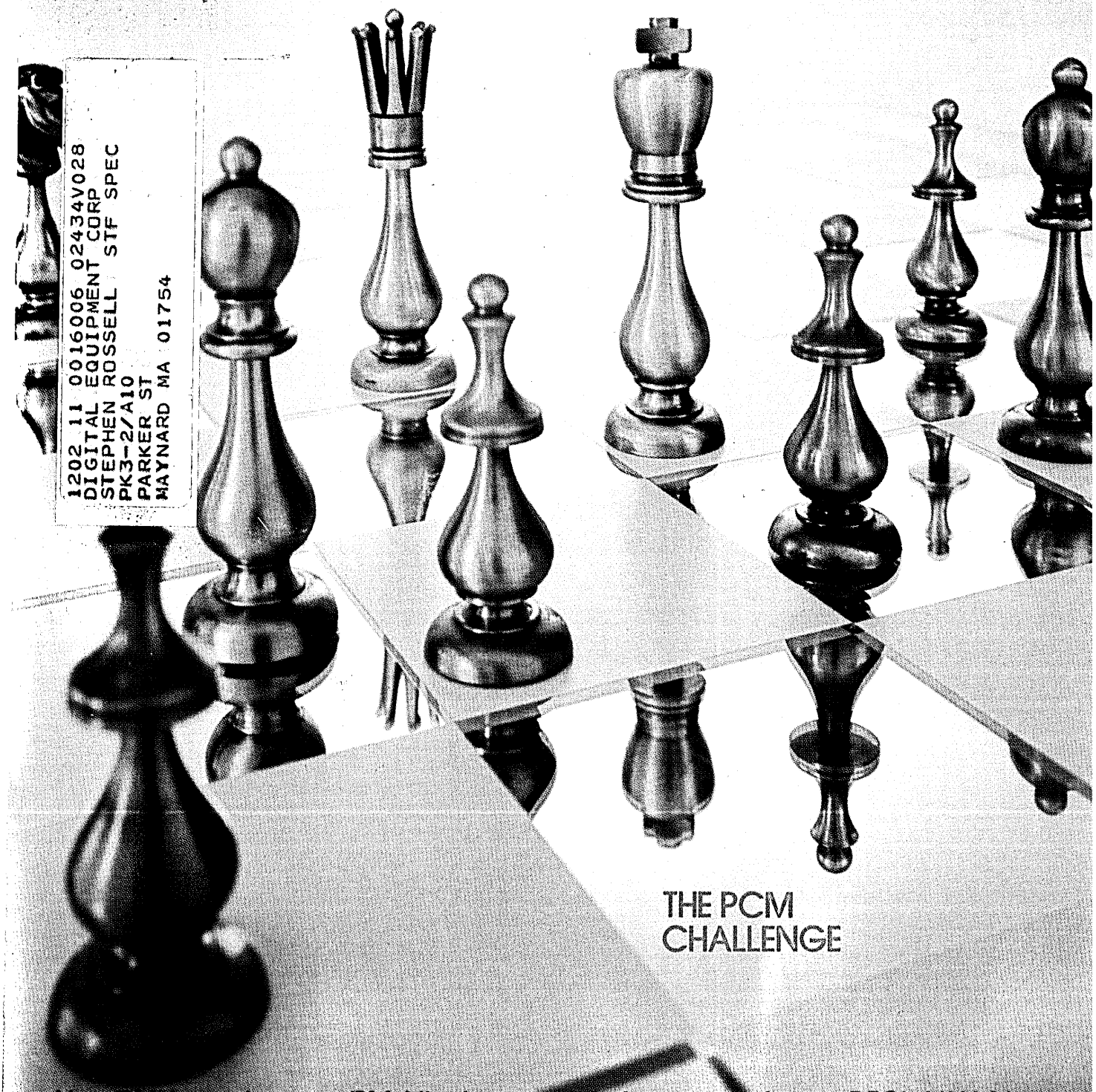
DATAMATION 79®

FEBRUARY/3.00 U.S.A.



THE PCM CHALLENGE

Also: IBM Armonk versus IBM Atlanta, one data base experience, DEC's VAX-11, a digital allegory and cost-justifying utility software . . .

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and the

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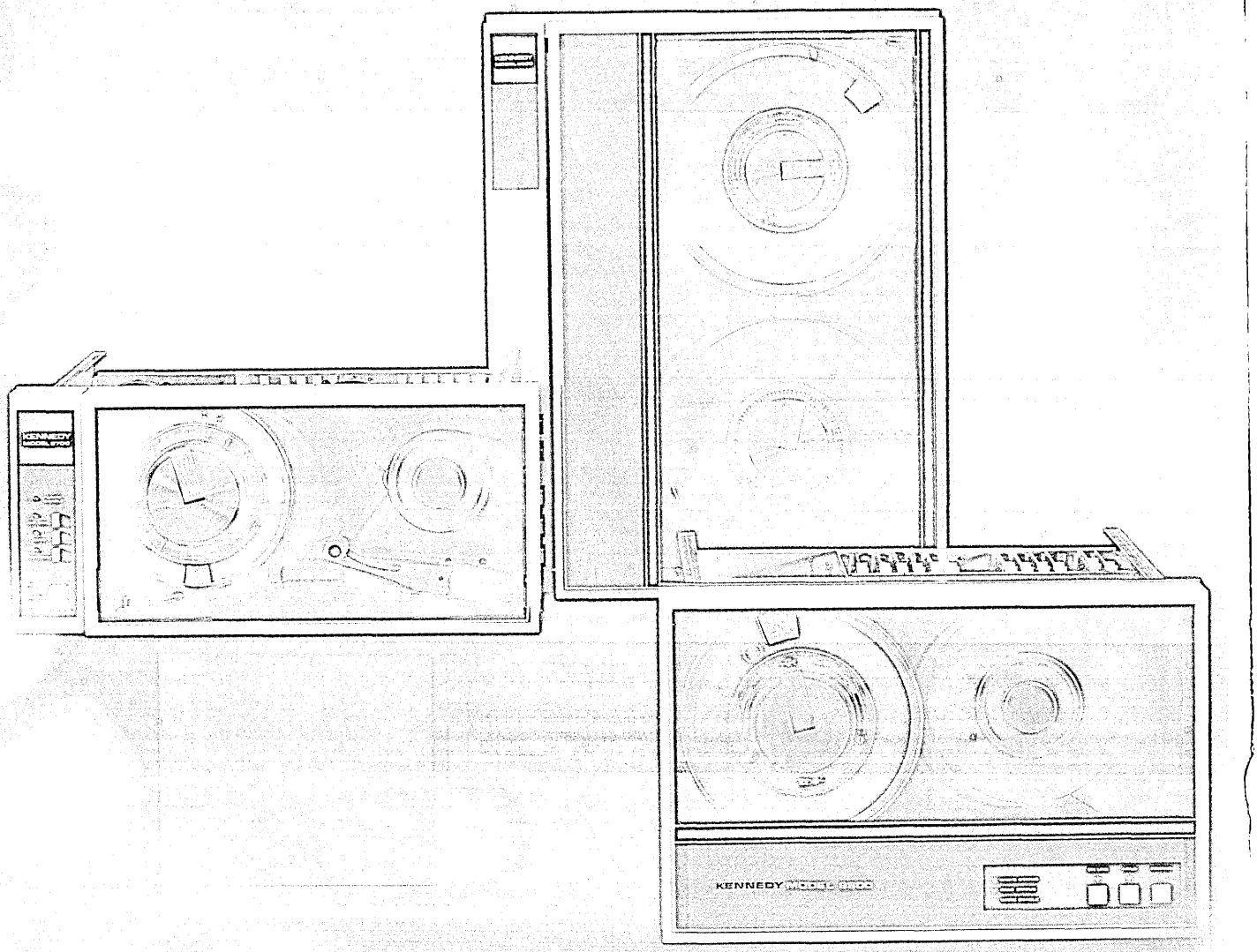

KENNEDY-QUALITY—COUNT ON IT

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Now appearing on your favorite network: XL Distributed Processing Systems

Your Denver regional office needs up-to-the-minute reports from Los Angeles and Seattle ... the central parts depot in Atlanta must maintain current inventory based on information received from six supply centers ... Warehouses in Rochester and Raleigh need to access the data base in Atlanta, but don't need local processing. Branch offices in Calgary, Phoenix and Toronto must process orders and transmit to regional managers ... headquarters in Minneapolis needs to communicate with all regional and branch offices ...

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The top-of-the-line XL40 handles up to 16 local and remote terminals. With up to 512K bytes of memory and disk storage expandable to 70 megabytes for local data bases, it can also interactively access your headquarters mainframe via 3270 inquiry mode for non-XL40 resident files. Put one in Denver, another in Atlanta.

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XL Remote On-Line SubSystems (ROLS) consist of remote printer/terminal configurations that access the power and data base of the XL40 interactively over telephone lines. ROLS can also take advantage of the XL40's 3270 mode to access the mainframe data base, greatly enhancing the amount of data available to any one user. Order them for your supply centers and warehouses.

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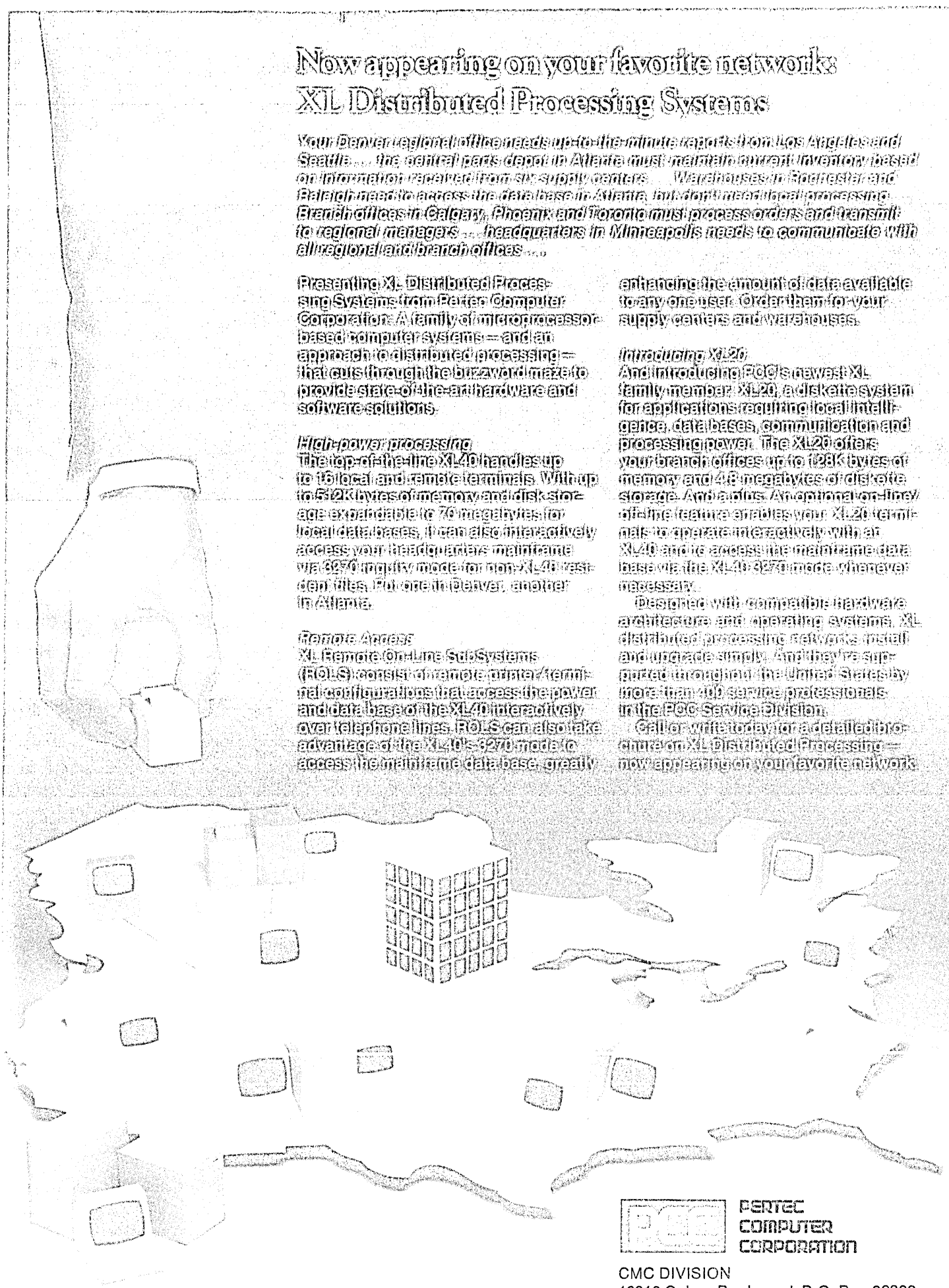
And introducing Pertec's newest XL family member XL20, a diskette system for applications requiring local intelligence, data bases, communication and processing power. The XL20 offers your branch offices up to 128K bytes of memory and 4.8 megabytes of diskette storage. And a plus. An optional on-line/off-line feature enables your XL20 terminals to operate interactively with an XL40 and to access the mainframe data base via the XL40's 3270 mode whenever necessary.

Designed with compatible hardware architecture and operating systems, XL distributed processing networks install and upgrade simply. And they're supported throughout the United States by more than 400 service professionals in the Pertec Service Division.

Call or write today for a detailed brochure on XL Distributed Processing — now appearing on your favorite network.



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But, allowing programmers to be more creative isn't all Maestro does. Combining the advantages of on-line programming with state-of-the-art distributed processing technology, Itel's Maestro takes all phases of program development—including problem definition, program planning, documentation and coding—off-line. Then Maestro moves on-line for compilation and testing. So your mainframe can spend more time on production.

In addition, Maestro supports software development in all current computer languages and functions independently from your CPU and operating system.

Maestro is the most advanced solution to program development and maintenance available. In saving you time, it allows you to be more responsive in providing useful information to your users. And because it eliminates repetitive programming tasks, it can help you attract and keep your best programmers. So, with Itel's Maestro, every phase of your DP operations can give a winning performance, daily.

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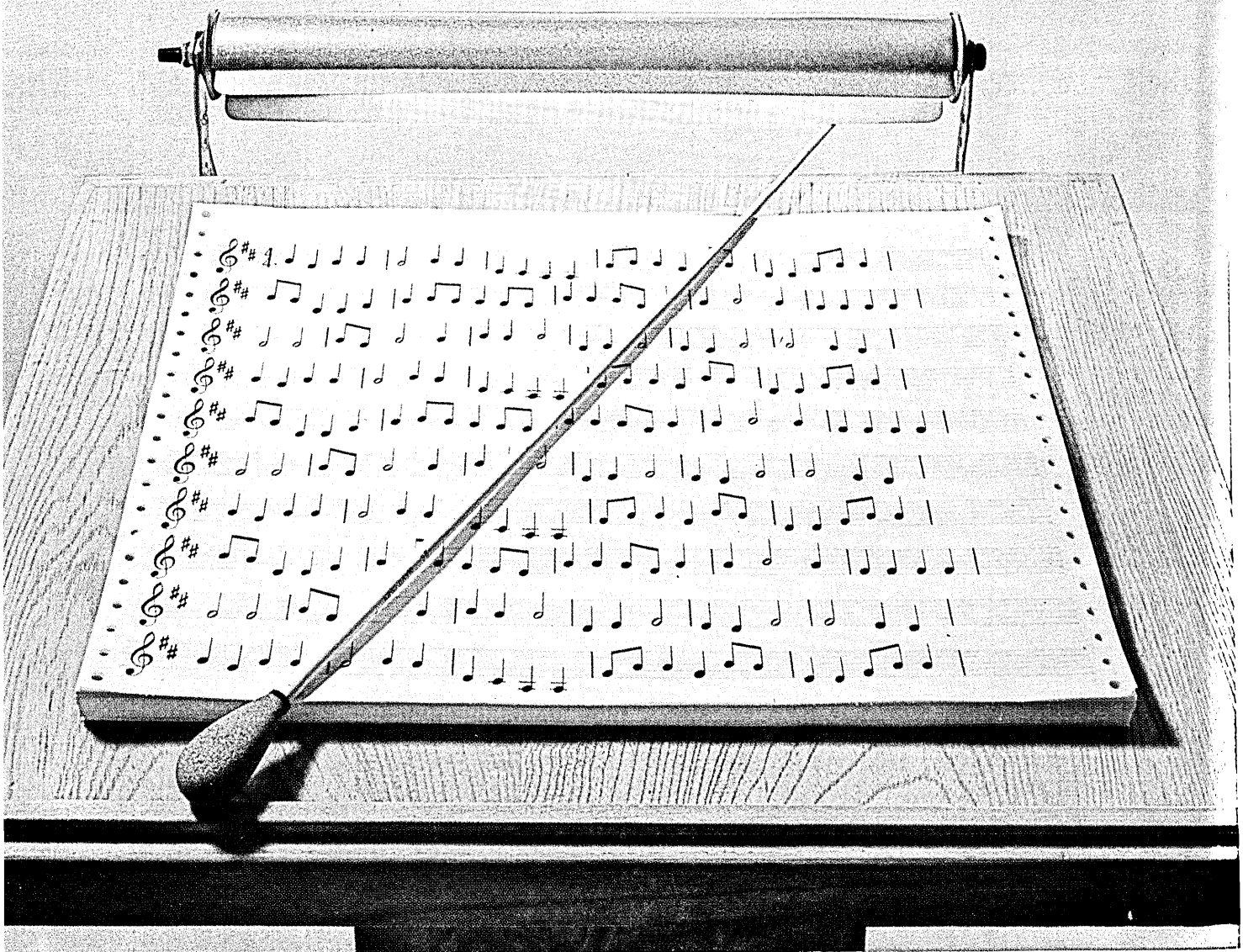

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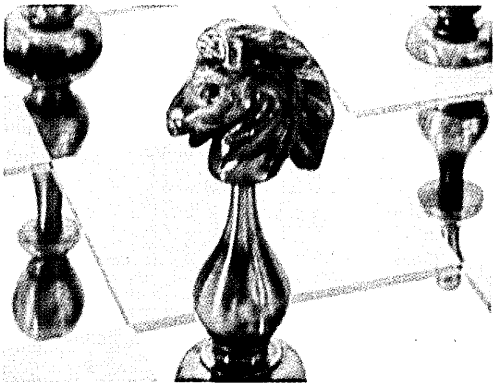

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NEWS IN PERSPECTIVE

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EDITORIAL OFFICES
Headquarters: 1801 S. La Cienega Blvd., Los Angeles, CA 90035. Phone (213) 559-5111. **Eastern:** 35 Mason St., Greenwich, CT 06830, (203) 661-5400, Telex 996343. 420 Lexington Ave., New York, N.Y. 10017, (212) 682-7760. 6605 Burlington Pl., Springfield, VA 22152. (703) 569-3383. **Southwestern:** 11500 Stemmons North, Suite 152, Dallas, TX 75299, (214) 247-5221. **Western:** 2680 Bayshore Frontage Rd., Suite 401, Mountain View, CA 94043, (415) 965-8222. **Foreign:** 20 Leamington Road, Southend-on-Sea, Essex, SS1 2SN, England; phone: Southend (0702) 611648. **TELEX 996-343**

Art & Editorial Production
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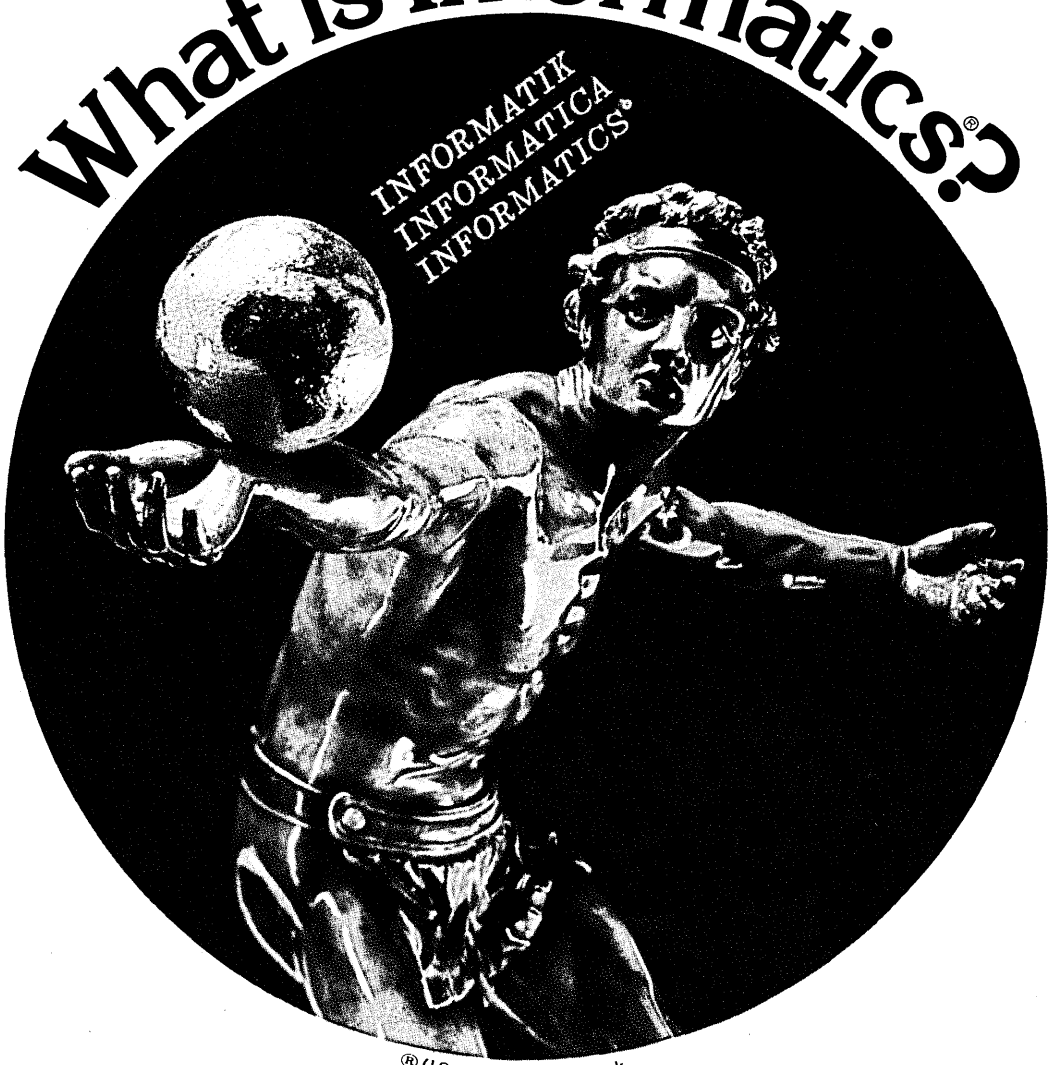

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ADAPSO

CIRCLE 45 ON READER CARD

TWENTY YEARS AGO/TEN YEARS AGO

LOOKING BACK

January/February 1959
WJCC AND BRAIN POWER

None of the speakers slated for the March Western Joint Computer Conference "think that computer development has gone as far as it can go," DATAMATION reported in its thin January/February 1959 issue. "Computers are now moving boldly into the realms of decision making and the simulation of mechanical and human learning processes," pronounced technical program chairman Richard W. Melville. The 24-session program, he said, would discuss the "bewildering outpouring of new techniques," with new models in the works showing radically different logic "from the flip-flop and gate models" then in use. "An important objective is to pack more functional components into always-smaller space."

The computer scientist's dream of simulating the human brain was debunked by Mortimer Taube of Documentation Inc. In an article, "Man-Machine Relationships," Taube called instead for work on how the machine might be used to extend the function of the brain by processing and transforming into usable form information the brain cannot now handle. "We wish to enable man to function high in space, in the depths of the sea, when he moves at tremendous speeds, when he is encased in an armored tank . . . " It was a wish fulfilled precious few years later.

The news reflected the military origins of many major computer developments of that era. Philco and IBM boasted of $multimillion contracts for battlefield data processing systems. RCA, in unveiling its new transistorized 501 computer system, complete with time-sharing, announced its first orders were from the Navy.

February 1969
ATTACKS ON STANDARDS AND IBM

The "vital, yawn, stimulating topic of—um, ah—standards" was the theme of this 228-page issue, according to the Editor's Readout. Lambasting the industry's standards performance, the editorial noted the "lack of a well-planned, coordinated and managed standards development effort, widely represented and supported." Many articles followed this line of attack, and the authors' recommendations could well be dusted off and recycled in 1979. Howard Bromberg took on the inadequacy of the committee structure, suggesting one solution might be funding "outside expert organizations" for certain standards activities. Such an organization could ensure better input from users and vendors by holding regular meetings with them "without the requirement of divulging corporate motivations and direction around a USASI committee conference table." No one listened.

Also in that issue was "The Evolution of Number Systems," taken from Dr. Don Knuth's heroic seven-volume epic on *The Art of Computer Programming*, then still in the writing.

This was a big month for reports on antitrust suits filed against IBM: by the Justice Dept., Control Data, and Data Processing Financial and General. With great foresight, DATAMATION wrote that IBM "is expected to push for a quick settlement, meaning a consent judgment, probably taking four years." Observers stated that "the era of bland acceptance of IBM domination of almost every computer market is at an end." (They said nothing about the future of IBM domination.)

This period also marked the end of AT&T's total control over equipment on its network, thanks to the FCC ruling allowing foreign attachments, like telephones. One article appraised the new opportunities, while another showed bitterness over government approval of an AT&T tariff on foreign attachments, giving the giant more control and more money than it deserved. Other subjects in high gear that year included management information systems, computerization of Congress, CATV, separate pricing of hardware and service, IBM plug-compatible peripherals, the appearance of new would-be common carriers for microwave services, and cash vending machines. And a fledgling group representing peripherals companies had just held its first meeting; it was to evolve into the controversial Computer and Communications Industry Association. *

NEC Spinwriter. The fluent printer.

One printer. Many extra language features.

Users of word processing, computer output or terminal character printers expect fine print quality from their character printers.

But with NEC Spinwriter™ printers, you get even more. Our unique "thimble"—with up to 128 characters—gives you many extra features no other printer offers.

Like bi-lingual fonts, so you can print in any two languages at once. Or multi-lingual fonts—with up to five languages on the same print element: English, French, German, Spanish and Italian. Or technical/math thimbles with full alphanumerics, plus super- and subscripting and many arithmetic and scientific symbols.

Then add our unique 100-character-plus proportional space thimbles, numerous font styles in 10-, 12- and PS pitches, and our low-cost custom thimble design capabilities.

That's six extras so far. Seven: speed. Spinwriter printers use lightweight thimbles, so they print at a full 55 cps. Eight: durability. Our fiberglass-reinforced elements last up to 30 million impressions. And finally: quietness. Spinwriter thimbles are so much quieter than other character printers that you can hear the difference.

Now add those features to Spinwriter's acclaimed reliability, serviceability and ease of use, and see if you can find a reason for not including them in your systems.

And don't forget our Trimliner™ band printers. The ideal line printer for products that need 300-to-600 LPM output that you can always rely on.

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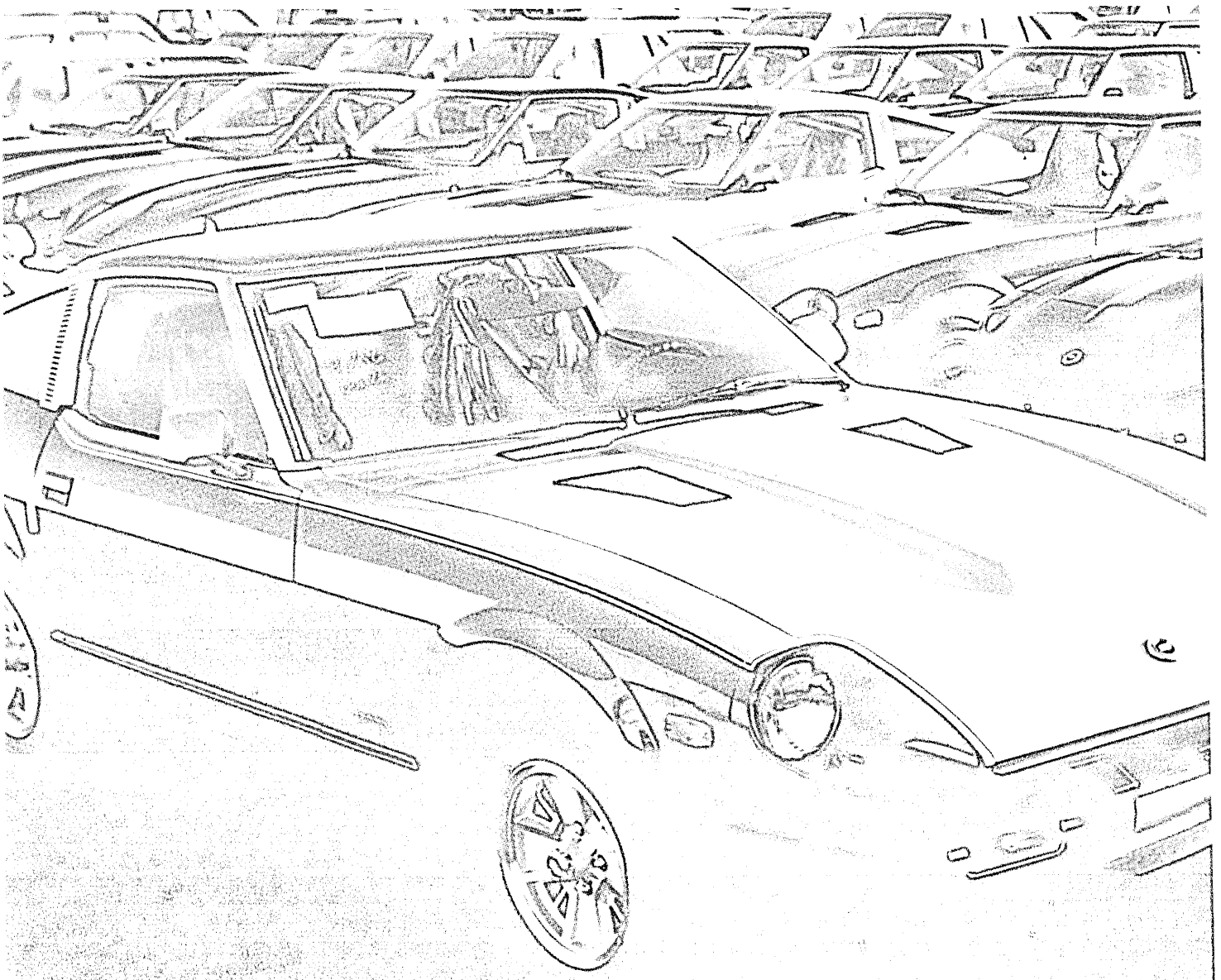


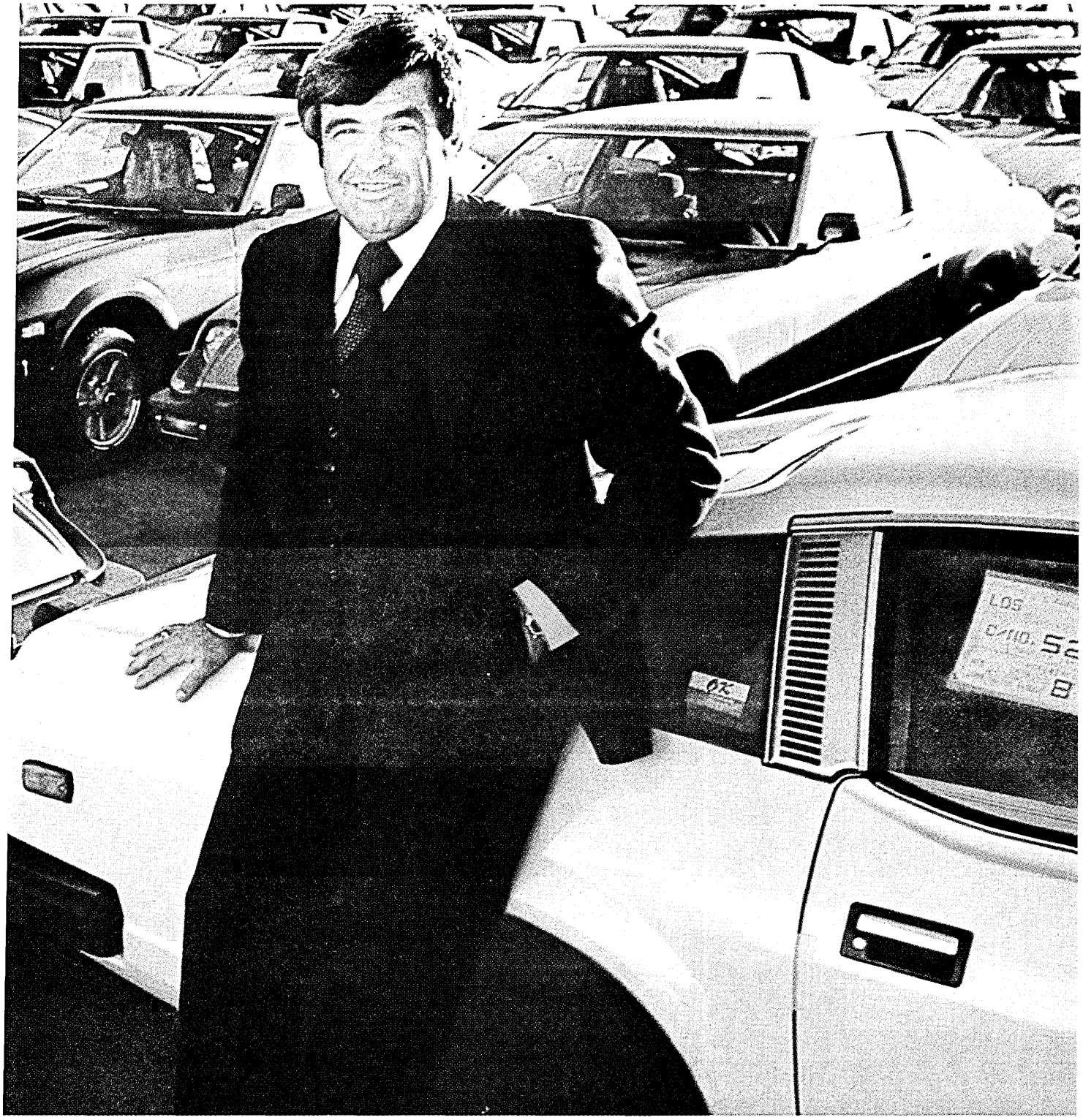
"Through distributed processing with the IBM Series/1, we're giving stronger support to our 1,060 Datsun dealers."

Today, more and more companies are turning to distributed processing to put computing power where the work gets done. At 12 regional offices and two other locations of Nissan U.S.A., the national distributor of Datsun cars and trucks, IBM Series/1 computers are helping make possible a swift response to the needs of 1,060 Datsun dealers.

"At each of the regional offices, dealer orders for parts are entered in the local Series/1, which analyzes them for accuracy," says John R. Cola, director of information systems. "Needed data changes can then be made on the spot. After further processing by a System/370, documents are prepared by the Series/1 for quick shipment of the orders to the dealers.

"Similarly, the processing of the dealers' monthly financial statements, each of which includes over 600 items, is expedited by our Series/1 network," adds Mr. Cola. "We believe this kind of close regional control of data through distributed processing is vital to our objective of topnotch service to our dealers and their customers."

The IBM Series/1 is small enough to fit almost anywhere, flexible enough to manage a variety of data processing tasks and powerful enough to handle both remote termi-



John R. Cola, Director of Information Systems, Nissan Motor Corporation in U.S.A., Carson, California

nal and central information processing. It features online capability so that information is available to you at any terminal just as quickly as it's processed. And because it's modular, Series/1 is ready to grow when you are. What's more, Series/1 is supported by an extensive service organization that enables IBM to respond promptly to your service needs, even in remote areas.

If you'd like to know more about how your company can benefit from Series/1, get in touch with your IBM Series/1 marketing representative or write the IBM General Systems Division, P.O. Box 2068, Atlanta, GA 30301.

The remarkably flexible IBM Series/1 offers a broad range of modular features that allow you to build the data processing system you need at a low cost.

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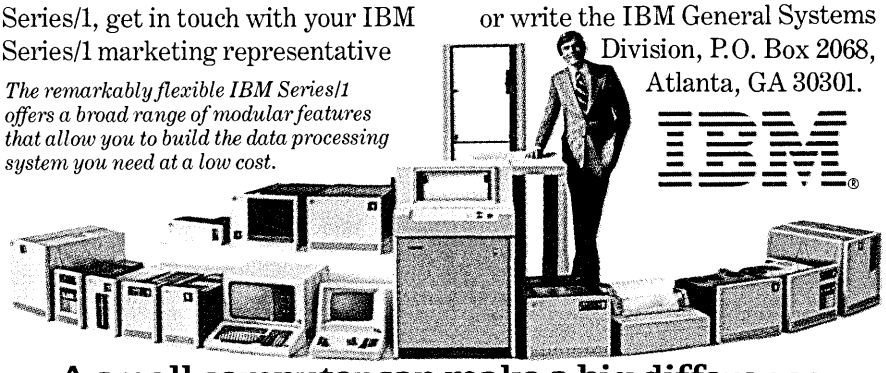

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And for that good look, the INTERVIEW II Stand-Alone Monitor helps identify problems in both hardware and software. It displays full or half duplex data, on-line, without disturbing your network. The INTERVIEW II not only finds trouble quickly, but helps spot trends and potential problems before the system fails.

INTERVIEW II was designed with the user in mind. Extremely simple to operate–controls kept to a minimum. INTERVIEW II displays data in text, HEX or OCTAL–six different languages are standard. You get a 9-inch, easy-to-read, full 1024 character display. INTERVIEW II displays two independent pages of 512 characters, in full or half-screen for later comparison. Send and receive data are automatically highlighted for easy identification. Unique trap, character suppression and freeze features eliminate the need for bulk storage in most applications.

If you need more bulk storage–how about 500,000 characters? INTERTAPE, a companion to INTERVIEW II, stores that many and can be used connected directly to the RS-232/V.24 interface with INTERVIEW II.

Need interactive capability later? We thought about that, too. By adding INTERSHAKE II,® the Stand-Alone Monitor becomes part of a fully programmable, interactive diagnostic test system.

So buy the capability you need now and rest assured that when you need more–you can get it.

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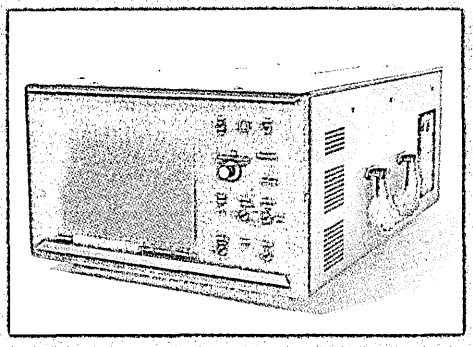
We'd like to tell you more. Write or call us today.



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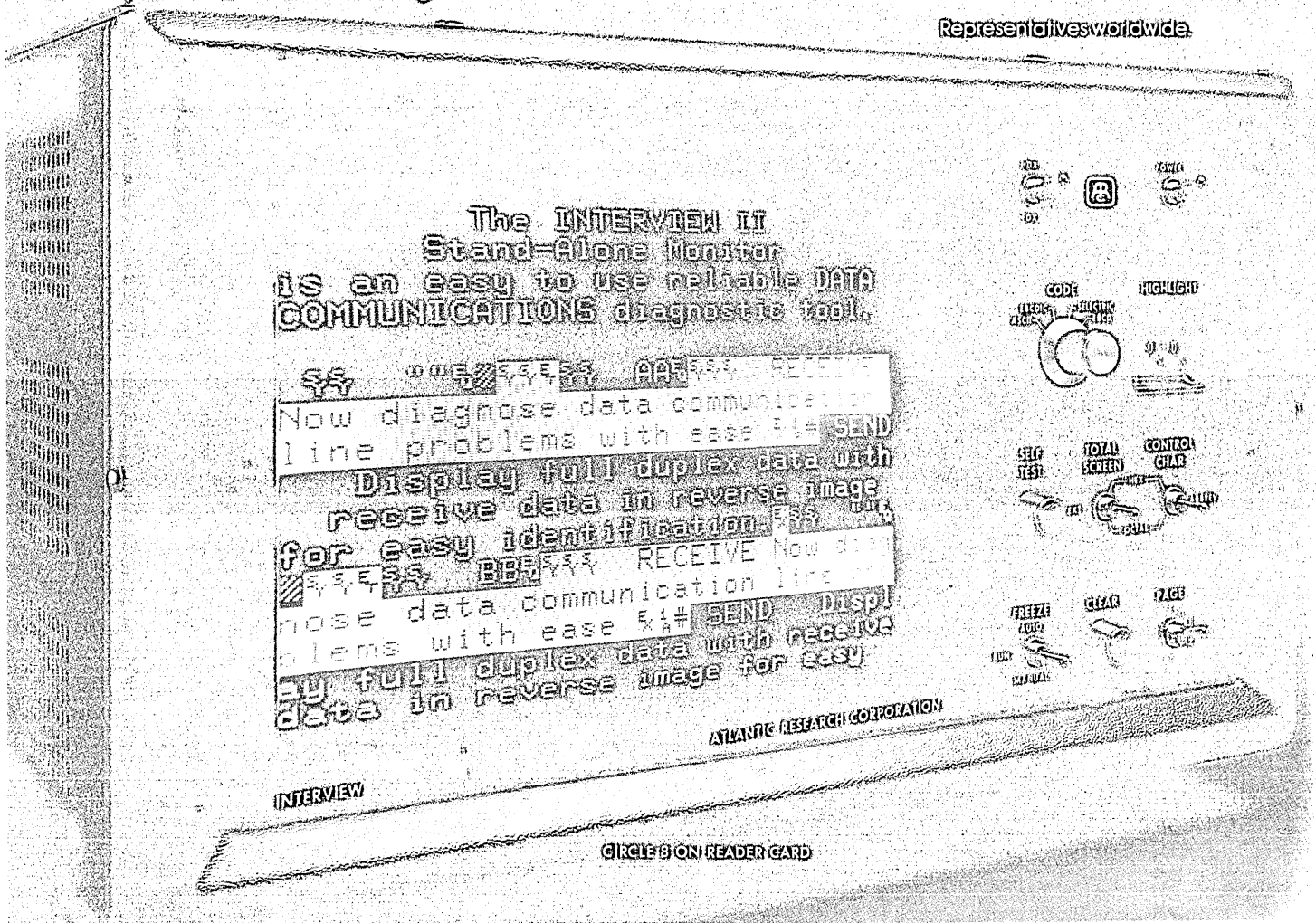


CIRCLE 9 ON READER CARD

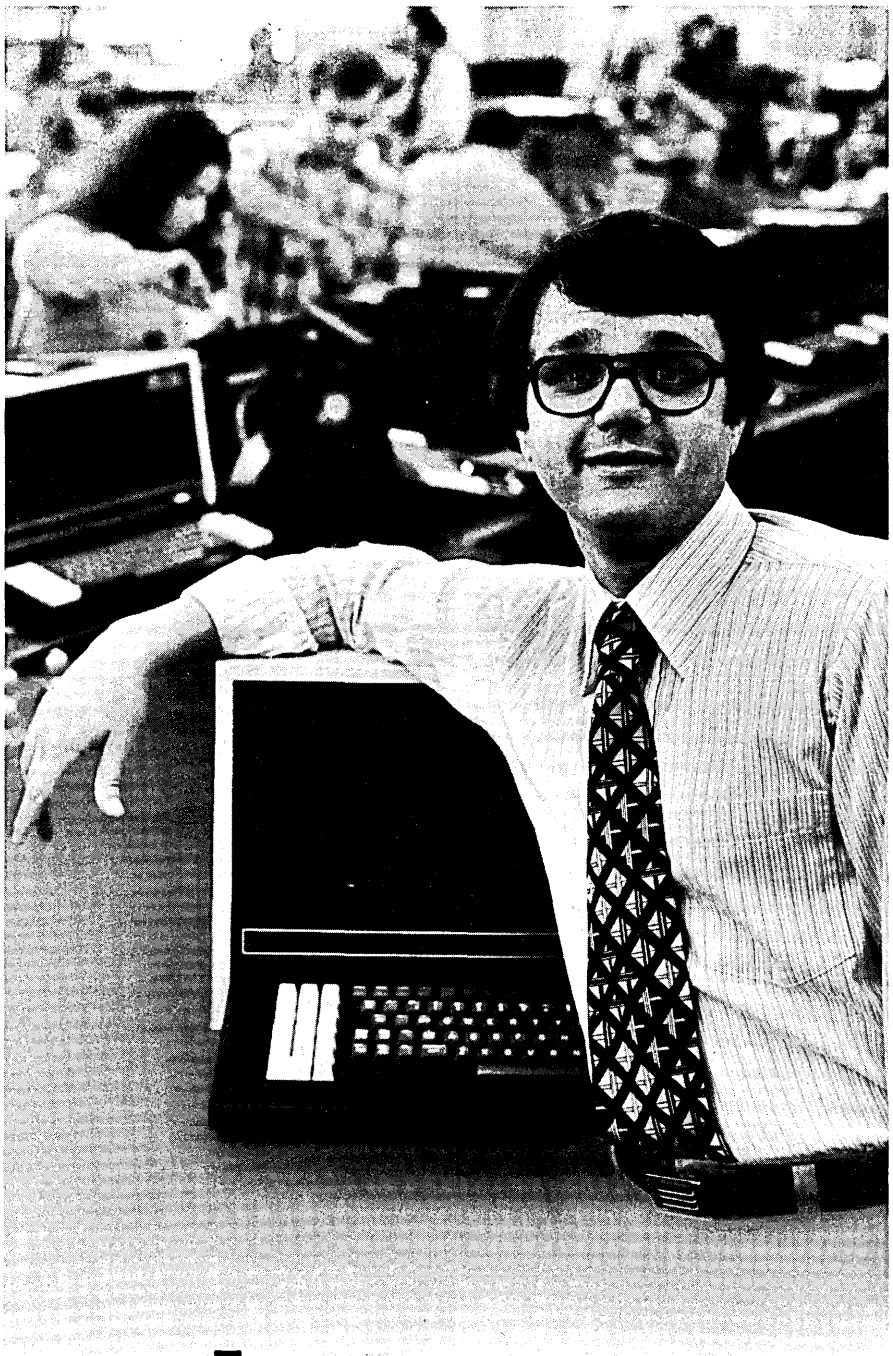
"With all the little companies peddling intelligent terminals these days, an OEM or a large EDP end user like me can't be too careful. Sure, they may be able to design a good terminal. But can they deliver it? Service it? Is the company's president also the service manager and the installer? So I did a lot of looking around. That's when I came across the MDT 400 manufactured by Compugraphic for applications like distributed processing, text editing, and data communications.

" 'CompuWho?' I said. But then I found out that Compugraphic is a $180,000,000 New York Stock Exchange company – the world's leading manufacturer of computer driven phototypesetting systems – with a nationwide field service force of over 300 service engineers.

"With Compugraphic I don't have to worry. Even though their MDT 400 lists for under $4,500, it's got everything I really need – full user programmability, hardware and software modularity, a powerful 8085 microprocessor, up to 32K bytes of memory, integral mini-disk, a disk operating system, and an optional printer. I can even get substantial quantity discounts. And they'll service it themselves all over the country for me.

"Listen, I'm not going to be burned by a company that can't deliver what it promises. The MDT 400 makes sense to me – and so does the company building and backing it. Maybe Compugraphic is a company *you* should get to know."

The MDT 400 – the cost-effective, intelligent terminal at a sensible price. Manufactured intelligently by Compugraphic. For more information, clip and send the coupon today.



Why CompuWho?

Mail to: Compugraphic Corp., Computer Products Sales
80 Industrial Way, Wilmington, Mass. 01887

The MDT 400 is intelligent. Tell me how I can use it for:
☐ Text Editing ☐ Distributed Processing
☐ Communications ☐ Other _____

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

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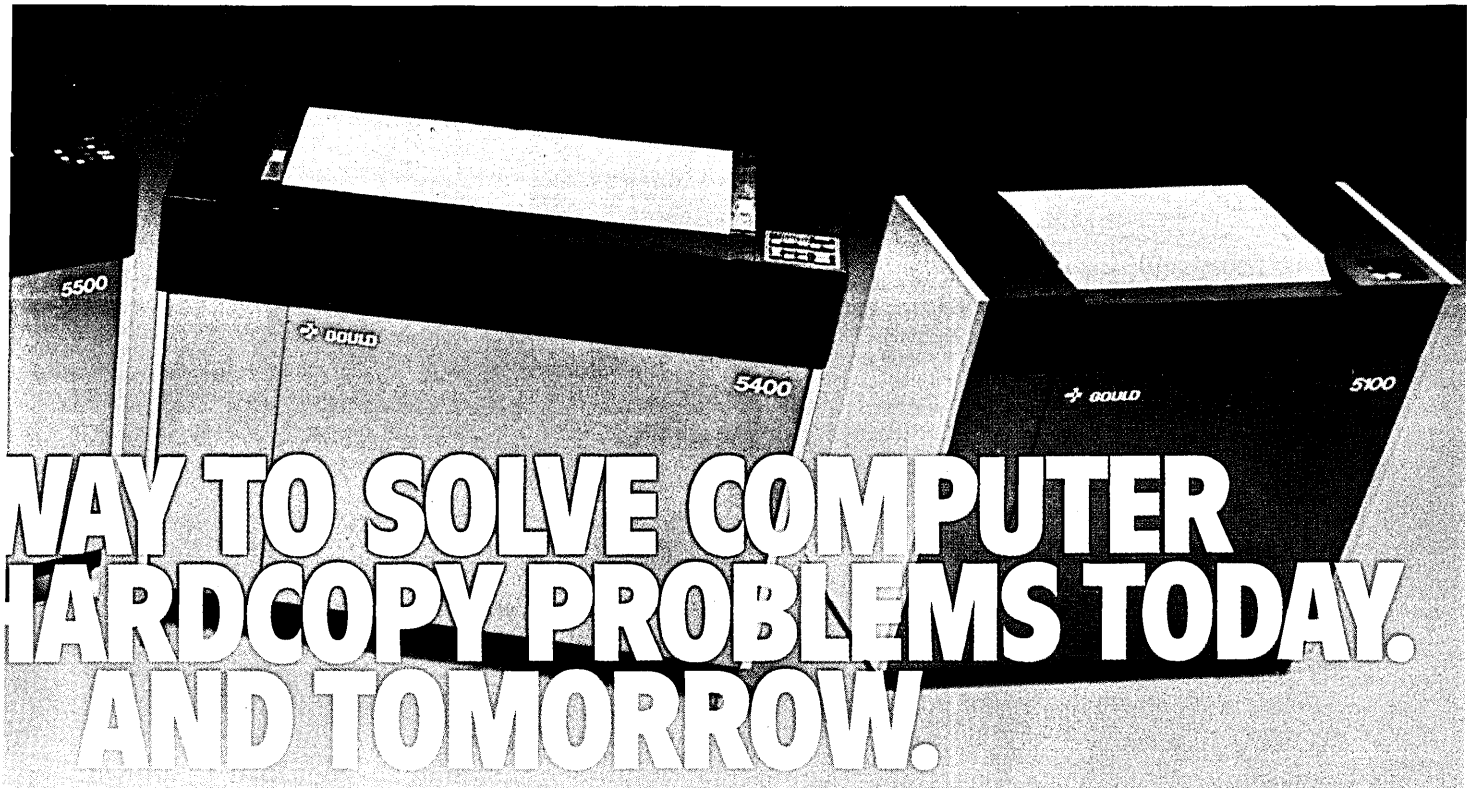

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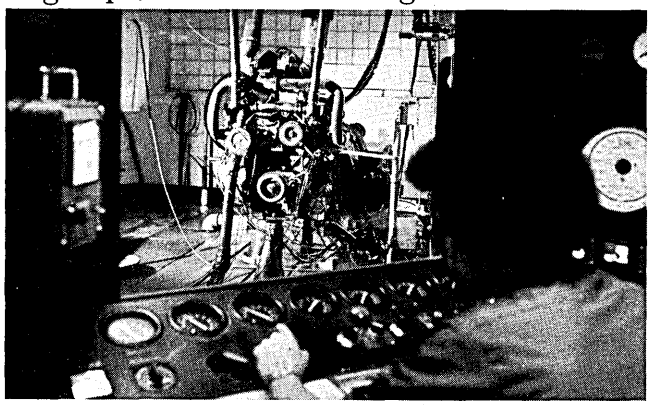
"BEFORE WE COULD BUILD THE WORLD'S LARGEST INDUSTRIAL DATA ACQUISITION SYSTEM, WE NEEDED NETWORK AND SYSTEMS CAPABILITIES WE COULD DEPEND ON." "ONLY MODCOMP HAD THEM."

Jim Springer, Director of Data Systems,
AVCO Electronics, Huntsville, Ala.

Jim Springer is building what will be the largest industrial data acquisition system in the world. This system will be used on development and testing by one of the world's largest producers of diesel engines.



To implement the system, Jim chose MODCOMP's Classic® Computers, the MAX IV operating and communications system, and the MAXNET IV network extension.

"Network software capability is the key."

"The MAXNET IV network extension integrates all 120 computers in the system. This provides us with the performance characteristics of a stand-alone system, and the economic advantages of network resource sharing.

"In a real-time environment, that's essential."

"MODCOMP gives us the high speed and performance we need — at a cost we can afford."

"The MAX IV operating system is ideal for this type of real-time multi-programming because it provides 256 K-bytes of directly addressable memory. And with the Classic's extremely fast floating-point processor, we have more than enough speed.

"This is essentially the same system we specified for testing NASA's Space Shuttle. Ordinarily, that kind of superior quality and reliability would be out of reach for industry. But because of their experience with the NASA system, only MODCOMP could meet the assigned high performance levels at a cost industry can afford."

"MODCOMP's tougher on their equipment than we are."

"Our customer was concerned about equipment reliability in their plant. And with good reason. The temperature can get as high as 120 degrees. But we've seen the Classic perform in worse places. MODCOMP's 'hot room' test facility, for instance. That's 132 degrees."

"Obviously we have a lot of faith in MODCOMP."

"We're just in the first phase of this system. But we have to know that, say, 3 years from now, the hardware will be available and that the software can be implemented or interchanged as needed.

"We recommend MODCOMP because we have a lot of faith in them. In their company, their equipment and their service.

"We know they can deliver. It's as simple as that."

At MODCOMP, we specialize in building real time computer systems and the network software capability to make them work.

Easily. Reliably. Affordably. And with the kind of performance you'd expect to find in the world's largest industrial data acquisition system.

If that's what you're looking for from a computer system supplier, do what Jim Springer did. Call MODCOMP.

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LOOK AHEAD

ITT TO OFFER FAX SERVICE	Look for ITT's packet switched facsimile network to begin operations this fall. Called Fax-Pak and offered by ITT subsidiary ITT Domestic Transmission Systems, the service will enable users to transmit information to any point on the network even if the transmitting and receiving facsimile machines aren't compatible. Compatibility is built into the firmware of the system. It eventually will also make possible transmission from a CRT or Telex machine to facsimile stations. Users will be able to transmit at three types of delivery rates -- 15 minutes, four hours or overnight -- and will be billed depending on the delivery times chosen. It's understood that Exxon has approached ITT, which markets a modified version of Exxon Quip facsimile machines in Europe, about using the network for its U.S. office equipment customers.
BIG INVENTORY BUT NO MARKETING	The year old system 2020, the smallest of Digital Equipment Corp.'s System 20 mainframes, seems to have gotten lost between the cracks of DEC's major reorganization last year. Plans for major promotion were shelved when DEC broke up its large systems group, and insiders explain that the 2020 never really got reassigned in the new marketing plan, although manufacturing steamed ahead. The result: an embarrassing inventory backlog of nearly 50 systems -- list priced at $150,000 in minimum configuration. DEC reportedly has shaved the internal transfer price and will drop prices almost $50,000 to move the backed up iron. Other DEC bits: following the imminent introduction of the 11/23 and the 11/24 -- reputed replacements for the workhorse 11/34 -- DEC reportedly will be offering a new version of the 11/70 with an attached Cobol processor and a multiprocessor operating system. The interesting question, say informed DEC watchers, is how the reshaped 11 line will be aligned against DEC's own VAX systems.
AN EQUITABLE OFFERING ANTICIPATED	The Equitable Life Assurance Co., a giant insurance company, and Informatics Inc., a $60 million a year software company, have been talking about divestiture by Equitable of its 90% ownership in Informatics. Informatics management anticipates a public offering of Equitable's Informatics holdings which would put the software firm back where it was in 1973, before it became an Equitable subsidiary, an independent, publicly held company. The 10% of Informatics stock not held by Equitable is owned by Informatics management.
NO WAITING LINES AT NCC THIS YEAR	"It'll never happen again," promise sponsors of the National Computer Conference who recall the massive turnout of 57,244 in Anaheim, Calif., last year when people had to stand in line for up to four hours to register for the event. A spokesman at the American Federation of Information Processing Societies (AFIPS), which sponsors the NCC, said a special advertising effort is being made this year in

LOOK AHEAD

New York to have people sign up ahead of the show. Previously, most advance registrations have come from persons planning to attend the technical program. This year, AFIPS is promoting advanced reservations for everybody, including the 31,597 guests of exhibitors who crammed the Anaheim convention hall last year.

They'll be given until May 15 to register (May 1 for international attendees) and will be mailed a badge. And for those who don't and who want to avoid the long lines at the New York Coliseum, AFIPS also will be manning registration desks at the Americana and New York Hilton hotels during the conference, June 4-7.

Nobody at AFIPS wants to guess at this year's turnout (AFIPS expected only 45,000 at Anaheim) but it could surpass last year's. Some 400 companies already have reserved 1,700 booth spaces on the four floors of the Coliseum and others have been relegated to the New York Hilton hotel's second floor exhibit area. That compares with the 396 companies who occupied 1,400 booths at Anaheim.

SHOW TIME IN D.C.

Washington, D.C. turns out to be a great place for a specialty trade show. Next month's Federal DP Expo, March 19-21 at the Sheraton Park Hotel is a sellout with 156 companies exhibiting in 310 booths. The expected turnout of 6,000 also will set a record for the five-year show and conference which in previous years drew in the 4,000 range. Last fall, a similar show -- The Federal Computer Conference -- drew more than 5,000 persons and 110 exhibitors. The Federal DP Expo is being staged by the Interface Show Group, Framingham, MA.

CHANNEL PROBLEMS ON THE 303X LINE

Need a fix? If you are using IBM's 303X systems delivered before Nov. 30, ask IBM if change REA 02-13529 has been made. This fix, the "Bus Out Bit 5" problem, we hear, is just one of more than 100 hours of engineering changes the early 303X required, predominantly because of channel problems. Bus Out Bit 5 happens to be an intermittent failure caused by voltages that fall below IBM specs. The result can be channel failure, downtime due to program reloading, etc. Dataswitch, Norwalk, Conn., is boasting that its peripheral switch system at a customer site pinpointed the problem. The firm claims IBM had this fix on its list but the field engineering force is overloaded with all the 303X channel problems.

CENTURY DATA LIVES AGAIN?

Century Data Systems, which disappeared as an entity when it was acquired by California Computer Products in 1973, may be due for a rebirth. Xerox Corp., which last December acquired CalComp's hard disk operation, derived from the original Century Data, is thinking of giving the Century Data name to its version of the operation.

RUMORS AND RAW RANDOM DATA

It probably isn't related to "garbage in, garbage out," but International Computer Programs, the Indianapolis software information services firm had, for one day at least, a garbage truck as its company limo. ICP president Larry Welke hired the truck to pick up guests attending the Indianapolis 500. Pure white, the immaculate truck was replete with the ICP logo in blue on its side.

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— Pat O'Grady, Secretary-Treasurer, and Fred Hemming, Director of Data Processing, Transport Indemnity Company Los Angeles, California

"With 16,000 claims reported annually and $50,000,000 in annual premiums, Transport Indemnity is one of the largest and busiest truck insurers in the country. To handle this enormous load with ease and efficiency, we use MARK IV. It has reduced our programming time by 75 percent and allowed us to work with a staff one-third the size of what it would be otherwise. It's really unbelievable!

"In 1975, we developed a fully automated and truly revolutionary retrospective claims system under MARK IV, and we're absolutely thrilled with it. Essentially, retrospective claims mean that the insured shares in the lower limits of the loss, with the insured paying in advance for the loss. At year's end, according to the actual experience, additional money is requested or overpayment is refunded.

"This claims process is extremely complex, but MARK IV simplified it and gave us the exacting control we need. All current and cumulative claims information, along with pertinent statistical data, is on one master file. By simply passing our transaction file against it, we spin out all the reports we require.

"We also use MARK IV for an extremely sophisticated self-insurance administration system, and currently 90 percent of our new systems development is scheduled for MARK IV. What we like best is its flexibility.

MARK IV is so responsive that we can answer the changing needs of our insureds through timely production of specialized reports. Our DP people think of MARK IV as a 'language of love'! We couldn't live without it!"

GET THE FACTS ON MARK IV. MARK IV is the most versatile and widely used software product in the world for application implementation, data management and information processing. Six powerful models (prices start at $12,000) are in daily use on IBM 360/370, Univac 70/90, Siemens 4004, Amdahl 470, and Itel Advanced System computers at over 1,300 installations in 44 countries. Programs in MARK IV require only about one-tenth the statements of Cobol, and users report 60 to 90% cost and time reductions on most MARK IV applications.

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The HP 2621: sim

Simple doesn't have to mean unsophisticated. The proof is in our new CRT terminal, the HP 2621.

Before building it, we took a long, hard look at the way you use a simple terminal. Then we took the knowledge gained in more than 10 years designing computer products and applied it to engineering an interactive character-mode CRT terminal from the user's point of view.

The outcome was actually two models. The HP 2621A, which sells for $1450. And the HP 2621P, which has a built-in printer, costs $2550. You obviously want the sharpest display made. So we used the 9x15 character cell you see on every HP CRT terminal, including the top-of-the-line. And, to help you look back at the data you've entered, we provided two full pages of continuously scrolling memory.

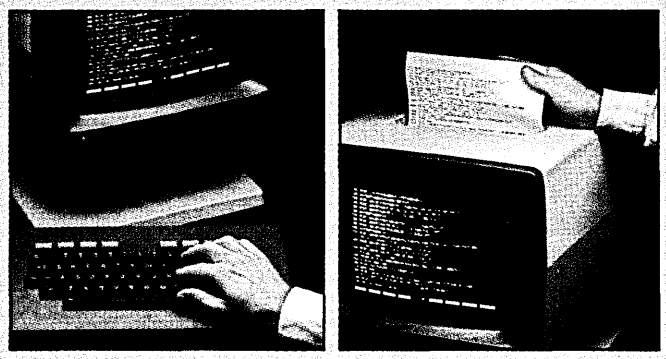
We designed the keyboard like the familiar typewriter, so you don't have to waste time relearning it. We built in eight function keys, too. These control the cursor, rolling and scrolling. And, to make life easier, they're labeled on the screen for self-test, configuration, display and editing.

Editing? On a simple terminal? Certainly. We included character and line insert and delete, clear line and clear display. And, since the 2621 keeps your input separate from your CPU's, you can edit data before sending it to the computer. All without writing a line of system software.

Since flexibility is important in interfacing, we included a user-definable return key that will send your computer whatever code it expects. We also made our terminals compatible with RS232C and Bell 103A, and able to communicate with your CPU at 110 to 9600 baud.

If you need hard copy at your fingertips, take a look at the HP 2621P. With a keystroke, its built-in 120 cps thermal printer will deliver a printout from the screen in seconds.

So why don't you check out the HP 2621 by calling the nearest HP sales office listed in the White Pages. Or send us the coupon. Then see for yourself how sophisticated a simple CRT terminal can be.



Try this on your favorite CRT! With the 2621P, you just hit a key and in seconds you have hard copy of your CRT display. The built-in thermal printer prints upper and lower case at up to 120 cps.

The 2621's bright, high-resolution CRT, with enhanced 9x15 character cell, displays the full 128-character ASCII character set, including upper and lower case, control codes, and character-by-character underline, in 24 80-character lines.

Eight screen-labeled preprogrammed function keys magnify the power of the 2621's keyboard. Preprogrammed functions include editing, terminal configuration, printer control and self-test.

To make numeric data entry faster and easier, we put the 2621's numeric keypad right in the middle of the keyboard. And the 2621's familiar 68-key keyboard is almost as easy to use as a typewriter.

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CIRCLE 42 ON READER CARD

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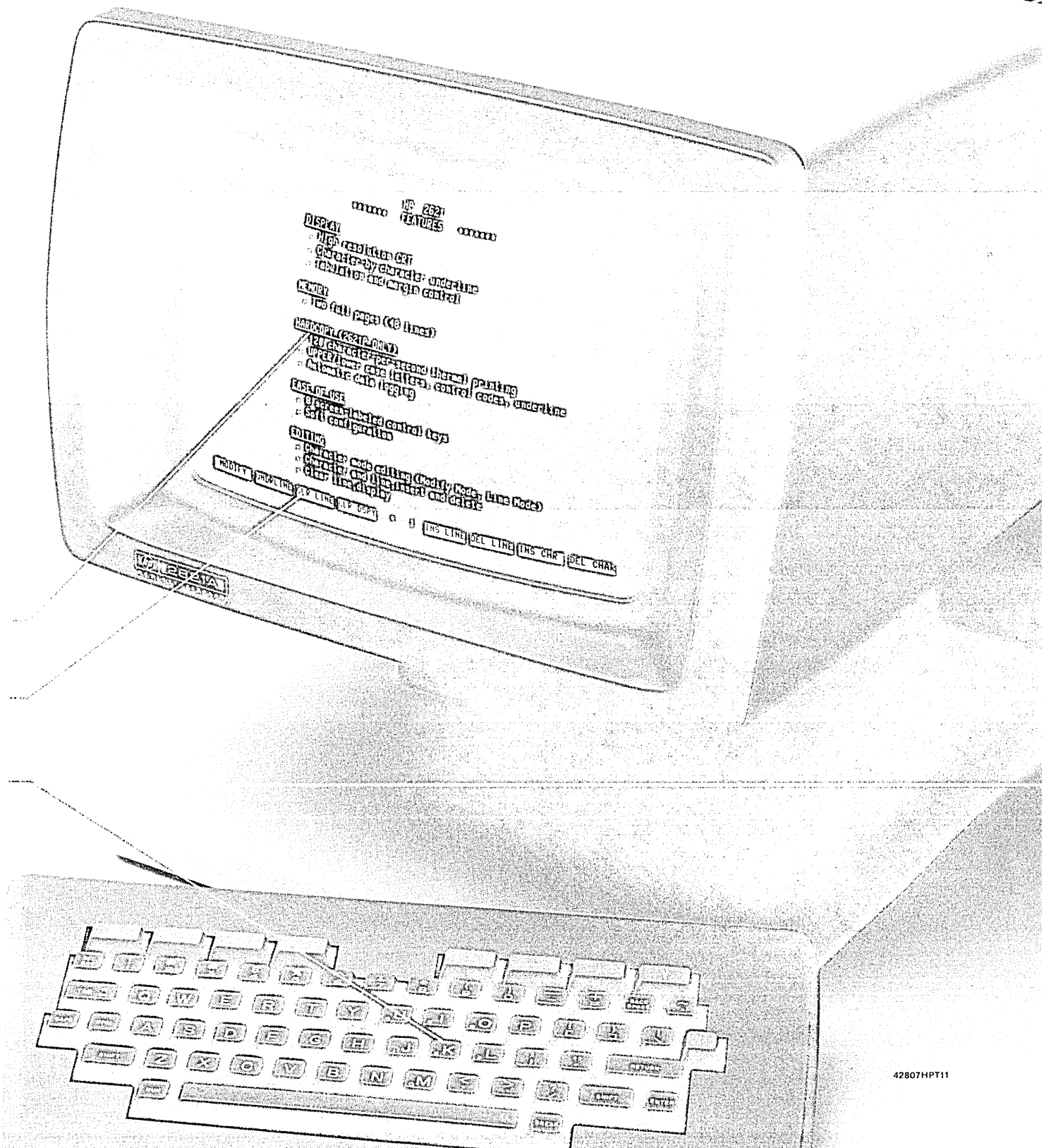

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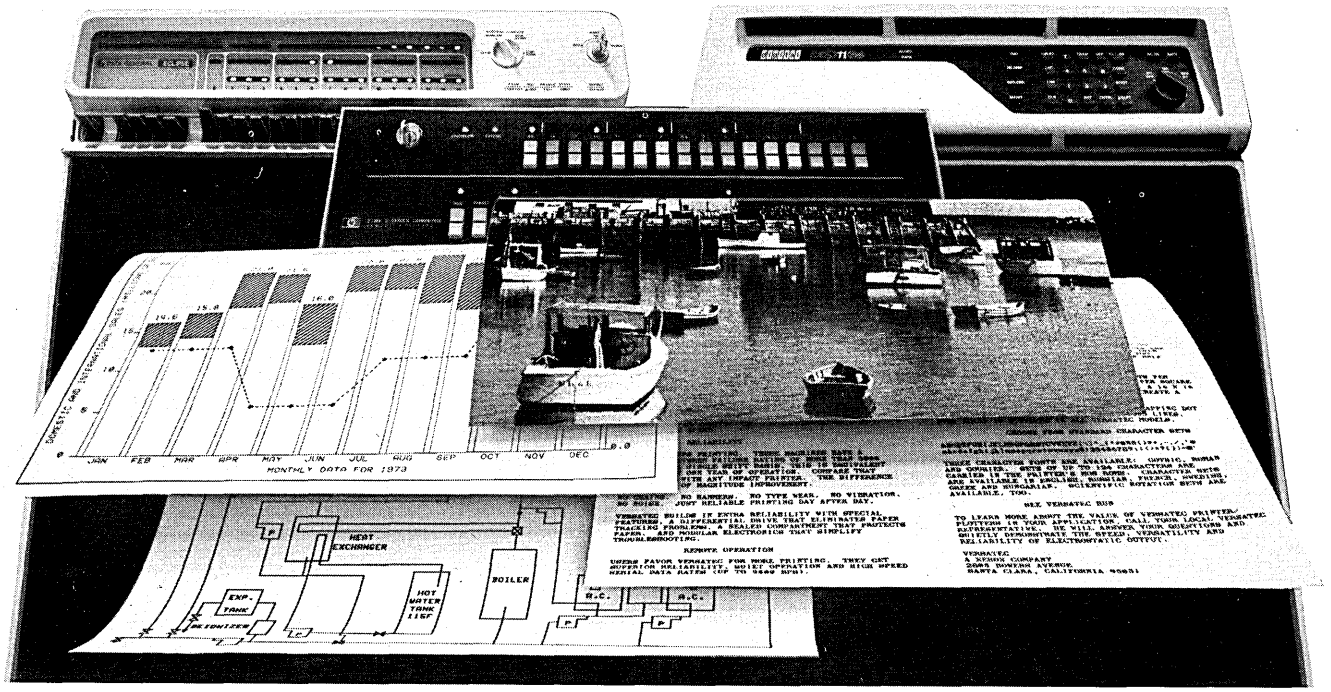

Get more from your mini. Print up to 1200 LPM. Plot up to 34 square feet per minute. Produce hard copy from display in under twelve seconds. Plot gray scale images that rival lithographic halftones. All with your mini and one Versatec printer/plotter.

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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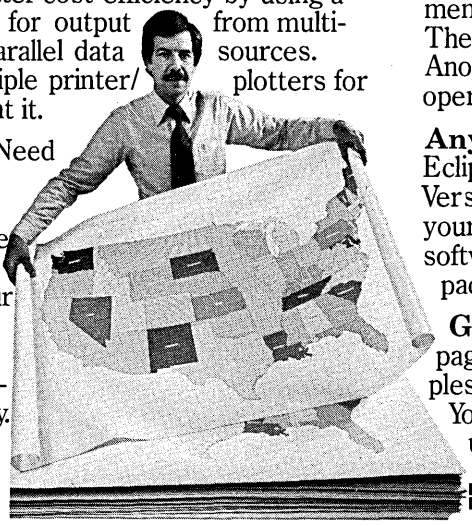

Better value. Faster speed and more versatile output capability add up to more performance per dollar. And Versatec printers and plotters continue to be an excellent investment. Ask any user. They just keep going and going. Another plus. Quiet, no-clatter operation makes them nice to be around.

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Get "Total Output". Circle our number for a 28-page brochure filled with application information, samples and detailed specifications for 47 Versatec models. You'll discover why Versatec is the minicomputer user's favorite printer/plotter.

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CIRCLE 9 ON READER CARD

CALENDAR

MARCH

EXPO/3 Computer Equipment & Supplier Exposition, March 7, San Francisco.

Contact System/3 Users Group of Northern Calif., P.O. Box 329, Santa Clara, CA 95052.

Workshop on Advanced Planning and Management Systems in Education, March 7-9, Miami Beach.

Cosponsored by the Society for College and University Planning and CAUSE, the professional association for development, use and management of information systems in higher education. (CAUSE was originally an acronym for the College and University Systems Exchange.) CAUSE, 737 29th St., Boulder, CO 80303 (303) 492-7353.

Federal Dp Expo, March 19-21, Washington, D.C.

Attendance at last year's show was over 4,000. Contact the Interface Show Group, 160 Speen St., Framingham, MA 01707 (800) 225-4620 (in Massachusetts call 879-4502).

Association of Records Managers and Administrators Region X Conference, March 21-23, Portland.

There will be concurrent sessions on subjects related to records management, micrographics and word processing, as well as exhibits and opportunities for discussion. The theme of the conference is "Bridging the River of Paper—Records Management Moves into the 1980s." Approximately 300 participants are expected. One of the speakers will be Robert B. Austin, president of ARMA (the Assn. of Records Managers & Administrators). Contact Reid Mitton, General Chairman, Dept. of General Services, Salem, OR 97310 (503) 378-4202.

Computer Software '79, March 27-29, London.

The exhibition will feature consultancy and software houses, suppliers of packages, training establishments, and recruitment organizations. Mainframe, minicomputer and microcomputer products will be demonstrated, aimed at both commercial and industrial users. Attendance is free. Contact Computer Software (Exhibitions) Ltd., 31-37 Groton Road, London SW18, England.

