics, timing diagrams or flowcharts," says Siggins. "As a result, we are tracing brain functions, cell by cell, just as a computer scientist working without documentation would examine individual ICs, trace conductors and view timing sequences."

Scientists know there is an electrochemical relationship between cells in the nervous system. Each cell generates millivolt signals that travel along conductors, called axons, to hemispherical structures adjacent to other cells. When the electrical signals reach the structures, known as synapses, they trigger neurotransmitter chemicals that pass to receptors in an adjoining cell. This generates additional electrical signals, which, in turn, are passed to other cells.

Ultimately, the signals reach nerve endings in the body to cause an action, such as moving, breathing or seeing. Some cell types have only one axon leading to another cell, while others have several axons with branches leading to many cells or to other axons. Brain cells are 5 to 50 microns in diameter, and axons vary in length from about 1/10 mm. to 2m.

The biggest problem in understanding the brain is our limited ability to conceptualize the interactions of such a large number of elements, says researcher Stephen Foote. "We are using computers to manipulate large amounts of data and to model cell reactions. While we have many specific biological techniques that are quite powerful for tracing pathways and determining physiological activities, we need the computer to store, analyze and compare massive data sets."

Probing the brain with μcs

Researchers at the Davis Center use minicomputers to investigate physiological, anatomical and behavioral brain functions. Four Digital Equipment Corp. MINC laboratory data-processing systems aid real-time study of the electrochemical interaction between cells. The LSI-11/03-μc-based MINCs, with 32K words of dynamic memory have a VT105 video terminal and two dual-density floppy disks with 1M-byte capacity. Housed in roll-around racks, the MINCs can be moved between laboratories and can be easily reconfigured with appropriate signal-conditioning modules for real-time acquisition of various experimental data. The system analyzes preliminary information and displays it on the VT105. Data are also stored on floppies, which are then loaded onto a PDP-11/40 for data reduction and statistical studies. Klaus Liebold, computer center director at Davis, wrote all application programs for the system.

Many studies involve the use of single cells from the brains of laboratory rats. "There are a number of neurological systems in rats that are quite similar to those found in humans," notes Siggins. "The motor

Klaus Liebold, computer director, *inserts module in MINC system. Preamplifier, ADC, digital I/O and analog multiplexer modules can be interchanged to accommodate various experiments.*

functions, the spinal cord and the cerebellum have almost a direct association. Other sections are similar enough to permit correlations between rats' and humans' brain functions. When we fully understand the functions of lower order neurobiology, we can progress to higher order animals, such as primates, which more closely resemble humans."

To determine chemical effects on the nervous system, a group of micropipette tubes and microelectrodes are inserted into and around a single brain cell. The tubes administer various chemicals that induce or inhibit electrical activity, while the electrodes measure internal and external signals. When activity-enhancing chemicals are applied, the cell generates thousands of 1-msec. output spikes with 60- to 120-mV amplitudes. Amplified signals and signals from a programmable clock are gated and routed to the MINC's A/D converter to produce a time-based histogram of events. Similarly, some drugs may be released to reduce cell activity to below-normal levels.

"The aspect of recording information from both inside and outside of a cell creates a new area of complex data," Siggins says. "A two- to three-hour test creates sufficient data for a week's worth of manual data reduction. Before we started using the computer, we had to count the spikes manually," notes Siggins. "Now, the MINC automatically counts the spikes, along with their associated intervals, and produces histograms that graphically depict the response."

There is a section of the brain called the hippocamus that is involved in emotional states, memory and pleasure senses. "This portion of the brain responds very nicely to alcohol," continues Siggins. "By adminis-

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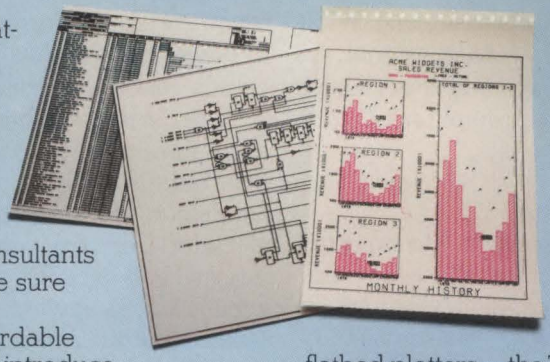

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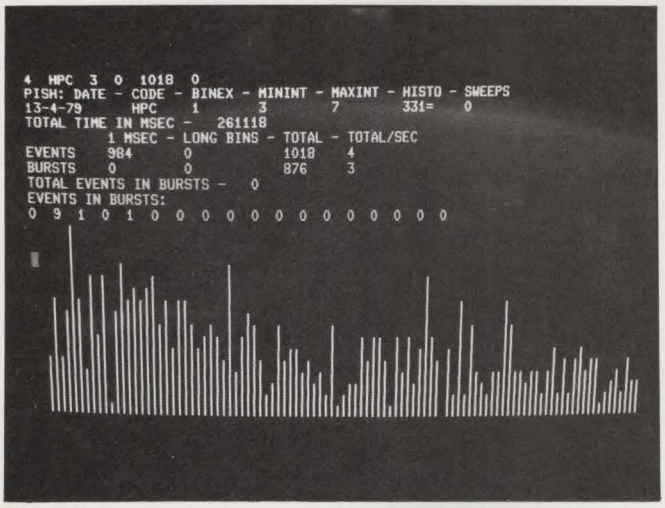
The PDP-11/40 digitizes coordinates and plots them on a Tektronix plotter, while slides of the brain cell slices are projected on the plotter surface.

tering various quantities and by plotting spikes, we can investigate cell tolerance levels and what happens when the substance is withdrawn.

"The studies often find some interesting correlations. For example, during one study, we discovered that certain types of multiple spikes come in 100-msec. bursts about 15 min. after administering low levels of ethyl alcohol. These are the same intervals that are associated with tremors and certain epilepsies. This suggests that when we fully understand the nature of



MINC has a command *that causes post-stimulus-time histograms to be generated and displayed automatically, such as a frequency distribution of multiple brain signals against time.*

electrochemical reaction we may be able to treat these dysfunctions."

Similarly, the center is studying chemical peptides called Enkephalin and Beta-endurphin, which are produced naturally in the brain. These are "the brain's own opiates," says Siggins, "because they have properties similar to heroin, morphine and other narcotics." Investigations of these chemicals and associated cell reactions may lead to understanding the brain's natural pain-blocking mechanisms and how they relate to narcotic addiction and withdrawal.

Other tests of single cells and cell groups analyze the learning phenomenon and cellular changes as aging occurs. One hypothesis is that aging not only decreases the number of cells, but also causes the remaining cells to suffer a loss of response to neurotransmitter chemicals. Examining changes in cell activity may lead to a better understanding of aging.

Mapping brain cells and their interconnections

Another problem in neurobiology is determining the precise locations of certain cells and how their axons are routed to other cells. Using a PDP-11/40 to map brain sections, Foote takes a nucleus of about 2000 cells and

Klaus Liebold *inserts a DECpack in the PDP-11/40, which is used to analyze data acquired on MINC system.*

makes wafer-thin slices through it. By treating the slices with chemicals or enzymes, the cells and their axons fluoresce when viewed under a microscope. Transducers attached to the microscope's viewing tables permit researchers to obtain X-Y coordinates of the cells and the axon paths.

The PDP-11/40 digitizes the coordinates and then plots them on a Tektronix plotter, while slides of the brain cell slices, taken through the microscopes, are projected on the plotter surface. This enables researchers to cross-check the microscope image and plot to ascertain that all cells on the slice have been correctly digitized.

The process continues using successive slices of the nucleus to produce three-dimensional plots of all cells and axons. The digitized data are stored on floppy disks and transferred to another PDP-11 for further graphical analysis. The 3D depictions are displayed on an Evans and Sutherland Picture System 2, on which they are rotated for viewing from several positions to determine cell locations and axon pathways.

Mapping previously was done manually—a slow process. Researchers viewed slices through the microscope and sketched cell locations. It was easy to overlook important cell bodies or connections because of the massive numbers of cells and the complexity of interconnections. Further, researchers had to examine a number of plots and place all locations in perspective because the sketches were two-dimensional.

"We are just beginning to understand the brain," concludes Foote. "In the future, we hope to develop computer models of the brain and test for physiological activity. Progress is slow, but as computer technology releases us from routine data handling, we can start unlocking some of the brain's secrets." ■

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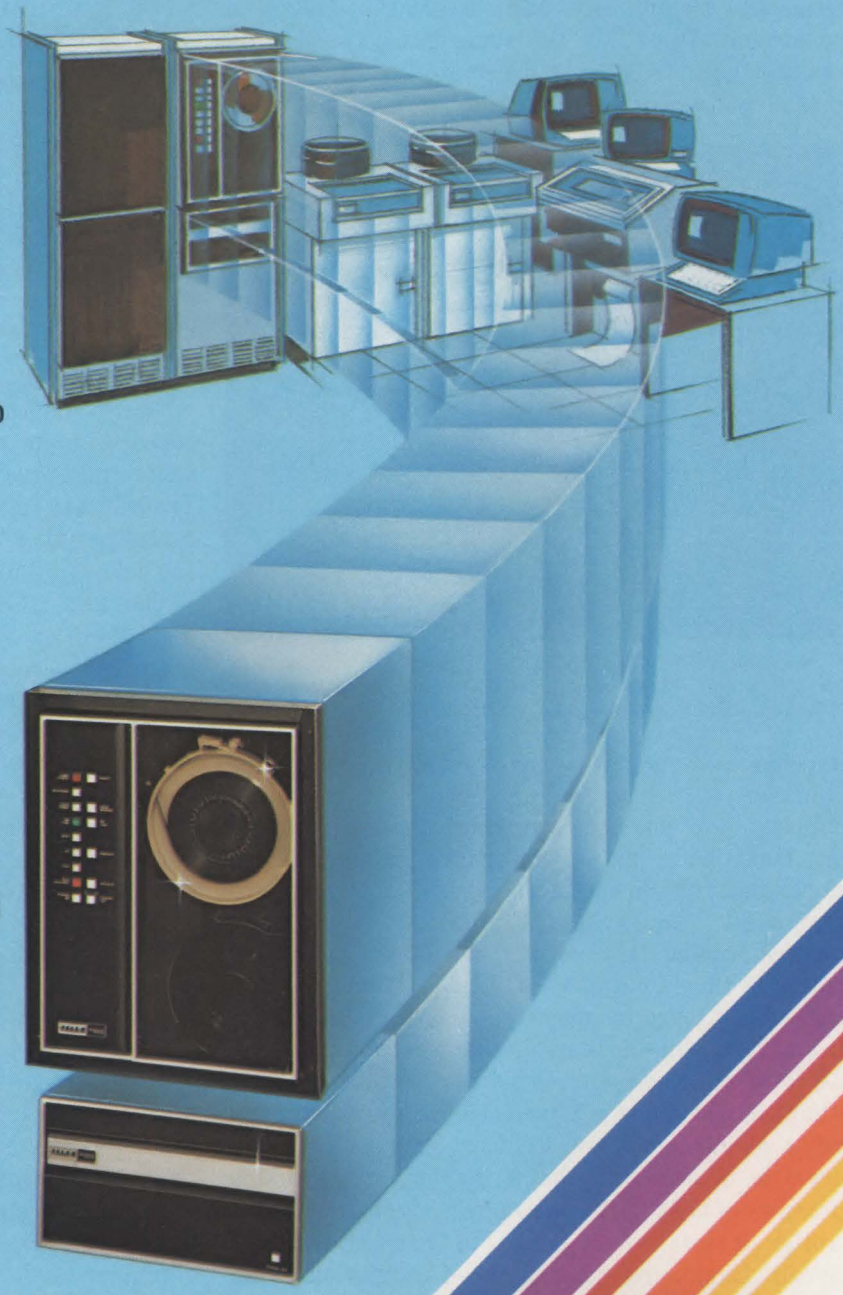

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CIRCLE NO. 104 ON INQUIRY CARD

SOFTWARE

Down-scaling DBMS to the microworld

HARVEY M. WEISS, Weiss & Associates

Developers and integrators of microcomputer systems should find MDBS invaluable in reducing development time

Until recently, system integrators who wanted to implement a data base management system in μc hardware had only one choice: they had to develop their own. Now, however, a company called Micro Database Systems, Inc., has come to the rescue with a pair of products—HDBS and MDBS—whose ability to reduce development time and implement processes not available elsewhere make them invaluable to integrators and developers of μc-based systems.

MDBS earned a rating of 243 out of a possible 400 points in our subjective evaluation, a score that is impressive for a package of its size. The price of MDBS is also impressive: less than $2000 for all available components.

Both products were designed to run on all 8080 or Z80-based μcs with CP/M TRSDOS, NEWDOS, North Star DOS, APPLE with APPLEDOS or Z80 soft-card operating systems, among others. HDBS supports a hierarchical structure, while MDBS supports the hierarchical and network standards as set forth by the CODASYL Data Base Task Group report. In addition, MDBS extends these concepts to include the "many-to-many" logical relationship concept.

Because of its greater flexibility and capability, this

File 1 (Sorted by Customer Name)	File 2 (Sorted by Customer Number)	File 3 (Sorted by Supplier Name)
Customer Name	Customer Name	Supplier Name
Customer Number	Customer Number	Supplier Number
Street	Street	Street
City	City	City
State	State	State
Zip Code	Zip Code	Zip Code

File 4 (Sorted by Supplier Number)	File 5 (Sorted by Part Number)	File 6 (Sorted by Part Description)
Supplier Name	Part Number	Part Number
Supplier Number	Part Description	Part Description
Street	Selling Price	Selling Price
City	Quantity in Inventory	Quantity in Inventory
State	Reorder Point	Reorder Point
Zip Code		

File 7 (Sorted by Part Number)	File 8 (Sorted by Date Received)	File 9 (Sorted by Order Number)
Part Number	Order Number	Order Number
Supplier Number	Customer Number	Part Number
	Date Received	Quantity Ordered
	Date Shipped	

Fig. 1. Files *to be described.*

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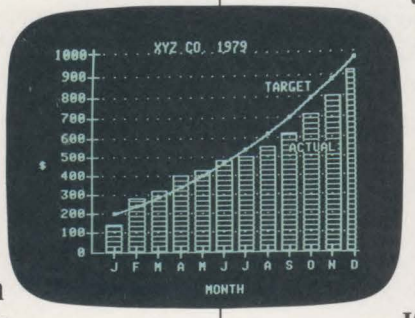

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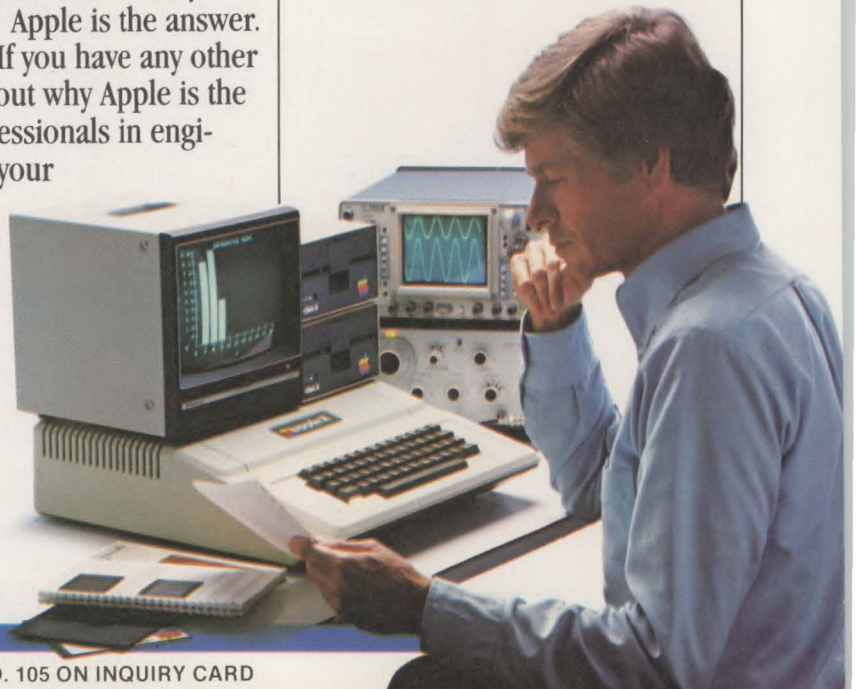
	Apple II	Apple III
Maximum Memory Size	64K bytes	128K bytes
Screen Display	40 column (80 column with peripheral card) 24 Lines Upper Case	80 column 24 Lines Upper Case/Lower Case
Screen Resolution (B&W)	280 x 192	560 x 192
Screen Resolution (Color)	140 x 192 (6 colors)	280 x 192 (16 colors)
Keyboard	Fixed	Programmable
Numeric Key Pad	Accessory	Built-in
Input/Output	8 expansion slots	4 expansion slots plus built-in: disk interface RS-232 interface Silentype™ printer interface clock/calendar
Disk Drives	Add-on one to six drives	One drive built-in, plus interface to support three more drives
Languages	BASIC Fortran 77 Pascal Assembly Pilot	Enhanced BASIC Fortran 77 Pascal Assembly
Typical Configuration Pricing	CPU, 48K RAM, single disk drive, B&W Monitor (9″), Silentype™ printer, and BASIC. **$2875.00***	CPU, 96K RAM, integrated disk drive, B&W Monitor (12″), Silentype™ printer, SOS, Enhanced BASIC. **$4865.00***
*Suggested retail price.		

apple computer inc.



CIRCLE NO. 105 ON INQUIRY CARD

MDBS offers the unique feature of providing an environment in which occurrences of one record type may 'own' occurrences of another record type.

evaluation will treat MDBS rather than HDBS. MDBS offers such big-system features as flow network CODASYL-oriented data structures, support of variable-length records, multiple levels of read/write protection, nonredundancy control over data, plus the unique feature of providing an environment in which occurrences of one record type may "own" occurrences of another record type.

What is even more incredible is that the system kernel requires only 18K to 20K bytes of real memory for the Z80 version, approximately 30K bytes for the 6502, and 22K for the 8080. MDBS was written in assembler language, making the product efficient in its code and execution time.

The package consists of a main module that includes the data definition language and data manipulation language components. Users can add the dynamic restructuring subsystem, which provides extraordinary flexibility in data base restructuring. In addition, a recovery-transaction logging subsystem records all data base transactions so that, in the event of a system failure, the data base can be recovered with minimal information loss. An interactive report writer/query subsystem is also available. It includes such features as customized processing for nontechnical users, complex retrieval formulas and the ability to design and print detailed reports quickly.

In summary, MDBS can provide μp users with a complete, inexpensive software system that offers the data-manipulation query and report-writer capabilities of a DBMS found on much larger and more complex computer systems.

DBMS overview

MDBS is truly a data base management system that implements CODASYL-supported structures as well as an additional structure called the many-to-many structure. The package has components for defining data structures and for storing and retrieving data. Add-on packages are also available that allow for logging transactions for recovery, restructuring the data base and query processing. MDBS is truly not a file-management system.

As with any data base management system, the first step must be the design and implementation of the logical data structures. This is accomplished through the use of MDBS's data-definition language. Once defined and stored in the system files, data management routines are written to perform the necessary operations of storing, retrieving, modifying or deleting records from the file using the data-manipulation language. When it is necessary to modify, delete or add structures to the file, an additional package is available from the vendor to provide these alterations without the need to dump and reload the data base.

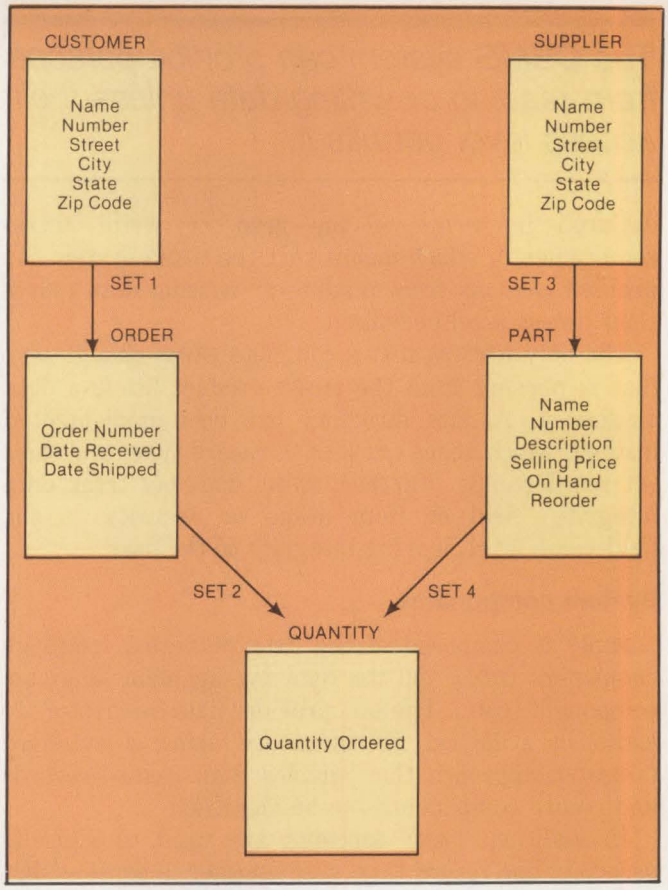


Fig. 2. Logical *relationships to be described.*

MDBS supports Microsoft's MBASIC, OBASIC, BASIC-80, FORTRAN and COBOL, and Digital Research's PL-1, Sorem, Pascal M, Micro Focus, CIS COBOL, North Star BASIC, TRS-80 Disk BASIC (models I and II), Apple Soft BASIC MT, Micro System's Pascal MT, Intersystem Pascal Z, Compiler System's CBASIC and any other languages that invoke the "call" concept.

The theoretical limits of MDBS allow data records to be as much as 65K bytes long, a data item as much as 9999 bytes long and as many as 255 items in a record or 254 record types in a data base. But the suggested practical limits are a data record less than 4000 bytes long, a data item less than 4000 bytes long, as many as 255 data items per record and 254 record types per data base. MDBS supports as many as eight on-line disk drives, each of which is typically limited to 32M bytes. The limit on the number of occurrences of a data record is restricted only by the amount of available disk space.

Security is provided at the user level and can be

This is the fifth in a series of evaluative reports on data base management systems for minicomputers. The first, on the ORACLE system, appeared in the August, 1980, issue, and the second which ran in October, reviewed SEED. Other articles reviewed QDMS in February, 1981, and TAGS last month. These reports are intended to provide sufficient information about DBMS to enable potential users to determine if they should consider installing the system. Each article surveys the features of a single DBMS and evaluates it against a standard set of criteria. If there is a particular system you would like to see reviewed, please send its name and supplier to: Editor, Mini-Micro Systems, *221 Columbus Ave., Boston, Mass. 02116.*

The DBMS system can prohibit persons from reading or writing data unless their access level permits it.

declared in terms of the read or write access requirements, which means that the DBMS system can prohibit persons from reading or writing data unless their access level permits it.

The only feature that a complete DBMS should have that is missing from the MDBS product list is a data dictionary. A data directory has been implemented instead, which keeps track of all record types and their set relationships. Further, MDBS does not track data integrity, field or item usage or security to the field-value level, leaving integrity to the user.

System components

MDBS is composed of the data definition language component (DDL) and the data management language component (DML). The DDL provides data descriptors to establish a logical file structure using a standard CODASYL approach that enables data items—records and record components—to be identified.

In addition, "set" concepts are used to logically associate one record type with another, a concept that brings about the data-base terminology of set owners and members, a CODASYL implementation. Sets that allow a user to enter the data base must be defined because sets control access to data-base records. This is accomplished by identifying some sets as having a record named "system" as the owner. Sets can also be structured with an order or sequence. The CODASYL concept of first in, first out (FIFO) or last in, first out (LIFO) is also implemented. An example of MDBS's file structure definition can be found in Figs. 1-3. Passwords can be established at the file level, providing security to the owner of the data.

The data manipulation language consists of a series of calls that, when established and when parameters are inserted, provide the ability to perform retrieval, modification and update functions common under a data-base management system. The format for the call is as follows: EO = Call (addr, "parameter 1, parameter 2, parameter n"). The first parameter (addr) identifies the data-base function, the second identifies the record required, and the others identify the blocks of data to be stored or retrieved.

An example of a computer program using the DBMS is shown in Fig. 4. In this example, a part is a candidate for reordering if the quantity in the inventory record is less than the quantity required for unfilled orders and is less than some reorder point. The reorder point varies from part to part and is stored in the data base as item "reorder" in record "PART".

Statement 1110 locates the first part to be processed. The logic in statements 1180 through 1320 access the quantity ordered of the part for each unfilled order in the system. The inventory quantity (on hand) is obtained from the data base, and the quantity on order for the part is used to calculate the adjusted inventory level. If this quantity is less than or equal to the reorder point, the number and the name of the part are then printed by statements 1450 to 1470. This process is repeated for all parts.

As the example shows, if a user is familiar with BASIC and the language of the μc, program development and data-base description is simple.

The ability to handle queries and report writer requirements is an important aspect of any data-base system. As a result, the developers of MDBS designed a package entitled queries/report writer, which furnishes a nonprocedural, English-like query language that enables a non-programmer to integrate any MDBS data base on an ad-hoc basis.

If the DBMS has been pre-defined through the data definition language, a user can quickly formulate

EXPLAINING THE EVALUATION MATRIX

The evaluation matrix is the chief tool used in evaluating MDBS. In a competitive evaluation, the matrix would list the criteria used, the vendors being considered and the ratings each vendor received. (Not all criteria are used each time.) The first step is to establish an importance weight factor for each criteria. This factor establishes the relative importance, on a scale of 1 to 10, of a feature or capability of the DBMS in meeting system requirements. The vendor's software is then rated, again on a scale of 1 to 10, according to its ability to meet that specific criterion, establishing the vendor's requirement score. Multiplying the importance weight factor by the vendor's requirement score produces an effective score for the vendor for that criterion.

For example, if one of the selection criteria, a data base loader (software), is extremely important, it could be assigned a weight of 10. If vendor 1 does not provide such an offering, its ability to meet this criterion might be rated as 1. The resulting effective score for this criterion for this vendor would be 10 (1 × 10 = 10). However, vendor 2 might provide such a product, receiving a rating of 10. That vendor's effective score would then be 100 (10 × 10 = 100).

Once all the criteria used in the selection process have been weighted, and all vendors' responses have been given a rating, their effective scores can be calculated and totaled, and the top vendor can be identified.

The criteria listed in the matrix comprise a standard list that could be used to define system requirements for a data base management system. Details of their meaning can be found in any document describing DBMS functions, or are available from Weiss & Associates.

The evaluation matrix is used here only to establish a rating for QDMS and its ability to meet all the criteria as if all had an importance weight of 10. If a criterion receives a score greater than 7, it indicates that QDMS could effectively meet that system requirement. A score of 4 to 6 indicates it is marginally satisfied, and a score lower than 3 is unsatisfactory.

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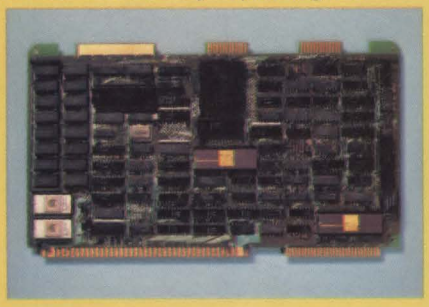

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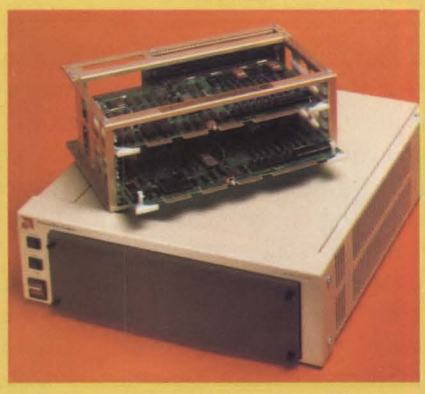

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CIRCLE NO. 106 ON INQUIRY CARD

The report writer features enable a user to specify control breaks in a report, with options permitting statistics—such as mean, variance, etc.—to be printed at each break and at aggegate levels.

queries for data retrieval. Utilities to aid beginners and the capability for defining macro instructions are included. A data-base administrator can define titles and synonyms of various data-base entities, making the query system even more user-oriented. A report generated in response to a query can normally be displayed in the standardized format supplied by MDBS.

A user can customize a report by invoking the report writer feature, which enables the user to specify control breaks in a report, with options permitting statistics, such as mean, variance, etc., to be printed at each break and at aggregate levels. The report writer can specify labels for variables and perform value associations.

Reports can optionally be generated on a screen or printer, or can be saved on file. The query report writer system also allows for the ability to change or modify a data-base value of any data item whose total length does not exceed 255 characters. The query/report writer system has implemented the LIST, FIND and conditional clauses as defined under the CODASYL standards. The code for any set of conditions given the system will accumulate and produce results from its file processing (Fig. 3).

The dynamic restructuring system, also available as a component of the DBMS, provides for the ability to alter data stored in a DBMS controlled by MDBS's data definition language. For example, if new data items are added to a record type, the system will scan the data base, locate all occurrences of the specified record type and allocate additional space within the record occurrence for the newly added items.

This product is available as either an interactive system from which DRS commands can be executed or a special version for use with host languages. Such functions as adding data items to the data base; reallocating pages on a disk; adding record types, set

```
PASSWORDS
        STOCKROOM                   10 10 317-54-7674
        SHIPPING                    20 20 SECRET
        ORDER PROCESSING            30 30 MAILROOM
        NEW ACCOUNTS                20 40 IGLOO
        PURCHASING                  30 50 317-742-7388
RECORD  CUSTOMER                    20 30
ITEM    CNAME       CHAR 30         20 40
ITEM    CNUMBER     BIN   2         20 40
ITEM    STREET      CHAR 20         20 40
ITEM    CITY        CHAR 20         20 40
ITEM    STATE       CHAR  2         20 40
ITEM    ZIP         CHAR  5         20 40
RECORD  SUPPLIER                    10 50
ITEM    SNAME       CHAR 30         10 50
ITEM    SNUMBER     BIN   2         10 50
ITEM    STREET      CHAR 20         10 50
ITEM    CITY        CHAR 20         10 50
ITEM    STATE       CHAR  2         10 50
ITEM    ZIP         CHAR  5         10 50
RECORD  PART                        10 10
ITEM    PNUMBER     BIN   2         10 50
ITEM    DESCR       CHAR 20         10 50
ITEM    PRICE       REAL  8         30 50
ITEM    ONHAND      BIN   2         10 10
ITEM    REORDER     BIN   2         10 50
RECORD  ORDER                       20 20
ITEM    ONUMBER     BIN   2         20 30
ITEM    RECEIVED    BIN   2         20 30
ITEM    SHIPPED     BIN   2         20 30
RECORD  QUANTITY                    10 30
ITEM    QORDERED    BIN   2         10 30
SET     SET1        MAN 1:N 20 30
                        SORTED ONUMBER
OWNER   CUSTOMER
MEMBER  ORDER
SET     SET2        MAN 1:N 20 30
                                FIFO
OWNER   ORDER
MEMBER  QUANTITY
SET     SET3        MAN 1:N 10 50
                        SORTED PNUMBER
OWNER   SUPPLIER
MEMBER  PART
SET     SET4        MAN 1:N 10 30
                                IMMAT
OWNER   PART
MEMBER  QUANTITY
SET     CUSTNAME    AUTO 1:N 20 40
                        SORTED CNAME
OWNER   SYSTEM
MEMBER  CUSTOMER
SET     CUSTNUM     AUTO 1:N 20 40
                        SORTED CNUMBER
OWNER   SYSTEM
MEMBER  CUSTOMER
SET     SUPLNAME    AUTO 1:N 10 50
                        SORTED SNAME
OWNER   SYSTEM
MEMBER  SUPPLIER
SET     PARTDESC    AUTO 1:N 10 50
                        SORTED DESCR
OWNER   SYSTEM
MEMBER  PART
SET     PARTNUM     AUTO 1:N 10 50
                        SORTED PNUMBER
OWNER   SYSTEM
MEMBER  PART
SET     ORDERS      AUTO 1:N 20 30
                        SORTED RECEIVED
OWNER   SYSTEM
MEMBER  ORDER
```

Fig. 3. DDL *code.*

EVALUATION MATRIX VENDOR RATING: MDBS

SELECTION CRITERIA	VENDOR SCORE
1. Data-manipulation capabilities:	
1.1 Data-manipulation processes	4
1.2 Privacy, security techniques	8
1.3 Error-recovery procedures	6
1.4 Data-integrity controls	2
1.5 Format-modifications ability	8
1.6 Redundancy/consolidation controls	8
1.7 File growth	8
Possible: 70	44
2. Query Capabilities:	
2.1 Availability of feature	10
2.2 Ease of use of feature	8
2.3 Capability of feature	10
Possible: 30	28
3. Application Programming Complexities:	
3.1 Program/data independence levels	10
3.2 Methods used to define manipulation and retrieval operations	8
3.3 Subsystem view development	8
3.4 Data base schema description process	8
3.5 Programmer skill required	3
Possible: 50	37
4. Physical File Design:	
4.1 Physical file organization(s)	6
4.2 Record types supported	9
4.3 Record change capability	4
4.4 Ability to combine records	4
4.5 File space management method	5
4.6 Indexing methods	4
4.7 Logical record definition process	8
4.8 Logical structures used	9
Possible: 80	49
5. Datacomm interface capability:	0
Possible: 10	0
6. System installation:	
6.1 Physical file distribution control	0
6.2 Data base loading facility	0
6.3 Hardware configuration requirements for DBMS	10
Possible: 30	10
7. DBMS Utilities:	
7.1 Performance statistics gathering	0
7.2 Minimum reorganization	10
7.3 Simulation facility	0
7.4 Data dictionary facility	0
Possible: 40	10
8. Secondary Features:	
8.1 System performance	8
8.2 DBMS maintenance policy	8
8.3 Systems design and development time	8
8.4 System designer training time	4
8.5 Ease of installation	9
8.6 Documentation available	8
8.7 Vendor support provided	4
8.8 Vendor responsiveness to hardware/software changes	8
8.9 Customer experience	8
Possible: 90	65
Total Possible: 400	MDBS: 243

Fig. 4. An example *of a computer program using DBMS.*

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CIRCLE NO. 107 ON INQUIRY CARD

Created by Dayner/Hall, Inc., Winter Park, Florida

Implementation of MDBS requires the same steps as those necessary to develop a logical data base in any mainframe application development.

members, set owners, set types or passwords; or changing, deleting or renaming any of these functions can be performed dynamically.

Execution may not be extremely fast, because the entire data base must be scanned, but it is certainly faster than rebuilding a data base. Given the trade-off between programming time and machine time, this restructuring system will be justified more often than not.

Using the data management system

Implementing MDBS requires the same steps as those necessary to develop a logical data base in any mainframe application development. The logical structure must be developed first. This requires the use of the data definition language, in which record types are established and set relationships are identified. Passwords and processing logic—the sequence in which records will be placed in the file and the manner in which they will be retrieved—are then established. Once this is completed, code development is performed in the host language of the machine, using the call concept.

Customer reviews

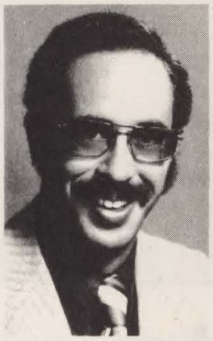
Micro Data Base Systems, Inc., claims to have more than 300 users. A review of some of these customers leads us to believe that most are companies that develop software and use the product for that purpose.

Customers in this category said the product resulted in the ability to implement systems 30 to 45 percent faster than under other file access mechanisms.

Therefore, if an end user buys the product and implements his own software, the same saving in development time could be achieved. In addition, the capability and the features of a full-blown CODASYL implementation provide more power than would normally be expected with the μc environment.

Some of the comments received from MDBS users include:

- "Programmer knowledge of file processing is no longer needed."
- "Development time and, in particular, system file changes are quick and easy to make."
- "MDBS provides a flexible record design that we could not have obtained elsewhere." ■



Harvey M. Weiss, president and principal consultant of Weiss & Associates, Denver, Colo., has had more than 20 years of experience in data processing. His firm's activities include development of data base plans and designs and evaluation and selection of data base management systems for clients in industry, education and government.

COMPANY PROFILE: MICRO DATABASE SYSTEMS, INC.

Micro Database Systems, Inc., was formed in mid-1979. The company, composed of individuals with data base expertise and another group with μc expertise, was organized to offer a product that would fill a perceived void in the μc area—the absence of a serious data base system that could be used effectively on μcs. Development of the products began in 1979, about a year before the company was formed.

The organization considers itself successful in that its product has been written in assembler language. Writing in assembler provides a product that can be implemented on a small- to medium-sized μc and can be fairly efficient in its execution. Its only competition was written in FORTRAN, which is often considered too large and too slow to perform the same functions.

MDBS is available for sale only. Price, including MDBS, the DRS, RTL and QRS options, is $1500. Purchase of the manuals and the language with which the product can operate establishes the price at less than $2000. The company provides training and systems assistance under a consulting agreement, as well as application classes.

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Some straight talk about computer terminals

The last official count identified 256 companies marketing display terminals. One of every four terminals brought to market in the past ten years has been discontinued. Makes it pretty tough on someone who's responsible for making the company's terminal buying decisions. Like, whom do you believe and who will be around tomorrow to talk to?

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DARRELL CROW, Zentec Corp.

Technique allows rapid viewing of data without burdening terminals with software overhead; data movement is minimized

Microprocessor-based computer terminals increasingly are off-loading data-processing and housekeeping chores that CPUs traditionally performed to control peripheral equipment. Terminal microprocessors now do tasks such as interpreting keystrokes, displaying characters, editing text and displaying forms composed of protected and unprotected characters. But an even greater change is affecting terminal design. The technology that brought intelligence into the terminal is bringing intelligence to the techniques of handling and displaying data within the terminal itself.

Illustration by Ralph Mercer

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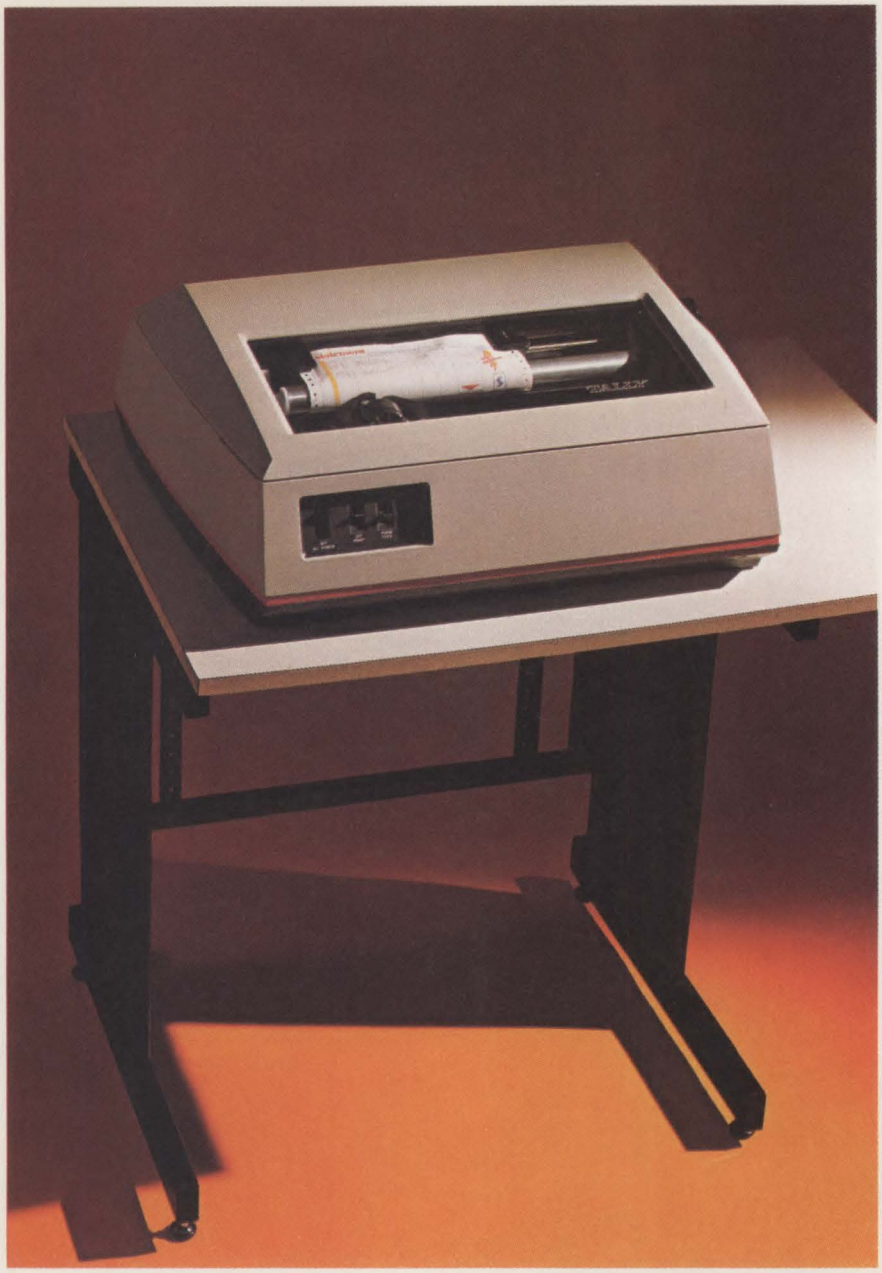

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It is essential to have a terminal architecture that allows rapid data viewing without adding to the overhead of the terminal housekeeping software.

Data are sent to a terminal over an I/O channel or via the keyboard. The terminal stores, processes, displays and disposes of the data. The greater the intelligence of the terminal, the more the data it may have to manipulate or store. It is essential to have a terminal architecture that allows rapid data viewing without adding to the overhead of the terminal housekeeping software.

Conventional terminals provide a video buffer for temporary storage of data to be displayed, which means that each screen position correlates to a specific

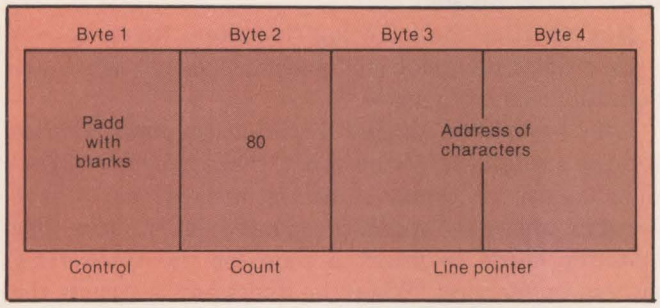

Fig. 1. A sample *list of entry.*

memory address in the video buffer. Such terminals have been enhanced by expanding the size of the video buffer to allow for limited scrolling and paging—usually one to four screens. The major disadvantage with this technique is that all data to be displayed must be moved to the buffer, displayed and then relocated if the data are to be saved.

Introducing video-list architecture

Considerable programming time could be saved, however, and performance could be increased if the intelligent terminal architecture allowed data to be processed, displayed and disposed without substantial movement. Such an architecture is available in the Zentec ZMS intelligent terminal series, which can operate in either the conventional manner (fixed memory reference) or the highly flexible video-list-architecture mode.

Video-list architecture can be software- or firmware-resident, depending on the application. If a programmer wants to use the same video values at all times, the architecture can reside in the firmware, but if he wants to change them constantly, they can be programmed into software.

Video-list architecture does away with the traditional video buffer and allows data that are to be displayed to reside virtually anywhere in memory. The data do not have to be contiguous, even on a line basis. In fact, a single line can be composed of many noncontiguous chunks of memory.

When in the video-list mode, the video hardware will scan through a list of control bytes in memory 60 times per sec. to determine the location and method of displaying data. The video list is composed of a variable number of entries. Each entry contains 4 bytes of control information, which is interpreted as follows:

Byte 1: Instructs the hardware to pad to the end of the display line with blank null characters, or read the next list entry to fill the remainder of the line. This allows for lines shorter than 80 characters to be displayed as a full line, or for displayed lines to be made up of multiple noncontiguous chunks of memory.

Byte 2: Contains the number of characters to be displayed.

Bytes 3 and 4: Contain the address of the first displayed character of the string defined by this entry. A list of entry, therefore, could look like Fig. 1.

Several list entries will be required to describe an entire screen because the maximum number of displayable characters that can be defined by byte 2 is 256. The hardware will "read" as many list entries as required to complete the entire screen.

Fig. 2 illustrates the relationship between the video list, the data residing in general RAM memory and the resulting display. Each list entry can point anywhere in RAM, and yet the hardware will have the lines of text appear contiguous on the display.

Video attributes are screen enhancements such as dim, blank, underscore and reverse video. They highlight the appearance of screen-displayed data and

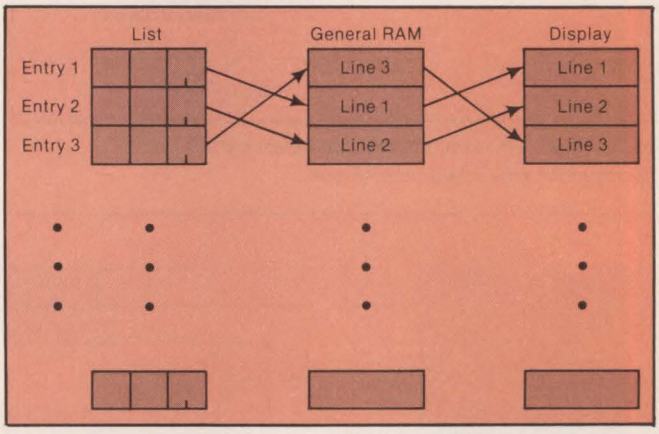

Fig. 2. The relationship *between the video list, the data residing in general RAM memory and the resulting display.*

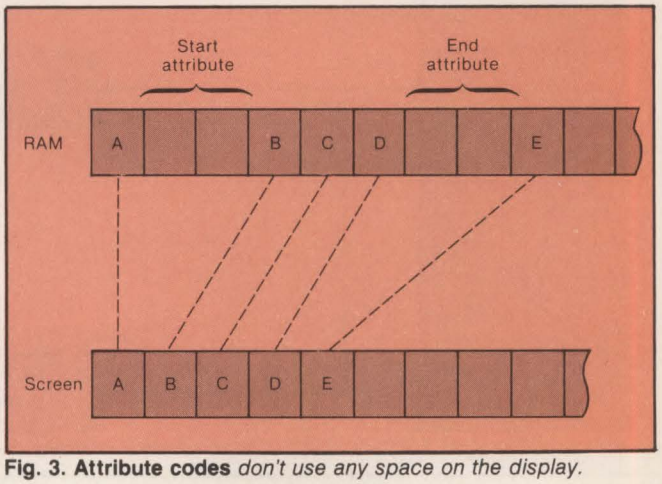

Fig. 3. Attribute codes *don't use any space on the display.*

Video-list architecture does away with the traditional video buffer and allows data that are to be displayed to reside virtually anywhere in memory.

require special handling but offer tremendous advantages for designers of data-entry and text-editing software. In the conventional fixed-memory mode, each code defining a video attribute requires one character position in RAM plus one blank screen position. Thus, a valuable character position on the screen is lost to users. This blank space is extremely frustrating in text-editing software, in which a user may wish to underline a word or a segment of a word.

In the video-list mode, these attribute codes, while embedded in the data stream, do not use a screen space. The approach taken is similar to computer transmission escape-code techniques. The code hex 83 in the ZMS product line is reserved as a special instruction to the video hardware. This 8-bit code is interpreted by the video hardware as meaning that the next immediate character is an attribute-definition code that is to be sent to the video-attribute generator rather than to the video-display shift registers. The result is that attribute codes don't use any space on the display (Fig. 3).

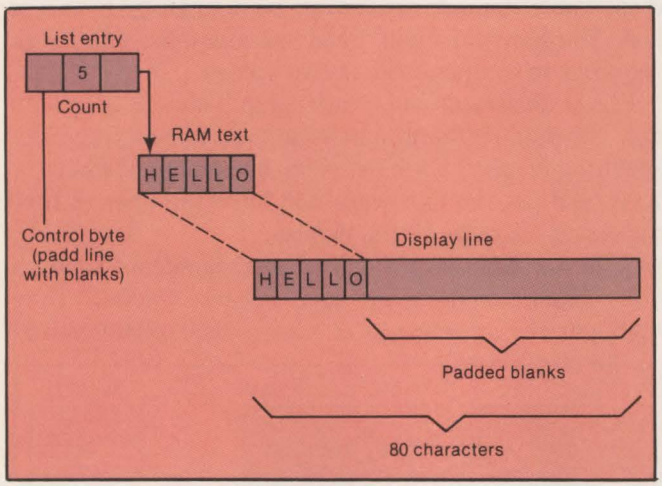

Fig. 4. A line *with fewer than 80 characters can be displayed as a full line on the screen.*

The escape code technique also allows for very fast data handling in many applications. The ZMS series intelligent terminals have four escape codes to provide special instruction to the video hardware. They are:

Hex 80: Does nothing, uses no screen space and is often used as a marker.

Hex 81: Blank the following character with one blank space on the screen.

Hex 82: Hide the following character. No space.

Hex 83: The following character is an attribute-definition code. No space.

Let's examine a specific text-editing application to see the usefulness of the other three escape instructions. A user is typing a manual and wishes to have certain words or phrases printed in italics. The operator needs to insert a code for the typesetting system to interpret. When the italics key is struck, the hardware would insert a hex 82 into the data, followed by an italics instruction code, but the display would remain unaltered.

If an operator wanted to review where the italics codes had been inserted, he would depress the "display italics" key, causing the software to search the RAM data and change all hex 82 codes to hex 80 codes. Resulting italics instruction codes would then be

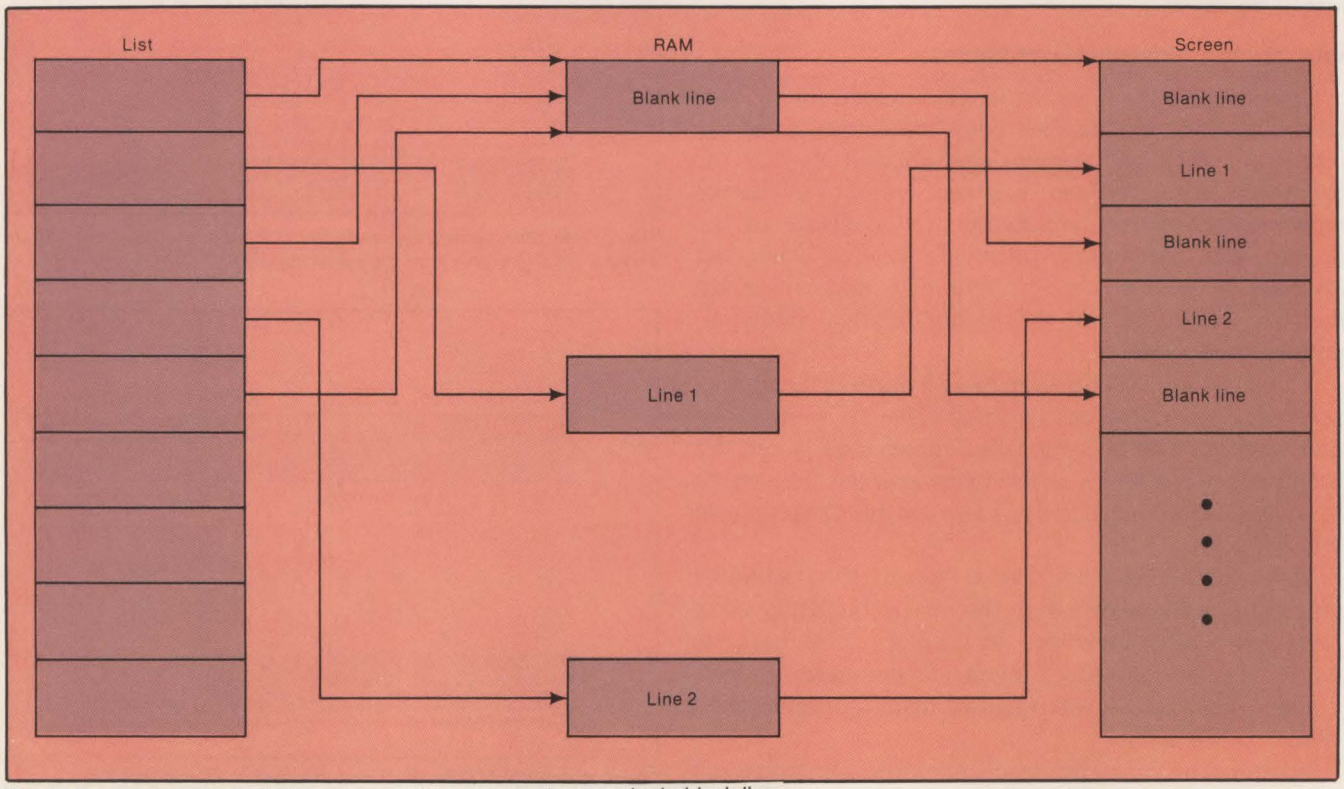

Fig. 5. A programmer *could have several list entries point to a single blank line.*

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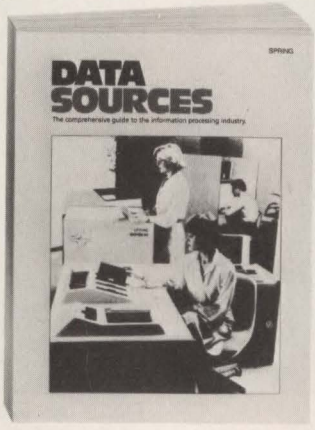

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Each list entry can point anywhere in RAM, and yet the hardware will have the lines of text appear contiguous on the display.

displayed automatically on the next video scan. The italics codes could be hidden in the same manner by changing the hex 80 codes back to hex 82. This is only one of many possible uses of the Zentec video list.

Improving memory efficiency

Byte 1 of each list entry, as noted before, gives the programmer the option to pad a display line with blanks for those lines that do not necessarily require 80 characters (defined by byte 2). Completely blank lines require only a list entry and no RAM storage space. Fig. 4 shows how a line with fewer than 80 characters can be displayed as a full line on the screen. In this example, only a list entry and five characters were required to display a full screen line. All padding is to the right of data and to the end of the line.

Another clever method that saves significant memory is to have multiple list entries point to the same data in RAM. This technique is particularly useful in forms applications, in which the same data are to be displayed in more than one location. Forms displays typically contain more than one completely blank line. Rather than actually having as many physically blank lines as

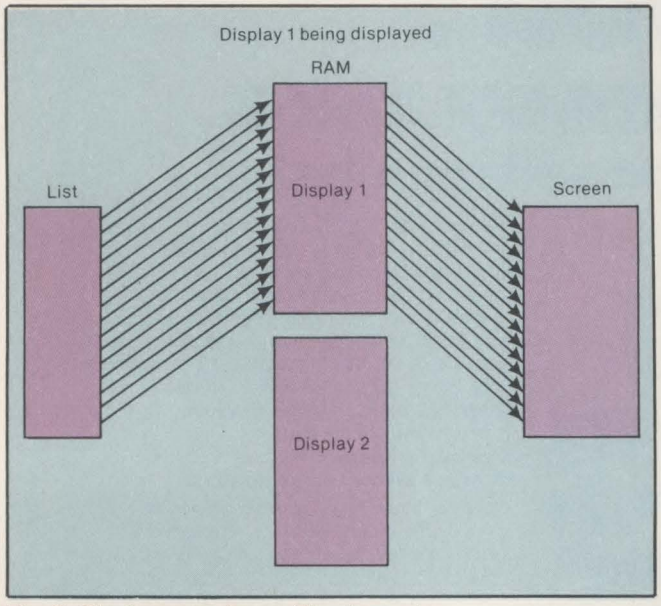

Fig. 6. Displays can *be rapidly changed by simply updating the video list.*

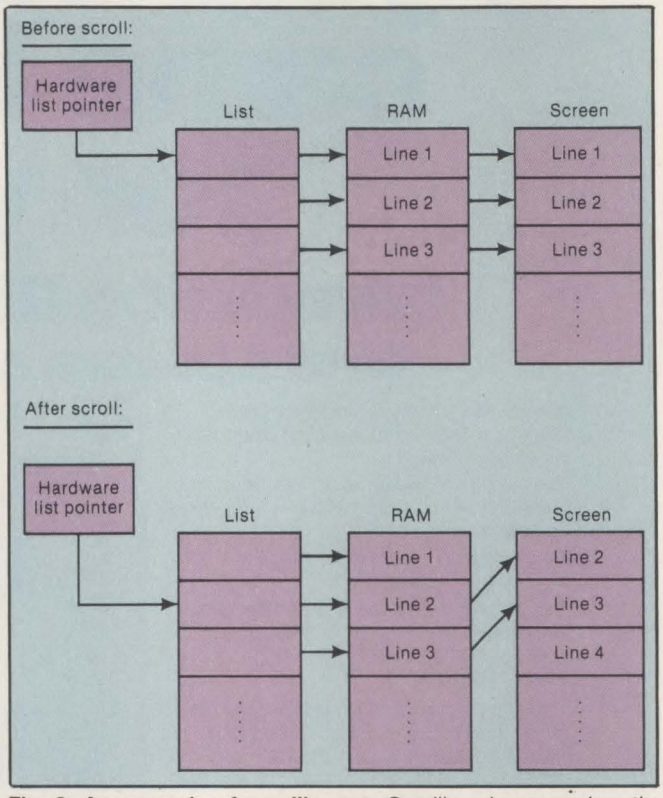

Fig. 8. An example of scrolling up. *Scrolling down requires the same amount of processing, but in reverse.*

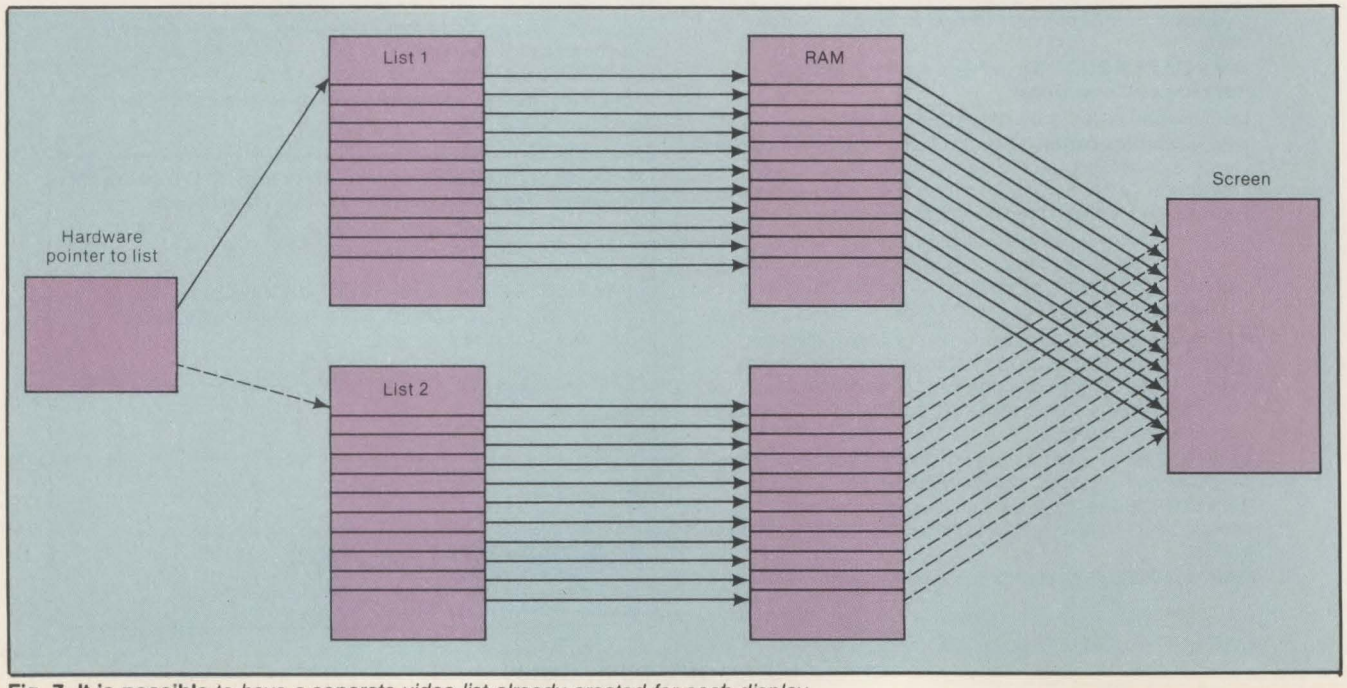

Fig. 7. It is possible *to have a separate video list already created for each display.*

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Because of the flexibility offered by the video-list display, data are not restricted to given addresses in memory.

required, a programmer could have several list entries point to a single blank line (Fig. 5).

Handling multiple displays

Nearly all applications that require the use of intelligent terminals require the handling of multiple displays. In forms applications, the operator must work with multiple-page forms, quickly entering data and moving to the next display page. In menu applications, it is even more important for the system to quickly create page after page of displays. A single entry on the menu will cause a new display to be created in most instances. In text editing, the need to create new forms quickly can easily be seen when an operator is required to scroll through a multi-page document.

In a fixed-memory-reference architecture, the μp must copy the new display byte-for-byte over the old when a display change is required. Copying is slow, and the old display is lost (overwritten). To salvage the old

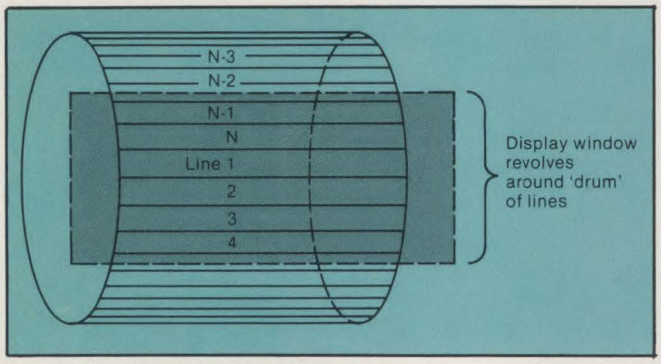

Fig. 9. The screen is viewed *as a window on a revolving drum of lines.*

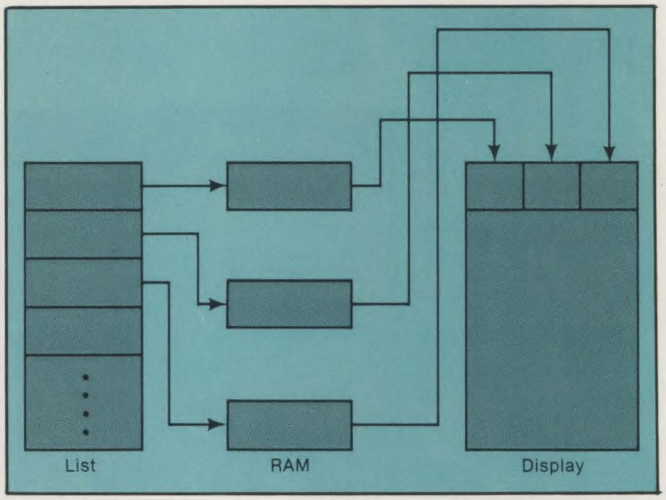

Fig. 10. Memory could look like *this example, where a single display line is composed of data residing in three separate noncontiguous sections of memory.*

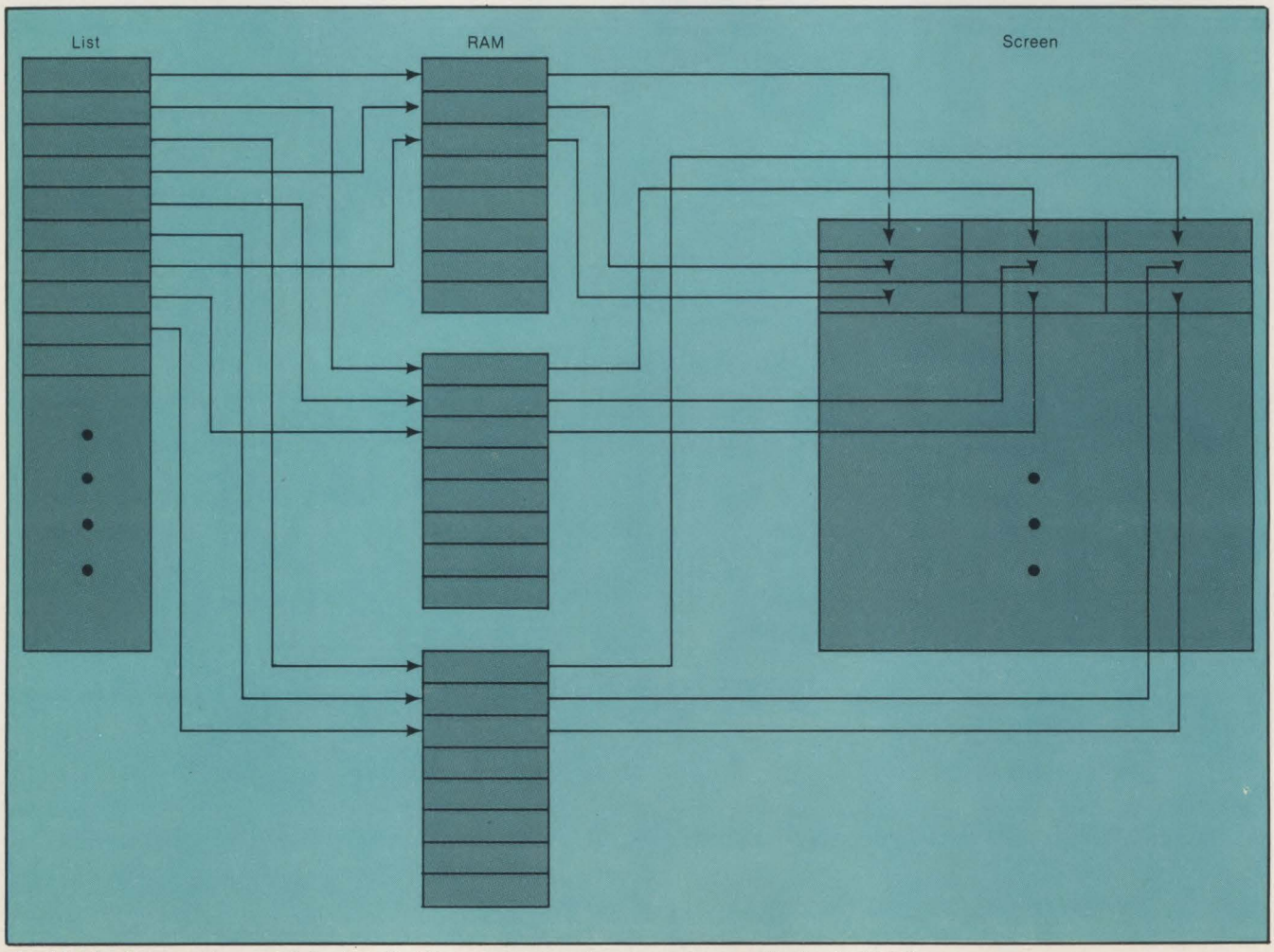

Fig. 11. The list must be maintained *so that three separate columns can be graphically displayed.*

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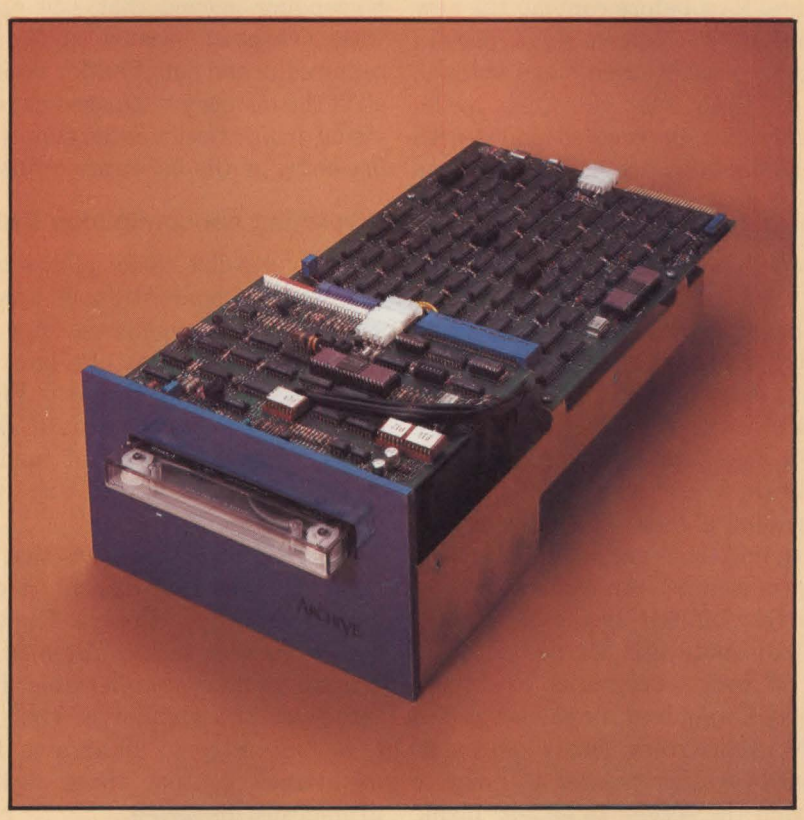

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The video list allows all of the memory to be used as part of the drum, with a visual drum effect created simply by updating the video-list entry or the hardware pointer.

screen, it is necessary to copy the old screen byte-for-byte into general RAM before copying the new screen into the video buffer. To change a single page in the fixed-memory-reference mode, then, 4096 bytes of data must be moved. With the video-list mode, however, several screens can be created and stored anywhere in memory before they are needed, and can be freely displayed without destroying or moving display data. Fig. 6 illustrates how displays can be rapidly changed by simply updating the video list itself (approximately 100 bytes).