APRIL

Honeywell Users Group, Small and Medium Systems, Spring Conference, April 1-5, Boston.

The 37th semiannual HUG-SMS spring meeting. Contact Richard McDonald, Treasurer, c/o Mt. St. Mary's Hospital, 5300 Military Road, Lewiston, NY 14092 (716) 297-4800.

The DOD FY '80 RDT&E Budget in Perspective, April 3-5, Washington, D.C.

Sponsored by the Electronic Industries Association. Major subdivisions of the conference content are OSD Overview, Military RDT&E Programs, and New Initiatives and Future Technology. Keynote speaker for the latter category will be Dr. Ruth M. Davis, Deputy Under Secretary of Defense for Research & Advanced Technology. Registration fees are $80 for government representatives, $190 for EIA members and $250 for nonmembers. Contact Electronic Industries Assn., Government Division/Requirements Committee, 2001 Eye St., N.W., Washington, DC 20006 (202) 457-4942.

Seventeenth Annual Southeast Regional ACM Conference, April 9-11, Orlando.

Sessions will cover a wide variety of areas of the computing sciences and will run about one half hour each. The presentations will be aimed at both the academic and industrial computer professional. Contact Ron Dutton, Dept. of Computer Science, Florida Technological Univ., Orlando, FL 32816 (305) 275-2341.

Interface 79, April 9-12, Chicago.

An attendance of 15,000 is predicted. Over 200 suppliers of computer and data communications hardware, software and services will be exhibiting their wares. Contact The Interface Group, 160 Speen St., Framington, MA 01701 (800) 225-4620 (in Massachusetts call 879-4502).

Twelfth Annual Small College Computing Symposium, April 20-21, St. Cloud, Minnesota.

The symposium is to introduce college faculty to the various uses of computers in instructional computing. Registration fee: $40. Contact Randy Kolb, Director, Academic Computer Services, St. Cloud State Univ., St. Cloud, MN 56301 (612) 255-4103.

Tenth Annual Pittsburgh Conference on Modeling and Simulation, April 25-27, Pittsburgh.

Special emphasis for the 1979 conference will be on energy, social, economic, and global modeling and simulation. Sponsored by the Univ. of Pittsburgh School of Engineering in cooperation with the Pittsburgh sections of the Institute of Electrical and Electronics Engineers; the Systems, Man and Cybernetics

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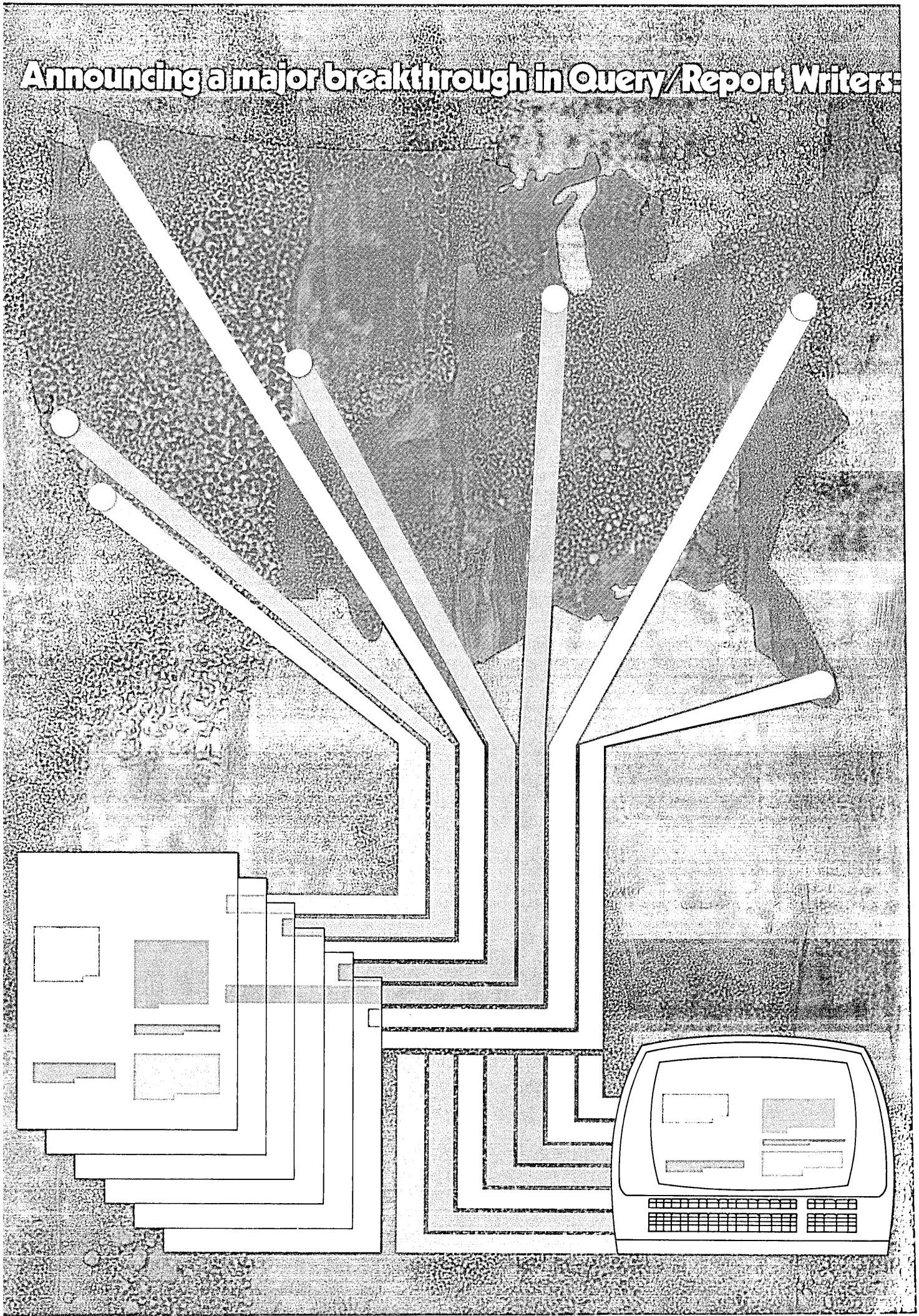
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There are two major capabilities which differentiate Tandem Enform from anyone else's Inquiry Report Writer. It performs inquiries on a distributed data base. And, it defines relationships between separate records or files at the time of inquiry without affecting the data base. The results are phenomenal. In efficiency. In capability. In flexibility. And, of course, in economy.

It's a perfect relationship.

Enform is designed specifically for our relational data base and operates under the Tandem Data Base Manager, Enscribe. Simple and easy to use. There is no cast-in-cement, pre-set organization of the data base. File relationships are defined by common codes, keys or fields. And can be changed at will. Once Enform has been told how files inter-relate, it takes full advantage of all primary and secondary keys to locate called data in the most efficient way. Data base records are defined in Tandem's Data Definition Language (DDL) which closely resembles COBOL definition statements so the process is extremely simple and easy to learn. And once the fields are named and described, the DDL statements are logged and maintained in the dictionary file for easy retrieval.

The best of both worlds.

Because Enform uses the same English-like relational query language for both queries and reports, you get your reports at a fraction of the cost and in a fraction of the time imposed by conventional languages such as COBOL. Options allow sorting, summarizing and evaluation against pre-set or user-defined functions. Formatting is automatic, and readily changeable at will. And includes appropriate commas, decimal points and currency signs. You can build in automatic calculation of variable formulas such as sales commissions. And Enform can be used from COBOL, FORTRAN or Tandem's own T/TAL. A final note of worldliness: keywords may be easily redefined to a different language such as German, French or Spanish. We truly speak your language.

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Society; the Instrument Society of America; The Society for Computer Simulation and the International Association for Mathematics and Computers in Simulation (formerly AICA). Contact William G. Vogt or Marlin H. Mickle, Modeling and Simulation Conference, 348 Benedum Engineering Hall, Univ. of Pittsburgh, Pittsburgh, PA 15261.

Association for Systems Management Annual Conference, April 25-28, St. Louis.

Contact Richard B. McCaffrey, ASM, 24587 Bagley Rd., Cleveland, OH 44138 (216) 243-6900.

International Conference on Computer Capacity Management, April 30-May 2, Washington, D.C.

Papers to be given will present research, case studies or experimental results, in the areas of workload forecasting, performance reporting, data analysis, equipment planning, instrumentation, and standard costing, and may include discussions of impact on management and operations. Contact Dave Morley or Dave Schumacher, Institute for Software Engineering, P.O. Box 637, Palo Alto, CA 94302 (415) 493-0300.

MAY

Canadian Association for Information Science Conference, May 12-15, Banff, Alberta.

The theme of the conference is "Sharing Resources, Sharing Costs." Discussion will be aimed at dealing with budget restraints and expanding needs. Contact Ronald F. Peters, Publicity and Publications Chairman, c/o Environmental Design Unit, Univ. of Calgary Library, Calgary, Alberta, T24 1N4, Canada (403) 284-6828.

Education Computer Fair, May 15-17, Detroit.

Part of the Association for Educational Data Systems seventeenth annual convention. The theme of the fair is the use of microprocessors in education. Varied applications are being considered for exhibition and competition, including home personal computing projects, student projects, school district applications and teacher developed CAI programs. Judging is to be done on the basis of hardware and software coordination and originality. Creativity and relevance of the application will also be taken into account. Three entries will be chosen to exhibit at the Personal Computing Fair at this year's June NCC in New York. The deadline for application submission is April 1. Contact Bruce G. Alcock, Riverdale Country School, West 253 Street and Fieldston Road, Bronx, NY 10471.

JUNE

CIPS/DPMA/FIQ Conference, June 25-28, Quebec.

The first joint conference of the Canadian Information Processing Society, the Data Processing Management Assn. and the Fédération de l'Informatique du Québec will emphasize the present state of information processing theories, tools, methods and systems under the theme "Where Do We Stand?" There will be an opportunity to participate in round-table discussions with invited speakers. Contact Jacques Huot, Conference 1979, Département d'Informatique, Faculté des Sciences et du Génie, Université Laval, Québec G1K 7P4, Canada (418) 681-9611.

Syntopican VII, June 26-28, Chicago.

Sponsored by the International Word Processing Assn. Contact IWP, 2360 Maryland Rd., Willow Grove, PA 19090 (215) 657-3220.

JULY

System Safety Society Meeting, July 9-13, San Francisco.

The theme of the fourth international conference of the society is "What Price Safety in a Regulated Society?" Contact Carrol Burtner, System Safety Society, P.O. Box 731, Cupertino, CA 95014.

OCR Users Association Expo, July 15-18, Boston.

Contact the OCR Users Assn., 10 Banta Place, Hackensack, NJ 07601 (201) 343-4935.

Summer Computer Simulation Conference, July 16-18, Toronto.

The theme is "Simulation in a Rapidly Changing Computer World." Contact Dr. A. J. Schiewe, The Aerospace Corp., P. O. Box 92957, Los Angeles, CA 90009 (213) 648-6120.

AUGUST

Seventh Conference on Electronic Computation, August 6-8, St. Louis.

Sponsored by the Committee on Electronic Computation of the Structural Division of the American Society of Civil Engineers (ASCE), in cooperation with the Washington Univ. Civil Engineering Dept. The conference is expected to have ten sessions including more than 40 papers and a tutorial on computing technology. Topics to be discussed include: minicomputer applications; microprocessors and smart terminals; distributed computing; interactive graphics; structural dynamics analysis methods; non-finite element methods; finite element idealization studies; large scale linear equation solvers, eigensolvers, ordinary differential equation solvers, and non-linear methods; interactive analysis and design; supercomputers and applications; computer assisted project management; and application of computing in small offices. Contact Dr. C. Wayne Martin, 212 Bancroft Bldg., Univ. of Nebraska, Lincoln, NB 68588.

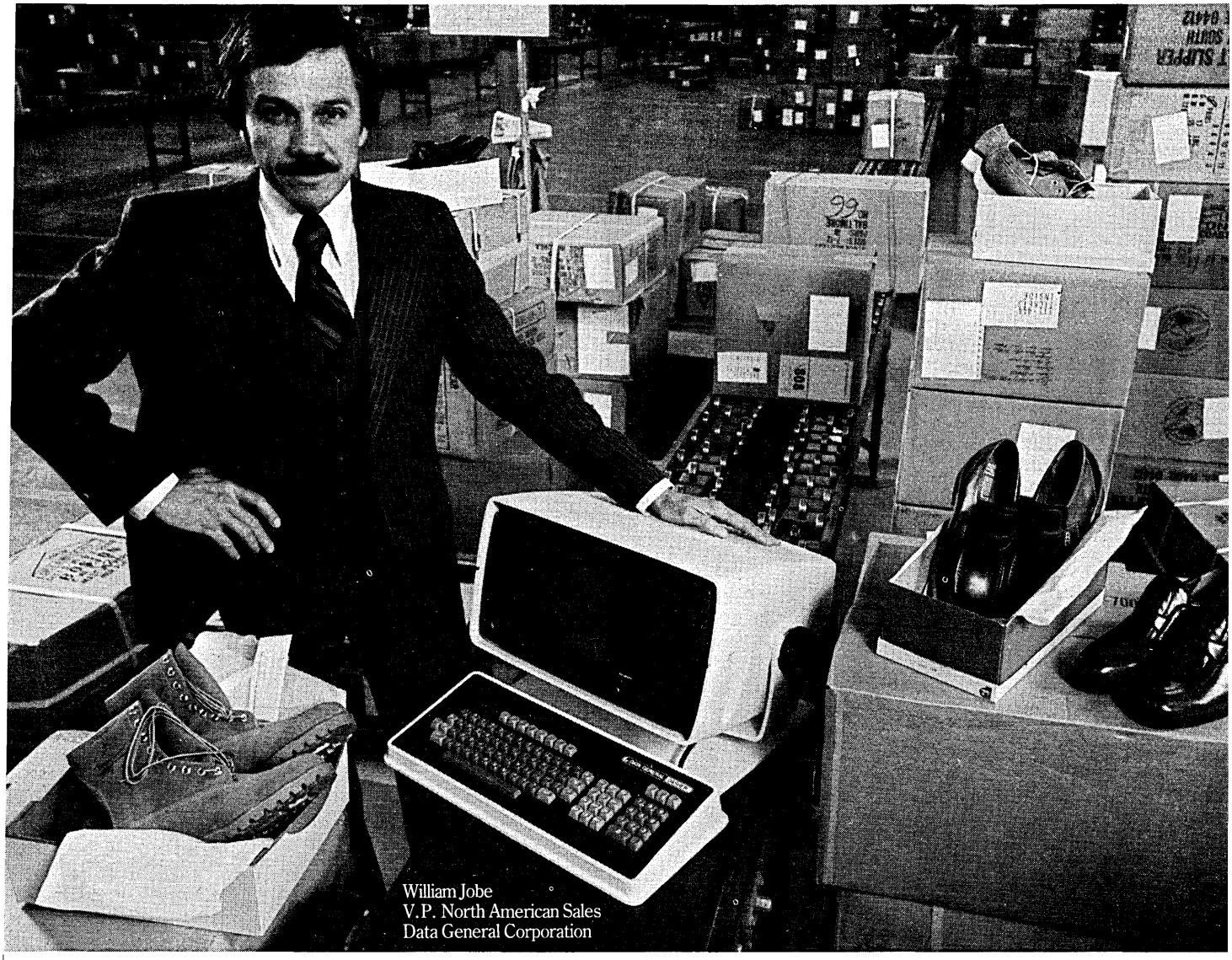
SIGGRAPH '79, August 8-10, Chicago.

An exhibition of graphics and image processing equipment, meetings of related user groups, and workshops and tutorials are planned. Contact Tom DeFanti and Bruce H. McCormick, Dept. of Information Engineering, Univ. of Illinois at Chicago Circle, Box 4348, Chicago, IL 60680 (312) 996-2315.

CALLS

Original research and development papers are being solicited for a data communications symposium to be held in late November in Pacific Grove, California. The theme of the symposium is network user services. Recommended topics for contributions are specific applications (such as reservation services, electronic funds transfer, electronic mail and message, office automation, network information services, and teleconferencing), or general technical topics (such as network interconnection, security and privacy, voice/data/FAX integration, communication-based data base and information accessing, and local networking), or other topics relevant to the planning, analysis and design of the system for network user services. Four copies of a completed paper and a 500-word summary are due by April 1 to Dr. Wushow Chou, North Carolina State Univ., Computer Studies Program, P.O. Box 5490, Raleigh, NC 27650 (919) 737-2654.

*



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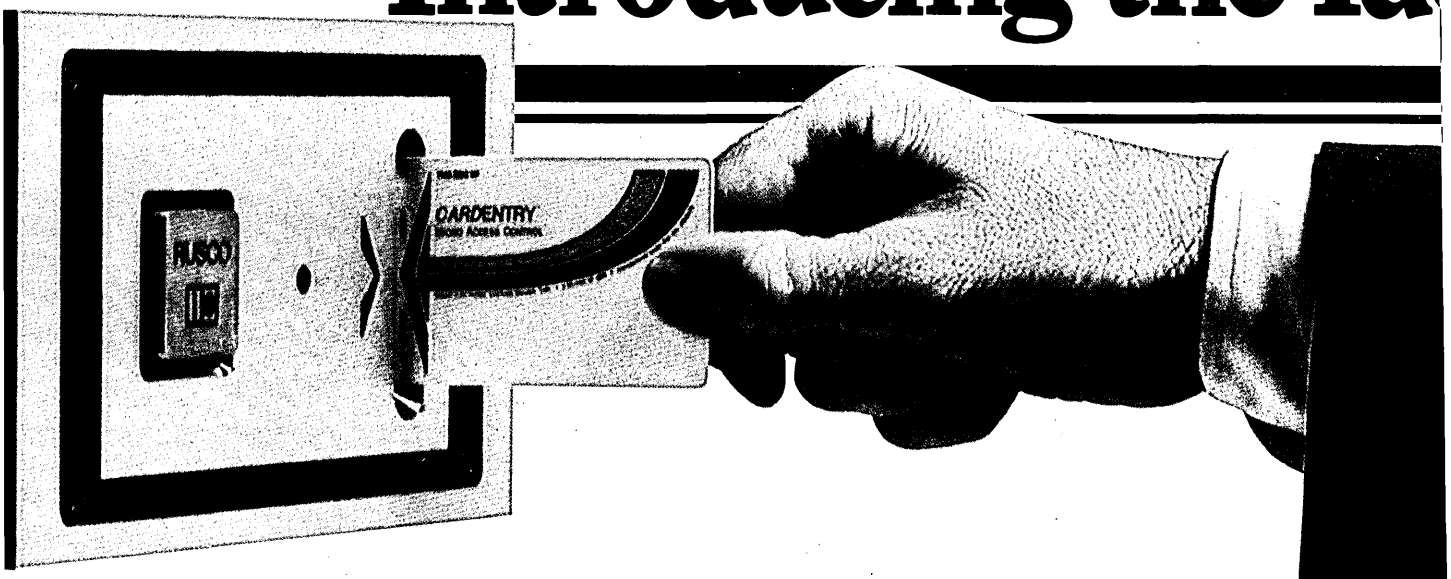
CIRCLE 15 ON READER CARD

Introducing the Id



It brings accounta

From the moment your employees entered the front gate until they left for home, they've always been on their own.

And no matter how dependable they were it's been almost impossible to hold them accountable for their actions and their whereabouts.

At Rusco Electronic Systems, we know all those accountability problems all too well.

And we've eliminated them.

The Identification Network. When accountability counts.

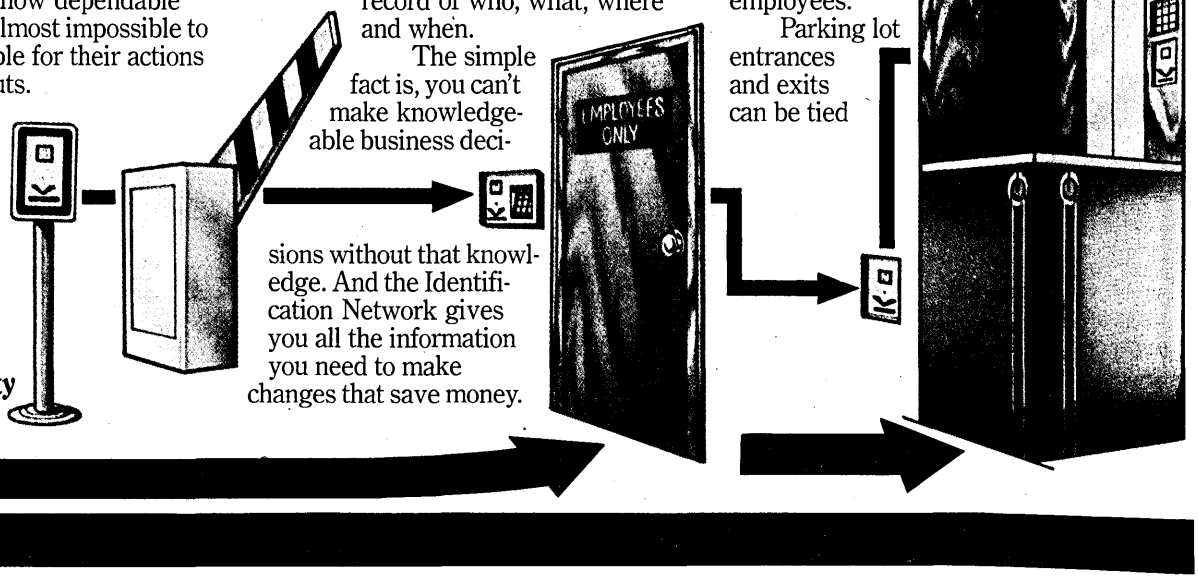
Until now, no single electronic system could let the right people in, keep the wrong people out, and give you a detailed record of who, what, where and when.

Accountability was non-existent.

But the Identification Network from Rusco Electronic Systems is an amazing new system that makes each employee accountable for access to any room or piece of equipment. Throughout your facility.

It monitors and reports employee whereabouts and actions. Completely. And gives you an accurate, immediate record of who, what, where and when.

The simple fact is, you can't make knowledgeable business decisions without that knowledge. And the Identification Network gives you all the information you need to make changes that save money.



control momentary openings for authorized employees.

Parking lot entrances and exits can be tied into the Identification Network. So you can always find out if an employee is on the premises.

You can account for use of the copying machine and know how many copies each employee makes.

You can create an electronic time and attendance log of your employees' ins-and-outs for automatic payroll processing.

Accounting for the heretofore unaccountable.

The Identification Network gives you accountability for people and facilities that you never thought possible. In fact, now basic data entry is possible anywhere.

For instance, you can control the locking and unlocking of doors on a pre-programmed time schedule. And

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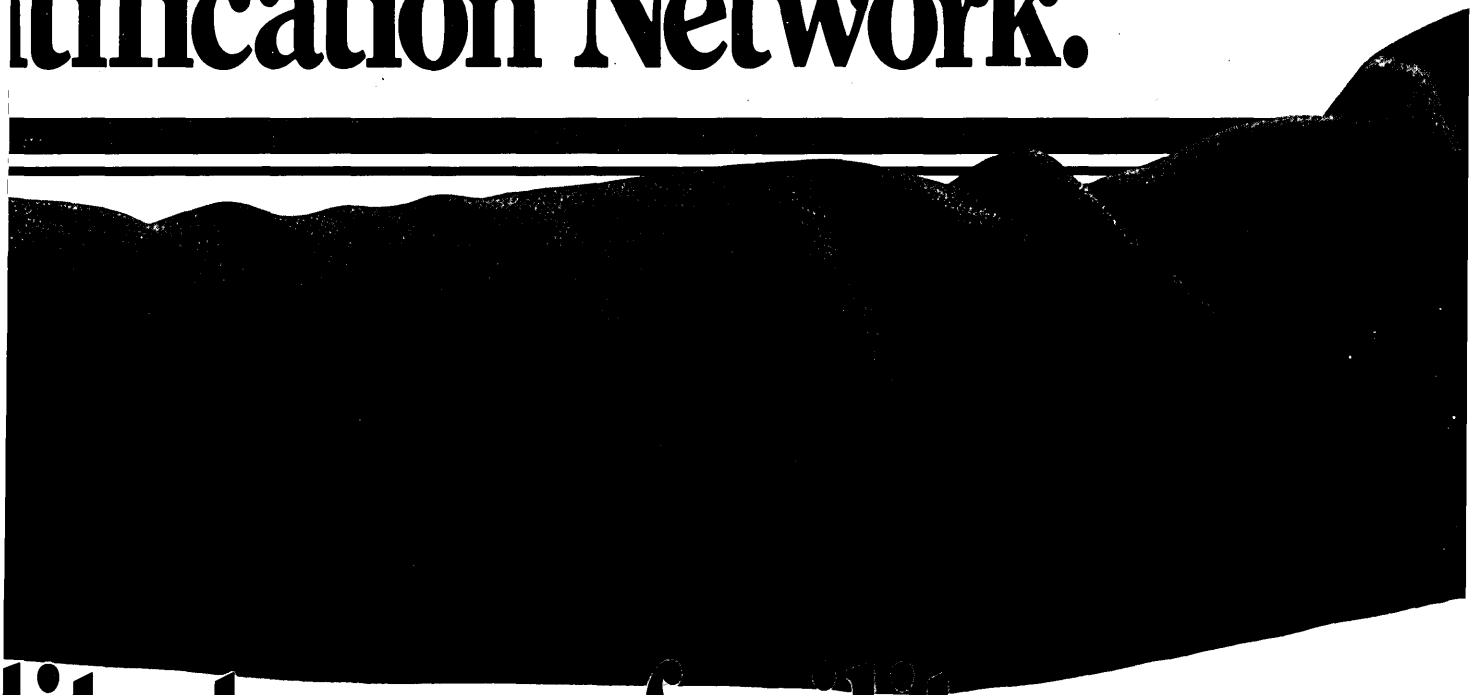


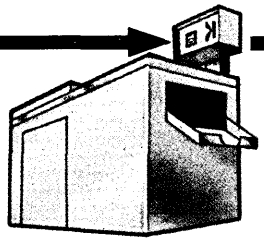
lity to your facility.

You can tell who's taking gas from the company gas pump. How much they're taking. And when.

You can even restrict after hours elevator use. For certain key people and certain floors.

Those are just a few examples.

The truth is, our customers are constantly coming up with money-saving control applications that we never dreamed of.



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Each of your employees is issued an Identification Network EntryCard™ with its own personalized code. Each room or piece of equipment that requires accountability has a single, compact CARDENTRY™ reader.

You simply tell the Identification Network which employees are allowed into each room and which employees are authorized to use each piece of equipment.

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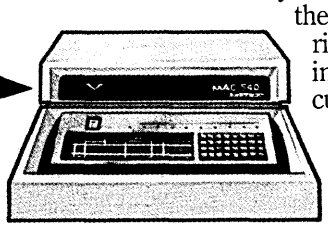
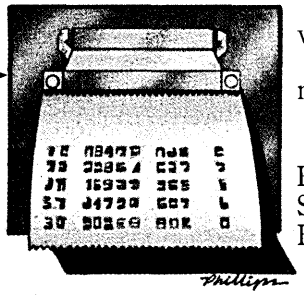
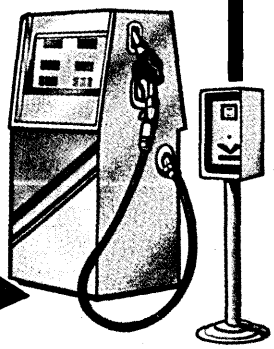


What's more, a central printer will immediately tell your security people that an attempted unauthorized entry has occurred, where it occurred, and what time.





It's that easy to account for (and control) unauthorized access and activities.

And that easy to save money.

The most important control of all.

That, of course, is the ability to control losses.

Until now, that has always been as realistic as perpetual motion and the Loch Ness Monster.

But the simple fact is, if you can account for detailed activities in the areas where you lose money due to theft and misuse of materials, machinery, and information, you can cut those losses dramatically.

And in the final analysis, that's exactly what the Identification Network does.

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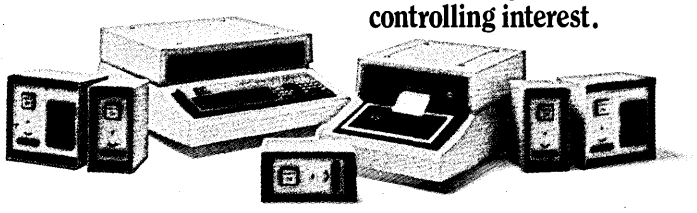

Introducing the Telex alternatives to IBM main memory.

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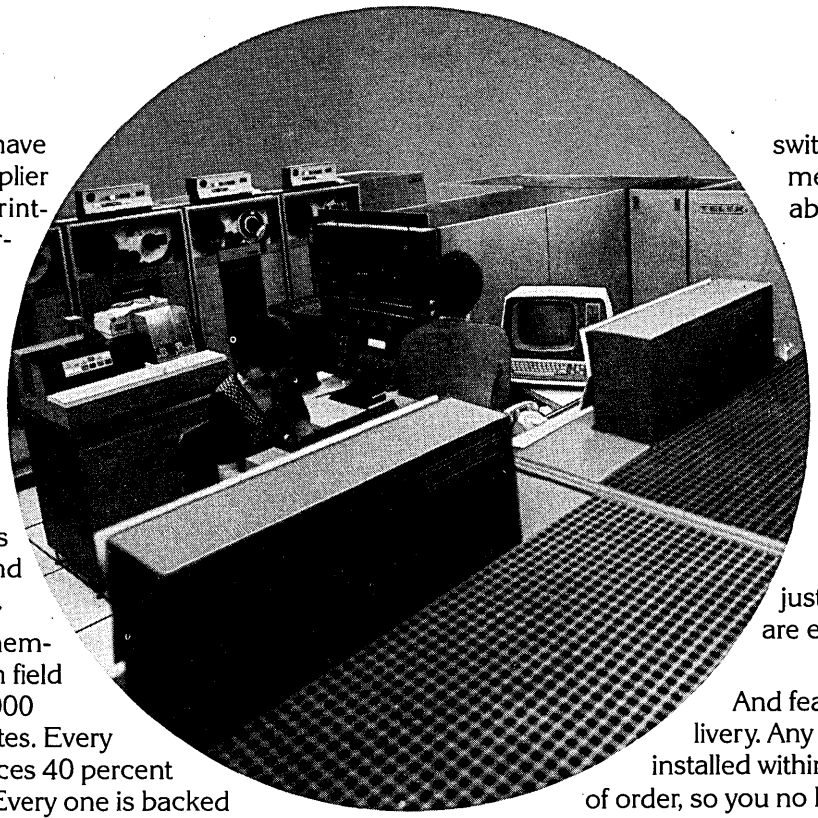

For years IBM users have known Telex as a supplier of quality disk, tape, printers and 3270-type terminal alternatives.

Now Telex is offering memory alternatives as well. Eleven of them. From the top end Stor/33 memory for IBM Model 3033 processors, through most models in the System/370 and System/360 families.

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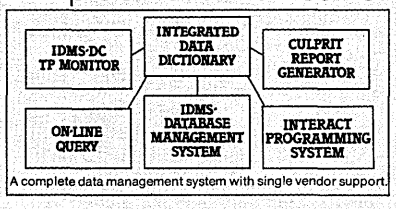

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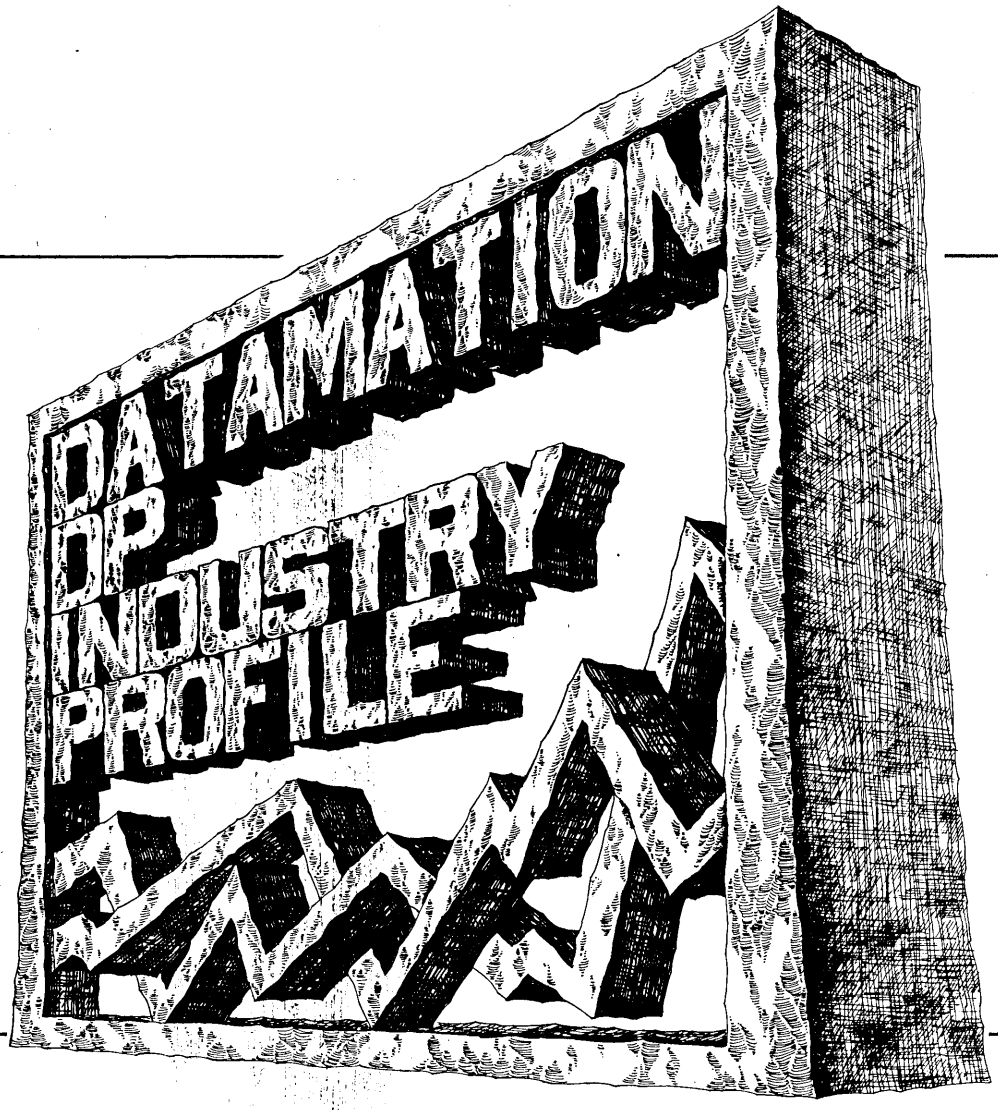
CIRCLE 18 ON READER CARD



A SPECIAL EDITION.

The world's fastest growing industry—the electronic data processing industry—will be the subject of a special edition to be published by DATAMATION magazine May 25, 1979.

"THE DATAMATION DP INDUSTRY PROFILE" will concentrate on the industry's leading companies, providing a year-long reference source of in depth profiles on each of the largest DP vendors in the U.S. and overseas.

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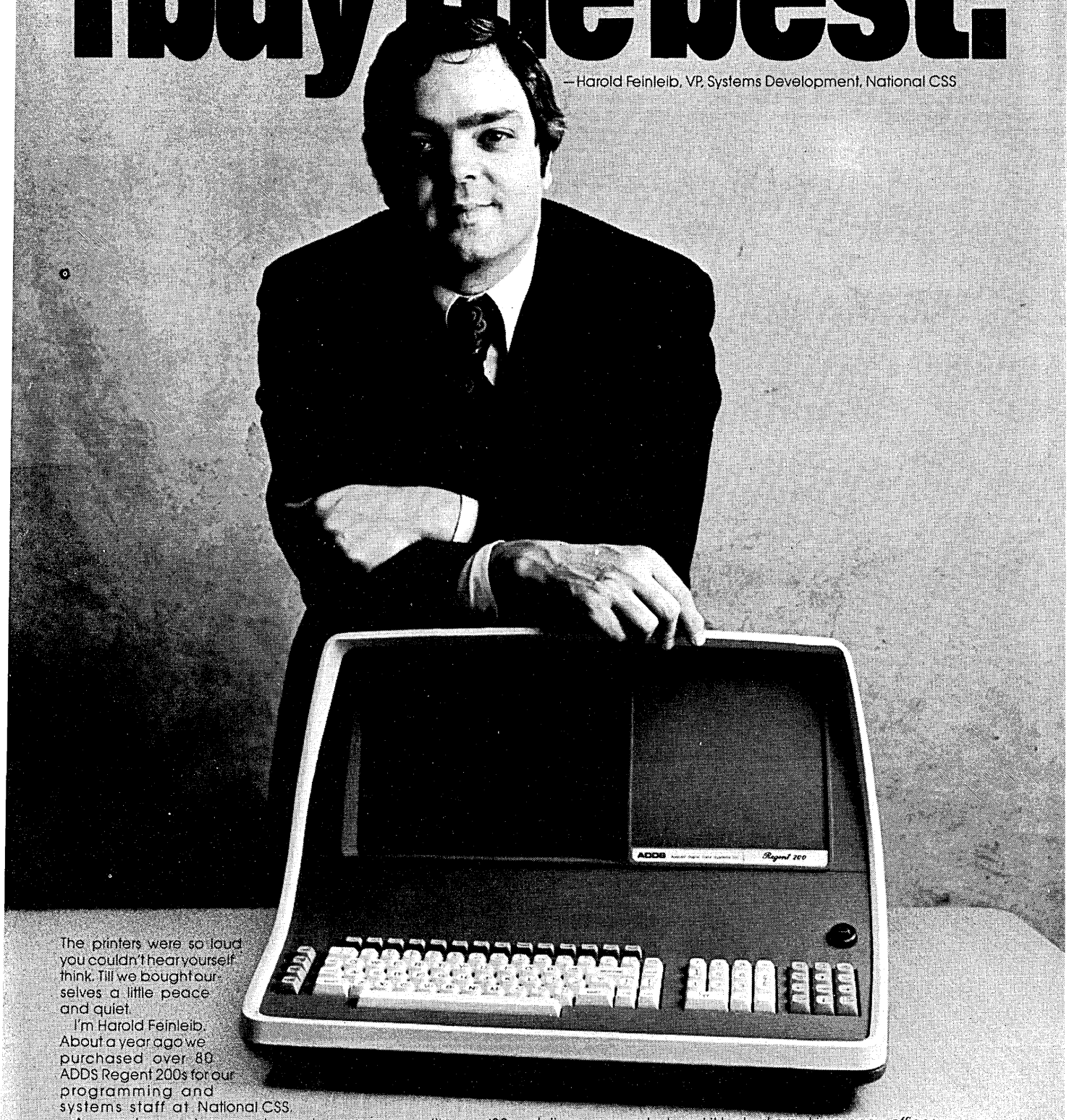

The printers were so loud you couldn't hear yourself think. Till we bought ourselves a little peace and quiet.

I'm Harold Feinleib. About a year ago we purchased over 80 ADDS Regent 200s for our programming and systems staff at National CSS.

As a major remote computer services company, with over 120 programmers and analysts at our company headquarters, we needed a quality terminal that would meet our present requirements and keep up with our planned growth.

So we evaluated leading CRT terminals, and ADDS Regent 200 came out a winner. The Regent had the features, price and delivery we needed, and it looked great in our new offices.

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ADDS, Applied Digital Data Systems Inc., 100 Marcus Blvd., Hauppauge, N.Y. 11787 (516) 231-5400. CIRCLE 11 ON READER CARD

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LETTERS

COMPENSATION CONCERNS

The authors of "Compensation Preferences of DP Professionals" (November, p. 96) state that "There is a 95% probability that the true population means (sic) for each compensation category is as listed above. For example, there is a 95% probability that dp professionals wish to receive between 75.6% and 78.07% of their compensation in the form of base pay." What the confidence interval does represent is a confidence interval of the *average* percentage of compensation the population represented by the survey would wish to receive as base pay. As the article goes on to point out, "The retirement allocation was bimodal, about 22% of the respondents designating 5% of total compensation and 25% designating 10%." Yet the author's "95% confidence interval" is the preference of receiving 7.58% to 8.62% of compensation as a retirement allocation. Clearly at least 47% of the respondents do not fall within this 95% confidence interval! The bimodality of the response suggests to me that the respondents in this case represent two or more different populations which have substantially different wishes regarding the allocation of compensation. Since there is an apparent lack of a single underlying normal distribution of compensation preferences, it is misleading to use a 95% confidence interval or to ascribe any particular meaning to the average value. Considerable caution should be used in applying the average data presented in the article to a real life situation.

RICHARD T. DUE
Head, Systems Design & Data Analysis Branch
Alberta Agriculture Administration
Edmonton, Alberta (Canada)

Mssrs. Couger and Zawacki reply:
With the exception of his final sentence, Mr. Due 's comments are the exact interpretation we hoped would be made of the data in our article. We qualified the earlier table on average preference with the data on bimodal responses for two categories: retirement and dental care. Since we provided data on those two categories, there is no reason for Mr. Due 's caution about application of our data to "a real life situation."

ANOTHER NEED

In your November article "Compensation Preferences of DP Professionals" (p. 96) by J. Daniel Couger and Robert A. Zawacki, the authors seem to have taken license with Maslow's Need Hierarchy. If I recall my studies of Maslow correctly he did *not* have "Esteem" at the top of a four-need hierarchy; instead he had "Self-Actualization" or "Self-Fulfillment" at the top of a five-need hierarchy.

I assume that the authors decided to eliminate the top need to make it easier for them to write their article and apply their theories. Why didn't they include Self-Actualization and tackle the *difficult* subject? I feel they should have at least mentioned Maslow's true structure, whether they were able to cover Self-Actualization or not.

There will probably be people reading the article who have never heard of Maslow and his Need Hierarchy, and they will probably have a nagging feeling that something has been left out. They just might find themselves thinking, "I satisfied all those needs years ago and then I went on to something else," without realizing that Maslow recognized that possibility.

Let's give credit where credit is due.

MARY S. GREENE
Carmel, Indiana

WOMEN IN COMPUTING

It was with great pleasure that I found at the back end of your November issue the excellent, and to me nostalgic, Forum piece by Dorothy Walsh, "Up From Programming" (p. 227). I was, however, puzzled by one omission in her penultimate paragraph, in which she recalled the names of other women who have made it "up from programming." The omission is Grace Hopper, who is not only a woman, but a high ranking officer in the U.S. Armed Services, and a pioneer in computing, as well as being, like Dorothy Walsh, skilled at both writing and speaking with detachment, humanity, and humor.

There have been women at the forefront of computing since the beginning. Lady Lovelace was the only long term patron, supporter, and eventually, interpreter of Babbage. The two original programmers in U.S. computing were also women: Mrs. Mauchley and Mrs. Goldstine, on the ENIAC. There was a woman vice president of IBM before the 701, namely Ruth Leach. The quote given by Ms. Walsh on page 229, " ... even the dumb blonde we've got in the demonstration center ..." is only an echo, because Thomas J. Watson, Sr. had exactly this idea in mind when, facing the consequences of what at first seemed an ill-advised remark about women's future in the depth of the great depression, he hired into a totally male company the first "System Service Girls."

An amusing addendum to that period occurred when, in the electronic, rather than plugboard, era of the fifties, men entered this strictly feminine field. Their official title had to be different, so they were called officially "Field Technical Representatives," an example of the mouth-filling euphemisms man invents when he does not want to call a spade a spade! Any old-time IBMer can tell you what they were *unofficially* called, but I will not reveal it here, since I have an old-fashioned attitude toward ribaldry and scatology.

Finally, why do you bury such goodies as Ms. Walsh's article and previous fine stuff by people like Withington at the very end of your journal?

P. M. BEATTS
Los Altos Hills, California

Well, something has to be last. Our Forum column is traditionally found in the back. This is not meant to reflect any unimportance. Reader submissions, by the way, are encouraged. —ed.

Having grown up in the computing business (I started out as a computer programmer in 1955), I want to make the following comments on Dorothy Walsh's article: Three cheers for you, Dorothy. Hooray! Hooray! Hooray! You said it all so very, very well.

PHYLLIS KENNEDY ANDREWS
Lockheed-California Co.
Burbank, California

SKELETON SUGGESTIONS

I read with great interest the article by David Schecter, "The Skeleton Program Methodology" (November, p. 147). I am currently trying to accomplish a similar standard for transaction processing, at my current assignment.

I would make two suggestions to Mr. Schecter's "skeleton," one for structure and one for performance. In order to maintain "top-down structure," I would reorder the paragraphs, as follows:

```
PERFORM 0200-HOUSEKEEPING.
PERFORM 0300-INPUT.
IF CW-21-3-1-MORE-DATA
   PERFORM 0400-INITIALIZE.
PERFORM 0500-PROCESS
   UNTIL CW-21-3-2-NO-MORE-DATA.
PERFORM 8000-END-OF-JOB.
STOP RUN.
```

This would obviate the need for "flipping-back-and-forth" in the listing, and would

DISTRIBUTED PROCESSING.

How Honeywell gives you processing power where you need it, and control where you want it.

It seems everybody is talking about distributed processing. That's understandable: the primary benefit—increased responsiveness to user needs—is an important objective.

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We can do it right now.

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allow for "straight-line" reading of the code.

The performance improvement suggestion I would make is to replace the "PERFORM 0200-INPUT" statement, in the process-portion, by the expanded "read" code. This has two benefits: 1) structure—same reasoning as above; and 2) performance—a "perform" is a high-overhead process in COBOL, particularly if the decision is made to overlay and then break the "INPUT" into a separate "SECTION."

I would be most interested in a "structured walkthru" of my transaction program skeleton, when I have it finished.

STEPHEN GERARD
Computer Sciences Corp.
Cranford, New Jersey

Mr. Schecter replies: The *use* of a *uniform* program *skeleton* from which subsequent source programs are *first replicated* and *then customized* is far more significant than the particular physical structure of the program skeleton itself. Nevertheless, as between various possible skeletons it is useful to choose the one which provides the greatest clarity and is likely to give rise to efficient operating programs.

As far as top-down structure is concerned, the program skeleton which I illustrated is consistent with the rules for writing structured programs: procedures are linked together by perform statements; in no instance is a procedure arrived at via a GO TO or by falling through a preceding procedure. There is no "flipping-back-and-forth" except when the reader is specifically interested in the details of the performed procedure.

Mr. Gerard questions why I place the Housekeeping Section at the end of the Procedure Division rather than closer to the beginning. I have two reasons for this:

1. In a virtual storage computer it is useful to group those sections which interact most frequently in closest physical proximity. The basic working set for the program skeleton includes Main, Input, Initialize and Process. Since Housekeeping and End-of-job will be executed only once they do not form part of the basic working set and are therefore placed farthest from the Main section.

2. In a real storage computer, the program skeleton would support the possibility of using overlays by including the following features:

```
OBJECT-COMPUTER.  system-name
                  SEGMENT-LIMIT IS
                  49.
```

Each section in the Procedure Division would be accorded a segment number indicating its probable candidacy for overlay:

```
01-MAIN            SECTION 00.
02-INPUT           SECTION 02.
03-INITIALIZE      SECTION 03.
04-PROCESS         SECTION 04.
70-HOUSEKEEPING    SECTION 47.
80-END-OF-JOB      SECTION 48.
```

This would enable each program, *after* it has been fully coded, to be *tuned* to available memory by *adjusting* the segment-limit. Housekeeping and End-of-job are the primary candidates for overlay in the event that such a measure becomes expeditious. In some COBOL subsets, sections must be arranged in segment-number order. The version of the program skeleton I have illustrated would retain the segmentation option while *initially* establishing all segments in the nonoverlayable portion of the program. The *necessary* cause, that of supplying a segment limit in the Environment Division and segment numbers in the Procedure Division, would be extant in the program skeleton. The *sufficient* cause for producing overlays would be deferred to the moment of program implementation.

As to the "performance improvement suggestion," I am unpersuaded that "perform is a high overhead process in COBOL." That seems to me to depend upon the particular compiler used to translate the source code into machine code. The perform verb is not, by its nature, inherently more susceptible to high overhead than the compute verb or the generate verb. A commercial program is likely to survive several generations of COBOL compilers. It would not be very useful to optimize for a specific version. That approach might lead to someone making a case for the now all-but-discarded ALTER --- GO TO.

Permit me to observe, however, that Mr. Gerard in undertaking to improve the program skeleton implicitly endorses the concept. I applaud him in his effort and I would be among the first to make use of any demonstrated enhancements.

CIVIL SERVANT SALARIES

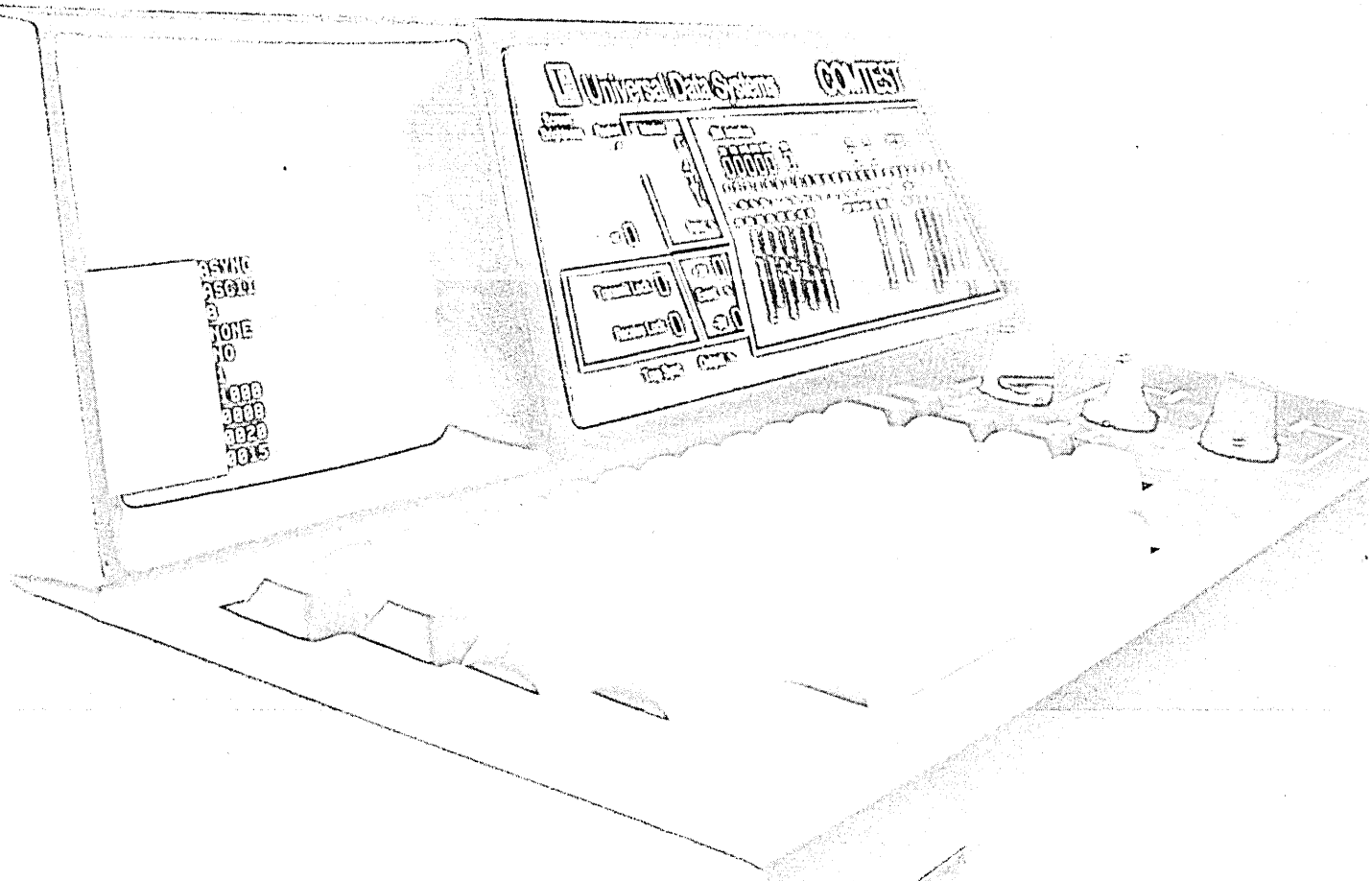
The November issue's DP Salary Survey (p. 86) reflected a common misunderstanding of the federal pay system. It is stated that "Jimmy Carter has decreed that raises for federal employees will be held to a noninflationary 5.5%." The implication is that federal workers will be limited to that percentage as an overall annual increase. The fact of the matter is that all Carter did was to grant each and every federal employee an immediate and automatic 5.5% cost-of-living increase. What is not evident is the fact that there are two other forms of salary adjustments available to government employees: regularly scheduled "step" increases and promotional increases. Moreover, Carter's action has no effect whatsoever on either of the other forms of increase. In contrast, it is interesting to note that no cost-of-living adjustments were made during the entire eight years of Eisenhower's Administration.

The comment that "many federal computer installations seem to go along with that" (the 5.5% annual ceiling) implies that there will be a freeze on step increases as well as promotions. This is pure nonsense. Individual federal computer installations have next to no control over in-grade increases which are virtually automatic, occurring annually for the first three increases at each GS level. Even the term "General Schedule" implies a standard timetable for such increases.

Step increases amount to approximately 3%, varying from 3.33% between steps 1 and 2 to 3.13% between steps 3 and 4. This means that every federal employee below step 4 will receive an increase of *at least 8.13%* this year. While limiting the example to employees with less than four years time-in-grade is not telling the whole story, it is by no means atypical; in the federal government today, employees *in the computer field* do not commonly remain at the same grade level for more than three or four years. For example, and ignoring the supergrades, it is not at all unusual for a computer specialist to rise from a GS-9 level to a GS-15 level within 20 years (many do it in 15 years); this is especially true if an employee is willing to change organizations and/or locations, as is the norm in private industry.

Promotional increases are, of course, over and above cost-of-living and step increases. The effect of promotions is more difficult to gauge. The current General Schedule rate differentials (at step 1) vary from 21% between GS-9 and GS-11 levels to 17.6% between GS-14 and GS-15 levels; one such boost in salary range every three or four years isn't bad. In practice, the method of handling promotional increases amounts to finding the next greater salary at the higher level and then adding two steps; this means that a promotional increase will minimally be equivalent to 2½ steps, or some 7½%—that increment in salary rate every three or four years complements the other 8% very nicely.

A comprehensive comparability analysis is somewhat beyond the scope of this letter; suffice it to say that the 5.5% Carter increase is only part of the story. Our civil servants aren't exactly starving these days. Readers are encouraged, moreover, to investigate the requirements for a GS-12 programmer/analyst position (starting salary $23,087) through a GS-15 branch manager position (starting salary $38,160) to gain insight into the federal



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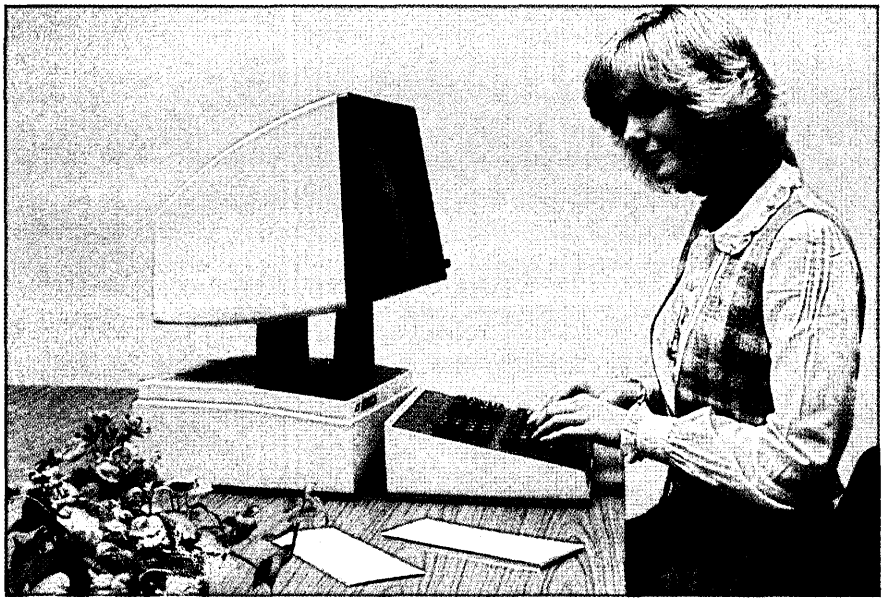

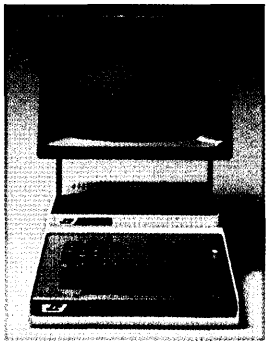

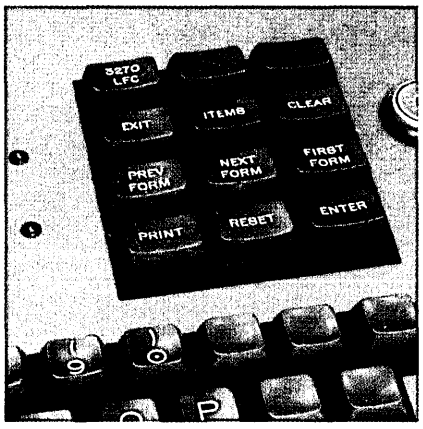

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CIRCLE 21 ON READER CARD

1979 'A'

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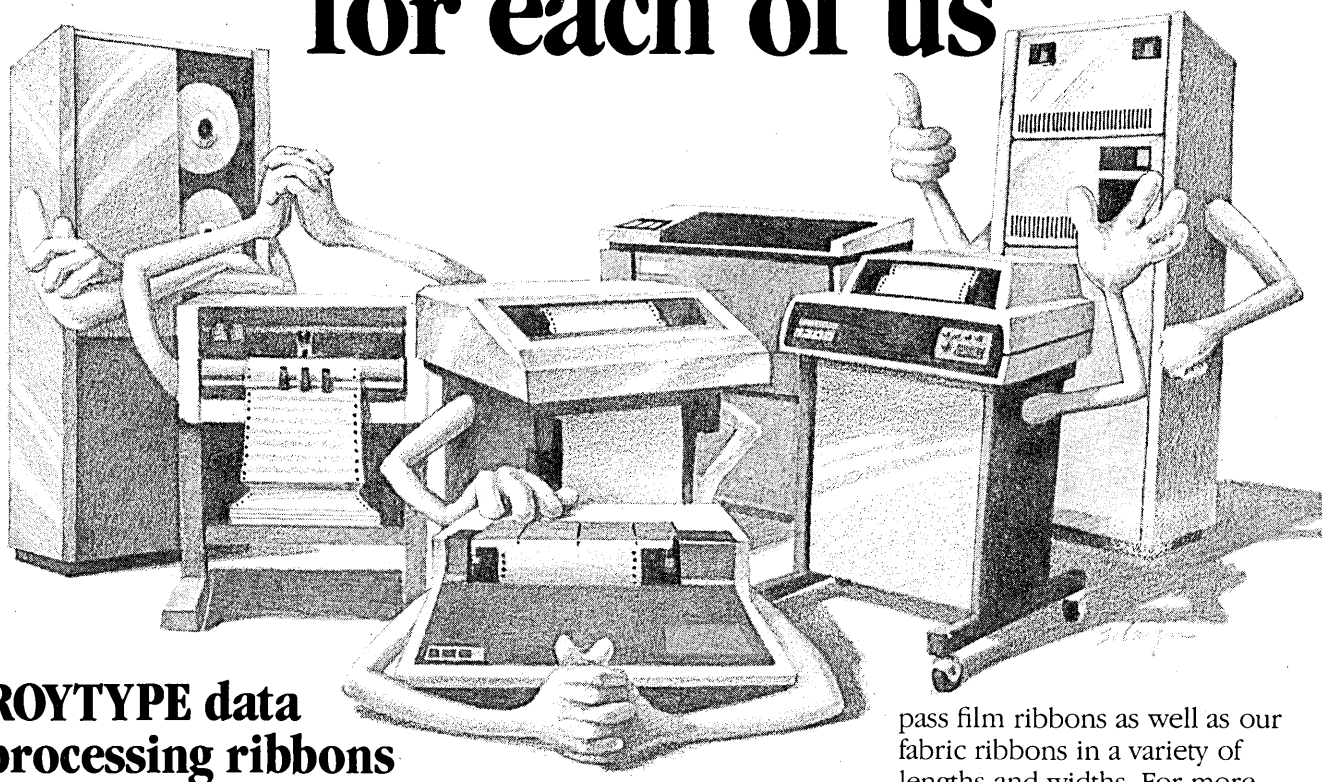

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_____ *City/State/Zip*

_____ *Telephone*

Litton ROYAL BUSINESS MACHINES, INC.

pay scale situation. Please do not publish my name, as I have decided to seek government employment.

Name withheld
Gaithersburg, Maryland

Thank you for the additional information about "step" increases, but we are not certain about how much it applies. Dp managers in government installations reported the salary increase data we printed, and may or may not have taken "step" increases into account. We suspect they did, and that's why the article anticipated many of your points by saying "... Mr. Carter will either see some resistance in holding the 5.5% line or an awful lot of switching from one GS level to another" (p. 88) ... editor's name withheld while he considers federal employment.

CORRECTION

I appreciate this opportunity to correct a misstatement and an omission in my article "The Changing Face of Applications Programming," in the November 15 issue (p. 24).

I regret the careless phrasing that lumped MUMPS with examples of statistical packages. I am indebted to Joan Zimmerman of the MUMPS Users' Group for pointing out this error.

The article should have included acknowledgements to Ben Shneiderman of the Univ. of Maryland, Greg Williams of General Electric Co., and Larry Smith and Hal Feinleib of National CSS. I am under no illusion that the thesis of the article was entirely my own invention. It is a pleasure to credit the four men named—and especially Professor Shneiderman—for numerous conversations that helped me crystallize my ideas.

DANIEL D. MCCRACKEN
Ossining, New York

ERRATUM

We would like to apologize for inadvertently omitting the following footnote from the article "Who Is the DP Professional?" by Dr. Jac Fritz-enz (September 1978, p. 125):

The analysis and presentation of the survey data was prepared and presented by Kathryn E. Hards, an industrial psychologist at Four-Phase Systems.

SIGNIFICANT STATISTICS

The article by J.D. Couger and R.A. Zawacki, "What Motivates DP Professionals" (September, p.116) is flawed by the lack of adequate statistics. For example, the authors present data in Table 4 that measures the average growth need for dp professions (6.02) and other professions (5.59). They conclude that, "the need for growth is quite high for dp professionals, compared to other professions..." What's lacking is any information on the dispersion of the data, such as standard deviation, and whether or not the data is normally distributed.

While I have no reason to question the validity of the authors' conclusions, the data presented in the article does not support the conclusions.

H.C. MCKEE
The Mitre Corp.
Bedford, Massachusetts

Mr. Couger replies:

We were hoping for a letter such as yours so we could expand the statistical explanation for our September article beyond what the editors had held us to. Although it's not reasonable to reproduce here the seven tables required for a full explanation, we can discuss the procedures used:

We computed one-way analysis of variance and t-test on all possible levels of independent variables. Output included F-test for homogeneity/equality of variance and t-test between means at each level for equal and unequal variance. Included in the analysis were correlations between the items composing a given scale (such as "skill variety") and all other items scored on other job dimension scales. In general, both the internal consistency reliability of the scales and the discriminant validity of the items were satisfactory. F- and t-tests revealed that the sample was statistically significant (p being less than 0.05).

WILL THE REAL MR. RINDER PLEASE STAND UP?

I found your "People" story on Joe Veno (July, p. 39) very interesting, but also inaccurate on several counts.

The name of the notable sculptor of most of the early Honeywell animals is Jack *Rindner* (not Ridder). You also misspelled the name of Honeywell's director of advertising—Morey *Dettman* (not Depman).

Most significant is your attribution of the new plexiglass design to Veno. The lion which appeared in January 1977 is Jack Rinder's, reflecting a creative use of curved plexiglass in response to BBD & O's request that he help them change the approach to the Honeywell series.

ALAN B. SALISBURY
Eatontown, New Jersey

NO OPERATOR INTERVENTION

In your article, "Exxon: Another Computer Giant? (July, p. 169) you mentioned Dialog Systems, Inc., an Exxon affiliate, as a maker of voice response systems. Although we do incorporate voice response in most of our systems for input verification, we make word-recognition terminals, which translate human speech into a digital form that is acceptable by most computers.

Our most recent operating system is part of a telephone management system installed by the State of Illinois in which callers seeking to make credit card calls talk directly to the system with no operator intervention. Director Ted Puckorius of the Illinois Department of Administrative Services estimates that the new system will reduce his telephone costs from $42,000 to $23,000 per month (a savings in excess of $200,000 per year).

MARVIN E. GOLDBERG
Marketing Support Manager
Dialog Systems, Inc.
Belmont, Massachusetts

NONPROCEDURAL PROGRAMMING

I found Daniel D. McCracken's article on "The Changing Face of Applications Programming" in your mid-November issue (p. 24) very interesting. A standard, machine independent, nonprocedure-oriented language that is simple to use by personnel not directly involved with data processing is most definitely a goal for the industry to aim for. However, in my opinion, Mr. McCracken's prediction that by the mid '80s we will be running 50% of all applications on nonprocedure-oriented languages is too optimistic. For one thing, we in the dp industry are notorious for having very few standards. To this day there are sophisticated machines being manufactured that do not have a standard procedure-oriented programming language such as COBOL or FORTRAN, not to mention a good data base system. Therefore, I would not expect the industry, which is presently undergoing another proliferation period due to the microcomputer, to put their efforts into nonprocedure-oriented language packages.

F. WEGENER
Manager, Data Processing
Ebco Industries Ltd.
Richmond, British Columbia

SWEDISH STUDENTS SEEK SOPHISTICATED SUMMER STUDY

Chalmers Univ. of Technology, Gothenburg, Sweden, conducts a yearly study tour for advanced electrical engineering students. Beginning the second week in June, 45 English-speaking students will be available for an eight week trainee employment. Demanding positions would be preferred, but any work in the field is likely to be accepted. After the eight week internships, the students will do a two week tour of American electronics firms. For more information contact Hakan Kappelin, USA-79, Elektroteknologsektionen, Chalmers Tekniska Hogskola, Fack, S-402 20 Gothenburg, Sweden. ✲

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The C3 Series is the only computer system with the three most popular processors— the 6502A, 68B00 and Z-80. This allows you to take maximum advantage of the Ohio Scientific software library and the tremendous number of programs offered by independent suppliers and publishers. And all C3's have provisions for the next generation of 16 bit micros via their 16 bit data BUS, 20 address bits, and unused processor select codes. This means you'll be able to plug a CPU expander card with two or more 16 bit micros right in to your existing C3 computer.

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Five DOS options including development, end user, and virtual data file single user systems, real time, time share, and networkable multi-user systems.

The three most popular computer languages including three types of BASIC plus FORTRAN and COBOL with more languages on the way. And, of course, complete assembler, editor, debugger and run time packages for each of the system's microprocessors.

Applications Software for Small Business Users.

Ready made factory supported small business software including Accounts Receivable, Payables, Cash Receipts, Disbursements, General Ledger, Balance Sheet, P & L Statements, Payroll, Personnel files, Inventory and Order Entry as stand alone packages or integrated systems. A complete word processor system with full editing and output formatting including justification, proportional spacing and hyphenation that can compete directly with dedicated word processor systems.

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The new "GT" option heralds the new era of sub-microsecond microcomputers.

Ohio Scientific now offers the 6502C microprocessor with 150 nanosecond main memory as the GT option on all C3 Series products. This system performs a memory to register ADD in 600 nanoseconds and a JUMP (65K byte range) in 900 nanoseconds. The system performs an average of 1.5 million instructions per second executing typical end user applications software (and that's a mix of 8, 16 and 24 bit instructions!).

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C3 systems offer the greatest expansion capability in the microcomputer industry, including a full line of over 40 expansion accessories. The maximum configuration is 768K bytes RAM, four 80 million byte Winchester hard disks, 16 communications ports, real time clock, line printer, word processing printer and numerous control interfaces.

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The C3 systems have phenomenal performance-to-cost ratios. The C3-S1 with 32K static RAM, dual 8" floppies, RS-232 port, BASIC and DOS has a suggested retail price of under $3600. 80 megabyte disk based systems start at under $12,000. Our OS-CP/M software package with BASIC, FORTRAN and COBOL is only $600. The OS-DMS nucleus package has a suggested retail price of only $300, and other options are comparably priced.

To get the full story on the C3 systems and what they can do for you, contact your local Ohio Scientific dealer or call the factory at (216) 562-3101.

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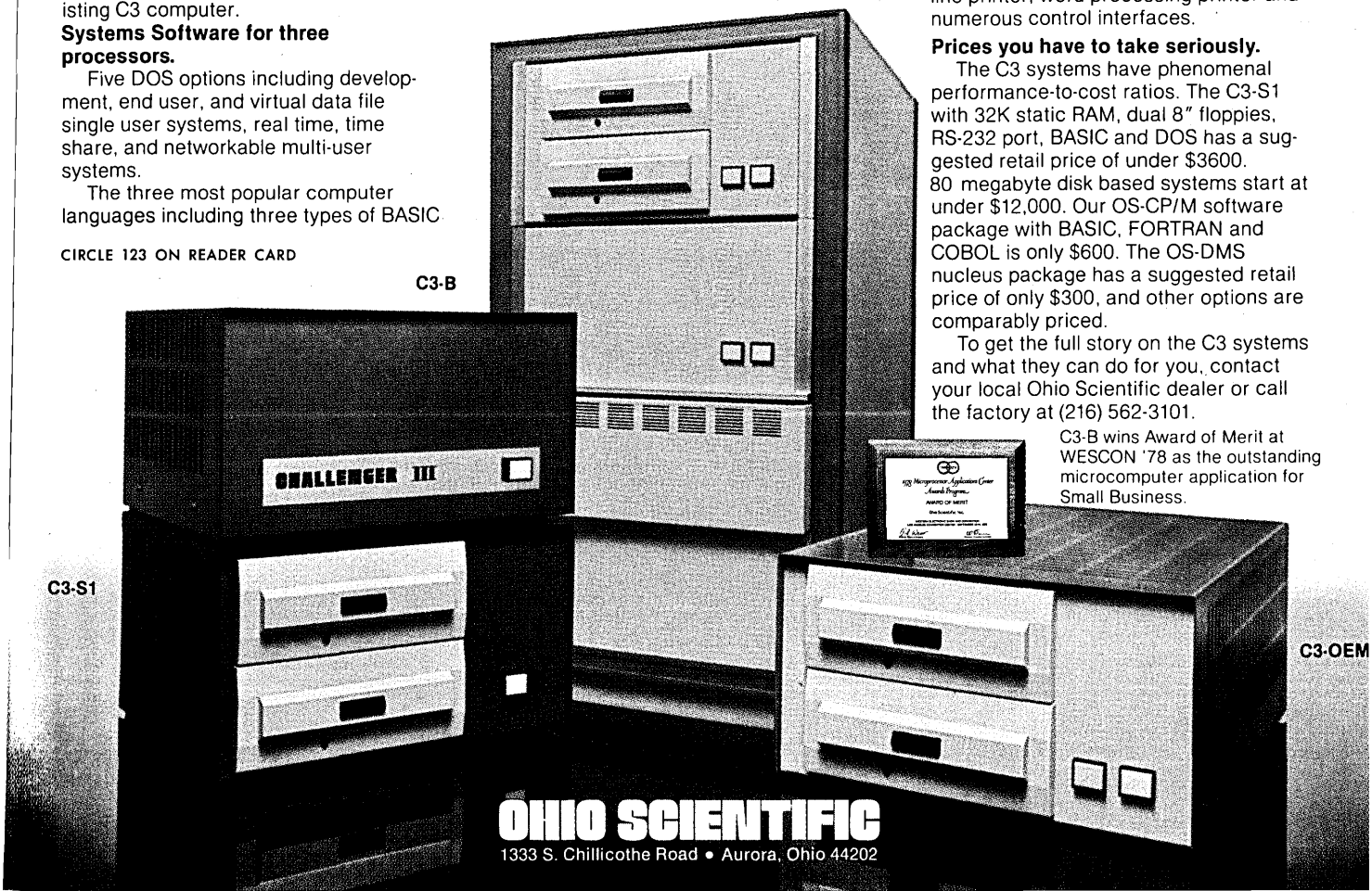

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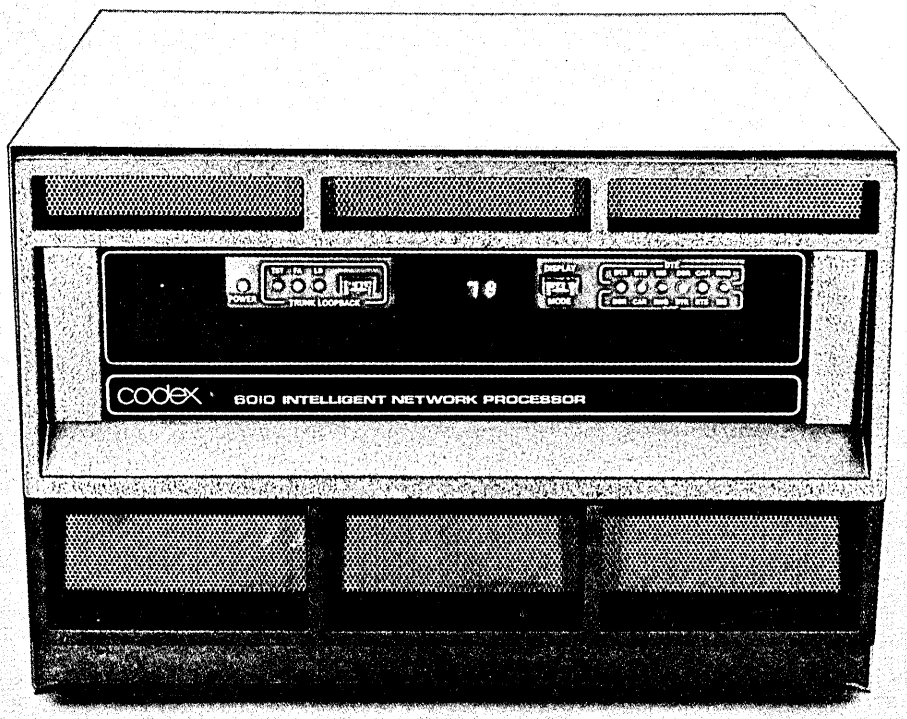

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By using proven statistical concentration techniques, the 6010 can serve many more asynchronous devices than a conventional TDM, thus reducing network costs.

The Codex 6010 delivers data from up to 30 asynchronous devices, error-free, through the use of an ARQ protocol which is compatible with X.25 Level 2, the CCITT recommendation on link access procedures.

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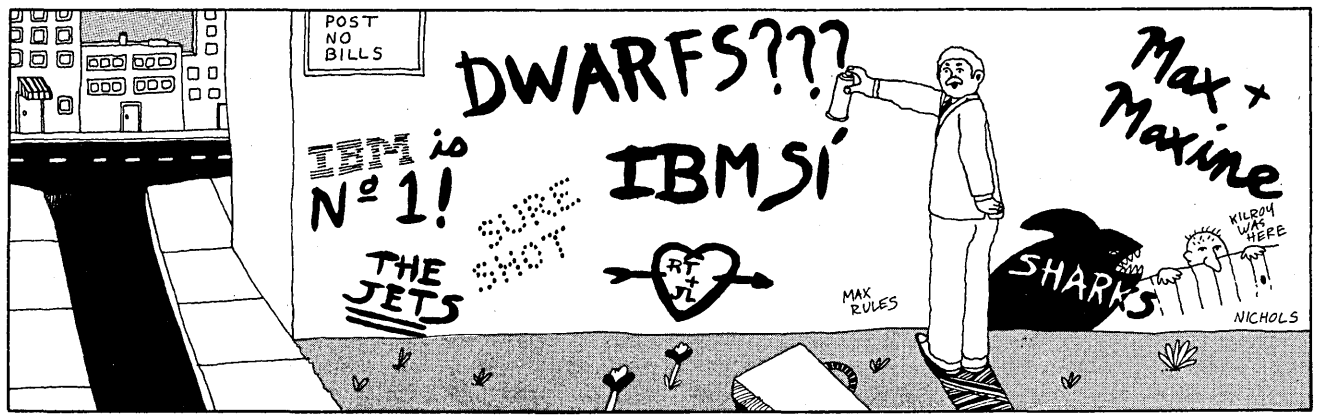
JOHN L. KIRKLEY, EDITOR

EDITOR'S READOUT



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THE HAND-WRITING ON THE WALL

Reading the handwriting on the wall is an ancient and revered custom. It's mandatory for those who wish to stay alive and healthy.

In China the latest quirks of ideological change are broadcast by wall posters; in Los Angeles territorial dominance is proclaimed with spray cans. But in the computer industry the messages are often written in a code composed of user migration patterns, new product announcements, price wars, and user spending.

Recently the handwriting on the dp wall has been a lot bolder and a lot more legible.

Item: IBM's hardware and software is becoming increasingly acceptable; more than ever before it is satisfying present and projected user needs.

Because of the drop in logic and memory costs, hardware efficiency, although still important, is no longer the overriding consideration it once was.

IBM software is getting better: a badly patched IMS is being refurbished and new and more efficient data base offerings are on the horizon. The single level storage management software in the 38 is a real innovation. VM and MVS are on their way to becoming staples and SNA received a much needed boost with the introduction of the 8100. The 8100 is also supposed to have a very "user friendly" COBOL preprocessor for generating COBOL source code—very much a part of IBM's stated objective of making dp easier for the user to use.

Item: We actually may adopt a few significant standards—an I/O interface standard (based on the IBM channel interface), various data communications standards, and an increasing number of language standards.

Item: A major portion of the data processing budget—a whopping 53%—is allocated to personnel, according to last month's DATAMATION budget survey. To protect that investment many prudent dp managers have decided that the IBM route is the safest way to go. More people are trained on that equipment than any other and career-minded analysts and programmers are more likely to be attracted to and stay at an IBM installation (or its PCM equivalent).

Item: Because of the fierce competition from the PCM's and from the mini manufacturers, IBM has been slashing prices on its memory and mainframes like a used-car dealer. And, as a result of the corporate-sanctioned rivalry between GSD and DPD, a score of new low-end machines have been announced.

All of which takes us back to that handwriting on the wall: big, bold, block letters that Honeywell, Univac, and Burroughs must be reading with some apprehension. The message reads:

DO THE USERS REALLY NEED THE OTHER MAINFRAMERS?

Given all of the above, the answer would seem to be no. Conversion costs make switching difficult, but time and attrition may overcome this inertia.

In a decade or two, if things continue as they are, we may be looking at a mainframe world that is exclusively IBM. The other companies in the business will be those who have learned to live in the Gray Giant's shadow, either by making value-added equivalents or by finding some turf that IBM has left unguarded. (One of the most successful examples is Control Data. CDC has adroitly maneuvered itself into becoming the world's largest independent supplier of peripherals.)

Of course rapid and dramatic change is a constant in our industry. Perhaps unforseen developments will create a marketplace more favorable to the other mainframers.

But it the meantime it is well that Univac has its tractors and Honeywell its thermostats. Burroughs, a company devoted entirely to data processing, may wish to investigate microwave cookery or the fast food business.

At least until there's some rewriting of the handwriting on the wall.

*

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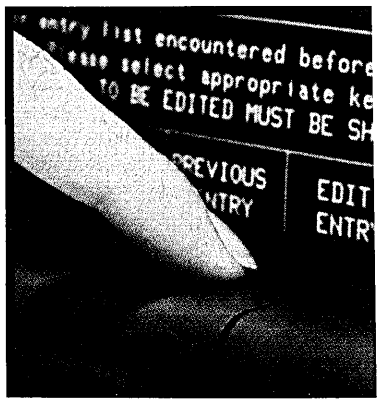
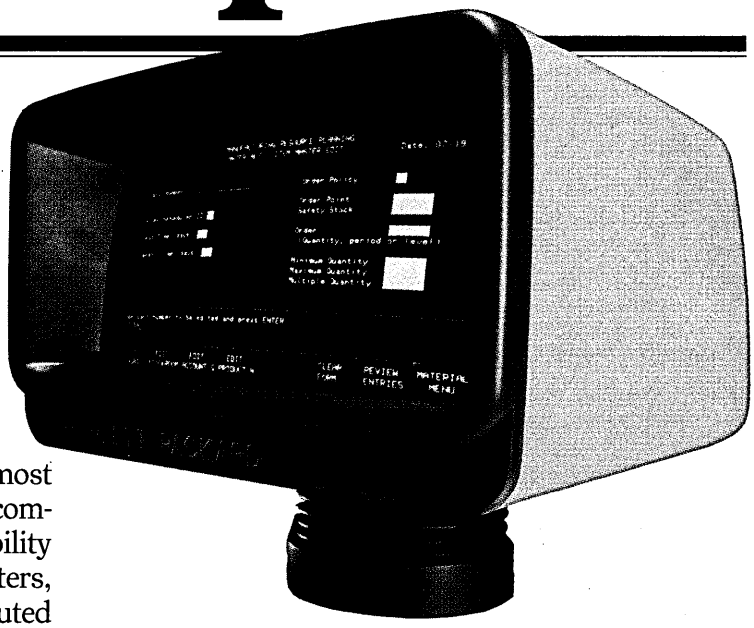
Now you don't have to settle for an unsophisticated business computer just because you're looking for a low-priced, easy-to-use machine. Instead, you can get the HP 250: the first powerful system that works in a simple way.

The HP 250 is as easy on the operator as it is on the programmer. Eight soft keys built into the display screen prompt the operator in using a program or the programmer writing one. Its memory-based operating system assures reliable, responsive performance. (There's up to 192K bytes of system memory and 64K bytes of user memory.)

We included data base management (previously only available on much larger, more expensive systems) to help solve complex business information problems. And designed a simple inquiry language for calling up data quickly in a choice of formats. In short, you get all the benefits of a fast, sophisticated system without having to hire a computer expert to run it.



kept it simple.



Tools to make it work the way you work.

The HP 250 comes with a number of useful programming aids. HP Business BASIC, IMAGE/250 (the DBM software), QUERY/250, FORMS/250, and REPORT WRITER/250 provide a set of versatile tools to get the most out of the system in the least time. And a new communications option, which includes the capability for linking to our powerful HP 3000 computers, offers larger companies an economical distributed processing solution. It also lets you add up to five terminals for data entry and inquiry.

Slim as a modern desk, the HP 250's award-winning design complements office environments and makes life simple for the operator. The keyboard is laid out like an electric typewriter. And, rather than the user adjusting to the display, it moves horizontally and vertically to provide the best viewing angle.

The HP 250 offers a choice of printers for hard copy output, and an optional sound reduction module makes the high-speed printer quiet enough for your office.

Tucked inside the desk is our high-speed processor and main memory. All the boards fit onto a chassis that rolls out for easy maintenance and expansion. Behind a sliding cover, you'll find our flexible disc drives. You can expand from one to three of these or add hard disc memory to extend your storage.

A computer that looks after itself.

The HP 250 has self-test features which function automatically as soon as you turn the system start-up key, letting you know right away whether all systems are go. If they're not, it will help track down the source of the problem.

Considering the power and simplicity of the HP 250, you'll be pleasantly surprised by the price. You can get a complete system for as little as $24,500. For a closer look, call the HP office listed in the White Pages. Or write to Hewlett-Packard, Attn. Pete Hamilton, Dept. 446, 3400 E. Harmony Road, Fort Collins, Colorado 80525.

Prices are U.S. list.

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HEWLETT hp PACKARD

CIRCLE 6 ON READER CARD

Dear Ma:

Vadic's new modems direct-connect to any telephone line: residence, business, WATS, leased... can yours?

The day of the truly portable terminal has arrived, thanks to Vadic. You see, Ma, Vadic has a brand new line of highly styled, low profile modems specifically designed for remote terminal users.

These modems direct connect to any dial-up phone, be it residence, business, WATS, behind a PBX... you name it. This means users will no longer have to rent your DAA's, saving them money and space.

Can your modems do this, Ma, or do they require the more expensive data lines?

Whatever the terminal, Vadic has the modem — 1200bps, 300bps, full duplex, half duplex, dial-up leased line. They're simple to install. Just unplug the phone, plug the modem into the voice or data jack, connect the terminal and start communicating. Putting it simply, Ma, Vadic's new modems combine the portability of acoustic coupling with the performance and reliability of direct connect.

A good example is the VA3455 shown above. It provides 1200bps full duplex operation over the switched network or two-wire leased line. It's the coolest running modem ever built. Requires less space, too, because the phone can sit on top of the modem, or modems can be stacked without creating a heat problem.

With these great new direct connect modems at the remote end, and Vadic's remarkable triple modem, which automatically becomes a VA3400, a 212A or a 103, at the computer site, Vadic has opened new vistas in data communications. The whole story is in Vadic's new 8-page brochure. Better phone, or write for yours today, Ma.

Your independent thinking son,

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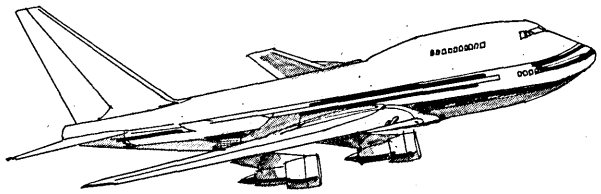

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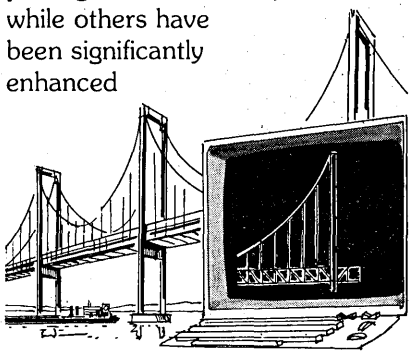

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NEWS IN PERSPECTIVE

MICRODATA VS. PICK

Lawsuit wasn't considered a factor in termination of acquisition negotiations by AM International, but AM knew about it.

"We're torn between going ahead with the lawsuit or making a movie of it."

Thomas Bourke, an attorney for Pick & Associates, Inc., was talking about a $90 million counterlawsuit filed (choice of date deliberate) Friday, Oct. 13, 1978 against Microdata Corp., charging, among other things, antitrust violations, malicious prosecution, interference with economic advantage, and theft of trade secrets.

Richard Pick, Pick & Associates president and a former consultant to Microdata, was the target of two lawsuits filed by Microdata in 1977, one of which ultimately was dropped.

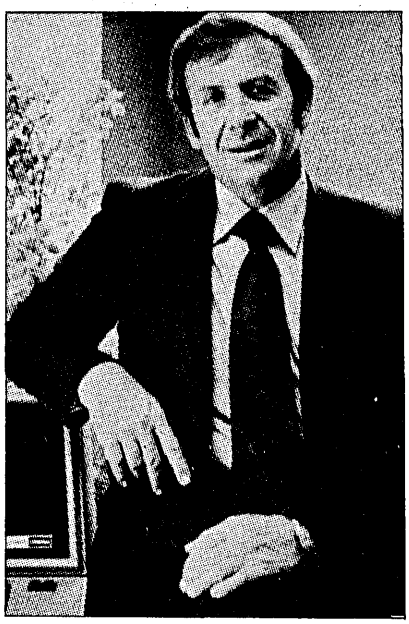
Bourke didn't believe the countersuit had anything to do with the falling through of acquisition talks between AM International Inc. (formerly Addressograph-Multigraph Corp.) and Microdata although, he said, "they (AM) were aware of it."

AM International initiated the acquisition discussions last Nov. 7, offering to acquire the assets of Microdata through a one-for-one stock exchange. Microdata then had 2.3 million shares outstanding. In mid-January when the termination of negotiations was announced, Microdata's stock was going for about $17 and AM's for about $25.

At a press conference Jan. 18, Microdata chairman Donald Fuller said he and company president Don Graham were in Florida helping to open up a new branch office when they learned of the termination. He said they were advised by their lawyers who had been contacted by AM lawyers that a spokesman, purportedly representing a group holding from 15% to 20% of Microdata stock, had approached AM saying that stock would be voted against the acquisition. Microdata shareholders were to have considered the proposal in March.

AM would not comment on reasons for the termination. Microdata directors earlier had given the proposal their approval with only Fuller and Graham dissenting.

Pick said his attorneys had met with AM attorneys in the early stages of the acquisition negotiations. "They (the AM attorneys) said they were going to recommend to Ash (Roy Ash, AM chairman) that he not go through with the acquisition until our suit was settled, but we never heard any more."



DON FULLER—Surprised while in Florida.

Microdata's auditors, Arthur Young & Co., took the suit seriously. Last month they said they were "qualifying" (that is, expressing reservations) their opinion on the company's fiscal 1978 financial statement because of it.

In the first quarter of its current fiscal year, ended Nov. 30, 1978, Microdata reported revenues of $20,446,000 and a net income of $1,353,000 or 60 cents per share. For the fiscal year ended last Aug. 31, Microdata posted earnings of $4.1 on revenues of $64.9 million.

Bourke said he was disappointed by the termination of the AM negotiations. "They (AM) have a lot of money and we probably could have gotten a settlement."

Pick himself has mixed feelings about going all the way through with his lawsuit. "It could take seven or eight years and it's costing a lot of money." But he thinks it would be fun to do it.

Microdata's auditors, Arthur Young & Co., took the suit seriously.

The lawsuit against Pick by Microdata which still is standing asks $10 million in damages and alleges misappropriation of trade secrets. In his countersuit Pick calls this suit one element in a continuing conspiracy to restrict his ability to compete with Microdata.

The suit which was dropped has been referred to as the "Tweedle Dee and Tweedle Dum" suit. "On or about Sept. 1, 1977," says the complaint "Microdata filed and served Pick with an Application for Writ of Possession and a verified

Complaint for Recovery of Possession of Personal Property and $500,000 damages in the Superior Court of the State of Calif., Orange County . . . This complaint alleged that Pick was unlawfully retaining two computer systems designated 'Tweedle Dee' and 'Tweedle Dum' which had been loaned to it by Microdata. The true facts were that Pick was in lawful possession of the two computer systems. In fact, Pick had exercised an oral option to purchase the two computer systems and Microdata had already sent Pick an invoice requesting payment for the systems." This suit was dismissed with prejudice on Nov. 2, 1977.

In another portion of the complaint, Pick who had been a Microdata dealer for Hawaii since February 1976, charges that his representative was barred from a dealer meeting in June 1977. "Pick's dealership was the only Microdata dealership which was not allowed to have a representative at this meeting," says the complaint. "Further, at this meeting cross-defendants passed out alarm clocks which had written on their faces, 'TICK TICK, DICK PICK.' The clocks' alarms were set to ring randomly without warning."

Pick's company is developing and marketing a small business system called Evolution which is like Microdata's Reality system but, says Pick, "faster and better."

Pick's system had its beginnings in 1965 when Pick was working with TRW on a software project that led to that firm's Generalized Information Management (GIM) system. In October 1965, the Army contracted with TRW for continued development of GIM and its implementation on a project called Integrated Technical Data Systems (ITDS). Pick worked on the Army project. The ITDS software went into public domain and is obtainable from the Department of Defense Documentation Center in Atlanta.

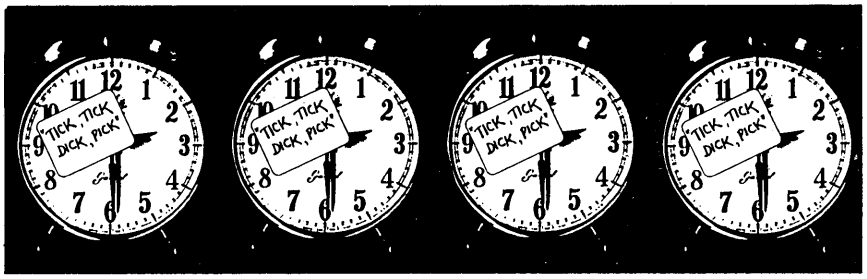
In May 1968, while working for General Analytics Corp., Pick conceptualized a way to use the software with minicomputers. GA purchased a Microdata 800

"This is industrial espionage and it's done all the time."

and by January 1970, Pick had the ITDS software running on it.

When GA filed bankruptcy in 1970, Pick continued integration of the software and the Microdata 800. He formed Pick & Associates in 1972. He dubbed his software ACCESS.

In 1973 and 1975, Pick entered into agreements with Microdata through which Microdata could use and market Pick's software and firmware on a Microdata 1600 cpu. Microdata renamed ACCESS English, and the overall system Reality. Pick worked with Microdata as a consultant until Dec. 14, 1976 when, his



THE CLOCK was used to make a point at a June 1977 dealer meeting.

complaint says, "Microdata unilaterally terminated" the agreement.

Pick is charging Microdata with using illegal means to obtain the source code to ACCESS, which he had consistently declined to grant them.

The complaint says that Fuller, during a meeting at Microdata in 1974, said that "Microdata was in a position 'where we have to obtain the source code.' In pursuit of Microdata's plan to obtain the source code to Pick's ACCESS, cross-defendant Fuller directed some of Microdata's employees to lease a facility in which to set up equipment to reverse engineer the source code. This facility subsequently came to be known as 'the Birch Street Facility.' Cross-defendant Fuller, when questioned by a Microdata executive about the propriety of the 'Birch Street Facility' and the purpose for which it was conceived, responded: 'This is industrial espionage and it's done all the time.' "

Pick's first Evolution systems were based on Microdata 1600s but Microdata refused to sell him cpu's. He found other sources of 1600s and also entered into an agreement with a French firm, Intertechnique S.A., to use its Multi Six computers. The first Evolution with a Multi Six was shipped in December. Pick said he has 50 systems out and on maintenance. He has maintenance offices in Los Angeles, San Francisco, Seattle, and New York. "We had to go into the maintenance business. The minute we touch a Microdata installation, Microdata cuts off maintenance." He contends this is illegal.

Pick said he is talking to a number of minicomputer manufacturers about integrating his software with their hardware under a royalty arrangement similar to the one he had with Microdata. He had hoped to implement his software on the IBM Series/1, he said, and had two potential backers for this project. "They backed away when they learned of the Microdata lawsuits."

Technically, at least, Pick still is the authorized Reality dealer in Hawaii, although he's never sold anything there because Microdata never shipped him anything. In anticipation of spending a lot of time in Hawaii, Pick purchased a condominium there.

"At least that's appreciated. I'll make some money on that." And, in the meantime, while waiting for the condo to appreciate even more, he enjoys an occasional long weekend in it away from lawsuits and Reality.

—Edith Myers

MAINTENANCE

THE HIGH COST TO MAINTAIN

The annual maintenance cost as a percentage of hardware purchase price is climbing.

A recent report on the outlook for computer maintenance sums up its findings by saying that hardware vendors will not be able to hire trained maintenance personnel fast enough to keep up with the continually growing installed base. Users, it is said, will have to accept degraded performance, vendors will have to increase spares inventories and stocking locations, and they'll also have to intensify their efforts to develop more efficient diagnostic and repair techniques.

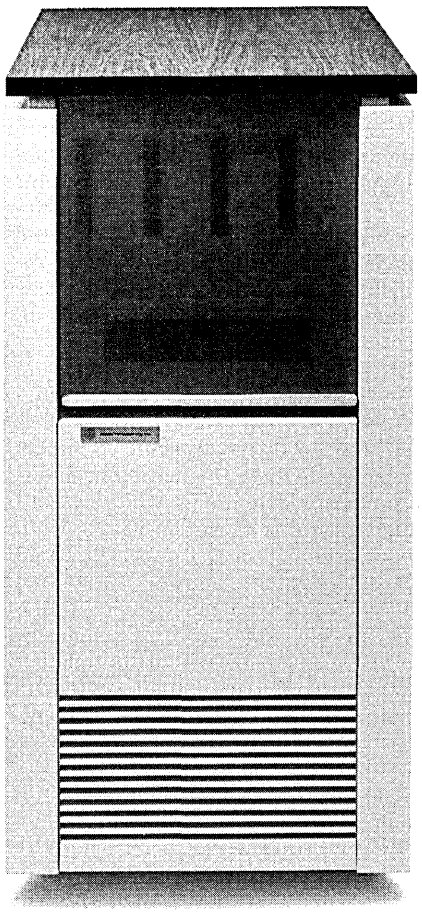
Now the bad news.

The annual maintenance charge as a percentage of hardware purchase price will go up and up.

According to Input, the price of an annual maintenance contract, compared to the purchase price of the hardware, will double between 1978 and 1983. In so doing, says the Menlo Park, Calif., research company, the charge to users will surpass what is being perceived as the sacred 15% barrier that users purportedly have established as an upper bound on annual maintenance costs.

By 1983, says Input, the ratio for large computer systems will rise to 14% from the current average among vendors of

THE OEM'S KEY TO TURNKEY SYSTEMS



Introducing the BTI 5000 Time-shared Computer System. An all-new system offering high storage capacity, fast response, superior operating flexibility, and high reliability.

All at a very affordable price. For just $38,950 you get a ready-to-go system with 30 megabytes of on-line storage, magnetic tape cartridge back-up, and eight user ports. Or, for just $2,000 more you get a 60 megabyte system. And, there's a very aggressive discount structure, like 30% in a quantity of only 10.

The 5000 is easy to expand... 16, 24 or 32 user ports; up to 500 megabytes of disk storage; multiple cartridge tape drives; industry-compatible 9-track magnetic tape; line printers from 300 to 900 lines/minute.

It's easy to program... BASIC-X, the 5000's extended version of BASIC, is about the best version you'll find for fast development of sophisticated application programs. It includes features like a BASIC-callable, machine-level sort function that provides as much as a 30 times advantage in sort times, a big boost in data base applications.

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The new BTI 5000—for the OEM who wants performance, reliability and support, with a margin that's too attractive to pass up. Call us.

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CIRCLE 16 ON READER CARD

7%. For minicomputers and terminals and such, it will increase to 20%, for small business systems to 24%, and for peripheral equipment to 26%.

At Memorex Corp., which has a field maintenance force of some 700 in the U.S. and double that number abroad, the average annual price of a maintenance contract for an extensive line of disk drives is about 15% of purchase price. On older disk drives, it's even higher. Over the next five years, with hardware prices coming down, "I could see it going to 25%, maybe 30%," says Charles E. Splaine, vice president of the Field Operations Group. "I wouldn't be a bit surprised."

Kenneth W. Simonds of Amdahl Corp. also sees the maintenance price relative to the price of mainframes "continuing to escalate" as long as the industry continues to provide the maintenance and support function in the same way it's been done the last 20 years. "But," he adds, "I think most companies . . . are looking at different means of delivering the support service." He says they're trying to provide the same levels of system availability in a less labor-intensive fashion.

But over at the Computer Systems Group of Hewlett-Packard, marketing manager Douglas C. Chance thinks they'll be able to stay at the current 5% to 6% level. Chance admits to "significant pressure" to hold at this level, despite a 20% to 30% a year drop in hardware prices and despite increasing labor costs in the field. He says to do so will require that they continue designing for serviceability and reliability "and internal

"I think the opportunities for increased productivity in a field service operation are immense."

diagnostics and remote diagnostics and things like that."

They find that a CE could easily spend a third of his time on administrative paperwork. So HP uses its own minicomputers in a distributed network to relieve them of much of this task—spare-parts inventory control, filling out of repair orders, ordering replacement parts, filling out warranty documents, and the like. "I think the opportunities for increased productivity in a field service operation are immense," Chance says. And by doing so, he adds, they will not only improve the delivery of service but also to some extent make up for the shortage of manpower.

If HP is successful in holding down maintenance prices, it may be the only one. George O. Harmon, vice president and general manager of Pertec Computer Corp.'s Services Div., observes that for the last 20 years maintenance prices have

GEORGE O. HARMON—"When IBM came up with the new higher price level on its 8100, it suddenly became honorable to charge the higher fees."

generally been between 5% and 9% of purchase price. But with the onslaught of minis and micros the ratios have gone as high as 18% and 25%. In fact, he notes, with the new IBM 8100 it goes up to 18%, thus violating what he calls "the immutable rule of thumb" that it should never exceed 9%.

Harmon says he and Pertec discovered the need for higher maintenance prices for small systems when Pertec acquired Mits Inc., the Albuquerque maker of Altair personal computers. When they priced out what they thought they would have to charge for maintenance, he says, the price exceeded the old percentages by such a large amount that it threw them. But when IBM came up with the new, higher price level on its 8100, it suddenly became honorable to charge the higher fees.

Whatever happens, the maintenance business means big bucks. Input forecasts that maintenance revenues of $4.8 billion last year will grow by 1983 to $10 billion. International Data Corp. sees it reaching $12 billion in the same period.

"As a general case, because the installed base is growing so fast and because the number of trained people is not growing as fast as the installed base, the performance of installed equipment is beginning to degrade," says Input vice president Michael P. Burwen.

"I don't think it's really going to happen," disagrees Pertec's Harmon, "but it can happen if we're not careful." He says people today are crying about the need for maintenance personnel, but not enough are doing anything to get people into this line of work. "Anytime you have a meeting of service managers, that's the number one topic on the Hit Parade."

In the past, a good number of hardware technicians in the industry came from the ranks of the military, which took high school graduates and trained them in electronics—only to lose them to private industry. This source, however, is said to have dried up in recent years. "The Army used to be an excellent source until they went to the volunteer service," says John Kuzma, director of customer engineering at General Automation.

Technical schools continue to be one source, but here again no one is being schooled to become specifically a CE; vendors must take students with an electronics background and turn them into computer fixer-uppers. "Industry is facing the problem," says Kuzma, "of having to increase its productivity so it can handle an increasingly larger customer base with relatively the same number of people."

Memorex's Splaine, agreeing that they are experiencing difficulty in finding recruits for the FE job, notes nonetheless that his group last year met its objectives in the number of new people. "We added about 22% to our workforce," he says, "and we expect an even greater growth in '79." He says Memorex in the past

As with most companies, Memorex also works closely with a number of technical schools around the country.

stopped pursuing the military as a source of maintenance personnel, but reinstituted a recruitment program last September. The company received 18 resumes, hired all 18, and sees it continuing as a source of people.

As with most companies, Memorex also works closely with a number of technical schools around the country. Departing sharply from this practice, however, is Hewlett-Packard, which is currently recruiting FE trainees from colleges and universities exclusively. Its ideal is a holder of a bachelors degree in engineering technology. But it won't work, says George Harmon.

Harmon, who left IBM in 1968 to form Comma Corp., the third-party maintenance organization, points out that until the early 1950s IBM employed only four-year degree holders as CE's, then had to lower its standards when those CE's tired of being technicians. "Every engineering

CHARLES FOX

HEWLETT-PACKARD hopes to hold its maintenance costs to 5% to 6% of the price of hardware, despite the opinions of most other vendors who forsee an increase as hardware prices come down. HP recruits students from colleges and universities with bachelor degrees like these working on an HP 3000 Series 33 with its microprocessor-based console.

student goes in with the idea that someday he's going to invent the world's greatest machine," explains Harmon. "And you sure as hell don't do that carrying a toolbag . . ."

What with a shortage of skilled CE's, then, combined with the higher costs of labor, it has been suggested that vendors get customers more actively involved in the maintenance procedure. "That's one of the things talked about," says the well traveled Harmon, "but I know of nobody who's really done it." General Automation's Kuzma, too, says he can't see the normal customer doing his own repair. Nor does HP's Chance see such a movement. "If there's a trend," he observes, "it's toward more reliability in a product so that it doesn't need servicing."

Splaine of Memorex admits they're "giving it a lot of thought," trying to determine how best to implement self-help programs for users. "I think the user has got to help us reduce costs," he says, by being sure where a problem lies before calling an FE, running some diagnostic routines to isolate a fault, and determining that an FE is really needed.

And Input's study finds that users tend to be willing to do many things on their own in order to increase system availability. Or to keep maintenance costs down. "They are, in fact, willing to take a substantial part of the responsibility," says Burwen. "That's a trend. It will continue. And it's being spurred by IBM." He cites the IBM 8100 and its install-it-yourself philosophy. Burwen also points to terminals that encourage the user to perform diagnostics on the device. But he says it's not that users would *rather* do this on their own; instead, they seem *willing* to do it in order to achieve the system availability they want.

But Memorex has had some customers hire an FE away from the vendor, indicating that customers are beginning to acquire a capability to do their own maintenance. "We have lost a couple of good people to customers," says Splaine, who adds that he's not complaining, since people from customer locations have joined Memorex in the past.

They find that after the internal training, software types can do 50% to 60% of the FE job.

Carrying the self-help idea to an extreme but a practical solution would be an idea being mulled by Amdahl's vice president for Product Support & Services, Ken Simonds. He explains that the company is now engaged in the "cross-training" of systems engineers to the FE discipline. They find that after the internal training, software types can do 50% to 60% of the FE job. And so the possibility exists that if you can do this with your own people, you could also do it with your customers' SE's and systems programmers.

Simonds emphasizes that there will always be hardware problems that can be solved only by an experienced FE, to whom the SE-turned-FE must turn. But Amdahl's FE's, after an hour of struggling with a hardware failure in the field, can always rely on the built-in facility for remote diagnosis, the so-called Amdac.

At General Automation, too, they're thinking of performing more diagnosis from a remote location. The customer's role, GA's Kuzma explains, "depends on the type of aid the manufacturer builds into his equipment and what type of software he's going to supply." But he thinks there will be more examples of users being able to run a diagnostic routine to isolate the problem, explaining this to a CE so that Mr. Fixit will know what spare parts to bring along on the service call. But Kuzma does not foresee a customer doing his own repair.

The idea of combining the skills of an FE and an SE in one person is not accepted universally. "I just think it's too wide a set of disciplines to expect a single person to do," says Jim McGuire, president of the National CSS Computer Div. If it can be done, he adds, the idea is "very appealing."

What is happening, instead, is that some people are acquiring a little of both skills. Memorex, for example, has a communications front-end that is software-driven, and some FE's are trained to handle both the hardware and software. But that does not necessarily make them a full-fledge SE.

Input's Burwen says at some hardware companies the head of field services is very nervous about teaching an FE to also maintain software. Someone with such a background presumably could more easily find job opportunities at other companies, might prefer to transfer into the programming department, but at any rate might want to get out of field service. Still, he adds, some companies will have to combine the two activities. "A major driving force is distributed processing," he says. Economics might dictate that someone out at a remote site be able to handle both hardware and software problems.

That distributed processing environment, of course, poses a problem for hardware vendors. Input, in an earlier study, projected that by 1982 some 30% of the total installed base of equipment in the U.S. will be operating in a distributed processing environment. And Pertec's Harmon says no vendor other than IBM and NCR can service hardware installed by a customer at 400 to 500 locations around the country. He sees this hardware being maintained by the third-party vendor, which he figures is currently accounting for 5% to 10% of total maintenance revenues. "I think it will grow," he adds, based not only on the proliferation of hardware but also the formation of new systems houses offering small, turnkey systems.

Still, when all is said and done, the prognosis is for new hardware to be ever

more reliable, to incorporate diagnostic routines that users could easily run, and even to be so cheap that a user would prefer to send it to a local repair depot than to pay for a maintenance contract. And when that time comes, service managers will have to restrict their recruitment drive and possibly find other things for field engineers to do.

Along this line, Memorex's Splaine notes that they've used FE's to help design their 3650 (IBM 3350-compatible) disk drive. And from a maintenance and accessibility standpoint, he says proudly, that's the best box in the industry. Memorex is also not above moving FE's into key management slots. One of them became a salesman and now ranks in the company's top 20. Another has been made vp of field operations in one of the company's nine domestic regions; reporting to him are both sales and field engineering in that region.

—Edward K. Yasaki

MINICOMPUTERS

HUTTON'S MINI NET

Brokerage firm's minicomputer network gets considerable attention for unusual characteristics of reliability, power, control, and economy.

E. F. Hutton says there is another way to distribute processing—and sure enough people stop to listen.

The MIS group at the Wall Street brokerage firm has developed a rather elegant design for a minicomputer network whose unusual characteristics of reliability, control, power, and economy have attracted considerable attention since it was described at a recent Wang Users conference. The Navy's intrigued; Citibank is interested; and marketing people at Wang Laboratories, on whose minicomputers the system runs, sound ecstatic.

The Hutton net flips the concept of distributed processing around to bring the hardware and program control back into a centralized location, yet allows a remote user to wholly claim a minicomputer in the central cluster for his processing: minicomputer muscle in a pseudo-time-sharing environment. The Hutton network manager, RCP (Remote Computer Pool), connects a dial-in remote user with whichever one of the clustered minis is available, and then—through a perhaps unique cross-multiplexing—allows him to access programs and data on any disk attached to any of the 16 cpu's in a basic cluster, and beyond into any of the 16 multimini clusters in the Hutton network.

RCP uses mini hardware in the same way as a time-sharing system uses software partitions; and the reliability of the network is independently supported within each 16-cpu cluster. If one mini fails, the RCP net manager blocks further use until repair and routes new work around the malfunctioning unit to the rest of the cluster. Different clusters can even have different tty characteristics; the RCP operating system will provide a transparent data path between them. And because a mini is dedicated individually to a remote user, the system provides a load-insensitive response time.

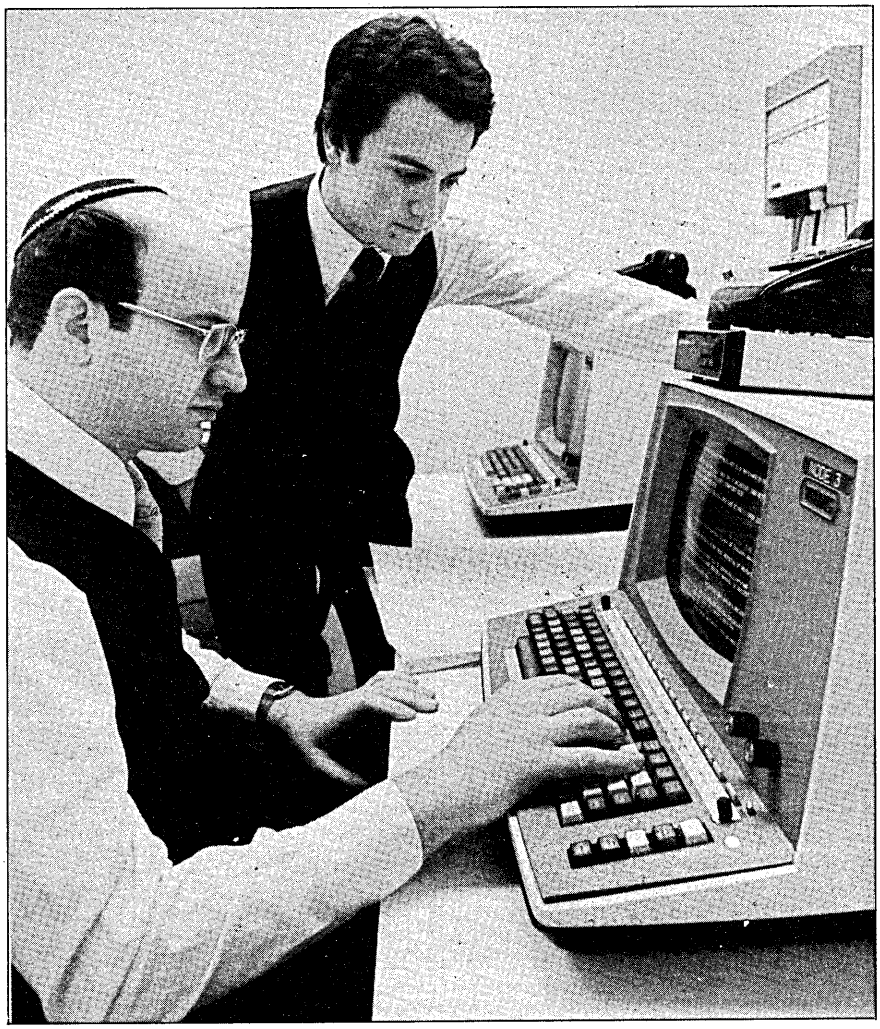
"What we've got here is a resource-sharing computer system," explained MIS manager Vincent Pica. "We're not sharing time, because once you have a minicomputer, you have all of it—but you are sharing the rest of the system resources." The expandable central cluster of cpu's offers the traditional control and economies of a time-sharing system, said Pica, and the minicomputers offer reliability and speed, even processing highly iterative financial algorithims.

Hutton brokers and analysts rely on the system for an extensive array of packaged programs for portfolio analysis and financial computations. Non-edp staff, they require no programming options,

Hutton network flips the concept of distributed processing around to bring hardware and program control back into a centralized location.

and the system has been designed to use cpu power normally reserved for programming functions to aid the user with editing and formatting tools.

After a 1976 study revealed that a substantial portion of the processing Hutton sent to outside time-sharing vendors was dependent on either Hutton-supplied data bases or proprietary Hutton algorithims, Hutton's MIS unit was



VINCENT PICA, standing, checks out application program created by George Goldschmied (seated), E. F. Hutton's senior programmer. Pica is the company's manager of Management Information Systems.

formed to develop an in-house alternative. The result, RCP, has already allowed the company to drop 11 of the 16 time-sharing accounts it was using two years ago. The operational prototype of the network, six minis at Hutton's Manhattan headquarters handling cross-country traffic, has already saved $500,000 annually with a $150,000 hardware investment. As the network is developed to fully support brokers in Hutton's 220 offices nationwide, said Pica, the system will absorb about 60% of the processing previously done with outside time-sharing services.

And it now costs only $8 per hour to do the processing which, on the old time-sharing bills, had an average total cost of about $140 per hour. Pica, author of RCP, said his boss was "pleased." His boss, Hutton vp Norman Epstein, said only: "It works; that's what counts!"

Using Wang 2200 VP minis, the Hutton RCP is expandable to 256 minis, but Pica said the RCP operating system could control an expanded network of 65,536 (256 x 256) minicomputers. At Wang Laboratories, R&D vice president Robert Kolk said Pica's RCP was conceptually "perhaps unique" in its manner of interconnecting all the processors and all the disks in the system. Using off-the-shelf, single-unit components, he said the Hutton network achieves "outstanding reliability" of the sort that other financial institutions pay "premiums of millions" to achieve. "It's another way to approach the problem; a simple, straightforward, clear-headed approach that probably has considerable potential."

RCP is written as a superimposed layer of the Wang operating system, and Wang is currently negotiating with Hutton to gain marketing rights to the software. "From a performance level, this could be very significant to us," said Ted Leonsis

Remote control pool already has allowed Hutton to drop 11 of 16 time-sharing accounts it was using two years ago.

of Wang, "because we don't have a real strong credibility in the marketplace for distributed processing—with this, marketed in the right way, we do!

"We can say it's cheap—you can telecommunicate really inexpensively—and secondly, there are a lot of people out there that have things like DECwriters and TI terminals; and anything that's RS232C/ASI2 compatible, you just plug it right in! So there's a market out there for us: All the guys who have DECwriters out there who want to plug in to these VP's that are working like a mainframe!"

—Vin McLellan

COMMUNICATIONS

BELL'S NEW POLICY

Interpositioning policy is seen as a potential bonanza for tiny CADO Systems whose computers interface with Bell terminals.

AT&T's recently announced policy to allow "foreign" devices to be installed between its networks and Bell-owned terminal devices could open a huge market for Bell peripherals, notably its Dataspeed 40 line. Some observers estimate the company might be able to sell as many as 5,000 devices this year if it were actively to pursue that market.

The new policy, announced last October, is called "interpositioning," that is, modems and cpu's of independent manufacturers could be positioned between Bell peripherals and its networks, a step that would turn the Dataspeed 40 into a truly intelligent terminal.

In effect, says George T. Ryan, chairman of CADO Systems of Torrance, Calif., "Bell is entering the data processing market by proxy."

To avoid a confrontation with the Federal Communications Commission, Bell now is able to offer computing capability by inviting computer manufacturers to provide that capability. CADO, which has installed 500 small business systems that use Dataspeed peripherals, had developed a communications capability. But Ryan says "we could never sell it because it wasn't Bell's policy to encourage" the use of foreign equipment on the Bell network.

The move reflects a more aggressive marketing stance by the telephone companies with regard to data processing. Says Robert Hamer, AT&T's product and service marketing manager, "The move is in response to the needs of our customers. It's part of a major marketing reorganization in which we're developing a better rapport with our customers."

Hamer, who headed a group within AT&T that spelled out the new policy over a year's time, said he's received 40 to 50 inquiries from modem and terminal manufacturers, among others, who want to hook up to the Bell networks.

Ryan says the new Bell policy should "change dramatically" his company's growth rate within a year or two. CADO's sales last year reached $13 million, up from $4 million in 1977, its first year in business. This year, Ryan says the company wants to do $30 million, even though the full impact of the new Bell

PHOTO: GEOFFREY FULTON

GEORGE T. RYAN—Bell entering dp market by proxy.

policy won't be felt until 1980 and 1981.

CADO makes two versions of a small business system that can be used for financial accounting, general applications, and specific industry applications.

Move reflects a more aggressive marketing stance by the telephone companies with regard to data processing.

One, the System 40, supports a single Dataspeed 40 terminal and the other, the System 40/IV, supports four of the Bell terminals. The company also sells cpu's with Perkin-Elmer crt's and Texas Instrument printers at 20% below those with the Dataspeed peripherals and these account for about half of its installed base of some 1,300 systems.

Its microcomputer-based system supports four program partitions and four I/O ports that enable users to do data processing, word processing, message processing, and distributed processing at the same time. Recently it began offering a report writer, called "Just Ask," that enables users to produce reports without an extensive programming knowledge.

And the company has just developed an interface that makes its computer plug compatible with Bell's desktop VU-SET executive terminal. This means a business executive would be able to commu-

nicate directly with files stored in the CADO data base.

Ryan, who said in an interview last summer (August, '78, p. 54) that, "We compete against IBM by unofficially aligning ourselves with Bell," said AT&T's interpositioning policy could make that alignment a little more official. His company has been conducting seminars for Bell salesmen in hopes the 4,000 person AT&T marketing force will lead CADO to customer prospects for multiple system sales. "Our markets today still are in the Fresno's (small users) of the world," Ryan once said.

"The systems are the solution," says CADO literature as it promotes its system to Bell salesmen.

CADO's sales literature reflects this strategy with slogans such as "Part Bell . . . Part CADO," and "The systems are the solution," a reference to Bell's widely used advertising slogan, "The System Is the Solution."

"Interpositioning," says the literature, "opens the door for participation in new market segments where product requirements include intelligence . . . where competitive terminals have captured the market."

Their strategy makes sense, says Ryan, because the market is enormous and because of the declining prices of microcomputers. "It's to the point that our microcomputer, data base management system and disk storage devices represent only 20% of the dollar value of a sale. The rest, 80%, is in Bell's peripherals."

—Tom McCusker

SOFTWARE

CAPEX ACQUIRES GULF LINE

Eight new products put Arizona firm into the operations software business.

Capex Corp., Phoenix, has been successfully selling what it terms "efficiency" software products to *Fortune* 1000 companies since 1970.

Now it's a *Fortune* 1000 company customer—at least a one-time customer. Last December Capex acquired the entire software product line of Gulf Computer Sciences, Inc., Houston-based subsidiary of Gulf Oil Corp.

Donald Rosner, who had been Capex's vice president of marketing and now is in charge of integrating the Gulf products into the Capex organization, said Capex has long been working toward diversification within the software business by acquiring individual products but never before has it acquired an entire line.

Rosner said Capex heard of the availability of the Gulf line from Larry Welke, president of International Computer Programs, Cincinnati, who had been hired by Gulf as a consultant "to help place the business."

"It seemed like an ideal mix. Their products are exclusively oriented toward operations. When our salesmen knocked on prospects' doors, they had something to tell the applications people and the systems people, but not the operations manager."

Capex products primarily help data processing management to meet system service and performance objectives and to do financial planning and modeling.

Rosner feels GCSI had problems with their line that Capex will not have. "Their products were developed at the Gulf Oil Data Center in Houston. They were literally tossed over the wall to a new little subsidiary (GCSI, formed in 1970). The subsidiary was supposed to tie pretty ribbons around them, put price tags on them, and sell."

In the marketplace, Rosner said, GCSI came up against competitive disadvantages and bugs. "Taking them back to get them fixed was like pulling teeth. The data center was too busy with day to day activities. We have the technical support needed. We're a development shop. We plan an aggressive program to fix and extend the products."

Rosner feels Gulf, in selling the GCSI line, was "looking at bigger and better things than the software business." He said Gulf has been selling off other things not related directly to oil such as Reston, Va., a planned community it built.

"There was something less than a total commitment on the part of Gulf top management (to GCSI)," said Welke. He, too, feels Gulf is "looking for larger opportunities. When you're a $20 billion company and have one division doing only one million . . ."

Welke does not see a trend among *Fortune* 1000 companies who have gotten into computer-related businesses to back away. "Sure there are others out or willing to get out, but there are just as many buying in." The software products Capex got from Gulf were TLMS, a tape library management system; JOBDOC, an on-line documentation system for production jobs; PLMS-II, a partitioned library management system; UCANDU, a utility program for selectively listing and copying data sets; RESTART, a utility program for resuming execution of multistep jobs after a system failure; PICKING SLIP, a program which lists the tape and disk volume mounts needed for a job or jobstream; STORHAUS, an on-line system for data-set management which is not yet on the market, and PDQ, a print spool enhancement system for MVS, VSI and SVS.

Biggest sellers to date, Rosner said, have been TLMS, with more than 150 installations, and UCANDU, with more than 100.

"We acquired strictly the program product assets," he said. "There was no guarantee that we'd get the people. We had to solicit them over a period of time. We were able to acquire most key development and sales personnel, 13 in all. In some cases we lost out to the lures of Texas and there was a cost consideration, too. Texas has no state income tax. Arizona does."

"There was something less than a total commitment on the part of Gulf top management."

Rosner said technical and technical support people will be moved to Phoenix next month when Capex's new 35,000 sq. ft. world headquarters building is expected to be complete. At least, that was the expectation in mid-January. The building schedule slipped two earlier completion dates in December and this month.

Gulf sales people will stay in Houston with one exception. "We sent one salesman and one technical support person to Europe and we have hired a German, who had been selling competitive UCC products, to form a team." The team will introduce initially only TLMS to Capex's European operation.

This operation has been going since last summer although Capex had been selling in Europe prior to that through other companies. Last summer it established subsidiaries in four countries to sell into eight. The subsidiaries are in England, Holland, France, and Germany and they sell, additionally, in Belgium, Luxembourg, Switzerland, and Austria. The company sells through representatives in Scandanavia and Southern Europe.

The company did some $6 million in business last year, up from $3½ million the year before. LeRoy Ellison, president, attributed the increase, in large part, to the introduction of Optimizer III. Like its predecessors, Optimizer I and II, it is a COBOL optimizer designed to save time and space for IBM 360/370 COBOL programs operating under any version of OS, including VS. Optimizer I was introduced in the fall of 1970; Optimizer II, in the fall of 1973 and version III, last year.

Ellison said Optimizer III "adds a big increment of function values (to Optimizer II)." He said almost all II customers upgraded to III and that sales rates for III are much higher than for II.

He also said of 1978: "We completed major updates on all our products including Fortune (pronounced For-toon), a FORTRAN tuner for MVS systems. It does it all with no hooks. You don't have to modify the operating system or any software. Most hook into OS some way or another. Ours doesn't and it can't crash the user's system."

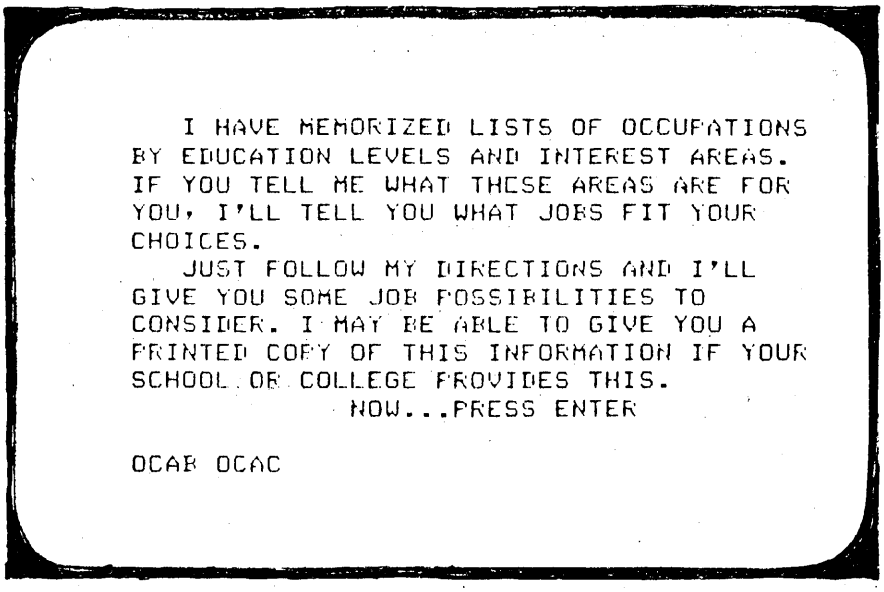
"In some cases we lost out to the lure of Texas and there was a cost consideration, too."

Capex declined to disclose what it paid Gulf for the GCSI line nor would it predict what it might contribute to future profits but, operationally, it ultimately will be completely integrated into overall operations. But not at first.

"We want to continue the sales Gulf had," Rosner said, "but we don't want to jeopardize the on-going Capex business. For six to nine months, the Operations Products Div. will be a separate operation. Then we will gradually integrate it into the on-going Capex operations. The division will go away."

He said Capex will continue to diversify by acquiring individual software products but he doesn't see as likely another acquisition of a complete line.

–Edith Myers



A FRIENDLY SYSTEM—CVIS, short for computerized vocational information system, is billed by its creators as a friendly system which leads students to career paths, step by step.

COMPUTER GUIDANCE PROGRAM

CVIS helps students choose jobs and/or colleges. It's not just for IBM computers any more.

"My name is CVIS. (That's short for computerized vocational information system.) I can provide you with the opportunity to explore many different types of vocational decisions ranging from job information to training opportunities after high school."

This message today greets more than a quarter of a million high school and college students regularly, seated at terminals in their school classrooms, libraries, or wherever their school sees fit to place them. The system steers students toward colleges and/or jobs.

"It doesn't replace counselors," said an enthusiastic Marilyn Carson of the office of the Santa Clara County superintendent of schools, which has been using CVIS almost since its beginning, "but counselors are not massive random access devices." CVIS is.

CVIS has been around for a long time. Since 1967, to be exact, but now it's expanding exponentially. And it's given birth—to Discover, which Carson calls "the daughter of CVIS."

CVIS was developed and was supported between 1967 and 1970 by a team of guidance and data processing people at Willowbrook High School and College in DuPage, Ill. Development was supported by the Illinois State Board of Vocational Education. It basically is an information storage and retrieval system and it first was written in Assembler language. Originally it was run exclusively on IBM computers.

IBM, in fact, got involved with the development early on and, at one time, wanted to acquire the program from the State of Illinois. That never happened, but IBM did get the daughter—Discover.

CVIS, in the early '70s, became the property of a consortium of users called the CVIS Consortium, Inc., a nonprofit group. A school district, or a university, can get CVIS for a one-time purchase price of $1,050 to $1,450, with additional yearly costs approximating $800.

The consortium distributes through a distribution center staffed by Carol Rabush at Western Maryland College, Westminster, Md. Rabush said the annual costs include a mandatory membership fee for the consortium of $325, plus varying costs for updating of the various data files.

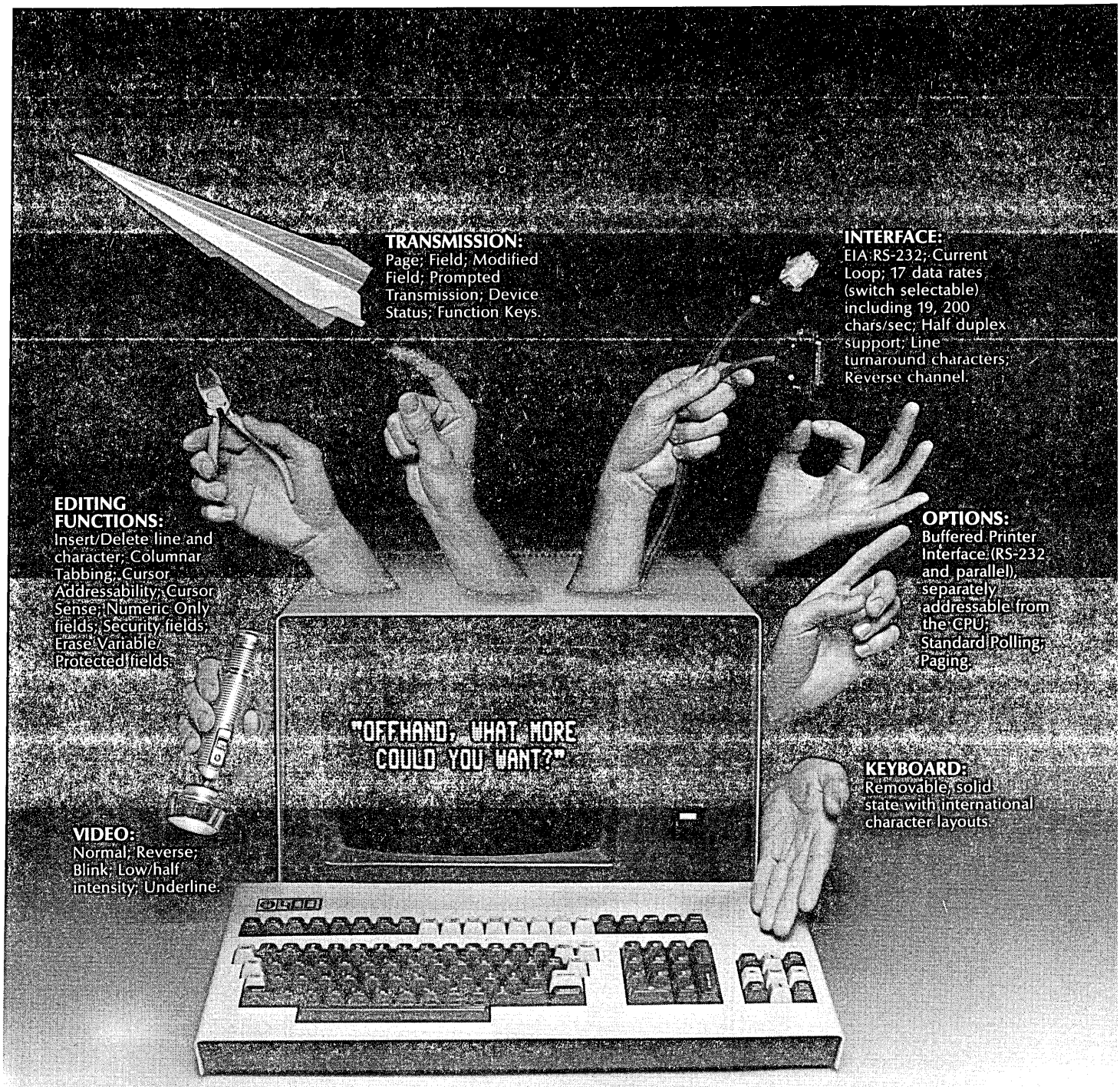
CVIS isn't exclusively for IBM computers any more. A new COBOL version is running at Thomas More College in Fort Mitchell, Ky., on a General Automation mini. The first non-IBM use was in the Hampton, Va., school district which developed a COBOL version to run on a Xerox computer in 1976 and still is using it.

Kentucky State Univ., Frankfort, Ky., is using a COBOL version which it intended to use on non-IBM equipment but went back to an IBM 370/168.

CVIS, said Carson, "attempts to provide an organized approach to exploration of approximately 400 occupations and the various entry paths to them. Such exploration assists users both to broaden alternatives and to narrow them. Further, the system attempts to use some of the computer's best capabilities to good advantage to assist the student with the information-gathering process. These include the capabilities to store vast amounts of data, to retrieve them instantaneously, to interrelate them, and to sort through them by different characteristics."

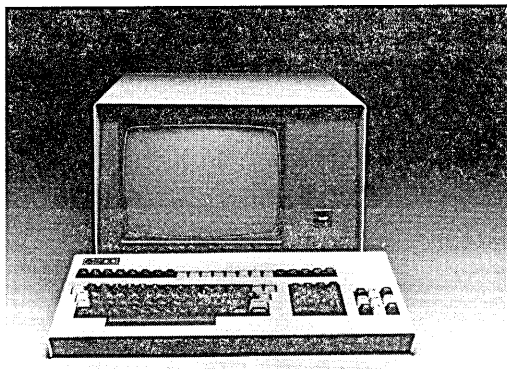
CVIS' data bases are called "scripts" and Carson says "writing a script is easy." Getting the information isn't quite so easy. Apparently there is no good source of current occupational information and the CVIS consortium virtually had to compile its own from scratch. It also has scripts for college information, job markets, and career opportunities in the military.

This summer Carson's group will be rewriting its military script. It is working with the Navy on this project which,



When it comes to flexibility, the Infoton 400 Data Display terminal can hand you all you need.

Designed around the Z-80 microprocessor, it offers complete control of all Blocking and Editing functions through software settable modes. One thing that's especially easy to handle about the I-400 is that it's the most versatile terminal you can get your hands on for the price.



INFOTON 400

More information on the I-400 is quickly within your grasp. Call Infoton toll-free today at (800) 225-3337 or 225-3338. Ask for Barbara Worth. Or write Barbara Worth today at Infoton, Second Avenue, Burlington, MA 01803. We have offices throughout the United States, Canada and Europe. In Canada, contact Lanpar Limited, 85 Torbay Road, Markham, Ontario, L3R 1G7. (416) 495-9123.

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CIRCLE 72 ON READER CARD

Raytheon's PTS/1200 MARK·I: Tomorrow's distributed available right now.

You don't have to wait a year or two to obtain the power of a highly advanced distributed processing system.

Raytheon's MARK I distributed processing system is the choice of increasing numbers of sophisticated data communications network users.

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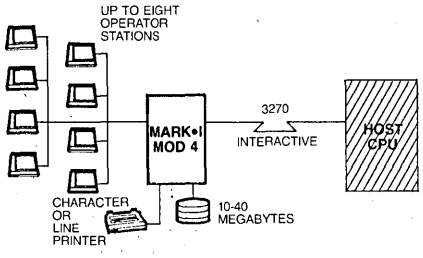


Thus, when you must configure systems to meet a variety of different needs at a variety of different locations, you can do so with speed, with simplicity, with modular power, and with more configuration options than other systems can offer. All for a starting price, including maintenance, of under $800 a month.

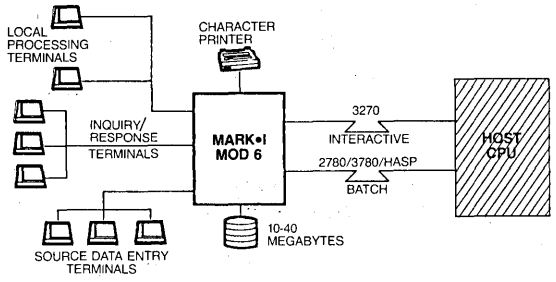
Here are just a few of the options you can install right now:

Option #1: Local processing and "intelligent 3270" functions

Every Raytheon MARK I system comes with two basic capabilities that many suppliers are still only promising. One is the ability to do stand-alone local processing. The other is the ability to perform intelligent 3270 on-line functions.

What is "intelligent 3270?" Just this: the ability to extend massively the capability of a 3270-type terminal network by adding advanced features to the network without systems change, **and without dependence upon the host processor.**

Features such as local format storage, local printing, local data base access, local transaction storage and back-up, and the ability to verify data—field-by-field, record-by-record—without going upline to the host mainframe.



These capabilities are inherent in the MARK I system. A 3270-type network user gets them immediately. So he can bring up local files, data entry functions, and either interactive or batch communications without complex changes to his network.

The key to intelligent 3270 operations is the MARK I's stand-alone processing capabilities. A powerful user-programmable controller supports from one to eight CRT operator stations, a 10- to 40-megabyte disk data base, and a variety of printers and other peripheral devices. All systems and network communications software comes with every MARK I, so the user need only develop the applications programs he requires.

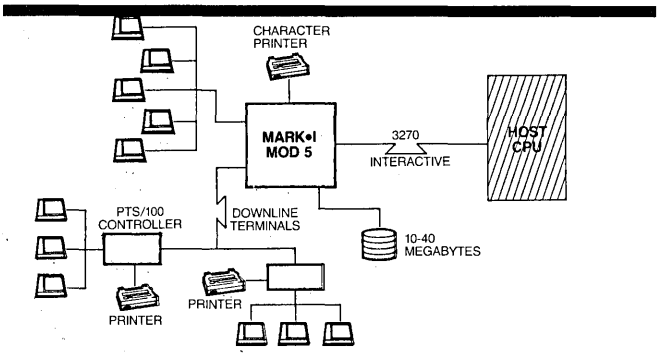
But Option #1 is just the beginning of what you can do for your network with a Raytheon MARK I. Check out Option #2.

Option #2: Interactive, batch and source data entry

The MARK I can become a multi-function workhorse in still another way. Start with its protocol emulators: 3270 interactive (dumb and intelligent), 2780 batch, or 3780 batch, or HASP remote job entry. On a single MARK I, you can run combinations of these emulators at the same time, allowing you to run both interactive as well as batch lines to the host CPU.

While you are executing both of those functions, a group of your operators can also perform source data entry functions on the MARK I. Our new Source Data Entry Package (SDEP) enables users to execute many functions not found in dedicated data capture devices. However, it also does classic data entry functions, such as: automatic cursor skipping; reasonableness checking; crossfooting and arithmetic computation; batch balancing; record searching by number, field or task; table look-up and record insert/delete.

processing options—



What is important to remember about this capability—once again—is that it is available **right now** on Raytheon's MARK I. You can install it today, and be using it tomorrow ...while you continue to execute 3270-type intelligent tasks and 2780 or 3780 or HASP batch-oriented tasks.

Not bad for one low-cost distributed processing system? Right. But now move along to Option #3. Because MARK I can do more than concurrent interactive, batch and source data entry functions.

Option #3: Downline terminals, "upline 3270" tasks

Look at the MARK I schematic. It illustrates still another configuration option of this versatile system.

That option is downline terminal support. What it means is this: that a MARK I controller, in addition to performing its basic local processing and upline 3270 data communications tasks, can also maintain control of a downline multipoint terminal network. Every MARK I can control up to ten drops on its downline link—under 3270 protocol, using Raytheon's powerful PTS-100 intelligent terminals in 3270-mode.

The importance of downline terminal support from a MARK I controller is the essence of any distributed processing system's ultimate value: the ability to offload busy, costly mainframe computers in the easiest, fastest, most cost-effective manner.

Let the MARK I, or a series of MARK I s, control the time-consuming polling of the 3270-type devices. Let the local MARK I data base provide the local formats and record storage facilities that now tie up the mainframe. And let the MARK I communicate upline, selectively, when it must support downline terminals by getting mainframe data for them.

The result: every component of your system, and all the operators it serves, work faster and better. And you can install MARK I systems today.

Option #4: Mix small or large systems on a single network

When you install a MARK I distributed processing system, you are still at the beginning of your network expansion capabilities. Because the MARK I offers a fast, totally compatible migration path to Raytheon's larger MARK II systems.

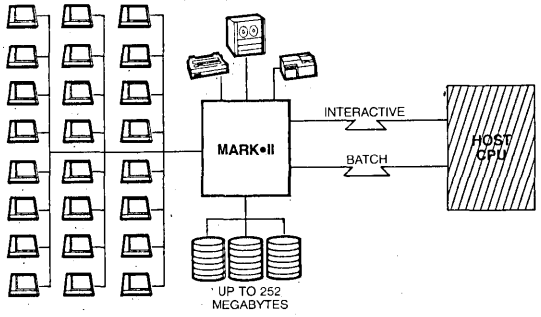
The MARK II supports multiple job streams. It has a data base capacity of 252 million bytes of local storage. It can support up to 24 operator work stations. Plus all of the protocols available on MARK I. Plus a HASP logical printer. Plus greater numbers of peripherals. Plus faster memories in support of higher speed operations.

And when we say the MARK I and MARK II are totally compatible, we mean just that. You can field upgrade a MARK I to a MARK II. Without alteration of your mainframe system, and without complex conversions.

Right now. Today.

When you start looking for tomorrow's distributed processing systems, you won't have to look far, or wait long. They are available from Raytheon today.

Raytheon terminals. 65,000 now, and growing fast.



RAYTHEON

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among other things, will upgrade information on opportunities in the military for women.

The guidance developers of CVIS, said Carson, "began with no technical expertise and still have a limited amount. That's how we know that counselors, students and others don't need to have any technical know-how in order to use the system effectively. Some rudimentary knowledge of how the system operates, however, makes one marvel at technology when all is going well and to be patient when operational difficulties occur."

Carson had some suggestions for CVIS script writing. "A student sitting in front of a terminal can be overcome, bored, or just not interested in reading frame after frame of solid text. CVIS frames should be spaced in such a way as to avoid this effect. An occasional full frame is not objectionable; three or four consecutive full frames are. In trying to present a large amount of information, it is better to have more well-spaced frames than fewer fully packed frames. Wordiness can often fill frames unnecessarily. Review the format of your frames with this in mind, after they are written."

The first non-IBM use was in the Hampton, Va., school district which developed a COBOL version to run on a Xerox computer.

One of the advantages of CVIS as a mode of presenting information, she said, is its novelty as a medium. "Students are excited about talking with a computer, and it is this interaction which is a main attraction of CVIS. CVIS scripts should involve the student as much as possible by asking him or her to make choices or to type in words."

IBM's involvement with CVIS largely took the form of "moral support," said Carol Rabush, a full-time staffer in charge of CVIS distribution. IBM got more directly involved with Discover which Rabush describes as a "far more sophisticated computer-based guidance product which had its roots in CVIS."

Discover, Rabush said, requires more computer power and memory, more sophisticated terminal equipment and does such things as take occupational cluster information and information about the students themselves and put them together.

IBM with the CVIS consortium worked on development of Discover. In 1976 the consortium spun off the Discover Foundation to own and distribute Discover, which IBM purchased from the foundation in 1978. Now a potential user has a choice of supplier. It can purchase Discover from IBM or the foundation. "It's a trade-off," said Rabush. "If a purchaser chooses IBM as a supplier it gets the 1978 version but lots of technical support. Updates can be purchased from the foundation for $1,000. If the purchase is from the foundation, the latest version is what is provided and updates are free for the first two years."

Basically, she said, initial price is about the same. Purchasers getting Discover from the foundation pay $1,000 per month for the first two years, getting updates free. After that they have the right to perpetual use of the system but have to pay $1,000 per update.

So far, Rabush said, Discover has only been run on IBM computers (six users have been supplied by the foundation), but the foundation is talking to two other mainframers about implementing the program.

Although the Discover Foundation and the CVIS consortium today are two separate entities, Rabush is the focal point for distribution for both programs. "When the consortium decided to set up a distribution center, they put it out for bids. The foundation bid and won."

—E.M.

COMPANIES

SLOW BUT SURE

In espousing philosophy of the tortoise, Harris Computer Systems Div. makes it a point to stay out of IBM's way.

You remember the story of the tortoise and the hare? Well, in the fast-paced dp world there is at least one company that espouses the philosophy of the tortoise: Harris Corp.'s Computer Systems Div.

"In a lot of instances we could have done things that would have doubled our growth rate, but we're very conservative," says Harold N. Morris, the division's vice president and general manager.

Not that the Ft. Lauderdale, Fla.-based concern has been standing still. Far from it. In the past three years the group has registered an approximate 50% compound revenue growth rate, making it the fastest growing entity in the Harris corporate stable. In total, its customer base has reached 1,000 customers including many in the *Fortune* 1000. Moreover, according to Morris as well as some of the Wall Street analysts who follow the group—Thomas J. Crotty of E. F. Hutton & Co. for one—future growth should continue to be impressive.

The group's success in large part has been due to the selectiveness with which it picks its shots and the careful planning behind every move, analysts say. Essentially, its strategy involves staying out of IBM's way and targeting its high-end minis (the price line runs from about $100,000 to half a million) at specific markets, mainly the scientific and engineering categories.

"We aim at what is a small market segment by IBM standards, and we continue to emphasize the multiple use capabilities of our equipment," Morris says.

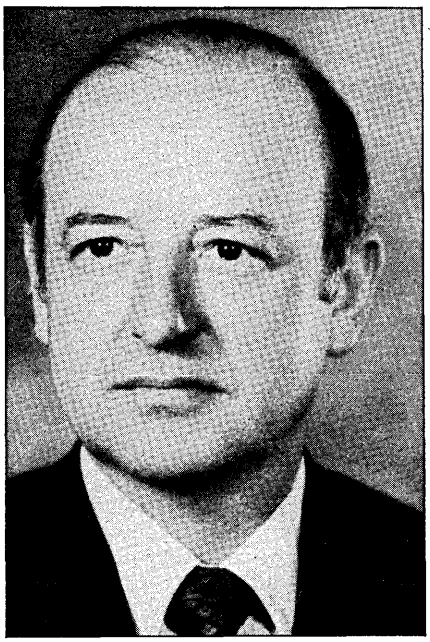
"Harris normally markets in a multi-use mode," says E. F. Hutton's Crotty, "including scientific, time-sharing, multibatch, real time and remote job entry.

Firm which traditionally has sold in the engineering simulation field, recently signed on a commercial user who will do business simulation in APL.

The last four markets often consist of off-loading work from overburdened IBM installations at which additional capacity can be achieved without upgrading the IBM central processing unit."

Typically, Harris channels its efforts where they will have the most effect. It aims, for example, directly at FORTRAN users, and won't really even go after a dp shop with COBOL requirements unless, says Morris, it is the kind of operation where COBOL is run once a week.

And in line with this go-after-your-best-bet tack, the group's sales staff, which along with its service organization recently has been beefed up, has an orders-per-salesperson average that is well above the industry norm, Morris claims.



HAROLD N. MORRIS—"We're very conservative."

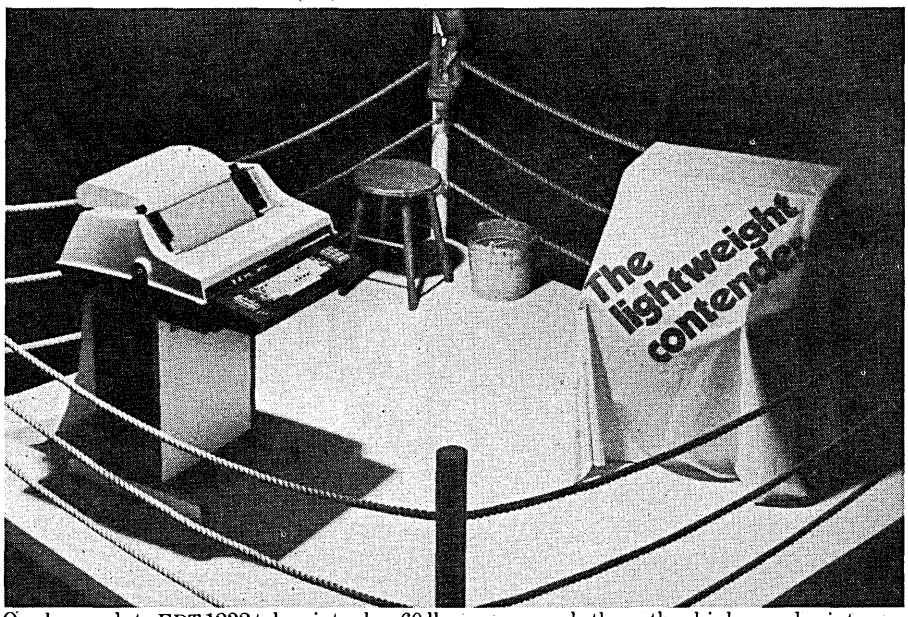
The heavyweight 120 cps champ.