It is also possible to have a separate video list already created for each display (Fig. 7). Thus, to display or change a screen requires only that the 2-byte hardware pointer to the video list be updated. (A 2-byte hardware pointer is provided in the Zentec ZMS products to inform the video hardware of the address of the first byte of the video list in general RAM. The video list can reside anywhere in RAM, and there are no limitations on the number of lists a programmer can compose.)

Because of the flexibility offered by the list pointer and the video-list display, data are not restricted to given addresses in memory. Programs are more flexible, and if no display is required, no memory need be used. For example, a program that requires no display can set the hardware list pointer to point to nonexistent RAM, causing the screen to appear blank; memory is required for the display.

An aid to scrolling

The speed of scrolling the intelligent terminal can be drastically improved with video-list architecture. An example of scrolling up is shown in Fig. 8. (Scrolling down requires the same amount of processing, but in reverse.)

The hardware list pointer is incremented (by 4) to point to the next list entry, provided that each list entry points to a complete line. This causes the video hardware on the next video scan to display the second line of the original display as the top line of the new screen. The screen now appears as though the data have physically moved up one line, but only one data byte has been altered. Another technique for scrolling is to move all list entries up one list entry. This has the same visual effect as the previous example.

The important point is that the actual data being displayed never have to be moved. The visual effect of moving massive amounts of data is accomplished simply by updating a few control bytes in the video list on the list pointer.

The complexity of implementing "drum scrolling" (circular list) is greatly simplified by using the video list. Drum scrolling is defined (Fig. 10) as having the screen visually appear as a window that is scrolling through a large number of text lines. When the last line is displayed, it is followed by the first line of the document, creating a circular effect. The screen is viewed as a window on a revolving drum of lines (Fig. 9).

In the fixed-memory-reference architecture, the size of the drum is limited to the size of the video buffer. Expanding beyond that size painfully increases software overhead because of the mass data movement required in and out of buffer areas. The video list allows all of the memory to be used as part of the drum, with a visual drum effect created simply by updating the video-list entry or the hardware pointer.

Displaying noncontiguous RAM data

The video list easily allows the display lines to be composed of noncontiguous RAM segments. There is a single list entry composed of 4 control bytes for each noncontiguous section of a line. For example, memory could look like the example in Fig. 10, in which a single display line is composed of data residing in three noncontiguous sections of memory. This use of the video list allows almost any conceivable line layout within RAM.

In the same manner that the list allows for noncontiguous data display, it can be used to provide for vertically split screens. The text of each split screen should be kept as a contiguous RAM segment to keep programming comprehensible. For each line displayed, there are the number of split-list entries describing that line. Fig. 11 illustrates how the list must be maintained so that three separate columns can be graphically displayed. ■

Darrell Crow is a senior product specialist at Zentec Corp., Santa Clara, Calif.

NEXT MONTH IN MMS

May being Minicomputer Month, our next issue will feature:

- Two mini surveys—one of general-purpose OEM computers, another on 32-bit systems.
- A summary of mini market trends based on highlights of Mini-Micro Systems' annual Mini Market Survey.
- Prognostications on the fate of the 16-bit mini by Efrem Mallach, Honeywell's manager for market and competitive analysis.
- Observations on changing patterns in minicomputer distribution by a leading small computer adviser.
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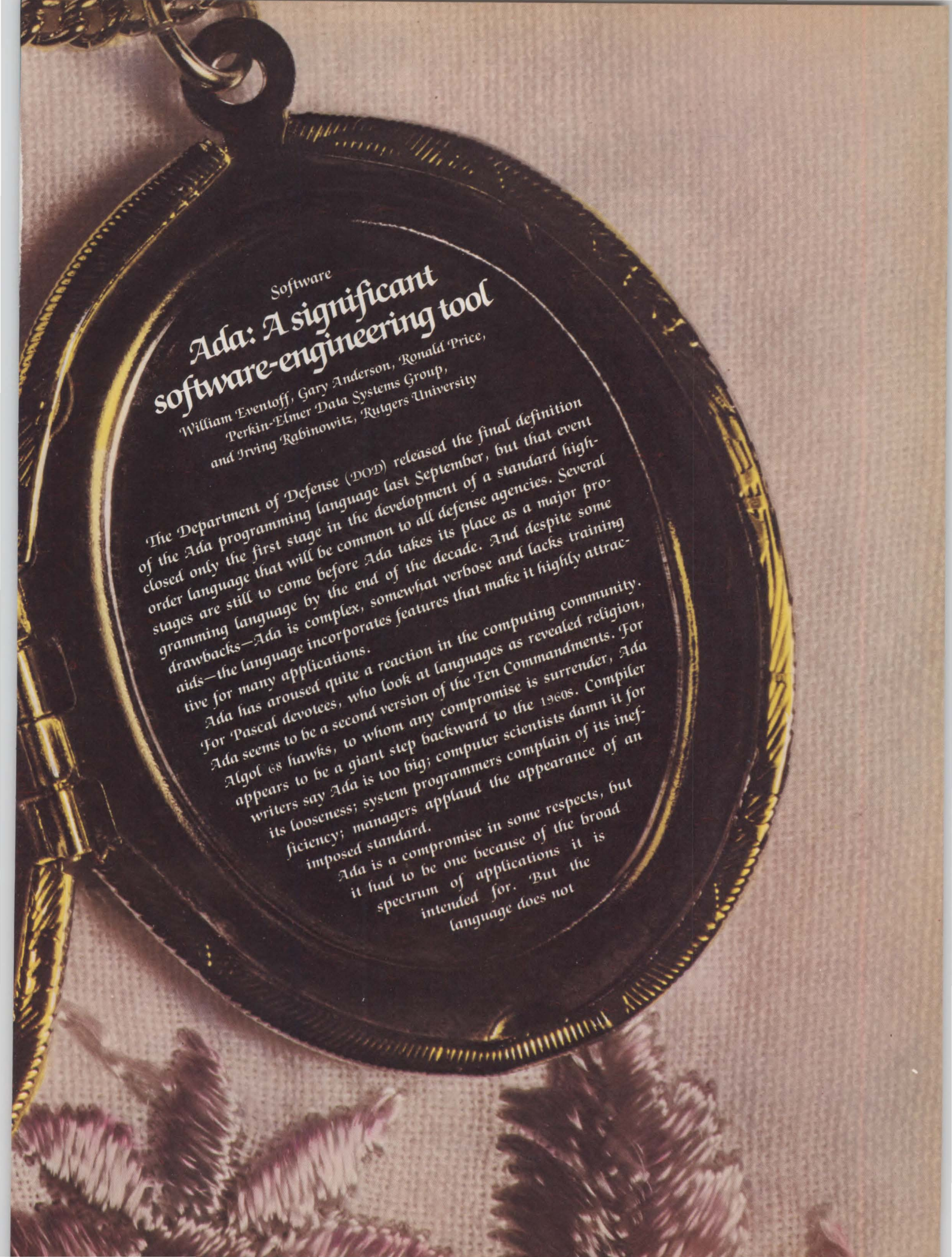

Software

Ada: A significant software-engineering tool

William Eventoff, Gary Anderson, Ronald Price,
Perkin-Elmer Data Systems Group,
and Irving Rabinowitz, Rutgers University

The Department of Defense (DOD) released the final definition of the Ada programming language last September, but that event closed only the first stage in the development of a standard high-order language that will be common to all defense agencies. Several stages are still to come before Ada takes its place as a major programming language by the end of the decade. And despite some drawbacks—Ada is complex, somewhat verbose and lacks training aids—the language incorporates features that make it highly attractive for many applications.

Ada has aroused quite a reaction in the computing community. For Pascal devotees, who look at languages as revealed religion, Ada seems to be a second version of the Ten Commandments. For Algol 68 hawks, to whom any compromise is surrender, Ada appears to be a giant step backward to the 1960s. Compiler writers say Ada is too big; computer scientists damn it for its looseness; system programmers complain of its inefficiency; managers applaud the appearance of an imposed standard.

Ada is a compromise in some respects, but it had to be one because of the broad spectrum of applications it is intended for. But the language does not

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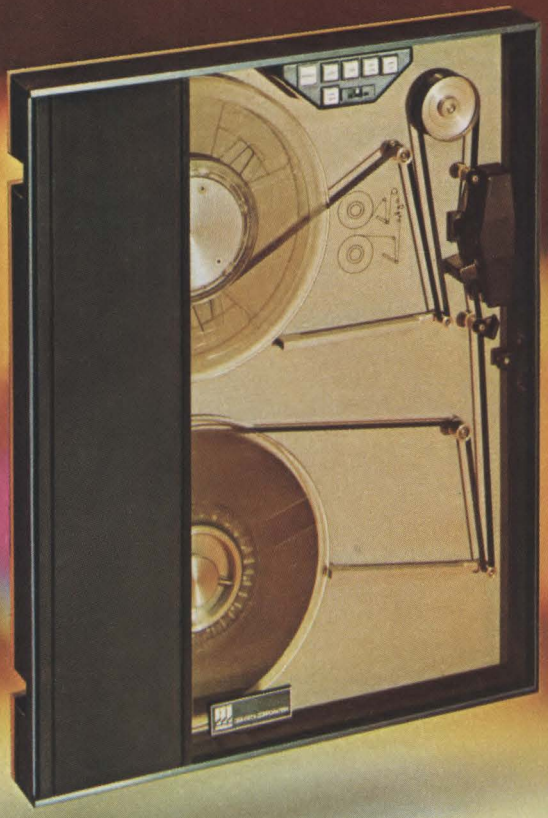

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While Ada is not expected to encroach on COBOL's position in the commercial community, its impact on the computing industry is expected to rival, if not exceed, that of COBOL.

compromise its major purpose—that of being an effective systems-engineering tool to help ease an existing software crisis in the DOD. That crisis has caused systems to be delivered late, to exceed projected costs and to fail to satisfy the original specifications; reliability and maintainability usually do not fare well, either.

The increasing complexity of software is due, in part, to cheaper and more capable computers, but applications are also becoming more complex as computing technology evolves. Tools are needed that will help produce efficient, reliable, large and complex programs that can be understood and modified by people outside the original system design team.

Fortunately, engineering principles and disciplines are evolving to cope with this software crisis. Ada incorporates many new and well-accepted concepts. For example, the language provides facilities for modularity, abstraction, localization and data typing, which is not surprising, considering the context in which it was developed (see "The evolution of Ada," p. 228).

Although Ada was designed to satisfy the needs of embedded-computer systems (computer systems that are contained in and provide the programmable logic for dedicated larger systems), it can also be used for most ordinary programming applications. Compiler writers, for example, can take advantage of its features. Even scientific programmers will find Ada suitable for problem solving in a more satisfying manner than offered by FORTRAN. And, while Ada is not expected to encroach on COBOL's position in the commercial community, its impact on the computing industry is expected to rival, if not exceed, that of COBOL.

Photograph and original art on previous page by Ralph Mercer. Photo of Augusta Ada Byron courtesy of the British Computer Society and Perkin-Elmer Corp.

```
Package VECTOR_FUNCTIONS is
        type VECTOR is array (1..3) of REAL;
        function " + " (u, v : VECTOR) return VECTOR;
        function "*" (u, v : VECTOR) return REAL;
          --scalar product
        function "*" (a : REAL; v : VECTOR) return VECTOR;
          --scalar times vector
  ...
end VECTOR_FUNCTIONS;
```

```
package body VECTOR_FUNCTIONS is
        --declarations of types, variables, and
          subroutines
        --used by the functions " + ", "*", and "*"

        function " + " (u, v : VECTOR) return VECTOR
          --is code for vector addition
        end " + ";
        function "*" (u, v : VECTOR) return REAL is
          --code for calculating a scalar product
        end "*";
        function "*" (a : REAL; v : VECTOR) return
          VECTOR is
          --code for multiplying a vector by a
          --scalar
        end "*";
```

Fig. 1. An example *of an Ada package that supplies subroutines.*

Part of Ada's appeal is that while it incorporates most of the features found in programming languages such as FORTRAN, COBOL, PL/I and Pascal, it also provides a framework and set of features that support well-accepted software-engineering principles. Those features include strong typing, packages, generic types, tasks and separate compilation.

When describing the properties and behavior of various objects in ordinary discourse, the notion of the type of an object is always implicitly present. Phrases such as "let L1 and L2 represent the lengths of the sides in inches," and "let A represent the area of the figure in square inches" are commonly used, and are intended to convey two things:

- The range of values of L1, L2 and A is to be

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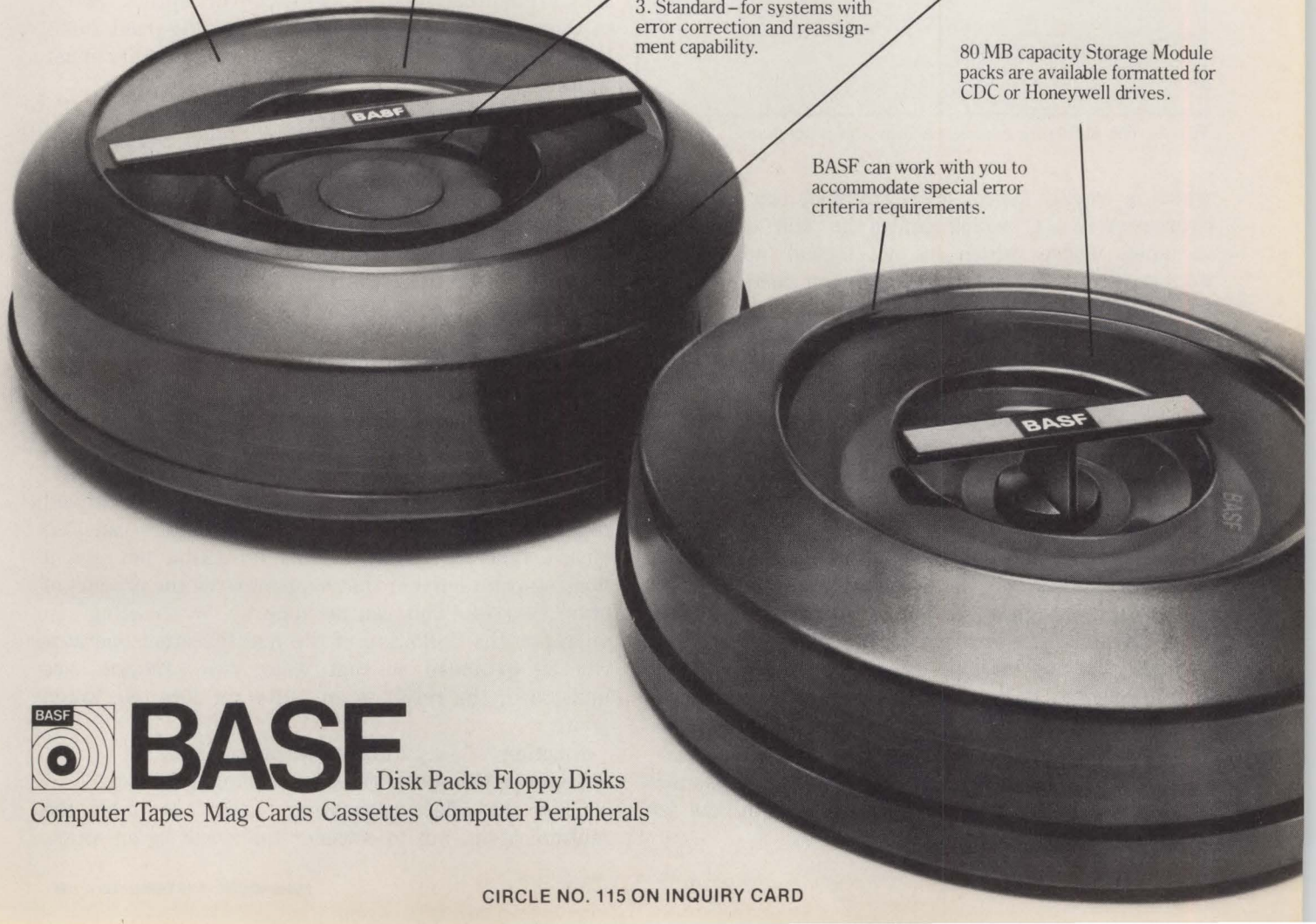

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Overloading is possible in Ada for all defined types, and can be exploited to great advantage in constructing packages of procedures to deal with objects of whatever types a programmer wishes to define.

restricted to positive real numbers, and

- L1, L2 and A can be used in formulas only in ways that are meaningful for lengths and areas. For example, adding L1 and A wouldn't be considered.

A common way to attach types to objects is to use typographical conventions, such as lower-case italics for scalars, lower-case boldface for vectors and upper-case italics for matrixes. These conventions provide a clear visual cue as to the type of a variable.

In a programming language, the analog of such usage is the concept of strong typing. Most languages require variables to have their type declared. PL/I, for example, requires statements such as

DECLARE A FIXED, I FLOAT;

But, strong typing implies more than just declaration. It restricts the values and operations that apply to a variable to those defined by the variable's type. In PL/I,

```
    PROCEDURE IN_LINE (L : IN_LINE);
and
    ENTRY IN_LINE (L: IN_LINE);
ARE CALLED VIA
    IN_LINE(X);
```

Fig. 2. The similarity *between entries and procedures.*

which is weakly typed, a programmer can write the expression "A & I," which applies the "and" operator to variables whose values are not logical (not of type BOOLEAN); a strongly typed language does not allow such freedom.

There are two primary advantages to a language with strong typing features over one in which typing is weak:

- The "conceptual distance" between the problem specification and its realization as a program is reduced; consequently, the programmer introduces fewer errors as the program is being written.
- The compiler has access to information that can be used to determine whether variables are used correctly; consequently, it can detect many of the errors caused by oversights.

In most languages, the type of an object is a reflection of its machine representation, usually an integer or floating-point number. All that could be said about L1, L2 and A in FORTRAN, for example, is

REAL L1, L2, A.

While this expression declares the three variables to be floating-point numbers, there is nothing in the language to prevent their misuse.

A type in Ada is much more problem-oriented, even though the primitive data types are machine-based. Thus, a programmer can declare that lengths are to be positive numbers no larger than 12 in., and that areas are to be no greater than 100 sq. in. by writing

type LENGTH is new FLOAT digits 2 range 0.0..12.0;
type AREA is new FLOAT digits 3 range 0.0..100.0;

and then declare variables of these types by writing

L1, L2 : LENGTH;
A : AREA;

Such declarations allow the compiler to insert run-time checks that will catch an erroneous setting of a length or an area to a number outside the respective range. Moreover, an accidental assignment of an area to a length, such as

L1 := A;

can be caught at compile time, as can "mixed-mode" expressions, such as

L1 + A.

While such constraints are useful, they can sometimes be a nuisance. Suppose we are interested in objects whose area (in square inches) is the same as the length (in inches) of a side. In a language in which type checking is not so strong, we could write

IF A = L1 THEN...

but this would be caught as an error in Ada. In a weakly typed language, we could write this statement even if it were not intended, and get away with it. Ada allows such mixing, but in a much more controlled way. The simplest approach is to explicitly convert both L1 and A to their underlying type, namely floating-point numbers, and compare them. An Ada programmer must write

IF FLOAT (L1) = FLOAT (A) THEN...

The important point is that all conversions between data types must be explicit in Ada. A programmer is forced to be aware that a variable is being used in an unusual way. This discipline can prevent surprises like those that await a PL/I programmer who writes

DECLARE B BIT(1) INITIAL (1);

and discovers that the value assigned to B, because of conversion between the fixed-point number 1 and a bit-string, is 0 (or more precisely, '0'B).

The benefits of such strong typing extend beyond the detection of bad assignments and mixed-type expressions. The facility also provides programmers with the tools to define meaningful operations in a natural way. For example, not only can two LENGTHs be multipled together to get an AREA but programmers can also ensure that the result is truly an AREA, not just a floating-point number that happens to be the product of two LENGTHs. This can be done by "overloading" an operator: the definition of the multiplication operator can be extended so that when two LENGTHs are multiplied, the result is an AREA. In Ada, we would write

function "*" (x,y : LENGTH) return AREA is
begin return AREA(FLOAT(x) * FLOAT(y)); end;

Then the effect of writing "L1*L2" is to do the multiplication, but to consider the result as an AREA,

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By incorporating strong typing into Ada, the language's designers have provided a software-engineering tool that eases both program development and maintenance.

not just as a floating-point number. Such overloading is possible in Ada for all defined types, and can be exploited to great advantage in constructing packages of procedures to deal with objects of whatever types a programmer wishes to define.

The strong typing characteristics of the language apply to all subroutines (procedures and functions) written by a programmer, not only to overloaded operators. When declaring a subroutine, a programmer is required to specify the types of the arguments and, in the case of a function, the result. For example, to declare the function COMPARE_AREAS we would write

```
function COMPARE_AREAS (L1, L2: LENGTH;
                        A :AREA) return BOOLEAN is
   --This is how comments are written in Ada.
   --Declarations of variables local to the
   --subroutine
begin
   --The body of the subroutine, which may multiply L1 and
   --L2 together, and compare the results to A, returning
   --TRUE if they are equal and FALSE if not.
end COMPARE_AREAS;
```

When we say that such subroutines are strongly typed, we mean that the function COMPARE_AREAS can only be applied to two LENGTHs and an AREA, and can only be used in a context in which the values TRUE or FALSE are meaningful. It makes no sense to write

```
AREA2 := COMPARE_AREAS(BASE, HEIGHT, 327.4);
```

because the value of the function result is of type BOOLEAN, while presumably AREA2 is of type AREA. The compiler is able to detect such violations, and report them in its list of diagnostic messages.

By incorporating strong typing into Ada, the language's designers have provided a software-engineering tool that eases both program development and maintenance. The feature facilitates construction of programs, permits detection of a variety of errors at compile time and documents the program in a way that eliminates any questions about the possible values of a variable or the operations that can be meaningfully applied to it.

Packages: another virtue of Ada

Besides Ada's strong typing facility, another virtue is the Ada package, which is one of the major aids to program modularization a programming language can provide. This language construct groups logically related objects together in a separate program unit, which is given a name so that the objects appearing in it can be treated coherently. Thus, a large program can

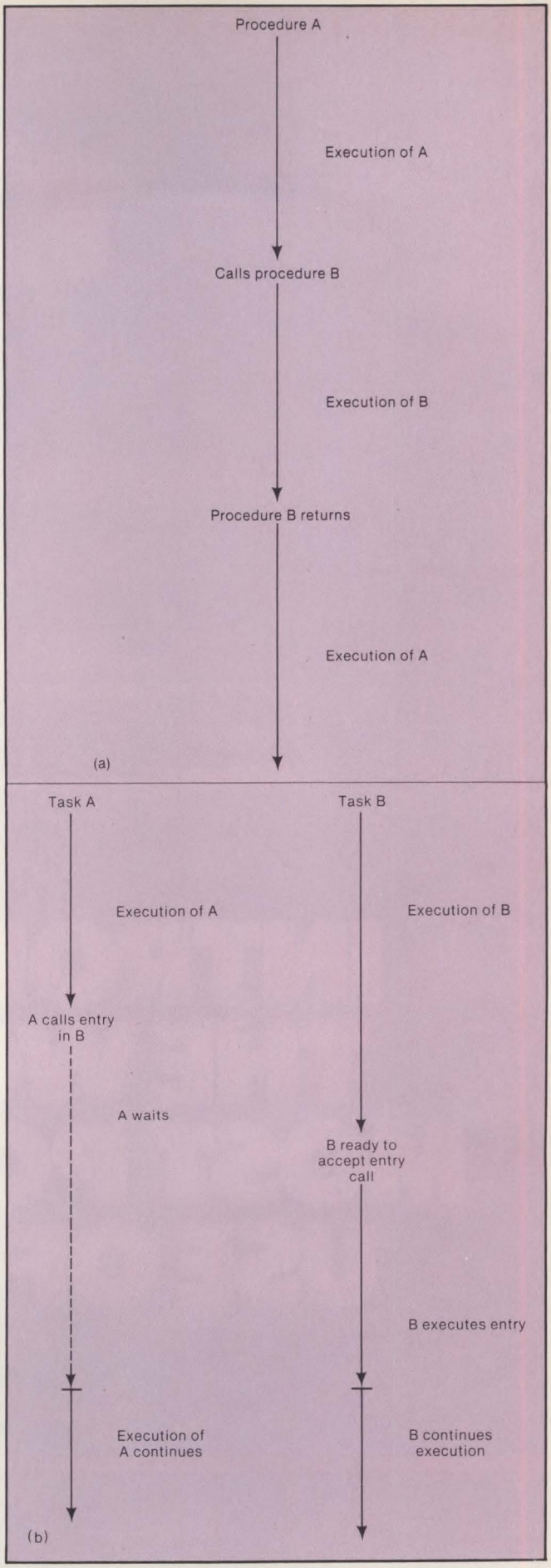

Fig. 3. Schematic diagram *of procedure execution (a) and entry execution (b).*

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There is enough information in the visible part of the package to allow a compiler to make thorough checks on the consistency of the declarations of objects and their use.

be segmented into a collection of smaller modules that can be developed independently and then linked together.

In addition to supporting one of the primary goals of modularization, Ada's package can also be constructed to hide information within its boundaries. This control over the visibility of items is an important safety feature, because it prevents other parts of a large program from having undesired access to what should be a closed unit.

The simplest form of a package is a named collection of constants and variables, which serves much the same purpose as a FORTRAN common block, though considerably more flexibly. Such a package might appear as

```
package PLOTTER is
   PEN_UP:BOOLEAN;
   X_MIN, Y_MIN: constant INTEGER: = 0;
   X_MAX, Y_MAX: constant INTEGER:= 1023;
   X, Y: array (1 .. 100) of INTEGER;
end PLOTTER;
```

A program with access to this package can then use these objects by references that specify both the package and the object. For example,

```
PLOTTER. PEN_UP := TRUE;   for I in 1 .. 100 loop
   PLOTTER.X (I) : = I;
   PLOTTER.Y (I) : = I;
   end loop;
   ...
```

Such references can be simplified by acquiring the name space of the package through a use clause, as in

```
declare
   use PLOTTER;
begin
   PEN_UP := TRUE;
   for I in 1 .. 100 loop
   X (I) := I; Y (I) := I;
   end loop;
   ...
```

A much more general use of packages is to group related subroutines, allowing them to share variables among themselves, while simultaneously inhibiting access to these variables from outside the package. Denial of access is achieved by making use of the information-hiding aspect of Ada's package. A package containing subprograms is defined in two parts: the package specification and the package body.

The package specification defines the interface between the package and its users. This interface consists of any declarations of variables and types that are to be made accessible to users, and all subroutine headings that can be called from outside. None of the variables or types that are to be hidden from users is contained in this part. They occur in the package body.

The package body contains the bodies of the subroutines and any variable and type declarations used exclusively by them. The routines in this part of the package can be used, but their internal algorithms are not visible. That is, parts of the program outside the package do not have access to any information relating to their implementation.

To illustrate the utility of this type of package, consider the package VECTOR_FUNCTIONS (Fig. 1). This package can be included as part of a user program. By giving a "use VECTOR_FUNCTIONS" clause, a programmer can use the names VECTOR, "+" and "*" without qualification. The programmer can declare objects to be VECTORs, and assign to them:

```
e1: constant VECTOR:= (1.0, 0.0, 0.0);
e2: constant VECTOR:= (0.0, 1.0, 0.0);
e3: constant VECTOR:= (0.0, 0.0, 1.0);
u, v, w : VECTOR;
```

Such declared objects can be used in the usual way:

```
v := 3.0*e1 + 4.0*e2 + 5.0*e3;
  --In this, the "+" means vector
  --addition, and the "*" is the
  --second multiplication
  --function.
xdisp := v*e1 + u*w;
  --The "*" is the first one, the "+" is
  --REAL addition, and xdisp must be REAL.
```

A programmer can also deal with the components of the vectors because they are known to be arrays:

```
v(1):= 6.0 + u(2) + w(3);
```

In short, a programmer who wants to work with vectors is given all the necessary tools, but none that are inapplicable. A programmer cannot apply any operators to a vector that are not defined in the package, unless such operators are explicitly defined elsewhere in the program. The Ada package allows the program to be written in a form that is closer to the abstract concept of vectors than is possible in other languages. The conceptual distance from problem to program has been considerably shortened.

But shortening that process isn't the whole story. While most of the internals of vector handling are hidden, a programmer still is aware of, and can use (or misuse), the vectors themselves, because their representation as three-component arrays of REALs is known. Suppose that for efficiency, storage considerations or a need for generality, the author of the package must rewrite it so that vectors are no longer represented by such arrays, but by some other data structure. Any program that used the old version of

```
ACCEPT IN_LINE (L: IN_LINE) DO
      SEQUENCE OF STATEMENTS
END;
```

Fig. 4. Example of an accept statement. *The sequence of statements bracketed by DO and END define the action to be taken when the entry IN_LINE is called.*

A concurrent Ada program will be more reliable and easier to maintain than its PL/I counterpart because Ada's task construct, unlike PL/I's, supports both information hiding and interface localization.

VECTOR_FUNCTIONS would then have to be rewritten and recompiled to use the new version. To allow even type representations to be hidden from the user, without restricting the use of all the capabilities of the package, Ada includes the concept of the private type, a type whose name is known outside the package, but whose characteristics are not. The new coding for the visible part of VECTOR_FUNCTIONS might then be:

```
package VECTOR_FUNCTIONS is
  type VECTOR is private;
  function "*" (u, v :VECTOR) return VECTOR;
    ...--Just as in the earlier version.
  function MAKE VECTOR(x,y,z : REAL) return VECTOR;
    --A new function.
  function XCOMP(v : VECTOR) return REAL;
    --Another one, to find the x-component.
    ...
private
  type VECTOR is
    --A type definition which must be here for use by
    --the compiler, but whose characteristics cannot
    --be used outside the package.
end VECTOR_FUNCTIONS;
```

A user of this package can no longer initialize e1, e2 and e3 as we did previously, because there is no assurance that "(1.0, 0.0, 0.0)" is a literal of type VECTOR. Although Ada allows the components of an array to be specified this way, the programmer doesn't know that a VECTOR is represented by an array. How then can we assign values to an object declared to be a VECTOR? We must use the function MAKE_VECTOR provided by the package, and write

```
e1: constant VECTOR:=MAKE_VECTOR (1.0, 0.0, 0.0);
```

While this appears to make using the package cumbersome, it is one more element of safety the language offers. The compiler will permit a user to operate on vector objects only with the subroutines provided by the package. A programmer cannot deal with VECTORs as if they were simply arrays, but must be aware that a VECTOR has properties that might be very different from an array. v(1) is no longer to be taken as identical with the x-component of v. A programmer has to say explicitly what is wanted: XCOMP(v).

The package VECTOR_FUNCTIONS can be considered as a realization of what has become known as an abstract data type. To completely specify what is meant by a data type, we have to know not only the set of values that an object of the type can take on, but also what operations are applicable to such objects. The Ada package fulfills both needs.

The benefits of the package go beyond program creation. There is enough information in the visible part of the package to allow a compiler to make thorough checks on the consistency of the declarations of objects and their use. Ada's abstract data type—the package—is a major software-engineering tool for program development.

Generics: building on the past

Most engineering problems dealing with physical systems are solved by using more primitive modules, components, algorithms, etc. The programming world rarely is able to take advantage of previous work, however. Even when a programmer takes the time to look up or investigate existing programs that might be equivalent or similar solutions of a problem, the conversion task is rarely worth the effort. Ada's generic facility both encourages and simplifies capitalizing on previous work, enabling programmers to be more productive.

A generic program unit can be thought of as a template for a whole class of program units, all of which share certain commonalities, but each of which is specialized for a certain use. Such parameterization is common in all programming languages, but in restricted areas. For example, a function definition can be regarded as a template for each of its calls, with each call specializing the subroutine for a specific applica-

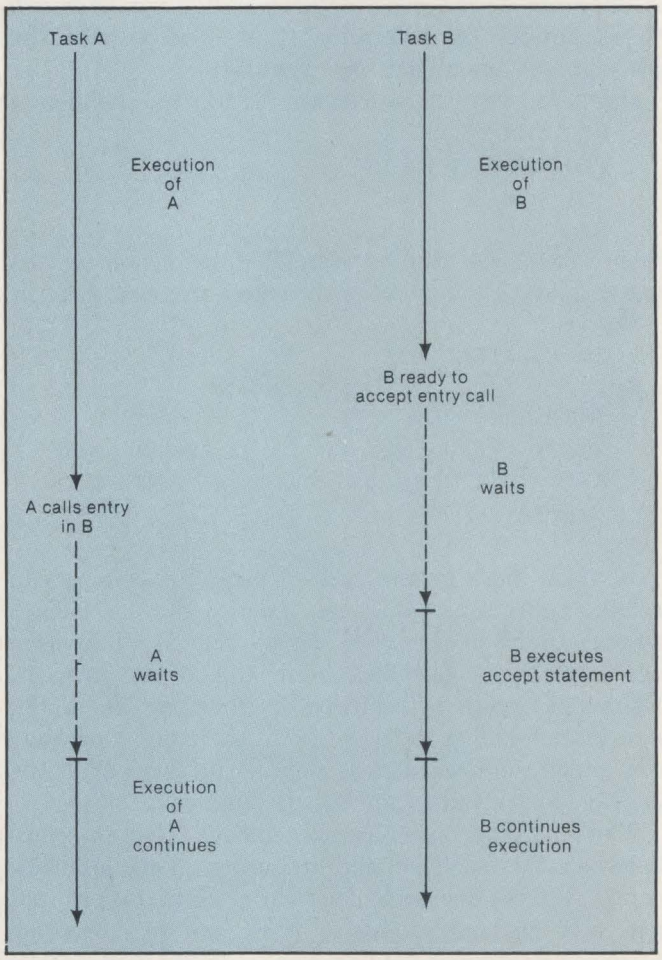

Fig. 5. Schematic diagram *illustrates the execution of an accept statement.*

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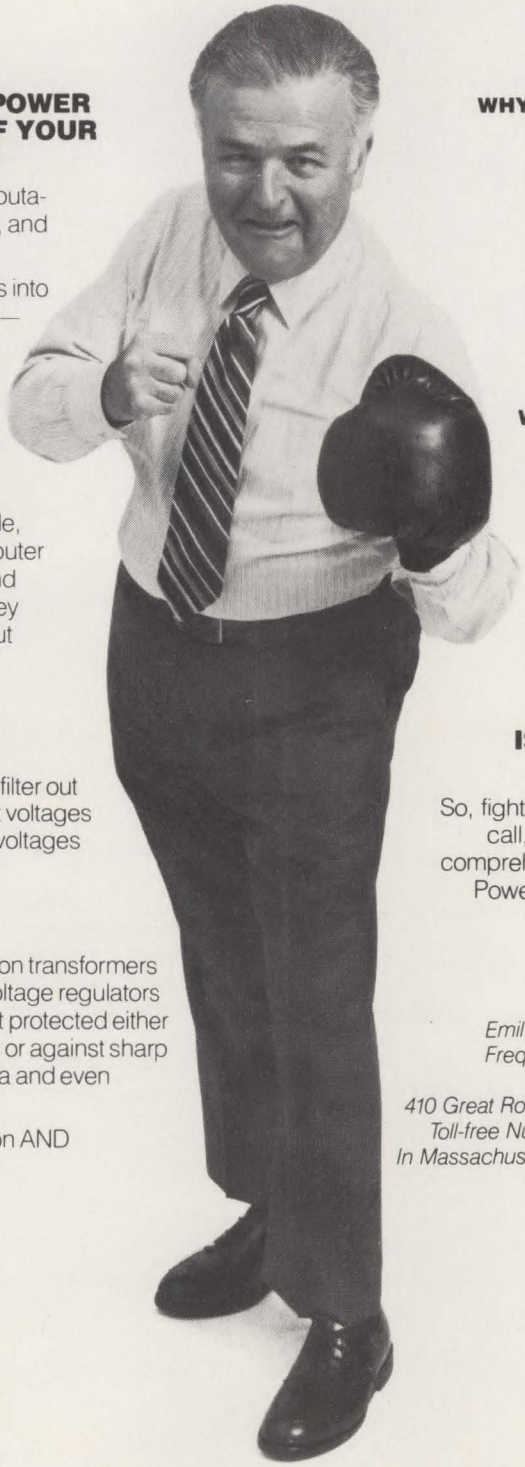

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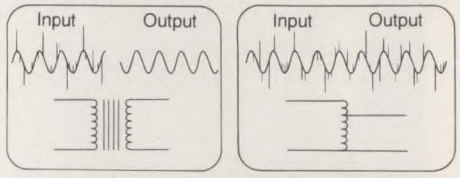

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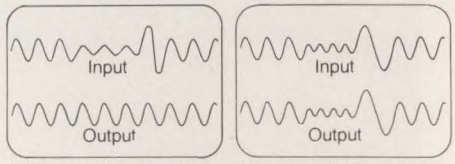

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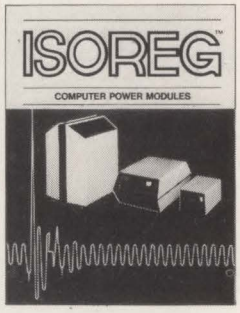

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The ability to separate the compilations of an interface definition from its implementation is a useful software-engineering tool to control program development.

tion. This idea of parameterizing a piece of code can be extended so that an arbitrary text can be treated at compile time in much the same way that the function definition is treated at run time. This technique of taking a generalized text and creating, or "instantiating," a specific instance of it at compile time will be more familiar to assembly language programmers, who have long had the macro facility available. A generic unit has characteristics in common with a macro, but is considerably extended and adapted to the language.