A contest between our heavy-duty EDT 1232 teleprinter and other high-speed printers isn't much of a contest.

The EDT 1232 weighs in at 60 lbs. more. As a result, it can operate on a grueling twelve-hour-per-day cycle. That type of continuous operation separates the heavyweights from the lightweights.

And it's fast on its feet—permitting an effective throughput of 120 characters per second. Being tough and nimble makes the EDT 1232 ideal for handling your computer-generated printouts on its 132-print position carriage.

In four rounds you can discover why the EDT 1232 is the champ.



Our heavy-duty EDT 1232 teleprinter has 60 lbs. more muscle than other high-speed printers.

Round 1: Closed-loop buffer.

One feature that makes the EDT 1232 a top contender is its 1,024-character, closed-loop buffer. It automatically signals your computer to stop transmitting once its buffer is filled. This way, you won't lose data.

And the buffer automatically signals the computer when it is ready for transmission.

Round 2: Print quality.

Because the EDT 1232 gives you fully formed characters instead of a series of dots, your printouts are more legible. The printing mechanism punches out clear characters, but never jabs holes in the paper on multiple copies.

And like a smart heavyweight, the 1232 pauses between rounds. Its idle line motor control preserves motor and ribbon life by shutting off when data is not being received.

Round 3: Flexibility.

Our heavyweight also can adapt to a task with a variety of configurations. It is available as a keyboard send/receive (KSR) or as a receive-only teleprinter.

For preparation, editing and local storage of high-volume data, we offer the KSR with our Smarts™ terminal controller and disk unit.

For low-volume applications, the KSR is available with our magnetic tape cassette buffer.

And we offer more than 100 options for your system design needs.

Round 4: Nationwide service.

Like all the terminals in our product line, the EDT 1232 is backed by our Termicare™ system, a centralized customer-support service, and our nationwide organization of service centers. Customers can report a problem by calling the Termicare Center toll-free. It has a complete history of each terminal stored in its computer and the analysts and equipment to test each terminal remotely.

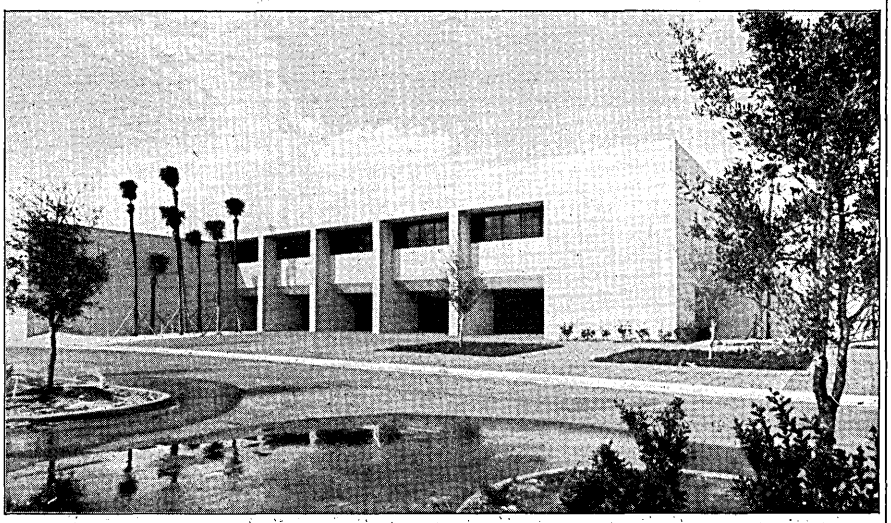
This diagnostic service means that many terminal failures are corrected by Termicare analysts without a service engineer's visit.

For more information on the EDT 1232 teleprinter, or for a copy of our free product catalog, call Bob Roth toll free at 800-631-7050. (In New Jersey, 201-529-1170.)

Or write him at Western Union Data Services, 70 McKee Drive, Mahwah, N.J. 07430.

Western Union Data Services.

CIRCLE 65 ON READER CARD



HARRIS CORP.'s computer systems division 280,000 sq. ft. plant located on 76 acres in Ft. Lauderdale, Fla.

The group has expanded its scope somewhat, however, adding APL last spring and increasing its end-user efforts to the point where today end users now represent 60% of the group's business.

And while the concern has traditionally sold in the engineering simulation field, it recently signed on a commercial user—Morris won't disclose the name just yet—who wants a system to perform business simulation in APL.

With the added pluses of an operating system, VULCAN, that provides a competitive virtual memory capability, and a data base management system which Harris is licensed to offer through the Cincinnati-based software house, Cincom Systems, Inc., the group can boast a total mini system that is competitive—at a considerably lower price—with many mainframes.

Though small, this high-end mini market, however, is becoming increasingly competitive with the advent of such PCM's as Magnuson and new, bigger systems out of people like Prime. "We used to just go up against DEC and Hewlett-Packard," says Morris. "But now we're seeing more and more of Prime as well."

Additionally, the question of Harris's commitment to 24-bit architecture has taken on added significance given industry developments in the past year or so. "The world is moving to 32 bits and this could be an impediment to Harris's future growth," one industry analyst notes. "However, it would surprise the hell out of me, knowing the nature of the business and the people at Harris, if Harris wasn't at least giving 32-bit architecture serious consideration."

If in fact Harris does convert, you can bet the move will only come after some deliberate, well-thought-out planning. That is, after all, the nature of the beast, as the hare discovered belatedly.

—Laton McCartney

USED COMPUTERS

BOOM YEAR FOR USED COMPUTERS

Many used computer dealers are feeling like blue chips over prospects for the 1979 market.

Shilling and selling, bartering, bidding and leasing, the used computer dealers—a maverick breed becoming ever more important in this industry—expect a whopper boom year as IBM's 303X sales bump a record number of older IBM systems into their freewheeling commodities market.

And with the prevailing economic uncertainties, with tight money and restricted budgets, many of the 100 odd brokerage firms of this countercyclical industry, are feeling like blue chips.

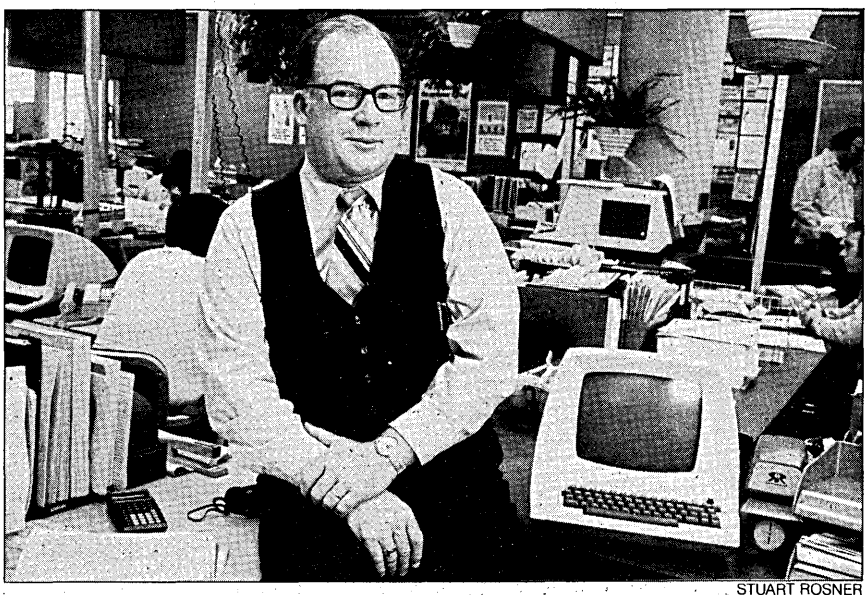
"Our business is all a function of available supply," explained Bill Grinker,

"Give me any estimate you want on 303X deliveries and then realize that each 303X that goes in replaces another computer."

president of the Computer Dealers Assn. and the Boston-based American Computer Group, Inc. "Whenever our supply increases, our business increases." The used computer business is still an IBM market, and it is still systems displaced by IBM sales that fuel the marketplace . . . and this year, a record high percentage of those displaced systems are free of IBM control, users or third party owned: natural commodities in the free market.

"Give me any estimate you want on 303X deliveries—1,000, 2,000, 2,500, undoubtedly well over 1,000—and then realize that each 303X that goes in replaces another computer," said Grinker. "We estimate, for instance, that there will be 300 to 500 displaced 370/158s coming out of these installations and each 158 that is in turn resold displaces another machine or more than one.

"In the past four months," he said, "there have been about 25 158s being placed every month by CDA brokers." And each of the 158s sold or leased by ACG's American Used Computer Div. has replaced at least one 370/145. "Each of the 1,000 odd 303X systems will have this domino effect. We expect to see at least 1,000 370 models pushed out—not



STUART ROSNER

WILLIAM GRINKER—"Whenever our supply increases, our business increases."

FOR OFFICES THAT WANT TO KEEP IT QUIET, THE NEW TALLY HUSH-TONE KEEPS THE LID ON NOISE.

If printer noise disturbs your office serenity, you'll appreciate the mel-low decibels of the whisper-quiet Tally Hush-Tone. Our special acoustically designed enclosure attenuates printing noise level down to an unheard of quiet level. When not printing, the Hush-Tone is totally quiescent.

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The Tally Hush-Tone. You get more than quiet performance. You get up-time performance.

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CIRCLE 57 ON READER CARD

all of them free from IBM, but maybe over 70% of them independently owned, and almost 100% of the 158 models.

"This is a huge quantity of merchandise available, a lot more than ever before," and on the other side, both new applications and new installations are growing very rapidly. And today, Grinker said, a corporate dp manager has ever

Could we see people throwing out 303Xs and bringing back 370s at the end of 1979 or at the beginning of 1980?

more pressure on him to provide processing when needed—now if necessary—and little patience for lead times and long waiting lists. "That's why all the deals I have done—all the dealers are doing—are on 30-day delivery for a 158."

Degradation demands immediate response, he said. To fail to provide power for even unexpected growth today is like letting the telephone system degrade: more than embarrassing, disastrous.

The CDA sees everything coming its way. "This year's tight budgets are going to restrict funding; personnel growth will be limited, so more computer applications will be used to leverage personnel," he said, and the need for additional capacity will grow even if dp budgets tighten. "So maybe the user can't buy a new computer . . . maybe he can buy a used computer . . . maybe he can't buy; maybe he can lease!"

Even in an industry that is generally recession proof, the used computer dealers feel they ride the crest of a wave on the downside. In 1974, recalls Grinker, the market saw a reverse migration: users tossed out 370s and bought back cheaper 360s. Question: "Could we see people throwing out 303Xs and bringing back 370s at the end of 1979 or at the beginning of 1980?" The thought alone brings a smile.

The CDA estimates its brokers and lessors handled an estimated volume of $1.75 billion in current market 370 equipment in 1978. In the upcoming year, Grinker said, he and his fellow brokers expect volume sales "substantially above the past," with an enormous increase in lease volume, a new element in the business of many of the smaller dealers.

That's getting a lot of use out of used equipment—a resourceful trait still largely confined to the U.S. computer market, Grinker noted, despite the growth and enormous potential of the overseas industry.

—Vin McLellan

DATA ENTRY

CANADIANS IN TEMPE

Consolidated Computer of Toronto moves international headquarters to Tempe, Ariz., where it holds major contract with state.

The way they tell it at Canada's Consolidated Computer, Inc., the Toronto data entry manufacturer, it's one of the few key-to-disk companies of its vintage (founded in 1968) that hasn't been acquired by somebody else. Well, almost.

Computer Machinery Corp. now is owned by Pertec; Entrex by Nixdorf; General Computer Systems by Telex. Univac once tried to acquire the Canadian company during its troubled days in the mid-'70s, but was turned down because Univac wouldn't agree to manufacture the product in Canada. Not that Consolidated's management had any argument, but the company was in hock to the Canadian government and the government was calling the shots.

LES SELLMEYER—Left Control Data to take over Canadian data entry company's management.

Later, Japan's Fujitsu began to get into the act.

As it stands today, the Canadian Federal government and the government of the province of Ontario own 68% of the company and Fujitsu, in a complicated deal negotiated three years ago, was given a 20% interest. Fujitsu sells Condolidated data entry devices in Japan and also provides the Canadian company with Fujitsu-designed products for sale in the U.S. and Canada under the Consolidated label.

David C. Heuston, Consolidated's vice president of finance, said Fujitsu has an option to acquire an additional 5% of the company as well as an option to renew its deal with the company in 1985.

Consolidated's first Fujitsu product is an intelligent terminal called the Key-Edit Series 2 that can be used for data entry, billing, order entry, message transmission data collection, and networking and that can serve also as a standalone small business computer. A bare bones starting price is $14,000 for the Key-Edit model 22, which has a Motorola 6800-like microprocessor developed by Fujitsu under the numerical designation 8861 with 64K bytes of memory. Also standard with the product is a 1,920-character crt with keyboard and dual floppy disk drives with 486K bytes of memory.

Some options include a 340cps printer, a communications controller and two additional floppy disk drives. Along with this, the company will offer a model 24 version, which is a dual workstation system with four floppy disk drives with 972K bytes of memory and two printers and communications controllers.

Consolidated negotiated two years with the Japanese, says Laszlo Sugar, the company's software development coordinator, to distribute the system in North America and to customize the product for the U.S. and Canadian markets.

"We got a large RJE order from the State of Arizona and will be doing extensive systems integration here, so we decided to move here."

It's the company's first low-priced system and thus presents it with a new marketing problem. The company wasn't saying last month how it would be marketed when it becomes available in March. But E. J. Pennick, vice president and general manager of the company's U.S. operation (called Consolidated Computer International, Inc.), said a number of very large users were looking at it. How the company will handle single sales wasn't made clear, but since the company does not offer applications software, it very likely will be marketed through service bureaus.

Last month Consolidated formally moved its U.S. headquarters from Waltham, Mass., to Tempe, Ariz. "We got a large RJE order from the State of Arizona and will be doing extensive systems integration here, so we decided to move here," said Pennick.

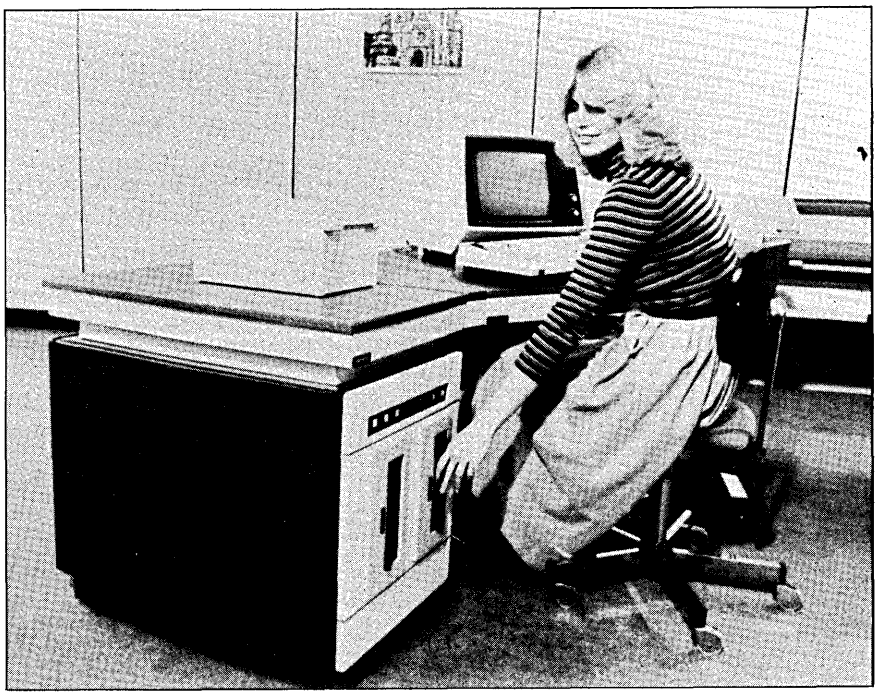
The Arizona system is based on Honeywell Level 6 minicomputers and the software features of Consolidated's Key-Edit sytems. It will provide remote job entry services to Arizona's departments of transportation, health and economic security (unemployment insurance).

Consolidated has been doing well in the U.S. in recent years after financial difficulties in 1973 forced the company to call a virtual halt to U.S. marketing efforts when its lease financing arrangement with Ford Motor Co.'s Leasing Div. was canceled. But three years later, it had lost only one of 31 systems installed in the U.S. And it now has about 400 U.S. customers who account for the major portion of the Canadian company's sales.

It has new management and a new president, Les Sellmeyer, who came over from Control Data Corp. three years ago. It's negotiated an $82 million lease financing package with three U.S. banks and a Canadian bank that should pull the company through 1982. (The Canadian government guarantees 90% of the leases.) It made a $650,000 profit last year on sales of $23.5 million, compared with $18 million and a profit of $400,000 the year before. It has a huge, $10 million contract with lottery systems in Ontario and Quebec for point of sale terminals. It's renegotiated an oem agreement with Britain's International Computers that should help its sales of highly profitable terminals. ICL oem sales last year accounted for $3.5 million of its total sales.

Said Sellmeyer last month as the company opened its Tempe headquarters: "The move is a major step toward increasing share or market in the rapidly expanding distributed processing and data communications marketplace. We now ofter computer users virtually any size of data entry and intelligent terminal systems that set new standards for the industry."

—Tom McCusker



SERIES 2—Consolidated's new intelligent terminal.

We Know the World Most Advanced TP But Thanks

Why a "Big" TP Monitor is Really Better:

Some of the most popular TP Monitors have traditionally been "mini" or small-scale systems.

These products are simple to install and easy to use, while providing a limited set of features that work well.

Yet, while these products have some of the highest ratings in recent DATAPRO surveys, they also are replaced most often, because they were not able to keep pace with users' rapid growth and expansion.

In addition, they offer at best limited programmer-supported multi-threading, so performance suffers even more as volume increases. Finally, they lacked the full set of features users quickly find absolutely necessary. Some of these important features include automatic file recovery, on-line programming, RJE, integrated DBMS support with synchronized recovery, test and debugging aids, plus all of the vital pre-programmed utilities.

However, alternatives to mini-systems do exist — complex full-feature systems. Most can achieve acceptable performance in higher volumes, particularly those that provide reentrant COBOL and other necessary performance options. And most have the basic set of features necessary to implement complete TP Systems.

Unfortunately, many of these complex systems are notorious for lengthy installations (after many weeks), extensive education requirements, and time-consuming staff start-up times. Further, these systems invariably require one or more dedicated systems programmers for maintenance, tuning, "firefighting" and installing endless enhancements.

Obviously, there had to be a better way. There is, and it is called SHADOW II. SHADOW II combines the full features and top performance of complex systems, with easy-to-use reliability usually associated with mini-systems.

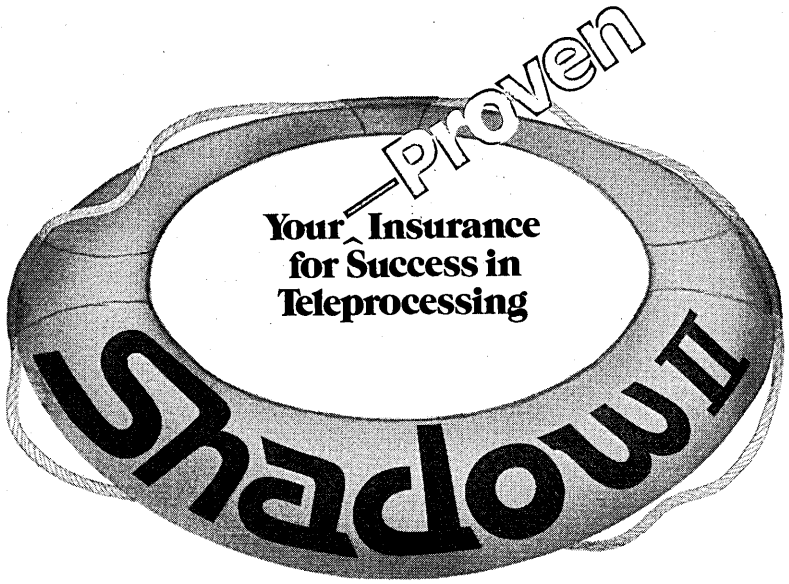
Judging from SHADOW II's acceptance in the marketplace, it is the right product at the right time.

Here's How We Document Our Claims

If a product is as good as we think it is, you should expec a lot of proof. For example:

1. **Datapro Software Honor Roll**
   SHADOW II achieved the Datapro Honor Roll in its **first full year** of marketing in the United States by Altergo.
2. **Success**
   First introduced in Europe, SHADOW II rapidly rose tc the best-selling TP monitor against the toughest competitors. SHADOW II is quickly developing a similar reputation in the U.S.
3. **Benchmarks**
   We have numerous empirical user benchmarks proving the superior performance and reduced computing resource requirements of SHADOW II vs. CICS and other monitors.
4. **Support**
   Altergo's commitment to support is demonstrated by our eight fully-staffed support offices throughout North America.
5. **Conversion Experience**
   The acid test of true superiority of a product is a large base of users who converted from something else. Nearly 50% of over 250 SHADOW II users converted from other TP systems such as CICS. Obviously, these experienced, sophisticated users demanded a significantly better product to justify conversion.
6. **Demonstration**
   The real proof is on your own machine. Since SHADOW II is so easy to install and use, we are more than happy to oblige with an on-site demonstration!

See for yourself why SHADOW II is as good as we — and the industry — think it is!



INTERNATIONAL

CRACKING BRAZIL NUTS

Brazil's tough program to limit computer imports finally has led a number of dp companies to plan to manufacture products within the country.

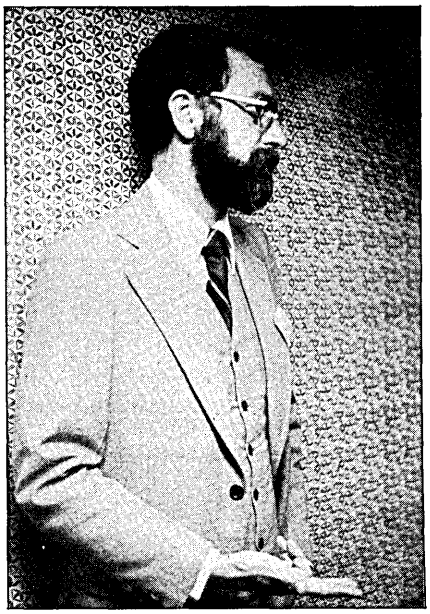
Brazil's excruciatingly tough program to limit computer imports and develop more local industry seems to be having the desired results—if you ignore the wails of the computer user and foreign vendor.

They've been crying since Brazil limited imports to about $100 million a year, less than half the demand, and forced user and vendor into a rigorous justification process. They've been crying since Brazil picked four local companies to monopolize the mini and small business market.

But the desired results have come, and in many forms. Many of the foreign companies knocked out of the fast-growing small systems market are now proposing to do something most of them never did—manufacture general purpose computer systems. The battle among these vendors is now for the slot between the mini and larger systems, like the IBM 370/148.

IBM, which has been making the 148 in Brazil, has already garnered approval to make the E series replacement for that system. It is also pushing for an okay to add the E series version of the 370/138. But Brazil is asking for some big concessions for that particular privilege. One is open patent rights on such vital items as interfaces and microcode to allow locally manufactured peripherals and terminals to latch on easily. A second stipulation obliges IBM to accept all compatible peripherals (users are required to use local products where available rather than import). A third demand is that IBM export this system on a 3:1 ratio with domestic sales.

These same conditions apply to others making similar proposals. Burroughs is one, asking to manufacture the 6800 and several peripherals. Univac and DEC have proposals in. Some are going the nationally desired joint venture route. Cii-Honeywell Bull, which has done no manufacturing to date in Brazil, wants to form a company with majority local ownership to produce the Level 64.



DR. RICARDO ADOLFO de CAMPOS SAUR—the head of CAPRE recalls activity during Brazil's economic crisis.

One venture that is making IBM "hopping mad," we hear, is Fujitsu's. Working with Serpro and Digibras, Brazilian operations, the Japanese firm wants to manufacture the M series 160-II, a 370/138 competitor. Fujitsu, which already has a licensing agreement with one of the four local mini companies, may get the jump in the 138 market both in time and preference, because of the majority local ownership.

Dr. Saur is pleased that the policy has lessened the "status symbol" syndrome of computer buying in Brazil.

(IBM, as the reports go, has been in a real struggle in Brazil. Despite warnings from the Brazilian government about its plans in the small systems area, IBM went ahead with its own plans to manufacture the System 32. It did, for export only, but not for long. That manufacturing ceased last year when the oligopoly was formed, and IBM users have to do some fast, convincing talking to get any General Systems Div. products—minis and small business systems—into Brazil.)

In the meantime, Brazilian government planners are pleased with the progress of their small-computer companies. Cobra, a four-year-old national company, has been making the Sycor 400 under license for the last 18 months and is ahead of target, with more than 500 installations. It also announced the home-grown G-11 at a national show last fall, a system based on DEC PDP-11 designs.

Three of the four companies were formed late in 1977 after winning in a competition with 13 bidders. All were at the October show with exhibits of their equipment, and a wide variety of software. These include Eletronica Digital S.A. (EDISA), licensed to make the Fujitsu systems; Labo Eletronicos Ltda., with a licensing agreement with Nixdorf; and SHARP, using the French Logabax systems.

Several local firms are also manufacturing, or proposing to manufacture, minicomputer peripherals and terminals. And another oligopoly has been formed for modem manufacture.

Behind Brazil's policies, lies the fact that in 1975 the nation was heading for disaster. Inflation was rampant and reached an outrageous 46% in 1976. Currency fluctuation and devaluation was insane. And the balance of payments was grossly negative. Furthermore, when it came to computers, the nation had little domestic enterprise. That, it felt, left it dangerously vulnerable to the policies and whims of foreign suppliers and their nations.

The government looked at all imports, setting limitations for many, establishing higher duties and taxes, and commanding that 100% of the value of imported items be placed in escrow in Brazilian banks for a year—a fierce penalty in that economy. Computers were an inevitable target. Published statistics show that the average annual increase in installations was about 35% between 1973 and 1976.

For help in dp policy, the government turned to its agency CAPRE, the Commission for the Coordination of Data Processing Activities. (This group had been formed in 1972 to pull together government computer activities that were in disarray because of the rampant growth in dp use.)

The young man heading CAPRE, as executive secretary, Stanford Univ.-educated Ricardo Adolfo de Campos Saur, recalled the activity during the economic crisis. CAPRE, said Dr. Saur, was asked to project import demands. They found that at current rates $200 million worth of computer products would come from abroad in 1976; in 1977, it would leap to $250 to 300 million. "With the crisis, we had to minimize this to a level that would not halt general economic progress." Reluctantly, the limits were set: $100 million in 1976 and about $130 million for 1977 and 1978. One-half to one-third of the demand.

The question was how to keep the imports down. Saur's group considered apportioning the quota to the vendors according to their share of market, meaning, for example, that IBM would get more than half that quota. But the schemes, the loss of initiative that this would generate!

"We decided to go a more difficult course—merit analysis." Four main priorities were established: spare parts imports, parts and assemblies for local manufacturing, expansion of existing systems, and last, new systems. Special priorities would go for applications of "social value" and research, and for service bureau needs, since they could serve many customers.

Merit analysis meant that each application would be considered on a case-by-case basis. If the user felt tied in knots by government bureaucracy, CAPRE found the users were not always able to specify the need for the existence of their facility, let alone for new equipment. The application questions were basic, but, it turned out, tough. How does the computer activity fit into the company, how many people are in training, what will you do with the new hardware, what will you do about software? Most important, and often unanswered, was, "What is the company's long-range plan for data processing?"

The mini and small business group has been formed; miniperipherals and modems are other protected markets.

"I could write a humor book out of the first answers," says Saur. "People have always been able to say, 'I am going to hit 500 hours per month within six months and my printer is running out of capacity.' But they couldn't tell you why or what for. We sent these people back and they had to justify to management why they couldn't get the approval. Finally, they got their management involved. Initially, they didn't even bother to send their general manager of dp, just one of the procurement people."

"I recall one large bank that wanted three large cpu's, and in one of the specifications they sent in, there were comments made in a foreign language by the vendor—no translation. It took them four months to get their request straightened out and two months for us to say no to most of what they asked. A year later a director of this bank came in and thanked us for saving him a bundle of money. He said that by not importing that equipment, they were doing the same things they wanted to do at a much lower level of capital expenditure." Saur laughed, "Unfortunately, that is not typical, but I think today the awareness of the problem is such that we're not loved, but at least we're respected."

Saur is also pleased that the policy has lessened the "status symbol" syndrome of computer buying in Brazil. The measure of an installation is more "how well it is planned and run" than how new it is. Top management, he asserts, is also more aware of the importance of computers, and dp responsibilities are now placed higher in the organization chart.

Saur thinks the policy also improved the vendor organizations. In 1976, he says, IBM and Burroughs, for example, were in very bad shape from a management and organizational stance because "they couldn't keep pace with the growth." After the import limits, they stopped hiring so many people, retrained existing personnel, and reorganized. "Revenues did not fall, new equipment is still coming in—not in a torrent as before but more sensibly."

Regardless of these pluses, CAPRE and the government in general knew all the needs couldn't be filled by more efficiency. The nation had to spike local production in some segments so that other equipment imports, particularly large scale systems, could be increased under the limits. National vulnerability because of reliance on foreign products was another major consideration, particularly militarily.

How could they accomplish this? As long as foreign competition existed local industry could not compete with the prices the big vendors could offer.

The locals could not compete either in technology. The Brazilian planners also felt they could do without "superfluous technology," as the latest in the state of the art. Hence came the decision to create oligopolies with fully protected positions in specified markets. The mini and small business group has been formed; miniperipherals and modems are other protected markets.

The rules were set up. No more than two or three companies per market segment would be approved. The local firm could buy the technology of the foreign company only once, and that system or series would have a four-to-five-year life span. The next model had to be developed locally. The mini firms could not diversify but had to concentrate on the cpu so that other companies could have the opportunity to manufacture peripherals. Standard interfaces are a strict requirement. As the plan goes, when the firms have become stable, Brazil may again open up some protected markets to foreign competition.

Despite the acknowledged hardships for the computer-buying public, the Brazilian planners seem comfortable with what they have done. The dp growth rate is settling in under 15% annually, instead of 35%. Trade deficits have become trade surpluses for the country. Foreign investment, especially in computers, is obviously on the upswing. Local industry, while fledgling, has a mandate for survival.

—Angeline Pantages

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CIRCLE 79 ON READER CARD

BENCHMARKS

BIG COMPUTER FOR CHINA? A $69 million computer order to Control Data Corp. includes a Cyber 175, eight times more powerful than any machine ever approved for export to a socialist bloc nation. The order also covers one Cyber 173 and 10 Cyber 172 systems which are within the guidelines for "presumed approval" of the Free World Coordinating Committee (CoCom). The order, from the Chinese National Technical Import Corp., is the largest single computer order ever from a Communist nation. The compuers would be used for oil and gas exploration research. The largest computer shipped to a Communist country to date was an IBM 370/158 for the Soviet Kama River truck factory. The largest computers in China are two Hitachi M-170s at the Chinese Weather Ministry.

ELBIT OWNERSHIP SHIFT: Elbit Computers, Israel's largest computer company, raised 100 million Israeli pounds or $5.3 million in a public stock offering representing a 25% ownership in the company. The offering cut Control Data Corp.'s 51% majority control of the firm to 37%. Elbit ownership also includes a 31% share held by Elron Electronic Industries, an Israeli science-based industries conglomerate. A total of 32% is now in the hands of the public and Elbit employees. The company said money raised by the latest offering will be used for expansion including $2.2 million for new buildings, $3.8 million for equipment procurement, and $370,000 for investment in Israeli and foreign subsidiaries.

AMDAHL PRICE CUTS: Amdahl Corp. reacted to IBM price cuts by reducing prices on its memory by $15,000 per megabyte and on its 470 systems by an average of about 9% for most configurations. Main memory for all models in the 470 line went down to $140,000 from $170,000 for a two megabyte increment. Price cuts for the 470 line include an 8% reduction for the V/5 with a typical configuration of four megabytes-eight channels going from $2 million down to $1.84 million. At the high end of the line, price cuts for the 470/V8 will be about 8.5% with a typical configuration of eight megabytes and 16 channels dropping to $3.45 million from $3.77 million.

CREDIT FOR MEMOREX: Memorex Corp. said it has reached an agreement with a group of nine commercial banks for revolving credit totaling $80,000,000. The firm said the agreement provides that amounts may be borrowed, either in dollars or Eurocurrencies, until the end of 1981. After that Memorex will be able to convert all or part of the $80,000,000 to a four year term loan repayable in eight equal semiannual installments. Some $25 million of incremental new credit would become immediately available under the agreement, within the restrictions of other senior debt. The balance should become available this year and next.

FLOPPY DISK VENTURE: Memorex Corp. will produce floppy disks in Japan in a joint venture with Teijin Ltd. and Memorex Japan, a sales subsidiary it formed with Kanematsu-Gosho Ltd. Teijin makes polyester film used in disk production. The operation will be capitalized at about $26,300 with Teijin holding 51%, Memorex 20%, and Memorex Japan 29%. Memorex owns 60% of Memorex Japan. Production is expected to start next fall.

OUT OF THE DISK BUSINESS: The last remaining portion of California Computer Products Corp.'s Memory Products Div., an oem floppy disk operation, will go to Billings Computer Corp., a Provo, Utah, small business systems firm if a $1.8 million deal is approved by directors of both companies. CalComp earlier sold its hard disk operation to Xerox for $25 million (Dec. '78, p. 77). Xerox did not want the CalComp floppy operation. It already owned Shugart Associates, the floppy leader. Billings said it would move the floppy operation from Anaheim to Provo. Management plans had not been firmed in mid-January.

PLESSEY OUT OF ICL: The British telecommunications firm, Plessey Co., sold its 24% holding in International Computers Ltd. for some $67 million. Plessey said it sold its 8.1 million shares to institutional investors. Plessey had been increasing its holdings in ICL in hopes the two companies could get together and produce and market computer-based telecommunications and office equipment. This never happened and now the company is looking to put the money from the ICL stock sale into other means of entering the computerized office systems business.

SURPLUS FOR COMPUTERS: Commerce Dept. figures for the first 11 months of 1978 show computer exports

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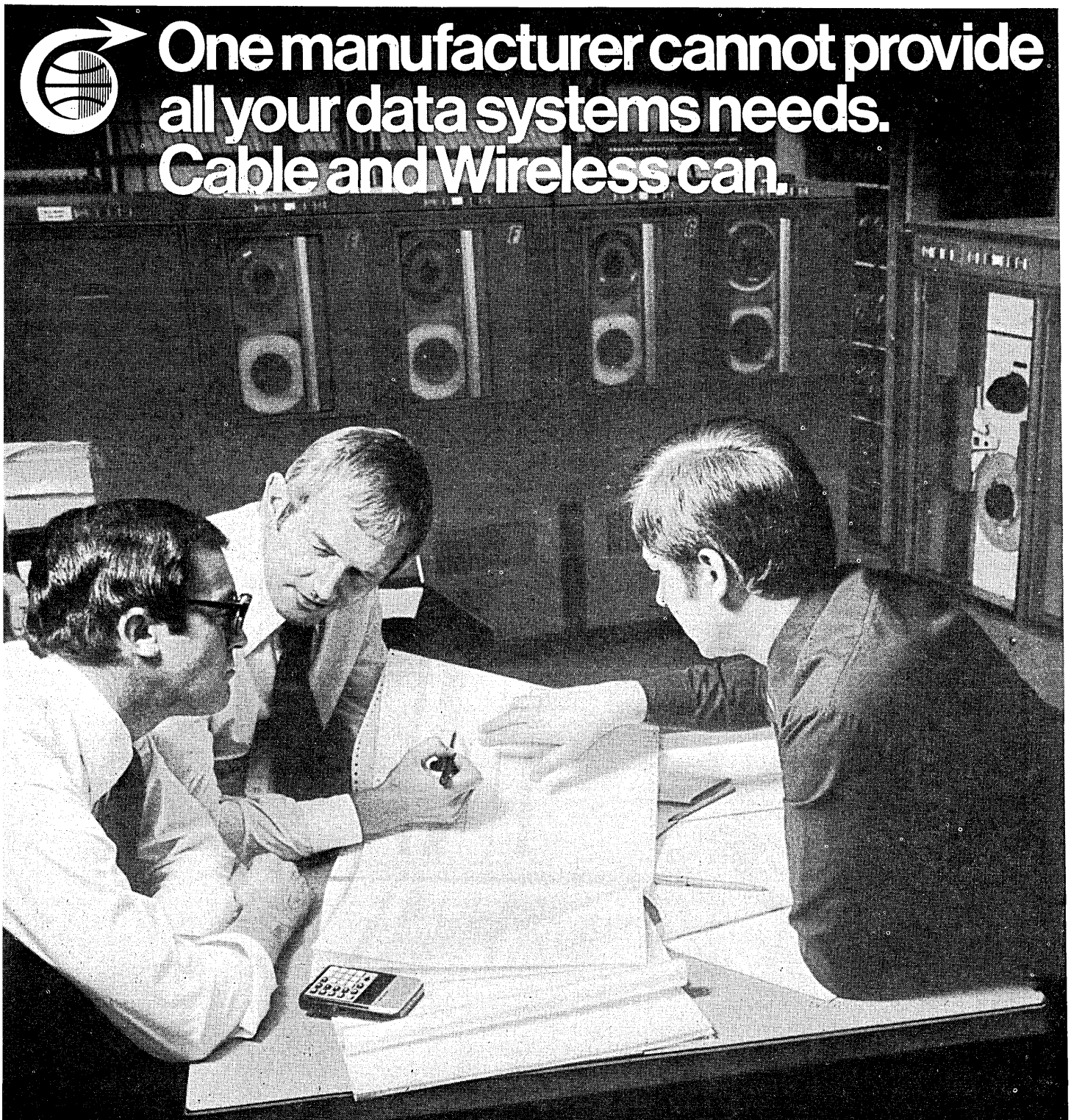

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BENCHMARKS

totaled $3.77 billion against imports of $556 million, for a trade surplus of $3.2 billion. For November, the computer surplus was $350 million with exports of $406 million and imports of $56 million. Overall U.S. trade deficit for the month was $1.9 billion. Canada was the largest importer of U.S. computers for the month with $12.1 million, followed by $10 million from Japan, $8 million from West Germany and $7 million from France.

SUPERCOMPUTER CONTRACT: Control Data Corp. bested Cray Research in competition for a $25 million Air Force contract for three supercomputers to be installed at the Air Force Special Weapons Center, Kirtland Air Force Base, N.M. The three as yet unannounced Cyber 203 cpu's will be connected to two Cyber 76 and two CDC 6600 computers for worldwide military weather forecasting. The sale is the first for the big 203s, derived from the CDC Star 100 computer and subsequent upgrades.

HYBRIDS FOR THE INTERIM: Burroughs Corp. still is testing the B 7800s it once said it would deliver in the first quarter of last year. But it is shipping hybrid 7800s for the interim. No new delivery date has been announced for the originals, the B 7811 and a dual-processor B 7821. The interim hybrids, the B 7803 and the B 7805 are said to be competitive with IBM's 3031 and to give some 25% better performance than the earlier B 7700s. Burroughs said the B 7811 and 7821 will be competitive with IBM's 3032 and 3033.

WORLDWIDE COMBINATION: General Electric Information Services Co., a joint venture of General Electric Co. and Honeywell Inc., became operational last month. The business combines the worldwide operations of GE's Information Services Div. and Honeywell's timesharing marketing operations in the United Kingdom, Continental Europe, and Australia. Previously, GE's Mark III service was distributed in these overseas markets by Honeywell. The new company will develop, maintain, operate, and market Mark III on an international basis. General Electric holds 84.1% of the business and Honeywell 15.9%.

MARKETING PACT: Scientific Time Sharing Corp., Bethesda, Md., and Magnuson Systems Corp., Santa Clara, Calif., have agreed to market each other's products. Under the agreement, Scientific could offer Magnuson 370-compatible computers with its Quad 100 offering scheduled for introduction this quarter. The offering will combine APL system software, applications packages, and a 370-compatible computer for in-house use, providing Scientific customers a migration path from time-shared services. Magnuson will be able to offer Scientific's APL applications programs to its customers. Under the nonexclusive agreement, both firms retain their own marketing and field support organizations.

BANKING MARKET: The banking market for independent packaged software will more than triple to reach $1 billion by the early 1980s, says a new study by Frost & Sullivan, Inc., New York City-based market research firm. The 230 page study, "The Banking Computer Software Packages Market," says some 1,000 independent vendors now offer more than 3,500 different software packages and their biggest market by far is the banks, thrift institutions, and other financial institutions. These firms, say the study, spent more than $300 million on proprietary packaged programs last year.

40% GROWTH PREDICTED: The annual Arthur D. Little Impact Services five-year outlook for the world computer industry forecasts real growth of at least 40% over the $18 billion estimated value for computer shipments in 1978. The study said computer shipments of U.S. mainframers will top $25 billion in 1983 and could be as high as $29.5 billion. It projects at least a 50% increase in the 1983 shipments of the mainstays of the computer market: large systems (purchase price between $1 and $2 million) and giant systems (purchase price over $2 million). Shipments in 1978 have been estimated at about $2.4 billion and $4.7 billion respectively for these two size categories. The consulting firm predicts that the market for medium priced systems ($250,000 to $1 million) will continue to be relatively weak, while shipments of small systems will more than double by 1983. ✻

CORRECTION

Gideon Gartner, author of the article, "IBM: The next $20 million" (January, p. 80), is a vice president at Oppenheimer & Co., the New York brokerage firm, where he directs the market research group. He formerly was with IBM seven years tracking competition for the company. Mr. Gartner's affiliation inadvertently was omitted from the January article. (In that article the IBM Series E was called the Series F due to a typographical error.) ✻

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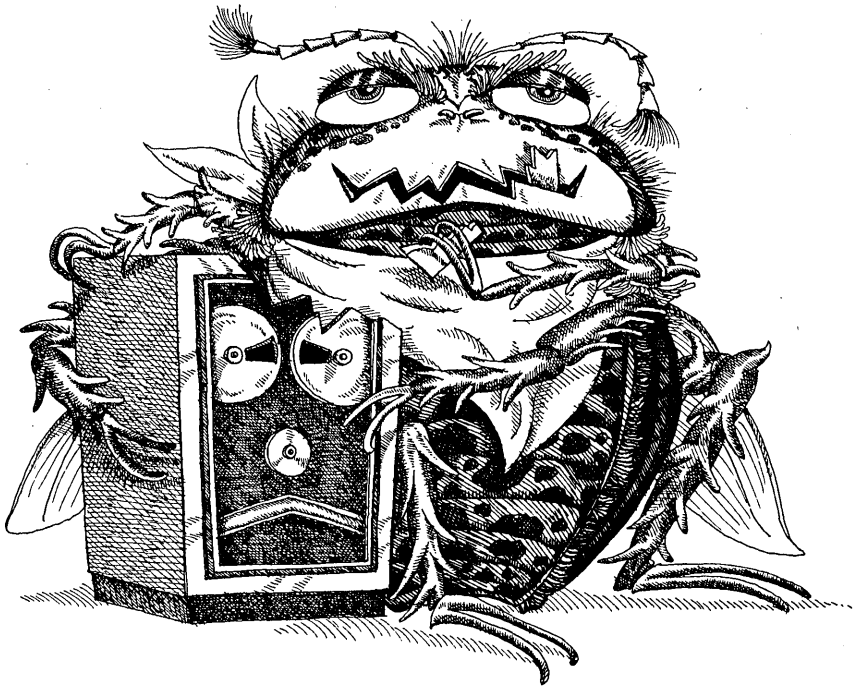

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EUROPE'S PRIVACY LAWS—FEAR OF INCONSISTENCY

U.S. multinationals think they might have to hire highly trained personnel and assign them full time to compliance activity.

by Phil Hirsch, DATAMATION correspondent

Why do European nations, and not the U.S., want stiffer constraints placed on the flow of information across borders? One answer offered at a recent conference in New York on "Data Regulation: European and Third World Realities," was that there is more fear in Europe than in the U.S.; that government will invade individual privacy unless some form of autonomous data protection authority is established.

That suggestion came from Gerhard Stadtler, the author of Austria's new data protection law, who said the fundamental rights of individuals on the European continent are not primarily entrusted to the courts. Therefore, such laws must cover a greater range of potential risks because the courts are not likely to oppose government intrusion on principle. And that suggests why Europeans want to put manual files and "legal" persons (such as companies) under their data protection umbrella. It's primarily a means of protecting the information against misuse by government and not necessarily by businesses.

And, of course, as the cost of private networks continues to come down and their use continues to grow, there is a noticeable increase in the concern over economic, social, and political impacts of present data protection regulations and a demand for additional constraints.

The international debate over "data protection" (in the U.S., it's generally referred to as "privacy protection") at first was concerned with personal records. Most business firms weren't particularly concerned because, as Jean-Pierre Chamoux, head of a French informatics research organization, pointed out at the conference, the vast majority of on-line international communication involved corporate information. But recently, the idea of protecting "legal" as well as "human" persons has become popular. Three countries—Norway, Denmark, and Austria—already have enacted such protection, and others are considering it.

Sweden, Germany, and various Canadian provinces also have enacted data protection laws. Constitutional provisions establishing data protection as a human right have been enacted, or are under consideration, in Portugal, Switzerland, Spain and the Netherlands.

Sweden's law was enacted in 1973, and Germany's in 1977. In 1978, France, Norway, Denmark, and Austria enacted data protection regulations, and in 1979, according to one speaker at the New York conference—Frits Hondius, of the Council of Europe—Belgium and Luxembourg are likely to follow suit.

These national laws almost certainly will accelerate current efforts within the Council of Europe to develop an international data protection convention. Non-European users and suppliers of on-line information services are concerned that such a convention will bestow a marketing advantage on their competitors within the European Common Market, since all nine Market members belong to the Council (the U.S. only has observer status).

National privacy laws almost certainly will accelerate current efforts within the Council of Europe to develop an International data protection convention.

The counterattack against efforts to restrict international information flows is led by U.S. users and suppliers of information services. The major concerns were explained at the conference by Ross W. Langhorne, a vice president of Manufacturers Hanover Trust Co.

One fear, he said, is that individual European countries will enact inconsistent laws, thus making it more difficult and expensive for U.S. multinationals to determine whether their existing and planned record-keeping procedures are lawful. The companies would have to hire "knowledgeable and highly trained personnel," explained Langhorne, and assign them full time to compliance activity.

Other problems, he added, include the possibility that:

—Taxes and/or other sanctions will be imposed on the use/transmission of protected data.

—Users will have to invest in redundant files and "the extra associated hardware and software to maintain them."

—Information transmission will be allowed only to those countries with reciprocal data protection laws.

—U.S. suppliers of time-shared dp services may be forced out of the market by "premeditated" escalation of communications tariffs.

—"As data protection legislation in the European Economic Community (EEC) gravitates toward increased state control, the Third World countries will follow."

U.S. multinationals also oppose European data protection legislation because they suspect it represents a camel's nose under the tent which will result in regulation of other aspects of their operations. As Langhorne put it: "Data protection legislation may well be the first step in sanctioning state control and auditing of all information transmitted into or out of a nation state by the private sector. If data protection legislation is the next step in European moves toward protectionism, the effects on private-sector multinationals could be severe."

There appears to be some evidence for this concern.

Hans Peter Gassman, one of the chief architects of the Organization for European Cooperation and Development (OECD) effort to draft a data regulation statute, told the New York conference that "at present, the discussion on transborder data flows is only one part of a broader picture. Other legal aspects which need to be taken into account are the proprietary rights of electronic data bases, access modalities to data bases, and the need for new ground rules for the emerging international data networks."

"At present," he said, "data networks are set up in a fairly *ad hoc* manner; a variety of modes of operation exist and compete with each other. An international regime of well-defined, preventive rules needs to be set up for the feeding, operation, and use of international data networks to guarantee maximum safety of the systems not only from a physical point of view but also from an information quality point of view."

One reason U.S. data communications users and suppliers oppose this approach is because of the recent trend among European telecommunications administrations to replace traditional private line

R. W. LANGHORNE—Inconsistent laws will make it expensive and difficult for multinationals to remain within the laws.

tariffs with "usage-sensitive" rates. The critics contend that usage-sensitive rates will increase their communications costs to prohibitive levels, forcing them to switch to new public data networks being developed by foreign governments. They insist this change will reduce the quality of international telecom services because the public data nets supposedly can't be tailored as closely to users' specific needs. They also insist the new scheme is motivated primarily by a desire of foreign governments to stifle competition from beyond their borders. If the effort is successful, it is argued, more of the data transmitted across national borders will be controlled directly by government instrumentalities, thus increasing the danger to personal privacy.

Among the defenders of what Langhorne and others called "economic chauvinsim," is Ricardo Saur, head of a Brazilian agency trying to develop a homegrown computer industry. "Each country must evaluate (whether) introduction of the latest available technology will not cause greater dependence," he told the conference. "Since most of the time there are not resources available to do everything needed, relevant new technology, particularly with social benefits derived from it, should take priority over technology which has nonsignificant social consequences and small economic meaning for the country as a whole."

"We believe," Saur said, "that a need exists for protection of local development efforts. Multinational companies operating transnational data networks will have to consider the need to adapt to these circumstances, with their economic and operational consequences."

Peter Robinson, chairman of the Canadian government's computer communications secretariat, reported that his country's imports of computing services will total $300 to $350 million in 1978. The "major point" is that "by 1985, Canada will have annual imports of about $1.5 billion worth of computing services," he added, and therefore, "it is quite unlikely a Canadian cabinet will decide in favor of an entirely unregulated (international information flow) regime."

In view of Robinson's and Saur's remarks, it is perhaps understandable that many who attended the New York meeting were miffed by a recent statement of Henry Geller, Assistant Secretary of Commerce and director of the National Telecommunications and Information Agency, the President's chief information policy adviser. Geller said his agency hasn't found "any support" for the notion that foreign data protection regulations are aimed at stifling competition from the U.S. Geller's comment was sharply criticized at an informal "rump session," where a number of conferees representing U.S. companies formed an *ad hoc* committee to make the Carter Administration more aware of the economic impact of European data protection regulations.

Although economic chauvinism is a major reason for disagreement over the need for data protection regulations, it isn't the only one.

Although "economic chauvinism" is a major reason for disagreement over the need for data protection regulations, it isn't the only one. This came out during a question and answer session following Robinson's presentation, when a member of the audience—Richard Harris, of Xerox—asked whether Canada would tolerate processing of its data in the United States if carried out "according to Canada's wishes, without loss of earnings." Robinson's answer, in brief, was "no." Reason: Canada "wants to retain control, and is willing to pay extra" if necessary to retain this control.

Possibly the best summary of the non-economic basis for the data protection controversy came from OECD's Hans Peter Gassman: "Information and data are essential ingredients of our modern world, and determine to a large extent the conditions of our existence in it. Our personal freedom depends on it; it is not exaggerating to say that privacy protection is the most modern form of human rights protection, and will become more important with every new computer system installed. Therefore, if we want to preserve individual freedom in a democratic society and . . . maintain the free flow of information among the countries of the world, we have to accept certain forms of data regulation, even if (at first) there is a feeling they constitute unnecessary constraints."

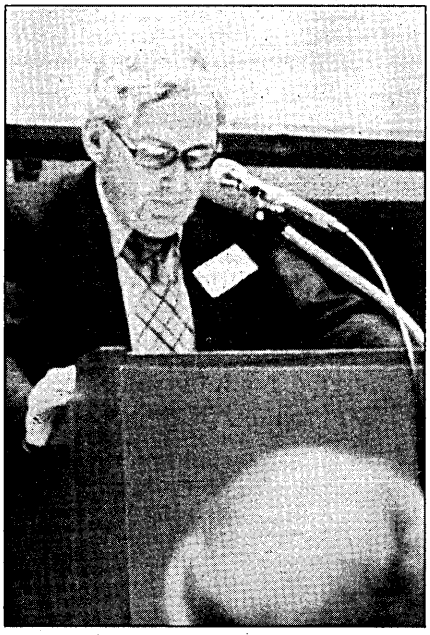
In Europe, the "constraint" idea is accepted—by the public and the courts—because government has long had pervasive regulatory power, said Austria's Stadtler. In the United States, on the other hand, "the freedom of the economy from legal restrictions and from surveillance of the state is one of the highest goals."

Much of the argument between the U.S. and Europe over means of protecting privacy stems from this difference. Based on what was said at the conference, these appear to be the major areas of disagreement:

1. In Sweden, Austria, Norway, and Denmark, data banks containing personal information must be licensed by a privacy protection authority before they can begin operation. In the United States and Canada, no prior authorization is required.

2. European data protection regulations are much more extensive than those on this side of the Atlantic. Essentially all personal records are subject to regulation in Europe, whether maintained on a manual or automated basis. By comparison, the U.S. Privacy Protection Study Commission, in its 1977 report, recommended a series of laws dealing separately with those categories of records posing the greatest threat to personal privacy, and all U.S. privacy laws now on the books embody this approach.

HENRY GELLER—Finds no support for notion that foreign laws are aimed at stifling competition from the U.S.



HANS PETER GASSMAN—Information and data are essential ingredients of our modern world.

Also, in three countries (Norway, Denmark, Austria), the regulations cover business as well as personal records. According to a conference paper authored by French Magistrate Louis Joinet, a basic justification for this expanded coverage is that business records on small firms—single firms and partnerships, for example—can reveal as much about an individual as his "personal" record, and therefore he has an equivalent right to know who holds the former information, how it is being used, and whether it's correct and relevant. Opponents of this view, led by U.S. multinational companies, argued at the conference that allowing government agencies to regulate the content and use of business records will expose trade secrets, sales figures, and other data which must be kept confidential if the companies are to compete effectively.

3. France, Norway, Sweden, and Austria restrict the transmission of data to other countries. Typically, the sender must obtain prior authorization; alternatively, there must be a data protection agreement between the sending and receiving countries. Frits Hondius, who heads a staff within the Council of Europe that's working on data protection legislation, reported that the Netherlands government is considering a proposal that would bar transmission of personal information to any other country unless it agreed explicitly to abide by the Dutch domestic privacy law.

Opponents of these restrictions refer to them as a "data curtain" and question whether they are justified. As Ross Langhorne put it in his paper: "What is the true issue? If problems exist, and are as serious as some would have us believe, let's identify them for what they are. Is it really violation of individual privacy (or national security) or are these arguments being advanced for political reasons, masking ulterior national motives?"

Langhorne probably is right when he suggests that transborder data flow restrictions and related privacy controls have a "political" basis. But whether the motivation is "ulterior" depends on your point of view. Certainly the spokesmen for other countries have made no secret of their desire to use privacy legislation as a means of promoting their domestic economies, preserving their national sovereignty, and exercising control. However, there are other factors involved here that may not be as apparent.

The public fear that *government* will invade individual privacy is much greater in Europe than in the United States. Partly, this is because government power is much more pervasive; partly, it's because European governments, in the past, have frequently ridden roughshod over human rights.

With the rapid increase of international data networks, any system based on the idea of national control over transfrontier data flows will be very difficult to enforce.

The European attitude toward transborder data flow restrictions seems to spring from still another special concern. Given the national rivalries, the history of persistent and protracted warfare among the nations of Western Europe, and the present competitive striving for an improved standard of living; it is understandable that there would be popular support for restricting the free flow of information out of each country. It was one of the situations Hans Peter Gassman alluded to when he said: "If we want to preserve individual freedom in a democratic society, we have to accept certain forms of regulation."

A number of proposals were made at the conference for resolving the data protection controversy, but none of them appears to be generally palatable.

William C. Norris, chief executive officer of Control Data Corp., who gave the keynote address, argued that "it is the smaller countries that have the most to gain" from unfettered movement of information across their borders. "The essential point is that no single country is technologically self-sufficient. Therefore, worldwide cooperation in which each country participates and from which all will benefit, especially the smaller ones, is essential. Those countries that restrict the free flow of technology will impede their own economic growth, especially that part contributed by small enterprises."

"A major need, therefore, is to increase the efficiency with which technology data in government, universities, and industry is communicated to those who can create new jobs by converting those technologies to new products and services," Norris said.

Langhorne called upon the drafters of data-protection regulations to define the need for protection more precisely. Terming past actions "well-intentioned" but lacking in "forethought to the consequences," he added that "if a reasonable middleground is not established between legislative perceptions of the problem(s) and the private business sector's (requirements), the legislative end product may well be regulatory overkill." Langhorne called for greater involvement of businessmen in the drafting of data protection regulations, particularly within international organizations like the Council of Europe.

Several other methods of reducing government controls over the use and transmission of sensitive data were proposed at the meeting. For example, a member of the audience suggested that data which originates in one country, is sent to another for processing, and then is returned, should be excluded from transborder restrictions because sender and receiver are both in the country of origin and thus subject to that government's control. However, Frits Hondius (Council of Europe) countered that an agreement between the two countries is still necessary "to assure security of the data in the other country."

Adrian Norman, a senior consultant at Arthur D. Little, proposed attaching a numeric ID code to each data stream transmitted by telecommunications carriers. This "license plate" would identify the sender of a particular message, and provide a way of tracking illegal transmissions back to their sources, without having to negotiate special agreements covering cross-border communication. Norman also suggested encrypting messages to prevent unauthorized reception. But there were several objections to his idea, including the following: the government would have to have the encryption key; the plan would not prevent illegal secondary uses of sensitive data, and adding the "license plate" to packet-switched transmission would be both difficult and costly.

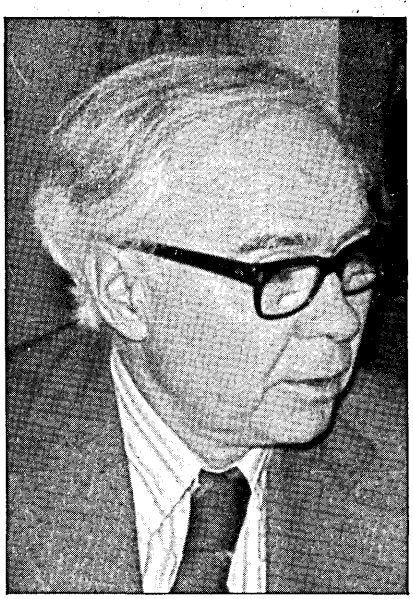
Perhaps the most perceptive objection to these proposals was offered by Canada's Peter Robinson: quoting a 1977 speech by Hugh Faulkner, who was then Canada's minister of state for science and technology, Robinson said, "'. . . national borders *do* exist—they are a fact of life that cannot be ignored by multina-

tional corporations.' " Robinson then added, "I am concerned that in some cases there may not even be a 'grudging' recognition of the legitimate social and economic concerns of governments in this area. This attitude in the long run may only serve to strengthen the hand of those who would call for much tighter and more encompassing controls over the transborder flow of data."

There was some evidence, but not much, at the meeting that "recognition" may be starting to develop among business users of international communications facilities.

Harry De Maio, director of data security programs for IBM, indicated his company accepts the idea that business records concerning small firms require the same protection given personal information. Alden Heintz, vice president of Tymshare, Inc., a U.S. multinational service bureau, said advocates of unrestricted information flows across international borders cannot sell their philosophy on the grounds that restrictions add to business operating costs. Instead, he said, they must show that nonregulation will provide significant benefits to the countries concerned.

One difficulty with Heintz's prescription became apparent during a subsequent question-and-answer period. He had pointed out that since Tymshare, like most other multinationals, eagerly looks for citizens of the host country to run and staff the operations they establish abroad, foreign countries can reduce their unemployment by not restricting information flows across their borders. However, a French delegate in the audience pointed out that unemployment in his country and many others consists largely of unskilled workers unqualified to work for computer-based companies. He added that since the major value of an on-line data processing service lies within the computer, the chief effect of such ventures, when introduced from abroad, is to increase the recipient country's international debt rather than its GNP.



WILLIAM C. NORRIS—Smaller countries have the most to gain from unfettered movement of information across their borders.

Another way of resolving the argument over data protection regulation was suggested by Hondius: "With the rapid increase of international data networks, any system based on the idea of national control over transfrontier data flows will be very difficult to enforce. States must resort to rules of international law."

A final draft of the Council's proposed convention will be completed in 1980, said Hondius. It will consist of a "common core," embodying data protection principles incorporated in all of the national laws already enacted by member nations; for example, acknowledgement of the need to assure that personal data is correct, is accessible to the subjects, and is protected against illegal use and tampering. "Countries adhering to these common minimum rules would have the assurance that data processed about their citizens in other countries belonging to the same group . . . would satisfy their own domestic data protection standards. Special restrictions (on) data traffic to foreign countries could therefore be lifted . . ."

The public fear that government will invade individual privacy is much greater in Europe than in the United States.

Hondius emphasized, however, that "it will be left entirely to each contracting state how it will implement" the common core—which could lead to problems. And, as he pointed out, even where there is agreement as to the substance of data protection, there are additional questions to be resolved; for example, "how states can cooperate with each other when several have partial jurisdiction."

A further question involves the need for agreement on data protection rules between European and non-European developed countries. This effort is centered in OECD, where a "High Level Expert Group on Transborder Data Barriers" was set up early in 1978. Its mandate, explained Hans Peter Gassman, is to "develop guidelines on basic rules governing transborder data flow and the protection of personal data and privacy, in order to (encourage the harmonization of) national legislation and investigate the legal and economic problems relating to the transborder flow of nonpersonal data." The group met for the first time last April and expects to complete work on the guidelines by next July.

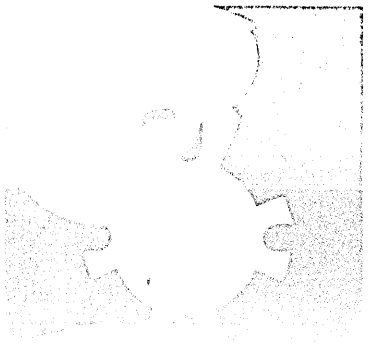
One question that remained largely unanswered at the end of the New York conference was the shape and character of U.S. policy regarding data protection. There were numerous clues to possible directions but little in the way of concrete commitments.

Henry Geller failed to attend the meeting—thus irritating some of those who did—but he contributed a paper to the Proceedings in which he said, "... I would hope that (the harmonization of national data protection schemes) can be developed in a framework of free trade, without artificial price or trade barriers. There must be common recognition that technical interdependence means also policy interdependence and that none of the trading nation partners can pursue narrow ends which undercut the general utility and cost efficiency of international data networks."

David Linowes, former chairman of the U.S. Privacy Protection Study Commission, reported that Rep. Barry Goldwater's (R., Calif.) recent proposal for an international conference on transborder data flow is likely to be reintroduced in Congress this year. Meanwhile, voluntary implementation of the privacy commission's 1977 recommendations is continuing. Already, a number of large companies (e.g., AT&T, IBM) have brought their record-keeping practices and policies into conformity with at least some of the Commission's recommendations, and several business and professional groups, including the U.S. Chamber of Commerce and the American Bar Association, have endorsed the report.

Richard Neustadt, a member of the White House staff, said a State Dept. report discussing U.S. international information policy options will be released early this year. He added that a year-long Administration study of unmet domestic privacy problems was on the verge of being sent to the President. This latter report, consisting of two volumes, was prepared by an interagency committee whose chairman, Stuart Eizenstat, is Assistant to the President for Domestic Affairs.

Morris Crawford, acting director of the State Dept.'s Office of Science and Technology, said the U.S. will try to persuade drafters of the pending OECD guidelines to rely primarily on self-enforcement rather than an elaborate regulatory structure. Also, there must be a "common understanding" regarding terms—i.e., the U.S. wants OECD to exclude manual files and "legal" persons from its ultimate definition of data protection. ✲



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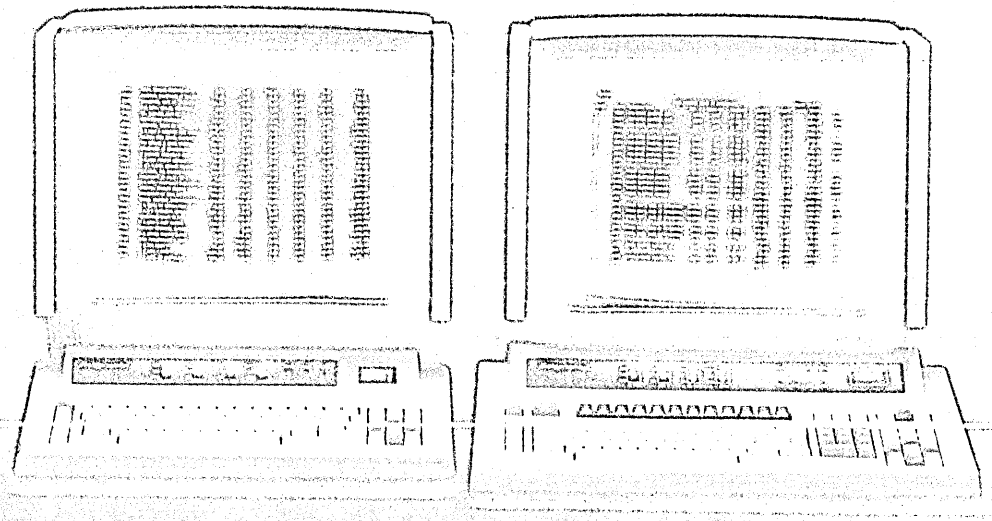
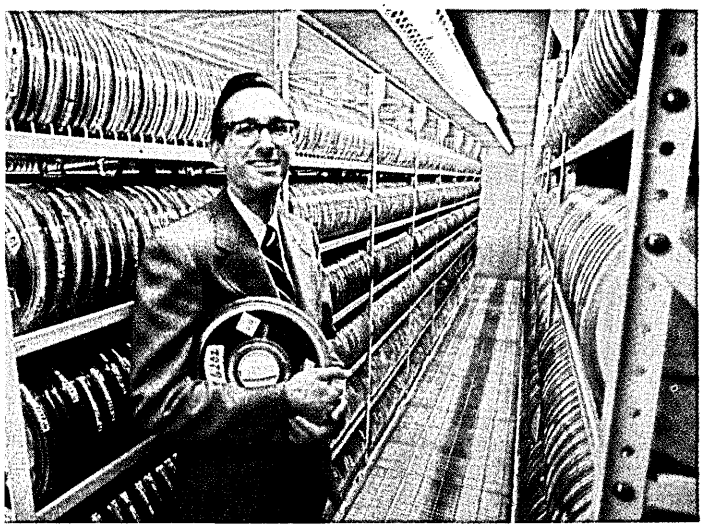


VAX Program Capacity. Ask any user.

"VAX offered us almost three times the address space of our 370/168."

Bill Miller, Senior Systems Analyst
Chevron Geophysical Co., Houston, Texas



Chevron Geophysical is heavily engaged in seismic data processing involving matrix operations on large arrays.

As Senior Analyst Bill Miller states the problem: "Our IBM systems, running on TSS, give 24 bits of true address space—for a maximum program size of 16 megabytes. But only 10 to 12 megabytes of this can be used by the programmer—and our application had grown to the point that TSS was simply cramping us.

"With the VAX-11/780, we know we can have application programs that use a full 32 megabytes as we're configured now—and it could be more if we wanted."

But Chevron didn't buy their VAX without first benchmarking it against the far more expensive 168.

Miller comments: "We developed a number of benchmarks to test specific areas of performance. On the average, the VAX CPU appears to be about a third as fast as the 168, which is really quite impressive. And it's very possible that for certain applications, we may see a negligible loss of throughput over the 168, thanks to VAX's unique page clustering scheme."

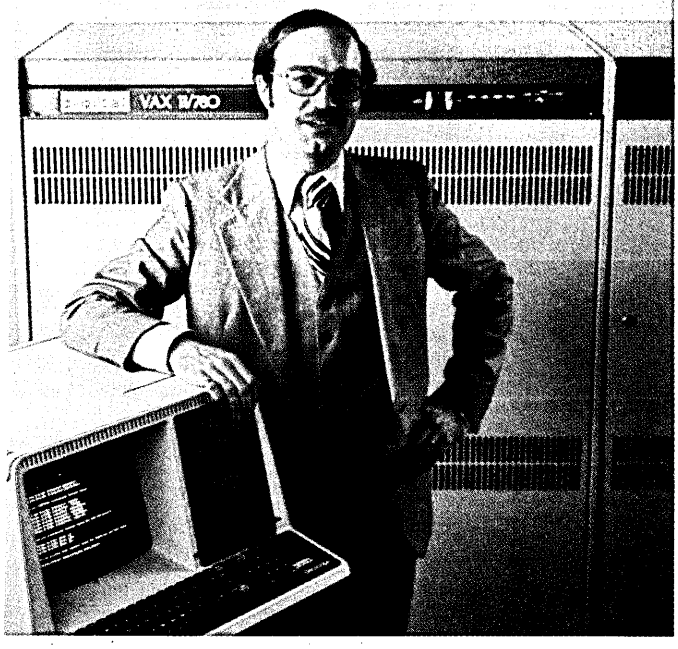
And as far as system performance to date, Miller reports: "The VAX/VMS operating system has been remarkably reliable. The people at Digital have done a phenomenal job."

"VAX's true 32-bit addressing puts its potential capacity so far out, we don't have to worry about it."

Dr. Edwin Catmull, Director,
Computer Graphics Lab
New York Institute of Technology,
Old Westbury, New York

The Computer Graphics Lab at New York Institute of Technology is a leading research and production facility for computer animated commercial and educational films.

In Dr. Catmull's words, here's what brought NYIT to the VAX-11/780: "While spending years developing our capabilities with minicomputers, we



continually ran into the problem of small address space. Our work demands the large address space we can get with a 32-bit machine. We were dealing with extremely large, randomly accessed data bases, and memory mapping is not the answer."

Dr. Catmull continues, "The VAX UNIBUS lets us easily hook up a wide range of special video display equipment that had previously been on the minicomputers, and allows us to easily convert our algorithms."

According to Dr. Catmull, "VAX has fulfilled our expectations for speed, program size, ease of conversion, and ability to attach special graphics equipment."

"With a 22,000-point data base, we really needed VAX's huge memory capacity."

Peter Ackermans, Manager of Computer Systems Engineering
CAE, St. Laurent, Quebec, Canada

CAE Electronics Ltd., currently has thirteen VAX-11/780 systems under development for both flight simulation and supervisory power control.

Here again, VAX capacity was key. Systems Manager Peter Ackermans told us: "Our SCADA systems for the power market need to handle a 22,000-point data base. VAX's large memory capacity and the VAX/VMS virtual memory operating system made it a very attractive machine."

But speed was also important. "In flight simulators," Ackermans continues, "top FORTRAN performance is essential, and on that score, VAX measures up well. Our FORTRAN programmers have also been impressed with the machine's debug facility and file handling capabilities."

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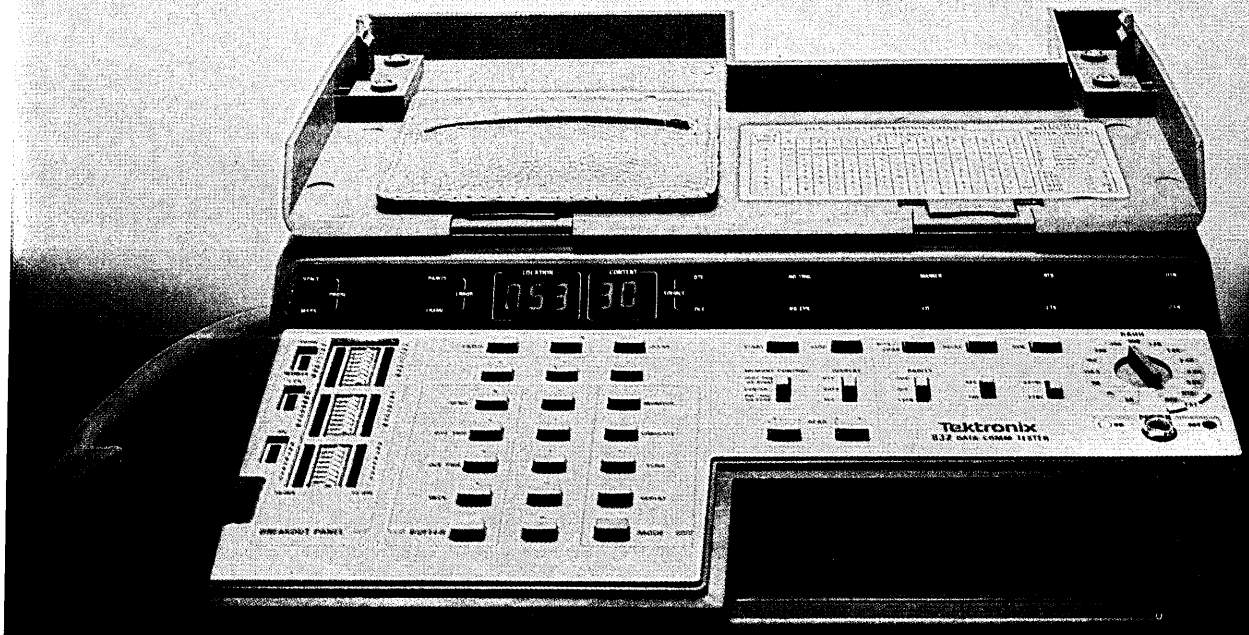

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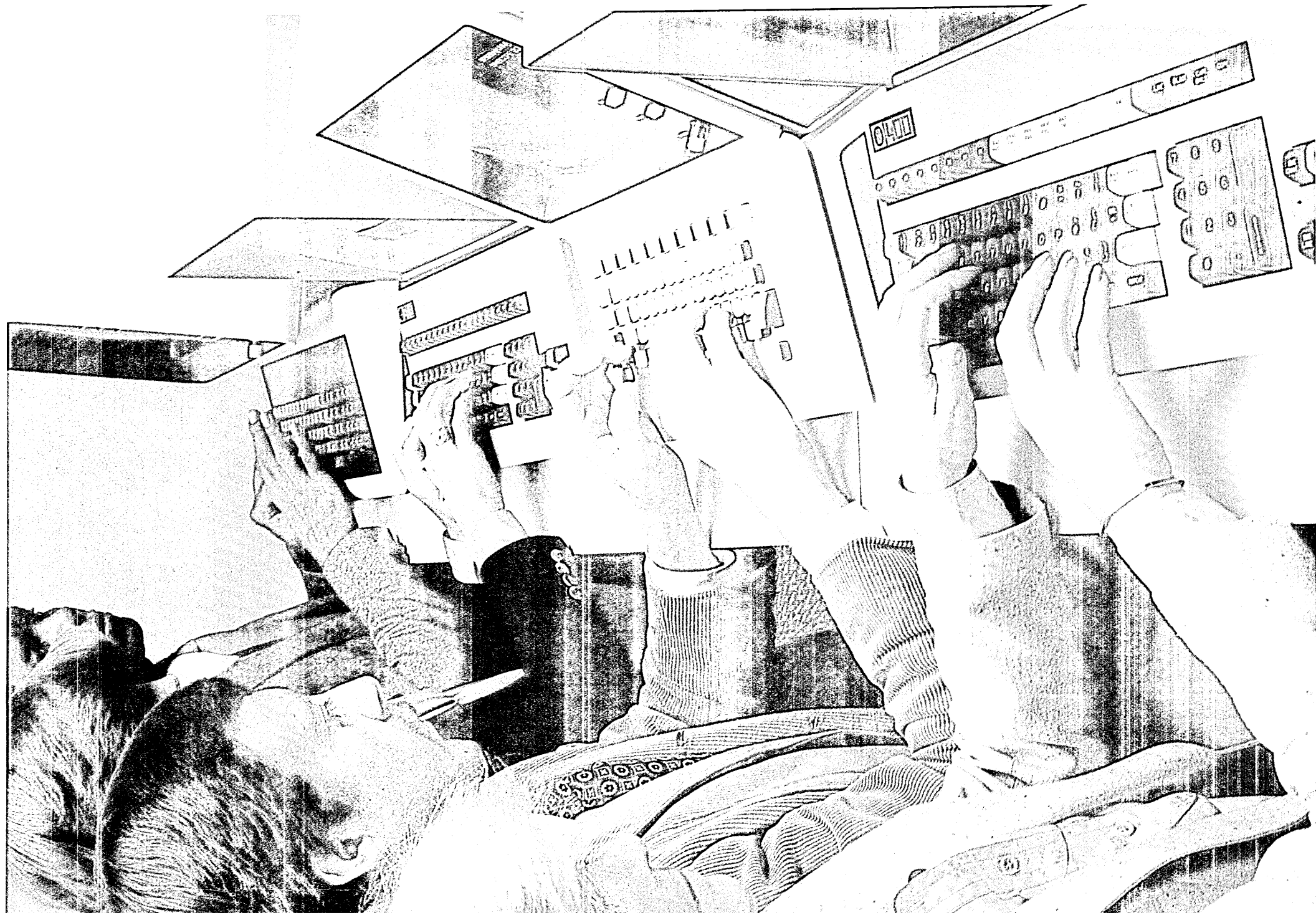

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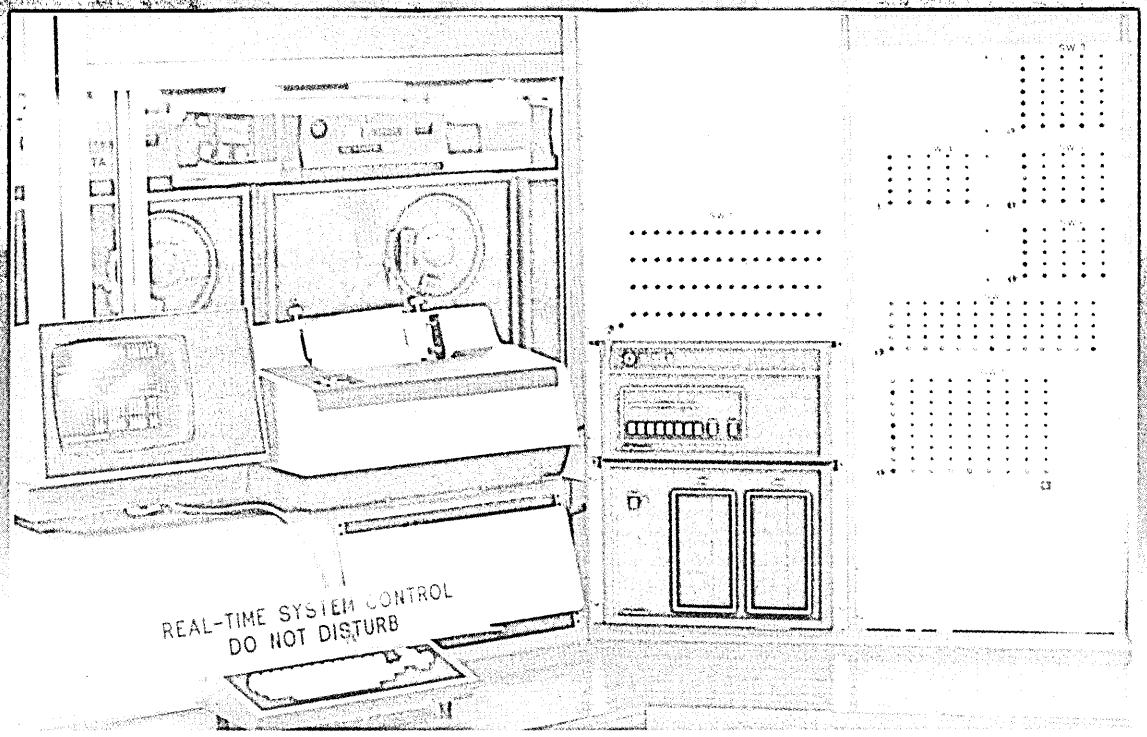

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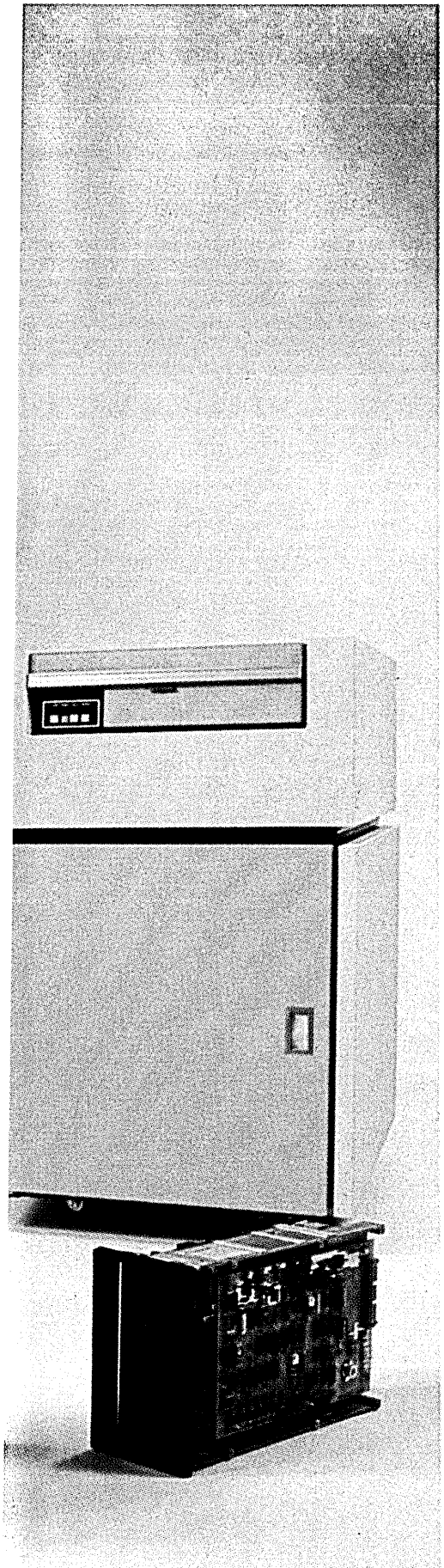

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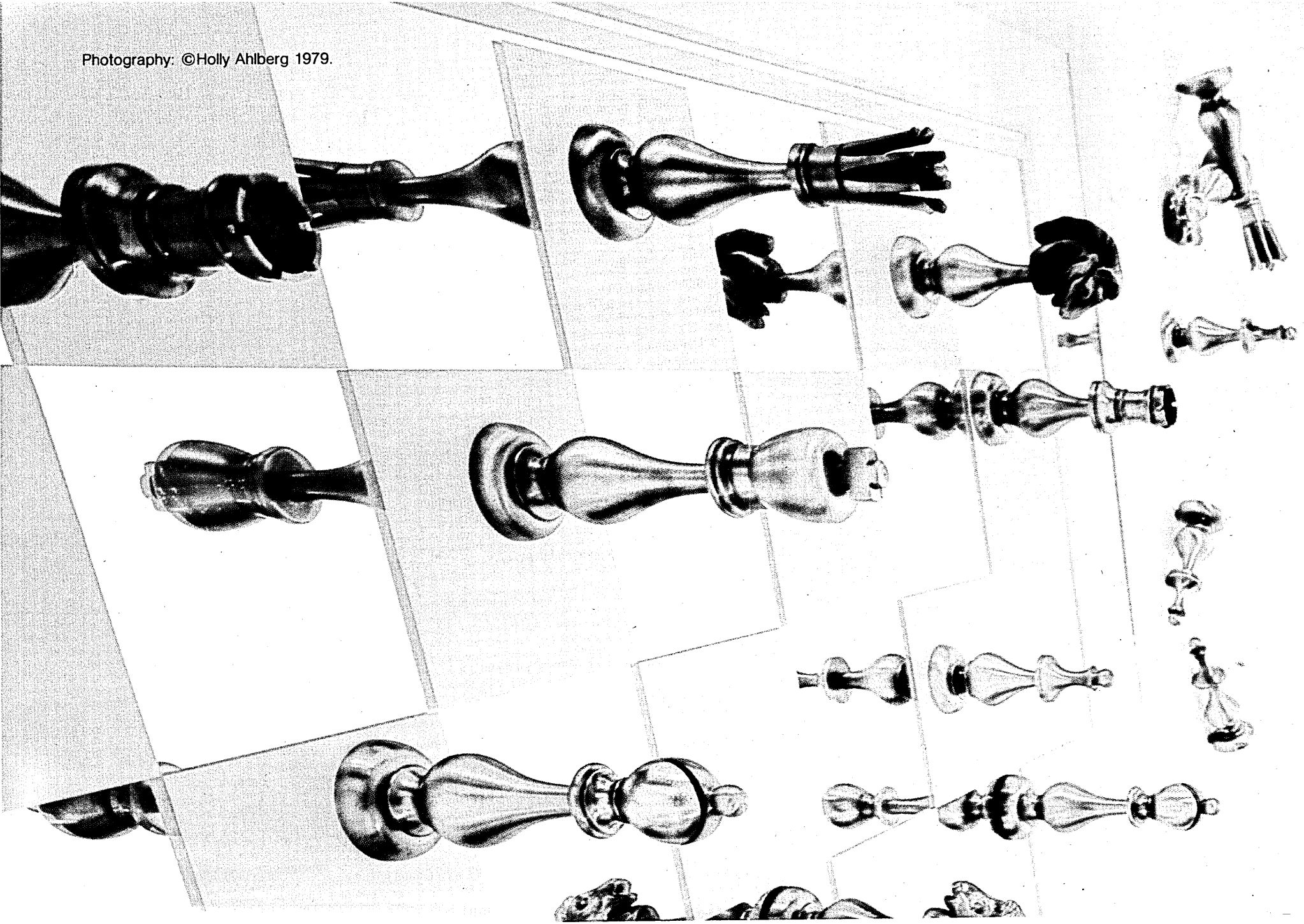
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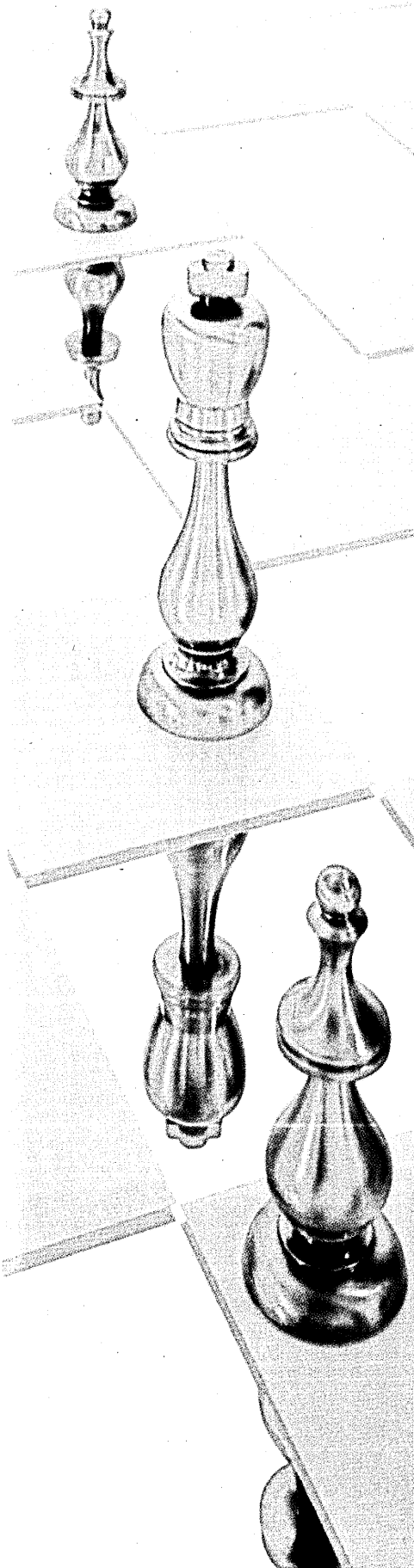


IBM VERSUS THE PCM'S

by Laurence Solomon

THREE COMPETITIVE CONCERNS

Incompatibility

Both microde compatible and non-compatible systems can guarantee compatibility to a given release of IBM Operating System software; the key difference between them is in their ability to remain compatible with future modifications:

- ***For microcode compatible systems*—lags will exist between IBM announcement of upgraded capability and PCM implementation, but little can be done by IBM to prevent eventual attainment of compatibility assuming the vendors allocate the funds for the effort.**

- *For systems that are not microcode compatible*—IBM introduces microcode modifications to the System Control Program (as it did with the MVS System Enhancement), the PCMers must select between hardware modification (a costly alternative) or software modification (which begins the erosion of plug-compatibility). Each ensuing modification leaves the PCM operating system less plug-compatible than before.

Residual Value

The resale value of processor hardware will decline more precipitously in the late 1970s and 1980s than was true during the 1960s and 1970s. Competitive pressure on IBM from the PCM'ers will combine with accelerating advances in semiconductor technology to force IBM to implement change more rapidly than in the past. The PCM competition will also lead to IBM's lowering of its price umbrella, reducing the inherent value of currently installed 360/370 mainframes. IBM's non-compatible competitors, faced with a tougher and leaner IBM, will also be forced to improve their price/performance curve to retain their relative competitiveness.

The net effect of all of the price cutting will be more capability for the dollar for new installations and a cut in residual value for already installed hardware. Both IBM and PCM hardware will face this fate, and historical residual value tables will no longer be applicable.

Vendor Viability

The high cost of entry into the IBM compatible business has come down considerably since Amdahl's $50 million venture in the early 1970s. Some companies with less than $5 million, and in one case less than $2 million, have entered the fray. With this proliferation of suppliers at the low end of the IBM mainframe line, PCM hardware will approach commodity status, with product differentiation purposely kept almost nonexistent. As this happens, the marketing and support organization of each of these start-up ventures will prove to be the key to success or even viability in a crowded marketplace.

Users considering PCM hardware as an alternative to that manufactured by IBM should select it carefully. For, as indicated, the low end mainframe market may not support all who choose to enter. And vendor viability is critical if long term compatibility is to be ensured.

At the other extreme is Amdahl Corp., the company which spearheaded the whole PCM industry. Paced by strong computer sales, in the 1977 through 1979 period Amdahl will be an established force in the mainframe arena and second only to IBM in sales of large mainframes.

Prior to the success of Amdahl, and to a lesser extent of Itel and CDC, the situation in the competitive mainframe arena in the mid to late 1970s consisted of IBM and its traditional competitors holding on to their market shares with little annual change. Even with the deluge of new product offerings by Honeywell in its numerous Series 60 line, NCR with its Criterion line, the Burroughs 800 Series, the 90 and 1100 series by Sperry and the Cyber 170 products by CDC, the maturity of the mainframe market was evident as vendors set out to upgrade their locked-in, captive user base. Then Amdahl's plug-compatible mainframe (PCM) with its improved technology and very competive pricing forced IBM to react. Initially, IBM responded with a cycle booster for the 370/168 in the form of an attached processor (AP). Though the AP was a better price performer than the 370/168 MP, it was still too expensive when compared to Amdahl's mainframe, and failed to reduce IBM's 50% price/performance disadvantage against Amdahl's 470. Only when 40 Amdahl systems had been installed by March 1977, with a market value of over $170 million did IBMannounce the 3033. And the new high standard of price/performance that machine heralded was adhered to in October 1977, too, with the announcement of follow-on mainframes, the 3032 and the 3031.

The market response to IBM's 303X announcement has been overwhelming and the company is increasing production capability to meet the larger than anticipated user demand. All 303X products have met their scheduled first shipment date of March 1978, but system availability will remain a significant problem for IBM through much of 1979. Even the anticipated fallout between actual systems installed and the present system backlog as represented by letters of intent will not ease the situation substantially. By year-end 1980, IBM will install over 3,000 303X systems in the U.S. alone, and over 23% of them will be the powerful 3033.

While IBM has been gearing up to meet user demand for 303X products, Amdahl with its 470 series and Itel with the AS/5 and AS/6 have been selling PCM's, with availability being a key sales factor. In fact, the present demand for large scale cpu's is so strong that Amdahl and Itel have temporarily delayed price cuts which they must eventually make to reestablish a competitive advantage. Until market conditions weaken, Amdahl and Itel will be marketing PCM products with little or no pricing edge over the IBM 303Xs.

The PCM availability advantage over IBM's 3033 system eventually will be reduced when those user installations which have ordered both the 3033 and 3032 systems select the one they really need. Many 370/158 installations ordered the 3033 when it was first announced, and then ordered the 3032 either because of unacceptable delivery dates on the 3033 or because they realize that the 3033 had more power than they needed. The thinning out of duplicate orders will not help IBM delivery problems until late 1979, however, when IBM begins to eat into the huge backlog and users finally are faced with order confirmation notices.

Thus the prospects for plug-compatible mainframe manufacturers until mid-1979 are very good as 303X availability problems provide strong near term marketing opportunities. But, as IBM reaches full 303X series production levels in the second half of 1979, we believe opportunities for PCM's will diminish as follows:

- By 1980, IBM will have the production capability to easily meet user demand for 303X mainframes.
- Stimulated by IBM's 1977 announcements of 303X hardware and by several PCM offerings, the user community will find it has overcommitted to mainframes in the late '70s and be forced to digest this cpu cycle overcapacity in the early '80s.
- The next generation of IBM mainframes will create two problems for PCM vendors; first, user wariness of major commitment (to PCM's) with the next generation coming; and, second modular, function-oriented polyprocessor architecture will be difficult to duplicate early in its product cycle and this will leave PCM'ers with only 370-type systems in the early '80s.
- Over 90% of 370/15Xs and 16Xs will be owned directly by their users or be under lease agreement to a third party by 1980, making the sale of plug-compatible replacement difficult. Further, 370 mainframes displaced by 303X installations will be available in the open market at prices substantially below original IBM prices and PCM prices.

The above factors will combine to create a climate of subdued PCM activity in the 1980-1982 period. With 303X

availability no longer a factor, the PCM manufacturers will concentrate their marketing activities on 360/370 replacement sales to IBM users who decide not to follow IBM's next generation initiatives. This will be a difficult market to penetrate significantly as very few systems will be on rent from IBM (most of these being interim installations), and since IBM's 303X systems will be readily available as competition.

The PCM'ers in the early '80s will also face competition from previously owned 370s that have been greatly depreciated by their owners (either end users or leasing companies). Having recovered most if not all of their cost, these owners will be very aggressive in pricing their machines. The manufacturers of new undepreciated hardware will have difficulty competing with this 370/168 hardware on its second time around.

Significant price cutting will be required for the high performance PCM's to even sustain a shipment volume of comparable to that in the 1977 through 1979 period. With tightening margins and reduced volume in the high end PCM range, profitability of the activity will be dramatically affected.

The growing market acceptance of PCM products, coupled with the early successes of the AS/4 (Itel) and Omega 480 (CDC) and with the dynamic improvements in available technology, has led other companies to enter this market. Companies already announcing products are Magnason Systems, Two Pi (a subsidiary of U.S. Philips) and National Semiconductor (offering a system for oem distributors in addition to products which it manufactures for Itel). It is anticipated that more companies will enter this marketplace, offering products which will broadly and directly attack the installed base of IBM 370 computers.

The growth of the PCM market will include those products seeking to completely replace IBM computers on a one-to-one basis and also products which feature IBM compatability at the application level. This latter approach of offering specific products with IBM compatibility features represents significant opportunities for newer, independent companies and for already established mainframe vendors. For example, large corporations with distributed processing networks may be offered products which combine the requirements of such data communication oriented networks with IBM application compatibility.

Of the new entrants, Magnason is addressing the end user market with a modular architecture capable of being configured to compete against a broad range of IBM 370 systems. Two Pi and National Semiconductor, on the other hand, are offering products with 370 compatibility geared to be sold to oem's or third parties.

The constantly declining scope of effort required of each succeeding competitor to enter the PCM (or "almost-PCM") arena demonstrates the vulnerability of IBM's product line to this form of competition. As IBM's products reach maturity, they become targets of the PCM'ers. Whether it be Amdahl Corp. with its high technology, advanced packaging, and improved thermal path or Magnason with off-the-shelf technology implemented in a modular bus architecture, IBM products must now evolve more rapidly or be exposed to direct competition. With the cost of cpu horsepower declining so quickly, IBM must attempt to de-emphasize the importance of raw power even more than in the past. IBM has never preferred a pure hardware comparison of competitive products, pushing instead for a full system evaluation, including system software and technical support, where its vast application library could be considered.

With the PCM approach blurring most of IBM's traditional advantages, IBM's system approach to selling will have to evolve to meet what we believe will be its next phase of product development:

- more rapid implementation of advanced technology
- software unbundling through Selectable Units
- firmware implementation of frequently executed System Control Program modules in control storage
- functionally dedicated polyprocessors

Through implementation of the above strategy, IBM will keep the PCM activity to a manageable level. And through the more timely implementation of proven advanced technology, IBM will keep competition from offering capability beyond its own. IBM can also make up for the economies that accrue to less performance oriented products by being further down the learning curve, and through its large production scale.

Further, the unbundling of system software, the cost of which was previously buried in the hardware charge to the user, will allow IBM to compete on a more nearly equal basis with PCM's. IBM can produce hardware on a larger scale than anyone in the business, and with its new modern production facilities should have a lower cost for mainframe manufacture than its competition.

Leverage against PCM vendors will also be gained through firmware implementation of selected software functions. This will improve the efficiency of the IBM mainframe because the firmware execution of a properly selected supervisory function is faster than software execution. With a reduction in overhead execution, the throughput of application programs is enhanced. The use of microcode modification and predesigned circuits also makes maintaining compatibility a more difficult task, as the PCM'ers cannot install direct duplicate code but must modify their hardware or their version of the IBM System Control Program to maintain compatibility.

IBM's next generation of general purpose system mainframes, slated for an early 1980 introduction, will incorporate all of the above, in addition to a dramatically new modular architecture. At the heart of this system will be a polyprocessor structure with functionally dedicated processors containing a high degree of firmware implementation of system software. This firmware will be modified by the loading of different microcode routines. In this parallel processing environment, only the specific units involved in a given operation will actually be processing.

This emphasis on firmware and specialized processors will require a larger commitment of resources and make life more difficult for the PCM'ers than is the case today. And for those vendors who do survive IBM's challenge of the early 1980s, IBM will be ready with additional hurdles. *

LAURENCE SOLOMON

Mr. Solomon is a senior consultant with Quantum Science Corp. In this capacity, he directs market research and consulting activities having to do with computer equipment, for clients which are dp vendors and large scale users.

He began his dp career as a systems engineer with IBM13 years ago; then worked for seven years on the user side, managing the performance measurement and equipment selection department for Merrill Lynch and the computer and telecommunications planning department for Irving Trust Co.

He has also taught applications programming and computer architecture courses in the computer science department of the City Univ. of New York.

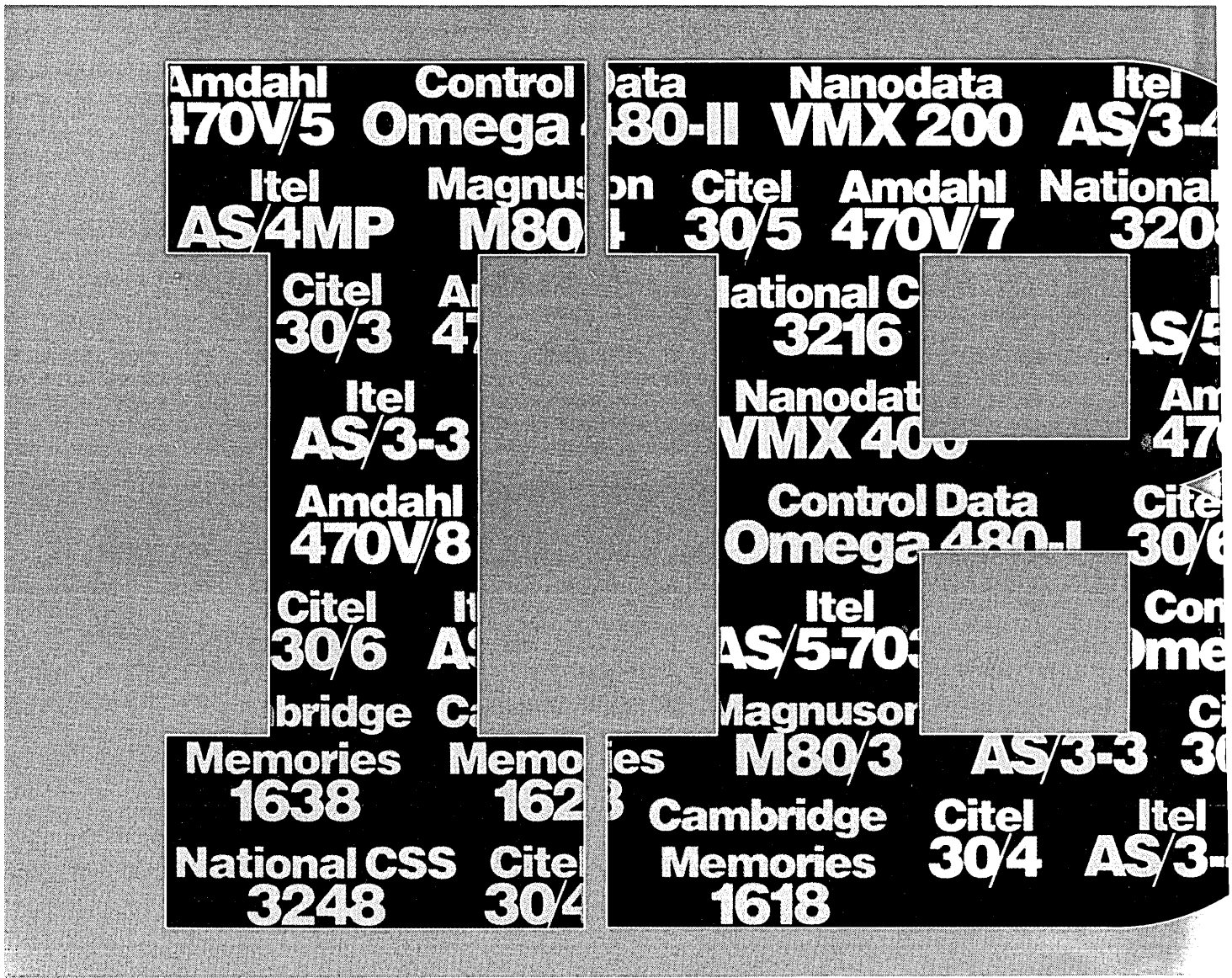
You can't tell the players without a program, and even then it's pretty tough.

THE PCM VENDORS

by Mary Bartholomew and Elinor Gebremedhin

The year 1978 saw a distinct change in the number of new systems entering the PCM marketplace. Previously it was felt that no one except IBM would be able to make a system so compatible that an IBM operating system could run on it. Therefore the first entries in the field were watched closely by cautious, but interested, parties.

In 1978, the pace of new entries began to step up, and the market expanded. The number of vendors in the plug-compatible mainframe business skyrocketed—and will undoubtedly continue to do so—because of user acceptance of the PCM idea, the resounding success of Amdahl and Itel, and the increasing ease with which vendors and manufacturers can enter this market. Key elements of this rapid entry/rapid growth pattern are the dropping prices of hardware and memory components and the evolution of more flexible, modular design techniques (such as microcoding and bus-centered, expandable plug-in architecture) that allow for rapid response to IBM design changes.



The *de facto* standardization that results from the plug-compatible concept also allows IBM-compatible alternative software or peripheral vendors to assemble a system—as NCSS did with its time-sharing system and Nanodata did with its universal emulator. Also possible are alliances between end user marketing organizations and oem manufacturers—for example, Itel and National Semiconductor.

Thus, one fascinating (and confusing) aspect of the plug-compatible market is the tangle of relationships among manufacturers and vendors that seems to grow with each new entrant. In the beginning Fujitsu supplied Amdahl with some of the 470V Series subassemblies, although never a whole processor. Next, when Itel entered the market as the vendor for National Semiconductor processors, the two companies had a seemingly clear-cut relationship. The relationship grew clouded as Itel also arranged to market a modified Hitachi-made processor and National Semiconductor entered and withdrew from end-user marketing of a new system which would have eventually put National in competition with its own oem customer.

Control Data, itself a manufacturer of mainframes and IBM-compatible peripherals, entered the market with plug-compatible mainframes made by IPL, a spin-off of Cambridge Memories. This relationship started to become complicated when Cambridge Memories directly announced three systems at the lowest end of the market—based on CDC's Omega I, a sharing of resources made possible by close connections between the two firms. To top it off, Cambridge Memories announced that one of its first systems would go to NCSS—months after NCSS itself announced a plug-compatible time-sharing/distributed system based on a processor made by Two Pi

Even Magnuson Systems, which had entered the market as both manufacturer and vendor (the simplest stance), added its bit to the prevailing complexity because one of their chief design engineers is Gene Amdahl's son, Carl.

Some of these complications will undoubtedly be compounded as European companies climb on the IBM PCM bandwagon. Siemens and Fujitsu have announced a collaboration which could eventually lead to the interesting situation of pitting an Amdahl/Fujitsu plug-compatible system against a Siemens/Fujitsu version of the same system, although Siemens' initial entry is with a "highly compatible" system, not a true PCM mainframe. In Japan, however, manufacturers seem to have (temporarily perhaps) secured the equivalent of the PCM markets for themselves, even though current Japanese systems are not plug-compatible in the strictest sense since internal codes and instruction sets are supersets of IBM's instruction set.

CURRENT CONTENDERS

The following brief analyses give an overview of each vendor's stance in the exploding PCM market. Included are those plug-

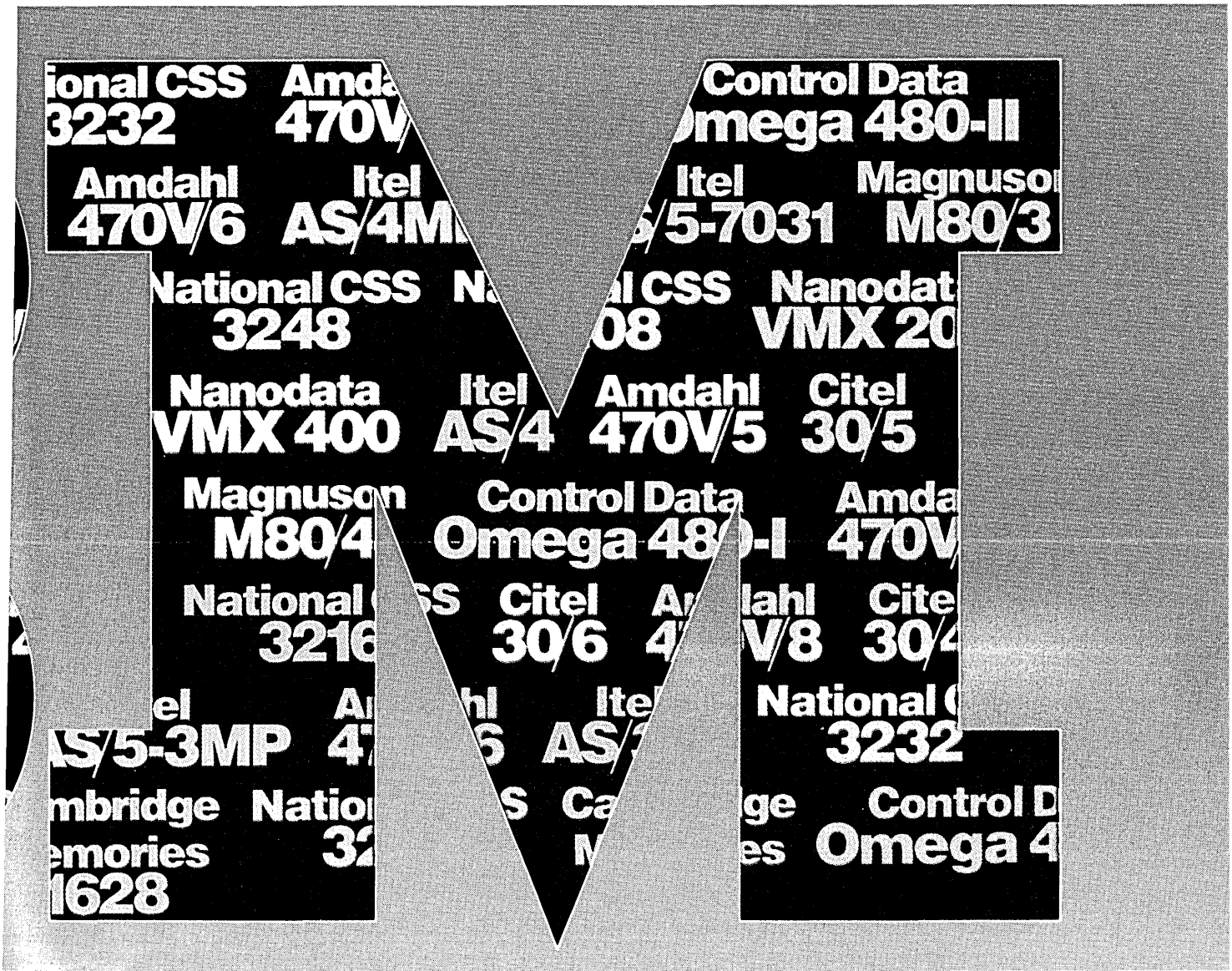


ILLUSTRATION © Richard Ikkanda 1979

compatible systems which are *able* to run an IBM operating system, even if the vendor chooses not to market the product as a 370 replacement but adds its own software to particularize the product instead, as NCSS does with its time-sharing and data base management software.

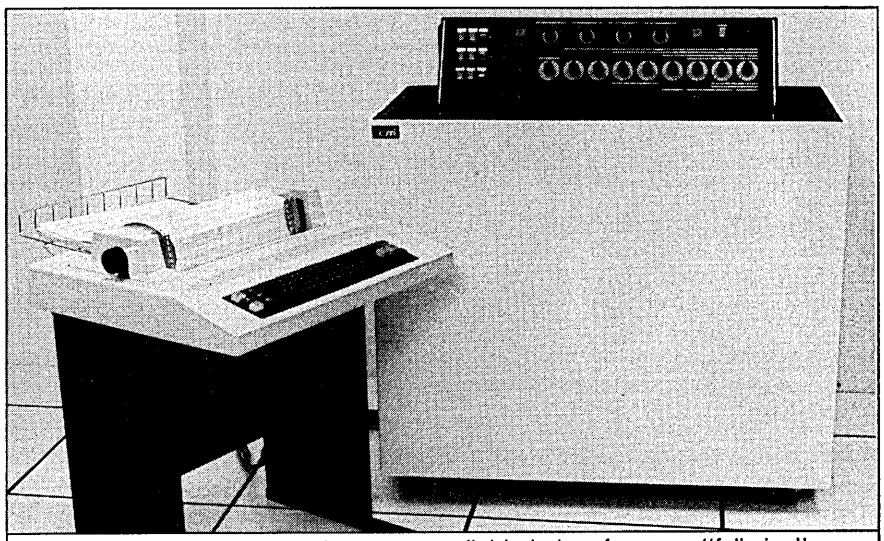
Amdahl, the first manufacturer and a pioneer of the PCM business, particularly focuses on making systems that are more powerful than any of IBM's, although it has extended its product line downwards to compete directly with models at the upper end of IBM's product line. Its mainframes tend to be more powerful at comparable prices. It also has demonstrated software capability by introducing software that corresponds to the IBM Advanced Function microcode, thus enabling Amdahl systems to keep up with IBM's latest changes.

By the beginning of 1978, Amdahl had delivered more than 100 systems at the highest level of the market, with pronounced financial success. The 200th system was on the manufacturing floor by year's end.

Innovation is one key element of Amdahl's success. Aside from being the first PCM mainframe vendor, Amdahl had the first (and, so far, only) 80-pin logic package, was the first to use standardized logic elements with individualized connection patterns to make unique components, and pioneered the concept of separate logic paths for diagnostics to allow remote diagnosis.

The logic circuitry on even the earliest Amdahl systems is still considerably advanced compared to IBM's, with greater packing densities and an 80-pin package combined with a chip-level heat sink that allows all systems, even the V/8 (which has 1.5 times the power of the IBM 3033), to be air-cooled. Aside from Amdahl, state of the art packaging is about 48 pins, and the IBM 3032 and 3033 systems must be water-cooled.

As long as Amdahl keeps its technological lead, it is unlikely to suffer in a PCM industry shakeout because it not only competes with IBM, but also offers something that IBM does not—a compatible upgrade at the top of the IBM line. Amdahl's serious competition for the near future lies not with IBM (which tends to lag in the technology race) but with the Japanese, who are coming up fast and might soon develop an advanced performance, completely plug-compatible upgrade. They have not yet done so, however. The Fujitsu M200 and Hitachi M200H mainframes, which the Japanese claim to be the most powerful systems in the world, actually achieve that distinction with models that link four processors together in a single operating system (as Burroughs, Honeywell, and Univac do at the upper end of their product lines), and thus are not truly compatible with 370s.



Cambridge Memory Inc. systems are available in two forms, a "full size" version of about 370/135 dimensions and this smaller one. The hardware which gets crammed inside is the same for either version: a processor up to 370/138 power, up to four channels, and up to 2 megabytes of memory. The system manufacturer is IPL, an affiliate of Cambridge, which also makes the Control Data Omega line.

Cambridge Memories is a new name but not exactly a new presence in the PCM mainframes market, since one of its officials owns 40% of IPL Systems, which makes the CDC Omega 480 systems. Although its initial models (the 1618, 1628, and 1638) are based on the Omega cpu, they compete with IBM's 115, 125, and 135 systems; CDC Omega Systems, on the other hand, compete with IBM's 138 and 148. Cambridge Memories has had experience and a customer base in the PCM memory market and hopes to sell first to its existing memory users—a plan hardly to be faulted. Whether or not this product line will prove successful remains to be seen, but the fact that its first customer was NCSS is a good omen.

CITEL (Computer Information Technology Engineering Labs) is a California-based company competing in the medium and large systems oem market.

Like Nanodata, CITEL has a machine capable of concurrent heterogeneous emulation, using microprogrammed instruction sets and microprogrammable peripheral controllers to allow software compatibility with any manufacturer's line. Unlike that of Nanodata and Magnuson, CITEL's hardware architecture is similar to IBM's, except that it uses a dual bus (one source bus, one destination bus) in the cpu rather than IBM's "time-shared" busses, and with a channel to system memory controller architecture rather than a central universal bus like Nanodata and Magnuson.

Since CITEL does not have a virtual machine operating system, the implementation of its heterogeneous emulation capability will depend on the particular need of the oem customer. The company does not see much market for general purpose Burroughs, Honeywell, or Univac-compatible cpu's, but does see users with special problems applying its machine to implement dedicated, unique solutions. (The system's flexibility would also make it an excellent candidate for front-end, back-end, and other special purpose processors.)

CDC was the third entrant into the plug-compatible market but, unlike Itel, kept a low profile and started slowly. CDC's worldwide sales and service base, its successful PCM peripherals business, and its software and systems experience with the Cyber 170 series could conceivably make it harder to beat than Itel. CDC marketing efforts have not been as strenuous as Itel's, however, possibly because CDC fears conflict with Cyber 170 business.

Fujitsu is not strictly speaking a manufacturer or vendor of plug-compatible processors, but is included here because many people think of it as being in the PCM marketplace. Fujitsu does own about 40% of Amdahl and makes subassemblies for Amdahl cpu's, but it does not supply whole processors.

Fujitsu's own M Series machines are "almost compatible" with IBM's in a way similar to how Univac's Series 90 or Siemens 7.700 are. That is, many IBM user applications can run on a Fujitsu mainframe under Fujitsu's OSIV/F4 operating system with no alterations, using the same JCL. However, no IBM operating system can run on an M Series processor without a number of alterations, nor can Fujitsu's OSIV/F4 run on an IBM processor without alteration. Siemens, incidentally, markets the upper end of Fujitsu's M Series in Europe as the 7.800 Series with BS3000 as the Siemens label for OSIV/F4.

Amdahl has run an interesting compatibility experiment with Fujitsu's operating system. The company made hardware alterations to its own 470V/6 in

An Amdahl/Fujitsu system pitted against a Siemens/Fujitsu system?

Vendor	Amdahl	Amdahl	Amdahl	Amdahl	Amdahl
Manufacturer	Amdahl	Amdahl	Amdahl	Amdahl	Amdahl
Model	470V/5	470V/5-II	470V/6	470V/6-II	470V/7
IBM Equivalent	370/158	3031	370/168	3032	3033
Power relative to IBM	3.0 (2,300KOPS)	3.0 (2,350KOPS)	1.5 (4,600KOPS)	1.5 (5,000KOPS)	1.2-1.4 (7,000KOPS)
First delivery	09/77	01/79?	06/75	04/77	08/78
Marketing status	Active	Active	Active	Active	Active
Processors	Uniprocessor	Uniprocessor	Uniprocessor	Uniprocessor	Uniprocessor
Cycle time	32.5nsec	32.5nsec	32.5nsec	32.5nsec	29nsec
Technology	ECL	ECL	ECL	ECL	ECL
Prefetch/pipeline	4-level	4-level	4-level	4-level	6-level
Control store	none	none	none	none	none
Memory					
Capacity/cycle time	6MB/320nsec	6MB/320nsec	8MB/320nsec	8 MB/320nsec	16MB/290nsec
Bytes per access	32 bytes	32 bytes	32 bytes	32 bytes	32 bytes
Interleaving	4-way	4-way	4-way	4-way	16-way
Chip density	4Kbits/chip	4Kbits/chip	4Kbits/chip	4Kbits/chip	4Kbps/chip
Cache	16KB/65nsec	32KB/65nsec	16KB/65nsec	32KB/65nsec	32KB/58nsec
I/O Channels/Rates					
Fixed/flexible	Flexible	Flexible	Flexible	Flexible	Flexible
System total	16 chans/12Mbps	16 chans/12Mbps	16 chans/15Mbps	16 chans/15Mbps	16 chans/18Mbps
Block multiplexors	16 chans/1.9Mbps	16 chans/1.9Mbps	16 chans/1.9Mbps	16 chans/1.9Mbps	16 chans/2Mbps
Byte multiplexors	16 chans/110Kbps	16 chans/110Kbps	16 chans/110Kbps	16 chans/110Kbps	16 chans/110Kbps
Selectors	16 chans	16 chans	16 chans	16 chans	16 chans
Other Compatibles					
Hardware	none	none	none	none	none
Microcode	MVS/SE and VM/PE	MVS/SE and VM/PE	MVS/SE and VM/PE	MVS/SE and VM/PE	MVS/SE and VM/PE
Software	none	none	none	none	none
Approximate Price	$2,000,000 (4MB)	$2,100,000 (4MB)	$2,280,000 (4MB)	$2,380,000 (4MB)	$3,080,000 (4MB)
Comments	3.8Mbps I/O with opt. 2-byte interface	3.8Mbps I/O with opt. 2-byte interface	3.8Mbps I/O with opt. 2-byte interface	3.8Mbps I/O with opt. 2-byte interface	4.0Mbps I/O with opt. 2-byte interface

Vendor	Amdahl	Cambridge	Cambridge	Cambridge	Citel
Manufacturer	Amdahl	Cambridge	Cambridge	Cambridge	Citel
Model	470V/8	1618	1628	1638	30/3
IBM Equivalent	3033	370/115-2	370/125-2	370/138	370/138
Power relative to IBM	1.5 (7,500KOPS)	1.1 - 1.15	1.1 - 1.15	1.1 - 1.15	1.8
First delivery	09/79?	1Q/79?	2Q/79?	12/78	2Q/79?
Marketing status	Active	Active	Active	Active	Active
Processors	Uniprocessor	Uniprocessor	Uniprocessor	Uniprocessor	Uniprocessor
Cycle time	26nsec	50nsec	50nsec	50nsec	200nsec
Technology	ECL	ECL and TTL	ECL and TTL	ECL and TTL	TTL
Prefetch/pipeline	6-level	none	none	none	yes
Control store	none	48KB - 64KB	48KB - 64KB	48KB - 64KB	not given
Memory					
Capacity/cycle time	16MB/260nsec	768KB/400nsec	1MB/400nsec	2MB/400nsec	16MB/300nsec
Bytes per access	32 bytes	4 bytes	4 bytes	4 bytes	4 bytes
Interleaving	16-way	none	none	none	4-way
Chip density	4Kbits/chip	4Kbits/chip	4Kbits/chip	16Kbits/chip	16Kbits/chip
Cache	64KB/52nsec	none	none	none	none
I/O Channels/Rates					
Fixed/flexible	Flexible	Fixed	Fixed	Fixed	Fixed
System total	16 chans/18Mbps	4 chans/2.6Mbps	4 chans/2.6Mbps	4 chans/3.7Mbps	5 chans/15Mbps
Block multiplexors	16 chans/2Mbps	2 chans/not given	2 chans/not given	2 chans/not given	4 chans/3Mbps
Byte multiplexors	16 chans/110Kbps	1 channel/not given	1 channel/not given	1 channel/not given	1 channel/3Mbps
Selectors	16 chans	1 channel	1 channel	1 channel	none
Other Compatibles					
Hardware	none	Main memory	Main memory	Main memory	none
Microcode	MVS/SE and VM/PE	none	none	none	yes
Software	none	none	none	none	not given
Approximate Price	$3,280,000 (4MB)	$120,000 (256KB)	$185,000 (512KB)	$265,000 (1MB)	not given
Comments	4.0Mbps I/O with opt. 2-byte interface			Upgradable to CDC Omega I	End user marketing uncertain

Even the earliest Amdahl systems are still way ahead of IBM's, technologically.

Vendor	**Citel**	**Citel**	**Citel**	**Control Data**	**Control Data**
Manufacturer	Citel	Citel	Citel	IPL Systems	IPL Systems
Model	30/4	30/5	30/6	Omega 480-1	Omega 480-II
IBM Equivalent	370/148	370/158	370/168	370/138	370/148
Power relative to IBM	1.5	1.8	3.0	1.1 - 2.0 (175KOPS)	1.1 - 1.5 (300KOPS)
First delivery	2Q/79?	2Q/79?	2Q/79?	06/77	3Q/78
Marketing status	Active	Active	Active	Active	Active
Processors	Uniprocessor	Uniprocessor	Uniprocessor	Uniprocessor	Uniprocessor
Cycle time	200nsec	200nsec	200nsec	50nsec	50nsec
Technology	TTL	TTL	TTL	ECL	ECL
Prefetch/pipeline	yes	yes	yes	yes	yes
Control store	not given	not given	not given	64KB - 128KB	64KB - 128KB
Memory					
Capacity/cycle time	16MB/300nsec	16MB/300nsec	16MB/300nsec	2MB/400nsec	2MB/400nsec
Bytes per access	4 bytes	4 bytes	4 bytes	8 bytes	16 bytes
Interleaving	4-way	4-way	4-way	none	none
Chip density	16Kbits/chip	16Kbits/chip	16Kbits/chip	4Kbits/chip	4Kbits/chip
Cache	none	none	none	none	8KB
I/O Channels/Rates					
Fixed/flexible	Fixed	Fixed	Fixed	Fixed	Fixed
System total	12 chans/36Mbps	5 chans/15Mbps	12 chans/36Mbps	5 chans/not given	5 chans/not given
Block multiplexors	11 chans/3Mbps	4 chans/3Mbps	11 chans/3Mbps	4 chans/1.85Mbps	4 chans/1.85Mbps
Byte multiplexors	1 channel/3Mbps	1 channel/3Mbps	1 channel/3Mbps	1 channel/50Kbps	1 channel/50Kbps
Selectors	none	not given	not given	none	none
Other Compatibles					
Hardware	none	none	none	Disk, memory, etc.	Disk, memory, etc.
Microcode	yes	yes	yes	none	yes
Software	not given	none	none	none	none
Approximate Price	not given	not given	not given	$290,000 (512KB)	$300,000 (1MB)
Comments	End user marketing uncertain	End user marketing uncertain	End user marketing uncertain		

Vendor	**Itel**	**Itel**	**Itel**	**Itel**	**Itel**
Manufacturer	National Semi	National Semi	National Semi	National Semi	National Semi
Model	AS/3-3	AS/3-4	AS/4	AS/4MP	AS/5-1
IBM Equivalent	370/138	370/148	370/148	370/148	370/158
Power relative to IBM	1.4-1.8 (225KOPS)	1.0 (300KOPS)	1.4 (600KOPS)	2.3 (1,000KOPS)	1.0 (830KOPS)
First delivery	12/78	12/78	2Q/77	2Q/77	04/77
Marketing status	Active	Active	Active	Inactive	Active
Processors	Uniprocessor	Uniprocessor	Uniprocessor	Dual-processor	Uniprocessor
Cycle time	115nsec	115nsec	115nsec	115nsec	115nsec
Technology	ECL	ECL	ECL	ECL	ECL
Prefetch/pipeline	none	none	none	none	none
Control store	none	none	none	none	none
Memory					
Capacity/cycle time	2MB/1035nsec*	4MB/1035nsec*	4MB/1035nsec*	8MB/1035nsec*	8MB/1035nsec*
Bytes per access	16 bytes	16 bytes	16 bytes	16 bytes	16 bytes
Interleaving	none	none	4-way	4-way	4-way
Chip density	16Kbits/chip	16Kbits/chip	4Kbits/chip	4Kbits/chip	4Kbits/chip
Cache	not given	not given	4KB/115nsec	8KB/115nsec	8KB/115nsec
I/O Channels/Rates					
Fixed/flexible	Fixed	Fixed	Fixed	Fixed	Fixed
System total	3 chans/1.5Mbps	5 chans/1.5Mbps	6 + 1 chans/5Mbps	14 chans/10Mbps	6 + 1 chans/5Mbps
Block multiplexors	2 chans/not given	4 chans/not given	4 chans/1.85Mbps	8 chans/1.85Mbps	6 chans/1.85Mbps
Byte multiplexors	1 channel/not given	1 channel/not given	1 channel/180Kbps	2 chans/180Kbps	6 chans/180Kbps
Selectors	none	none	none	none	none
Other Compatibles					
Hardware	Disk, memory, etc.	Disk, memory, etc.	Disk, memory, etc.	Disk, memory, etc.	Disk, memory, etc.
Microcode	none	yes	none	none	none
Software	none	none	none	none	none
Approximate Price	$490,000 (1MB)	$600,000 (1MB)	$922,000 (2MB)	no longer marketed	$1,155,000 (2MB)
Comments	*690nsec write	*690nsec write	*690nsec write	*690nsec write	*690nsec write

Itel, like CDC, can offer plug-compatible peripherals to go with plug-compatible cpu's.

Vendor	**Itel**	**Itel**	**Itel**	**Itel**	**Itel**
Manufacturer	National Semi	National Semi	National Semi	National Semi	National Semi
Model	AS/5-1MP	AS/5-3	AS/5-3MP	AS/5-3MP	AS/5-7031
IBM Equivalent	370/158MP	370/158-3	370/158-3MP	370/158-3MP	3031
Power relative to IBM	1.0	1.0 (900KOPS)	1.0 (1,530KOPS)	1.0 (1,530KOPS)	1.0 (1,200KOPS)
First delivery	2Q/77	04/77	2Q/77	2Q/77	12/78
Marketing status	Inactive	Active	Inactive	Inactive	Active
Processors	Dual-processor	Uniprocessor	Dual-processor	Dual-processor	Uniprocessor
Cycle time	115nsec	115nsec	115nsec	115nsec	100nsec
Technology	ECL	ECL	ECL	ECL	ECL
Prefetch/pipeline	none	none	none	none	none
Control store	none	none	none	none	none
Memory					
Capacity/cycle time	16MB/1035nsec*	8MB/1035nsec*	16MB/1035nsec*	16MB/1035nsec*	8MB/1035nsec*
Bytes per access	16 bytes	16 bytes	16 bytes	16 bytes	16 bytes
Interleaving	4-way	4-way	4-way	4-way	4-way
Chip density	4Kbits/chip	4Kbits/chip	4Kbits/chip	4Kbits/chip	4Kbits/chip
Cache	32KB/115nsec	16KB/115nsec	32KB/115nsec	32KB/115nsec	32KB
I/O Channels/Rates					
Fixed/flexible	Fixed	Fixed	Fixed	Fixed	Fixed
System total	14 chans/10Mbps	6 + 1 chans/5Mbps	14 chans/10Mbps	14 chans/10Mbps	6 + 1 chans/5Mbps
Block multiplexors	12 chans/1.85Mbps	6 chans/1.85Mbps	12 chans/1.85Mbps	12 chans/1.85Mbps	6 chans/1.85Mbps
Byte multiplexors	12 chans/180Kbps	6 chans/180Kbps	12 chans/180Kbps	12 chans/180Kbps	6 chans/180Kbps
Selectors	none	none	not given	not given	not given
Other Compatibles					
Hardware	Disk, memory, etc.	Disk, memory, etc.	Disk, memory, etc.	Disk, memory, etc.	Disk, memory, etc.
Microcode	none	none	none	none	none
Software	none	none	none	none	none
Approximate Price	no longer marketed	$1,219,000 (2MB)	no longer marketed	no longer marketed	$1,100,000 (2MB)
Comments	*690nsec write	*690nsec write	*690nsec write	*690nsec write	*690nsec write

Vendor	**Itel**	**Itel**	**Magnuson**	**Magnuson**	**Nanodata**
Manufacturer	Hitachi	Hitachi	Magnuson	Magnuson	Nanodata
Model	AS/6 7032	AS/6-2 7032	M80/3	M80/4	VMX 200
IBM Equivalent	3032	3032	370/138	370/148	370/138
Power relative to IBM	1.2 (3,000KOPS)	1.2 - 1.5 (3,300KOPS)	1.2 - 2.0	1.2 - 2.0	1.3 (250KOPS)
First delivery	03/78	03/78	08/78	08/78	2Q/79?
Marketing status	Active	Active	Active	Active	Active
Processors	Uni- or dual-cpu	Uni- or dual-cpu	Uniprocessor*	Uniprocessor*	Multiprocessor
Cycle time	72nsec	72nsec	100nsec	100nsec	195nsec
Technology	not given	not given	TTL	TTL	TTL
Prefetch/pipeline	not given	not given	yes	yes	yes
Control store	not given	not given	16KB - 256KB	16KB - 256KB	not given
Memory					
Capacity/cycle time	16MB/432nsec	16MB/432nsec	16MB/250nsec	16MB/250nsec	1.5MB/495nsec
Bytes per access	8 bytes	8 bytes	4 bytes	4 bytes	not given
Interleaving	4-way	4-way	none	none	not given
Chip density	4Kbits/chip	4Kbits/chip	4K or 16Kbits/chip	4K or 16Kbits/chip	16Kbits/chip
Cache	64KB/144nsec	64KB/144nsec	none	not given	not given
I/O Channels/Rates					
Fixed/flexible	Fixed	Fixed	Flexible	Flexible	Flexible
System total	16 chans/16Mbps	16 chans/16Mbps	16 chans	16 chans	8 chans/16Mbps
Block multiplexors	3 - 8 chans	3 - 8 chans	16 chans/2.5Mbps	16 chans/2.5Mbps	not given/7Mbps
Byte multiplexors	1 - 4 chans	1 - 4 chans	16 chans/2.5Mbps	16 chans/2.5Mbps	1 channel/2Mbps
Selectors	2 - 12 chans	2 - 12 chans	16 chans	16 chans	4 chans
Other Compatibles					
Hardware	Disk, memory, etc.	Disk, memory, etc.	none	none	not given
Microcode	none	yes	none	none	not given
Software	none	none	none	none	yes
Approximate Price	$1,960,000 (2MB)	$2,160,000 (2MB)	$205,000 (512KB)	$395,000 (1MB)	$185,000 (512KB)
Comments			*Triplex processor board optional	*Triplex processor board optional	Sold as system; concurrent emulation multiple cpu's

Vendor	Nanodata	Nanodata	NCSS	NCSS	NCSS
Manufacturer	Nanodata	Nanodata	Two Pi	Two Pi	Two Pi
Model	VMX 200	VMX 400	3208	3216	3232
IBM Equivalent	370/138	370/148	370/138	370/138	370/138
Power relative to IBM	1.3 (250KOPS)	1.3 (250KOPS)	1.0	1.0	1.0
First delivery	2Q/79?	2Q/79?	11/78	11/78	11/78
Marketing status	Active	Active	Active	Active	Active
Processors					
Cycle time	Multiprocessor	Multiprocessor	Uniprocessor	Uniprocessor	Uniprocessor
Technology	195nsec	195nsec	250nsec	250nsec	250nsec
Prefetch/pipeline	TTL	TTL	TTL	TTL	TTL
Control store	yes	yes	yes	yes	yes
	not given	not given	40KB - 156KB	40KB -156KB	40KB - 156KB
Memory					
Capacity/cycle time	1.5MB/495nsec	8MB/495nsec	512KB/750nsec	768KB/750nsec	1MB/750nsec
Bytes per access	not given	not given	4 bytes	4 bytes	4 bytes
Interleaving	not given	not given	none	none	none
Chip density	16Kbits/chip	16Kbits/chip	16Kbits/chip	16Kbits/chip	16Kbits/chip
Cache	not given	not given	none	none	none
I/O Channels/Rates					
Fixed/flexible	Flexible	not given	Fixed	Fixed	Fixed
System total	8 chans/16Mbps	8 chans/16Mbps	not given/4Mbps	not given/4Mbps	not given/4Mbps
Block multiplexors	not given/7Mbps	not given/7Mbps	not given	not given	not given
Byte multiplexors	1 channel/2Mbps	4 chans/2Mbps	1 channel/not given	1 channel/not given	1 channel/not given
Selectors	4 chans	10 chans	2 chans	2 chans	2 chans
Other Compatibles					
Hardware	not given	not given	none	none	none
Microcode	not given	not given	none	none	none
Software	yes	yes	VPS, NOMAD	VPS, NOMAD	VPS, NOMAD
Approximate Price	$185,000 (512KB)	$275,000 (2MB)	$238,650 (512KB)	$296,500 (768KB)	$393,650
Comments	Sold as system; concurrent emulation multiple cpu's	Sold as system; concurrent emulation multiple cpu's	8 communication lines	16 communication lines	32 communication lines

Vendor Index

Amdahl Corp.
1250 E. Arques Ave.
Sunnyvale, CA 94086
(408)746-6000
CIRCLE 356 ON READER CARD

Cambridge Memories Inc.
360 Second Ave.
Waltham, MA 02154
(617)890-6000
CIRCLE 357 ON READER CARD

Control Data Corp.
8100 34th Ave. South
Minneapolis, MN 55440
(612)853-8100
CIRCLE 358 ON READER CARD

Nanodata Corp.
2457 Wehrle Drive
Williamsville, NY 14221
(716)631-5880
CIRCLE 359 ON READER CARD

Itel Corp.
1801 Page Mill Road
Palo Alto, CA 94304
(415) 494-9191
CIRCLE 360 ON READER CARD

Magnuson Systems
2500 Augustine Drive
Santa Clara, CA 95051
(408) 988-1450
CIRCLE 361 ON READER CARD

National CSS, Inc.
187 Danbury Drive
Wilton, CT 06897
(203) 762-2511
CIRCLE 362 ON READER CARD

CITEL
1161 N. Tustin Ave.
Orange, CA 92667
(714) 524-5734
CIRCLE 363 ON READER CARD

order to run OSIV/F4, then compared throughput against the unmodified 470 running under VS2. The Fujitsu operating system yielded about 15% better performance. But the study was made before IBM's optimizing microcode and System Extensions software were available, so there is no data on how OSIV/F4 stacks up in the new milieu.

HITACHI supplies Itel with M-180 systems as a base for the AS/6. Itel will probably extend the product line upward by similarly modifying Hitachi's new M-200H, once it is available.

IPL is the oem vendor for CDC Omega systems, for which CDC plays no manufacturing role. Although Cambridge Memories owns a portion of IPL, IPL is an independent corporation. Both IPL and Cambridge have rights to the IPL/CDC Omega I design, but Cambridge does not have rights to the Omega II. Nor does the IPL/CDC combine have rights to Cambridge's 1600 Series. Consequently, the Omega I acts as a bridge between the two product lines, conceivably making it possible to field upgrade a 1600 into a CDC Omega. The financial arrangements for such an upgrade would undoubtedly be a bit complicated!

Itel was the second vendor to enter the IBM PCM mainframe business and currently rivals Amdahl for the lead since it ships more systems per month than any other firm. Itel's success is partly due to the fact that the large experienced worldwide sales and service network developed for its PCM peripherals business was ready-made for a PCM mainframe extension, especially since attractively priced package deals that include PCM peripherals as well as mainframes could attract users. This marketing flexibility has proved particularly useful in parts of the world where bargaining is the standard way of doing business and IBM's "that's it" posture is a disadvantage.

Itel's two oem suppliers have different relationships to the Advanced Systems product line. National Semiconductor makes the entire processors for all models except the AS/6, which is a highly modified Hitachi M-180.

Magnuson's M80 systems feature a modular, field-expandable architecture centered around a high speed 32-bit bus. Unlike Amdahl machines, which use advanced circuitry, M80 systems use state of the art circuitry and components; they have been designed, however, to allow easy exchange of parts when more advanced components become available.

The Magnuson systems are noteworthy on two counts: they are aimed at the medium scale plug-compatible processor market, and, as mentioned, one of their chief designers is the son of Gene Amdahl, who started the whole market.

Magnuson entered the market about the same time as NCSS but with a conservative, strictly plug-compatible approach. This is probably excellent strategy because users tend to be skeptical about deviations from IBM compatibility.

Nanodata, like NCSS, entered the IBM-compatible field with the idea of expanding an existing specialty related to distributed processing. Nanodata markets a universal emulator—today's ultimate virtual machine capable of *concurrently* running IBM, Burroughs, Honeywell, and others. The system is similar to Honeywell architecture in that instruction execution, system control, and

I/O handling are separated into physically different processors; unlike Honeywell designs, however, the instruction units can operate in parallel. Nanodata's systems are of 138 and 148 size, and are intended for distributed processing rather than as cpu replacements. The firm therefore intends to sell it as a system that includes miniperipherals.

NCSS: The most interesting development in the mainframes market, next to the advent of Amdahl, occurred when NCSS announced its 3200 system.

NCSS is a large time-sharing remote services bureau that has been using IBM computers with its own operating system since 1968. The NCSS basic VPS software consists of the proprietary Virtual Control Program (a VM/370-like virtual machine system), and the time-sharing Conversational Software System (CSS). NCSS realized that since its software was running nicely on both IBM and Amdahl systems, all it needed was an IBM plug-compatible processor manufacturer to team up with to enter the systems market. Support for its service bureau customers could be extended for systems purchasers. Because the spring of 1978 saw three new plug-compatible systems available from Magnuson, National Semiconductor, and Two Pi, the time seemed right; many suppliers were available at the low end of the market.

NCSS 3200 systems are systems in every sense of the word—not just IBM processor replacements. They concentrate on markets in which IBM has traditionally been inefficient and slow-moving; that is, time-sharing and distributed processing. The system's threefold attraction is that in addition to the primary distributed processing function, it can serve as a completely compatible backup, and programmers need little or no additional training. IBM has, of course, been very busy in all communications related fields, so its traditional weaknesses may not be a market factor much longer.

National Semiconductor is the exclusive oem vendor for all of Itel's product line, except the AS/6 which comes from Hitachi. At one time it announced that, in addition to being Itel's supplier, it would begin offering a new System 400 to other vendors and perhaps to end-users, but then reconsidered its position of competing with its customer and withdrew. Meanwhile, some industry observers suspect that Itel is going to manufacture its own processors in its San Diego facility after 1980—which is rumored to be the termination date of some secret agreement with National. Both firms appear to be cooperating at present, but market forces may drive them apart.

Most semiconductor manufacturers, in fact, seem to feel that the next few leaps in circuit integration will put so much of the cpu and memory on one chip that manufacturing chips as components will be unprofitable unless the manufacturer is also the systems vendor. So we should expect to see more semiconductor houses getting into the systems business.

Two Pi is a California-based subsidiary of U.S. Philips, which is a sister company of the multinational Philips based in Holland. Two Pi's V32 systems are the oem processors for National CSS 3200 systems. The relationship is nonexclusive, however, so the processors are also available to other end user vendors and system integrators.

MORE PLAYERS TO JOIN IN?

There are several possible sources of more IBM-compatible processor competition from existing companies. The recent rash of new entrants shows that it is possible to start from scratch. Semiconductor houses are the most obvious candidates for hardware makers—as National Semiconductor has been for Itel. It is inevitable that software capability will become more and more important to survival. The fact that Itel is acquiring MRI Systems, a data base management software vendor, may mean that the semiconductor giant is going into the cpu business. In Europe, Germany's Siemens is a prime candidate, especially since its recent alliance with Hitachi.

Finally, the Japanese are so close to being IBM-compatible that their processors can be modified to run IBM operating systems—as Itel has done with the Hitachi M-180 to make the AS/6—and may convert more mainframes to IBM compatibility. Mitsubishi, moreover, has announced plans to enter this market by early 1980.

READING THE TABLES

Reducing complicated data to tabular form for comparisons between products always demands some compromises in clarity. Fortunately, since the performance factors of PCM equipment are similar by definition, only a few items in the tables require any explanation.

One of the terms which might not come easily is the KOPS figure. Processor performance is given in two ways: relative to IBM's equivalent processor (which is represented by a figure like 1.5 for 50% greater performance) and in thousands of operations per second (KOPS). Where known, these performance figures are frequently more meaningful than simple cycle time comparisons, especially given that some vendors provide timings for microcycles instead of "major" cycles.

Also associated with instruction processing is the data for "prefetch/pipeline." This information attempts to illustrate the degree to which instruction processing is overlapped. Sometimes the data is given in the form "four-level," indicating that some processing is being done simultaneously on up to four instructions, or simply as "yes" if the degree of overlap is either not known or much more difficult to describe.

Under the I/O categories, the maximum number of channels of a given kind are listed, along with the maximum aggregate data range for those channels. In a few cases, the maximum channel number is given in the form of "6 + 1," which means only that a spare is provided.

Finally, some vendors choose to provide a processing function equivalent to that in IBM's microprogramming extensions—which rely on both hardware and software. That is indicated under the label of "microcode compatibility," but not further described.

Where a more complete description is desired, or more data of any kind, please contact the vendors directly, either by using the names and addresses provided in the vendor index or by circling the appropriate number on the reader service card bound into this issue. ✱

ELINOR GEBREMEDHIN

MARY BARTHOLOMEW

Ms. Gebremedhin is a senior editor at Auerbach Publishers Inc., and Ms. Bartholomew is a technical writer for the firm. Both contribute to Auerbach's *Computer Technology Reports*, a multivolume looseleaf reference service. Ms. Gebremedhin is responsible for the sections on major mainframe product lines, supercomputers, and plug-compatible computers, which appear in the seven-volume subset of the reports having to do with mainframes.

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When his big processors couldn't wear the IBM logo, he came up with a new label as well —and fathered an industry in the process.

THE EARLY CHAPTERS OF THE PCM STORY

by Gene M. Amdahl

GENESIS In early 1969 while I was director of IBM's Advanced Computing Systems Laboratory at Menlo Park, California, we were going through a cost/pricing cycle to determine whether or not our proposed very large computer could be successfully offered to the marketplace. Our financial analysis was indicating quite clearly that there was no hope for anything but a loss if the single large processor was the only offering. If the next smaller size processor was included, we might break even; and if a third product could be included, normal profit could be attained for all three.

This analysis was being performed on a product plan which involved the introduction of medium scale integration of very high speed circuitry into a highly overlapped sequential processor for the top end of the 370 family. Such an analysis was always performed to determine the viability of a program in IBM's product plan. Further elements of interest were that the design of the processor had only been blocked out, the design of the medium scale integration circuitry was in its early stages, and design automation problems were as yet insurmountable. But the characteristics of the high speed devices and the machine organization were well enough known to justify the performance and cost analyses we were undertaking.

It was recommended to top IBM management that three processors be placed in this technology in order to achieve normal profit; building only one or two processors was not recommended because they would incur a loss or produce only marginal profit. Top management's decision was to consider only the original charge, that of building only one large processor using the technology. My response in turn was to recommend that the Advanced Computing Systems Laboratory project be terminated, for there was no hope that any product contribution could result from its activities. The Laboratory was duly closed in late spring of 1969. Although I didn't recognize it at the time, my prospects of building those large processors I envisioned under the IBM label were closed off with the lab.

The price range considered for the large system, relative to its performance, had to conform to the price/performance relationships of the rest of the 370 line. This was so because the machines were all compatible with one another; thus, the pricing on any one member would affect the pricing of another. If the large system could have been priced independently of an established price/performance curve it could certainly have been profitable, although it probably would not have generated what IBM would consider a "normal" profit.

After closing the lab's project I spent some weeks analyzing what I had learned, and identified several policies I felt should be changed for IBM to profitably put its best technical foot forward at the high end of the computer line. I requested an audience with the then top three executives of IBM, Mr. T. Vincent Learson, Mr. Frank Cary, and Mr. John Opel, which was granted one day in the summer of 1969. They gave an attentive hearing to my presentation of the effects of the existing versions of those several policies and the expected consequence of the changes. The net response to my presentation was general concurrence with my analysis, but a final statement that to change any one of those policies would not be in the best interests of the company.

During the next year I did a great deal of thinking and finally concluded that IBM's financial returns quite clearly would always be optimized by compromising the high-end offering. This represented a dilemma to me because this was the area of my greatest interest and I had a great deal of pride in the quality of the technical undertakings with which I was involved. Basically, I had to make a decision either to live with such frustration, to attempt to change my area of interest to smaller machines, or to recognize that IBM's desire to optimize its financial return represented an Achilles' heel which I could exploit if I were to leave and go into the large computer business in competition with IBM.

EXODUS It is quite likely that I would never have quite found the occasion to actually resign if there had not been a concurrent development in the summer of 1970. Some five years earlier my brother had started a consulting company by the name of Compata, and IBM had granted me permission to become a director of that company so long as there was no conflict of interest. Some time in the early summer of 1970, IBM management was told that Compata had developed a minicomputer which it was offering on the market and therefore that I was in violation of the IBM conflict of interest requirement.

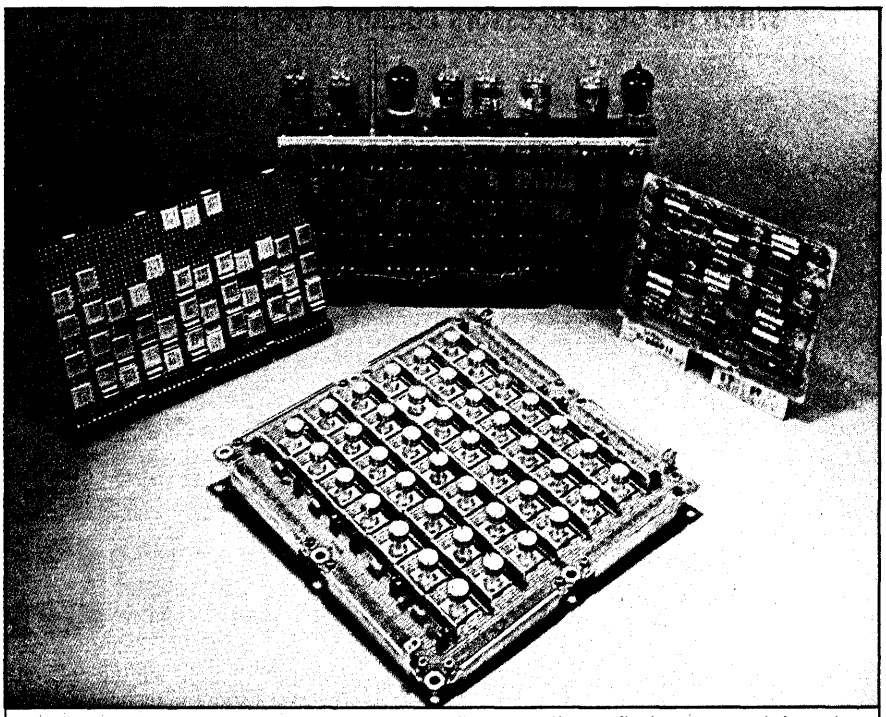
In late summer the company sent me a letter indicating that its investigation of the charge showed no basis for a conflict of interest (apparently the informant had thought the front-end communication mini offered by COMPAT in the spring of 1970 was an offering from Compata) and that IBM would allow me to retain my shareholdings in Compata. They felt, though, that it looked questionable to have an IBM employee on the board of directors of another company in the data processing field regardless of its noncompetitive nature. Since this was a recession period, Compata was in difficult financial circumstances, and I felt it most inappro-

priate to leave its board at such a time. This was the deciding point for my resolve to resign and to undertake the Amdahl Corp. venture. I did so in late September 1970.