Consider a procedure to interchange two real numbers:

```
procedure SWAP(x,y : in out REAL) is
   temp : REAL;
begin temp := x; x := y; y := temp; end SWAP;
```

A procedure to interchange two vectors would look exactly the same, except that it would have VECTOR where we have REAL. In Ada, we can abstract this kinship by defining the type of the objects to be exchanged as a parameter. We write the generic subroutine declaration

```
generic
   type T is private;
   procedure EXCHANGE(x,y : in out T);
```

and the generic subroutine body

```
procedure EXCHANGE (x,y : in out T) is
   temp: T;
begin temp:= x; x:= y; y:= temp; end EXCHANGE;
```

(Note that "type T" is the parameter of this generic subroutine.) We cannot actually use EXCHANGE because it is only a template for an executable procedure, but we can create actual procedures for whatever types we need. For example, we can create a procedure to interchange two REALs by writing

```
procedure SWAP is new EXCHANGE (REAL);
```

This creates a procedure SWAP, like the one above, and allows it to be used as if it were written specifically for REALs. Now if we need to deal with vectors, we can simply write

```
procedure SWAPVEC is new EXCHANGE(VECTOR);
```

and a completely different procedure will be created. The operator overloading mentioned in the section on strong typing can be used here as well. We do not have to give a separate name to the vector-swapping procedure, but could write

```
procedure SWAP is new EXCHANGE(VECTOR);
```

with no possibility of confusing the two SWAPs because the appropriate procedure would be selected based on the type of its arguments.

This macro-like capability is not restricted to having only types as parameters; variables and subroutines can be parameters as well. For example, the generic unit may include a call to some function

```
Y:=FUN(a,b,c);
```

and the function itself may be a parameter:

```
generic
   type T is private;
   type U is private;
   with function FUN(x,y,z : T) return U;
package P is
   ...
end P;
```

This example is a generic package that defines a function, plus the types of its arguments and result, to be parameters of the generic clause. Having this definition of the generic, it can be instantiated as

```
package QWERTY is new P(REAL, REAL, INTEGRATE);
```

where presumably INTEGRATE is a function that already exists, and is to be substituted for FUN in this instance.

A major power of generic units is that their parameters are very general, and the body of the unit may be a complete package. It is not restricted to a single procedure. The package P in the last example can be almost a complete program that exists in a library. A programmer can extract this program and specialize it for a specific application by defining application-related parameters in the "new" statement. This program-development approach has tremendous advantages over systems that require a programmer either to

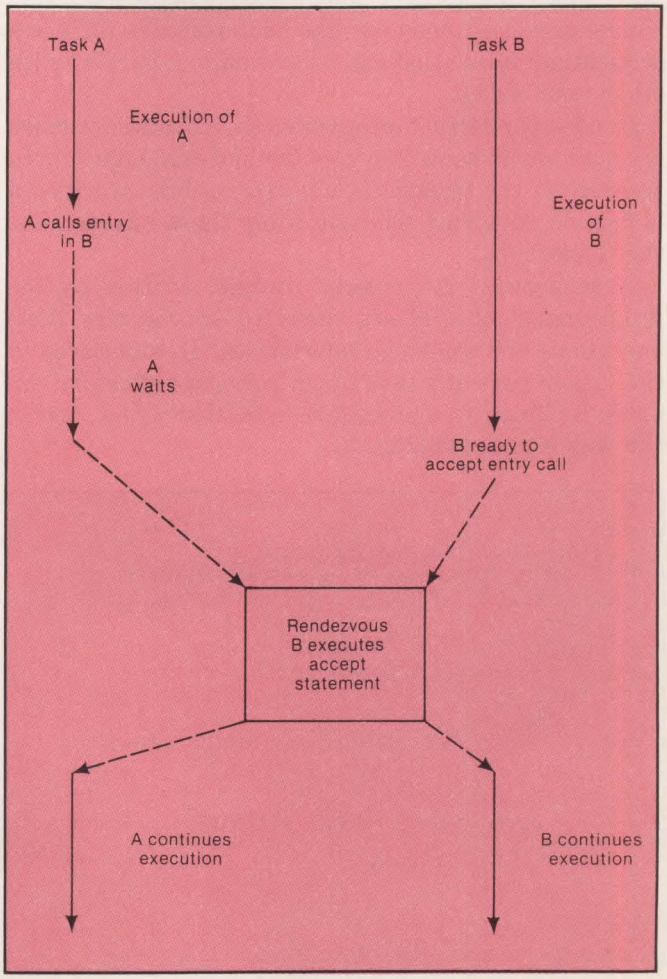

Fig. 6. Schematic representation *of Ada's rendezvous concept.*

Wordiness complicates the writing of Ada programs and will probably be considered a detriment by some users, especially those engaged in producing software that is short-lived.

hand-tailor a program unit to meet application needs or to tolerate the inefficiencies of a general-purpose program that uses run-time interpretation of parameters to perform such tailoring.

Tasking: a rendezvous with Ada

Tasking implies executing two or more sequential routines in parallel. Although actual parallel execution requires a multiprocessor system, it can be simulated in a single-processor system by interleaving the execution of the routines. Tasking is an important programming concept because it can increase efficiency and/or aid in conceptualizing certain applications. In Ada, routines that can be executed in parallel (i.e., concurrently) are called tasks.

Tasks are the basic building blocks of a concurrent Ada program. They are similar to packages in that they comprise both a visible part, which defines the task's interface to the remainder of the program, and a body part, which defines the implementation of the interface. Unlike packages, however, the body part also defines a sequential routine that can be executed in parallel with other task bodies.

In most concurrent programs, the constituent tasks are not independent; they interact and exchange data to accomplish the program's objectives. Ada provides a high-level construct for controlling these interactions: the rendezvous.

A rendezvous is a special routine, written by the programmer, that allows tasks to synchronize their operations and exchange information. It is declared in the visible part of a task by an *entry* specification. An entry is similar to a procedure in textual layout, and in the way it is called (Fig. 2).

```
task CHAR_TRANSFER is
   entry PUT_CHAR (L : in CHARACTER);
   entry GET_CHAR (C : out CHARACTER);
end;
task body CHAR_TRANSFER is
   I:CHARACTER;
begin
   loop
      accept PUT_CHAR (L : in CHARACTER) do
         I := L;
      end Put_CHAR;
      accept GET_CHAR (C : out CHARACTER) do
         C := I;
      end GET_CHAR;
   end loop;
end;
```

Fig. 7. Ada representation *of a buffer task for character transfer.*

But the rendezvous routine differs from a procedure in internal behavior (Fig. 3). A procedure is executed immediately when called as part of the calling process. A rendezvous routine, on the other hand, is executed by the task that owns it (contains its specification) when that task is prepared to accept the entry call. The task that issued the entry call (requested the rendezvous) waits until the rendezvous routine has been executed.

The point at which a task is prepared to honor an entry call is defined by the second component of the rendezvous concept: the *accept* statement. Each accept statement is associated with one of the entries owned by the task, and defines the action to be taken when that entry is called; that is, it implements the rendezvous routine (Fig. 4).

If more than one task requests a rendezvous, the calls are queued, and only one is processed each time the accept statement is executed. The calls are selected in first-in/first-out order. If an accept statement is encountered during the execution of a task body and the corresponding entry has not been called, the task waits until the appropriate entry call is issued (Fig. 5).

The complementary behavior of entry calls and accept statements is the basis for Ada's rendezvous concept. Two tasks are said to rendezvous when one calls an entry owned by the other, and the task owning the entry executes an accept statement. During the rendezvous, execution of the two tasks is synchronized, and the tasks can exchange arguments as if they were procedures. Parallel or interleaved execution is resumed after the rendezvous is completed (i.e., the "end" of the accept statement is reached). The rendezvous concept is illustrated in Fig. 6.

The concepts of task and rendezvous allow decomposition of a concurrent application into a collection of small, manageable and conceptually natural entities, which interact through well-defined, enforceable interfaces. A programmer does not have to worry about protecting control variables, queuing requests or other problems associated with concurrency because these are all handled by the underlying implementation in accordance with the rules of Ada.

For example, consider a program to transfer characters from an input device to an output device that runs at a different speed. In Ada, the program would consist of an input task, which enters characters in a buffer; an output task, which retrieves characters from the buffer; and a buffer-management task. The interactions among the three tasks would be defined by the visible part of the buffer-management task (Fig. 7). The interface would define the entries (rendezvous) to be called to enter items into and retrieve items from the buffer, and the type and number of objects associated with each transfer. The compiler would verify that each call adhered to these specifications. In this example, the body of the buffer-management task supports alternating put and get calls; a more flexible implementation is defined below.

Another important aspect of Ada's task construct is information hiding. The definitions of a task's interface

and its implementation are separate. The only information available to the calling tasks is the interface specification; the implementation is hidden. Thus, once the interface has been agreed upon, the tasks can be developed independently. This also enhances the program's maintainability because changes to the implementation that do not affect the interface specification do not affect other system components.

A third basic component of Ada's tasking facility is selection. The *select* statement (Fig. 8) provides a way to choose one of several alternative rendezvous. The entry to be accepted (selected) is determined by evaluating conditional expressions, and then arbitrarily choosing one of the called entries that has a true condition (an open entry). If none of these entries has been called, execution of the select statement is suspended; it is resumed when one of the open entries is called. To prevent excessive waiting, and to handle situations in which all the conditions are false, a select statement may contain either:

- A delay statement, which defines the processing to be performed if an entry cannot be selected within a specified time interval, or
- An else part, which defines the processing to be performed if all of the conditions are false, or an entry cannot be selected immediately.

Selection is an important concept. Without it, the behavior of concurrent programs would be very similar to their sequential counterparts. For example, consider the CHAR_TRANSFER buffer task (Fig. 7). Although the task entering characters into the buffer, the task getting characters from the buffer and the buffer task itself could be executed in parallel, the behavior of the program would be sequential; each put call would have to be followed by a get call. The alternative construction of the CHAR_TRANSFER buffer task, which uses selection to allow put and get calls to occur in any order, is shown in Fig. 9.

Of the languages that are widely used (FORTRAN, PL/I, COBOL and Pascal), only PL/I provides a facility for multiprocessing. This facility comprises tasks, event variables and wait statements. Inter-task communication is accomplished through the use of shared variables. The programmer is required to use events and wait statements to ensure that these variables are accessed at appropriate times.

PL/I's tasking facility is quite primitive compared to Ada's. The required use of low-level synchronization constructs and shared variables complicates the design of concurrent programs. Moreover, it is error-prone. A programmer can easily forget to set, reset or wait for an event. This can cause time-dependent errors that are difficult to detect or, worse, can cause deadlock.

In addition to being more reliable than its PL/I counterpart, a concurrent Ada program will be easier to maintain because Ada's task construct, unlike PL/I's, supports both information hiding and interface localization. The advantages of these concepts have been discussed above.

We have highlighted only the main features of Ada's tasking facility; there are others. In fact, Ada's state-of-the-art constructs are more comprehensive than those offered by any modern language. Ada simplifies the realization of concurrent applications to such a great extent that this style of programming will undoubtedly lose its mystique and become much more widely used.

Separate compilation: look to the library

Historically, independently compiled program units were collected together after compilation by a program called a linker. This is the approach used in FORTRAN, PL/I and assembly languages, in which information that is shared between compilation units is limited to entry point names and simple variables, such as COMMON blocks.

```
SELECT
   WHEN CONDITION = >
   -- ACCEPT ALTERNATIVE (i.e., an accept statement)
   -- SEQUENCE OF STATEMENTS

OR
   WHEN CONDITION = >
   -- ACCEPT ALTERNATIVE
   -- SEQUENCE OF STATEMENTS
   .
   .
   .

END SELECT;
```

Fig. 8. Format of *a simple select statement.*

In these languages, the compilation units are truly independently compiled; only minimal checking of the compatibility between compilation units is performed by the compiler. Consequently, a programmer must provide run-time checks to ensure that shared properties are used consistently by all compilation units.

Independent compilation is inappropriate for languages that incorporate strong typing because it violates the intent of this concept. Consequently, the opinion has been that programs written in strongly typed languages should be compiled all at once, as a single unit (the Algol 60 and Pascal approach). In practice, however, such a monolithic model complicates program development and maintenance; some sort of "afterthought" separate compilation facility, which ensures the sharing of language-dependent properties between compilation units, is invariably added to such compilers.

Ada's designers have avoided the afterthought approach by incorporating a separate compilation facility into the language. Ada compilers provide the same degree of checking for a program submitted as several compilation units as they do for the same program submitted as a single compilation unit. The heart of this facility is the program library.

Ada's program library is an integral part of the compiler. It is the repository for all information that is shared between a program's constituent compilation

Despite its drawbacks, the Pentagon-sponsored language has many features that make it highly attractive for a variety of applications.

units and the compiled code for the compilation units themselves. The compiler uses this library to verify that shared properties are used correctly, and to monitor program development. In effect, a compilation unit is not separate; the compiler views it as part of the program library. This approach not only ensures that separate compilation is natural, but also that it is handled consistently by all Ada compilers.

An Ada program is a collection of one or more compilation units that can be compiled together or separately. Subroutines (functions and procedures), packages and tasks can be written as separate compilation units. Moreover, the specifications of subroutines, packages and tasks can be compiled separately from their bodies. In other words, a compilation unit can be thought of as one or more interface definitions and/or one or more interface implementations.

The ability to separate the compilation of an interface definition from its implementation is a useful software-engineering tool to control program development. It supports both hierarchical, top-down program development and the principle of information hiding. Once a large program is decomposed into a collection of smaller units, and the interfaces between the units are agreed upon, the remaining parts of the program can be developed independently; there is no need to make the source code for a unit available to other programmers. Thus, Ada's separate compilation facility ensures that the intent of the top-down methodology is followed during development (Fig. 10).

```
task CHAR_TRANSFER is
   entry PUT_CHAR (L : in CHARACTER);
   entry GET_CHAR (C : out CHARACTER);
end;
task body CHAR_TRANSFER is
   type LINE is array (1 .. 80) of CHARACTER;
   BUFFER:LINE;
-- other declarations
begin
   loop
      select
         when not FULL = >
            accept PUT_CHAR (L : in CHARACTER) do
               BUFFER(I) : = L;
            end Put_CHAR;
            -- adjust pointer and state of buffer
         or
         when not EMPTY = >
            accept GET_CHAR (C : out CHARACTER) do
               C : = BUFFER (J);
            end GET_CHARACTER;
            -- adjust pointer and state of buffer
      end select;
--other processing
   end loop;
end;
```

Fig. 9. Ada representation *of a buffer task for character transfer using the select statement.*

Ada's separate compilation facility also supports bottom-up program development. Routines that are commonly used can be compiled separately and made available to other compilation units through a with clause:

with UNIT_ABC, UNIT_XYZ, . . . ; .

A compilation unit containing a with clause may access those parts of the named compilation units that would have been accessible had they been compiled together. Considering the support Ada provides for defining generic programs, this aspect of the separate compilation facility is exceedingly useful; generic packages for common utilities, such as sorting and queue management, can be developed, compiled and tested, and then instantiated for particular applications (Fig. 11).

Both the bottom-up and top-down program development techniques specify dependencies between the separately compiled units. These dependencies define the order in which units must be compiled, and the requirements for their recompilation. For instance, compilation units that name other compilation units in a with clause must be compiled after the named compilation units have been compiled and may have to be recompiled if the named compilation units are recompiled.

In the case of a large program, keeping track of these dependencies can entail substantial effort. Ada's designers have recognized this, and have incorporated the rules for compilation order and the requirements for recompilation into the language. Thus, the compiler—not the programmer—is responsible for their enforcement. Although this complicates the compiler, it simplifies the use of the separate compilation facility and encourages a software-engineering approach to program development.

Ada as a system specification and modeling tool

Another important software-engineering aspect of Ada is that it can be employed as a specifications language. For example, the package and generic type facilities enable system designers to describe the proposed design in terms of logical components and logical structures. The tasking facility enables a designer to describe the interactions and access rights of the parallel components of the system in logical terms. Thus, the programming language itself can be used to document the system.

A specification description written in Ada is also a program that can be compiled and executed (assuming that sufficient details of the program body are provided to model the system). Type checking and other composition requirements will identify most problems at compile time. Such modeling efforts can also assist in debugging run-time problems before actual installation. Even different implementation strategies can be simulated. Because the system specifications can be controlled and compiled separately from the implementation details, development can be managed as a

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The Ada package allows the program to be written in a form that is closer to the abstract concept of vectors than is possible in other languages.

smoothly flowing evolutionary process under Ada.

In short, Ada is a powerful tool for software development. However, there are a few problems that might impact its initial implementations and acceptance.

Shortcomings: Ada has warts, too

A discussion of the language's liabilities is in order to present a balanced overview of Ada. Our discussion will be limited to the three aspects of the language we feel complicate program development and/or programmer training. The topics are I/O, verbosity and size. The problems in these areas are not technical errors; as far as we can tell, the language is technically sound.

Ada provides I/O services through two pre-defined packages: INPUT_OUTPUT and TEXT_IO. INPUT_OUTPUT defines a set of operations applicable to files containing elements of a single type, and TEXT_IO, as the name implies, provides primitives for handling text files. While the primitives provided by these packages are comprehensive, they are awkward to use, especially for formatted I/O. The primitives for inputting and outputting data are applicable only to a single data element, and provide formatting only for that data element. If additional formatting is required, separate formatting routines must be invoked. Thus, numerous procedure calls can be associated with the output (or input) of a single line of data.

For instance, consider the following example taken from the Ada reference manual:

```
procedure DIALOGUE is
  use TEXT_IO;
  type COLOR is (WHITE, RED, ORANGE, YELLOW,
GREEN, BLUE, BROWN);
  INVENTORY: array (COLOR) of integer :=(20, 17,
43, 10, 28, 173, 87);
  CHOICE:COLOR;
 --additional text ... CHOICE:= BLUE;
  PUT(CHOICE, LOWER_CASE => TRUE);
  PUT ("items available");
  SET_COL (25);
  PUT(INVENTORY(CHOICE), WIDTH => 5);
  PUT (";");
  NEWLINE;
 --additional text
```

In this example, six procedure calls are used to output the single line: "blue items available 173;".

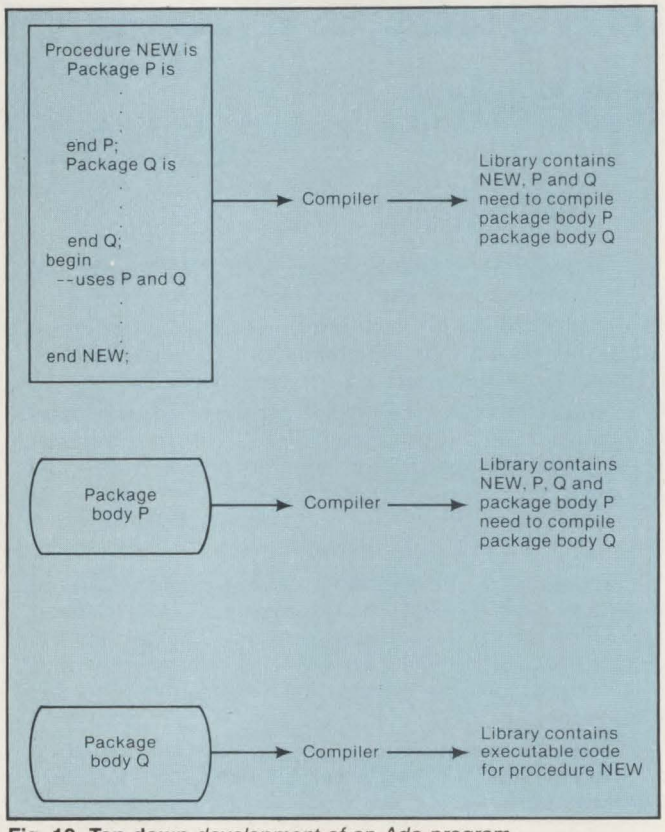


Fig. 10. Top-down *development of an Ada program.*

THE EVOLUTION OF ADA

When the Department of Defense (DOD) set out in 1975 to alleviate its software crisis, it was experiencing burgeoning software costs and development projects that taxed the supply of programmers. DOD recognized that a proliferation of programming languages and dialects was aggravating the problem, so it set out to define a high-order language that would be common to all defense agencies.

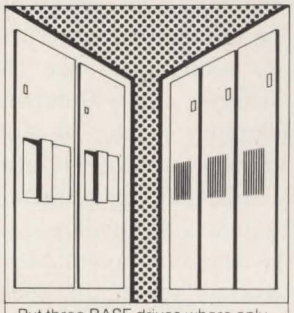
The language is named after the first programmer, Augusta Ada Byron, for her work 150 years ago on Charles Babbage's machines. Ada's requirements and specifications were defined over three years through an iterative process that included participants from government, industry and the academic community.

Once the language's characteristics were defined, DOD funded a well-coordinated R&D project to define the language itself. Contracts were let for alternative designs and subsequent redesigns. In 1979, the language design submitted by CII Honeywell Bull was selected as the preliminary definition of Ada. It became the proposed standard for the Ada programming language last September, after appropriate modification that was based on the results of an intense test and evaluation effort.

DOD also realized that significant benefits would accrue from integrating the language into a standard programming environment and issued requirements for a portable Ada programming support environment. The environment encompasses various items, such as text editors and other utilities, standard program libraries, the structure of Ada compilers, interfaces and command languages.

DOD has made every effort to ensure the success of the Ada project. From the beginning, DOD has encouraged U.S. and foreign government agencies, industrial concerns and academic institutions to participate in developing the language.

Small miracle.



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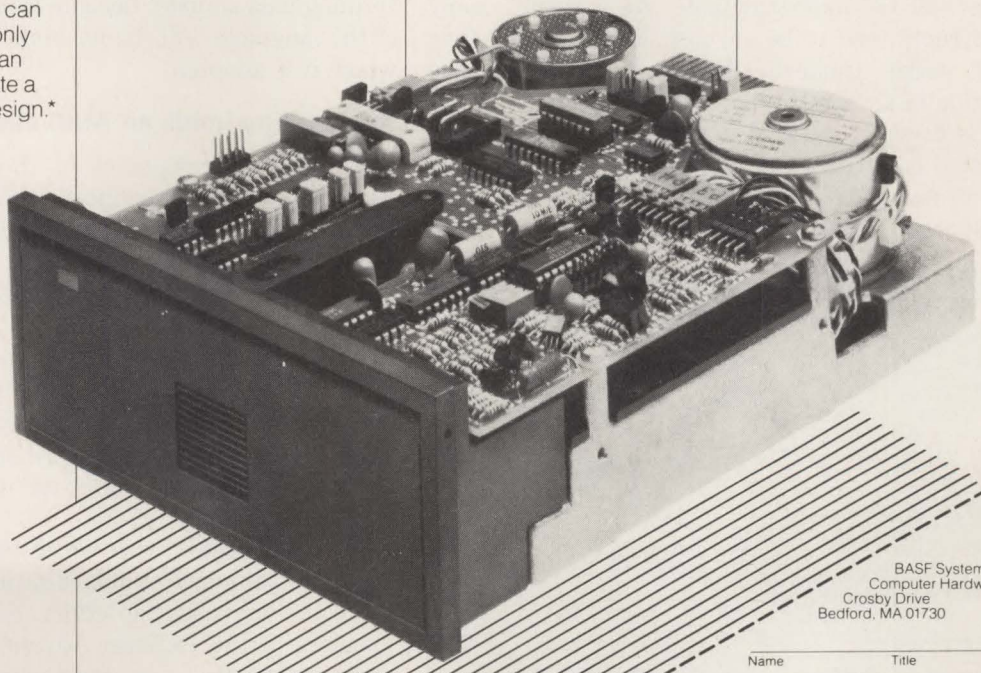

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The need to use an excessive number of procedure calls to manipulate formatted data in Ada is cumbersome and can obfuscate a programmer's intentions.

The need to use an excessive number of procedure calls to manipulate formatted data in Ada is cumbersome and can obfuscate a programmer's intentions. The I/O facilities provided by FORTRAN, COBOL and PL/I are as comprehensive, and are more concise. Even Pascal, which does not provide comprehensive format control primitives, allows I/O requirements to be stated more succinctly than Ada. This inferiority could seriously hamper Ada's adoption for applications that depend heavily on formatted I/O.

In fairness, it should be pointed out that the designers of Ada envisioned that the language's I/O capabilities would be improved by users through development of more sophisticated I/O packages.

Verbosity: words, words, words

Ada is by no means a cryptic language because its designers have gone to great lengths to ensure that programs will be understandable. As a result, many Ada constructs tend to be verbose. For example, four reserved words (underlined) are required in the specification of an array type:

type I is array (1 .. 10) of INTEGER;.

Wordiness complicates the writing of Ada programs and will probably be considered a detriment by some users, especially those engaged in producing software that is short-lived. But this opinion will not be shared by those involved in developing large, long-lived software systems; they will find that the text clarity and the attendant reduction in maintenance costs more than offset the increased program-development effort.

Thus, while Ada's verbosity may affect the language's initial popularity, we believe, it will cease to be an issue with the advent of syntax-directed editors.

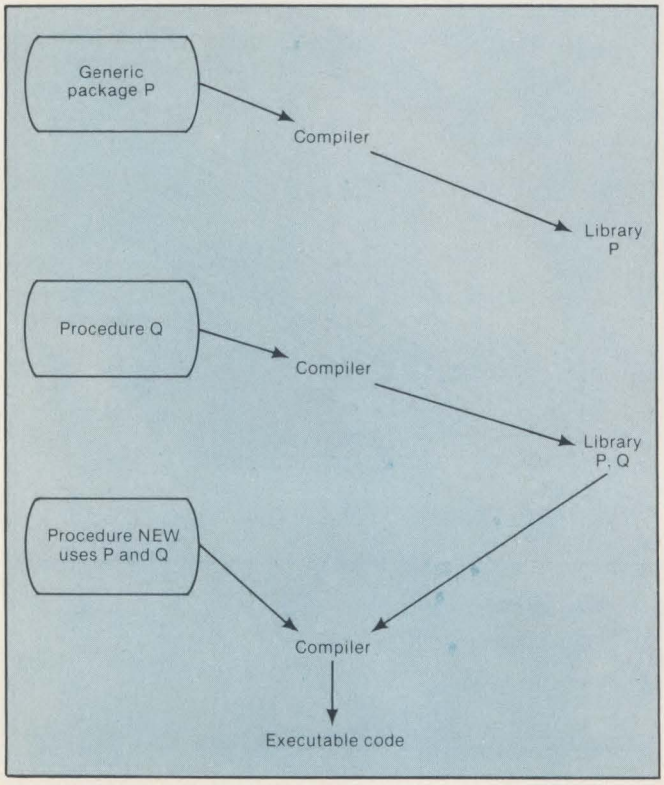

Fig. 11. Bottom-up *development of an Ada program.*

Complexity: a deterrent to learning

Ada was designed to satisfy the requirements of a broad spectrum of applications, making it a rather large and complex language. While the language's designers have attempted to minimize the number of constructs and the diversity of notation, learning to use the language effectively could be difficult, and will depend greatly on the quality and availability of training aids.

While DOD has not been known to have initiated development of a high-quality Ada training program, indications are that such programs will be developed by the private sector. Further, the academic community's interest should result in the availability of textbooks and courses on Ada, and seminars on the effective use of the language will probably supplant the various introductory seminars that have been offered. Unfortunately, however, this is not guaranteed. Unless these training aids actually become available, the complexity of the language will, in our opinion, limit the extent to which it is adopted.

Ada's future holds an ANSI standard

Although development of the final Ada language definition was a major effort, it was only the first stage in the evolution of the language. Subsequent stages will encompass development of a compiler validation facility, production-quality compilers and an integrated programming environment.

Ada must be standardized to accomplish its long-term purpose. DOD recognizes this and has already approached the American National Standards Institute to establish an ANSI standard for the language. DOD hopes eventually to have an international standard established.

The seriousness with which DOD is approaching the subject of language standardization is also evidenced by the compiler validation effort. Softech Inc., under the auspices of the Defense Advanced Research Projects Agency (DARPA), is developing an extensive Ada compiler validation capability (ACVC). The ACVC will consist of tests to determine the extent to which an Ada compiler conforms to the language standard, and an implementer's guide to assist compiler developers in complying with the standard.

The Army, Air Force and DARPA are sponsoring major compiler development efforts (MMS, December, 1979, p. 33). Computers targeted for Ada support in 1982-1983 include IBM 370, Digital Equipment Corp. VAX-11/780, Perkin-Elmer 8/32 and various military machines.

The prospects for the Ada environment are not as

clear, however. While both the Army and Air Force are pursuing development of an Ada environment, their efforts do not appear to be coordinated. This means that, while the language will be standardized, the evolving support environments could be incompatible, which is unfortunate. The definition of how programmers and operators interact with the environment, the definition of how the tools interact with each other and the definition of a minimal tool set are just as important, if not more important, than the compiler itself.

The availability of Ada compilers and programming support environments will be important factors in facilitating the language's acceptance. Availability of trained Ada programmers, which can be expected to result from the academic community's interest, will also provide an impetus for using the language.

The major obstacle to the widespread use of Ada is the current investment in other languages. It will be impractical in some situations to convert to Ada, even within the defense establishment. The Navy, for example, which is heavily committed to a language called CMS-2, has not begun to develop an Ada compiler. Moreover, indications are that CMS-2 will remain on the list of approved languages, at least for now.

The language's shortcomings will also hinder its acceptance. Some organizations will view them as significant problems and decide that their current languages are superior. The risks of producing products that may someday be incompatible with a "government" standard Ada programming environment will also deter commercial development.

Ada's future is thus uncertain, but the potential exists for it to have a major impact. The private sector has shown an intense interest in the development of the language; many organizations have spent considerable time participating in conferences and workshops and in testing and evaluating the preliminary language definition. The realization of this potential depends on the quality of the compilers and programming environments that are developed, and the extent to which the language's shortcomings are rectified. ■

William Eventoff is principal member of the technical staff at Perkin-Elmer's Data Systems Group, Tinton Falls, N.J.; **Ronald Price** is director of advanced systems development, and **Gary Anderson** is a consulting member of the technical staff. **Irving Rabinowitz** is a professor at Rutgers University and a consultant to Perkin-Elmer's Data Systems Group.

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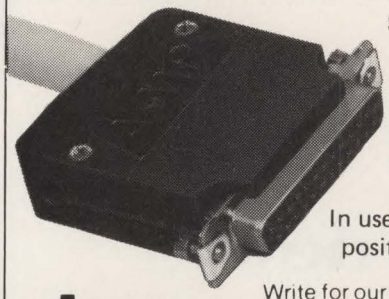

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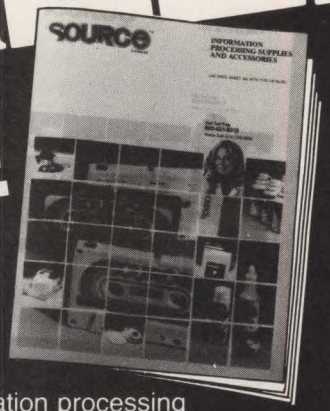

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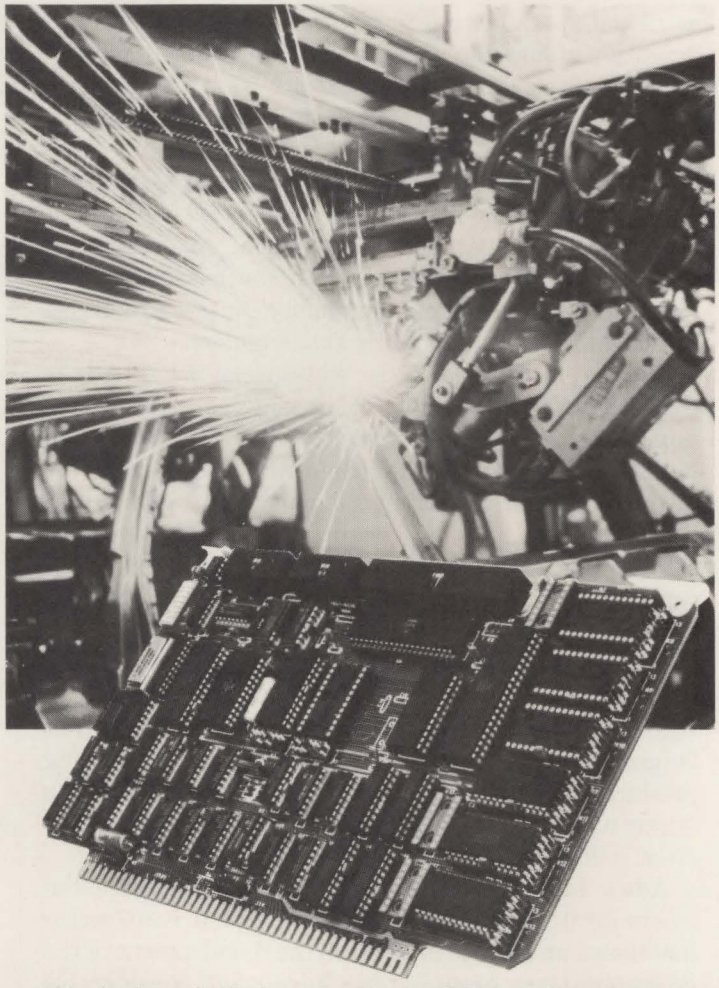

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MSC introduces two software development stations

Previously only a board level supplier, Monolithic Systems Corp. is expanding its product line to include two new software development stations, the MSC8801 and the MSC8802. According to MSC spokesmen, both systems can substantially reduce software-development I/O overhead, with the more expensive 8802 reducing overhead by as much as 80 percent.