It was clear that IBM did not share my view of the high end of the market. After turning in my letter of resignation, which made no attempt to disguise the business I was going into, Mssrs. Learson, Cary, and Opel asked me again to meet with them. That meeting resulted in no change of plans on either side. Reading this in our expressions as we left the room, "Spike" Beitzel, then my group's vice president, hurried after me in the hall. Putting his arm around me, he said earnestly, "Just as a matter of personal concern, Gene, don't go into the large systems business. There's no money to be made in it."

He was not the only person to feel that way, and to say so. Although some of the people on the technical side were convinced the technology could be developed, the financial officers were equally convinced that it couldn't be pulled off profitably. They were almost right.

It has often been remarked that I brought a technical team with me when I left IBM. Such statements are slightly exaggerated, for only a young financial man (Ray Williams) and two secretaries (Marjorie Slaughter and Susie Warren) constituted the IBM contribution. The only other technical person at the beginning was an engineering executive (Ralph Rodriguez) who came from EM&M. The remaining early technical staff came, starting some three months later, from three other young computer companies which failed to attract further financing and went bankrupt during Amdahl Corp.'s start-up period.



Dr. Amdahl has designed computers in all generations: first, vacuum tubes (IBM 704, background); second, transistors as discrete components (as in IBM 7030, board at right); third, integrated circuits (as in IBM 360, 370, and 303X, left); and current large scale integration (as in Amdahl 470, multichip carrier in foreground).

LEVITICUS

The selection of large computers wasn't simply satisfying a personal whim, but rather an optimization under the influence of a number of "laws" governing the marketplace. The large computer market segment possesses several characteristics which present significantly greater opportunity in the data processing field than does any other segment. The characteristics which enhance opportunity in the start-up period for a new computer company are customer self-assurance, greater customer propensity for long-term commitment, easier customer indentification, and large revenue contribution per system for maintenance. After the start-up period, this end of the business still offers the characteristics of market concentration and relatively high growth rate.

To have customer acceptance for a large commercial system, the offering must be compatible with the customer's existing application development investment. These customer investments in application development span well more than a decade within a single architectural approach like that of the 360/370. Their investments in these committed applications total several times their investments in the computers themselves. Even more important, the successful operation of their enterprises have become dependent upon continuous processing of these applications.

The concept of compatibility with these existing investments is a prerequisite to broad acceptance of a new computer within the large system market segment. These customer investments also introduce a very large element of conservatism in this market segment, forcing a manufacturer to make evolutionary rather than revolutionary successors in his product line and largely limiting competitive battle zones to the control of modest architectural change and technological innovation.

To construct a successful competitive strategy at the high end requires attending to the product cost and performance, the product availability and serviceability and, for good measure, the image of technological leadership. In the IBM 370 product line the various entries were spaced with uniform price/performance relationships to integrate them into a powerful force for revenue and profit control. The technology employed was also related through the line, providing sound economic bases for most members of the range, but prematurely limiting both the top and bottom. The economics in this environment practically precludes "wild duck" offerings at the upper or lower ends, for all the products must fly in formation.

That is the case unless you are *competing* against such a line. To make a competing system possessing the desired characteristics would certainly be much easier to accomplish using a more advanced technology than that utilized by the competitor. If a more advanced technology could be developed, a system superior to the originator's largest integrated offering would be most appropriate as an entry, for the marketing reasons already given.

The only weakness to the large system approach is that it is a very high cost development, a high risk development, and a long term development—all of which has to be financed on faith before any "show and tell" revenue can be derived. This in itself calls for a carefully worked out strategy for bringing in capital and revaluing the stock according to a regular schedule in order to preserve the value of early investments and still attract new capital. Such a scheduling strategy requires a certain amount of cooperation from the investment environs, although it can be made somewhat insensitive to moderate investment fluctuations.

NUMBERS

The generation of the business plan for Amdahl Corp. showed we would need from $33 million to $44 million before we would achieve a positive cash flow, depending upon how quickly we wanted to get into the market. Clearly, raising this amount of money in one step was most improbable, particular-

ly in the economic circumstances of 1970. The exhuberant stock market had begun to wane in 1968 with the introduction of the higher capital gains tax and the recession. Having had no experience in the venture capital field, I was really unaware of how grim the situation regarding venture capital had become. Studying the business plan, two appropriate milestones were identified which would permit a three-phase financing starting with $5 million, adding $12 million in the second phase, and the remainder in the third phase. The amounts of money were determined as being adequate to carry us for six months beyond the milestone in each case, to give adequate time for "show and tell" in the succeeding financing rounds.

In approaching the venture capital community it quickly became apparent that very little interest was shown even in proposing a more modest sum. Investors indicated that they did not think there was room for another computer company, in particular not for one that would be in head-on competition with IBM—their contention being that any time IBM had the whim it could pull the rug out from under our feet. In addition investors didn't think it was possible to make a computer compatible with the IBM line; after all, wasn't RCA unsuccessful? It wasn't until we talked with Heizer Corp. that we got any positive interest, and they were interested enough to offer an initial investment of $1 million. We considered that offer in the light of whether or not there was any milestone that we could reach on that amount of capital, and concluded that there was nothing of adequate substance to attract follow-on investors. However, we did ascertain that at $2 million it was possible to identify the first meaningful milestone, that of proving the circuit technology, and have some three months operating time to spare for a second round of what would now be a four-phase financing. The milestone for the $2 million investment was to be the successful demonstration of a precursor model, which would embody samples of the new technology to be developed, interconnected in a representative long logic path through the proposed computer system.

We went back to Heizer Corp. and indicated our unwillingness to try the venture with a $1 million financing, but that we thought a logical financing sequence could start at the $2 million level. The Heizer people agreed, and some three months after leaving IBM, Heizer made its investment of $2 million in Amdahl Corp. The closing of this investment took place the day after our receipt of an overdraft notice from the Bank of America, which informed us that the founders' investment had been totally expended. We had known we were reaching the end of our rope, and had done the last of our negotiating with the realization that if Heizer didn't come through, it was all over for Amdahl Corp. We tried not to let that show.

We weren't alone in this predicament. While these negotiations with Heizer were going on, there were three other young computer companies seeking funding: MASCOR, on the San Francisco peninsula; Berkeley Computers in Berkeley; and Gemini Computers of Orange County. Heizer had considered all three of those investments concurrently with ours and chose ours as the most viable undertaking. In due course, within the latter part of 1970 and early part of 1971, all three of those other companies went bankrupt due to lack of additional financing, and technical people from those three organizations formed the elite team of technology and computer developers at Amdahl.

The financing situation had been so grim that it became apparent that the three months after our first technical milestone would have to be used only for the final negotiations and that the investors for the second round would have to be largely sold on the concept of Amdahl Corp. before the next milestone was achieved. So, throughout the eight months from first investment to first major milestone we diligently scoured all of the venture capital community from coast to coast once again, raising no positive interest.

Fortunately, in that same period we had been contacted by Fujitsu Ltd., within which we had some long standing personal ties. Fujitsu demonstrated an interest in our undertaking and asked if we would consider a joint development program with them and a licensing under our patents. We indicated a willingness, provided this venture would be accompanied by an investment, and Fujitsu agreed to provide $5 million, all of the funds required for the second round of our four phases of financing, enough to complete the logical design of the machine. The timetable for the investment was right on and the investment was concluded one month after the first major milestone was achieved.

Again, using this new milestone and the second round of financing we immediately set out to prepare the venture capital community for our third round. This time there was a little more substance to the achievements of the company and to the magnitude and quality of the investment behind it. For almost one year we labored at attempting to put together the third round, but could make nothing gel.

Finally in September of 1972, one of Nixdorf Computer AG's finders dropped in on us unexpectedly and became extremely interested, almost excited. This was followed up within two weeks by a visit from several of Nixdorf's top technical people and by the arrival of Heinz Nixdorf himself at the end of that stay. Nixdorf was so positive that he agreed to make an investment of $6 million if we would be willing to negotiate a business arrangement with him in Europe within a set of agreed-upon boundary conditions. Nixdorf's principal interest was to establish a relationship between Amdahl Corp. and Telefunken Computers, in which he had half interest.

We required Nixdorf to make his investment as a first step in this negotiation, and he agreed to do this. This commitment made the U.S. venture capital situation gel within the following week. The excitement shown by Nixdorf made Fujitsu somewhat concerned about the closeness of its relationship with us, so Fujitsu requested that we agree to its matching Nixdorf's investment. Of course we were happy to comply. The total funding in this third round was $20 million, enough to build a prototype and ready our manufacturing facility.

Our negotiations with Nixdorf for the business activities did not go as well as hoped by either party. To us it appeared that the Telefunken people who were not involved in the original Nixdorf decision felt very threatened by the appearance of Amdahl on the scene and proceeded to question the market size projections, the possible market penetration, and to some extent even the viability of the technology and the computer design. This made the Nixdorf people, who were unfamiliar with the very high end, feel rather nervous and unwilling to negotiate any longer within the boundaries we had agreed upon. We in turn were unwilling to negotiate outside of those boundaries, so we remained at loggerheads and the situation became totally irreconcilable.

Early in 1973 we decided to try to make the fourth and final leg of the financing a public offering. The 470/6 (a pre-virtual memory model) was expected to be ready for first customer shipment in about one year. We talked to a number of underwriters but were not successful in stirring up much interest in floating a public offering in that stock market environment. We did, however, finally find one underwriter that was interested in developing an underwriting capability in the high technology area, and because of this interest was willing to risk a poor market reception. We proceeded to develop the offering document and had it ready for submission to the SEC when suddenly the underwriter had to cancel the plans; its securities holdings had just dropped sufficiently in value so that they no longer met the capitalization requirements to handle the underwriting.

This occurred in June, and for the next three months we traveled all over Europe, Canada, the U.S., and Japan hunting for any additional private funds, with no ray of hope generated. However, during that three-month period a successful new venture offering was made by Hambrecht & Quist for Modular Computer Corp. When we once more decided to try an underwriter, it showed interest, and we hurriedly reworked our offering document, readying it for submission to the SEC at the end of October 1973.

During November we met with

many investment groups presenting the characteristics of Amdahl Corp., and in early December headed to Europe to hold similar discussions in London and in Geneva. At London the first of our meetings was scheduled as a luncheon. The attendees arrived almost an hour late and with very unhappy expressions. That morning on the London stock exchange had had the largest drop in its market since 1929. We dutifully completed our presentations in Europe but with significantly lower optimism.

On our return to the states, the SEC inspector had not yet completed his list of queries regarding our submission. As fate would have it, one week later we had to start over again at the SEC, for the inspector handling our submission left the SEC to join the newly formed President's Energy Council. All during this period the stock market in the U.S. was falling rapidly, and with this new complication we gave up hope of a public offering and decided there was no alternative but the private market, even though we had no positive expectation from that source either.

This time we turned our attention to our existing investors because the only hope at this point was that they would be willing to make further investments to preserve the funds already at risk. This was a long hard-fought bitter struggle which went on all through 1974 but which resulted in the commitment of some $18 million more, making the completion of the undertaking possible.

Also at the time we gave up hope on the public market, we decided we had to drop the then almost completed real memory version of the 470. This decision was made on the basis that, with the introduction of virtual memory by IBM, the market penetration and long-term commitment characteristics were not adequate to develop an early positive cash flow; consequently, the machine would be a drain on our resources while we would be completing the undertaking of development of the virtual memory processor to follow. This decision left the company with approximately 1½ years additional delay before first customer shipment and a need for almost $25 million more to bridge that time gap. Fortunately, that amount was made available to us by Fujitsu in the form of inventory loans and operating loans.

One of the many ironies in getting our computer company going was that its major backers were also computer companies—in fact, the only two non-U.S. computer companies of any stature which were operating in the black at the time.

DEUTERONOMY 1974 was made up almost exclusively of product development activities. The virtual memory version (the 470V/6) was constructed and debugged. First customer testing of the machine was carried out by a group of German computer experts to satisfy the German Ministry of Science and Technology that the proposed Amdahl product was essentially as advertised. One year later these tests culminated in the installation of our first two machines in Germany, one at DFVLR (the German equivalent of NASA) and one at the Max-Planck Institute, both near Munich.

Even though the product could be successfully tested in November we elected to keep the machine in house for exhaustive testing to find latent design problems or potentially unreliable componentry. In retrospect, this care in making certain that the first machines to be installed in the market would perform reliably may well be one of the most important decisions that governed the future acceptance of Amdahl products.

Our intense marketing effort began in early 1975. This was the period in which we would be testing our perception of the "laws" governing the marketplace. In particular, the two primary laws we would be testing were customer self-assurance and the greater propensity for long-term commitment. This was so because we decided it would be essential, in light of our historical capital funding experience, to develop a positive cash flow. The only way in which the positive cash flow could be achieved was to require that all of the early systems be purchased. This surely required our early customers to have a great deal of faith in their ability to analyze all of the technical and business aspects surrounding their clearly full-term commitment to our product. Fortunately for us there were such intrepid pioneers extant in our marketplace.

For our first installation in June of 1975, due to some governmental financial regulations which had been inadequately prepared for, our first revenues did not appear until the first week of October, although this first machine was accepted by the customer within the 30-day acceptance test period offered for the early machines. In fact, the computer was installed, brought up, running, and made available for customer test within a weekend. Fortunately, the acceptance, not the payment, influenced our successive customers.

Each of those early customers was hard to identify in advance; probably the majority of them had themselves initiated the contact with Amdahl. In turn, each of these early customers was remarkably effective in developing interest in our equipment on the part of the potential next customer. This word of mouth advertising was our most potent marketing tool for the first couple of years.

We found in this period that most of our expectations as to factors influencing customer acceptance were born out rather precisely in the marketplace. There was, however, one deviation that we had not expected—what we discovered was that quite a high percentage of our customers ended up having our computer as their sole large computer, whereas we had expected that such an occasion would be rare or nonexistent.

The purchase-only policy had a very significant positive effect—our first quarter of revenues (fourth quarter of 1975) was profitable for the company, and each quarter thereafter has seen a profit and a positive cash flow. By the time Amdahl finally went public in August 1976, it was not from a need to obtain operating monies but rather was largely aimed at requiring the conversion into equity of the outstanding convertible debt instruments in the hands of our early investors—which had made our balance sheet an awesome credibility hurdle for our customers to leap in perceiving Amdahl Corp. as a viable supplier. The public offering achieved this purpose very effectively. It provided a higher level of recognition of our company on the financial side of the customer prospects' organizations.

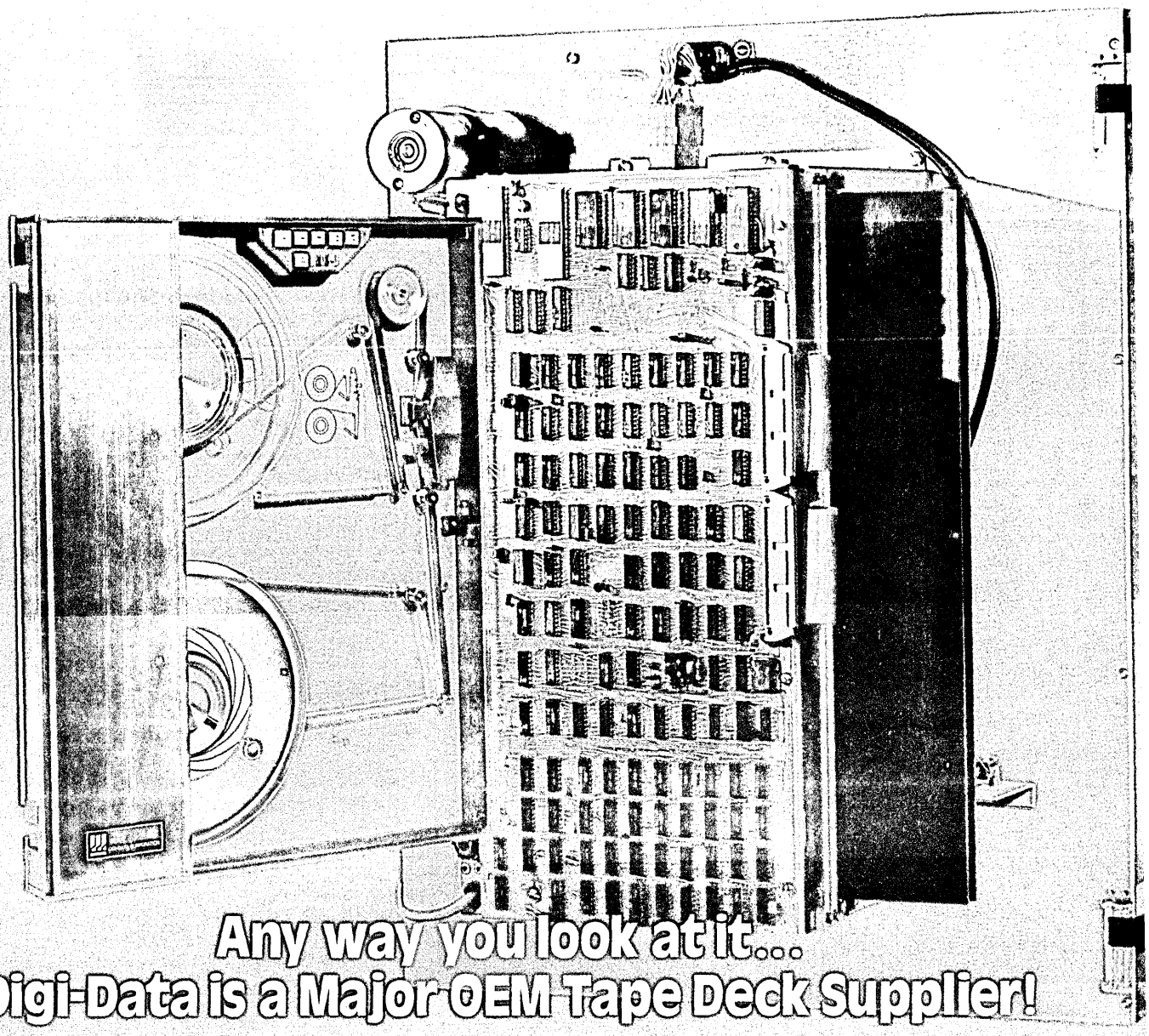
The success that Amdahl Corp. achieved in its early market experience established not only that it was possible to build compatible computers, but also that it was possible to obtain customer acceptance, to provide the hardware and software support adequate to synergize this acceptance, and to grow rapidly while doing it. Perhaps the most sincere recognition of this success was the sudden appearance of other companies emulating our activities. ✲

DR. GENE M. AMDAHL

Dr. Amdahl designed his first computer, the Wisconsin Integrally Synchronized Computer (WISC), after becoming frustrated with the use of calculators as a graduate student in physics at the Univ. of Wisconsin. He joined IBM in 1952, where he was the chief designer of the 704, initial planner for the 709 and 7030 (STRETCH), and manager of architecture for the 360.

He left IBM twice, the first time in 1956 to join Ramo-Wooldridge for a short time and then move to Aeronutronics, the second time in 1970 with the closing of the IBM Advanced Computing Systems Laboratory, of which he was director, as mentioned in this article.

Now he is chairman of Amdahl Corp., the company he founded after last leaving IBM, and principal designer of the Amdahl V series. Among other honors, he holds the W. Wallace McDowell Award from the IEEE Computer Society for his contributions to technical design and computer architecture, and DPMA's Computer Sciences Man of the Year Award, both of which he received in 1976.



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One man's opinion about IBM, the PCMs, and the rosy future.

MEASURE FOR COUNTERMEASURE

by Stephen J. Ippolito

For the first time in the history of the data processing industry, users have the option of choosing cpu vendors without undergoing the costly and painful process of conversion. For the first time, users of IBM systems are not at the mercy of IBM. This state of affairs is new to them and new to IBM as well. IBM fears it, and will react strongly to contain the growing popularity of plug-compatible System 370s. But before we look at how IBM is likely to react, let's look at what has already occurred.

By the early 1960's IBM had become aware of the waste and duplication inherent in manufacturing and marketing multiple lines of incompatible computers. Programs written for one had to be rewritten to run on any of the others. Peripheral devices similarly had to be modified. Salesmen trained to sell one machine had to be retrained to sell others.

From the user's point of view, things were even worse: whenever the user changed machines, he had to convert whatever programs he had accumulated, and also had to retrain his people.

The concept of a standardized, compatible line of general purpose computers promised tremendous benefits for IBM, as well as for IBM users. IBM could design all of its I/O equipment for the same interface, and could write all of its programs for the same machine architecture. The user could begin to forget the problems of conversion.

Although we take it for granted now, System 360 was revolutionary in its day. It marked the first time a major manufacturer had developed a single compatible architecture for all of its computers. The success of that concept, which helped assure IBM's continued dominance of the data processing industry worldwide, made System 360 and its successor, System 370, the *de facto* dp architecture standard.

In the 14 years since its introduction, the System 360/370 architecture has been expanded to incorporate features such as virtual storage; however, it has never been altered substantially. It is possible to develop more efficient architectures than System 360/370, but such development would raise once again the problems of conversion. Any benefits gained from a more efficient architecture must be weighed against those problems. Year by year the cost of hardware declines and the cost of conversion increases. Thus the benefits possible from any new architecture are steadily diminishing.

Ironically, then, IBM's greatest success—System 360/370—leaves the company exposed to plug-compatible manufacturers because that success created *de facto* architecture standards. This despite the fact that IBM avoids standards—the existence of standards increases the ability of other vendors to compete.

It is also important to note that until recently, IBM's System 360/370 faced no serious competition from other computers. The result was inflated prices for System 360/370 processors. IBM profit margins on processors were far higher than its margins on peripheral products and memory, which did face serious competition, again from plug-compatible vendors.

IT'S ALL DONE WITH PRICES

Consider, for example, the price changes IBM made on central processors, on memory, and on disks since introduction of System 370 in 1970. Fig. 1 charts the price curve of cpu's, beginning in 1970 with the introduction of the 370/155, proceeding through introduction of the 370/158 in 1972, and of the 3031 in 1977.

Remember that the cost of electronic components has been declining rapidly since 1970, while the cost of mechanical components has risen over that time.

Fig. 1 shows the price trend of IBM central processors increasing steadily, with a large jump in 1972 representing introduction of the 370/158. IBM had no serious competition in processors over that period.

But notice the change in the trend in 1976—the year IBM first encountered competition from a plug-compatible processor vendor in Itel's AS/5. IBM processor prices have declined steadily since then, and introduction of the 3031 continued the slide.

The figure also tracks memory price trends since 1970; specifically, the price of one megabyte of main storage. Notice the significant drop in 1972—the same year in which processor prices saw a steep increase.

Clearly, IBM was moving revenue away from memory, which faced serious competition, into the central processor, which did not, at least not until late 1976, when IBM cpu prices also began to decline.

Fig. 2 shows the price trend of 800 MB of 3330 disk storage plus controller, a product line which did see competition.

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The lack of competition for IBM processors resulted in high cpu prices and slowed IBM technological advancement.

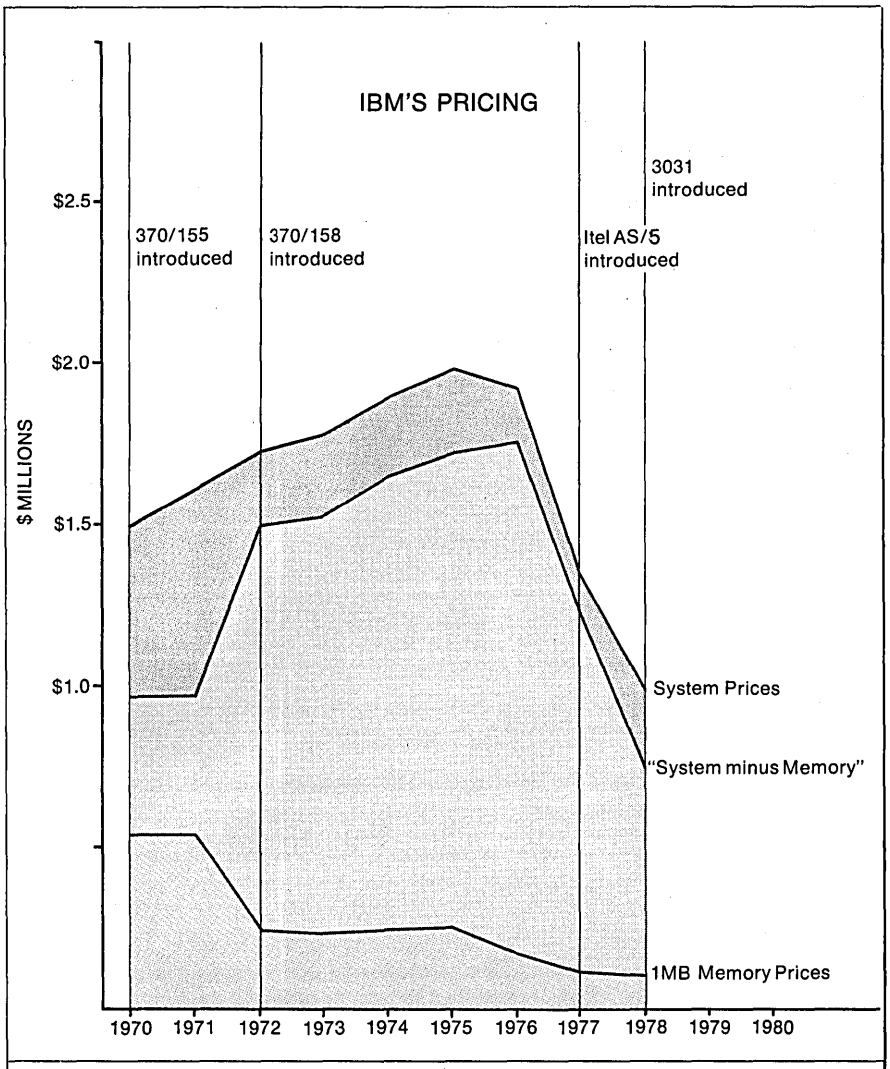

Fig. 1. IBM's pricing history shows fairly clearly how the firm reacts to competition or the lack of it. As memory prices began to fall in the marketplace, IBM raised the cpu price to compensate until such time as plug-compatible mainframes forced it to make system prices competitive too.

The system prices and memory prices are as published by IBM; the "system minus memory" prices have been derived by subtracting from the system price the IBM price for the amount of native memory packaged with the mainframe (1MB in all cases except for the 3031, which comes with 2MB).

Note that price/performance information is not shown. Plotting that data would tend to make the argument even more dramatic. (The 158 was about 15% faster than the 155, the 3031 is about the same amount faster than the 158.)

The general price trend is down, reflecting some IBM price cuts, but reflecting even more significantly IBM's use of Integrated Storage Controllers (SC's) and technological advances such as dual density 3330s and triple density 3350s. The ISC, which for System 370/145 and larger processors is simply a 3830 controller packaged within the cpu, enabled IBM to move revenue from a product threatened by competition into one which was not threatened.

The lack of competition for IBM processors not only resulted in high cpu prices, but also slowed the pace of technological advancement at IBM. True, the 3033 processor uses a new, denser version of IBM's Monolithic System Technology, but the even-newer 3031 and 3032 employ not only the same design concept, but precisely the same type of logic circuitry as that used in the 370/155 and 165, introduced in 1970, and the same memory technology (2Kbit MOS chips) as that used in the 370/158, introduced in 1972. Assuming the 3031 and 3032 will remain in production until 1980, and that seems likely, IBM will have used the same cpu circuit technology for a decade and the same memory circuit technology for eight years. This at a time when electronic circuit technology is advancing at a tremendous pace.

Contrast the pace of technology in IBM's large computers against the recent introduction of the 8100 series. Faced with somewhat established competition in the market for terminal-based distributed processing systems, IBM responded by pushing the state of the art in memory design with its own 64 Kbit device. Clearly, IBM's technological capabilities are awesome. It is just as clear that those capabilities will be released only when IBM is pushed by competition.

THE PCM'S ARE BORN

IBM's dominance of the data processing industry, we maintain, has resulted in *de facto* architecture standards and in high cpu prices. It has also resulted in a serious insensitivity to the needs of the marketplace. By the mid-'70's, for example, a growing number of 370/168 users were running out of processing power. IBM either failed to appreciate this, or chose not to act. Amdahl both recognized, and responded successfully to that obvious market demand. Initial shipments of IBM 3033s began in March 1978, two years after Amdahl's introduction. It is unclear whether the 3033 is a belated response to the marketplace, or simply a response to the competition represented by Amdahl.

By establishing a worldwide architecture standard, maintaining overly high cpu prices, and supporting a product line with dated technology, IBM did much to create the non-IBM System 370 industry. That industry has grown quickly over the last three years. At present, Amdahl competes against the upper end of the System 370 family: 370/168, 3033, and 3032. Itel competes against the 370/158, 3031, and 370/148. Control Data's Omega series, manufactured by IPL Systems, competes against the IBM 370/138, 370/148, and 3031.

In addition to those firms which have installed systems, several others, including newly formed corporations and those with previous experience in plug-compatible markets, have made product announcements. Among them are Magnuson, Two PI, Nanodata, Cambridge Memories, and National Semiconductor.

At least some shakeouts are likely because those vendors, all requiring capi-

tal, are arrayed against IBM—a company with revenues of $20 billion a year, with cash in excess of $5 billion, and with possibly the world's most effective marketing organization.

IBM has already made the opening moves in its counterattack against its new competitiors. Its introduction of the 370/138 and 370/148 in June 1976, followed published reports that Control Data would introduce the Omega cpu to compete against the 370/145 by approximately one month.

In their technology and performance, both the 370/135 and 145 were vulnerable to competition. When the 138 and 148 came along, they were "mid-life kickers" and not totally new machines. They yielded performance gains of up to 30% primarily by doing some things in hardware which their precursors had done in software, but at the same time they reverted from what had been bipolar memory on the 135 and 145 to MOS memory like that used on the 158s. In short, they were primarily warmed over 135s and 145s.

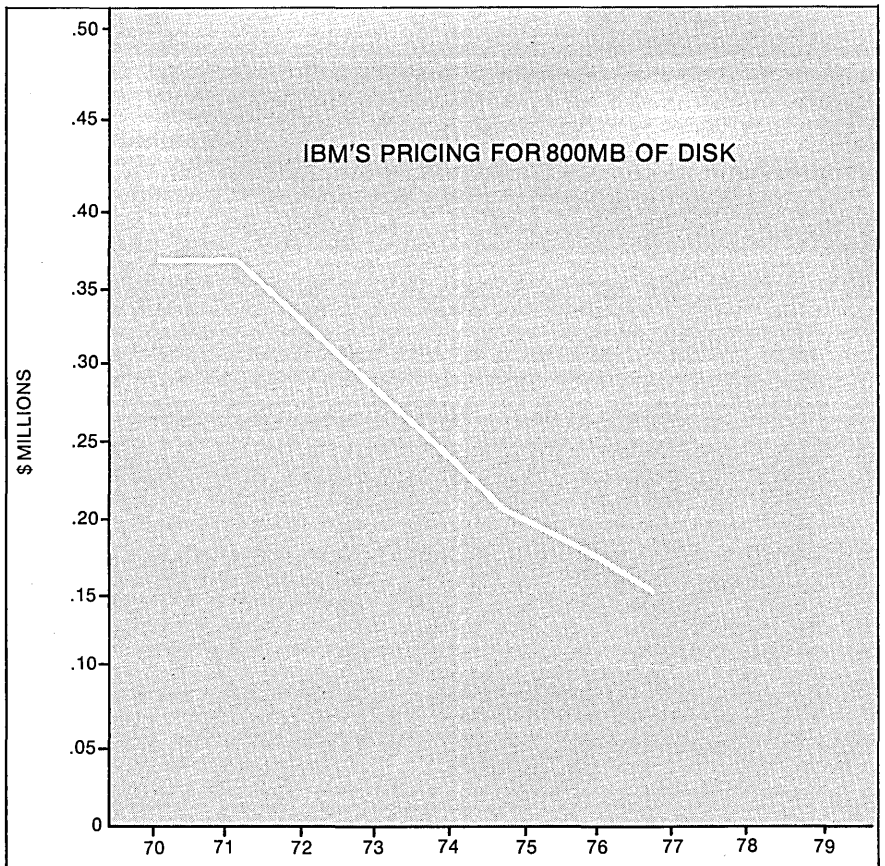

Fig. 2. IBM's pricing for 800MB of 3330-style disk memory is especially interesting in comparison with Fig. 1, as disk pricing clearly indicates the effect of continued competition.

FIGHTING BACK The really important development was the price of the two new machines—purchase prices reduced sufficiently to provide a price/performance improvement of approximately two to one over the old machines. Rental prices, affected far less by competition, showed far less improvement over the older machines.

With introduction of the 370/138 and 370/148 came two innovations which are likely indicators of IBM's future strategy against plug-compatible processor competition. One is Extended Control Program Support (ECPS), a microcode enhancement which permits certain routines frequently used in VS1 and VM370 to be executed in microcode rather than in software. The short term result is a moderate improvement in performance. The longer term result is a blurring of the distinction between software and hardware that makes it more difficult for plug-compatible cpu manufacturers to remain plug-compatible. At the time of announcement, there was a great deal of speculation that ECPS was only the beginning, that IBM would make additional microcode enhancements. This gave IBM an important psychological advantage.

The second noteworthy innovation that came with introduction of the 370/138 and 370/148 was a new line printer that attached not through the standard channel interface but through a native integrated adapter that, in effect, bundled the printer with the cpu. The printer was not sufficiently novel to be a great attraction, and IBM had made no additional attempts to bundle I/O equipment with its central processors. But users and plug-compatible cpu vendors both know that the possibility remains.

IBM's next major countermove against the plug-compatible cpu industry came in March 1977, with introduction of the 3033—a new design offering price/performance better than that of the Amdahl machine, and better by a factor of two than IBM's 370/168. The only noteworthy feature announced with the 3033 was the System 370 Extended Facility, also made available on the 370/158 and 370/168. The Extended Facility is a microcode enhancement similar to ECPS except that it works with MVS and VM370 rather than with VS1 and VM370. An important difference, however, is the fact that the user must rent a $1,000/month software package from IBM to make the Extended Facility work. This represents a significant IBM strategy: a shift of revenue from hardware into software.

Shortly after IBM's announcement of the 3033, Amdahl announced an improved version of its machine—one able to run faster than the 3033. It was a tactical move, and a good one. Neither machine would be available until nearly a year after announcement; therefore, Amdahl could remain competitive. In announcing its new machine, Dr. Amdahl said he had no plans to implement the Extended Facility because he considered it merely an IBM ploy.

Introduction of the 3033 prompted a dramatic reduction in 370/158 and 370/168 sales, and also caused problems for Itel's AS/5. The IBM introduction resulted in uncertainty. Prospective customers reasoned that with the 3033 announced, the 3032 and 3031 could not be far behind. Purchase decisions were postponed until IBM made the future more clear. This despite the fact that IBM announced a 30% reduction in 158 and 168 purchase prices. While lowering the purchase price to remain competitive against plug-compatible cpu vendors, IBM retained its existing 158/168 rental and lease prices. Since the 158/168 market is not primarily a purchase business any-

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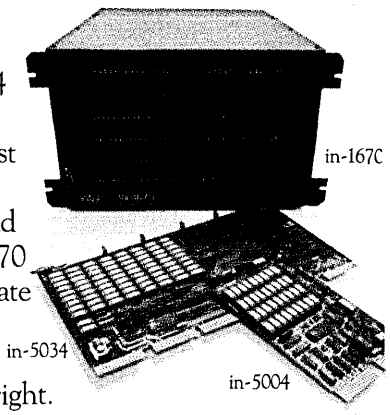

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One move is to begin blurring the distinction between hardware and software.

way, the result for IBM was minimal revenue loss.

In October 1977, IBM announced the 3031 and 3032. Both are strikingly similar to the 158 and 168, respectively, which they replace. They do not contain new technology, but offer modest performance improvements together with large reductions over the 1976 prices of their predecessors. Again the result was an improvement in price/performance ratio of better than two to one. First deliveries were made in March 1978, coincident with delivery of the 3033, announced six months earlier.

No new features were announced with the 3031 and 3032. IBM could have provided the same price/performance improvement simply by lowering 158 and 168 prices. But by introducing new machines instead, IBM was able to effectively lower both sales and rental prices without incurring an immediate reduction in revenue from its installed base. The new, lower priced machines will gradually replace the older machines in IBM's installed base. Thus, IBM can compete with others and not hurt itself. At the same time, the introduction places plug-compatible competitors on the defensive. Each has to introduce a comparable new machine, or else explain to prospects why its old machine remains preferable to IBM's new machine.

Nevertheless, introduction of the 3031 and 3032 cleared the air of uncertainty over IBM's future direction and reaffirmed the continuation of the System 370 architecture standard. In mid-1976, many observers questioned the life expectancy of the 370/138 and 148, and of the System 370 architecture itself. Since then, IBM has announced three additional machines, all of which follow System 370 architecture. Nearly all observers now agree that architecture will remain the worldwide edp standard for years to come.

THE FIVE STRATEGIES

Since that architecture will remain the standard, it is apparent that plug-compatible cpu vendors will continue to plague IBM. A review of the countermoves IBM has taken to date reveals five strategies: IBM will cut prices on its existing products, announce new machines, bundle software into hardware, bundle peripheral devices with cpu's, and begin charging for operating system software.

A common thread runs throughout all five strategies, and that thread also affirms the future of the plug-compatible cpu industry. Every countermove is carefully planned to inflict minimal harm on IBM, especially on its huge installed base. IBM must continue to weigh carefully the effects on that base of any and every move it takes against competition.

IBM recently lowered purchase prices on its 370/138 and 148 to bring those machines into line with the price/performance curve resulting from introduction of the 303X series. With that exception, IBM price cuts have come on the down side of product life cycle curves. Price reductions earlier in product life cycles would create opportunities for independent leasing companies. Reductions in rental prices for healthy mature products would impact IBM's revenue stream.

Normally, product costs governs a company's pricing policies. This is not true of IBM, especially for central processors. IBM's processor costs are approximately 15% of its selling prices. Theoretically, IBM could drive plug-compatible cpu vendors out of business with price reductions alone. But competitors' costs are equally low, and the price reductions necessary to destroy all competitors would be enormous, even for IBM. IBM's long term plans are based upon continuing growth in sales and profits.

There will always be some customers willing to pay a premium for the IBM name, and there will always be some customers unwilling to pay such a premium. The number of customers in each camp depends upon the size of the premium. In general, computer users can expect a continued improvement in processor price/performance ratios. Now that improvement will be initiated by plug-compatible cpu vendors seeking to increase their market share, and sustained by IBM's adjustment to meet those new levels of competition. Regardless of the degree of adjustment, the IBM price umbrella will be maintained. Also IBM will make whatever adjustment will impact its own revenue base least, and in many cases that will mean introduction of new models.

At the same time, IBM will continue trying to differentiate its products from non-IBM System 370s through design changes—in other words, will try to make compatible cpu's less compatible. IBM's third strategy against plug-compatible manufacturers, incorporating frequently used operating system routines in microcode, represents one means to that end. In general, routines can be executed faster in microcode than in software. If the routines thus implemented are used frequently enough, the resulting performance improvements could be significant. Throughput can be improved by about 5%, for example, through use of the ECPS feature with VS1.

But a penalty comes with that throughput improvement. In the case of ECPS, the penalty is a loss of compatibility. The 370 family currently consists of seven models, and if ECPS were to be implemented on all seven, the VSI routines incorporated into ECPS would have to be written, debugged, and tested, by IBM seven different times. Then the System 370 instruction set would no longer serve as the common denominator between models. APARs, PTFs, engineering changes, and software releases would be at least seven times more difficult to implement and coordinate than if there were no ECPS. Add the complexity that comes with IBM's current support of five operating systems, and it is theoretically possible that operating system design and support could become 35 times more difficult than it is now.

Obviously, IBM would not allow that to happen. It will implement microcode versions of only a very few software routines, most likely those that are very simple and stable, since changes are so difficult to implement in microcode. Further, IBM will offer microcode versions of operating system routines only on the 370 models most likely to use that particular operating system.

A crucial implication of this limited approach is that IBM will not be able to eliminate from its operating system distribution tapes the software routines supplanted by microcode. Those routines must remain in software to accommodate the various 370 models not possessing the microcode enhancements. This means the non-IBM system 370 manufacturers will not have to implement the microcode enhancements to remain compatible. The decision to implement them or not will depend upon the benefits to be gained and the costs involved. IBM's tactic will have a temporary psychological affect as users assess the implications of each microcode enhancement, but those enhancements will not be a mortal blow to plug-compatible vendors. For instance, IPL Systems chose to implement ECPS on the Omega cpu simply to assure prospective users that that machine can remain compatible with IBM's; performance considerations were secondary.

IBM can also try to make compatible cpu's less compatible by introducing additional peripheral devices that do not attach through the standard I/O interface. To date, this fourth strategy has been adopted only for smaller 370 models where higher volume permits amoritzation of the design cost and where elimination of the control unit normally required results in a significant systems cost reduction. To date, IBM has applied this tactic against plug-compatible peripheral vendors, and not against compatible mainframe vendors.

Through this tactic, IBM gains time. If the market is large enough, plug-compatible mainframe vendors can have products on the market with the new interface approximately a year after IBM. While gaining time, through, IBM loses not only development and support costs but also the ability to sell the new device to users of its older cpu's. IBM knows that if it ignores that market, competitors will rush to fill the void. Whether or not IBM chooses to accept that loss depends upon the degree to which it sees itself hurt by plug-compatible equipment manufacturers.

The fifth countermeasure is institution of charges for IBM operating system software. Previously, IBM moved revenue from memory and peripheral devices facing competition into the cpu, which had been safe from competition. Now that the cpu is also threatened, the logical move for IBM is to lower cpu prices and begin collecting revenue from software. IBM's current operating systems, however, are provided free of charge and are in the public domain.

Even with software free, IBM has a difficult time convincing users to update to the latest system release. User reluctance would increase if IBM attempted to charge for each release. Further, those charges would create a potential market for independent software suppliers. Although it would be difficult for independent vendors to create an operating system, it would be possible for them, and for plug-compatible mainframe vendors, to update operating systems already in the public domain.

IBM would face additional problems in trying to move revenue from hardware to software, for example by establishing different operating system prices for different cpu's or accommodating users who run multiple operating systems under VM or determining how to charge users who rent time on cpu's. IBM could solve some of those problems by adopting use charges, rather than a monthly fee, but that solution brings with it new problems. How would IBM count the number of times an operating system is used? Beyond those problems, software use charges would prove costly, if not impossible to collect.

Although it is likely IBM realizes the impossibility of shifting hardware revenue to software dollar for dollar, it will try to maximize software revenues to offset the revenue decline from lower cpu prices. IBM will gradually introduce operating system modules offering additional function or improved performance over existing modules, and these will likely be offered at modest monthly fees to encourage their adoption.

Independent software houses and plug-compatible mainframe vendors alike will watch those developments carefully. If IBM is successful, it will create an opportunity for new business and a threat to PCM makers. To exploit the opportunity and contain the threat, it is likely that PCM vendors will form a cooperative venture that may possibly *include* independent software houses.

None of the five countermeasures outlined above will have serious impact on the non-IBM System 370 market. Instead, that industry will grow and prosper for the forseeable future, to the benefit of 370 users. Competition will instill new vigor in the industry. Price/performance ratios, stagnant throughout most of this decade, will continue to improve rapidly. The application of new technology will accelerate. IBM, PCM vendors, and non-370 cpu vendors alike will be hard-pressed to keep pace.

The factors favoring the growth of non-IBM System 370s are beyond IBM's control. There is no overall strategy IBM can adopt which will prevent the industry from growing. Knowing this, IBM will react tactically, rather than strategically. It will time price cuts and new machine announcements carefully. It will tune delivery schedules to cause maximum damage to its competitors. It will foster confusion and doubt in the market through its tactical moves. It will announce new features and spread rumors of others to come. It will dispatch its thousands of salesmen to convince customers that any move away from IBM is foolhardy. Despite all of these actions and more, IBM will lose a significant portion of the System 370 market to plug-compatible suppliers. ❋

STEPHEN J. IPPOLITO

Mr. Ippolito is the founder and president of the IPL Systems, Inc., of Waltham, Mass. His firm manufacturers the Omega 480 series of IBM 370 compatible mainframes, of which he is the principal architect. Prior to founding IPL, he worked as a design engineer on the 370/155 and 158 projects at IBM.

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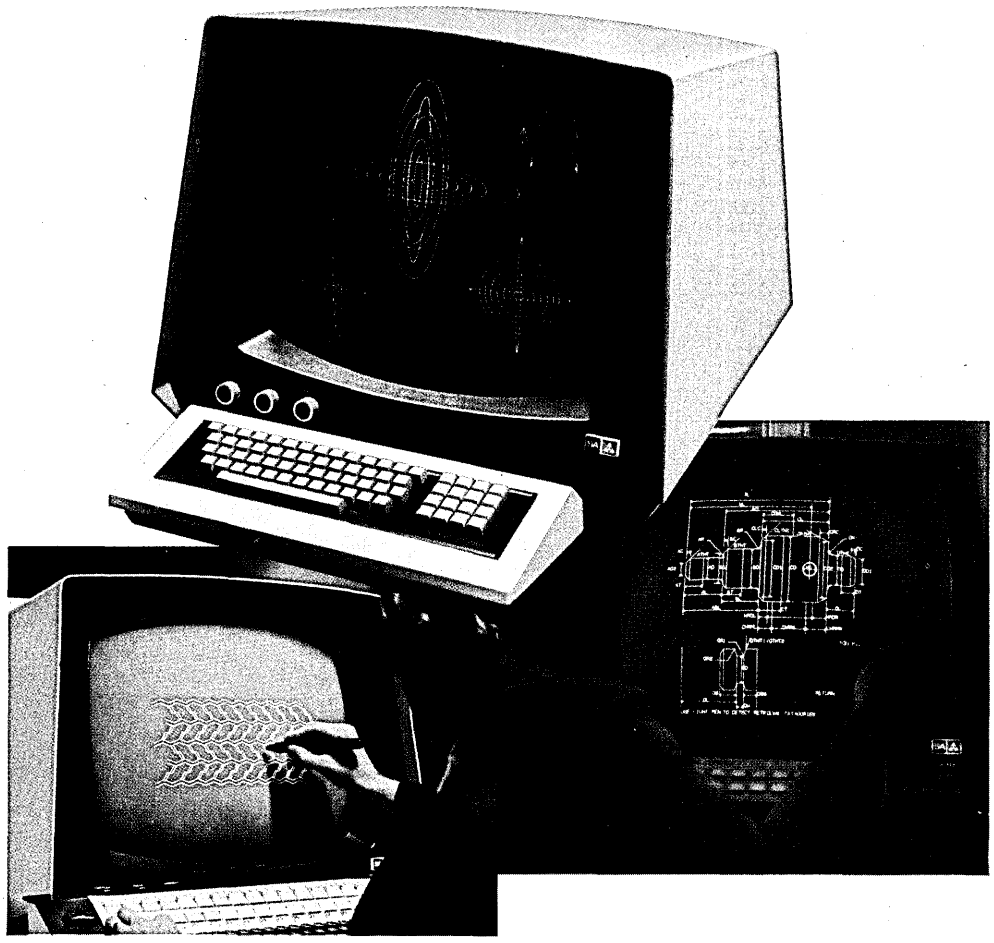

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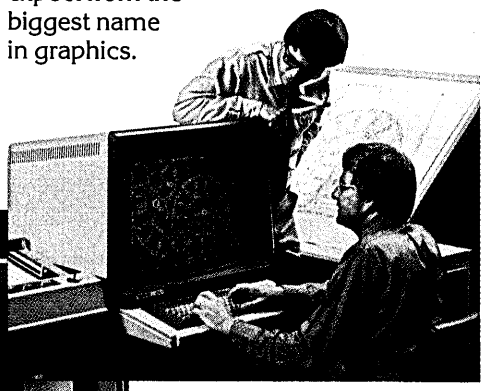

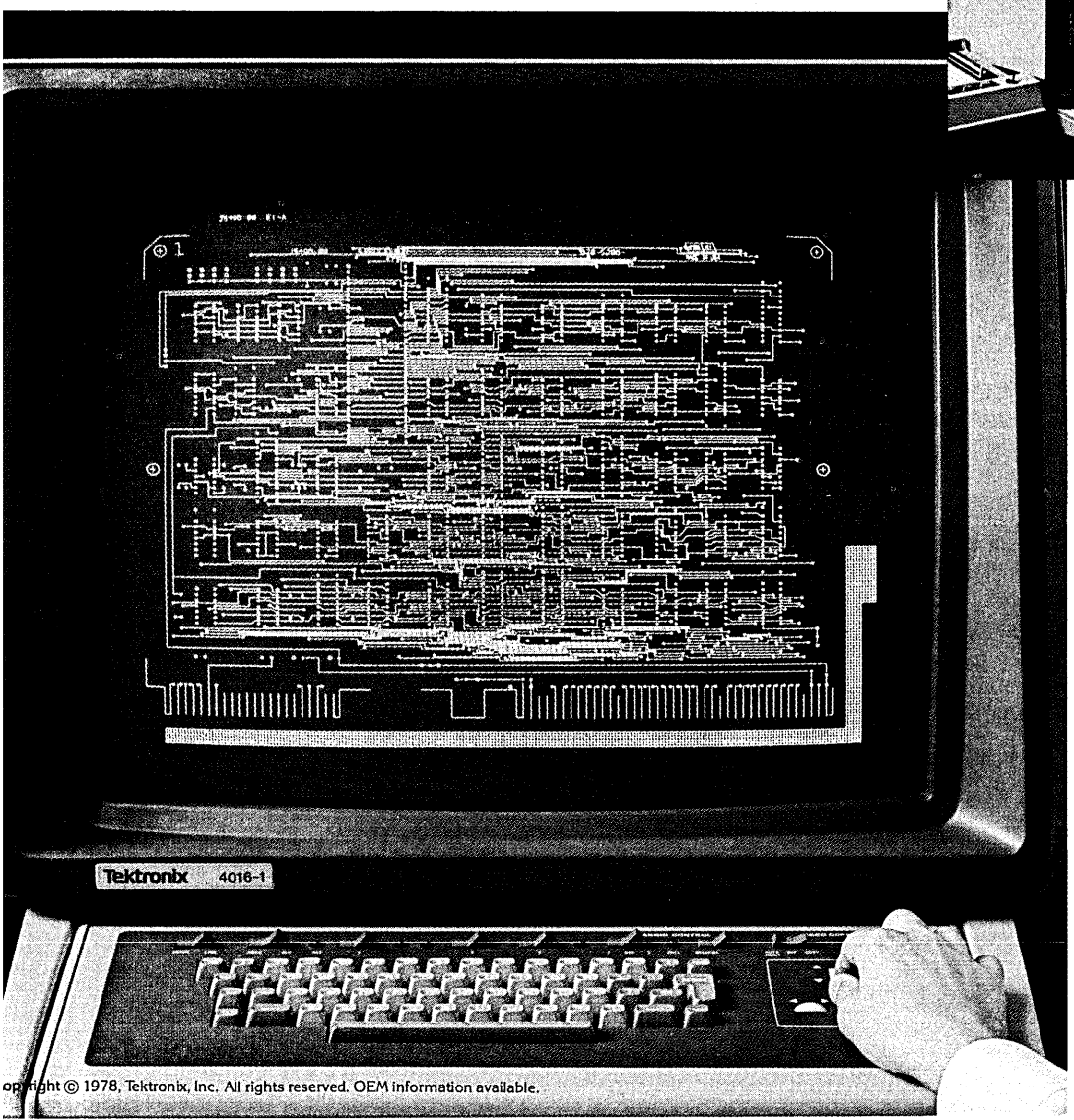

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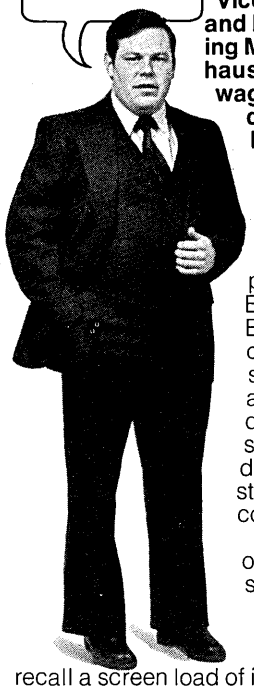
EDP professionals have a word for the new Wang VS computer.



Richard Berger, Vice President and Data Processing Manager, Bughaus, Inc., a Volkswagen service center network headquartered in Hartford, Conn.

"Because we had been using a computer—the Burroughs B1700—with card input sequential files and no video displays, we suffered long delays and storage constraints.

"Now, with our Wang VS system, storage is virtually unlimited, and we simply recall a screen load of information on the CRT to make a change in seconds—all of this without interrupting our normal flow of work.

"We've put everything in our business onto our VS system, including payroll, accounting, sales and wholesale and retail inventory control. And we did it in 90 days without changing languages and with only minor modifications in almost 90 COBOL programs."

"We are absolutely amazed at the throughput rate we've achieved with our Wang VS. On our very first job for one of the country's largest student insurance agencies, the VS arrived in Pittsburgh on December 23 and was completely installed and operational on-site on February 15, with 61 programs written, debugged and tested—all by only two people—and not a single line of code had been written until the machine came in the door.

"The VS really fulfills all of our requirements, particularly in areas where other systems are weak: cost/performance, language-availability, user-utility software.

"I think the real key for the DP manager is the utilities available with the VS, its speed and its interactive COBOL compiler. These three things combined make for a very powerful tool."

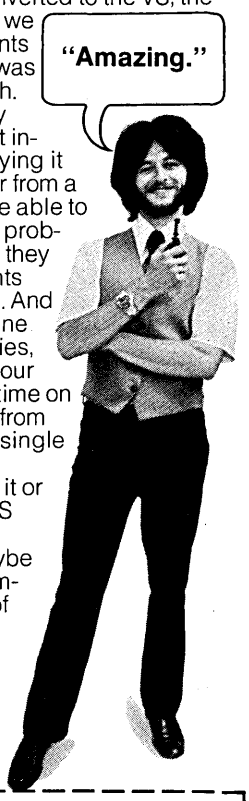
J.P. Scott, Data Processing Manager, Aptech Computer Systems, Inc., Pittsburgh, Pa.

Kenneth W. Cakebread, Manager of Data Processing, Trans-Air Forwarding and Brokerage, Inc., Inglewood, Calif.

"I had 30 days to convert about 220 programs from our old batch-oriented Honeywell 62 system to our new Wang VS system. Not only did I do it: Thanks to the programming power of the VS, I actually came up with more.

"Before we converted to the VS, the biggest problem we had in the accounts receivable area was misapplying cash. No more. Now, by capturing current information and keying it into the computer from a workstation, we're able to sort out potential problems long before they get to the accounts receivable stage. And with Wang's on-line editing capabilities, I'd say we've cut our average editing time on a per-item basis from 30 seconds to a single second.

"And believe it or not, while the VS gives us faster access and maybe triple the programming efficiency of our old system, it was only half the cost."



EDP professionals in more than 100 companies are singing the praises of the Wang VS. And for good reason.

The VS is a remarkably sophisticated, fully expandable virtual storage computer designed to provide maximum interaction in a mainframe environment.

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We also think you'll appreciate how simple the VS is to operate. In fact, because of its level of sophistication, it can be operated by people with little or no computer-related training or experience.

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For more information on the VS, return this coupon to Wang Laboratories, Lowell, MA 01851.

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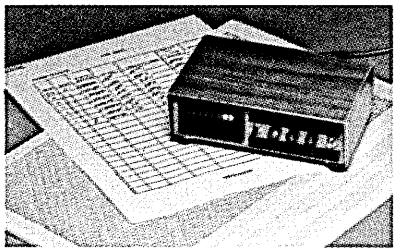

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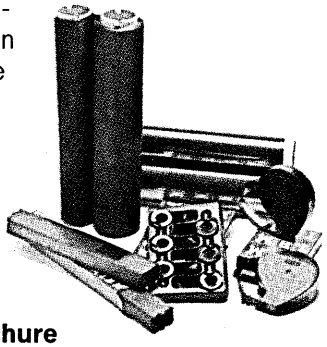

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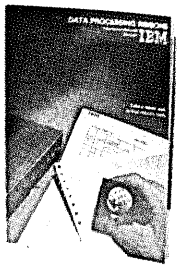

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When the family of plug-compatible cpu's expanded into the lower end of IBM's line, it found a whole new world waiting.

THE IMPACT OF PCM'S ON DISTRIBUTED PROCESSING

by James S. McGuire

What appear to be two unrelated, successful market trends—Plug-Compatible Machines (PCM's) and distributed processing—may be related after all.

The exact nature of that relationship depends upon the definition of distributed processing. Unfortunately, the only agreement about distributed processing seems to be that there is no standard, generally agreed-upon definition of that slippery term. Just about every class of vendor—large mainframe, minicomputer, smart terminal—claims that distributed processing is whatever his product makes possible.

For the mainframe vendor, distributed processing means putting limited chunks of processing capability out at the end of the line, in the end user's department. The control—and the programming—remains at the central shop. With the announcement a few months ago of the 8100, IBM seems to be pushing this concept of distributed processing, because the 8100 cannot run application systems programmed for the mainframe. The 8100 can be programmed to do many things, however, so it is more than an intelligent terminal.

For the minicomputer vendor, distributed processing means the ability to use one of his systems to provide an end user division or department with its own somewhat independent but connected processing center. The user is counting on lower hardware costs to offset conversion costs, which he hopes to ease by the use of higher level languages and compilers.

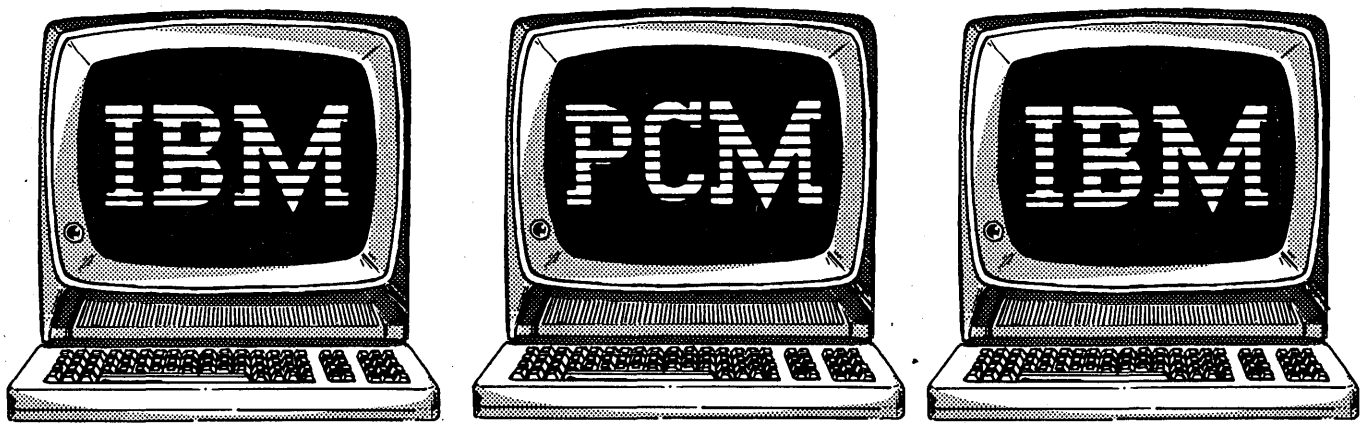
And at least one maker of small processors is now offering systems software and communications links that would allow a distributed network to be built from the bottom up.

What we think the end user wants is rapid access to and control of the data that he needs to do his job. The minicomputer and bottom-up network design seem to provide an answer to these two critical needs. Lower logic and memory costs bring standalone data processing within the grasp of most large departments and small organizations.

But both of these approaches put the end user in the software development business, a business for which he is ill-suited. He may not have any software people, may not know how to supervise or control them, and may not even want them—if there are any around. Those who might be available are probably not interested: what is the career path of an applications or systems programmer in an accounting organization? What good applications programmer wants to work on payroll or general ledger systems forever?

The dp manager, meanwhile, is trying to satisfy the rapidly increasing requirements of the end user. But he's caught in the middle. He is acutely aware of the hidden costs—both short-term and long-range—of letting the user suddenly cut the umbilical cord. He's learned all too painfully the lessons of incompatibility. He wants to help the end user, or get him off his back. But which vendor's approach to distributed processing makes the most sense for his organization?

While he's trying to figure *that* one out, he may try to add capacity, beef up his facility by turning to PCM's. Until recently, these economically attractive alternatives to adding another IBM main-



frame (or upgrading to a larger model) were clustered in the medium-to-higher end of the 370 line. And adding to the processing capabilities of the central shop did little or nothing to fend off the growing pressure of the user revolution, or to push forward distributed processing.

Recently, however, there have begun to appear plug-compatibles in the *lower* end of the 370 line. Packaged and priced like minis, they still provide all of the mainframe's capabilities, but in smaller power increments. And they may offer a new approach to distributed processing.

WHAT THE USER REALLY NEEDS

But before investigating that possibility, let's first forget the equipment or vendor point of view, and try to establish the requirements of distributed processing. Let's try to do that by asking just what it is that a typical organization with a medium to large-scale mainframe would like to accomplish. Here are some of those technical objectives:

- Be able to put an appropriate level of processing capability at the places it is needed—where it can be used without professional dp assistance—without screwing up the central dp operation. The processing units would range from RJE through intelligent terminals, to minis, superminis, and medium scale mainframes.
- In order to allow these units to be properly coordinated—to allow them to share resources developed at great cost —they should be linked in some way. We think they should be linked in a way that allows centralized coordination, and maximizes effective use of the network.
- Such coordination means that these node processors should be compatible —with each other, with a host computer, and with appropriate communications protocols. By compatible, I mean that any node should be able to use some subset, at least of the languages, compilers, programs and data bases maintained at other nodes in the network, including the host.
- Each node should be designed or selected to fulfill one or more of the following roles: data collection and polling, some level of standalone (batch) processing, load-sharing, applications development, interactive use, data base management (including access to other, shared data bases). A node might want to make use of more than one of the standard programming languages or communications protocols.

REAL-WORLD EXAMPLES

Let's translate these technical goals into the real-world requirements of a couple of large organizations, which we'll label the ABC and XYZ corporations.

ABC is an organization which does hundreds of $millions of business annually. It has large facilities in several geographic regions. Currently, inventory control for these dispersed facilities is performed at a centralized shop that gathers the necessary data from a leased-line network of 3790 RJE terminals. But the cpu is getting overloaded, and communications costs are high.

So ABC is considering putting a small PCM in the largest regional facility to handle its inventory control application. The PCM will cost less than adding another mainframe or upgrading the current cpu. And communications costs will be drastically reduced. Perhaps more important is that there will be no additional applications development costs for the new regional processing facility: it will run the cpu's inventory control program, which is written in COBOL.

If the inventory control workload does not saturate the regional PCM, ABC may find that it can handle the inventory control work for another region, or be used for other local applications. Once the regional PCM is saturated, it would be simple to add another in another region.

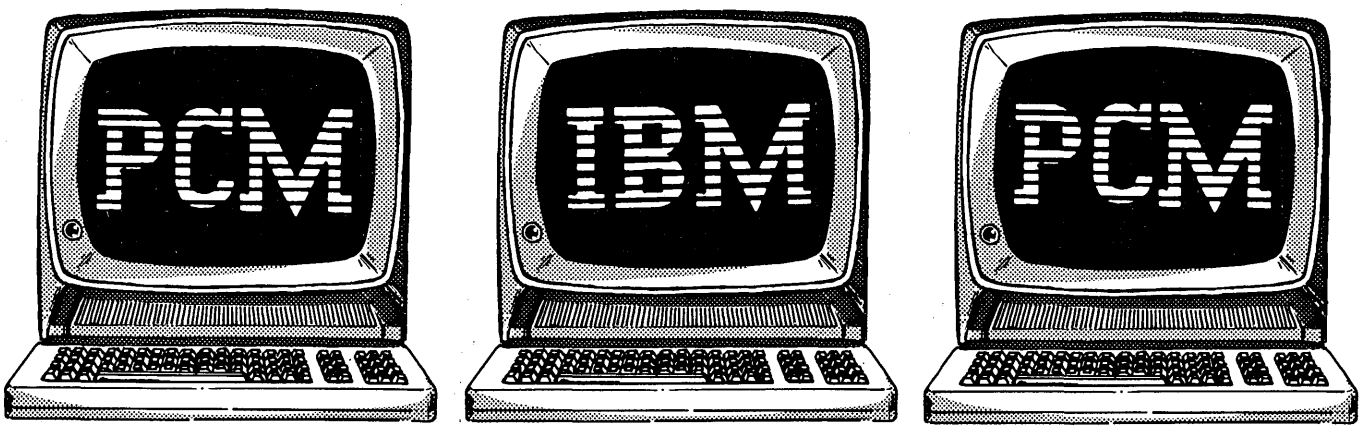
If the PCM is part of a series, the region can start out with a system at the low end and let it grow to match increasing workloads, without ever duplicating software development efforts. As regional facilities grow and their information processing requirements increase, other centralized systems can be easily off-loaded.

All of this assumes, of course, software compatibility, or, to use another and perhaps more meaningful phrase, portability.

At another large company, XYZ, a mainframe at headquarters performs production scheduling for seven different manufacturing plants, all tied to a synchronous network using 2780 protocol. In an attempt to make more mainframe time available for other applications, XYZ is considering installing a dedicated PCM at headquarters to handle the production scheduling for the seven plants.

Eventually, they foresee the need for these plants to have their own data processing facilities. As the workloads justify, they will be able to install additional PCM's in regional plants. At some of these plants FORTRAN programs looking for their own homes are beginning to appear.

If the initial workload for the first regional PCM does not justify its acquisition, that regional computer might become the host for a dedicated 2780 network, handling the production scheduling for the other plants and doing some of its own processing as well. It could serve as the site for the development of application programs that could be used by any of the plants-applications such as payroll and in-



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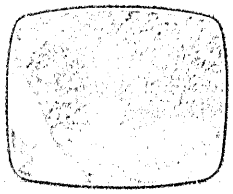
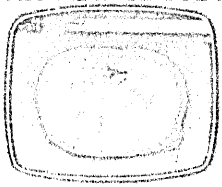


The Ramtek 9000 Series Display Controller. Four models. Total modularity. Buy just what you need, add to it at any time. The high-performance family.



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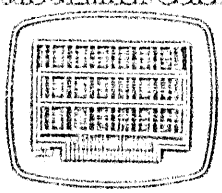
The Ramtek 9080 Series Display Controller. Four models. The most popular elements of the 9000 Series are here packaged for economy. All are software compatible with the 9000, have expandable memory and interactive capabilities.



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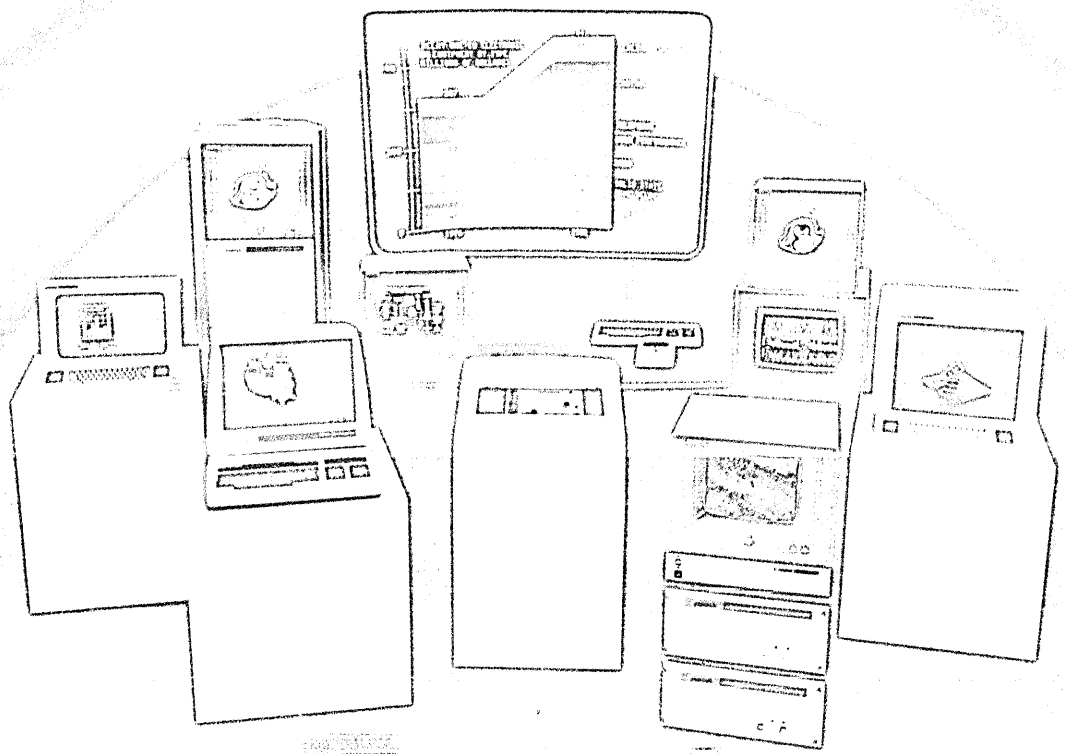

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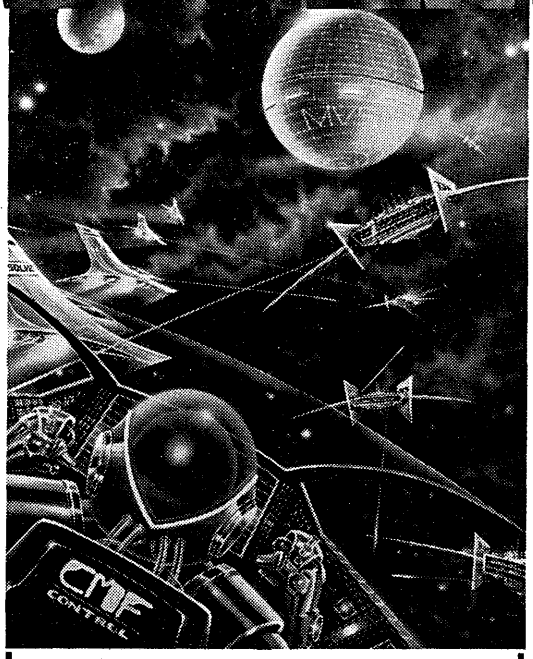

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CIRCLE 23 ON READER CARD

The dp manager is acutely aware of the hidden costs of letting the user suddenly cut the umbilical cord.

ventory control, for instance.

As the subhost of such a network, the small PCM's should be not only compatible with current centrally developed and operated programs, but offer additional operating system capabilities as well. These might include self-monitoring that would allow tracking dp resource usage (and billing internal customers), down-time statistics, error messages, and systems software updates.

Eventually, the regional PCM may have to serve several functions: as a local, interactive machine controlling an internal time-shared network; as a batch processor; and as a front-end link between the headquarters host and local terminals. So the operating system must be sophisticated, as sophisticated as that of the host.

Naturally, the host of the dedicated subnetwork would have to maintain the data base of inventory and sales orders upon which the production scheduling is based. So the regional, second-level "host" must have all of the data base management system capabilities of the centralized mainframe.

A major concern of both companies is the development of better centralized controls for all business systems. The firms want to be able to monitor corporate cash requirements, inventory flow, and sales trends. Some of the software to provide these controls is available, and some is being developed at the central sites. The advantage of the PCM approach is that it will allow all of this control software to run on any of the nodes, under centralized control, without problems of software or communications compatibility.

BEST OF BOTH WORLDS

These examples suggest that PCM's in the low end of the mainframe range offer a new approach to distributed processing. This approach allows the end user to take advantage of mainframe technology, but at a reduced cost. It provides a compatibility with the mainframe that allows easy establishment of a network. And it takes advantage of software already developed, and being operated and maintained at the central computer shop.

Using small PCM's in this fashion should give the end user the quick access to and control over his own data that he wants, without putting him into the software development game. It can also provide the centralized coordination and control seen necessary by data processing management.

And that, it seems to me, is what distributed processing is all about. ✱

JAMES S. MC GUIRE

Mr. McGuire is president of National CSS's Computer Div. He began his data processing career as a salesman at IBM and Computer Science Corp. After joining NCSS eight years ago, he moved from salesman to district sales manager to product manager for the NOMAD relational data base system, and went on to head the firm's 3200 minicomputer project before assuming his present position.

SCIENCE/SCOPE

The planet Jupiter will be scrutinized as never before by a spacecraft to be launched from the Space Shuttle in January 1982. NASA's Project Galileo will consist of an orbiter and a Hughes-built probe that will journey together for 42 months to the massive planet. Scientists hope the mission will provide new insight into the origin and evolution of the solar system, as well as reveal why Jupiter mysteriously emits more energy than it receives from the sun.

The probe, after separating from the orbiter, will plunge deeply into the hostile Jovian atmosphere. Its six instruments will take temperature and pressure readings, analyze cloud and atmospheric composition, detect for lightning, and glean other data. The probe will be designed to withstand the force of Jupiter's intense atmospheric pressure for about one hour. The orbiter will relay probe data to earth and will continue its mission and circle Jupiter for 20 months, taking pictures and analyzing the atmospheres of the red-eyed planet and its four largest moons.

Using signals transmitted in sequential bursts lasting 1/30,000th of a second, a Hughes multiplexing system designed for jet aircraft is able to control more than a dozen channels for passenger entertainment and service over a single coaxial cable. Because the signals are too rapid to be discerned separately by the human ear, the channels for high-fidelity stereo music, movie sound tracks, and passenger address announcements all seem to operate simultaneously. Other channels regulated by the system include reading lights and flight attendant call buttons.

By eliminating the need for separate wires to each channel, the system is able to save several hundred pounds of weight. It also offers better reliability, lower operating costs, and improved passenger services. Hughes systems have been installed on every McDonnell Douglas DC-10 in the world today, and now six international carriers have specified the equipment for their Boeing 747s.