"This type of system has been available for years at prices to the tune of $25,000," says MSC marketing engineer Dan Meizner. "Now, for the first time, we're selling it for less than $10,000."

Each CP/M-controlled system includes a Multibus-compatible Z80A-based computer, 64K bytes (for the 8801) and 80K bytes (for the 8802) of RAM, two double-density 8-in. floppy-disk drives, a seven-card slot Multibus chassis and power supplies.

Basic features of the lower priced 8801 system, which uses the MSC8009 board, include a key activated on/off switch, three external AC outlets, provisions for as many as eight serial communications channels, two 50-pin cable connectors for parallel I/O interfaces, three BNC connectors for video-graphics applications and six spare card slots in the computer chassis.

The 8802 system combines the 8009 circuit board with the MSC8007A. The added board allows the system the same features as the 8801, along with additional RAM and EPROM, three more serial I/O ports and one more parallel port. Access time of the 8802 is rated six times that of the 8801. System packages are sold with a Televideo 920 C 12-in. CRT terminal with an ASCII keyboard and an 80-cps Epson MX 80 printer.

Monolithic Systems Corp.'s model 8802 software-development station *includes a Multibus-compatible Z80A-based computer.*

Software support includes the standard CP/M 2.2 operating system with a universal BIOS program. Disk format, copy routines, editor and assembler are also provided. Optional BASIC and Pascal are available for high-level language software development.

Single-unit price of the MSC 8801 system is $7985. The MSC8802 sells for $9675, with OEM discounts available. Delivery time is 45 days. **Monolithic Systems Corp,** Englewood, Colo. **Circle No 220**

—Frank Catalano

CalComp controller pulls plotting functions off-line

California Computer Products (CalComp) has announced two vector-to-raster controllers, a boon for users involved in applications such as computer-aided design and manufacturing (CAD/CAM) and mapping. According to representatives of the Anaheim, Calif., company, the models 951 and 953 μp-based controllers can operate as

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The TransTerm 1 is a compact, low cost alpha-numeric keyboard/display terminal designed for efficient man-computer communications. The TransTerm 1 consists of a two line 64 character liquid crystal display and a 53 key TTY style keyboard packaged in a 2" high by 12" wide by 7" deep case. The terminal communicates in full duplex RS-232 serial asynchronous ASCII with 20 ma current loop or RS-422 available as options.

The TransTerm 1 is ideal for applications where low cost and minimum size or portability are desirable. The TransTerm 1 can be used on a horizontal desk-top surface or mounted on a vertical plane. Typical applications include:

- Dial-up data entry/retrieval
- Factory floor data collection
- Portable console terminal
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  - Block Send
  - Multidrop Polled
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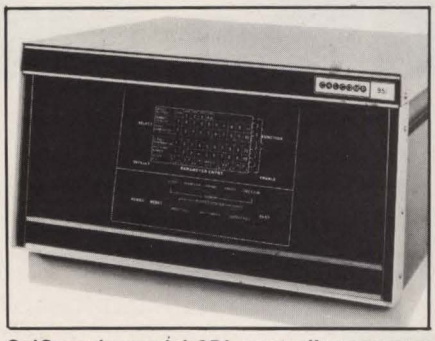
many as eight CalComp electrostatic (raster) units and one pen (vector) unit and can reduce host computer time signficantly.

The model 951 operates on-line and accepts plot data via an RS232C or bisynchronous interface. Features include 256K-byte memory, operator control panel, plot data-processing and vector-memory



CalComp's model 951 controller *operates on-line and accepts plot data via an RS232C or bisynchronous interface.*

modules and vector-to-raster conversion capability. Also available are an additional 256K bytes of memory and a 21M-byte hard-disk memory.

The model 953 controller has off-line/on-line 907 format random vectors across asynchronous and bisynchronous data lines. The 953 controller comprises a μp with 256K bytes of memory expandable to 512K bytes, operator control displays, magnetic tape drive, a plot data-processing module, a vector-to-raster conversion module and a raster-output module.

An optional 21M bytes of hard-disk memory are also available. With the 953 controller, vector and raster plotters can be driven either locally or remotely.

Price for the 951 controller is less than $18,000, and the 953 controller sells for less than $30,000. Deliveries are scheduled to begin this month.

Hewlett-Packard has also entered the μp-based controller market with its HP 7580A vector plotter. The plotter is compatible with virtually all Hewlett-Packard desk-top computer systems, from the HP 9825 to the Series 9000 System 45, as well as the HP 1000 or 3000 computer systems.

The model 953 controller *from CalComp has both off-line and on-line capabilities.*

Interfacing is easily accomplished via an HP-IB (HP's version of the IEEE 488 interface bus standard) or an RS232C interface. The HP 7580A's μp control executes more than 60 commands precisely and accurately, says the vendor. Pricing is $15,450, with delivery estimates at eight to 15 weeks.

California Computer Products, Anaheim, Calif. **Circle No 414**

Hewlett-Packard Co., Cupertino, Calif. **Circle No 221**

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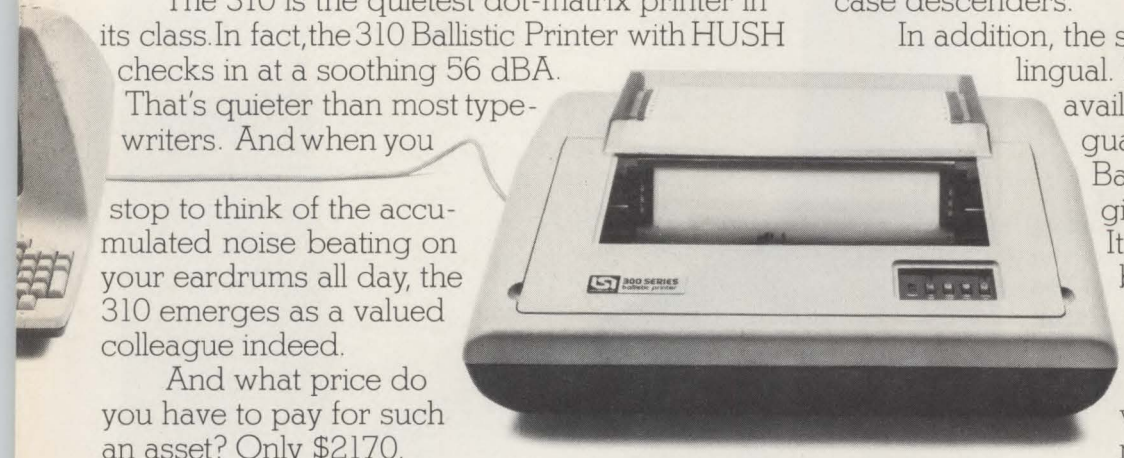

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Wang adds μp functions to small-business systems

This integrated information system work station adds word-processing functions to the vendor's 2200 series of small business products. Features include document editing, creation, print, storage and filing capabilities. The system includes 3270 emulation. The 2200 word-processing software package sells for $2000; the 2236DW work station is $3500. Upgrades of present terminals are $1000. **Wang Laboratories, Inc.,** Lowell Mass.

Circle No 222

Stand-alone system has 2K-byte ROM

The model 2000 stand-alone μc system supports the network operating system version of CP/NET from Digital Research. The unit includes a Z80 μp, two RS232C interfaces, a 32K-byte RAM and a 2K-byte ROM. Options include parallel interfacing, a Z80 counter timer circuit and as much as 8K bytes of ROM. Price is $795. **Algo, Inc.,** Columbia, Md.

Circle No 223

Comptek announces system for law firms

The Barrister/110 shared-logic system provides financial-management and word-processing capabilities to law firms with five to 15 attorneys. The system includes a CPU, 2000 pages of on-line storage, a visual display screen for input and editing and a daisy-wheel printer. Other features include cursor editing, automatic page numbering and renumbering, automatic paragraph numbering, table of contents and table of authorities, footnoting, sorting, global search and replace and a math package. **Comptek Research, Inc.,** Buffalo, N.Y.

Circle No 224

H-P offers personal computer

The HP-83 personal computer includes business software that provides data-base management for list-keeping, inventory and reporting. A graphics package produces charts and text for reports and overhead-projection transparencies. The system includes floppy-disk drives with mass storage from 270K bytes to about 5M bytes. A data communications package provides asynchronous communications from 300 to 9600 baud. Software prices start at $200. **Hewlett-Packard Co.,** Palo Alto, Calif.

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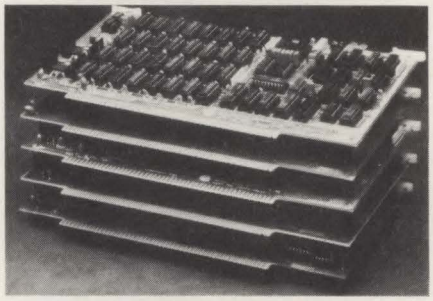

CCS introduces μc systems

This line of Z80A-based systems provides real-time hardware vectored interrupt and interrupt-nesting capabilities. The DMA structure permits multiprocessing with interleaved data transfer rates of as much as 2M bytes per sec. The CPU also includes two programmable real-time clocks, two 8-bit parallel interface channels and two independently baud-rate-programmable RS232 I/O channels. **California Computer Systems,** Sunnyvale, Calif. **Circle No 230**

PC/M announces all-CMOS μc

The model PPS-12 μc system employs an IM6100 CMOS μp for data-acquisition and control applications where only battery and/or solar power are available. The system includes three parallel I/O ports, one optically isolated 20-mA/RS/232 I/O port, a programmable real-time clock, 4K words of CMOS EPROM/RAM memory, a memory-expansion controller and an on-board transparent monitor/debugger. The 12-bit system uses a binary instruction set identical to that of DEC's PDP-8 and VT-78 DECstation minicomputer. Single-quantity price is $999. **PC/M, Inc.,** Dublin Calif.

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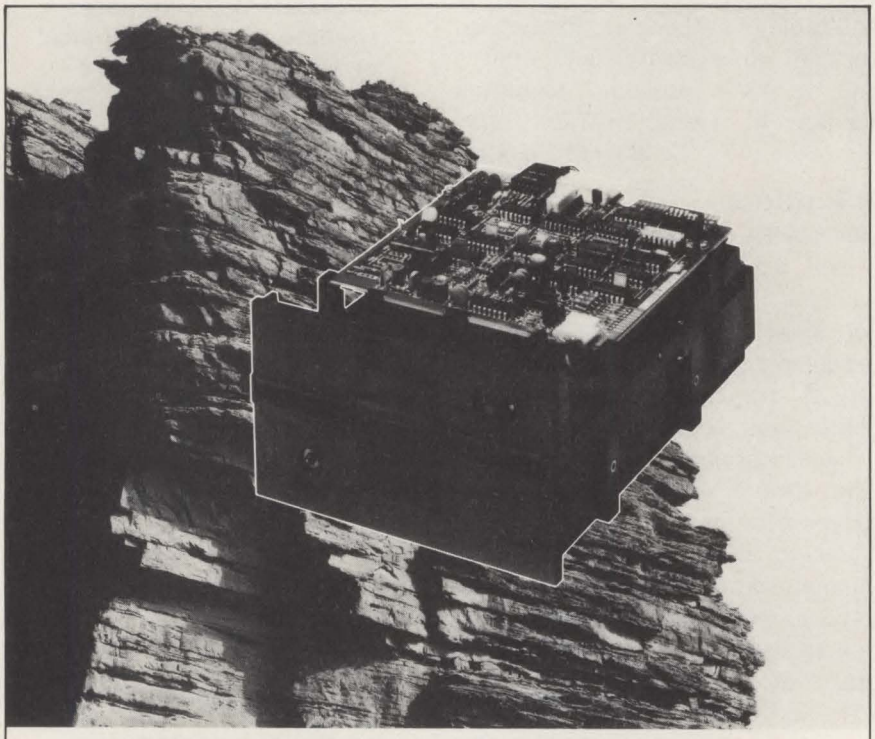

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According to a leading financial journal, two major areas holding back the economic recovery of the United States are: the high cost of oil; and good software. There's not too much POINT 4 can do about the first, but when it comes to good software ... that's another story.

For example, our IRIS Operating System, with over 7000 successful installations, has become the world's leading independently-supplied Interactive Multi-User Operating System for POINT 4 and NOVA*-type minicomputers. IRIS supports multiple languages, including Business BASIC. It is a multi-tasking system that supports time sharing and batch processing tasks.

POINT 4 Data specializes in providing System Builders with fully integrated application software packages which can be easily adapted to customer requirements. MACS, our interactive, fully integrated Management, Accounting, and Control System is written in Business BASIC and designed to operate under IRIS.

For Word Processing applications, POINT 4 Data offers STYLUS, an easy, cost-efficient way to add multi-user, multi-terminals, shared-logic word processing to POINT 4 or NOVA-type computers using IRIS.

The READINET Project Control System was designed for utilization in complex projects typical of the Construction, Aerospace, Government, and R&D industries. It combines interactive computing techniques with PERT/CPM time, cost, and resource allocation analysis. READINET allows the project manager to plan the project, optimize the critical parameters within a set of constraints, and then monitor performance until the project is successfully completed.

But perhaps most valuable of all ... POINT 4 Data offers FORCE, an applications program generator that allows the system designer to specify screen layouts, file formats, data elements, etc. Fully coded, commented and documented programs are then automatically generated by the computer itself ... sometimes in 1/100th the time needed for manual programming.

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CIRCLE NO. 129 ON INQUIRY CARD

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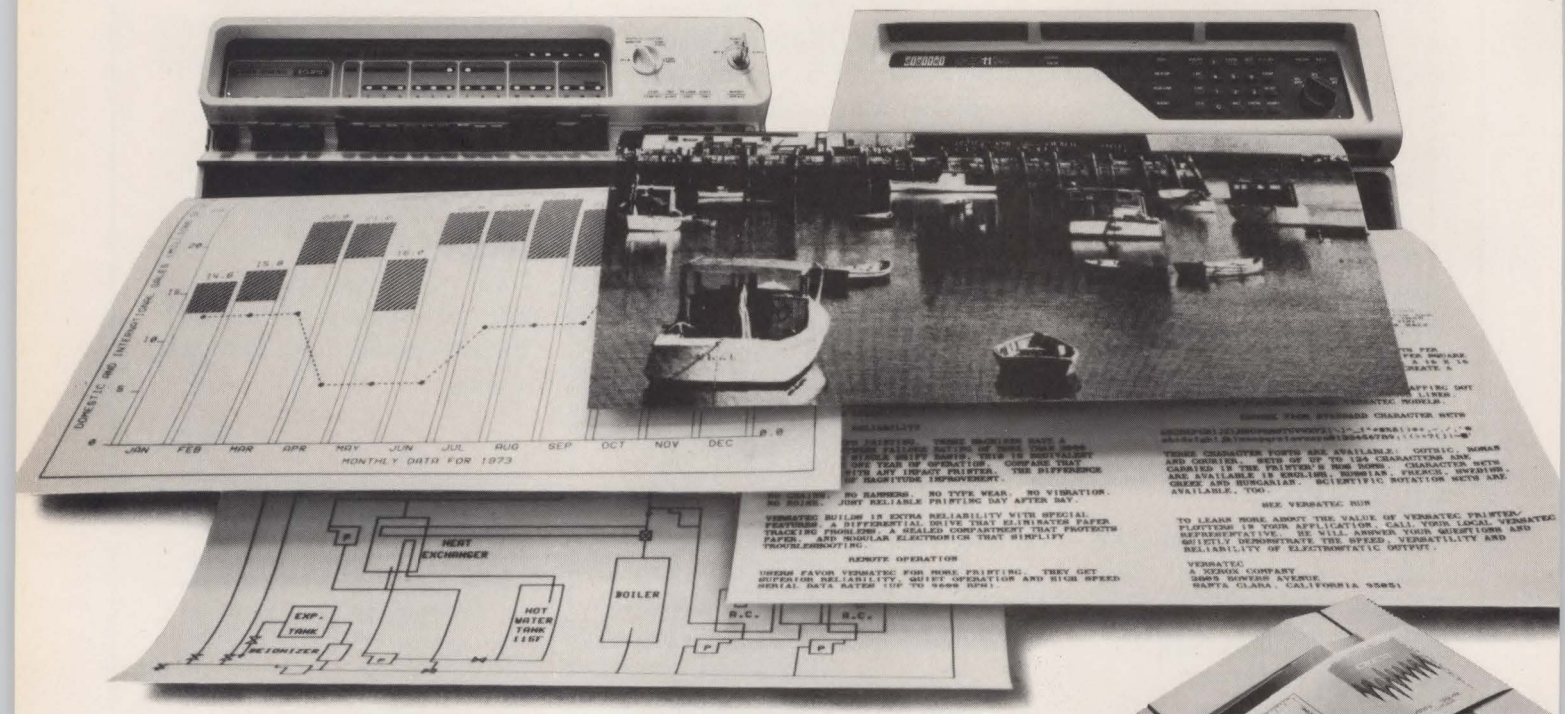

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Do more. Log data from mini-based instrumentation. Get hard copy plots from multiple stations in an interactive mode. Gain better cost-efficiency by using a single printer/plotter for output from multiple computers and parallel data sources. Or send data to multiple printer/plotters for output where you want it.

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CIRCLE NO. 130 ON INQUIRY CARD

New Systems

System includes 8080A μp

The MSC-6600 family of Multibus-compatible μc systems includes an 8080A μp, 64K bytes of RAM, dual 8-in., double-density, single-sided floppy-disk drives and CP/M operating system software. The system supports a standard RS232C CRT keyboard and a parallel printer interface under CP/M. The unit is available in four- and eight-slot card packages that sell for $7300 and $7745, respectively. **National Semiconductor,** Santa Clara, Calif.

Circle No 232

Small-business system has multiple Z80s

The model SB700 small-business system includes multiple Zilog Z80 μps operating under control of proprietary modular system logic software, including the CP/M software monitor. The system consists of four Z80-based processor modules, a 10M-byte fixed-disk drive, an 8-in. floppy-disk drive, two keyboard/display work stations, a 150-cps printer and operating software. Price is $24,975. **Symcro Systems, Inc.,** Fort Washington, Pa.

Circle No 235

TI adds to DS990 family

The model 7, an addition to the vendor's DS990 minicomputer line, uses the 990/10 CPU and the CD1400/32 cartridge disk system with 32M bytes of mass storage, 16M bytes of fixed-disk storage and 16M bytes of removable cartridge-disk storage. The system includes an error-correcting disk controller, 128K bytes of memory, a 13-slot chassis with programmer panel and a model 911 video display terminal. Price is $39,150 in single-unit quantities. **Texas Instruments Inc.,** Houston, Texas.

Circle No 233

TI enhances DS990 family

The model 9, an addition to the DS990 minicomputer line, uses a 990/10 CPU and the CD1400/96 96M-byte cartridge disk system with 80M bytes fixed- and 16M bytes removable- cartridge disk. The system includes an error-correcting disk controller, 128K bytes of memory, a 13-slot chassis with programmer panel and a model 911 video display terminal. Price is $46,150 in single-unit quantities. **Texas Instruments Inc.,** Houston, Texas.

Circle No 236

Apple interface intended for lab applications

The APPLAB μc system for laboratory applications is used with an Apple II+ computer to control or collect data from scientific instruments. The system's hardware interface includes 12-bit D/A and A/D converters. A 32-bit real-time clock permits timing of events to an accuracy of 0.1 sec. The APPLAB interface card, including three cables, a self-test adapter board, diagnostic software and two manuals sells for $495. **Interactive Microware, Inc.,** State College, Pa.

Circle No 234

P-E announces 3220S system

The model 3220S system includes a processor with 512K bytes of MOS memory, an 800-cpi, 45-ips tape, an 80M-byte fixed disk and four video display units. The system is intended for use with the vendor's Multiterminal Monitor transaction-processing software and enables concurrent development in any mix of ANSI-standard COBOL, globally optimizing FORTRAN VII, Pascal and RPG II. The 3220S is priced at $52,369 in quantities of three to five. **Perkin-Elmer Corp., Computer Systems Division,** Oceanport, N.J.

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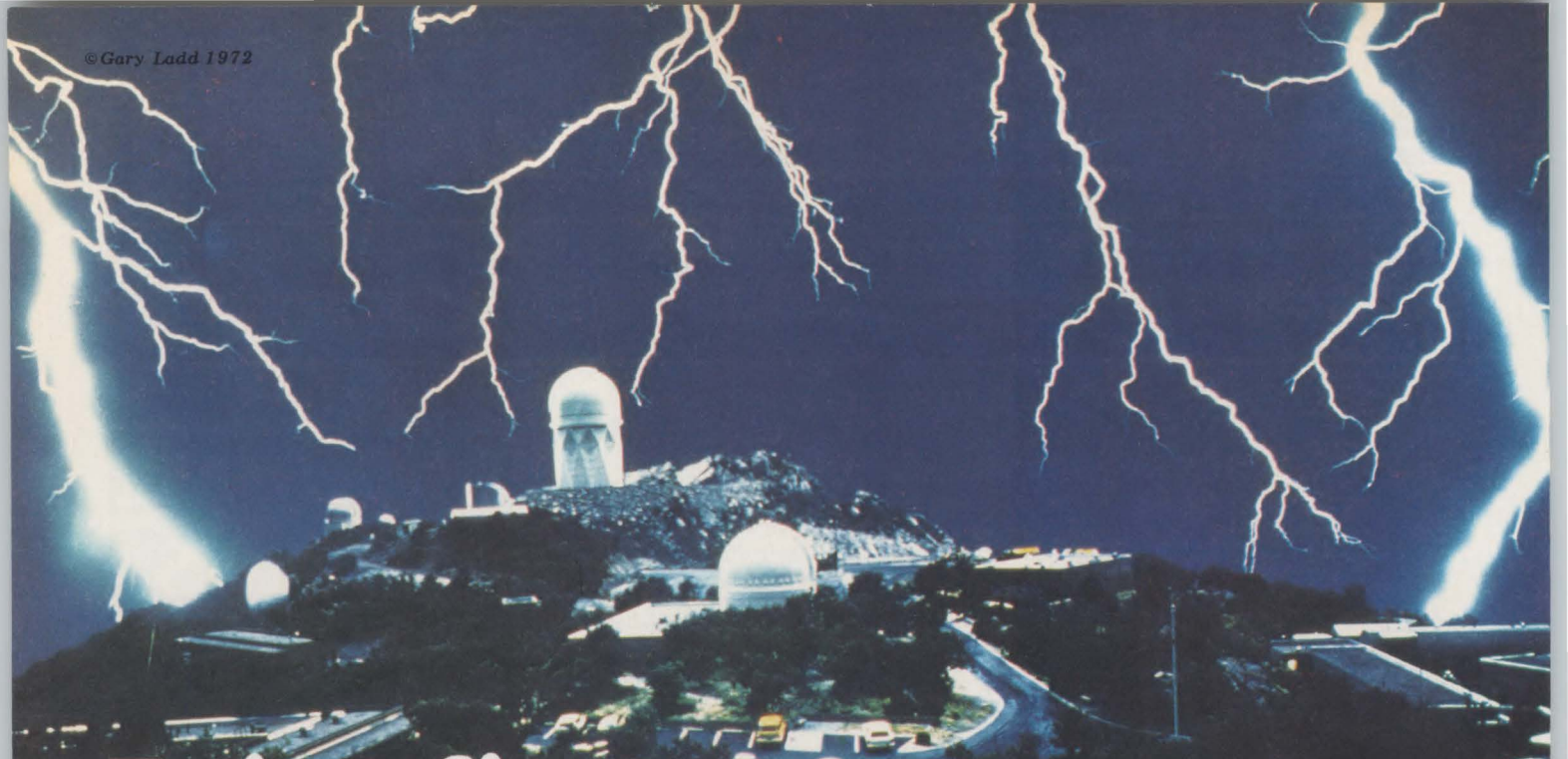

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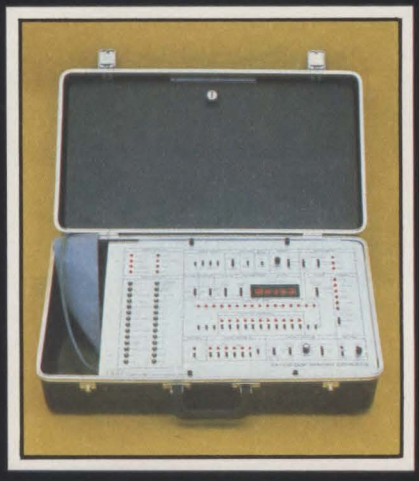

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CIRCLE NO. 132 ON INQUIRY CARD

New Products

datacomm

Kapusi announces redesigned transceiver

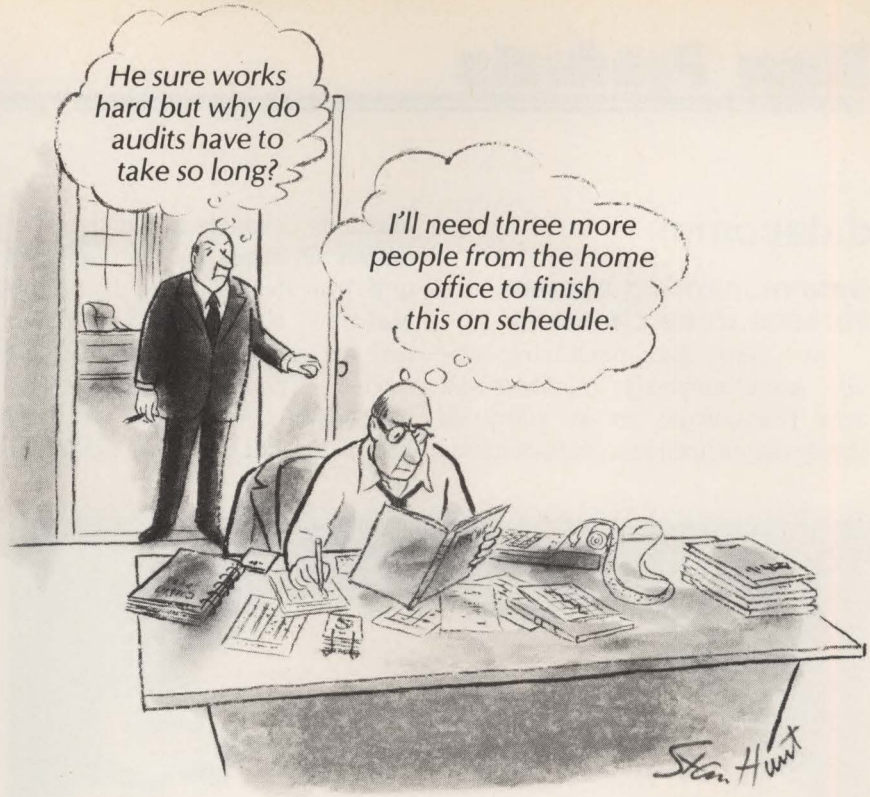
The redesigned DT19.2L data transceiver short-haul modem fits as many as 88 stand-alone units in a 19-in. rack. The transceiver works synchronously and asynchronously at 19.2K bits per sec. over twisted pairs with DC continuity. It meets RS232C, CCITT V.24, V.28 and Bell 43401 specifications. The system sells for $994 in quantities of one to nine. **Kapusi Laboratories,** San Mateo, Calif. **Circle No 238**

RS232-to-current loop adapter announced

The ADA400 two-circuit RS232-to-current loop adapter converts an RS232 signal to a 20-mA current-loop signal and vice versa. The device can be paralleled to drive a Teletype or RS232 printer while using a computer's regular terminal. The ADA400 does not alter baud rate and uses standard power supplies with low current requirements. It sells for $24.50. **Connecticut MicroComputer, Inc.,** Brookfield, Conn. **Circle No 239**

Emulex unveils multiplexer for DEC computers

The CS11/H communications multiplexer provides users of PDP-11 or VAX-11 computers the ability to connect as many as 64 asynchronous communications line devices to a controller in the CPU. The multiplexer uses a single hex-size circuit board for a communications controller that is connected to as many as four distribution panels. A configuration including one controller, one distribution panel and adapters for 16 channels is priced at $5800 in single-unit quantities, with OEM discounts available. **Emulex Corp.,** Santa Ana, Calif. **Circle No 240**



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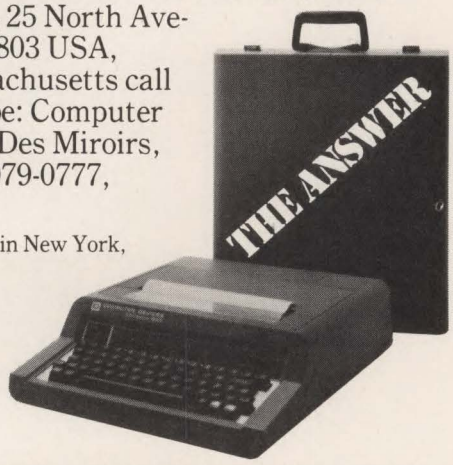

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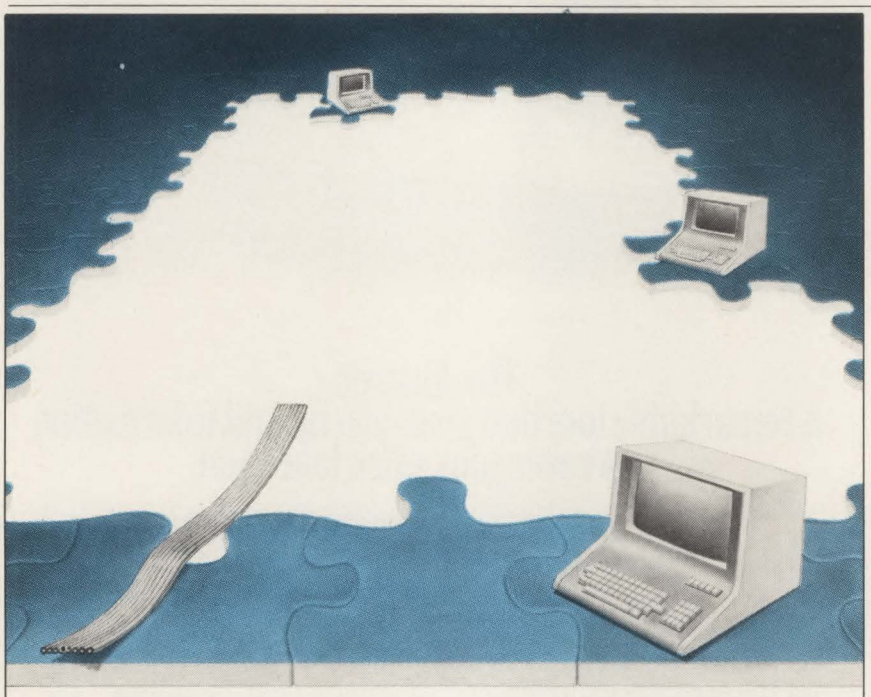
CIRCLE NO. 133 ON INQUIRY CARD

datacomm

Data-monitoring system screens three channels

The CM310 data-monitoring system simultaneously monitors all data transmitted on as many as three asynchronous data-communications channels and displays the output on three CRT screens. The unit provides full- and half-duplex real-time monitoring and display and arrested display and scrolling modes. The CM310 can display changes in EIA functions and flag or highlight data-stream problems, such as parity errors or the absence of echo-back data. Price is $4500 in single-unit quantities. **Timeplex, Inc.,** Rochelle Park, N.J. **Circle No 241**



Other Nets.

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DEC announces direct-connect modem

The DF02 freestanding, full-duplex modem, for asynchronous data communication between computer terminals and processors over dial-up telephone lines, operates at data rates as high as 300 bits per sec. The modem can originate and answer calls either manually or automatically and offers voice- or data-communication capabilities when a standard telephone is used to originate and answer calls. The DF02 is priced at $450. **Digital Equipment Corp.,** Merrimack, N.H. **Circle No 242**

Modem replaces Bell 212A

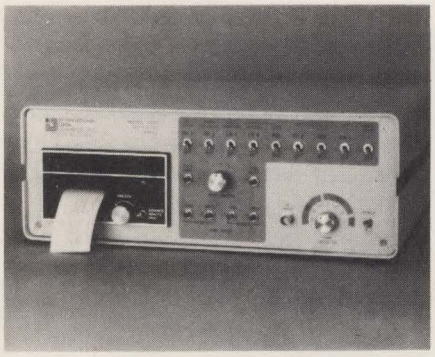
The model TC2121 Bell 212A modem replacement provides full-duplex transmissions at 300 or 1200 baud over switched networks. Features include auto-answer and manual originate/answer, μp control, four local and remote test capabilities, visual diagnostic indicators and asynchronous or synchronous operation. The unit sells for $849 in single-unit quantities, with quantity discounts available. **Tek-Com, Inc.,** San Jose, Calif. **Circle No 243**

HP offers three products for 3000 series

The interactive mainframe link/3000 and the multileaving remote job entry/3000 networking products enable any HP 3000 series 30, 33 and 44 to communicate with large mainframe systems. The multipoint terminal system/3000 enables multipoint terminal connections between an HP 3000 computer system and a mixture of many HP data terminals on a single communications line. The IML/3000 is priced at $4200, the MRJE/3000, $2400, and the MTS/3000, $1200. **Hewlett-Packard Co.,** Palo Alto, Calif. **Circle No 244**

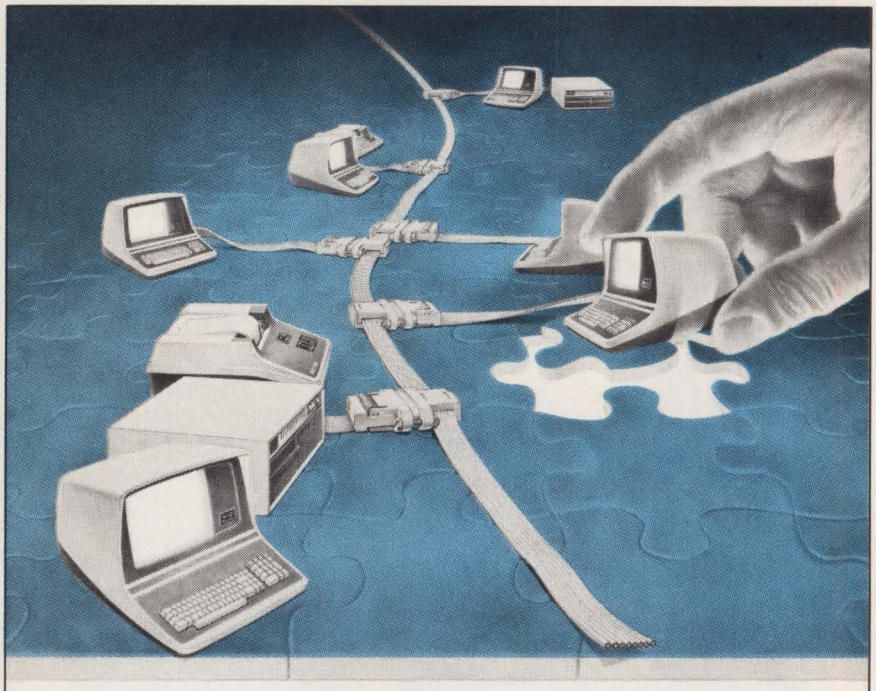
H-P offers fiber-optic link

The HFBR-0500 snap-in fiber-optic link includes a transmitter, a LSTTL/TTL - compatible receiver, 1-mm.-core-diameter plastic fiber in bulk or terminated lengths, connectors and a polishing kit. The transmitter incorporates an LED, and the receiver incorporates an integrated photo detector, a shielded wide-bandwidth DC amplifier and an open collector and output circuit. The fiber-optic link sells for $55 in quantities of one to 99. **Hewlett-Packard Co.,** Palo Alto, Calif. **Circle No 245**



IDS introduces data test set printer

The model 2910 data test set printer operates with a radio digital terminal and test sets equipped with the vendor's model 25 full-duplex long-word converter kit or adapter kit. The printer can obtain a record of failures of critical signals in the interfaces under test or a record of data errors, block errors and failure of EIA interface signals. Features include a presettable real-time clock, three selectable print routines, six selectable trigger channels and seven selectable print intervals. Price is $4410. **International Data Sciences, Inc.,** Lincoln, R.I. **Circle No 246**



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CIRCLE NO. 135 ON INQUIRY CARD

datacomm

IDS announces EIA RS232 data recorder

The model 7000 Datatape μp-based recording device provides nonvolatile mass storage for EIA RS232C and CCITT V.24 communications interfaces. The device can be used as a stand-alone unit or with the vendor's Hawk 4010 Datatrap. The Datatape records transmit data, receive data and seven critical control signals. Operation is independent of data code, line protocol, code level and parity for synchronous and asynchronous data links. The model 7000 is priced at $5500. **International Data Sciences, Inc.,** Lincoln, R.I. **Circle No 247**

Kaufman announces true port concentrator

The model 870 true port concentrator for the IBM 3270 protocol enables users to employ ADDS, Hazeltine, Zentec, Teletype and other terminals. Data rates range from 110 to 19.2K bits per sec. Communication with the IBM system is bisynchronous at speeds as high as 19.2K baud. The unit enables a single IBM sytem port to support 32 nodes of eight terminals each. A basic model 870 with one line interface module is priced at $4765. Additional modules sell for $690 each. **Kaufman Research Manufacturing, Inc.** Los Altos Hills, Calif. **Circle No 248**

Modems intended for coaxial cable

The USM-1 synchronous and the UAM-1 asynchronous RS232C data modems for coaxial cable have maximum data rates of 19.2K and 9600 bps, respectively. The modems transmit on a 5- to 18-MHz frequency and receive on a 72- to 96-MHz frequency. The modems include front-panel LED indicators for received and transmitted data and for RS232 control lines. The UAM-1 sells for $250, and the USM-1, $450. **Cable Bus Systems Corp.,** Beaverton, Ore. **Circle No 249**

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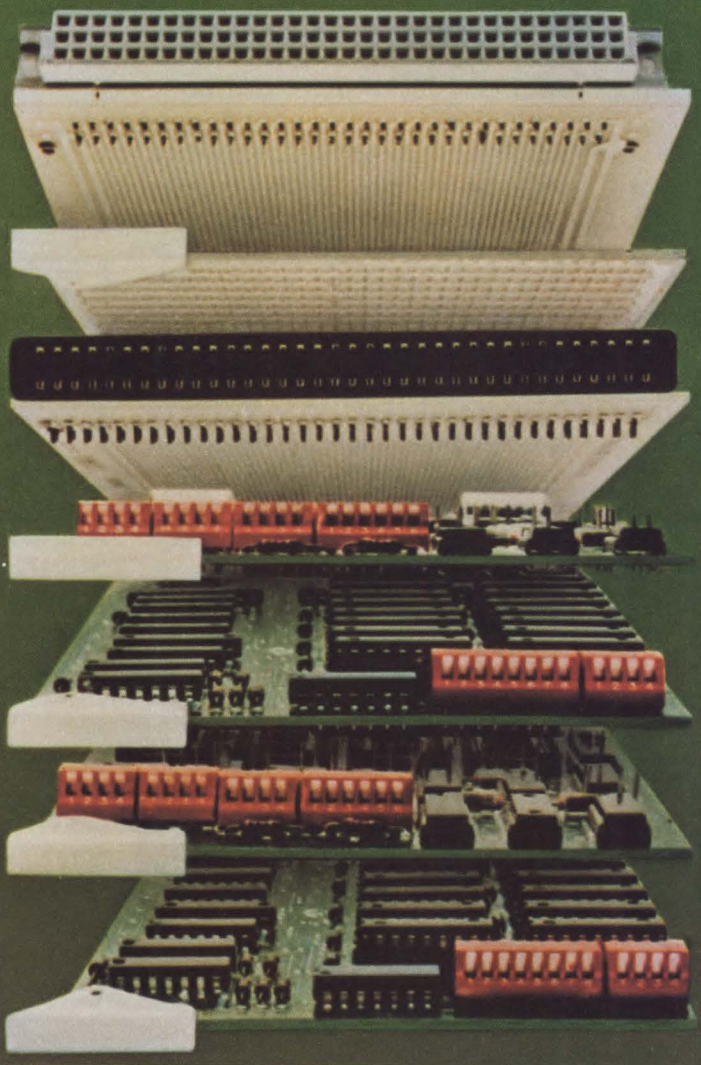

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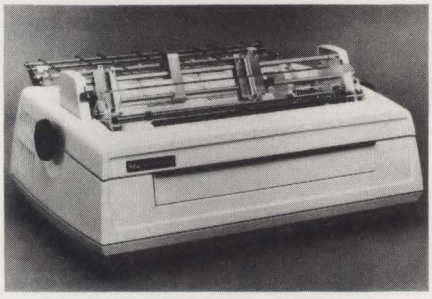
New Products

printers

Memorex announces model 2087 matrix printer

The model 2087 matrix printer, which is compatible with IBM's 3270, attaches directly to the vendor's 2076 remote cluster controller or to the IBM 3276 and 3274 controllers. The unit offers a 180-cps print speed, a 7 × 8 dot-matrix character printout, as many as 132 characters per line and 10 characters per in. The printer can accommodate six-part fan-fold forms at a slew rate of 15 ips, with rear or bottom feed, and can print subscripts, superscripts and overprinters. The unit sells for $5995. **Memorex Corp.,** Santa Clara, Calif. **Circle No 250**



Spinwriter printer has 700-wpm throughput

The Sellum I NEC Spinwriter-printer includes an on-board Z80 μp, a 16K-byte RAM, a 4K-byte ROM, multiple interface compatibility and full data handshaking signals. Other features include bidirectional printing, switch/software-selectable baud rate and logic-seeking capabilities, which allow a maximum throughput of as many as 700 words per min. Price is $3495. **Intersell,** Mountain View, Calif.

Circle No 251

Printers feature two-color printout

The P2010 printer with RS232C interface, and the P2020 with IEEE 488 interface, feature two-color, 31-column printout with mixed chracters, 7 × 7 dot-matrix characters and integral paper feed. The P2010 interfaces with μcs, computer communications and other applications having baud rates from 75 to 4800, and the P2020 interfaces with instrumentation, computer peripherals and test equipment. Both units include a 2.4-lps paper feed speed, 7.2-lps printing speeds, six lpi, 31 cpl and 0° to 40°C operating range. **Canon Business Machines,** Costa Mesa, Calif.

Circle No 252

Anderson Jacobson offers printer terminal

The AJ880 printer terminal features 10- to 30-cps print speeds, RS232C communications interface and 110 to 300 baud transmission rates. It accepts multicopy sheet or roll paper from 3- to 14⅞-in. wide in one to four parts. It offers a typewriter-style keyboard, a full ASCII character set and keyboard settings for margins, tabs, horizontal and vertical pitch and data transmission rates. Price is $1295 in single-unit quantities. **Anderson-Jacobson, Inc.,** San Jose, Calif.

Circle No 253

Laser printer uses 8½ × 11-in. paper

The HP 2680 laser printing system, designed for use with the HP 3000 business systems, prints 45 8½- × 11-in. pages per min. The printer enables users to produce complex page layouts and forms. As many as eight information blocks can be designated on a single page of output. Character sizes range from 2 per in. to 1.38-in. wide. Software includes the Interactive Design system and the Interactive Formatting system for configuring output. The system, including software, is priced at $121,000. **Hewlett-Packard Co.,** Palo Alto, Calif. **Circle No 254**

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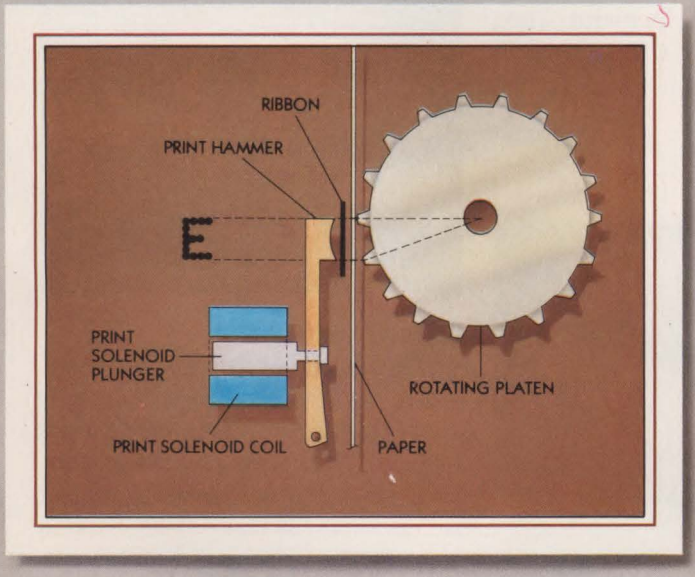
At an incredible unit price of $399!

Because of the unique Uni-Hammer design, the GP-80M is smaller and simpler than other dot matrix printers yet costs considerably less. Which makes it a natural for OEMs needing compact, reliable, low cost printers for system use, and also for the personal or small business user who wants a quality impact printer at the lowest possible price.



How the Uni-Hammer Works

The GP-80M, which prints both graphics and alphanumerics, uses a rotating platen with protruding splines positioned behind the paper (see diagram). The character or graphics image is created by multiple hammer strikes in rapid succession as the print head advances across the paper. The precision gear train assures exact positioning of the print hammer relative to the splines on the platen, to provide excellent print quality.

A Complete Printer

The GP-80M has features comparable to printers selling for thousands of dollars. These include upper/lower ASCII character sets, ribbon cartridge, 80 columns at 12 characters per inch, adjustable tractor feed, original and 2 copies, 30 characters per second, and full graphics with a resolution of better than 60 dots per inch in both horizontal and vertical axes.

Plenty of Interfaces

Interfaces include Centronics parallel, RS232C, serial TTL, 20mA current loop, IEEE-488, Apple, TRS-80, PET, HP-85... and more.

See the GP-80M in action at your local computer store, or write for the distributor in your area.

A Product of the Seiko Group

The GP-80M is manufactured by Seikosha and exclusively distributed in the USA by Axiom. It took a company such as the Seiko group, world's largest watch manufacturer, with vast experience in the design of small, intricate, precision products, to come up with a totally new concept in dot matrix printing.

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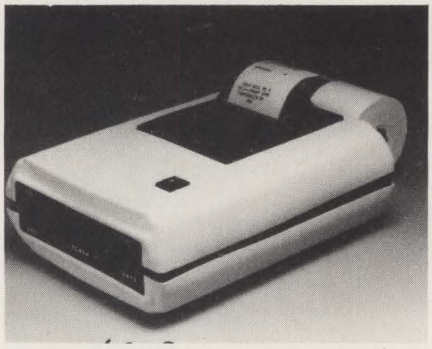
CIRCLE NO. 140 ON INQUIRY CARD

New Products

printers

Modification converts 80-column printers into 132

The model 132 modification converts an 80-column TI 743/745 into a 132-column portable terminal. The modification replaces the socketed μp with a small PC board, and changes the motor pulley and cable. The enhancement operates via the TI terminal on 8½-in.-wide paper. The 132 presents output in a 35-dot matrix and 5 × 7 format at 15.6 characters per in. The model 132 sells for $375, with OEM discounts available. **Texprint, Inc.,** Burlington, Mass. **Circle No 255**



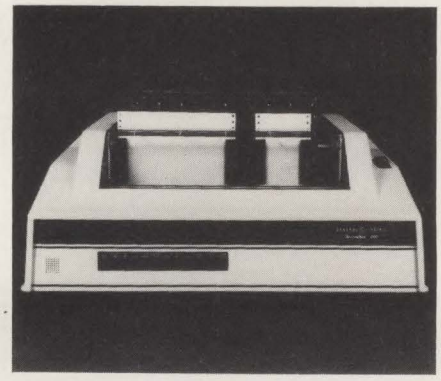
Impact printer used with small CRTs

The EZ Print 21 for small-screen CRTs records an exact audit trail of all terminal data on a standard adding machine paper tape. The unit prints in a 21-column format at a maximum throughput rate of 42½ cps. The device includes a buffer that allows input at the rate of 120-cps. Customer-specified fonts, non-English-language characters and transmission speeds as high as 1200 baud are optional. Price is $395. **Mepcom International,** Dallas, Texas. **Circle No 256**

Dot-matrix unit prints 136 columns

The model 3432 dot-matrix printer provides 136-column printing at 150 cps in a 9 × 7 format to form 94 ASCII characters. The unit offers bidirectional printing and parallel or RS232C interface. The model 3432 sells for $1995. **TEI, Inc.,** Houston, Texas.

Circle No 257



GE introduces enhanced Terminet

An enhanced TermiNet 200 split-platen line printer allows users to print two forms simultaneously. The unit provides serial interface for operation as fast as 9600 baud at a maximum print speed of 200 cps. Strappable selections provide for operation at 110 to 4800 baud. Both sides of the split-platen can print from one- to nine-part forms with a maximum thickness of 0.028 in. **General Electric Co., Data Communication Products Business Department,** Waynesboro, Va.

Circle No 258

Now, a low-cost smart CRT joins the Bantam family.

Need block mode editing capability? An optional second page? Our new 550S is for you. Doing a lot of numeric data entry? Our new 550E has the features you need. Want a terminal that's easy to operate and easy on your budget? Our economy Model 550B is the simplest operating CRT you can buy.

And all three come with a full-year warranty on parts and labor.

The star of this low-cost CRT family is the new microprocessor-driven 550S. It's functionally three terminals in one, with distinct operating modes for conversational timesharing, transaction processing, and text manipulation or software development.

On site and/or depot maintenance services for all Perkin-Elmer terminals are available through our own service force of 450 people located in 53 cities coast-to-coast.

The other new member of our 550 family is the highly reliable 550E. Like the 550B, it's driven by a custom LSI chip and has only 19 integrated circuits, giving you a 42,000 hour MTBF. The 550E features a dedicated keypad for numeric entry and cursor movement.

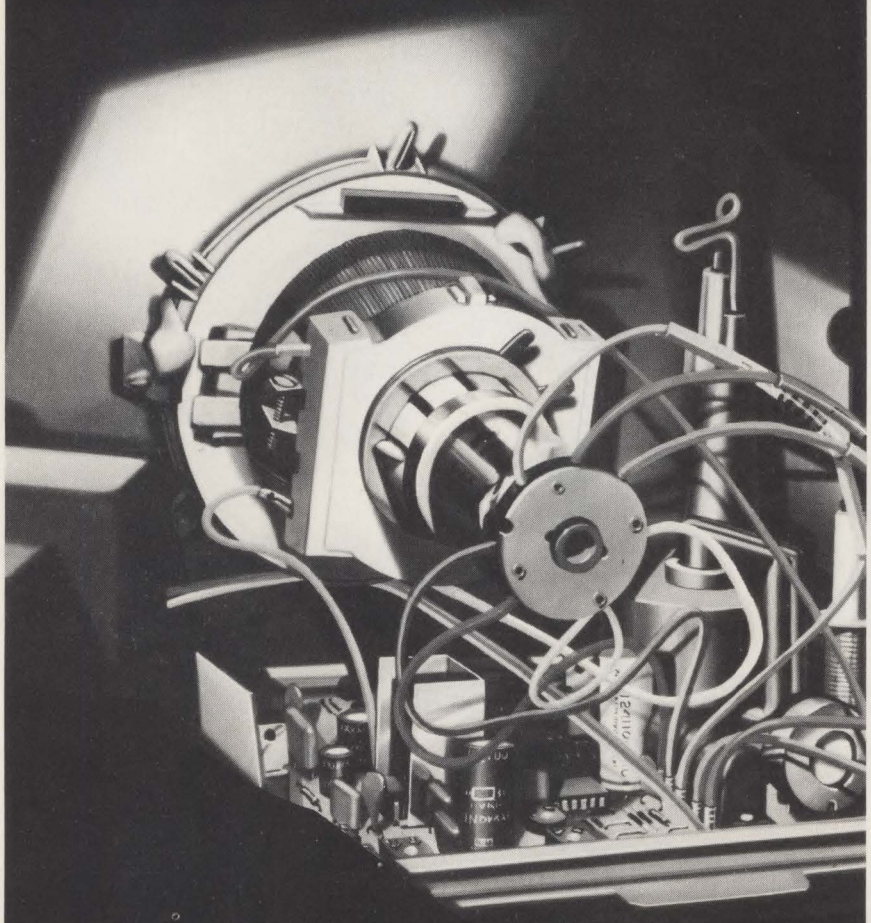
Perkin-Elmer is a Fortune 500 company with terminal sales offices located in Atlanta, Boston, Chicago, Los Angeles, New York, San Francisco, and throughout Europe. Distributors: Arrow Electronics • Automated Business Computers • Computer Peripherals of New England • Computer Peripheral Technology • Data Terminal Mart • The David Jamison Carlyle Corp. • PAX Computer Co. • Selecterm • The Thorson Company • Transaction Data Systems • U.S. Robotics • Westwood Associates.

For more information write: Perkin-Elmer, Marketing Communications, 2 Crescent Place, Oceanport, NJ 07757. **Or call toll free: (800) 631-2154. In NJ, call (201) 870-2412.**

PERKIN-ELMER

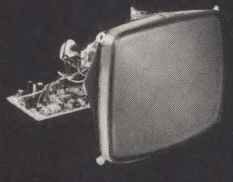
CIRCLE NO. 141 ON INQUIRY CARD

Motorola's unique generation of high performance display modules uncovered!



Look into Project Alpha, the NCC Show's most advanced CRT Display system.

Booth 1236



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CIRCLE NO. 142 ON INQUIRY CARD

New Products

micros

16-bit μc includes Z8001 μp

The model 1868+A 16-bit μc module includes a Z8001 μp, the segmented version of the Z8000 μp. The unit has 8K bytes of EPROM, as much as 20K bytes of local RAM and 64K bytes of main-system RAM. The 1868+A can be used as a stand-alone μc or as a master or slave in a multiprocessor environment. A two-channel serial I/O chip provides serial communications as fast as 500K baud. **Xycom, Inc.**, Saline, Mich. **Circle No 259**

μc supports 24K EPROM

The TPC 2000 μc can operate stand-alone or as a smart remote controller in data-acquisition and supervisory-control systems. Each unit supports eight transient protected, multiplexed 12-bit analog inputs (expandable to 64 single-ended, 32 differential), three optically isolated 16-bit pulse accumulators and 16 optically isolated digital inputs (expandable to 48). The unit has RS232C-compatible communications capability and can support as much as 24K bytes of EPROM and 4K bytes of RAM. **Advanced Logical Solutions,** Pleasanton, Calif. **Circle No 260**

Z80-based μc is STD-compatible

The model RMC-80 single-board computer, which is compatible with the STD bus, includes a Z80 CPU that operates as a 2 MHz, 64K-byte RAM, EPROM and ROM, as many as four serial I/O asychronous ports and an optional AMD-9511A arithmetic processing chip. A real-time clock provides the ability to establish a time base in format of months, days, hours, minutes or seconds. **Environmental Systems Corp.**, Knoxville, Tenn. **Circle No 261**

disk/tape

Memorex announces cartridge module series

The CMD-16 removable, single-disk cartridge module for use with Phoenix-type cartridge module drives provides 16M bytes of unformatted storage capacity. The system features 384-tpi track density and 6048-bpi bit density, 808 data tracks and 15 alternate tracks. Price is $295 in quantities of one to five. **Memorex Corp.**, Santa Clara, Calif. **Circle No 270**

100M-byte system provides DEC LSI-11 backup

The "mirror" backup system for the vendor's disk drives used with Digital Equipment Corp's LSI-11 computer systems provides backup data at 1M-byte-per-min. using standard video cassette recorders with 120M-byte capacity cassettes. When used for archival storage, a system file can be retrieved in minutes from a 100M-byte cassette. The system, which uses a Z80 μp, contains CRC error detection and complete software. Price is approximately $1500. **Corvus Systems, Inc.**, San Jose, Calif.

Circle No 271

Data separator uses phase locked loop

This 5-in. data separator for the TRS-80 model I uses a phase locked loop circuit that adjusts to match the data from the disk drive. The data separator plugs inside an expansion interface, with no additional wires or cut traces required. It includes a FD1771 disk controller and sells for $250. **Parasitic Engineering Inc.**, Oakland, Calif. **Circle No 272**

Floppy drive features 12,000-hr. MTBF

The model 8302S, double-sided 8-in. floppy-disk drive is compatible with Shugart's 851R double-sided 8-in. floppy. The unit uses a proprietary linear stepper motor design and features an MTBF of 12,000 hours. The drive sells for $670 in 100-unit quantities. **Decitek Corp.**, Westboro, Mass.

Circle No 273

Winchester-disk drive is DEC LSI-11 compatible

The 20L Winchester-disk system emulates the DEC RL01 and RL02 cartridge drives. The 20M-byte system uses a self-contained intelligent disk controller and an interface card that connects the LSI-11 bus to a standard bus. Price is $6950. **Corvus Systems, Inc.**, San Jose, Calif. **Circle No 274**

The perfectly natural interface.

Touch. Man uses it to learn. Before sight, before taste and long before anything as complex as keyboarding.

Mother Nature invented the sense of touch. But Carroll Manufacturing developed the technology to apply it as an interface on displays.

Carroll is the leader in touch technology. To solve the man/machine interface dilemma. To make your system friendly and more responsive.

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The newest members of our line are our new Comp-DK & Comp-DF Backplanes, which are DD11-DK and DD11-DF equivalents, and our Comp-CK & Comp-CF which are DD11-CK and DD11-CF equivalents. Our lead time is typically 30-45 days, ARO. SUPPORT? We offer the finest, over the phone or on site.

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CIRCLE NO. 146 ON INQUIRY CARD

New Products

power supplies

Plug-in power supplies give 25W output

These switcher power supplies deliver as much as 25W of regulated DC power. Two versions are offered: a single-output (+5V at 5A) and a triple-output (+5V at 2.5A, and ±12V at 0.2A). The units meet all requirements of UL standards 1012 and 1310. An optional filter can be added to meet forthcoming EMI requirements. **Ault, Inc.,** Minneapolis, Minn. **Circle No 262**

Unit protects against voltage spikes

This active tracking spike and transient suppressor protects μp-based equipment, instrumentation, control equipment, computers, disk drives and peripheral equipment from voltage spikes, transients and noise on the power line. It suppresses spikes of 900V to 5V peak to peak. Energy content is approximately one joule. Performance is not affected by line or load impedance, from zero through full load current. Units are available from 1.0A through 600A load currents, and for single- and three-phase voltages through 600V. **Control Concepts Corp.,** Binghamton, N.Y. **Circle No 263**

Power control console protects against transients

The "Spike-Spiker" power-control console protects against power-line transients and provides RF filtering between an electronic apparatus and motorized equipment in the vicinity to help prevent interference. The unit includes eight 120-VAC outlets in two rows of four filtered circuits, a main on/off switch, a fuse and an indicator light. **Kalglo Electronics Co., Inc.,** Bethlehem, Pa. **Circle No 264**

Standby power supply protects minicomputers

This standby power-supply unit provides a self-contained power source for use in brownout or blackout. The unit can protect minicomputers, μps, security systems, electronic scales and cash registers, portable instruments, communications equipment and remote test equipment. Upon loss of commercial AC power, the unit generates a regulated quasi sine AC wave from a sealed, gelled electrolyte battery in less than 25 msec. Input voltage is 117 VAC ±5 percent; output power is 400W maximum for 40 min. **Welco Industries, Inc.,** Cincinnati, Ohio.

Circle No 265

Switching power supplies have 65W output

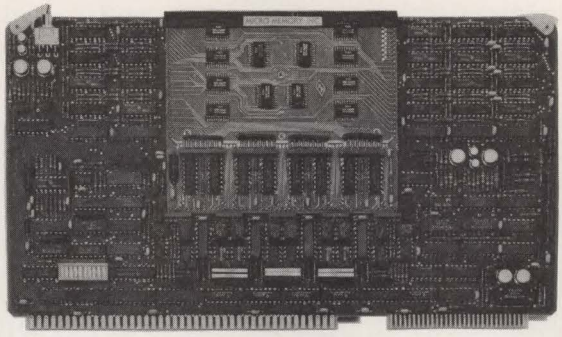
The NQ 65 series of 65W open-frame switching power supplies includes quad output capability with post-regulated auxiliary outputs in a 20-KHz fixed-frequency pulse width modulated design. Features include: built-in line filtering and soft-start circuitry, 115/230-VAC input capability, fully regulated auxiliary outputs, LSI control circuitry and built-in overvoltage protection on main output. Price is $143 in quantities of one to nine, $107 in quantities of 100 to 249. **National Power Technology,** Anaheim, Calif.

Circle No 266

MULTIBUS* CORE MEMORIES

*NON-VOLATILE *WRITE-PROTECT *POWER-FAIL INTERRUPT

MM-8086/16



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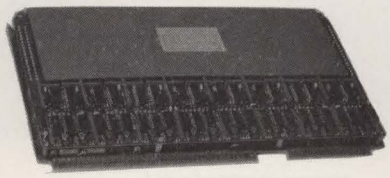
16K BYTES

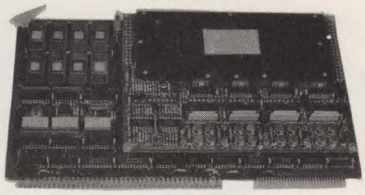
* Single Card Slot 16K Bytes of Read/Write Memory
* Compatible with 8 and 16 Bit Processors
* Non-Volatile — Requires no Back-up Battery
* AC/DC Power Monitoring for Data Protection
* Write-Protect Control in 4K Bytes Increments

MM-8086



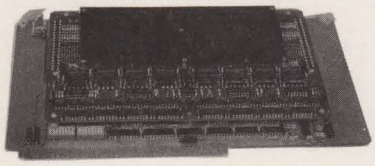
32K BYTES

MM-8080B



16K EROM & 8K CORE

MM-8080/16



16K BYTES

MODEL	PRICE
MM-8086/16	$875.00
MM-8086	$1275.00
MM-8080B	$790.00
MM-8080/16	$849.00

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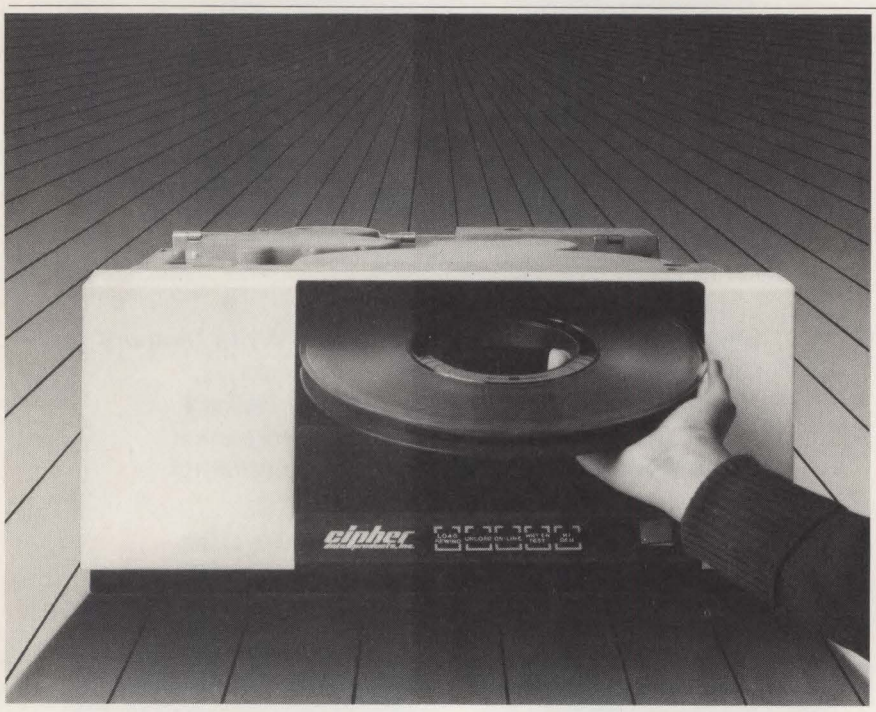
CIRCLE NO. 147 ON INQUIRY CARD

power supplies

Power General announces triple-output switcher

The series 325 25W triple-output switchers includes two models: +5 VDC at 4A and ±12 VDC at 400 mA or +5 VDC at 4A and ±15 VDC at 400 mA. Line regulation is ±0.1 percent; load regulation is ±0.2 percent. Temperature coefficient is ±0.02 percent; transient response is 300 μsec. to 1 percent of the final output. The units provide 1500-VAC input to output isolation and a hold-up time of 16 msec. after loss of AC power. Full rated output is provided over an ambient temperature range of −25°C to +50°C with no derating and 50°C to 71°C with derating of 2 percent per °C. Prices for both versions start at $89 in single-unit quantities. **Power General,** Canton, Mass.

Circle No 267



There are other streamers, but only the Microstreamer™ gives you completely automatic tape loading.

There's only one tape drive family you can buy that totally eliminates the manual handling of tape. With Cipher's Microstreamer, loading and threading of tape reels is totally automatic. All you do is open the door, insert the tape reel and close the door. That's it. The machine threads the tape by itself. No more operator training. Anyone can use it.

That's exciting, but there's more.

In addition to offering you exclusive auto-load features, the Microstreamers also give you these exclusive benefits:

- ☐ choice of 1600 or 1600/3200 selectable recording density
- ☐ higher 25 ips speed for start/stop use
- ☐ choice of 50 or 100 ips streaming speeds
- ☐ automatic diagnostics
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SEE US AT NCC BOOTH #311

15K-VA UPS protects against power outages

This 15K-VA uninterruptible power supply protects against unplanned power outages, keeps sine-wave distortion to a maximum of 2.5 percent and controls output frequency to 60 Hz, ±0.5 Hz. Voltage levels are regulated to ±2 percent. The unit includes a 137 DC bus and a 120V battery backup capability. The unit also incorporates a static bypass switch with a fault-transfer time of 4 msec. and is also available in a 750-VA version. Prices for the 15K VA start at $21,050, excluding battery packs. **Clary Corp.,** San Gabriel, Calif.

Circle No 268

UPS is aimed at small minis, μcs

The 2.5K VA Mintaur series of uninterruptible power systems for small minicomputers and μcs offers an optional solid-state or electromechanical transfer switch. The system provides 125 percent overload for 15 min., 150 percent for 1 min. and 1000 percent for five cycles via the solid-state transfer switch. The system delivers full rated power over a temperature range of −20° to +50°C. The system operates at 120 VAC and includes an output voltmeter, a battery ammeter, a low-battery alarm, circuit protection, an output short circuit, current limiting and thermal protection. Price is $4275. **Nova Electric Manufacturing Co.,** Nutley, N.J.

Circle No 269

CIRCLE NO. 148 ON INQUIRY CARD

Facit, a distinguished family of printers.

Now Facit offers you a family of serial matrix printers with models to match your printing needs exactly.

Meet the Facit 4520, a superquiet, 100 cps matrix printer. It's ideal for educational systems, personal computers, data logging and for providing a hard copy printout from CRT terminals. With both parallel or serial interfaces available, the Facit 4520 gives you flexibility and intelligent printing at a very smart price.

For even more speed and flexibility, meet the Facit 4525 and 4526. Both give you bidirectional printing at 150 cps...with up to 5 copies. A tractor mechanism feeds the paper from either the bottom or the front—you set the linespacing.You can also choose between true upper and lower case characters, parallel or serial interfaces, and either of two format sizes, 80 and 132 columns.

With our Flexhammer Print Head and some incredible capabilities, the new Facit 4542 is the head of this family. It prints labels, charts, curves, diagrams, and text in any size. All in both black and red. It can give you proportional spacing and a justified right hand margin. And in a grey scale mode the Facit 4542 can even print pictures in 10 shades!

So if you need a reliable, high quality printer, call your nearby Facit Data Products representative today. And ask him to introduce you to Facit's remarkable family of data printers.

Facit. Simply better made.