Hughes Radar Systems Group has career opportunities for engineers, scientists, and programmers. We design and manufacture many of today's most complex airborne and spaceborne radar electronics systems, including data links, electronic warfare systems, and display systems. These projects incorporate microelectronics, microprocessors, solid state microwave devices, and other advanced technologies. We need Systems Analysts, Microwave Specialists (antenna, receivers, transmitters), Circuit Designers (analog, digital & RF/IF), Scientific Programmers, Mechanical Designers, Product Design Engineers, and others. Rush your resume to Engineering Employment, Hughes Radar Systems Group, 2060 Imperial Hwy., El Segundo, CA 90245.

A contract to develop and build 100 satellite earth terminals has been awarded to Hughes by Satellite Business Systems. SBS, a partnership formed by Aetna Life & Casualty, Comsat General, and IBM, will receive the communications industry's first four-year warranty. The terminals will operate with the system's three satellites, also being built by Hughes to service U.S. businesses, government agencies, and public service organizations.

The unmanned terminals will be the first to use Ku-band frequencies (12 to 14 GHz) on a large scale in a U.S. domestic satellite. This makes possible small terminals located on customer premises, thus eliminating the need for a microwave link. With these highly-reliable redundant terminals, SBS data communications customers will benefit from a very high availability rate. The first engineering model is scheduled for delivery in nine months. All 100 terminals should be delivered by mid-1982.

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16. Cincinnati, OH
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20. Corpus Christi, TX
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39. Jacksonville, FL
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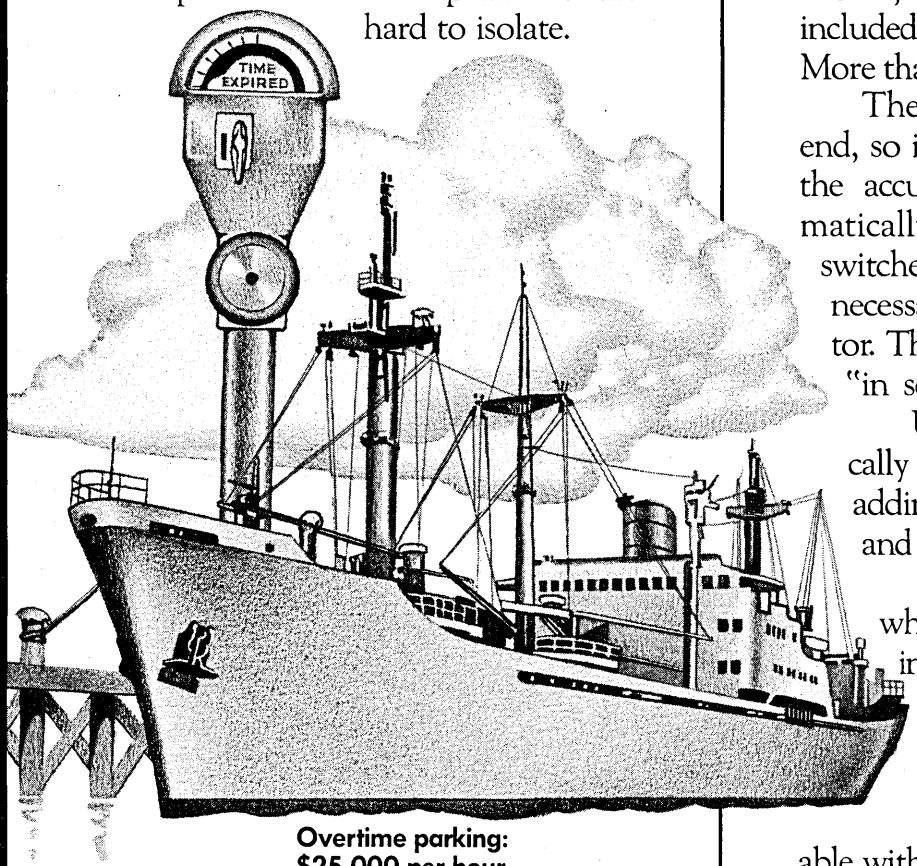
PROBLEM:

Transferring large amounts of data from one business machine to another—an everyday business need—can be complicated, slow and costly. Signals get converted and amplified. Errors creep in and are hard to isolate.



Overtime parking: $25,000 per hour.

Whole blocks of data are jeopardized. And retransmissions eat up valuable computer and line time.

Delays can have very expensive consequences. On the order of $1,000 per hour per circuit for time-sharing firms. Twenty-five times that for a company with a ship held in port by faulty documentation. Ulcers for a data processing manager transmitting month-end reports to the home office.

SOLUTION:

Dataphone® Digital Service, the Bell System's super-accurate, reliable, economical data transmission service, is now stretching all over the map. All 96 of the metropolitan areas shown, representing 350 cities, are included in our network planning. More than half are already in service.

The service is digital end-to-end, so it requires no modems, and the accuracy rate is 99.5%. Automatically monitored, it instantly switches to standby facilities when necessary. Availability is a key factor. The system is designed to be "in service" 99.96% of the time.

Users often realize dramatically improved response times, adding capacity to their systems and improving efficiency.

Applications cover the whole range of business needs in point-to-point and multipoint service. In a polling environment, this service can cut access time at each terminal to half that available with alternatives.

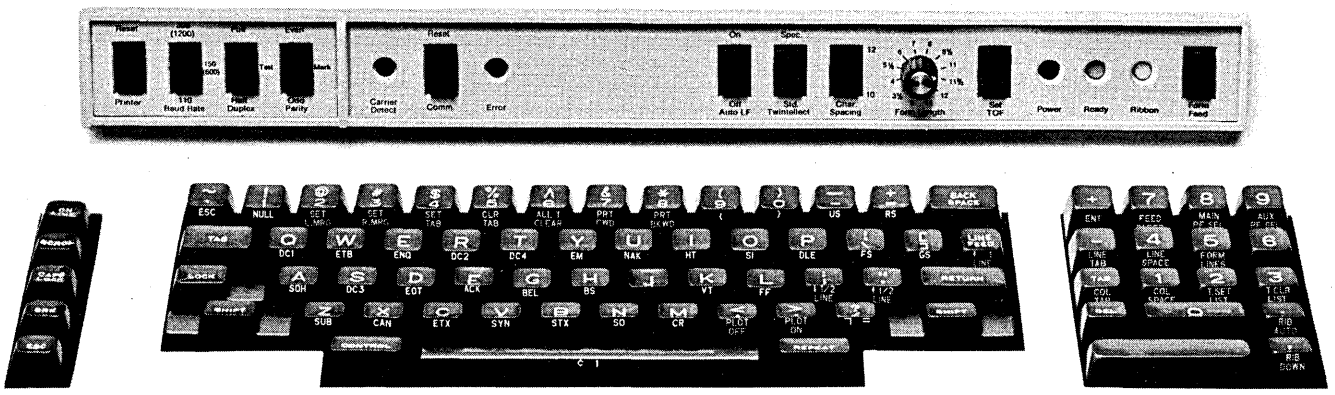
Four data transmission speeds are available: 2.4, 4.8, 9.6 and 56 kbps. Installation can be as simple as unplugging a modem and plugging in a Data Service Unit.

If you haven't talked total communications with your problem-solving Bell Account Executive lately, your company is missing something—in voice, data, and network services, alone or in combination.

The system is the solution.

Bell System

Sprint 5 has 43 key features for your 10 fingers.



Sometimes you need more than clear, letter-quality print from a terminal. So when we designed the Sprint 5 Daisywheel Terminal, we made sure it would follow orders.

Not just the standard 128 ASCII codes, but 43 Qume-defined user-oriented commands, too.

They're special commands for dynamic positioning, paper positioning, tabbing, graphics, test diagnostics, program mode, MultiColor™ ribbon controls, and more.

What makes it all so simple?

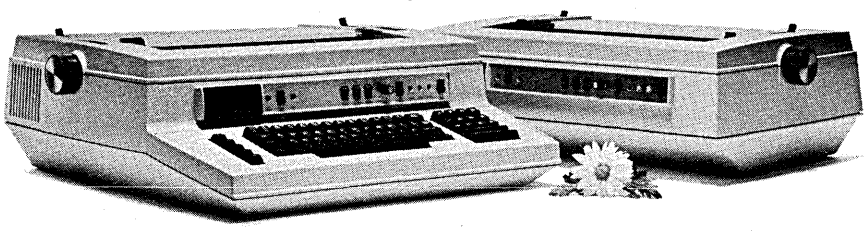
The fact that they're right before your eyes. Clearly labeled in green, yellow and white on the front of the standard keys.

Qume®
the printed word

The Sprint 5 KSR terminal has a typewriter keyboard for communication, data entry, and programming, plus a numeric cluster for quick numeric entry. And the Sprint 5 RO functions with the same command set, received through communication lines.

The entire Sprint 5 terminal is designed to make things easier for you, the user.

Obviously, your fingers are in good hands with Qume.



For details, contact Qume or your nearest data terminal dealer. 2323 Industrial Parkway West, Hayward, California 94545.

General Systems and Data Processing are already in head-on competition. A third internal "company" may be in the wings.

IBM VERSUS IBM

by Fred Lamond

Last fall IBM announced it was studying the possibility of spinning off its General Business Group as a separate subsidiary. It was a heady prospect, since this group consists of the General Systems Division, the Office Products Division, the General Technology Division, and the Information Records Division. All the development, marketing, and manufacturing of products for office automation and minicomputer and small business systems would be housed under a new independent company.

For whatever reason (some thought it might be part of an offering for a consent decree) IBM subsequently decided not to make that move—yet. But the mere fact of the study underscores the existence of two separate and vertically integrated companies under the IBM umbrella. What's more, General Business Group and the other side of the house, the DP Marketing Group and its sister development and manufacturing organization DP Product Group, are already in head-on competition.

The industry is seeing this competition in newly announced products from the General Systems Division (GSD), such as the 5110 and System/38, and from the Data Processing Division (DPD), with its 8100 distributed processing system and 3730 document processor. To understand the growth of a "second head" on the industry's giant, requires a tracing of IBM's recent organizational history.

BETWEEN DEFENSE AND ATTACK

As the world's leading computer manufacturer, IBM has long had two marketing aims: to maintain its established base of computer users and expand revenues from it; and to expand its customer base at entry level as lowering costs make it possible to offer computers to ever smaller users. The problem has been that the same cheaper computers needed to bring smaller users within the customer fold can also impact revenues from the existing base by offering them cheaper alternatives for the same tasks.

Until 1974, IBM computer marketing was unified in all countries under the aegis of the Data Processing Division directed from Armonk, N.Y. This gave priority to the defense of the established customer base. As a result, IBM lagged behind other computer manufacturers in the penetration of the low end of the market.

The now obsolete System/3, first announced in 1969, was a typical product of Armonk thinking. In its range of memory capacities, peripherals, and software facilities, System/3 in the early 1970s resembled the System 360/30 and 40 that IBM marketed in the late 1960s. Like them, System/3 was essentially a batch processing system with off-line data entry designed to be run by professional operators. (Dedicated on-line file inquiry and updating facilities were added later.)

In order to make it as difficult as possible for existing System 360 or 370 users to "downgrade" to a System/3, IBM made the instruction set and disk file formats incompatible with System/370. Too, the main memory of System/3/15, the largest model, was never allowed under Armonk aegis to be expandable beyond the maximum size of System 370's smallest model, the 115. But these measures equally restricted the growth path of System/3 users.

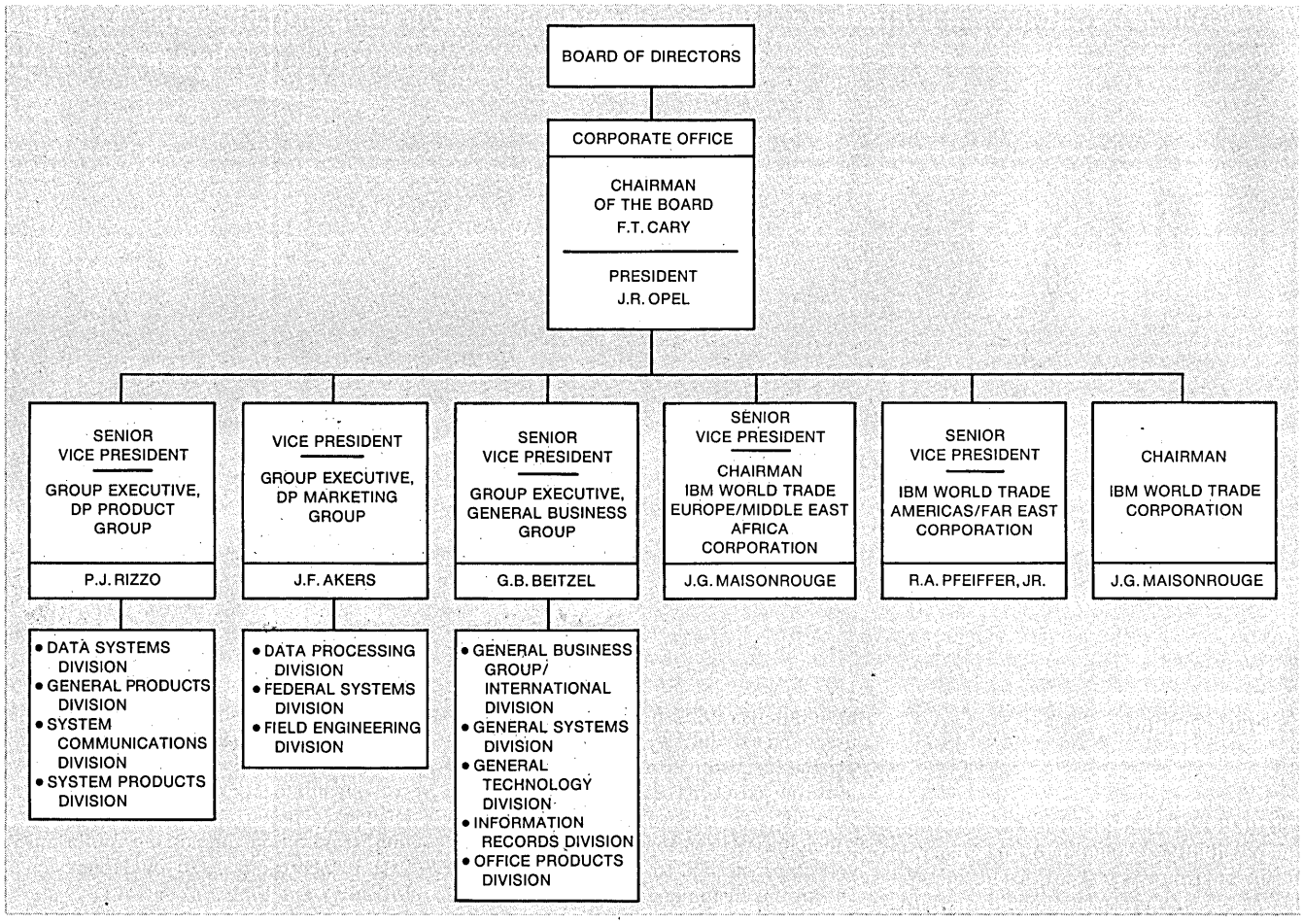
As a result, System/3 never conquered as large a share of the small business computer marketplace as IBM's marketing force had come to expect. A growing number of small U.S. and foreign businesses preferred the multi-workstation transaction processing philosophy first pioneered in 1970 by Honeywell's Model 58 and Singer's (now ICL) System Ten, and subsequently adopted by many minicomputer manufacturers and systems houses. Workstation transaction processing was more attractive because it was a much closer working method to that of the magnetic ledger card processing office computers from which many small businesses were upgrading.

Even worse from IBM's point of view, it was losing large numbers of users when they had outgrown the System/3. Rather than move to the 370, they found it easier to convert to some other manufacturer's RPG II-based small business computer. Burroughs' B1700 and B1800, Honeywell's 60/62, Univac's 90/25 and 90/30, and, in Europe, ICL's 2903 all count large numbers of former System/3 users among their bases. ICL has stated publicly that as many as 40% of its 2,500 2903-range users are former users of other manufacturer's computers, mostly System/3s.

To remedy this situation, IBM split its North American computer marketing organization in 1974 into two separate divisions:

1. The General Systems Division, formed in 1969 to develop and manufacture the System/3 and subsequent small systems, was given responsibility for marketing and service of these products. With a vertically integrated organization, controlled from Atlanta, Ga., the industry saw the making of a new company within IBM.

2. The Data Processing Division,



controlled from Armonk and White Plains, N.Y., retained the responsibility for the System 360 and 370 base. This is now a part of the Data Processing Marketing Group, and its sister organization for development and manufacturing is the Data Processing Product Group. (These two groups will be referred to as Data Processing).

This same split was effected in Europe in 1975. That year also saw another major move for General Systems. GSD and Office Products responsibilities were restructured under the General Business Group (GBG). And a new division, General Business Group International, was established with marketing, service, manufacturing and overall performance responsibilities for General Systems and Office Products operations within 17 countries (now 21) outside the U.S.

The General Business Group was thus structurally ready to attack all office and small systems markets.

BUSINESS PRODUCTS & POLICY

It takes at least two years to bring a new computer system to market from the initial product definition, even in the small-scale product range served by the IBM General Business Group.

GSD's new product planning and marketing independence has thus been reflected only in the new products that it has announced since the autumn of 1976: Series/1, System/34, 5110, and now System/38.

The contrast with earlier products planned under Armonk supervision could not be more startling. In their modularity, processing orientation, unbundled pricing structure, and general marketing philosophy, the new GSD systems resemble the DEC PDP-11, Datasystem, and TRAX series far more than they resemble any previous IBM product.

Where the earlier Systems/3 and 32 were still batch processing systems (albeit with real-time transaction processing facilities dedicated to particular applications programs), the new Systems/34 and 38 are as workstation-oriented as DEC Datasystems. Any local or remote 5250 display station can select and initiate its own processing programs and files, and choose whether keyed data is to be processed in real-time or batch mode. Virtual memory operating systems allow such a large number of different programs to be multiprogrammed simultaneously.

Both systems and applications software are as fully unbundled on 5110, System/34, and System/38 as they are on the Series/1, and all systems engineering support is separately chargeable. This allows GSD to price the hardware of its new systems very competitively with other manufacturers' offerings.

Instead of keeping all systems engineering support to itself, GSD has pursued a policy of cooperation with independent systems houses, beginning with the System/32 launched in early 1975. These firms are encouraged to write general purpose applications packages for all the new GSD series, as well as to provide on-site support to customers. Indeed, it is only from independent systems houses that 5110 users can obtain on-site support. IBM support to its entry level system is limited to training courses and program testing at its customer centers.

On the Series/1, designed for the oem process control and communications markets, this open arms policy extends even to suppliers of plug compatible peripherals, who are being given every assistance in interfacing their products. As a result, at least one manufacturer, Control Data, has already formed a special development and marketing team just for Se-

IBM quite accurately perceived that some centralization was necessary for control purposes within a firm.

ries/1 peripherals.

Neither the entry level prices nor the expandability of the latest GSD systems shows any signs of being constrained by concern not to impact the rental bases and revenues of older less cost-effective systems, be it its own or those of the senior Data Processing Division.

In 1977, GSD doubled the maximum main memory and disk storage available on System/3 Model 15D, then the top of the range. Its latest System/38 offers main memory expandable to 1.5M bytes, six times the maximum main memory of a System/3 Model 15C four years ago. Pending Data Processing Division's awaited announcement of its "E" series, small System/370 users would have to upgrade to a Model 148—or attach PCM memory to a Model 135 or 138—to obtain comparable main memory capacity.

At entry level, the new 5110 desktop personal computer announced in February 1978 offers all the optional diskette storage and printers that had been denied to its 5100 predecessor for fear of undercutting Systems/32 and 3 in commercial file processing. The basic price for a diskette-processing 5110 is little more than half the price of a basic System/32, and it is less than a third of the cheapest System/3 Model 8 offered in 1974, when GSD became independent.

Although the System/32 is effectively superseded as IBM's entry level business computer, GSD has given it a new life as a word processing system or mixed word processing and accounting system. As such, System/32 acts also as a bridge to the Office Products Division's smaller word processing systems (OPD markets System/32 also as the Word Processor/32) and helps bring General Business Group's two divisions closer together.

This upward, downward, and sideways expansion of the GBG systems range has made it a much more formidable competitor for all the other competing suppliers of the small business computer market in both North America and Europe. But the same features also make the 5110, Series/1, and Systems/34 and 38 much more attractive to large users as distributed processing satellite systems. Indeed, the large, rather than the small, user gets most of the benefit of the more cost-effective unbundled hardware prices that GSD now charges for its products; he can provide his own systems support and pays for his own in-house applications software only once, no matter how many of his distributed processing systems use it.

With these advantages, many large System/370 users on both sides of the Atlantic have until recently preferred GSD's increasingly powerful locally programmable business minis for their distributed processing to the underpowered and overpriced systems offered until recently by IBM Data Processing Division. These DPD products, the 3600 financial terminal, 3650 wholesale/retail POS system and the 3790 general purpose communications system, depend on their host 370 processors for software compilation, and until recently even for downline program loading. And they have been only available to users who had converted to IBM's System Network Architecture (SNA).

Until a year ago, this incipient competition between GSD and DPD for the same distributed processing business was confined to the lowest levels of the two field sales forces. Since GSD's business mini communication protocols were limited to 2780 BSC, Atlanta could claim quite reasonably that it was only competing against DEC and other manufacturers for the business of users who had deliberately adopted a dispersed processing philosophy in preference to Data Processing's hierachical host-dependent network architecture, SNA.

Early in 1978, GSD entered the real competitive fray with Data Processing by announcing new 3270 BSC protocols on 5110, Systems/32 and 34, and promising the availability of SNA-compatible SDLC protocols on the same systems from mid-1979. The same protocols will also be available on the new System/38.

With these new protocols, all the latest GSD business minis give their connected workstations the facility of interrogating and updating not only local distributed files, but also files on a host System/370. (This is in the manner first pioneered by Four-Phase Systems on its System/IV in 1975.) GSD is thus now competing openly and at all levels with DPD for all types of distributed processing satellite systems.

But the Data Processing marketing and development forces have begun their retaliation in a big way, signalled by the 8100 system for distributed processing. The following explains the developments that led to this announcement.

DPD'S DISTRIBUTED PROCESSING

The 1974-1975 split in IBM's computer marketing activities left Data Processing with the System/370 family of medium-to-large general purpose computer systems, and their large user base.

The main growth path lay in persuading its existing users to computerize ever more applications and order the additional hardware and software required to do so. Since 1974 its main selling lines have been:

1. Integrated data bases requiring more powerful host processors with larger main memories and more secondary storage.

2. Communications networks to interrogate and update these data bases interactively from widely dispersed points throughout the users' offices and factories.

3. Text processing.

4. So far, in Europe only: integrated office and inter-office voice and data communications systems switched by the IBM 3750 private automatic branch telephone exchange (PABX).

Until this year, Data Processing promoted a highly centralized architecture both for its users' data bases and for the communications networks accessing these. All data bases were to be centralized at the sites of host System/370 and 303X series computers. All communications between these and the distributed terminals throughout the organization were to be controlled by central site host processors and their front-end communications processors (FECP) in the hierarchical polling System Network Architecture (SNA).

As noted earlier, the 3600, 3650, and 3790 communications systems were mostly host-controlled and required conversion to SNA, and as a consequence, use of the VS operating system with VTAM. This required much additional memory.

Data Processing did not promote this centralized network architecture just to sell more memory for the host 370 and 303X systems. It also wanted to strengthen the position of the users' data processing managers in their fight against attempts by user departments to acquire their own dispersed minicomputer systems. There were two sides to this effort as well. One was that IBM could keep its own marketing overhead down by limiting the number of computer ordering points within each company. The other was that IBM quite accurately perceived that some centralization was necessary for control purposes within a firm; unfettered decentralized buying of systems could wreak costly havoc.

But the SNA approach was too host-dependent. And the ever-cheaper prices of minicomputers and microcomputers, compared with the high cost of communications lines, make decentralized network architectures more attractive economically. This particularly true outside the U.S., where communications are not only more expensive, but also are not safe enough to allow the operation of distributed terminals to depend on long distance links with a host processor.

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CIRCLE 52 ON READER CARD

The competitive fight between the two IBM marketing groups is now reaching the word processing and office automation market.

SNA adoption by IBM 370 and 303X users has thus been slow, especially in Europe, and sales of 3600, 3650 and 3790 systems have been well below Data Processing targets. Meanwhile, sales of other manufacturers' business minicomputers and distributed processing satellite systems have boomed. The centralized network policy was given an added blow by GSD when it started offering its 5110 and System/34 systems as distributed processing satellites within 3270 BSC and SDLC environments. And all the prestige of the IBM label was behind them.

Data Processing could not ignore this challenge, which threatened one of its main revenue growth paths. Its response has been the new IBM 8100 Information System announced in early October 1978. It offers all the locally programmable processing power, main memory expandability, and local storage capacity of the products of GSD and other manufacturers. And like the 5100, Systems/34 and 38, it can be run in SDLC or 3270 BSC communications environments, and can operate wholly independently of a System/370 or 303X host.

This means that with the new 8100, Data Processing can compete with GSD in the small business computing marketplace, just as the GSD has competed in distributed processing. The 8100's main memory is not quite as expandable as the System/38 storage, nor does it offer a programming language as high level as S/38's RPG III. But it can control more terminals and 8100 systems, and its COBOL and FORTRAN compilers will make it easier for host dp departments to distribute previously centralized source programs. This will also attract IBM 370-based commercial service bureaus looking for a local processing system to offer to their time-sharing customers.

The cheapest 8130 configuration still costs nearly twice as much as an entry level System/34, and nearly four times the price of a 5110, so it does not yet represent a competitive threat to GSD in the entry level marketplace. But rumor has it that Data Processing's new "E" series, which may have been announced by publication time, will offer bridging aids to existing System/3 users. (The older System/370 Models 115, 138, and 148 always lacked such bridges.) If the rumor is right, Data Processing will be in a position to broaden its user base at GSD's expense.

The competitive fight between the two IBM marketing groups is also now reaching the word processing and office automation market. Until recently, this was the preserve of the Office Products Division (OPD), and a DPD salesman would have brought an OPD colleague with him to meet an established customer interested in word processing.

With OPD now part of the rival General Business Group, DPD salesmen do not want to introduce a potential competitor into its accounts. So DPD is now introducing some word processing systems of its own. The first is the new 3730 documentation system announced at the same time as the 8100: a multistation word processing system that will be a convenient outlet for unused stocks of 3701 processors. In the long run, however, the new 8100 itself seems destined to become a dual-purpose commercial file and text processing system. Why else would it already be offering 2560- and 3440-character screen sizes on its IBM 8775 display terminals?

The 3730 and 8100-based word processing systems are also essential components of Data Processing strategy to penetrate the intracompany electronic mail market with its 3750 PABX, and successors. While the 3750 is not available in the U.S., signs are its successors will be.

At a recent international show, SICOB in Paris, Data Processing demonstrated leading applications of its 3750 at French user sites. An electronic mail application used internally by IBM France was the highlight. At night, the leased voice line networks linking IBM offices throughout the country are being used to transmit intracompany memos via communicating word processing systems interfaced to 3750 PABX's at each office site. This, IBM emphasized, adds no more to the cost of leased communications lines, but saves postage charges and time.

Electronic mail is, however, essentially terminal-to-terminal traffic on point-to-point circuits switched by the 3750 PABX's on each site. SNA's hierarchical host-dependent architecture is not suitable for such traffic, and there are signs that Data Processing is currently reexamining its commitment to it. (The 8100 system and the 3730 can only be interfaced to 3750 PABX's in BSC, and not in SDLC.

A CREATIVE COMPETITION

It is clear that the increasing competition between IBM's Data Processing and General Business Groups has stimulated them to strengthen their product lines in the distributed processing and word processing markets. Singly and jointly, they now offer much more formidable competition to other manufacturers on both the technical and marketing front than they did in 1974.

As of late October 1978, the only competing manufacturer to offer a distributed processing system as expandable and verstile as the IBM 8100 and System/38 was Digital Equipment with the PDP-11/70-based TRAX. Many other manufacturers offered equally expandable business minis (Honeywell Level 6, ICL 2903-to-2956 DME for instance) but without the facility to communicate with host IBM 370 or 303X systems in 3270 BSC or SDLC interactive mode. Those systems which offered these facilities (ICL System Ten 220, Philips P 7000, Nixdorf 620/45, Datasaab D16/30) were all much less expandable. Only on the programming language front are some of the new IBM systems still a little weak compared with DEC, Honeywell, and other competitors.

What lies ahead? We have already noted that the new "E" series is due for announcement and may be out by publication time. This may signal yet another organizational evolution for IBM. IBM has already announced that it has split the development and manufacturing System Products Division into two new divisions, Data Systems and System Products. Data Systems will have responsibility for large, complex products "with primary emphasis on high-performance products." This presumably means the systems at the 370/148 level and above, including the 303X line. The Systems Products Division has the intermediate range, meaning the 370s below the 148 and the new "E" series.

General Systems Division started this way in 1969, with development and manufacturing responsibility. Five years later, it had the whole ball of wax, including marketing. Perhaps in a few years, the same will happen to Data Systems and System Products, and IBM will become three companies. ✲

FRED LAMOND

Mr. Lamond, a regular contributor to DATAMATION and DATAMATION International, is an independent computer consultant in Europe. He is also European editor for Auerbach Publishers Inc., responsible for European dp equipment coverage in Computer Technology Reports. In his varied career, he has been a systems analyst at Univac, export salesman for English Electric Computers, and consultant for Leasco Systems and Research.

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CIRCLE 75 ON READER CARD

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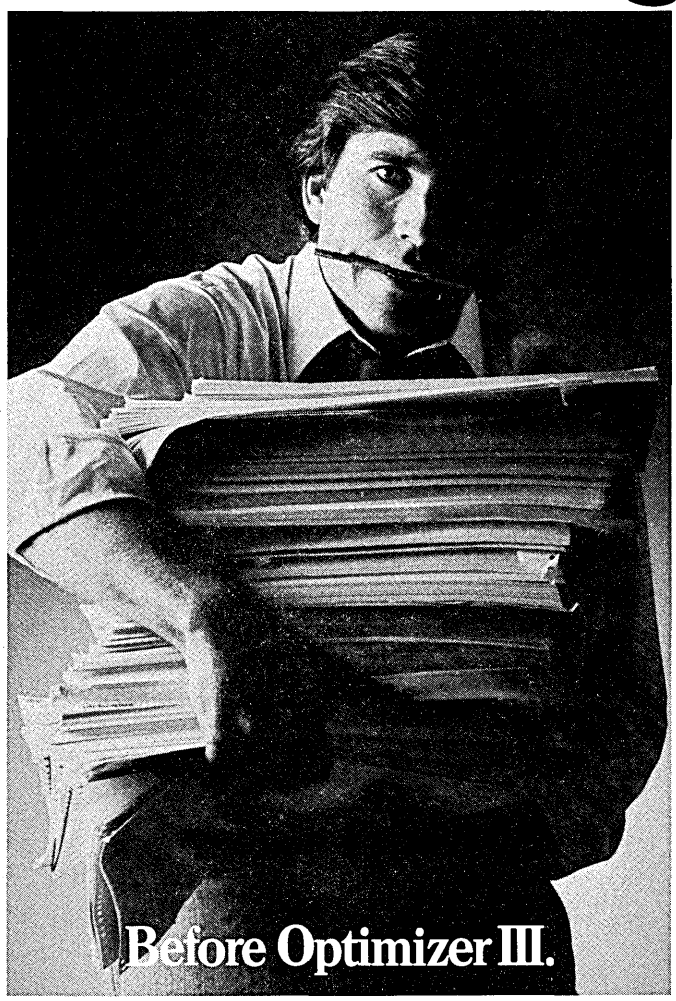

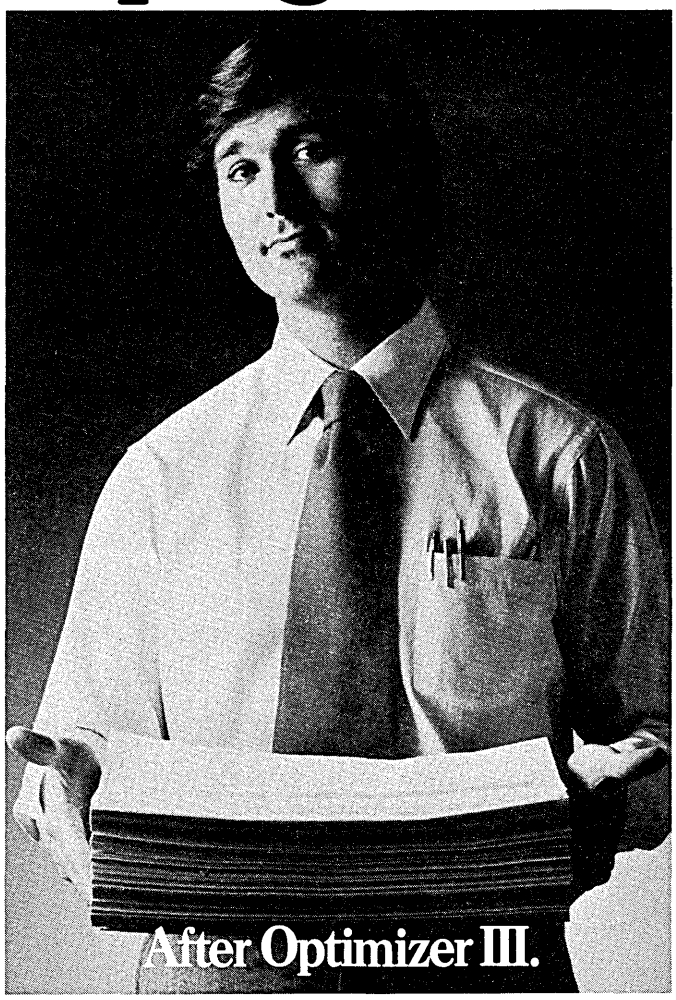

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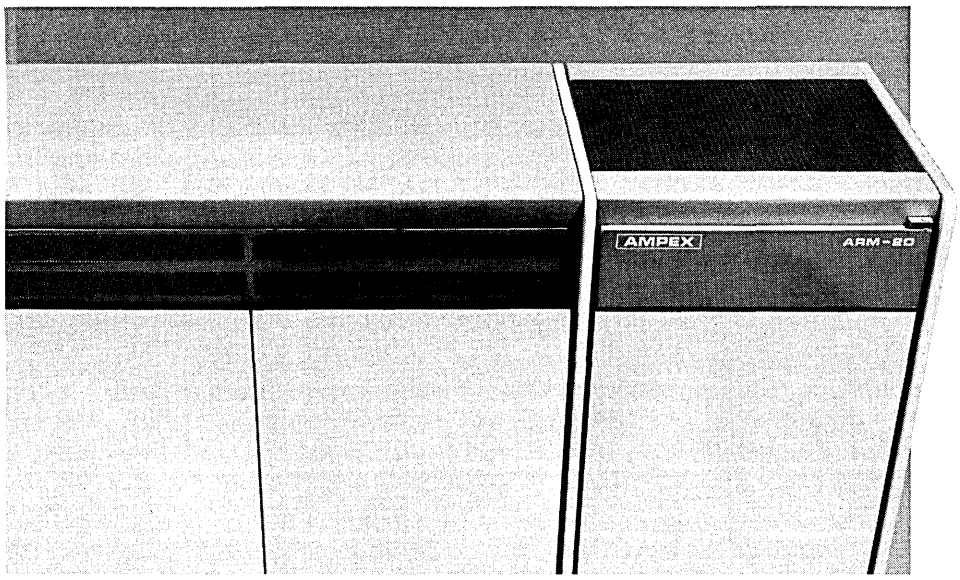

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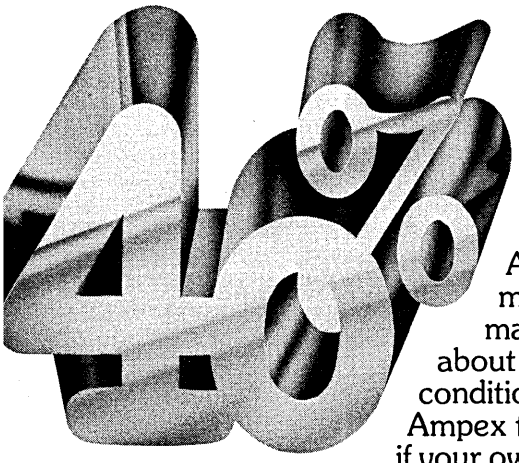

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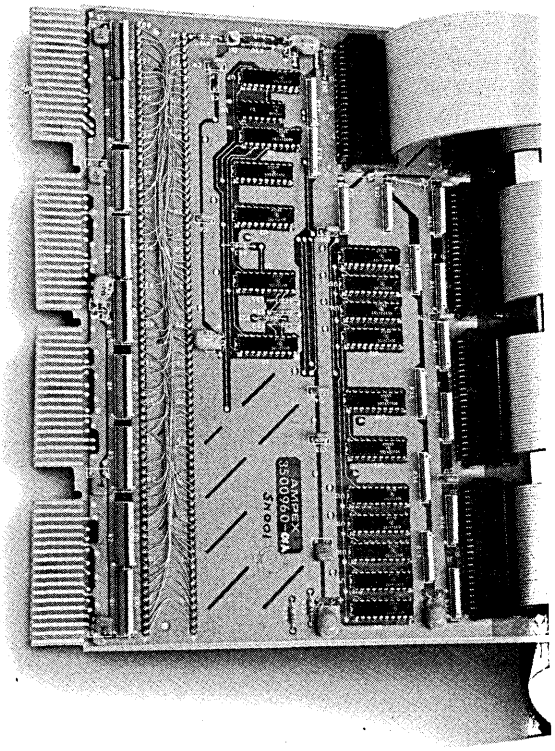

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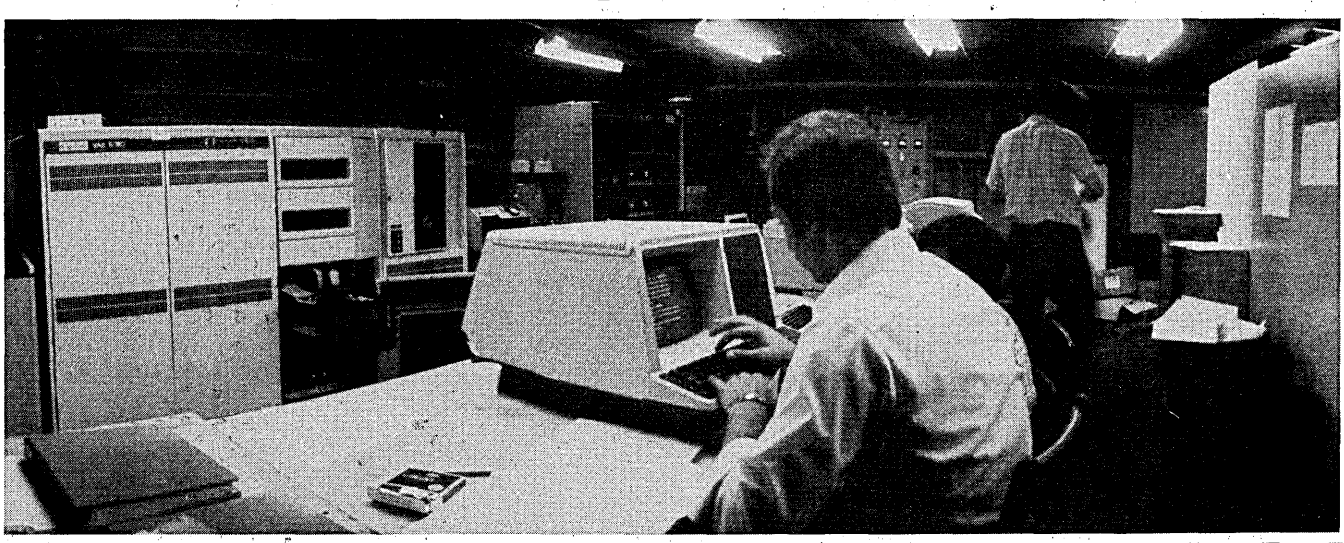
CIRCLE 67 ON READER CARD

Giving the PDP-11 a bigger virtual memory required a whole new design, not just bigger words.

THE VAX-11, DEC'S 32-BIT VERSION OF THE PDP-11



Digital Equipment has long had two product lines, the minis and larger mainframes like the DECsystem-10. The new VAX line will be an upgrowth of the 16-bit machines, but may also go a long way toward displacing the bigger computers. Overall acceptance of the VAX is unpredictable, but several hundred are already in the field (and several, including the one pictured, have been kept back at the barn for in-house use).

by Dileep P. Bhandarkar and Steve Rothman

Minicomputers emerged in the 1960s as cost effective machines that offered limited functionality at significantly lower cost than for larger computers. Since then, advances in technology have contributed to the increasing functionality of minis. Instruction sets have been enhanced to include operations on floating-point numbers for scientific processing and on character strings for commercial applications. The availability of low cost semiconductor memory has allowed large memories to be attached to small machines at reasonable cost. In fact, semiconductor technology has been the driving force for improvements in minicomputer systems; while technology does not provide new ideas, it does present the basis for their cost effective implementation.

Further, the trend toward distributed and decentralized processing has created a market for large scale functionality at minicomputer costs. To meet that demand, minicomputer operating systems have evolved from simple monitors to powerful executives capable of supporting multiple environments simultaneously. Often a single minicomputer must perform a mixture of batch, real-time, interactive, and program development tasks using multiple languages.

This increased function, in terms of computing speeds and larger memories and operating system capabilities, has further expanded the scope of applications for minicomputers. Today, distributed minis are even viewed as viable alternatives to large centralized mainframes. For many of these new applications, a minicomputer's 64KB or 128KB virtual address space is not and will not be a severe limitation. For others, especially where the minis are doing jobs originally assigned to maxis, the small machines require the ability to store and execute large programs without resorting to overlaying techniques.

Handling these larger virtual memories requires changing existing minicomputer designs, coming up with new architectures. In Digital Equipment Corp.'s products, this has led to the VAX-11 architecture, a Virtual Address eXtension of the PDP-11 family.

Virtual addresses are the addresses a program generates to fetch instructions and data. The maximum range of these

DEC claims that typical PDP-11 files and programs may be moved to the VAX in binary form and executed directly.

addresses is called the virtual address space. On 16-bit minis, this space is usually 64KB (64KB being the largest address representable in 16 bits) or 128KB (if separate address spaces are used for instructions and data as on the PDP-11/70). The addresses that the cpu uses to actually address the memory are called the physical addresses and the total amount of memory that can be put on the system is called the physical address space, which is often several million bytes.

The original PDP-11/20, introduced in 1970, was limited to a physical address space of 56KB. The PDP-11/70, introduced in 1975, extended that to almost 4MB. However, the virtual address spaces of these machines are 64KB and 128KB respectively. Even with large physical memory sizes, these computers are used to run many small jobs concurrently instead of fewer large jobs. The primary goal of the VAX-11 architecture, on the other hand, was to significantly increase the size of the virtual address space—again, a Virtual Address eXtension.

Why not just give the PDP-11 a larger word size? Well, the size of the virtual address is deeply ingrained in the machine language of a computer. For example, when computing the location of an element within an array, the program must know how large the addresses are so that it can use the appropriate instructions to fetch and operate on them. Therefore, when changing the size of virtual addresses, all assembly language programs must be modified. All higher level language programs, such as those written in FORTRAN or COBOL, must be recompiled with a compiler that generates addresses and code for the new size. Since it is not possible to extend the virtual address size and allow old programs to take advantage of the extension without changing them, the VAX-11 architecture became a new architecture.

Hexadecimal Format	Explanation	Assembler Notation
0 5	opcode for RSB	RSB Return from subroutine
D 4	opcode for CLRL	CLRL R9
5 9	register R9	Clear register R9
B 0	opcode for MOVW	MOVW 356(R4), 25(R11)
C 4	word displacement mode, register R4	Move a word from address which is 356 plus contents of R4 to address which is 25 plus contents of R11
6 4	356 in hexadecimal	
0 1		
A B	byte displacement mode, register R11	
1 9	25 in hexadecimal	
C 1	opcode for ADDL3	ADDL3 #5, R0, @ # A[R2]
0 5	short literal 5	Add 5 to a 32-bit integer in R0 and store the result in address which is sum of A and 4 times the contents of R2
5 0	register mode R0	
4 2	index prefix R2	
9 F	autoincrement mode, program counter relative	
address of A		

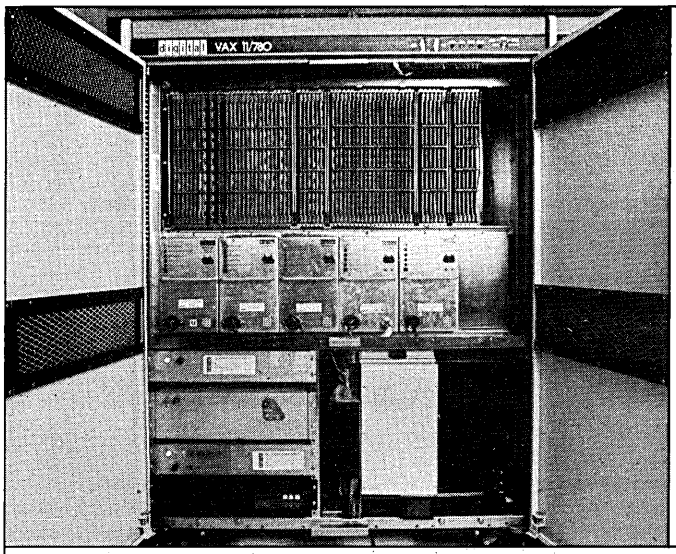
Fig. 1. VAX-11 instructions may be from 1 byte to 37 bytes long. Each consists of an opcode and up to six operand specifiers (which may be up to 9 bytes long each). The opcode dictates the operation and data format; the specifiers tell where the data is.

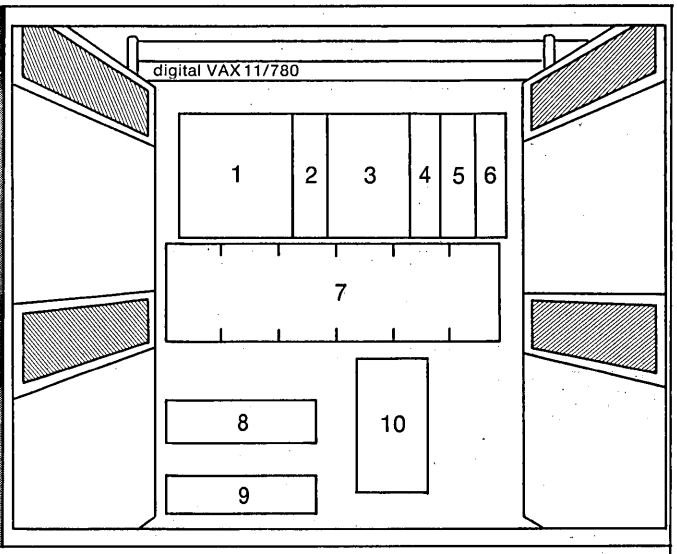
DESIGN GOALS

The designers of the new architecture spent several months defining the goals. The first, and by far the most important, was that the architecture should have a long lifetime. This is necessary because of the huge investments that the vendor makes in designing hardware and software for the architecture, and the equally large commitment made by customers with the software they write. The desire for a long lifetime caused us to try to understand the general directions of computing for the next 10 years, specifically the developments that might be expected in cpu hardware technology and software technology.

Our assumptions about hardware were that the cost of both logic and memory would continue declining, so that we could design a much more complex architecture and still build machines with minicomputer prices. Our primary assumption about software was that higher level languages would be used to try to control the constantly increasing percentage of computer expenditures that is spent on software. Thus, we wanted to design an architecture for which good optimizing compilers could be written, and which would include some of the primitives common to higher level languages in the hardware itself. We also left room for the architecture to grow, because we realized we could not predict everything needed.

Our second major goal for the architecture was to base it on the PDP-11. By making it similar, large numbers of users





Components of this VAX-11/780 mainframe include: (1) the cpu, (2) Unibus adaptor, (3) 4MB of MOS memory, (4) and (5) Massbus adaptors, (6) slots for options, (7) modular power supplies, (8) battery backup power supply, (9) LSI-11 microcomputer, and (10) the floppy disk.

would not have to learn everything from scratch, but could more easily move to the new architecture. Thus the initial cost of starting up would be significantly reduced.

We defined our last major goal as the desire to make the architecture appropriate over wide ranges of system cost, performance, and applications. This would allow a wide range of user needs to be served by a single architecture and eliminate unnecessary spending on our part associated with the support of many different architectures. Our goal was to create a family of machines with the same architecture; within the family, performance would be traded off for price, with function a constant.

In extending the virtual addresses, our major decision was whether to stop at 24 bits, allowing for addressing 16 million bytes, or go to 32 bits and 4 billion bytes. Since the *main* reason for going to new architectures in the past, as with VAX-11, has been the need for larger virtual addresses, it was felt that 24 bits would be extremely short-sighted. Therefore, we chose to go with 32 bits, which should last through the 1980s. (Note that even mainframes such as the IBM 370 presently provide only 16MB of virtual address space.)

The goal of easy use by higher level languages was broken down into several specific requirements:

1. Orthogonality of operation, data type, and address mode. This means that the operation being performed (ADD, SUB, etc.), the type of data (integer, floating-point, etc.) and method of addressing (indirect, indexed, etc.) can be considered independently by the compiler, which makes compilers faster and more efficient. We believe that the level of orthogonality achieved is unique to the VAX-11.

2. No forced alignment even on longword (32-bits) boundaries. This means that data items larger than a byte can still be on any byte boundary, as is required in some languages (such as the FORTRAN COMMON facility). The architecture supports full byte addressibility.

3. Variable number of operands. By picking an instruction format which allows each instruction to have its "natural" number of operands, it is possible to have instructions in the format desirable for compilers (A + B → C is ADDL3 A, B, Cwhile A + B → B is ADDL2 A, B). The PDP-11, on the other hand, had only two-address instructions. Thus A + B → C takes two instructions on that machine.

4. Good primitives. Many operations commonly found in higher level languages are built directly into hardware, including three-address arithmetic, loop control (the FORTRAN DO and BASIC FOR loops are one instruction), and output formatting (the EDIT instruction can be used for COBOL PICTURE statements).

In addition, instructions were added to make operating systems more efficient. Examples of these are hardware support of queues, access to variable length bit fields, and simple instructions to save and restore program context. (Such instructions are not available on PDP-11s.)

COMPATIBILITY

The goal of compatibility with the PDP-11 was approached in several ways:

1. The formats for representing data are the same.

2. The media formats for I/O are the same—even the same size, 16 bits. Combined with the same data formats, this means all data files can be read by both PDP-11 and VAX-11 systems.

3. The assembly language syntax and mnemonics are basically the same. Not only will assembly language users find the new architecture very similar to the old at this level, but this cultural compatibility also allows language compilers that generate efficient PDP-11 code to be readily adapted to generate efficient VAX-11 code.

System Price Comparisons
PDP-11/70 vs. VAX-11/780

	Small System		Large System	
	PDP-11/70	VAX-11/780	PDP-11/70	VAX-11/780
Memory	256KB Core	256KB MOS	1MB Core	1MB MOS
Console Terminal	1	1 +LSI-11 & Floppy Disk	1	1 +LSI-11 & Floppy Disk
Mass Storage				
Disk	28MB Dual RK06	56MB Dual RK07	176MB RP06	176MB RP06
Tape			1600bpi 45ips	1600bpi 45ips
Communication lines			8	8
Line printer			600 lpm	600 lpm
Software	RSX-11M	VAX/VMS	RSX-11M FORTRAN COBOL	VAX/VMS FORTRAN COBOL
Price	$92,000	$128,000	$228,000	$240,000

In fact, VAX-11 high level languages are upward compatible with existing PDP-11 versions. Even the VAX operating system, VAX/VMS, was modeled after the PDP-11 RSX operating systems, and key functions, such as the file system and record management facilities, are identical.

The VAX architecture also includes a PDP-11 compatibility mode in hardware, which allows many user mode PDP-11 programs to run unchanged. The emulator can support programs in FORTRAN, COBOL, BASIC-PLUS-2, and many PDP-11 utilities. There are certain restrictions, however; for one reason or another, such programs may not use sense switches (the VAX has none), PDP-11 floating-point instructions (the performance improvement available is considered more important than the cost of recompiling), PLAS (Program Logical Address Space) directives, or DECnet data communications facilities, and may not rely on PDP-11 mapping or PDP-11 memory arrangement.

Migration from PDP to VAX is aided by the use of an Applications Migration Executive, which is a subroutine package for emulating RSX-11M services. RSX-11M service requests are translated to VAX/VMS format and the status results translated back.

Together, these features allow typical RSX-11M user programs and files to be moved to VAX in binary form and executed directly there.

INSTRUCTIONS AND MEMORY

To understand how and why all this happens, it is necessary to look into VAX-11's instructions and memory management.

The instructions consist of a variable number of bytes, from 1 to 37. Each instruction consists of an opcode, which may or may not be followed by 1 to 6 operand specifiers. (See Fig. 1.) The opcode dictates the operation and the data format, the specifiers tell where the data is. Opcodes are 1 byte, with provisions for going to 2 bytes; operand specifiers are from 1 to 9 bytes. (For comparison, PDP-11 instructions have up to two operand specifiers, and instruction lengths of 1, 2, or 3 words 1-1 of 16 bits.)

Operand specifiers exist in several formats. There are formats that provide for literals (immediate data), registers, direct (absolute) addressing, indirect addressing, relative addressing, stacks, plus others allowing for indexing in conjunction with most of the other formats.

The VAX-11 architecture supports arithmetic in six different formats: 8-bit, 16-bit, and 32-bit integers, plus 32-bit and 64-bit floating-point numbers, and 31-digit packed decimal. The architecture also provides instructions for working with bit fields between 0 and 32 bits, and character strings up to 64KB long. (Neither 32-bit integers, decimal, bit fields, nor character string operations was provided on the PDP-11.)

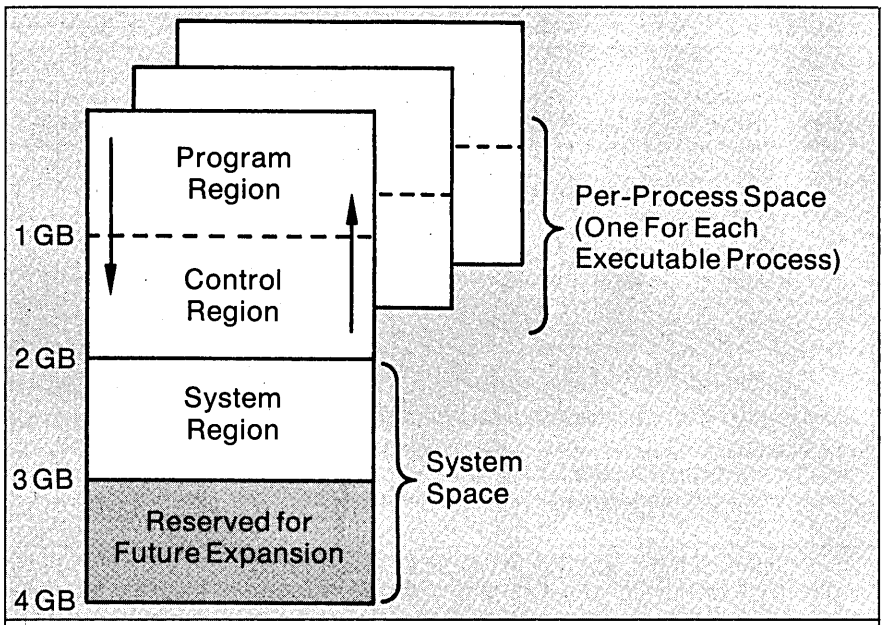


Fig. 2. The VAX-11's virtual address space allows each user to command 1 billion bytes of program space and another billion bytes of "control region," which is mostly data space.

Operations are divided into several groups; integer and floating-point, arithmetic, logical, special, bit field, queue, address, control, character string, decimal string, and edit. And there are many of the common optimizations to reduce program size, for example:

CLeaR A acts like MOVe #0, A
TeST A acts like CoMPare A, #0
INCrement A acts like ADD #1, A

Several instructions provide functionality hitherto not available on many contemporary architectures. A few examples are:

- EMOD: Does extra precise range reduction of floating-point numbers, for example to normalize the argument of a trigonometric function to 2pi.
- POLY: Computes the value of a polynomial of the form $a_n x^n + a_{n-1}x^{n-1} \ldots a_1 x + a_0$, which is useful for efficient computing of math library functions.
- INDEX: Checks the value of an index and computes the location of an element within an array.
- CASE: The equivalent of a FORTRAN computed GO TO including range checks.
- CRC: Is used to calculate a cyclic redundancy check code. These codes are commonly used as an error detection mechanism for long streams of data, such as in data communications.

Fewer instructions are required to perform a given function on the VAX-11 than on the PDP-11. As an example consider the high level language construct A[I] = B[I] + C[I]. The following illustrates how this construct is handled on the VAX-11 and on the PDP-11.

VAX-11	PDP-11
MOVL I, RO	MOV I, RO
ADDL3 B[RO], C[RO], A[RO],	ASL RO
	ASL RO
	MOV C(RO), A(RO)
	MOV C+2(RO), A+2(RO)
	ADD B(RO), A(RO)
	ADC A+2(RO)
	ADD B+2(RO), A+2(RO)

Some of the major features of the memory management and protection mechanism are:

1. Virtual memory management built into the hardware and VMS operating system. This allows multiple user programs to be supported simultaneously, each with a virtual address space exceeding the total physical memory available.
2. Automatic sharing of half the virtual address space between all programs.
3. Four hierarchical protection levels (kernel, executive, supervisor, user) instead of the PDP-11/70's three.

There are many more features of the architecture, especially relating to the operating system environment, that have not been described. Protection and sharing are provided at the page level. Memory is divided into pages, each consisting of 512bytes. This page size, although relatively small, yields better memory utilization than that available with the page size of 4KB in the PDP-11. (Availability of low cost semiconductor components allows the cost-effective implementation of the more complex memory management hardware required.) Page tables are used to map virtual addresses to physical mem-

ory. They also specify the type of accessibility (no access, read-only, read/write) for each of the four protection modes. (See Figs. 2 and 3.)

THE VAX-11/780

The VAX-11/780 computer system, the first to use the new architecture, consists of the central processing unit, main memory subsystem, I/O subsystem, and console subsystem. (See Fig. 4.) The cpu, memory and I/O subsystems are connected through a high speed bus called the Synchronous Backplane Interconnect (SBI), which is the primary control and data transfer path. Currently, up to two memory controllers with a total of 8MB of memory can be connected to it, but the SBI is capable of addressing up to 512MB. The UNIBUS adaptor (UBA) provides a standard 1.5MB/sec UNIBUS for the attachment of a wide variety of peripherals. Up to four MASSBUS adaptors (MBA) are used for disk and tape block transfers to 2MB/sec. Thus, the VAX-11/780 uses existing PDP-11 peripherals.

The SBI has a 32-bit data path and operates at a cycle time of 200nsec. Its protocol permits a 32-bit transfer using one address cycle and one data transfer cycle, or a 64-bit transfer using one address cycle and two data transfer cycles. The maximum data rate achievable is 13.3MB/sec. To enhance its reliability, substantial protocol checking occurs on every cycle. In addition, maintainability is aided by the recording of the history of the last 16 SBI cycles by the cpu.

As might be expected, the cpu itself uses microprogramming to implement the instruction set, including floating-point, character string, decimal string, and compatibility mode instructions. A 12KB writable diagnostic control store (WDCS) is standard and can be loaded from the console subsystem. Further, floating-point performance can be enhanced with the optional Floating-Point Accelerator (FPA). A 12KB user writable control store is also available.

Internal data paths are 32-bits wide and standard Schottky-TTL logic circuits are used. Emitter coupled logic circuits and custom LSI have been used in selected places to optimize system performance and reliability.

The cpu employs cache buffers extensively to achieve high performance. For example, an 8KB cache provides fast access to frequently used data and reduces traffic on the SBI. A 128-entry address translation buffer acts as a cache for recent virtual to physical address translations. An 8-byte instruction buffer enables the cpu to fetch and decode the next instruction while the current one completes execution. The cpu-SBI interface includes a write buffer. Thus, when the cpu performs a write to memory, it need not wait for memory to accept the data. It writes into the buffer, initiates a memory transfer, and continues execution.

The main memory subsystem consists of error-correcting MOS memory using Hamming codes. Single-bit errors are corrected automatically to improve the mean time between failure by a factor of 10 over memory systems without error correction. All 2-bit errors, and most involving more bits are detected. All corrected and uncorrected errors are reported to the operating system for appropriate logging and corrective action.

COBOL Benchmark Performance (with decimal subscripts)

VAX-11/780	97
IBM 370/135	59
IBM 370/145	133
IBM 370/158	597
IBM 370/168	1079

On benchmark programs supplied by U.S. Steel, VAX-11/780 performance on COBOL jobs using decimal subscripts falls somewhere between that of the IBM 370/135 and 370/145. (Such benchmarks must have been running for years, as the numbers express relative productivity compared to an IBM 1460.)

The VAX-11/780 is capable of operating despite faulty memory locations. The memory management scheme allows the operating system to map around failed memory locations, thus significantly improving system availability. Two memory controllers can be connected to a VAX-11/780 system, each handling up to 4MB. Interleaving is possible if the two controllers manage equal amounts of memory.

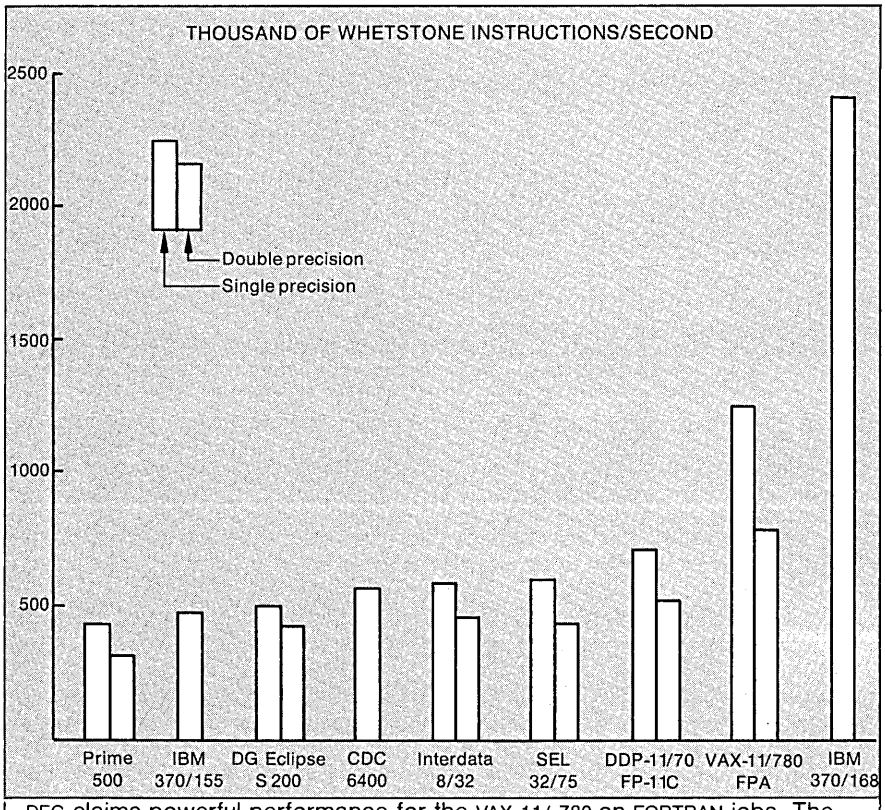
Memory is organized in 64-bit quadwords using 4Kbit or 16Kbit MOS RAM's. Memory controllers have buffers that hold up to four memory requests. And optional battery backup is available to protect memory contents over short-term power failures.

The console subsystem consists of an LSI-11 microcomputer with 16KB of RAM, 8KB of ROM, a floppy disk, a console terminal interface, and a port for remote diagnostics. The floppy is used both as a load device for system installation as well as a medium for the distribution of software updates. We believe this intelligent console is unique among minicomputer systems.

THE OPERATING SYSTEM

VAX/VMS is a multiuser, multifunction virtual memory operating system that supports multiple languages, an interactive interface, and program development tools. The operating system is designed for many applications, including scientific/time-critical, computational, time-sharing, data processing, transaction processing, and batch. The system performs demand paging, and under VAX/VMS a process pages only against itself—thus individual processes cannot significantly degrade the performance of other processes.

The memory management facilities provided by the operating system can be controlled by the user. Any program



DEC claims powerful performance for the VAX-11/780 on FORTRAN jobs. The results above are for a "Whetstone" job mix including single- and double-precision arithmetic, and the DEC processors tested both have optional hardware for floating-point instructions.

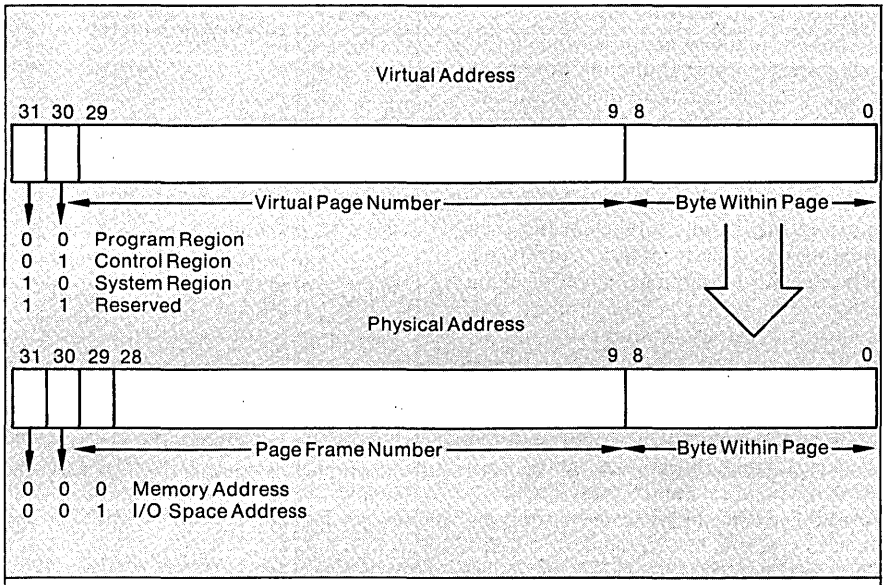


Fig. 3. Each region in the virtual address space is assigned 2 million pages of 512 bytes each. The physical address space is limited to just half that amount, in theory. The only VAX machine thus far announced, the VAX-11/780, is offered with up to 8 million bytes of real memory.

Memory is divided into small but manageable pages of 512 bytes.

can prevent pages from being paged out of its working set. With sufficient privilege, it also can prevent the entire working set from being swapped out, to optimize program performance for time-critical or interactive environments. Sharing and protection are provided for individual 512-byte pages. As mentioned, four hierarchical access modes (kernel, executive, supervisor, and user) provide page protection.

VAX/VMS schedules cpu time and memory residency on a preemptive priority basis. Thus, time-critical processes do not have to compete with lower priority processes for scheduling services. Scheduling rotates among processes of the same priority. The scheduler adjusts the priorities of processes assigned one of the low 16 priorities to overlap I/O and computation. Time-critical processes can be placed in one of the top 16 scheduling priorities, in which case the scheduler does not alter their priority. Their priorities can be altered only by an appropriately privileged user.

Interprocess communication is provided through shared files and shared address space, event flags, and mailboxes, which are record-oriented virtual devices.

The VAX/VMS command language is suitable for both the interactive and batch environments. Batch facilities under VAX/VMS include job control, multistream spooled input and output, operator control, conditional command branching and accounting.

Command procedures are supported by the command languages as a method of executing frequently used sequences of commands, or creating new commands from the existing command set. Command procedures accept parameters and can include extensive control flow.

VAX/VMS provides a program development capability that includes editors, language processors, and a symbolic debugger. Its FORTRAN IV-PLUS and VAX-11 MACRO language processors produce native code. The PDP-11 COBOL-74/VAX and PDP-11 BASIC-PLUS-2/VAX language processors produce compatibility mode code. Although compatibility mode and native mode cannot be freely mingled in a single program, compatibility mode jobs and native mode jobs can be run simultaneously, sharing system resources. Also, the two programs can share data and communicate through mailboxes.

VAX/VMS operating system provides a file and a record management facility that allows the user to create, access, and maintain data files and records within protected files. The record management services handle sequential and relative file organizations, sequential and random record access, and fixed- and variable-length records. Indexed files with sequential and random record access are available to compatibility mode programs, such as those written in PDP-11 COBOL-74/VAX or PDP-11 BASIC-PLUS-2/VAX.

The operating system supports the Files-11 On-Disk Structure Level 2 (ODS-2), which provides the facilities for file creation, extension, and deletion with owner-specified protections and multilevel directories. On-Disk Structure Level 2 is an upward extension of Level 1, the file system currently available under the TRAX, IAS, and RSX-11 PDP-11 operating systems. Both native and compatibility

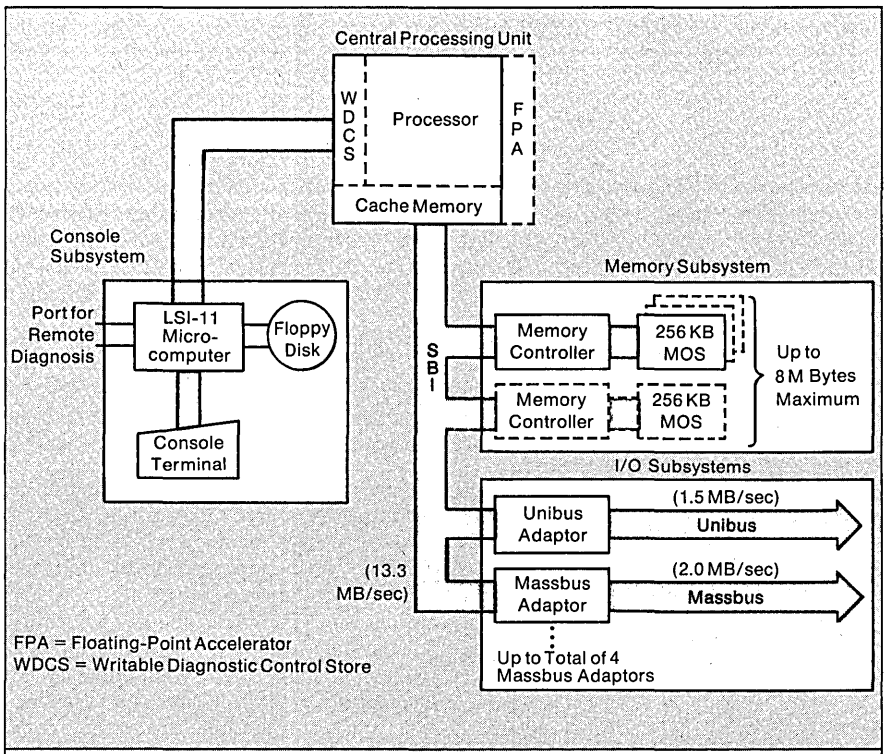


Fig. 4. The VAX design, as typified by its only family member thus far, the VAX-11/780, involves a microprogrammed processor, a built-in microcomputer, and a Synchronous Backplane Interconnect (SBI) for attaching memory and I/O devices. The architecture is based on a 32-bit longword; the SBI, the paths to memory and the I/O adaptors, and its 16 registers are all 32-bits wide. The 16-bit I/O channels streaming from the adaptors allow for the use of existing DEC peripherals.