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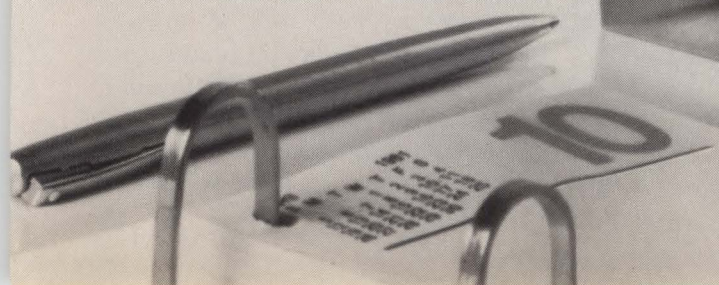

CIRCLE NO. 149 ON INQUIRY CARD

data entry

Scan-Data Corp. announces OCR work station

The Scan+Plus OCR work station scans documents, such as utility meter-reading forms, charge-sales tickets and remittances, at 6000 documents per hr. in continuous-feeding applications. The work station includes a medium-speed document transport, a single-line numeric OCR reader, a document view station, two program-selectable output stackers and a key station that can be used as a standard key-disk facility for OCR-related data entry or correction, or for supervisory system commands. **Scan-Data Corp.,** Norristown, Pa. **Circle No 275**

Laser scanning system reads bar-code labels

The MS105 high-speed, noncontact laser scanning system reads bar-code labels on packaging and print media, including tubes, cartons, bottles, highly polished surfaces and foil. The system includes two built-in μps, one for decoding, and one for management functions. It provides identification for packaging lines and other in-line high-speed operations. The system communicates with data-processing systems, CRT terminals and printers. Price is $4875. **Metrologic Instruments, Inc.,** Bellmawr, N.J. **Circle No 276**

Cognitronics announces educational system

The OCR-801 educational data-entry system can be used for scoring tests, reporting grades and attendance, scheduling courses, tax billing and surveys and gathering medical data. The system includes Autoform II, a user-oriented, parameter-driven program package, which recognizes OCR A, OCR B and IBM 407E numerics, hand-print numerics and mark read. As many as 3000 8½ × 11-in. mark-read sheets can be processed per hr. OCR and mark-read data can be mixed on a single line of a document. **Cognitronics Corp.,** Stamford, Conn. **Circle No 277**

The Disk Controller With More Punch For Users of Perkin-Elmer 32-Bit Minis.

Includes the Perkin-Elmer 7/32, 8/32, 3220 or 3240's. DIVA can give you storage capabilities that will satisfy you on two big counts: price and performance.

COMPARISON:	DIVA Computroller V	Perkin-Elmer Controller
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7 Byte Error Correction:	Both header and data	None
Formatting Speed: (e.g. 300 Mbyte Disc Pack)	8 Minutes	8 Hours
675 Mbyte Disc	Yes	No
Drives:	8/Per	4/Per
Buffering:	Full FIFO	No
Mix/Match Disc Drives:	Yes	No
Data-Lates:	No	Must Start Over
CPU Space:	One B or E Selch	Two I/O's
Construction:	Multiwire	PC

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- Real Time Operating Systems
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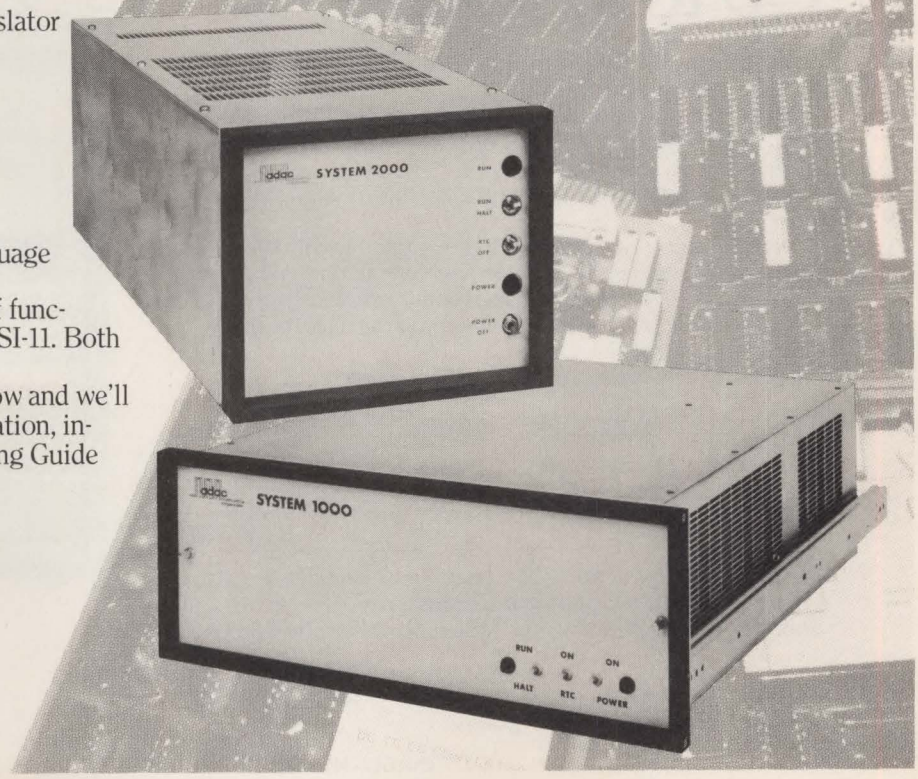

ADAC offers the widest selection of function cards and complete systems for LSI-11. Both analog and digital.

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CIRCLE NO. 151 ON INQUIRY CARD

LSI-11 SYSTEMS FROM ANDROMEDA

Any size you want.

No matter what your LSI-11 system needs are, Andromeda can satisfy them.

For example, the 11/M1 system shown on the right weighs only 14 pounds yet contains 102kb of mini disk storage (expandable to 389kb), 64kb of RAM, space for up to 16kb of EPROM, 4 serial ports, and the LSI-11/2 CPU. All of this for less than $4000. While the 11/M1 will run the RT-11 operating system, it is best suited for dedicated applications where its small size but large processing power are needed.

Near the other end of the scale is the 11/H23-DDF system shown at the left. The mobile enclosure includes the LSI-11/23 processor, 256kb main memory, 10mb of storage on the double density RK-05 cartridge disk and 1.2mb on the double density floppy disks. This system also has 4 serial ports and 7 empty dual width slots for additional interfaces. The $22,500 price includes the video terminal shown, a 150 CPS matrix printer, and the RT-11 operating system.

These are just two examples of the many LSI-11 based systems available from Andromeda. And the standard systems are just starting points; we will provide any combination of package, processor, memory, interfaces, and peripherals to meet your requirements. In addition to general purpose systems, we also have turnkey packages for word processing, time-sharing, data acquisition, and graphics.

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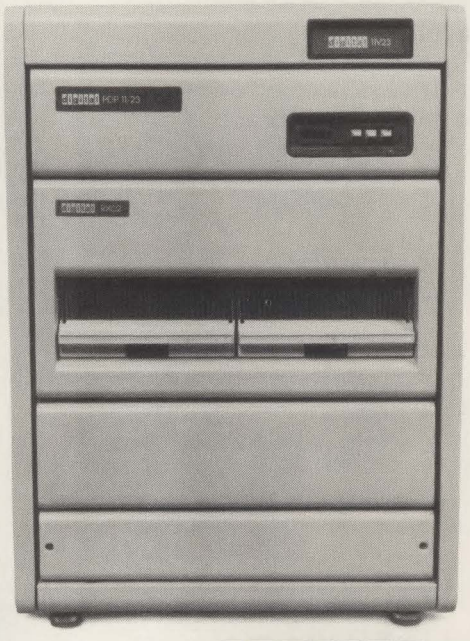

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data entry

TRW-Fujitsu introduces POS terminal

The TFC 7880 retail point-of-sale terminal includes as much as 1M byte of internal storage using bubble-memory technology. The μp-based terminal's memory capacity ranges from 32K to 1M bytes. The TFC 7880 offers an optional magnetic-stripe credit-card reader, a choice of two keyboards for sales recording and data entry and a choice of three display types. **TRW-Fujitsu Co.**, Los Angeles, Calif. **Circle No 278**

Scanner reads bar code at 30 ips

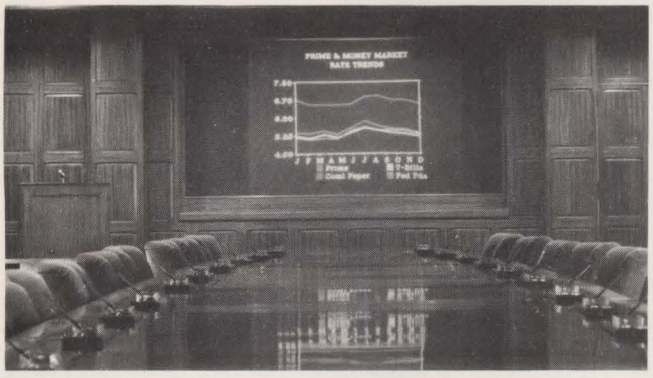
The SSR scanner, designed for use in libraries, inventory control, blood identification, mail sorting, hospitals and package identification, has a typical read range of 0.000 to 0.075 in. between 50 percent-resolution index points. A .075-in. depth of field permits scanning without touching a surface. High-speed scanning allows the system to read bar codes at 30 ips with consistent accuracy. **Welch Allyn, Inc.**, Skaneateles Falls, N.Y. **Circle No 279**

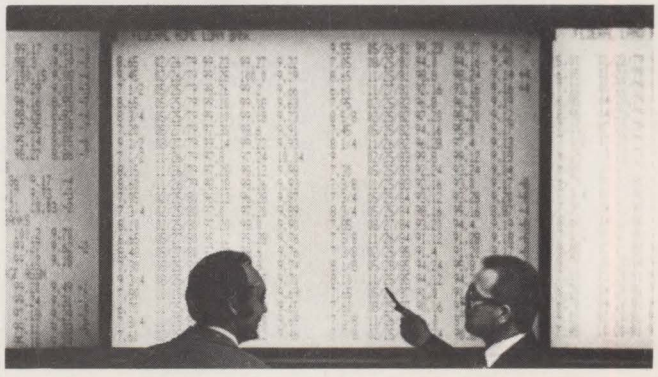
Data-reporting system reads bar codes

The RAMS retail administrative and merchandising system for in-store use by retail chains with centralized computer information processing includes μp-based handheld terminals with 16-character keyboards and memory storage of 32K bytes. The terminal can be used with optical wand scanners that read bar codes and feed the information into the terminal or with optical character readers that can read merchandise tickets and other alphanumeric printed records. **MSI Data Corp.**, Costa Mesa, Calif. **Circle No 280**

Data-entry system reads serial numbers

The series 200 data-entry system for reading serial numbers directly from products includes a camera with a scanning light source and a photodiode detector to capture as many as 18 alphanumeric characters. The terminal displays the image of the scanned area and informs the viewer when data has been sent to the host computer. The system can recognize any type size or font, on any material. The series 200 is priced less than $13,000, in multiple quantities. **Datacopy Corp.**, Palo Alto, Calif. **Circle No 281**





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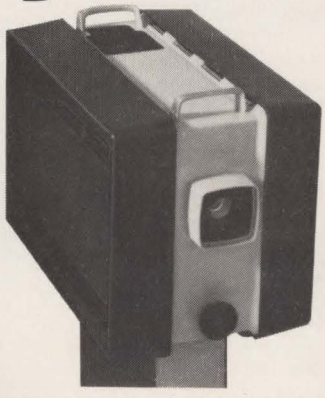

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GENERAL ELECTRIC

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accessories and supplies

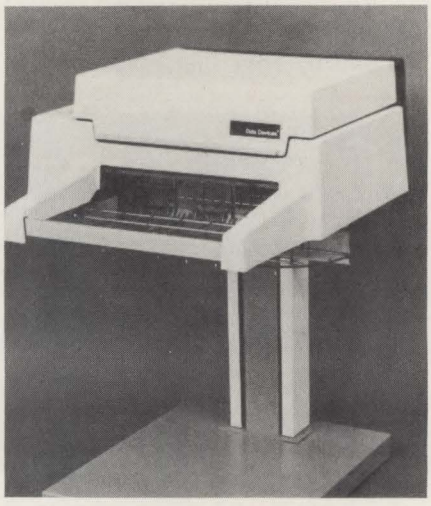
CRT tray holds printouts

This Plexiglas acrylic plastic sheet, which sits securely on top of a CRT console, measures 16 × 12 × 2½ in. It accommodates 14⅞-in.-wide data-processing printouts and work papers. A lip in the front of the tray fits over the edge of the console to hold the tray in place, and the unit rests on four slip-resistant corner cushions. An open front and thumb notch provide easy access to the tray's contents. **Perk Co.,** Palo Alto, Calif. **Circle No 282**

Sheet feeder handles 12½-in.-wide paper

The Autoflo 200 automatic sheet feeder feeds as many as 230 sheets of standard paper or multipart forms from two feed trays, and as many as 250 envelopes from an optional envelope hopper. The unit handles paper 6- to 12½-in. wide, and up to 14 in long. Price is $2270; the envelope feeder is $1025. **MQI Computer Products,** Fountain Valley, Calif.

Circle No 283



Data Devices introduces power formstacker

The Datastacker continuous formstacker handles 300- to 2000-lpm printer speeds and 80-ips skip rates. The unit stacks all standard continuous forms, including 11-lb. single-part paper. A stacking tray lowers as forms height increases, and an alarm notifies an operator to remove forms. Options include an interface control for Dataproducts model 2550 printers and an acoustical noise-reduction cabinet. The Datastacker sells for $1995. **Data Devices International,** Chatsworth, Calif. **Circle No 284**

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AMPEX CIPHER CONTROL DATA DIGI-DATA KENNEDY MICRODATA PERTEC TANDBERG DATA (IDT) WANGCO TDX	AMPEX CAELUS CENTURY DATA CONTROL DATA DEC DIABLO IOMEC MICRODATA PERTEC WANGCO WESTERN DYNEX DRI	AMPEX CONTROL DATA	AMPEX CENTURY DATA CONTROL DATA BALL COMPUTER MITSUBISHI	BASF CONTROL DATA FUJITSU KENNEDY MEMOREX PRIAM SHUGART SEAGATE QUANTUM IMI
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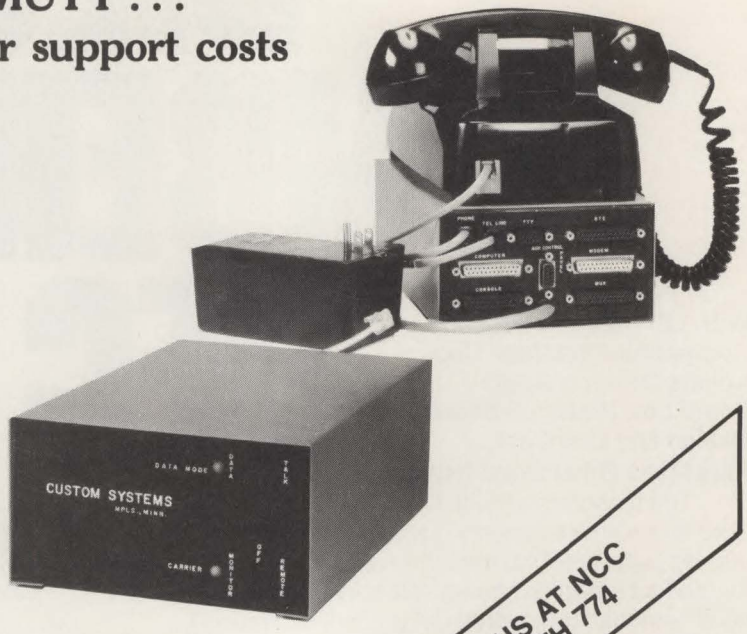

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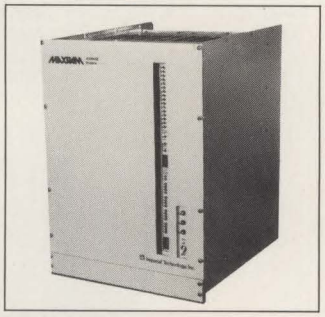

The non-rotating MaxiRam is a solid-state disc replacement storage system that operates at the speed of main memory. It is ideal for the following:
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New Products

accessories and supplies

Case protects 50 floppy disks

The "En Route" floppy-disk case carries as many as 50 8- or 5¼-in. floppies. A polyethylene inner lining provides a smooth surface of low porosity, which protects disks by preventing dust buildup. The case weighs 2½ lbs. and measures 10 × 10 × 7½ in. Other features include an aluminum valance and an interlocking system that prevents moisture and contamination. The case is priced at $65, with quantity discounts available. **Inmac,** Santa Clara, Calif. **Circle No 285**

Maine Manufacturing offers systems desk

The Data-Mate systems desk includes a 19-in. EIA bay, pedestal leg inserts, a textured finish, stainless steel wear guards and rubber-cushioned adjustable levelers. Prices start at $575. **The Maine Manufacturing Co.** Nashua, N.H. **Circle No 286**

Computer stand holds small computers

The Comstand computer work station for personal and small business computers includes a shelf for storage of instruction manuals or other reference material. Two models are available. The model 2036 is 36 × 54 in.; the model 2048 is 48 × 47 in. Both styles have 20-in.-wide tables. An optional printer stand has a 20- × 24-in. table with a slot in the middle to allow paper to feed into the bottom of the printer. The model 2036 sells for $150, the model 2048, $165, and the printer stand, $140. **Ever Roll Specialties Co.,** Springfield, Ohio. **Circle No 287**

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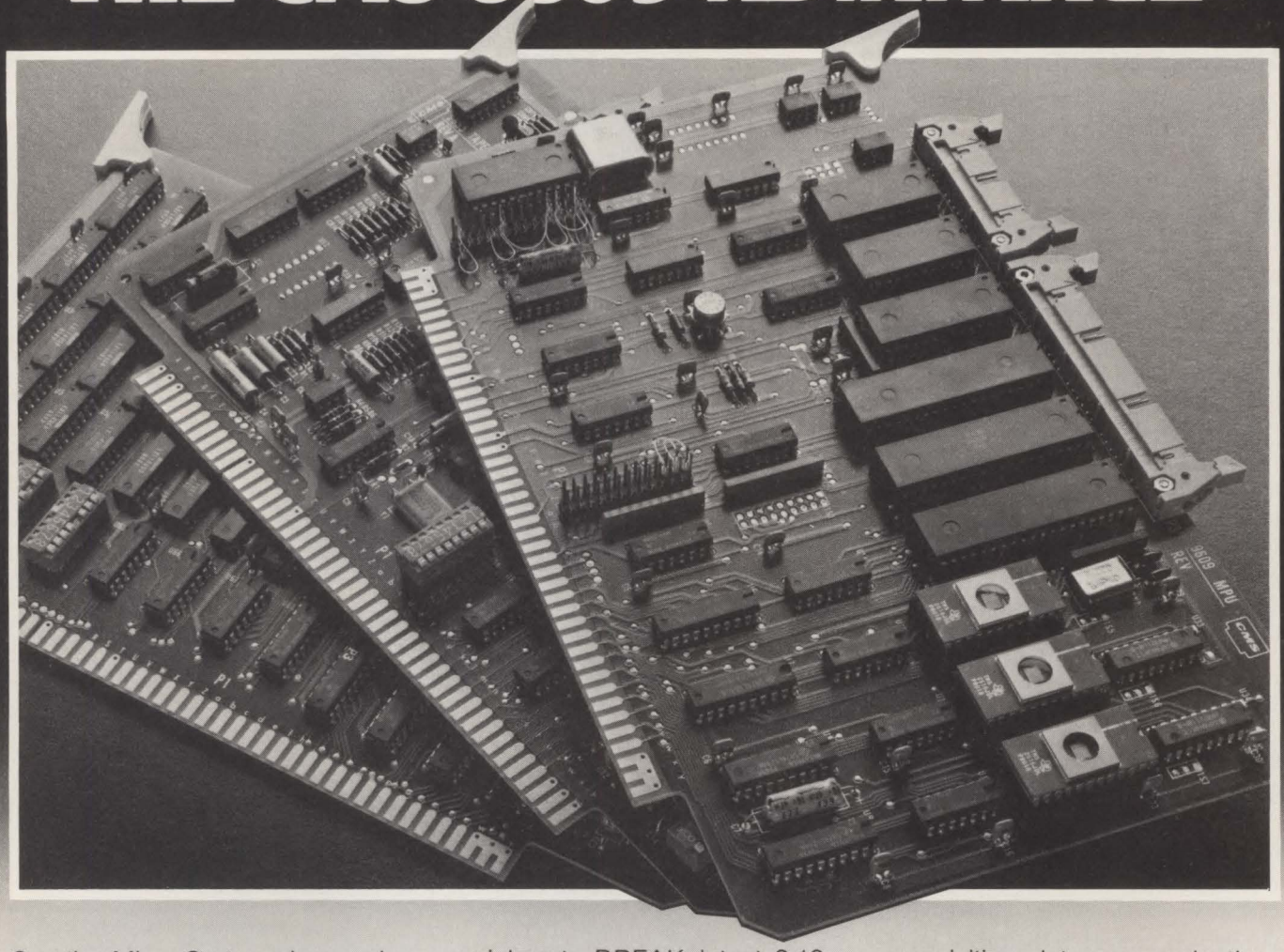

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New Products

accessories and supplies

ANSCO offers alphanumeric tape-numbering system

This alphanumeric tape-numbering system enables users to select a four-, five- or six-digit numerical or alphanumerical sequence to control and identify 1000 to 10 million reels of magnetic tape. Features include color-coded, pressure-sensitive labels, vertical strap labels, horizontal reel labels, a two-digit tape rack label and a number-repair kit. The Easy Load II set includes mini-numbers for use above a self-loading slot. Prices start at $114 in 1000-unit quantities, with quantity discounts available. **American National Supply Corp.,** Gardena, Calif. **Circle No 288**

Printout rack holds 3600 sheets

The Mini-Rack II printout storage and retrieval system includes a suspension rack with casters and four pressboard hanger binders. The rack holds as many as 3600 14⅞- × 11-in. printout sheets. The units can be stacked or placed on a desk top or counter. An optional T-bar suspension system enables binders to be removed from the sides. The unit sells for less than $48. **Wilson Jones Co.** Chicago, Ill. **Circle No 289**

Tray provides convenient disk filing

The Plexi-Tray desk-top file for disks stores and classifies as many as 50 disks, with day-of-the-week adjustable dividers, movable reference tabs and color-coded labels. An index card provides fast reference and retrieval of contents. The tray is available in two sizes, to house 8- or 5¼-in. disks. **ACCO,** Wheeling, Ill. **Circle No 290**

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OPTIONS
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- PROJECT ACCOUNTING
- DISK ACCOUNTING
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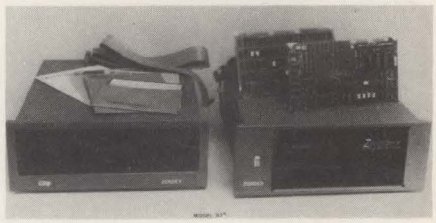
New Products

design aids



Zendex announces development system

The model 805 development system provides a place for Intellec MDS users to plug in spare Intellec cards, left over after upgrading. The system includes two cabinets. One houses an eight-slot Multibus backplane, a disk controller, a PIO module and front-panel interrupt and reset switches. The second cabinet houses dual Shugart SA801R drives, a power supply and fans. The model 805 sells for $6740. **Zendex Corp.**, Dublin, Calif. **Circle No 291**

In-circuit tester performs at 10 MHz

The Thalamus-I dynamic in-circuit digital tester performs tests at speeds of 10 MHz in real time. The system requires no user programming, and can test most logic families and programmable and nonprogrammable devices, including memories and μps. Thalamus-I includes a self-contained library covering a comprehensive range of devices, and can be upgraded to cover proprietary and military components. **Thalamus Electronics Inc.**, Mississauga, Ont., Canada. **Circle No 292**

Zendex announces PROM program

The model ZX-908 programs the Intel 2716, 2732 and 2732A EPROMs, and programs 16K bytes of EPROM in one operation. The system operates a Multibus chassis with software drivers and requires a 5V

power supply. The system includes eight zero-insertion-force sockets for PROM insertion and withdrawal. The ZX-908 sells for $720. **Zendex Corp.**, Dublin, Calif.

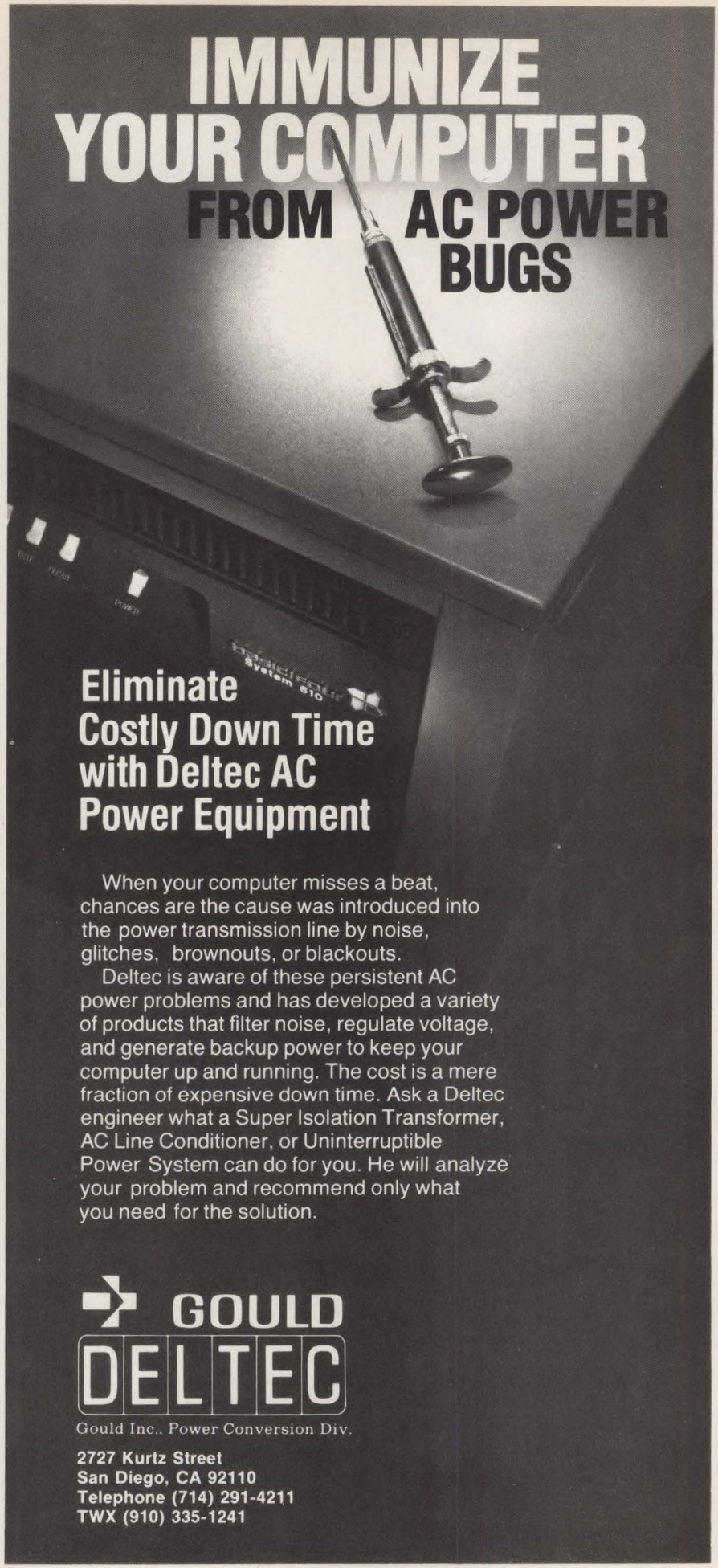
Circle No 293

Millennium releases 6801 personality module

The MicroCable personality module supports Motorola's 6801 μp development on the vendor's MicroSystem Designer. The unit enables 6801 software to be downloaded over an integral RS232C port, without constructing prototype circuits. Features include the ability to allow a user to create interrupts asynchronously via a special keypad and support of maskable and nonmaskable interrupts. The module sells for $1250, the MicroSystem Designer, $990. **Millennium Systems, Inc.**, Cupertino, Calif. **Circle No 294**

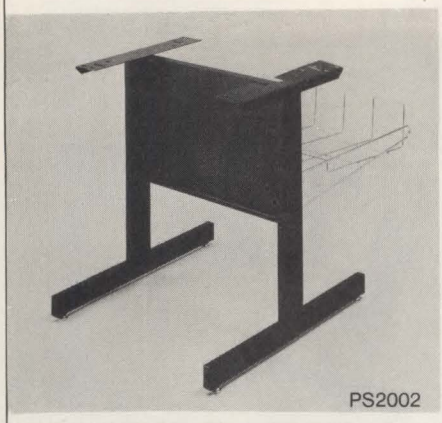
Module enclosure has four-slot card cage

The TM990/522 μc module system enclosure for the TM990 family of 16-bit μc modules includes a 75W power supply, a fan, a front panel and a four-slot card cage that accommodates μc, memory, I/O or peripheral interface modules. The enclosure measures 7 × 17 × 16.7. Price is $1620 in quantities of one to nine. **Texas Instruments Inc.**, Dallas, Texas. **Circle No 295**



CIRCLE NO. 167 ON INQUIRY CARD

Printer Stands ~~To Go~~


PS2002

PS2004

PS2003

Here are the printer stands that fit a wide array of popular printers while maintaining a professional and appealing appearance that fits into any office or computer room decor. And, they're available from stock.

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- Centronics 700 Series
- Diablo 630, 1400 and 2300
- Lear-Siegler 300
- NEC Spinwriter Series
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- Qume
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PS 2003
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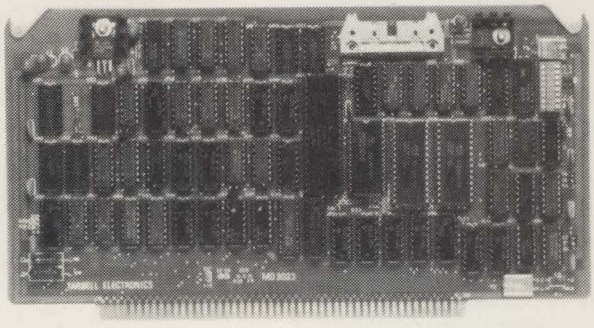

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New Products

graphics

H-P announces eight-pen plotters

The models 9872 C/T, 7220 C/T and 7221 C/T eight-pen plotters are intended for business and financial planning, computer-aided design, chemical analysis, measurement and test data recordings, manufacturing and engineering drawings, numerical control verification and cartography. Features include 10 pen colors and two line widths. The plotters automatically store pens and select new pens at the push of a button or on receipt of a program command. Prices start at $5300. **Hewlett-Packard Co.,** Palo Alto, Calif. **Circle No 296**

Graphic system has MC68000 μc

The model GS 8000 graphic system includes a 112-nsec. raster display processor and a Motorola MC68000 16/32-bit μc. The system uses a 31-bit world-coordinate system, which provides a virtual resolution of 4 billion points per axis and accepts graphics primitives, including lines, circles, filled polygon areas and text, and retains them in memory. Hardware includes the graphics processor with a 64K-byte RAM and 24K-byte PROM, a display processor and parallel interfaces. Prices start at $26,200. **Lexidata Corp.,** Billerica, Mass. **Circle No 297**

Interactive terminal supported by AD-2000

The Series II vector refresh display terminal includes a 19-in. CRT with 2048 × 2048 addressability and built-in 16-bit μcs. The AD-2000 software package provides computer-aided design, total tool path design and numerical control tape production, fully annotated drawings and comprehensive management information. The Series II, without software, sells for $15,000 in single-unit quantities. **Imlac Corp.**, Needham, Mass.

Circle No 298

Lexidata introduces video hard-copy recorder

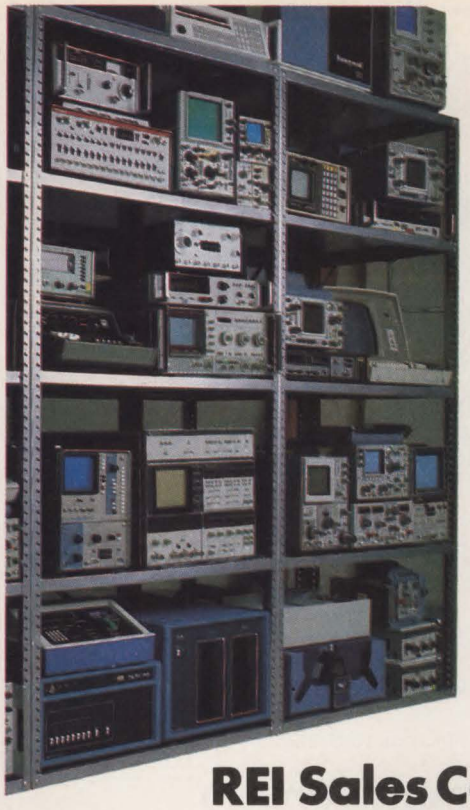
The model 4000 video hard-copy recorder produces black-and-white or 16 continuous-tone images from video output. The recorder generates resolution of 1280 × 1024 pixels and uses dry silver paper that provides a permanent, non-fading record. An optional built-in test pattern generator performs troubleshooting or calibration. A four-channel multiplexer enables the unit to be used with four display processors. Prices start at $5445 for a monochrome version and $8156 for a gray-scale version. **Lexidata Corp.**, Billerica, Mass.

Circle No 299

Graphics tablets are pressure-sensitive

These pressure-activated graphics tablets for cursor motion, handwriting input, soft keyboards and electronic blackboards are available in ballpoint pen- or fingertip-sensitive versions. The resistive-technology-based tablets provide analog coordinate output. Resolution is determined by the controller's A/D conversion, and resolutions of 1/4000th of tablet dimensions are typical. **Elographics, Inc.**, Oak Ridge, Tenn.

Circle No 300



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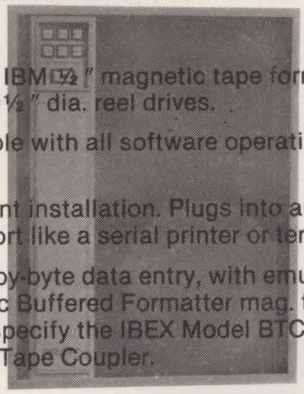

- Standard IBM ½" magnetic tape format; 7" and 10½" dia. reel drives.
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CIRCLE NO. 173 ON INQUIRY CARD

New Products

memories

Dataram announces memory for Honeywell 316

The BC-316 bulk core memory system for Honeywell, Inc.'s model 316 minicomputer is available in 7- and 15¾-in. chassis sizes. The smaller version holds as many as two 128K × 18 core modules; the 15¾-in. version holds as many as eight 256K-byte core modules. Average access time is 6.4 μsec., and data transfer rate is 156K or 312K words per sec. Single-unit prices start at $9600 and $24,600, respectively for the 7- and 15¾-in. versions. **Dataram Corp.,** Cranbury, N.J. **Circle No 301**

Add-in memory is PDP-11/44-compatible

The PINCOMM 44S memory modules provide as much as 1024K bytes of storage and are hardware- and software-compatible with DEC PDP-11/44 minicomputers. They are available in 512K-byte, 256K-byte and 128K-byte increments. Diagnostics provide a full functional check of the data and error-correction circuits. A diagnostics and chip location chart allows direct isolation of failures at the chip level. The 256K-byte version is priced at $3995, the 1024K-byte version, $13,440 in single-unit quantities. **Trendata Corp.,** Santa Ana, Calif. **Circle No 302**

256K-byte memory fits on dual-width board

The CI-1123 dynamic memory system for use with the DEC 11/23 provides 256K bytes of memory on a dual-width board. The system includes a 4M-byte address field, parity checking, a 64K dynamic RAM, a 240-nsec. access time and a 400-nsec. cycle time. Single-quantity price for a 128K × 9 version is $1925. **Chrislin Industries, Inc.,** Westlake Village, Calif. **Circle No 303**

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Pascal compiler runs under MDOS

This Pascal compiler runs under the MDOS or FLEX operating system. The compiler is said to include most of the Jenson and Wirth standard, except for pointers and records. Extensions are provided for manipulating hex (16-bit unsigned) data values, strings and I/O. A set of floating-point and scientific functions are included, along with program chaining and dynamic I/O switching. The package includes the compiler, relocating assembler, linking loader and interactive symbolic debugger for $215. Source on disk for the run-time library is $50. **OmegaSoft,** Sunnyvale, Calif.

Circle No 304

COBOL package detects errors

The SELFIX06 COBOL-callable subroutine automatically detects and corrects keystroke errors in data-entry applications. The subroutine also detects more than 99.9 percent of all errors other than single-digit errors and transpositions. The user print program first supplies an 11-digit data field to be protected; SELFIX06 generates a corresponding six-digit check field to be printed. **Selfix Corp.,** Lowell, Mass.

Circle No 305

C compiler intended for 68000 μp

The C68 compiler executes on a DEC PDP-11 processor running the UNIX operating system. Consisting of a pre-processor, a compiler, a relocatable assembler, a linking loader, a support library and utilities, C68 generates programs that execute stand-alone or under operating system control on the Motorola 68000 μp. The compiler produces assembly-language code that is subsequently assembled into relocatable object code. Price of a single-CPU binary license is $950. **Alcyon Corp.,** San Diego, Calif.

Circle No 306

Screen editor offers word processing for DG

ZIP provides word-processor-like capabilities for programmers working with Data General equipment. The Language command allows the programming language in use to be specified. ZIP can delete, move and copy program language statements. Statement label resequencing is permitted. ZIP enables a user to

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point at the text on the screen to insert, move and copy material and to scroll the file up and down. Price is $900 for the DOS and MP/OS operating systems, $1200 for RDOS and $1800 for AOS systems. **Information Processing Techniques,** Palo Alto, Calif.

Circle No 307

Convergent announces Pascal compiler

Convergent Pascal, said to conform to proposed ISO standard ISO/IC9/SC5/NS29, runs on the vendor's 16-bit minicomputer under the CTOS operating systems. The package, also claimed to be compatible with UCSD Pascal, provides language extensions, including support for independent compilation with cross-type checking, 1M-byte addressability via long pointers and a retype mechanism to control type interpretation. The compiler sells for $2500, with OEM discounts available. **Convergent Technologies,** Santa Clara, Calif.

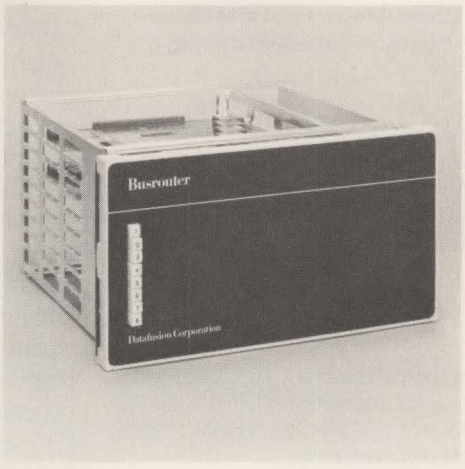
Circle No 308

Package provides networking for P-E 3200

NNF32, a network control task for Perkin-Elmer 3200 computers, interfaces with P-E's OS32 operating system and ZDLC protocol to provide a packet-switching network architecture for multiple P-E systems. NNF32 performs packet assembly/disassembly, end-to-end flow control, packet switching, logical-connection maintenance, error control and adaptive routing. Features include: multiple precedence levels, data encryption and datagram and logical-connection operating modes. A single-CPU license is $5000. **Transaction Data Systems, Inc.,** Orlando, Fla.,

Circle No 309

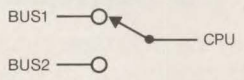
Reconfigure your PDP11 Unibus* with the push of a button.



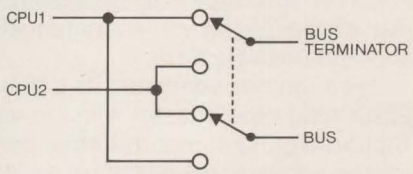
Do you need to share peripherals? Do you have multiple cpu's with a limited number of peripherals? Do you need to selectively choose which peripheral is on the bus?

If so, Datafusion Corporation's OSR11-A Busrouter can help. It is a passive, manually operated device to perform the physical and electrical switching of the Unibus* for PDP11 series computer systems: up to eight switching planes (i.e., configurations); electromechanical switching relays (simple, high reliability, minimal electrical loading).

Essentially, each Busrouter switching plane can be viewed as a single pole, multiple throw switch.



The application shown here is a situation opposite the first, where one peripheral bus can be switched between two cpu's with the cpu not selected being terminated.



Many more configurations are available such as sharing multiple peripheral devices between multiple cpu's and then selectively choosing to switch each one or all to one cpu or another.

Other PDP11 products available are a bus repeater, bus cable tester, and an associative processor for high speed text search – a hardware approach.

We also have some ideas for the application of our products which might not have occurred to you. If you can't get the performance that you would like from your PDP11 system, maybe we can help. Please telephone our Marketing Manager at (213) 887-9523 or write to Datafusion Corporation, 5115 Douglas Fir Road, Calabasas, California 91302.

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New Software

Operating system is add-on for IBM Series/1

The program executive system (PXS), a supplement to the EDX operating system for IBM Series/1 computers, provides user facilities for program development and distributed-processing operations. PXS, with its own high-level language, automatically performs functions that otherwise must be coded during applications development or handled by an operator at execution time. Price for a license for the development components of PXS is $1250. **Alan Hochschild, Inc.,** San Francisco, Calif. **Circle No 310**

Z8000 cross-assembler runs on IBM 370

This cross-assembler for the Zilog Z8002 μp uses the IBM 370 as a host. Input is assembler source on cards, using Zilog mnemonics and conventions. The output is hexadecimal code in Tektronix format with checksum on cards. The output may also be transmitted over telephone lines directly to the Z8000. The package sells for $960 on magnetic tape with a reference manual. **Alan Associates,** State College, Pa. **Circle No 311**

SDA develops prompter for COBOL

Prompter allows COBOL users to create SCORE parameters in a conversational mode. SCORE, a COBOL program generator, can define program requirements in the form of single nonprocedural statements. SCORE writes COBOL programs by specifying the problem variables. With SCORE Prompter, a programmer need not be concerned

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CIRCLE NO. 181 ON INQUIRY CARD

with card column numbers or the creation and maintenance of card decks. **SDA,** New York, N.Y.

Circle No 312

Package provides computer security

The CONTROL package, implemented for the DEC PDP-11 under the RSTS/E operating system, permits security management personnel to monitor interaction at randomly selected terminals without interruption or intrusion into job sessions. This activity cannot be detected by a user. All keystrokes entered at the user terminal and all information presented to the user terminal are also presented to the terminal of the security manager. Price is $595. **Clyde Digital Systems,** Bedford, Mass.

Circle No 313

Software briefs

Mini-Micro Systems receives dozens of news releases each week about new software products that may not warrant the detail included in the foregoing New Software section. Nevertheless, we don't want to deny readers the opportunity to get more information about the latest software developments. Toward that end, we offer the following brief entries, compiled and edited by Malcolm L. Stiefel, contributing editor.

LANGUAGES AND DEVELOPMENT TOOLS. Advanced Systems Design, Los Angeles, announces a Pascal string routine for IBM mainframes, Digital Equipment Corp. minicomputers and µcs. **Circle No 418...Ontel Corp.,** Woodbury, N.Y., announces a FORTRAN compiler for its MDOS and HDOS operating systems. **Circle No 419...Pactel,** London, England, unveils a cross-assembler and Intel 8048 simulator for Digital Equipment, Data General, Harris, Hewlett-Packard and Prime computers. **Circle No 420...Software Tools,** Willowdale, Ontario, has a new Pascal cross-compiler for Intel 8086 and Digital Equipment

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DigiTec's popular 6400 Series Printers now offer you a choice!

DigiTec has added two new thermal models to the tried and proven 6400 Series Alphanumeric Printers. You can now choose thermal or electrosensitive printing and get all the DigiTec benefits with either. Fewer moving parts than impact printers guarantee increased reliability. Plus, non-impact means no hammers to clatter or wear out and no messy ribbons to change. A built-in microprocessor provides the simplest possible interfacing.

Input configurations satisfy all the popular data communication interfaces. The serial models are programmable for either RS-232-C or 20 mA current loop at either 110 or 300 baud while parallel input models accept data at rates up to 1000 characters per second (higher rates optional).

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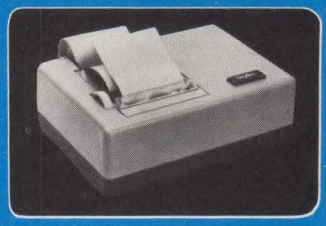
Choose either thermal or electrosensitive ... if it's DigiTec, you've made the right choice.



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New Software

PDP-11s under RSTS, RSX-11 and IAS. **Circle No 421...Western Wares,** Placerville, Colo., announces a relocatable assembler for 8080, 8085, Z80, CP/M and ISIS-II systems. **Circle No 422...Synergistic Systems,** East Thetford, Vt., has a new BASIC language-development tool for Texas Instruments' DS990 computers. **Circle No 423...Software '70,** Anaheim, Calif., unveils FORTRAN IV extensions for minicomputers and μcs. **Circle No 424...Wintek Corp.,** Lafayette, Ind., introduces a FORTRAN compiler for its Sprint 68 development system and UCSD operating systems. **Circle No 425.**

UTILITIES, COMMUNICATIONS AND OPERATING SYSTEMS. Communications and Special Software, Spring Lake, Minn., has a voice response package for Honeywell Level 6 and DPS 6 computers and GCOS MOD 400 operating systems. **Circle No 426...Interplex, Inc.,** Mountain View, Calif., announces an EPROM programming update for Digital Equipment LSI-11 computers and RT-11 operating systems. **Circle No 427...Prosoft,** North Hollywood, Calif., introduces a "software speedup" analysis for BASIC programs for Radio Shack TRS-80 model 1 Level II and disk BASIC. **Circle No 428...Star-Kits,** Mount Kisco, N.Y., unveils a memory dump via loudspeakers for 6800 and 6809 μps, **Circle No 429,** and a monitor for 6809 μps. **Circle No 430.**

Transactions Data Systems, Inc., Orlando, Fla., has an interface-to-transaction controller for multidropped terminals for Perkin-Elmer computers. **Circle No 431...Viking Software Services, Inc.,** Tulsa, Okla., introduces a forms manager for terminal data entry for Digital Equipment PDP-11 and VAX-11 computers. **Circle No 432...Xmark Corp.,** Costa Mesa, Calif., unveils a multi-work-station controller for its office automation systems. **Circle No 433.**

BUSINESS APPLICATIONS. Cimarron Corp., Costa Mesa, Calif., announces its Attorney accounts-receivable and time-accounting package for Commodore 8032 computers. **Circle No 439...Cyber Engineering Corp.,** Huntsville, Ala., introduces a stock-market-analysis package for Hewlett-Packard 9845 computers, **Circle No 440.**

ADDITIONAL INDEPENDENT SUPPLIERS OF WORD-PROCESSING PACKAGES FOR DESK-TOP COMPUTERS
(Refer to p. 123)

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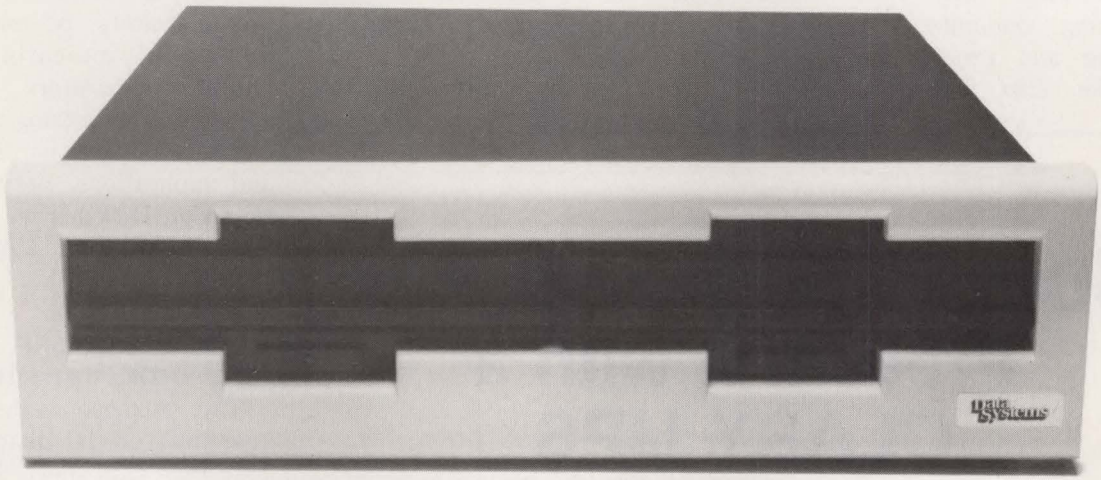

AND MORE.

The DSD 440 is the only alternative to the DEC RX02 that's 100% software, hardware and media compatible with LSI-11, PDP®-11 and PDP-8 computers, including those with extended memory. It can be configured as an RX02 for DEC double density or IBM 3740 single density recording, or as an RX01 for backward operating system compatibility.

MORE

A 512-byte hardware bootstrap is built into all PDP-11 and LSI-11 interfaces. It loads system software automatically from either single or double density diskettes. Extensive self-testing is DIP-switch selectable with the "Hyperdiagnostics" that run without being connected to a computer. The low profile 5¼-inch DSD 440 features write protection and diskette formatting.

FASTER

The optimized DSD 440 microcode increases system throughput when using the RT-11 foreground/background monitor. In particular, the DSD 440 with an LSI-11 runs fill and empty buffer operations 20% faster than an RX02.

FOR LESS

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CIRCLE NO. 184 ON INQUIRY CARD

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New Literature

Publication explains laser trimming

The W511 functional DC laser trim system is detailed in a brochure. The six-page booklet describes measuring, trimming, controlling, handling and programming. The pamphlet also features multiple voltage sources; a Q-switched YAG laser; a galvanometer beam positioner; data-gathering and reduction software; and data-logging, distribution and correlation-analysis information. **Teradyne, Inc.**, Boston, Mass.

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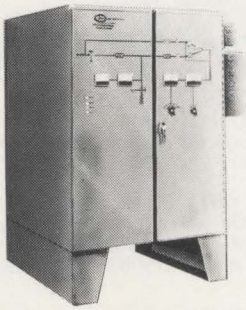

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CIRCLE NO. 185 ON INQUIRY CARD

Booklet examines rotating components

A line of process control components is detailed in a catalog. The 36-page booklet lists tachometer generators, DC motors, speed-drive and indicating systems, digital comparators and control systems. The catalog also contains technical information, specifications and applications. **Servo-Tek Products Co.**, Hawthorne, N.J.

Circle No 315

Pamphlet details fiber-optic transmitter

The OTX5000 series fiber-optic transmitter is described in a four-page data sheet. The pamphlet details the system's semiconductor diode laser and feedback-stabilization system. The data sheet also details applications and specifications and includes a block diagram, a dimensional drawing and performance curves. **Optical Information Systems**, Elmsford, N.Y.

Circle No 316

Bulletin covers electronic furniture

A line of electronic technical furniture is described in a catalog. The four-page booklet covers pre-wired and dedicated circuits, plan views of a basic unit and add-on units. The catalog also details information-processing work-center installations, options and accessories. **Structural Concepts Corp.**, Spring Lake, Mich. **Circle No 317**

Brochure details magnetic data storage products

A line of data-storage products is described in a brochure. The illustrated pamphlet details disks, magnetic data storage media and a protective case. The brochure lists configurations, model compatiblity, dimensions and capacity information. **The Standard Register Co.**, Dayton, Ohio. **Circle No 318**

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Booklet details CMOS switches and multiplexers

A line of dielectric and non-dielectric isolated linear CMOS switches and multiplexers is detailed in a catalog. The 56-page booklet includes functional diagrams, truth tables, ordering information, performance and switching characteristics, test circuits and absolute maximum ratings. The catalog also provides packaging information, terminology and circuit applications. **Micro Power Systems, Inc.**, Santa Clara, Calif. **Circle No 319**

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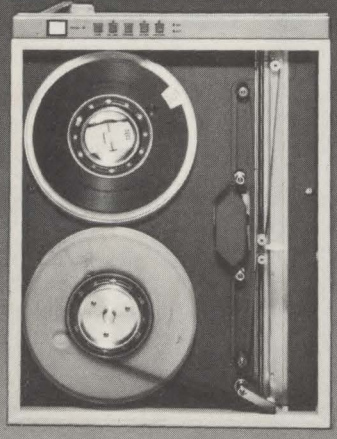

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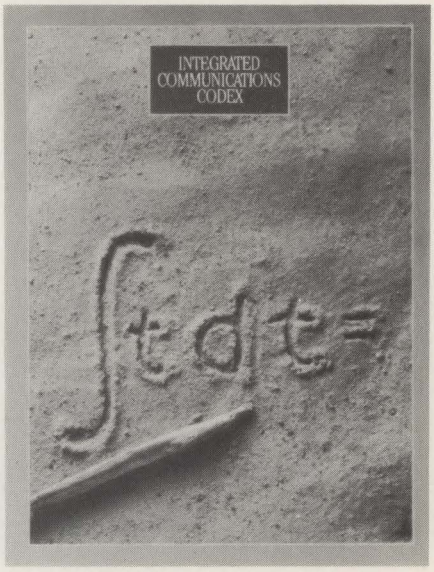

Integrated communications detailed in a catalog

A line of integrated communications products is detailed in a brochure. The 12-page booklet describes transport, command and exchange functions; modems; multiplexers; voice digitizers; network-control and management systems; and terminals. The publication also contains network schematics and applications. **Codex Corp.**, Mansfield, Mass. **Circle No 320**

Brochure details CAD/CAM system

The AD-2000 automated design, drafting and manufacturing system is described in a brochure. the 12-page pamphlet details the CAD/CAM software system, drafting functions, geometric elements and numeric control. The catalog also lists available forms, applications and management information and provides a question-and-answer section. **Manufacturing and Consulting Services, Inc.**, Santa Ana, Calif. **Circle No 321**

Publication describes display systems

The SM-810-001/002 display systems are detailed in a booklet. The 16-page catalog provides a system

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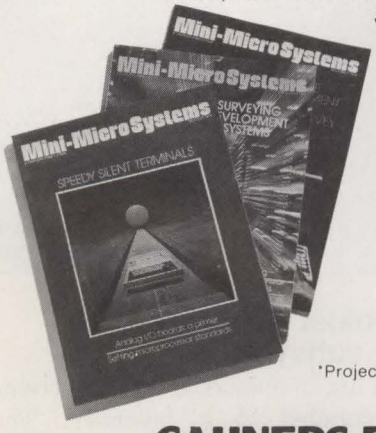

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overview and describes system operation and program sequences. The brochure also explains data/control word-entry and status-read for handshaking entry and dynamic-mode operation. **Beckman Instruments, Inc.**, Scottsdale, Ariz. **Circle No 322**

Bulletin details dot-matrix printers

A line of dot-matrix printers for air cargo, oil drilling, research and wholesale/retail-labeling applications is described in a brochure. The pamphlet discusses the printers' hammer-bank printing mechanism and "print-draw" capability. The brochure also includes graphics, bar codes, labels, alphanumeric forms and functional and general specifications. **Printronix, Inc.**, Irvine, Calif. **Circle No 323**

Guidebook details data-communications network

The Dataswitch intelligent switching system for on-site data-communication networks is detailed in a guidebook. The 20-page booklet describes network design and components and examines software configurations, operator language, operator control and automatically recorded statistics. **Develcon Electronics Inc.**, Doylestown, Pa. **Circle No 324**

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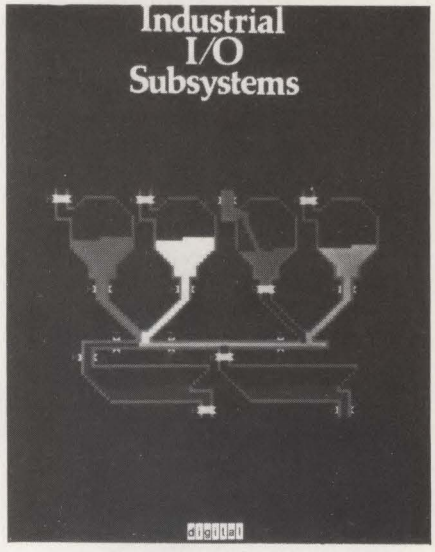
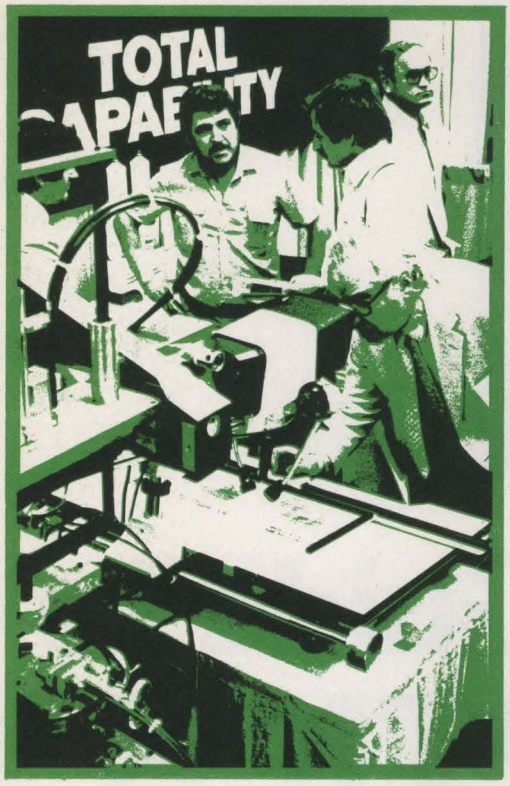


Booklet examines I/O subsystems

A line of industrial I/O subsystems is detailed in a brochure. The 32-page booklet describes the IP11x and IPV12 subsystems for local process monitoring and control; the IP300 stand-alone μc system; and the DPM50, an LSI-11/23-based monitor and control subsystem with multidrop communications support. The brochure also summarizes specifications and configurations. **Digital Equipment Corp.**, Merrimack, N.H. **Circle No 325**



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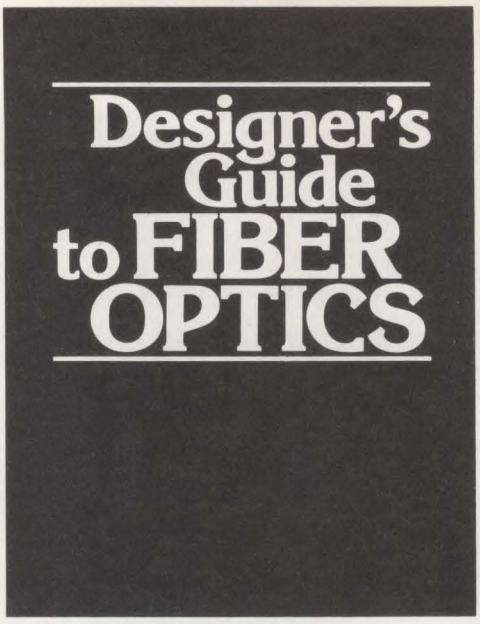

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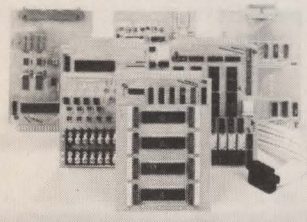

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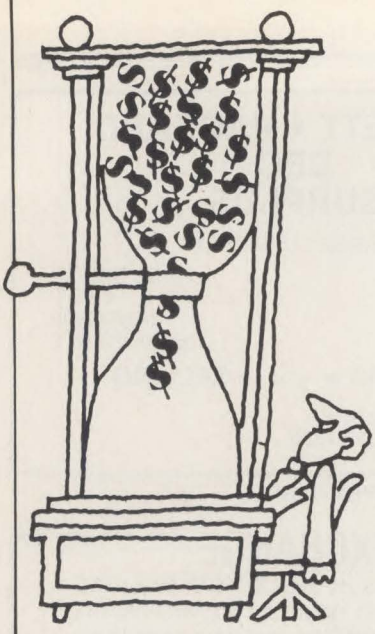

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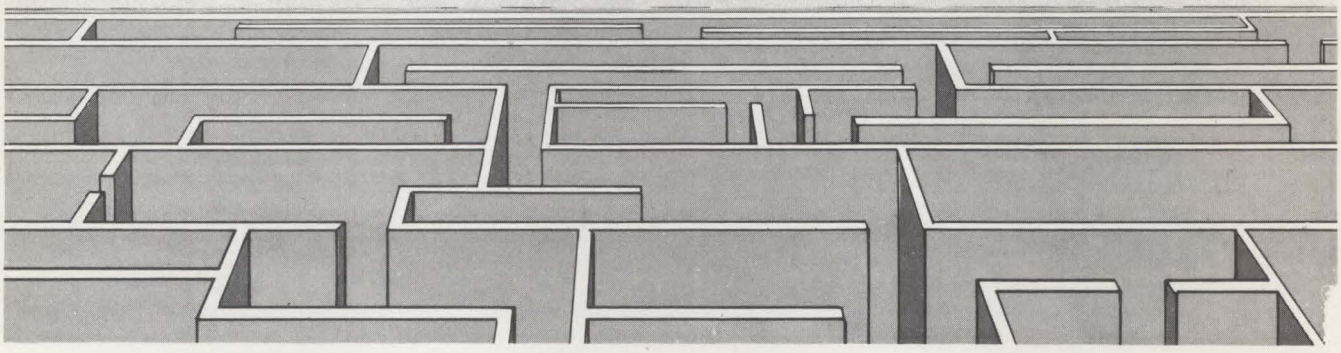

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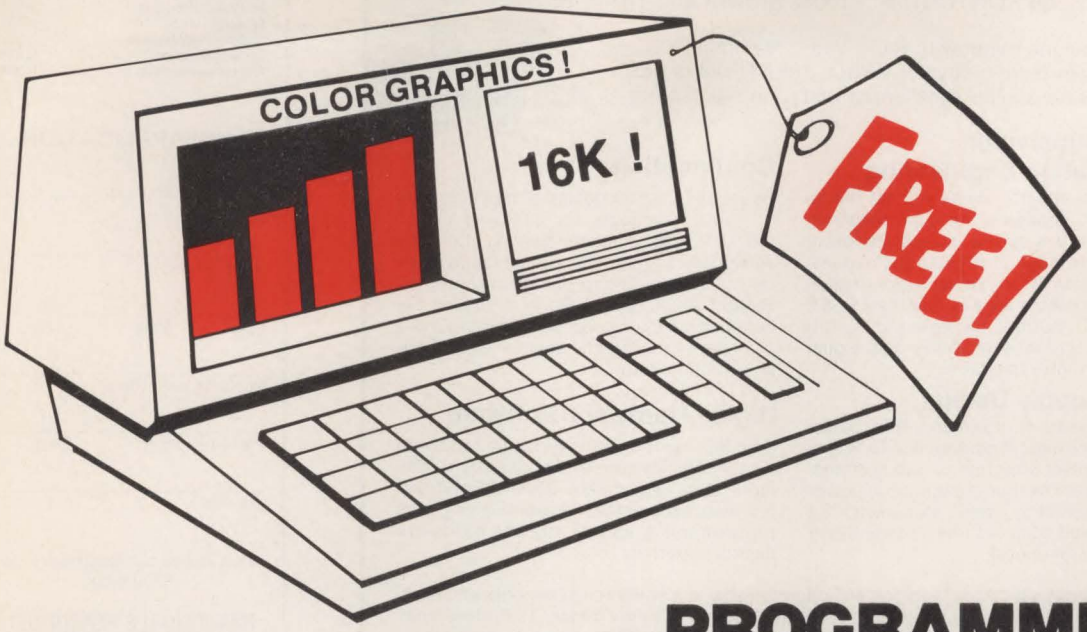

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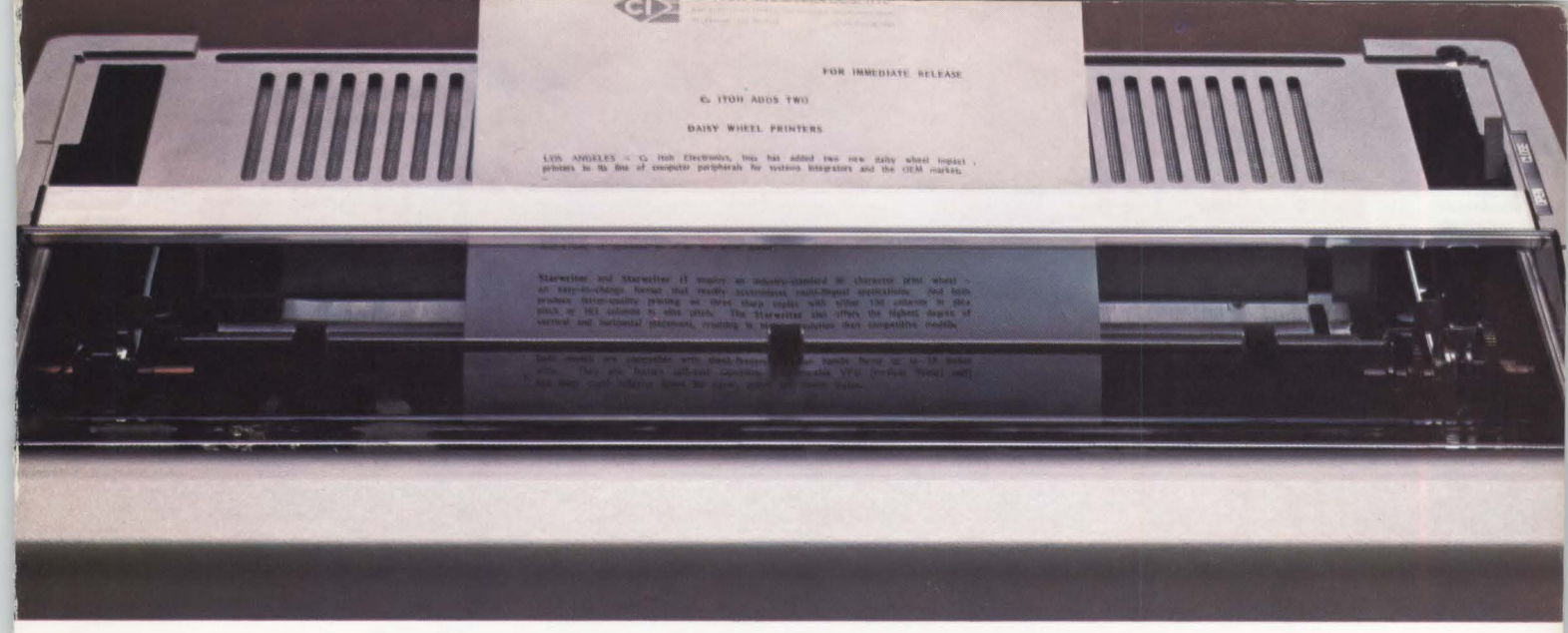


LETTER PERFECT.

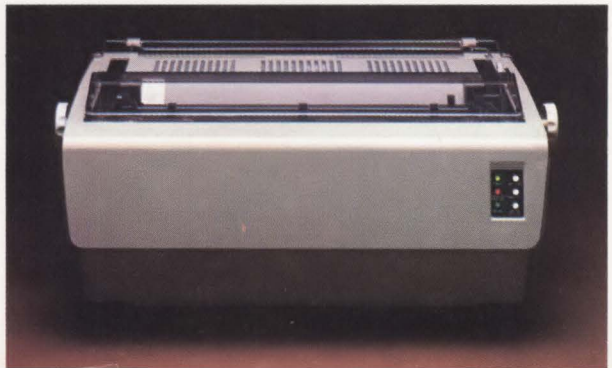
You can actually see the superior print quality when you use C. Itoh's new daisy wheel impact printers. Besides clear and crisp print characters, you also get the throughput performance you're looking for, at prices never before available to quantity buyers of Daisy Wheel printers.

C. Itoh's Starwriter offers you a print speed of 25 cps while the Starwriter II operates at 45 cps. Both machines incorporate the latest LSI technology and utilize an easy-to-change industry standard 96-character wheel. Starwriter printers are the perfect choice for multilingual and multi-discipline applications.

The two Starwriter models also feature self-test capabilities and a programmable VFU. You'll be able to print up to 163 columns on multiple copies and you can process paper widths to 381 mm (15"). Both models are equipped with front panel indicator lamps and switches.

You can put our printers to work the minute they're delivered. They're plug-compatible and meet either the industry standard parallel interface specifications or serial RS 232 C with voltage or current mode capacity.

So if you're looking for perfection in printing, let our Starwriters do the job. All printers are backed by C. Itoh's warranty and nationwide service organization. For more information, contact C. Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, CA 90066; Tel. (213) 390-7778. Chicago Office: 240 E. Lake Street, Suite 301-A, Addison, IL 60101; Tel. (312) 941-1310. New York Office: 666 Third Ave., New York, NY 10017; Tel. (212) 682-0420. Dallas Office: 17060 Dallas Pkwy, No. 108, Dallas, TX 75248; Tel. (214) 931-0177. Represented in Canada by Canadian General Electric.



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SEE US AT NCC BOOTH #645

MICOM announces ADLC™ Data Communications for Minicomputer Users

If you use minicomputers and 'dumb terminals', you probably have a very cost-effective system. But those 'dumb terminals' are a bit of a gamble when you connect them to your computer over telephone lines. They have no retransmission-on-error, for example, so any phone line 'glitch' makes your CRT's go crazy; and since they cannot be addressed or 'polled', you need to install an expensive phone line for each one.

The terminals used with mainframe computers don't have the same problems but they cost a lot more, and they need complex software to support the 'communication protocol' they use.

MICOM's data communications products provide *add-on* communication protocol to minicomputer-based 'dumb terminal' configurations *without requiring any changes to existing hardware and software*. We call this unique concept ADLC™ — Add-On Data Link Control. MICOM ADLC™ products eliminate transmission errors, save computer ports, and allow low-cost 'dumb terminals' to be clustered, multidropped and polled on a single telephone line *with no special software*.

To complement the ADLC™ products, MICOM offers a range of low-cost data transmission devices, including short-haul local datasets and long-haul modems, all specially designed to meet the asynchronous communication requirements of the minicomputer user. And for the user with multiple minicomputers, or the minicomputer system running short of ports, MICOM's innovative Port Selector provides a unique solution.

Send for complete details today...and if you would like to learn more about the subject of data communications, ask about our *tutorial seminars* designed specially for the minicomputer user. MICOM seminars are offered nationwide throughout the year.

If you're installing remote terminals, whether as an end user, systems house, or OEM, don't take a chance...talk to MICOM, the one-stop shop for all you need, or need to know, in data communications for the minicomputer user.

MICOM™ MicroComputers for DataCommunications™

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