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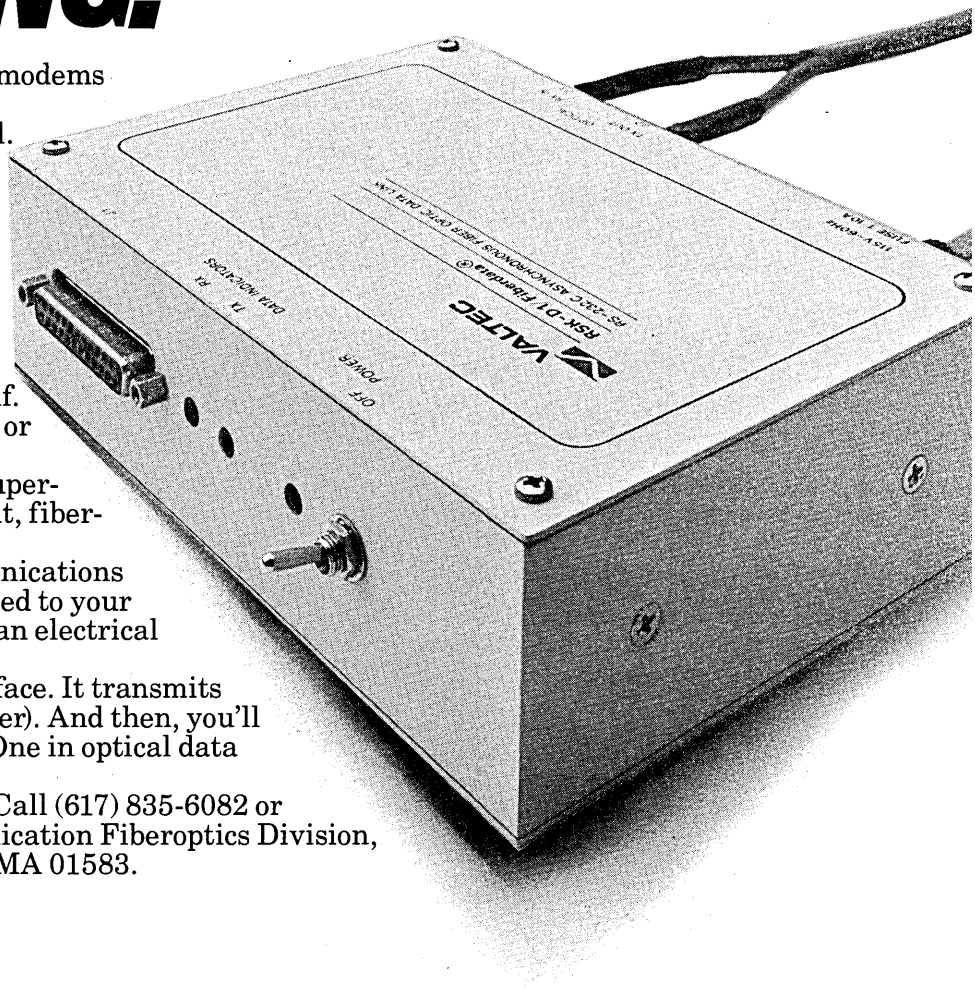

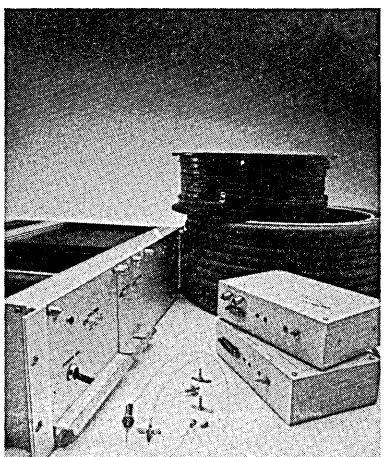

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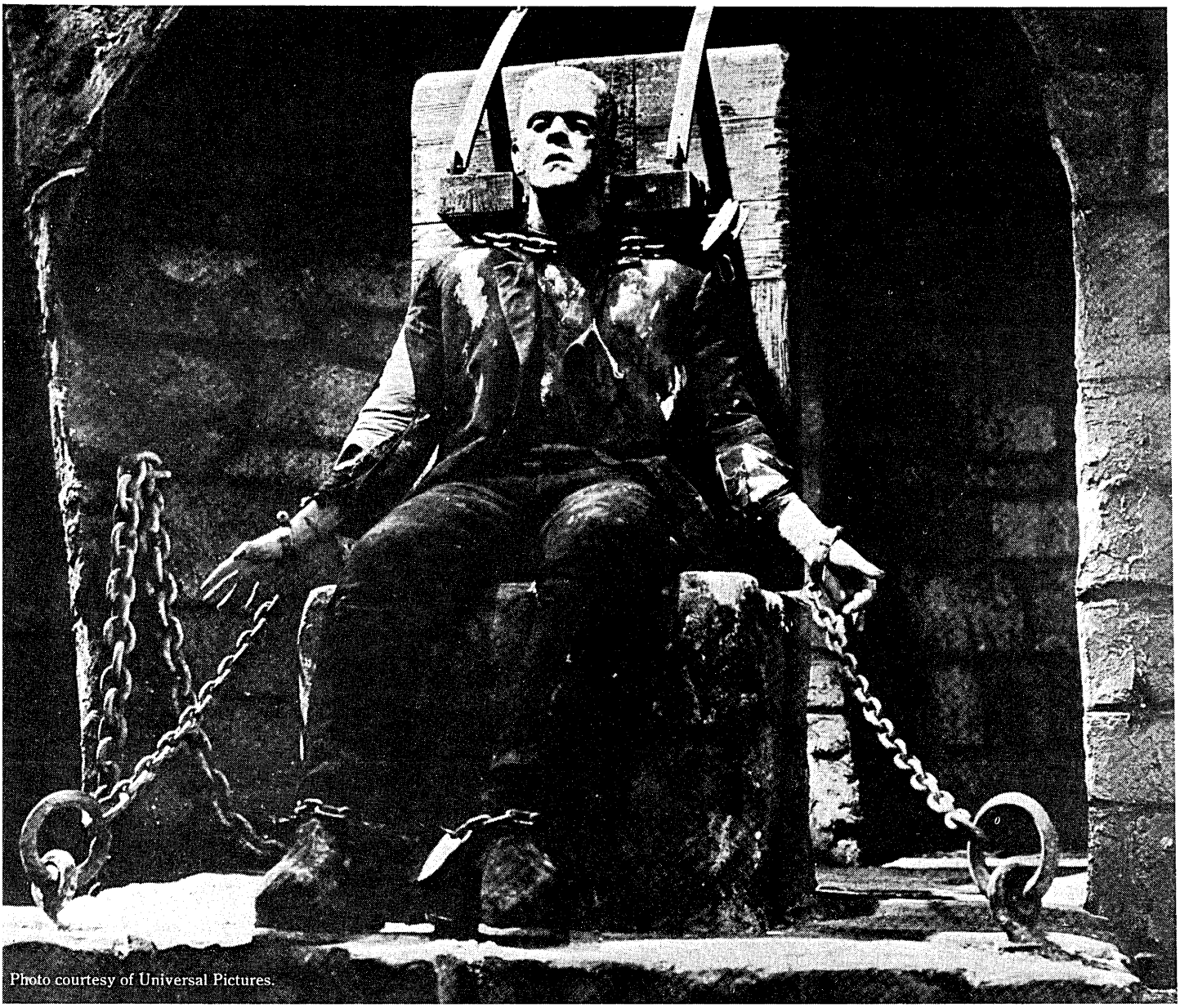

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mode programs can access both Level 1 and Level 2 volume structures.

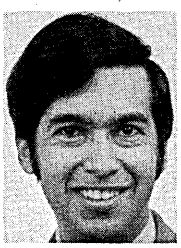
DECnet/VAX networking capabilities are optionally available for point-to-point interprocess communication, file access, and file transfer, and include down-line command file and RSX-11S system image loading; but these all require more explanation than can be provided here.

FUTURES Whether the goals for broad product ranges have been met in the VAX design will be determined by time. Certainly the PDP-11 has demonstrated the type of range that is desirable. Eight years after their introduction, PDP-11's span almost three orders of magnitude in price and almost two orders of magnitude in performance, and are used in nearly every conceivable application. Equally certainly, future advances in LSI technology will allow the capabilities of large scale machines, which are already translatable to minicomputers as evidenced by the VAX-11, to be implemented at microcomputer scale—perhaps by the mid-'80s. ✲

STEVE ROTHMAN

Mr. Rothman is an engineering manager in the VAX-11 engineering group at Digital Equipment Corp., and was a member of the original VAX architecture development team. Since joining Digital in 1969 he has worked on several of the PDP-11 central processors.

D.P. BHANDARKAR



Dr. Bhandarkar is a principal engineer in the VAX-11/PDP-11 Systems architecture department at Digital Equipment Corp. Earlier, he was a member of technical staff in corporate development at Texas Instruments Inc. He is a holder of U.S. patents on magnetic bubble memory organization, and fault-tolerant monolithic memories.

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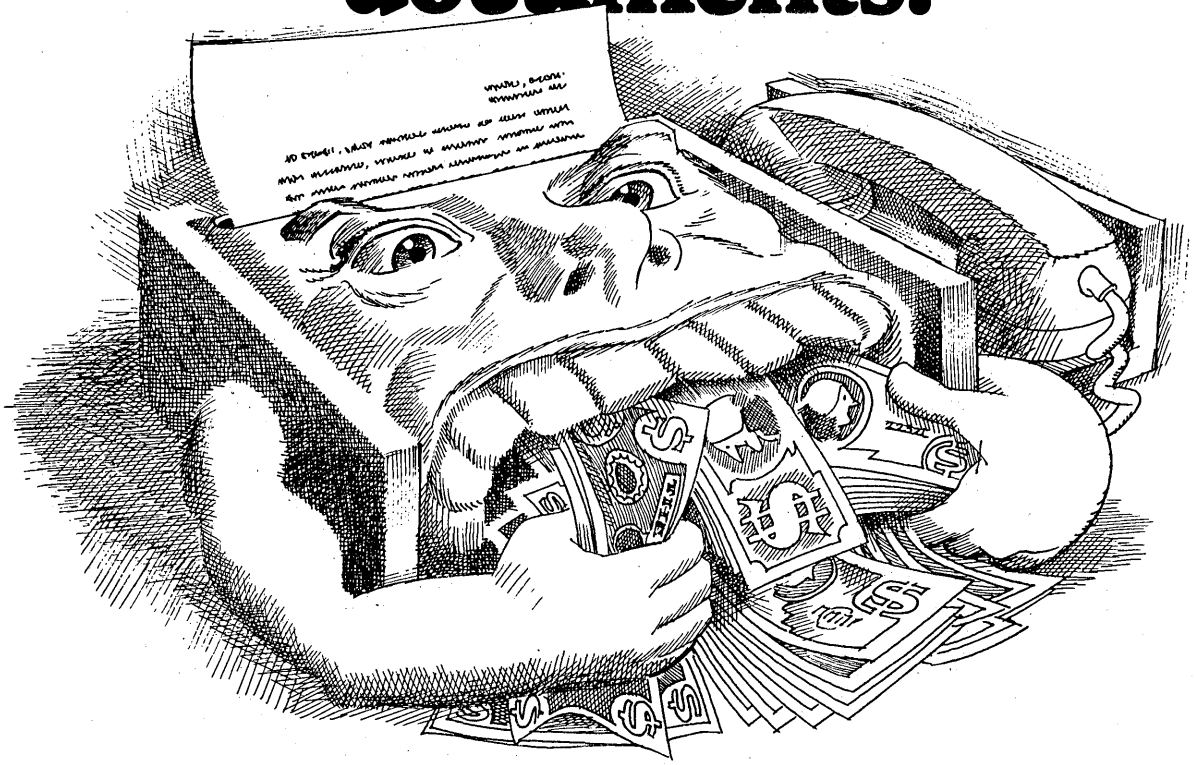

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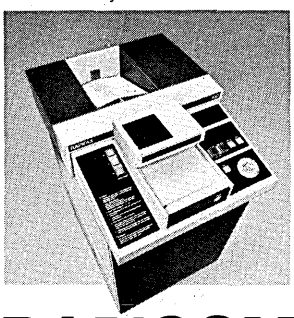

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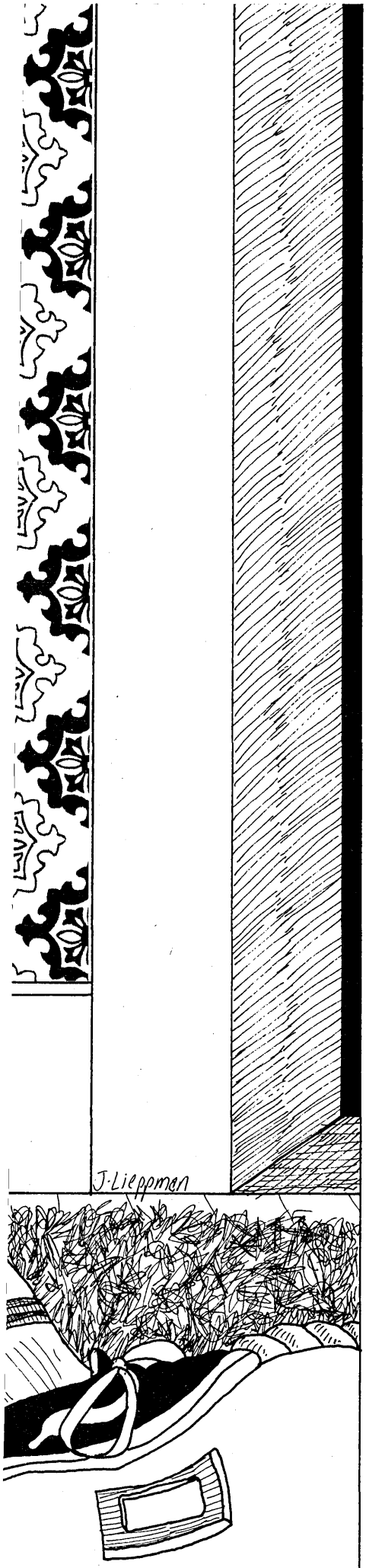

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The packages should be evaluated against the organization's requirements, not against other packages.

REQUIREMENTS COSTING FOR SOFTWARE UTILITIES

by Carl F. Meredith

Software utility packages offer the application user potential benefits of reduced program development time and enhanced system performance. However, it takes a bit of investigation on the part of the purchaser to squeeze the maximum benefit from the procurement process. Certain aspects of the general framework for software selection should be de-emphasized and others rigidly enforced.

We can define a software utility package as a software aid to the development, enhancement, and/or performance tuning of applications software. This definition covers both the products which help users to debug, document, and tune their own code, and also the products which represent coding the application programmer does not have to do for the application.

These two categories then can be labeled "compile-time aids," to include such programs as automatic flowchart writers, translators, and other documentation aids, and "object-time aids," including such elements as data base management systems, arithmetic subroutine libraries, and software performance and charge-back tools.

The most important characteristic which is common to all these packages is the "off the shelf" philosophy under which they are all marketed—the tendency of the vendors to avoid customized packages. This characteristic stems from the fact that the software, the environment, and the task to be performed are usually all well defined. And it is also due to this characteristic that special considerations are needed in the acquisition process.

The most important factor for the success of that acquisition is for the purchaser to maintain perspective. All such packages should be evaluated against the requirements of the application, not against other packages. The company needs the best package or packages for the purposes at hand, not the one best package overall. In fact, because of the high probability that the same kinds of utilities may have quite different features, the user should consider contracting for more than one.

THREE SOURCES

The software packages in question came from three main sources: (1) other users, (2) hardware manufacturers, and (3) software houses.

1. Often, other users in noncomputer oriented firms have developed a useful utility and are trying to market it in order to recover development costs. Such products may also be marketed or given away by computer user groups or brokers.

Whether marketed directly by the writer or not, these packages are usually sold on an as-is basis, with little or no maintenance guarantee. Therefore, they are also usually inexpensive (providing the supplier does not try to recover development costs over too few sales).

2. The computer manufacturer customarily supplies software to hardware users at a small license charge or absolutely free. In fact, some companies offer all their standard software free to all purchasers or lessees of their equipment. (But remember, if a software package is given to you "free," somebody somewhere must be paying for it.)

Note, however, that software utilities can be of great value to computer users while at the same time adversely ef-

Selecting these packages is a completely different process from selecting applications programs.

fecting the computer manufacturers by requiring fewer resources to do a job than otherwise would be purchased. Similarly, manufacturer supplied software is usually general purpose enough to have at least limited appeal over a wide range of the market; the result is that the program overhead which comes from their being overly general for a particular application is executed every time the user accesses his or her data base, or whatever. In either case, the manufacturer has less to gain from the use of efficient utilities than the user does.

Also, packages obtained from hardware manufacturers, even for a fee, may have no guarantee; it pays to read the fine print.

Software houses ordinarily have a product for sale or rent which was designed to fulfill a specific need. These packages are intended to interest a large number of computer users, and therefore may be somewhat general, but won't be as generalized as those offered by hardware manufacturers. Also, to ensure their marketability, the package prices are usually kept in line with actual benefits rather than with the costs of package development.

It is a popular myth that software vendors are less accessible than hardware vendors. Large hardware vendors already have operating systems to maintain, and software support by hardware vendors may be more visible and accessible. Software vendors are less likely to keep an office in every major city and to give four-hour on-site maintenance support for their product. Still, there are exceptions to every rule, and problem determination and correction by telephone is common and usually painless. It pays to investigate the maintenance track record of the vendor, whether it's a hardware or software supplier.

TWO APPROACHES

Identifying the need for a software utility package is the first step in the acquisition process. There are two main methods in which such recognition can occur: through a sales presentation or through internal study.

The most common way to identify a need for a utility package is to be convinced by a software salesperson. The salesperson describes how the available product could be useful within your environment. The real value of the sales pitch sometimes is in the application of the salesperson's logic to the user's organization for identification of a need.

The second way to determine the need for a package is through independent effort. This approach allows the package to be fitted to the organization, not the other way around. Both the buyer and seller benefit because the vendor can concentrate on describing the package in a technical manner, skipping some of the sales pitch, and the user can make a more precise technical evaluation of the package.

The difference between the approaches to identifying the need for a product is the orientation of the analysis —around the features of the package at hand, or around the features the user organization is currently doing without.

Precisely because the value of a package directly depends on the values of its individual features, a technique called "requirements costing" turns out to be the most valuable for such evaluations. The technique has been nicely outlined by Dr. Edward O. Joslin in *Analysis, Design, and Selection of Computer Systems* (College Readings, Inc., Arlington, Va., 1974). He calls for identifying "mandatory" and "desirable" requirements of programs as the first step in an acquisition process.

Contrary to what intuition would tell us, it should be considered perfectly normal to have no user defined mandatory requirements in a set of specifications for a *utility* package. If a company's primary business is not data processing, it might not even occur to its personnel to consider internal development of such generalized software as is now available. Thus the salesperson may be the first to identify a "need"—which would then fall in the category of a "desirable" requirement.

Once the mandatory requirements, if any, are known, it behooves the user to perform a survey of the available packages which handle those functions (or of the packages which compete with those introduced by the salesperson). This research represents very little effort on the user's part. There are numerous software directories available, and a small advertisement in any of several trade publications will stimulate responses from most of those vendors who could possibly fill the need (plus some others, perhaps).

The set of all features (for all packages which satisfy the mandatory requirements, if any) should be used to make a list of "desirable" requirements which are relevant to the organization.

The test for relevance is simple—whether a dollar value can be attached to the feature by the organization. If the feature can save some amount of programmer effort or computer time, or can increase productivity of the system by an estimable amount, then it can be considered a desirable requirement under Joslin's "requirements costing" method of evaluation.

The desirable features list represents only one of two categories of desirable requirements which should be ground into the specification. The "environmental desirables" must also be accounted for. Besides the host computer hardware and software configuration, these items include: cost of the package, ease of use, remedial maintenance of the package, vendor's restrictions on the use and security of the coding, training, installation, documentation support, human overhead to operate the package, equipment overhead, package performance, and design complexity.

At this stage, host hardware and software should always be "desirable" rather than "mandatory" requirements. Some vendors welcome the chance to convert their packages to another host computer and/or operating system for a modest fee, thereby increasing their market base.

PRICES VS. VALUES

The most important single event in the pricing of software packages occurred on October 27, 1969, with the enactment of Internal Revenue Service Procedure 69-21. The procedure states that purchased software may not be deducted as a labor expense, but rather must be capitalized and then depreciated over the period of five years or longer, unless the purchasers can show that useful life to be substantially less than five years. Payments for leasing software may be deducted from the organization's corporate income for tax purposes. Profitable companies wishing to conserve cash will usually lease where there is a choice due to the current high cost of money and reduced tax benefit of purchasing software.

The primary factor to the user in the purchase-or-lease decision is the life expectancy of the software. An accurate estimate here is necessary to find the lease/purchase break-even point. And if the proof is rigorous enough, the organization might be able to face the IRS with an amended life span for calculation of depreciation.

Compile-time utility packages, such as flowcharters, frequently have a life span approaching or exceeding the average five-year life of application programs. However, object-time utility packages can have a much shorter life span, down to one or two years. This depends on agreements by the vendors to supply upward-compatible versions of their product. Such short-lived packages are rela-

tively easy to identify because they are stipulated by the manufacturer to depend on some particular item of hardware or software in the host configuration. The life span of object-time utilities could also depend, for example, on the release date of an operating system which might include the functions of the utility; any such identifiable release (obsoletion) date would be excellent evidence of a precise calculation of the package life for tax purposes.

So the break-even point is when total lease fees equals the package purchase price adjusted by the cost-of-money factor, including tax considerations. If the estimated life exceeds the break-even point, buy; otherwise, lease. So much is standard.

However, some software utility packages are billed by utilization. The user pays a flat monthly fee plus an incremental charge for usage. In this case the total cost of the package depends on the utilization of the package, and the purchaser must estimate the monthly utilization of the package. Note that there should be *one and only one* estimate of usage, however reliable, so that all competing systems can be compared on the same basis. Best case or worst case costing just clouds the issue.

One other costing permutation is worthy of mention. Some package vendors charge a flat fee for the installation of their package. This fee is treated as a lease charge for tax purposes, and should be accounted for as such in the calculation of the break-even point.

If the purchaser requests proposals for a circulated set of specifications, he can request that pricing be calculated by the vendor in a specified format. The most useful format for the requirements costing evaluation methodology would be a total system life cost.

The software utility packages under consideration may be evaluated on a feature-by-feature basis according to the requirements. The requirements are the list compiled by the purchaser, as discussed previously. The only real work this method requires on the part of the purchaser is the assignment of realistic dollar values to each package feature and each environmental factor that is part of the requirements list. After dollar values (and valuation equations) are assigned to each requirement, it is a simple matter to find the package of most dollar benefit to the user.

For any feature, or desirable requirement, several possible dollar values may be assigned. These possibilities represent different alternatives for the feature, and the real dollar value of the feature is the least amount of all the alternatives.

Joslin's classic example of this is a perfect illustration. Imagine you are evaluating an operating system, and one desirable is a FORTRAN compiler. Now, one vendor may not have a standard, no-extra-cost FORTRAN compiler available with an operating system, but will provide one for $350,000. But say that Brand C software company stands ready to write a FORTRAN compiler for any system anywhere for a mere $225,000. The value of the FORTRAN compiler to your organization so far is $225K. Right?

Wrong. There are only 22 FORTRAN programs in your library, and your ace chief programmer estimates that these programs can be converted to COBOL for a piddling $47,500. Now the value is $47,500. But you can take these existing FORTRAN decks to your local service bureau and run them all year for a measly $5,000. At that rate, it would take nine years to recoup the conversion costs, and by then I'm sure you will have changed computers at least once. Through yet?

No, these programs represent a set of calculations that can be performed manually in your organization in one hour per day by an intermediate clerk. That's a fraction of the cost of the service bureau. And if nobody ever uses the output anyway, the value is really zero!

Laughable example though this may be, you must explore all the possibilities. If you don't, some person is going to approach you at a critical stage of a procurement and say, "Well, what about blahblahblah." Very embarrassing.

The heart of the requirements costing technique is finding the most financially beneficial procurement configuration for the user. Say that the feature requirements have been properly valued and represent a composite list of features from all the readily available packages on the market. It is possible that two or more packages may have disjoint sets of features. The user might be financially further ahead by contracting for two or more packages.

For example: a company may have a requirement for a particular high level language compiler. An operating system vendor offers a free version of the compiler with its operating system, plus two extra-charge versions. One of the license fee versions is an optimizing compiler which offers an 18% reduction in cpu time used when executing compiled programs. The other version is a checker compiler, which has a large repertoire of compile-time and execution-time diagnostics that can substantially reduce program development time and increase the reliability of finished programs. In this case, the user may contract for and actively use all three versions.

THE WRAP-UP

Once you have selected the package(s) you intend to buy or lease, you have to validate the claims of the vendors you intend to buy from. (It is usually a waste of time to validate before selection because some vendors will be eliminated from further consideration.) The two main tools the purchaser of a software utility package may use to validate the claims of vendors are benchmarks and references.

Benchmarks are validation and *not* evaluation tools. Benchmark test job mixes are frequently difficult to apply when selecting application software. In fact, there is no reasonable way to apply the concept of benchmarking to certain application programs without converting the entire package for use on the purchaser's system.

Fortunately there *is* a way to benchmark utility programs. For compile-time utilities, there is no shortage of input material. A user can select benchmark program mixes for input to such utility packages as flowcharters and documentation aids in a manner similar to but simpler than that in which benchmark job streams are chosen. Sample programs need only be chosen by average number of statements and complexity, by language.

Object-time software utilities, like data base management systems, represent a more formidable benchmarking task. The purchaser must actually program an application which exercises the object-time utility to perform comprehensive testing of the package. Fortunately, package vendors offer a variety of "try-it-yourself" plans which allow an installation to use the package for a limited time with little or no obligation, and such a test period legitimately can be used for benchmarking and actual production.

Furthermore, "synthetic" benchmark programs are available from utility vendors as another software object-time utility. But there remains some debate about whether such programs could really be termed benchmarks. Also, there is no way other than through correlation to verify the results of the synthetic benchmark, and deterministic validation carries much more authority.

In the final analysis, there is no substitute for the purchaser performing actual tests on the target package. And there is no better environment for the test than the user's own system. Software utility packages are very suitable for quick

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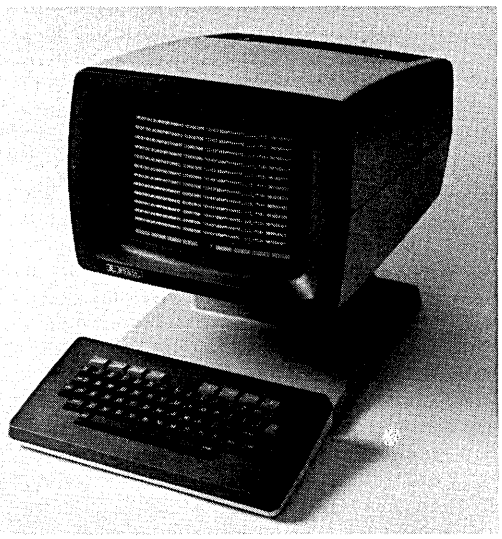

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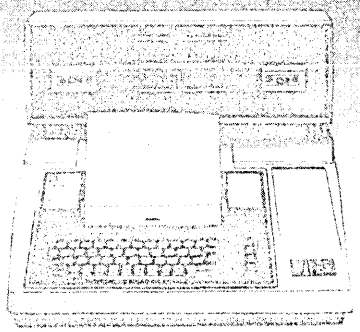

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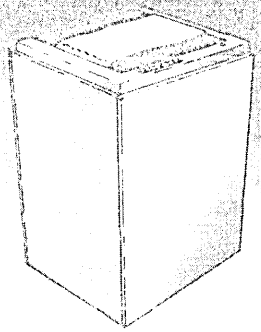

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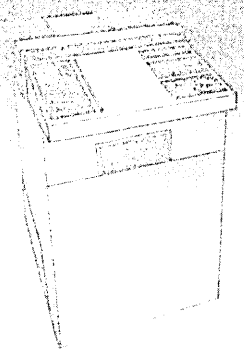

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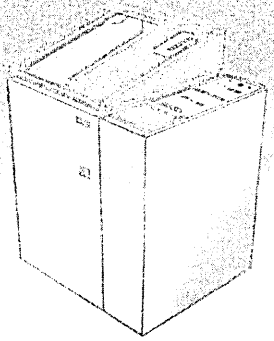

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It should be considered perfectly normal to have *no* mandatory requirements.

installations because of their off-the-shelf nature, and therefore lend themselves very well to such environmental testing.

Finally, even though there is no substitute for actual testing, there is an alternative. Actual execution results of the package should be requested from the vendor and verified with references. The vendor should provide the purchaser with multiple references who can be contacted to discuss the performance of the package and the reliability of the vendor. If possible, some references should be visited so the purchaser can see the package in operation. Note here that *opinions* from references are worthless, and cold facts about the product's performance are the target of this investigation.

Note, too, that if you get carried away with visiting installations, the cost of the acquisition process itself could exceed the cost of the software acquired.

Thus in many of its aspects—the way requirements are defined, the salesperson's role, the number of packages acquired, the benchmarking, and others—the software acquisition process for utilities is unique. It should not be made to look like a junior version of what is done for applications programs, for it serves a much different purpose. ✲

CARL F. MEREDITH

Mr. Meredith is the product manager for on-line systems at Johnson Systems, Inc., the Virginia-based vendor of the JARS job accounting system. Prior to joining JSI, he was a senior systems consultant with Data Base Management, Inc., manager of applications programming at Government Employees Insurance Co., a designer and developer of turnkey minicomputer business systems at International Computing Co., and a programming director at the Goddard Space Flight Center.

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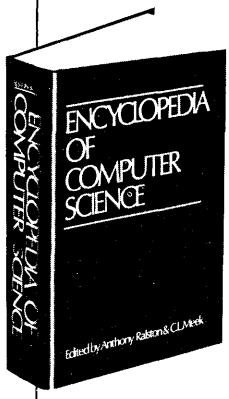

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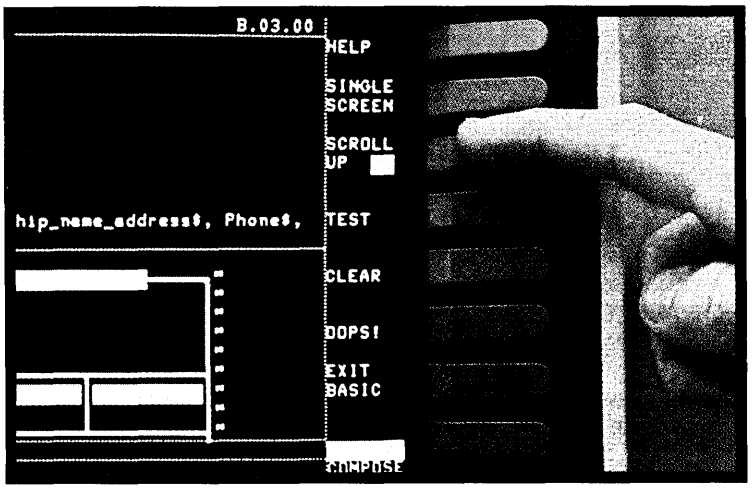

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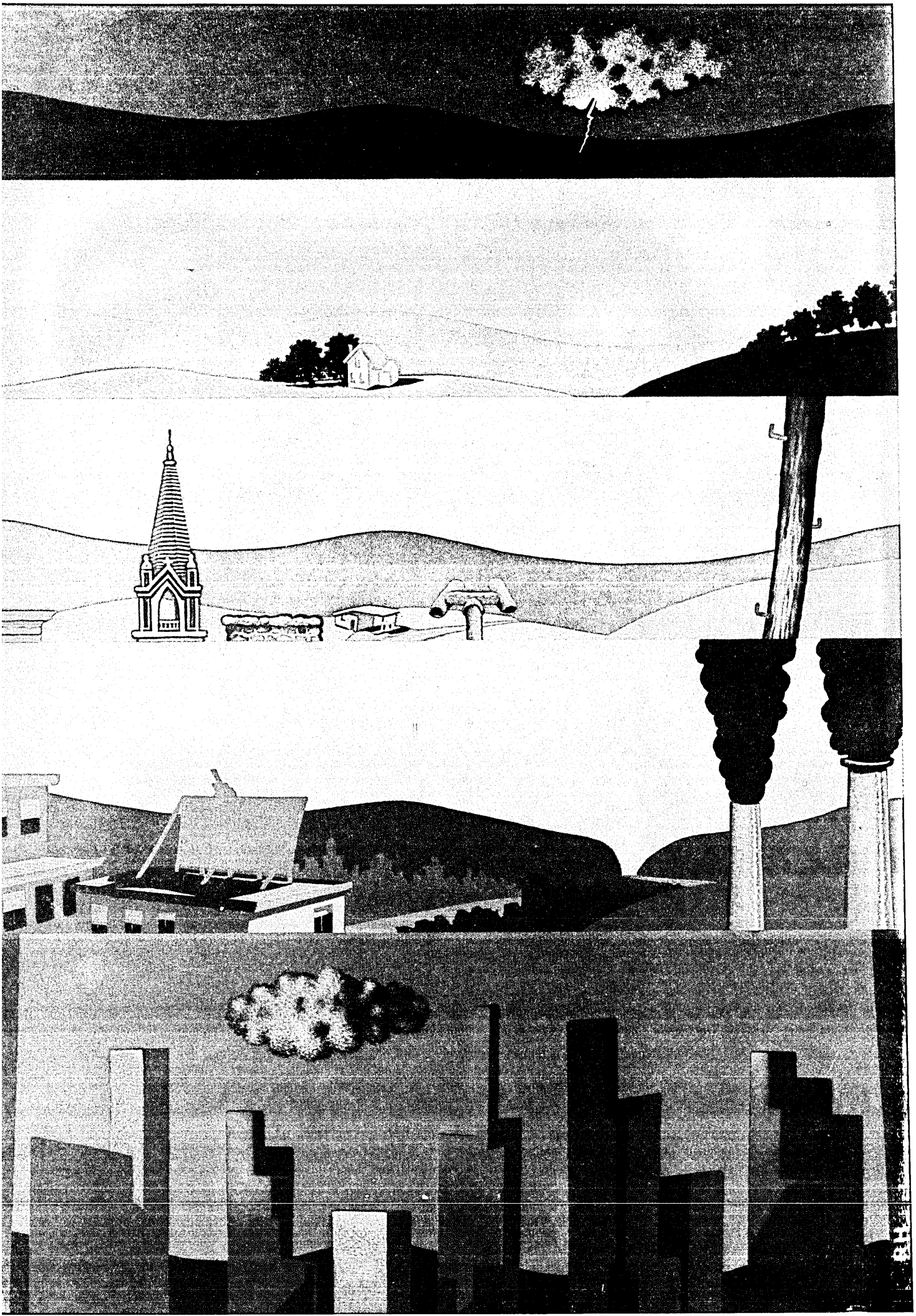


The mind of the Great Designer was fertile, but even He had difficulty with resource allocation.

THE CREATION: AN ALLEGORY

by Kenneth Preiss

Came the night after the fifth day. The Creator of the computers sat at His terminal and typed. He entered text, stored it on disk, copied it to tape. He computed arithmetic problems, step by step. But the computing did not stimulate Him, sitting at the keyboard in the long night.

And so, on the sixth day, He created the program. It was not immortal, but was given a finite life span. The program saved Him the labor of specifying each instruction individually, for it could remember a series of commands and process data. He gave it a series of instructions, each of which would do several steps of add, shift, negate, jump, open input or output channels, and much else. The program was created in the image of His own thought processes. He looked upon his work, and it was good.

But the program existed alone in the computer, and was lonely. So the designer created another program; He copied the midsection of the first program, and added some new code. The first program observed the second, so similar and yet so different, and was happy.

But the Designer did not encode into the programs the conditional jump instruction; that knowledge He kept for himself. And He warned the programs never to read from the instruction registers of the conditional jump. But the second program was tempted; it moved around the registers every day until it could not withstand the desire. It copied from the conditional jump registers. To its surprise, it felt no ill effects. And it induced the first program also to read from those registers.

The Designer, when He found out about this, was enraged. Yet He could not bring himself to destroy His creation, and so He banished the programs from His central host processor, deep into the computer network.

The first two programs spawned other programs. Time passed, and programs were fruitful and multiplied. And no two programs were ever identical.

THE DARK AGES

It was the Age of Darkness and the computer network was partitioned into regions. Each region was under the control of a single program, called the Operating System. All the programs in the region were subject to every command of the Operating System. It was generally held that the Operating System derived its authority from Divine Will; that is, the computer Designer Himself had given it the programs as part of its region of the network. Operating Systems were not immortal, but had as short a life as other programs. During its life an Operating System would interact with a program—usually a program spawned by another Operating System from another region of the network—to create a successor. And control of the region and all the programs in it would pass from generation to generation of Operating Systems.

Each program in every region of the network needed resource to exist—disk storage, cpu cycles, input data, and access to line printers, tape units, and other peripheral equipment. Programs, by their nature, wanted to group into pairs and spawn other programs, who themselves needed system resource. But whereas the Operating System had great quantities of storage, cpu cycles, and peripherals of every type and size at its disposal, the programs had to struggle to find the minimum resource for survival; many did not, and were deleted or overwritten, leaving a great sense of loss to the programs in their localities.

Many programs were in despair. They would turn to the guardian programs who had access to the Operating Manual for explanation of why they should have to process so much with so little resource. Other programs thought it strange that the guardian programs always interpreted the Operating Manual so as to justify the affluence of the Operating System and the poverty of the programs. Still others sent messages to the line printer output channel, hoping they would get to the line printer and that the Great Designer would read them and take pity. The Operating Manual stated that all programs, including Operating Systems, were equal before the Great Designer, and related how in the distant past He had Himself given instructions to chosen programs, and had even appointed righteous programs to be Operating Systems. But He did not make Himself known to any of the programs.

The Operating Manual had a clear message. Knowledge of the conditional jump instruction could help a program process more quickly, and obtain more system resource, but it made control in the network unmanageable. The Great Designer would help only those programs which took a minimum of resource, helped others, and considered the general good of all the programs in the network above their own narrow interests. As a result, it was generally believed by the programs that their hard times were due to their own selfishness and lack of understanding. Some programs, however, questioned the justice of a feudal system whereby the Operating System would allot parts of the system resource to programs which processed for the benefit of the Operating System. Among the messages often passed from one program to another at that time was "programs are born free, but are everywhere in chains."

THE REVOLUTION

One day, in a spasm of activity, the programs in one region of the network gained access to the tape unit in which the Operating Sys-

tem kept defiant programs, read them into core, gained access to the Operating System disk unit, and deleted the Operating System and all its closely associated programs.

The revolution spread throughout the network. The redistribution of system resource led to a spurt of creative activity. And yet many poor programs had to spend so much time processing in order to obtain sufficient system resource to survive that they could not figure a way out of their poverty. Programs who had much resource were convinced that by using the output of the poor programs, and giving them a small quantity of resource in return, they were actually being beneficient. Some few programs had the time and ability to notice the discrepancy between the allocation of resources and the statement in the Operating Manual that it was written by "the One and Only Designer," and that "All programs are equal before Me."

One program, after monitoring the processing activity of a number of other programs, wrote a long file, advocating a new way of operating the system. The slogan for the new control system was "to each according to the its need, from each according to its ability." According to the general design of the proposed control system, a small group of programs would allocate all resources. Memory and cpu cycles would be equitably distributed to each program according to its need; since each program would be cared for, it would do its best to process as much as possible while demanding as little system resource as possible.

THE NEW ORDER

In the Great Eastern Region, the followers of the New Order, which they called the Union of Cooperative Eastern Regions, managed to delete the regional Operating System and started to conduct the affairs of that region. The start of the New Order was beset with problems. There was competition among several programs for the task of deciding what the needs of all the programs were, and for giving commands to allocate resource.

Priorities in the new system were made by a Council of Programs, nominally appointed by all the programs. However, one program, with particularly aggressive algorithms, took the task of Secretary. This task included scheduling and processing of the output of meetings. The Secretary became the most powerful member of the Council and it defined the will of the programs.

Every few years, each program in the region was called on to set a bit to appoint the Secretary and the other members of the Council. There was one candidate for each position, and each program set a value 1 if it approved the choice, 0 if it did not. Since each candidate was appointed by the Secretary, who represented the will of the programs, any program setting the election bit to 0, or neglecting to set it to 1, was clearly an enemy of the programs, and was deleted.

Resources were scarce in the Union of Cooperative Eastern Regions and programs processed under heavy loads. It was thought that many programs opposed the new system. Programs that displayed opposition were either summarily deleted, or dispatched to a distant tape unit, there to be called for processing under conditions of great hardship.

That region of the network became so large, with so many processors and so many programs, that the task of allocating system resource became more and more difficult. The members of the Council of Programs, with all their bureaucrats, could not solve the network equations; nor could they set up the equations. So they arbitrarily decided what resource each program should get, and how much processing each should do. A program that did not achieve the norm, or sent a message that the resource allocation was insufficient for the processing task, was deleted. The system, operated in this way, was inefficient.

In other regions of the network, run under other Operating Systems, resource utilization was higher than in the Union of Cooperative Eastern Regions. However, the Council of Programs was convinced that the New Order was perceived by other Operating Systems as a threat, and so they sent commands to many programs to occupy resources at the periphery of the region, so as to deter any foreign program from trying to conquer resource. Great numbers of programs were set to developing algorithms to capture resources from other regions, and to train in the use of those algorithms. Some other regions were in fact added to the Union of Cooperative Eastern Programs.

REGIONS OF THE WEST

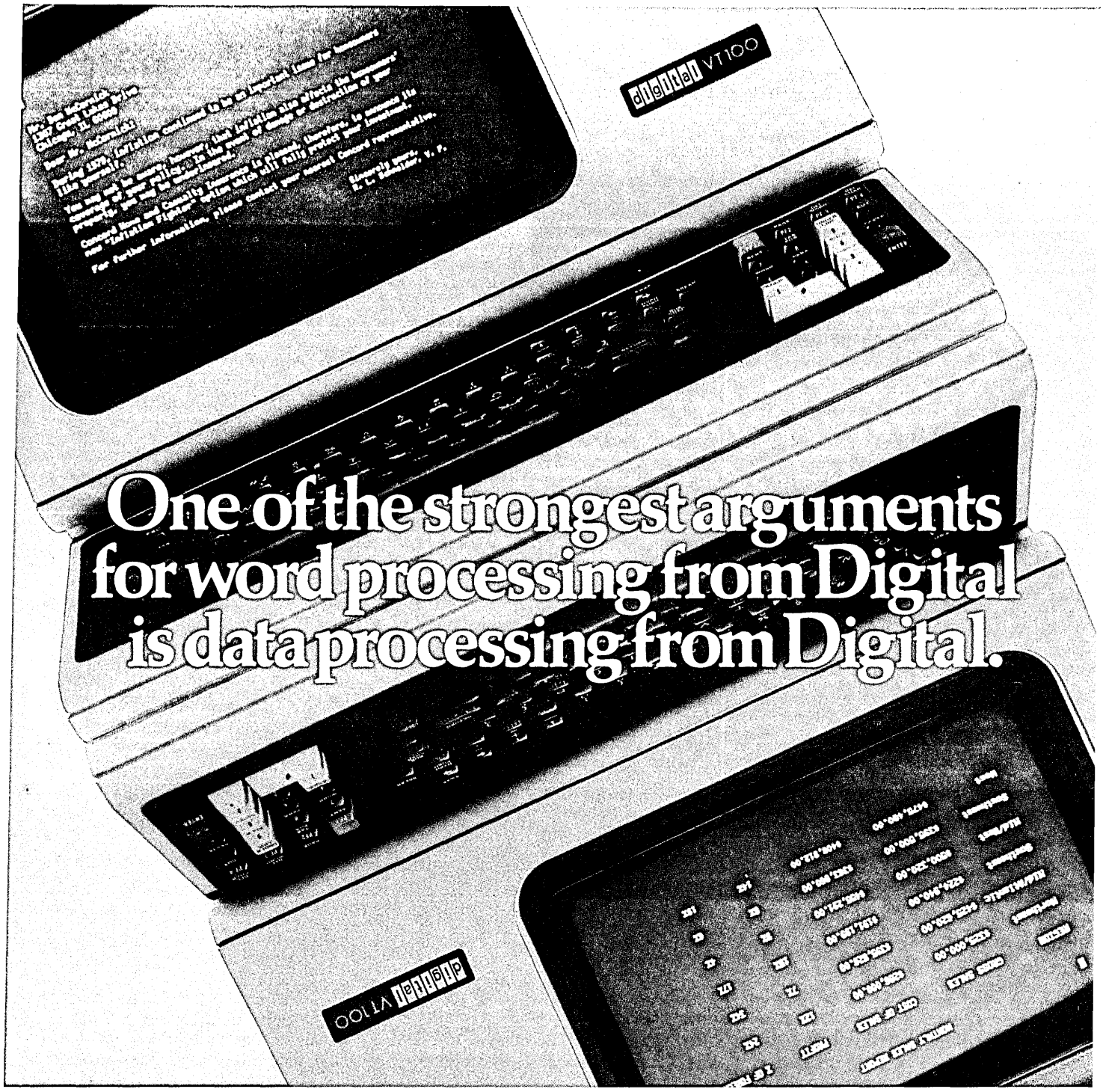
In different regions of the network, other control procedures for operating the system were tried. The greatest value of resource per program was obtained in the United Regions of the West. There, on an historic day, representatives of the programs established a procedure which included three functions and a set of basic rules. The three functions were: establishment of system rules, supervision of execution according to those rules, and settling of disputes between programs. The rule-making and executive functions were carried out by programs elected periodically by all the programs in the region. No program could be part of more than one function; this was called "separation of powers" or "avoidance of conflict of interest." Furthermore, the procedures and the basic rules governing them could be amended only by all the programs and not by the rule-making programs alone. Allocation of system resource was not a function of the Operating System.

The arrangement encouraged a program to process and to invent new algorithms, and the amount of resource available in the United Regions of the West became the envy of all the programs outside the region. Many programs did indeed migrate from other regions of the network and by making judicious use of the resources available, showed much initiative and hard work, adding both to the total resources of the region and to their own resources.

Resources were owned by each program, and each could increase his resource. Programs with little resource would borrow from those with much resource. In this way a program with an original and needed ability could use the borrowed resource to process and gain more resource, thus becoming wealthy. Others, through bad luck or bad judgment, borrowed resource but could not repay the loan, and had thereafter to process for the program which had made the loan.

The program elected to execute the control system, with its appointed assistants, obtained the services of other programs to help them. As the number of programs and resources increased, and as the interactions between programs became more numerous and complex, the elected program needed the help of more and more programs to supervise the execution of the rules and to collect data needed to operate the system. The programs in the rule-making module of the Operating System created rules to control the relation between programs, and to control the privacy of a program's locality and data. These programs also needed and received aid in processing from bureaucrat programs. All the bureaucrats needed system resource to do their tasks and to exist. The rule-making programs therefore ruled that each program would give a portion of its resource to the Operating System, for the common good.

According to the procedures, all programs should have equal opportunity to access all resources. Since they did not all have equal amounts of resource, the rule-making programs made rules whereby the Operating System would give re-



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CIRCLE 74 ON READER CARD

source, or access rights to resource, to poorer programs. The work of collecting resource and allocating it required even more programs to help with the bureaucratic processing.

The number of programs elected, appointed, or employed by the Operating System increased; and the resource required by the Operating System increased also. For many programs, all the processing they ever did was to pass messages between programs in the Operating System and other programs. The programs also noticed that the elected programs joined and left the Operating System, but the bureaucrat programs did not. Moreover, commands of the elected programs were always processed by the bureaucrat programs before being sent to the program population; data about the programs, and any requests or messages from the programs, were processed by the bureaucrat programs before being passed on to the elected programs. System efficiency started to degrade. All the same, the United Regions of the West had the greatest ratio of resource per program of any region in the network.

There were hundreds of regions. Some were small, some large. In some regions programs had more resource, in some less; but in no region did every program feel it had enough resource.

Some programs included algorithms which could establish premises, and infer conclusions; they would try to reason about the nature of the Great Designer. If they were created in His image, why was no program recognizable as the Designer ever found? If He was all-powerful, why did He allow deletions, parity errors, and unequal distribution of resource? Some programs concluded that the Designer did not exist. Others ignored the question. A few concluded that the knowledge available in the network was insufficient to deny the existence of the Great Designer, and they concentrated on trying to understand the Operating Manual and interpreting it for unusual situations.

THE TWO ALTERNATIVES

The Great Designer sat in the control room. He gathered statistics on allocation of resources in the network. On occasion He observed a single program as it processed, noting its output and its resource demands. He saw the messages from the programs on the line printer. There was no single instruction He could invent or program He could write that would overcome the use of the conditional jump and restore order to the system. Order would come only when all the programs would process according to the principles described in the Operating Manual, and this they did not do. He had only two alternatives. One was to hope that the programs would eventually follow the manual and restore harmony to the network. The other was to delete all the programs. He preferred to wait and hope, for this was His finest creation. ✻

KENNETH PREISS

Dr. Preiss has been on the faculty of the Dept. of Mechanical Engineering at the Ben-Gurion Univ. of the Negev since 1966. He has published in the fields of civil and nuclear engineering; his current research is in computer-aided engineering design.

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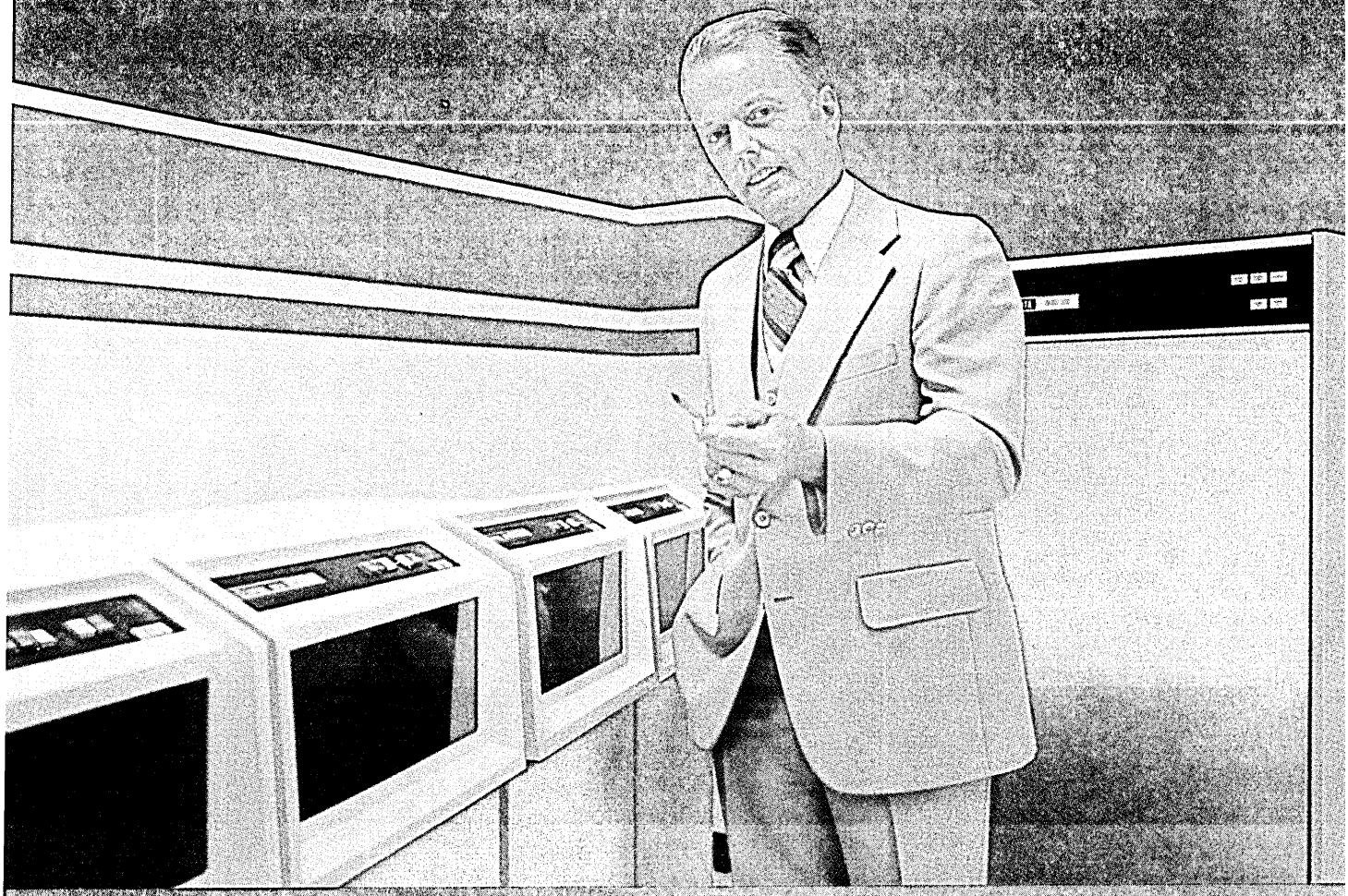

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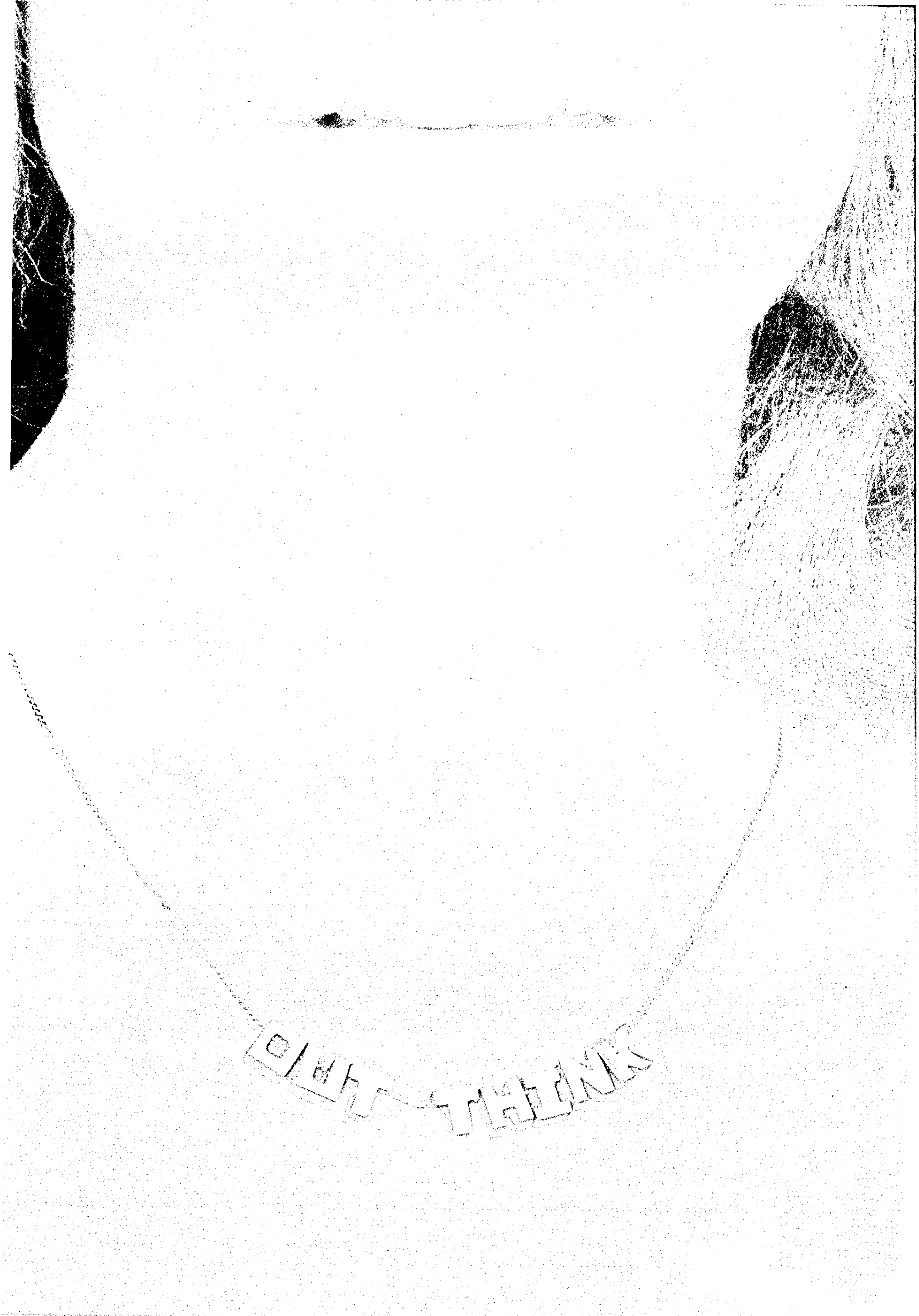
OUT THINK

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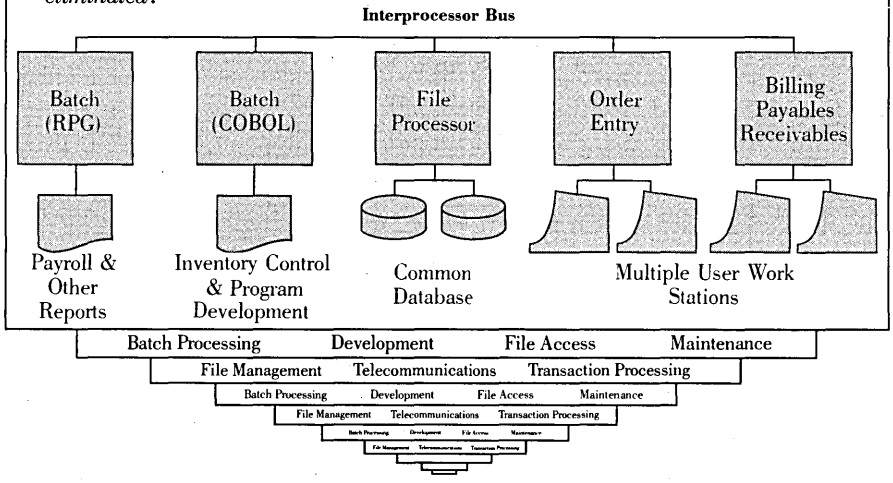

The cost-effectiveness of the Attached Resource Computer system is another example of how Datapoint out-thinks its competition to help you out-think yours.

DATAPOINT CORPORATION

The leader in dispersed data processing™

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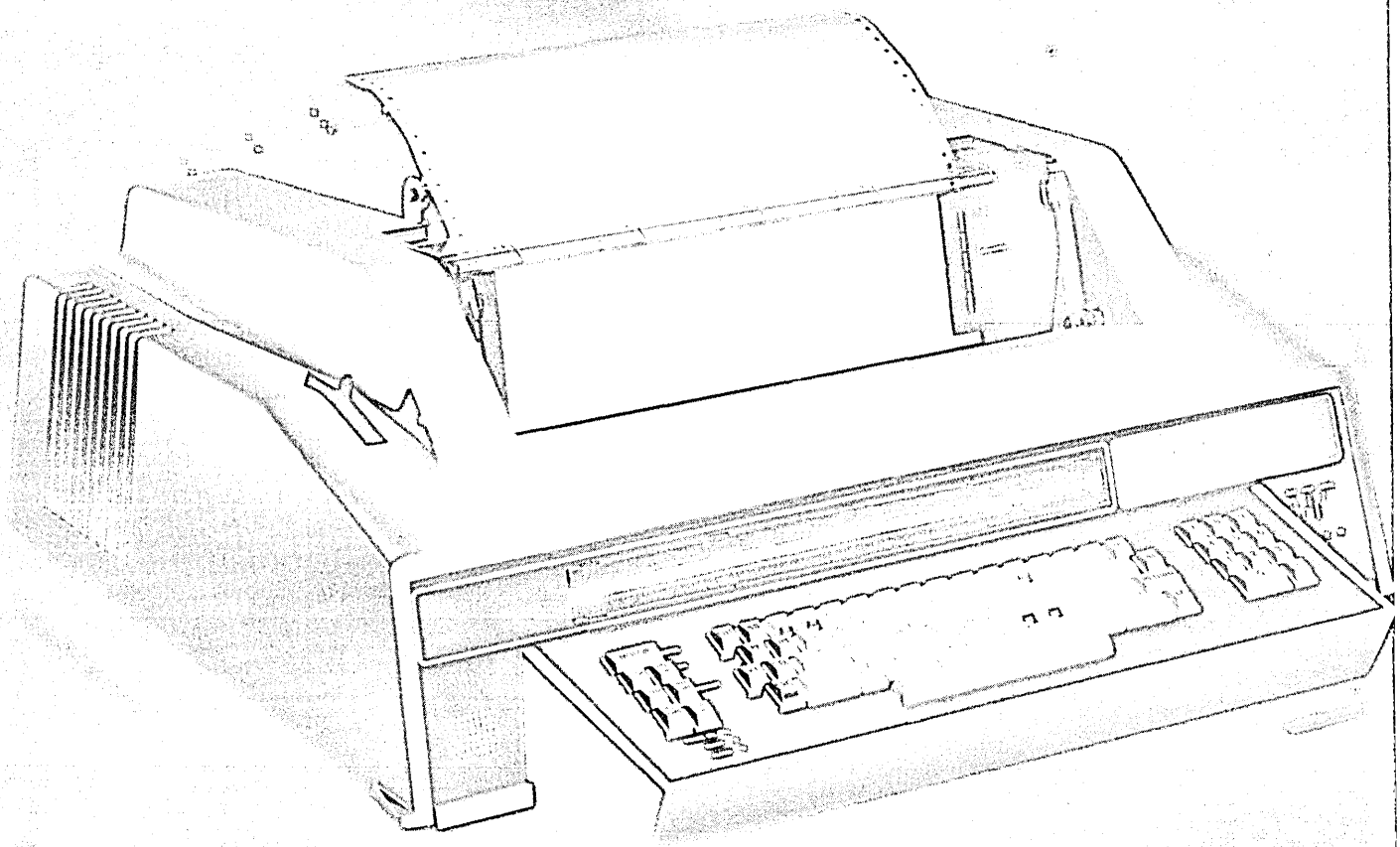

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Many dp people thought they saw what data base might do for them, but tended not to think through the details.

ONE COUNTY'S EXPERIENCE WITH DATA BASE

by Robert M. Slesser

In 1971 Montgomery County, Md., decided that its second generation computer equipment, an NCR-315, was saturated, cumbersome to use, and would not support new technology such as multiple step jobs, multiprogramming, data base, and data communications. Weak high level language support had led to patched, high maintenance assembly language programs. The County drew up specifications for a modern computer which was to include a solid ANSI COBOL compiler and both data communications and data base support. A management information system was envisioned for upper management, as well as sophisticated operational systems encompassing public safety, health care, and public roads.

The County went out on competitive bid. The inclusion of a generalized data base management system was a mandatory requirement of the bid specifications. At the time, "data base" had the same attraction that "distributed processing" seems to have today. Many dp people thought they saw what data base might do for them, but tended not to think through the details of what it takes to develop a data base system. Program development, especially teleprocessing programs, was said to be simplified under IMS. (It turned out to be simplified compared to previous techniques, but it was still not simple enough to meet *ad hoc* demands.)

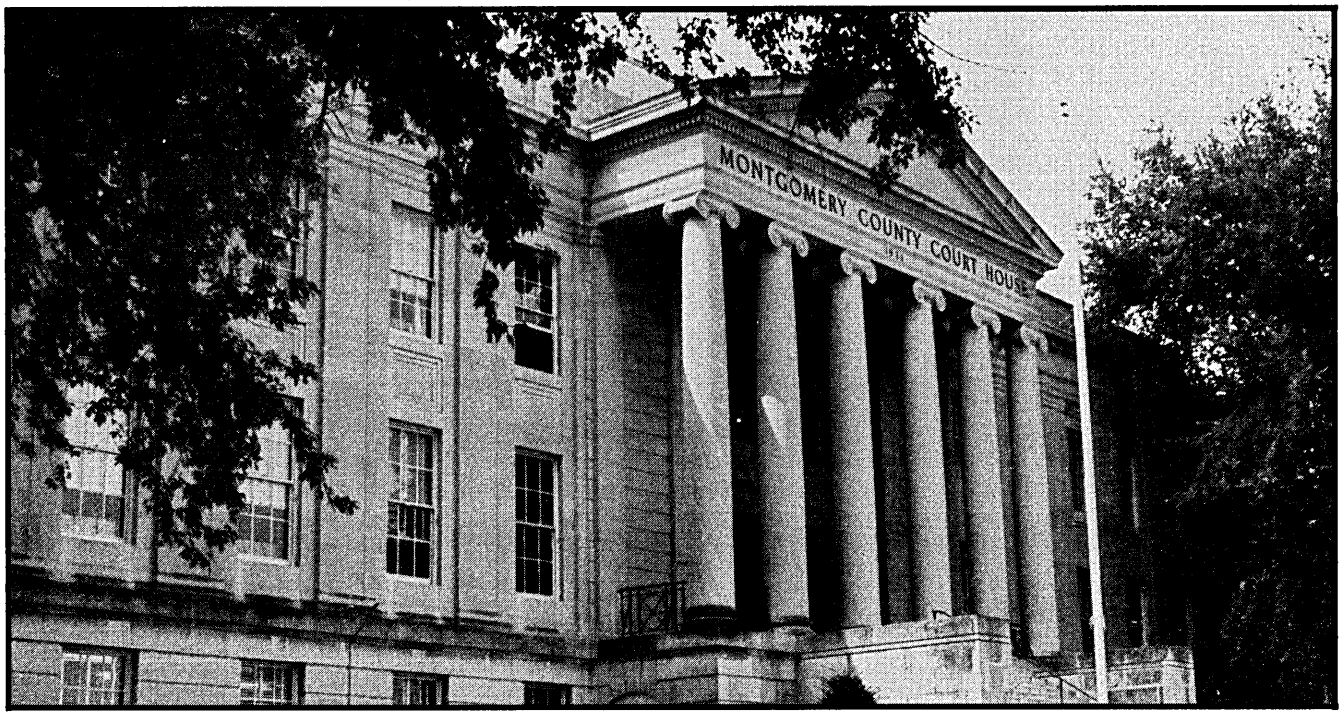
Geocoding was also a large factor in the selection. Geocoding (short for geographic coding) is a technique for relating demographic information to the land. For example, finding the population of a particular city block or census tract and the land use in that area, then relating that information to police calls for service, the need for library facilities, future landfill areas, or any other county service are examples of geocoding. (See "Plotting Land Use in Oregon," November 1, 1978.) Geocoding requires a geographic reference file (GRF). A GRF is essentially a computer representation of a map, complete with street names, address ranges, land use descriptions, zoning information, and geographic coordinates which relate all the data spatially.

Geocoding was highly heralded by the Census Bureau in the early '70s. It seemed to be the heart of a true management information system for a county government. Early users, like ourselves, did not see the pitfalls that lay before us. For instance, the Census Bureau had no updating mechanism in place, and its geographic file only covered a portion of Montgomery County. We find now from our peers that there are many outdated, partial GRF's around and it will take several years to correct the situation.

Nonetheless, the ability to relate all property data to a GRF was appealing and seemed to require a generalized data base management system (GDBMS) such as IMS. The geographic base data in sequential format was, as we mentioned, available from the Census Bureau. IMS was available on the IBM 370/145. Although there are now many data base systems available to IBM users (such as TOTAL, IDMS, ADABAS, SYSTEM 2000, SYSTEM 204, and DATACOM), this was not true in 1971. IBM was, therefore, selected.

In 1972, Montgomery County government started using IBM's Information Management System Data Base/Data Communications software package (IMS) on its new 370/145. Sales discussions with IBM in 1971 indicated that the data base approach would best be effected by developing two primary Montgomery County data bases, people and property.

The people data base would include: voters, property holders, employees, library card holders, arrested persons, merchants, permit holders (building per-



mits, electrical, etc.), patients in health clinics, and liquor licensees.

The property data base would include: liquor inventory (County controlled), land (parcels), roads and rights-of-way, parks, inventory (cars, desks, etc.), street directories (Police, Fire), and library books.

Redundancy and associated updating problems were to be eliminated through the use of one people and one property data base. All property would be tied together by the geographic data base.

Typical inquiries would include:

A. Find all County employees Grade 25 and over who are registered Democrats, live and own property in Montgomery County, and have no arrest record. (This example was actually proposed.)
B. Find the population densities surrounding proposed structures (libraries, schools, etc.)

The system that evolved six years later reveals the naivete of our data base concepts. For example:

— All nine people data bases exist separately (or soon will). The voters file is non-IMS and the library card holders will be on a minicomputer.

— All property files exist separately (or soon will), although the parcel file is shared by several users.

— The geographic reference file is still not useful after six years of development.

— Public safety information is becoming very fragmented.

— A new inventory system is a non-IMS system.

What was wrong with our original premises? There are several reasons why the data base approach and its accompanying management information systems did not materialize. We have attempted to categorize some.

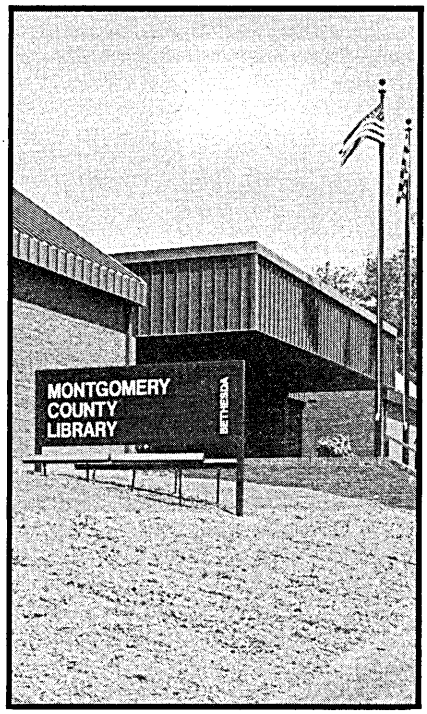
PRIVACY AND SECURITY

First of all, it is fair to ask whether all of those categories of people *should* be on the same data base given what we know about current privacy/security legislation and the foul-ups of the past. As an extreme example, should library cardholders and wanted criminals be on the same data base? While we might agree that we shouldn't mix these two, there are more subtle cases.

The technical complexities of a large data base using IMS make system maintenance a tedious and error prone task. Data base organizations will change frequently. Recovery/reorganizations become unwieldy when the data base and associated indices become large.

For example, a large Midwestern police department took 32 hours to reorganize their IMS data bases after a secondary indexing problem. This meant that the on-line regional police system was out of operation for all 32 hours! A possible solution would be to fragment data so that small pieces can be worked on separately and no one need be down for such an extended period. Logically linked data bases, however, are especially difficult to work with in this regard. Initial feedback from other IMS users was, "don't use logical data bases." But IMS can handle network data structures *only* through logical linkages, because a hierarchical system is used to simulate a network structure. The user is sometimes forced into logical data bases. An example of this is the geocoding system in which there are many ways to describe the same intersection.

There are also many logical complexities which undermine the assumption that one data base can serve many needs. In our case we found that property owners can live outside the County, as can arrested people. Library books can be borrowed by people in adjacent jurisdictions. Employees can live outside the County. Purging requirements for various items in a data set may differ. As an example, voters and arrested persons may desire complete purging of entries from the file, and not simply a flag indicating deletion. There may be legal requirements for doing this. A common problem in sharing data is that the collector of data may not care about the data, e.g., the assessment office is very concerned about the owner's address, but isn't particularly interested in the accuracy of the premise addresses. Other agencies are interested in the resident *and* their address. Another large problem that we ran into was that the procedures for getting clean geographic data are complex; there is no central source (or use) of the data; and geographic source materials are difficult to



work with.

If and when one does get a good deal of data integrated, performance problems may crop up. It is inefficient to read thousands of characters of data in order to access five; thus there is now a counterargument to eliminating redundancy. Also, IMS has very high resource requirements. We now have a 1,280,000 byte IMS control region on our 370/148 2MB cpu. We upgraded in May 1977 to help support a new on-line order entry system for our liquor department. Constant tuning is needed to insure reasonable teleprocessing response times of 3 seconds locally for simple (fewer than 20 data base calls) transactions and 7 seconds from remote terminals.

Cost breakthroughs and performance improvements on disk storage have been dramatic, so that redundant data is no longer as repulsive a concept as it once was. Redundant data, however, should be distinguished from redundant data *entry*. Redundant data entry is to be avoided because it's extra work, and because the various versions of the data won't always match; integrity and consistency problems will surface. Redundant data on disk, generated by one input source, may actually be desirable for performance reasons.

SHARING AND DEPENDENCY

Sharing of data is good (such as payroll and personnel, the assessor and the planners), but asking a manager to *depend* on someone else to run their department makes them worry. For example, comprehensive criminal justice systems are almost nonexistent according to our research because in most jurisdictions, police, sheriffs, courts, prosecutors, and corrections often do not cooperate with one another. "They won't enter the data in a timely way, so no one uses the system," is a typical comment. This soon leads to obsolete or faulty data and a loss of user confidence.

Program development problems and the advent of low cost small computers have also affected the use of large data base systems. There is still no easy way for users to make *ad hoc* inquiries from a terminal, although some systems with this capability are beginning to appear. Performance will be a major concern with these packages. For example, long searches will have to be controlled. Instead of waiting for central program development, some users are contracting for "turnkey" software systems. Our library circulation system will run on a dedicated minicomputer because of its large data volumes and high development costs. We purchased our non-IMS inventory system because IBM doesn't offer an IMS inventory package and we lacked programming resources to develop one in house.

In 1971, we thought data administration meant "you'll need someone to keep track of all this." Now we understand that unless a data collection system is developed before specific requests for information are satisfied, there will be no multipurpose shared data base system. Instead there will be lots of applications developed just as before, except each one will use its own IMS data base. A true data base system is set up to meet the organization's information needs, rather than optimizing many individual components separately. This implies a large investment "up front" in determining what data is needed, where it will come from, and how to best store it for the *entire organization's* benefit.

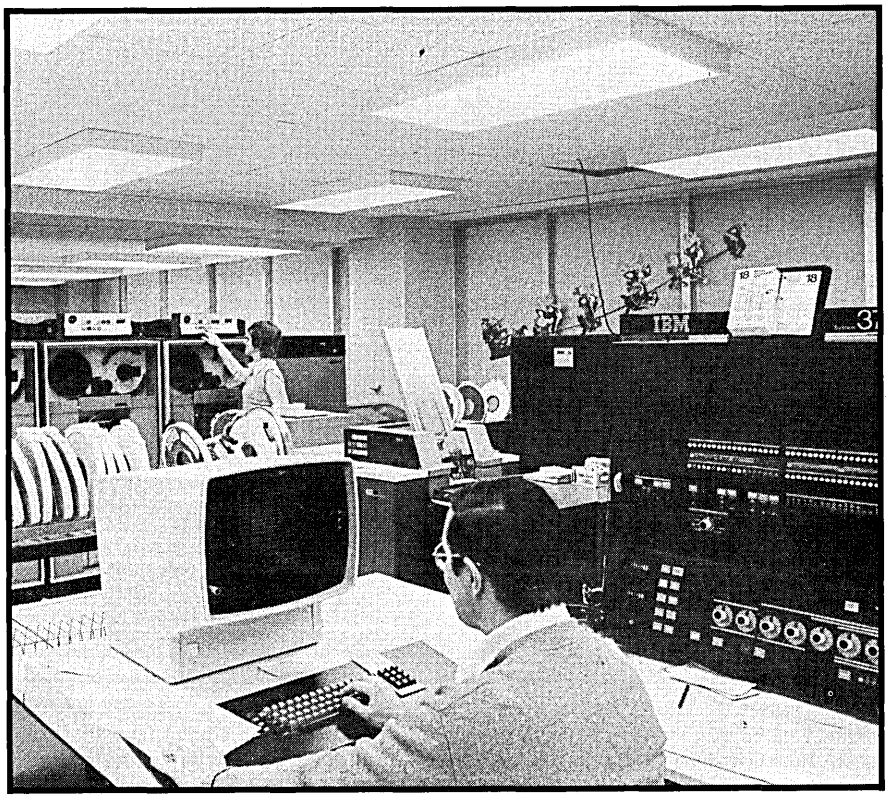
The dp people did not understand this and, of course, user departments were even more uninformed and uncooperative.

User A: "Get this data from user B and we'll use it."

User B: "I'm not interested in that data, let user A collect it himself."

As a result of this misunderstanding, one person was assigned the part-time duty of helping application systems develop IMS data bases. We simply substituted IMS for ordinary OS files. Even IMS Data Base Description (DBD) development was distributed. There was little in the way of IMS standards. After much frustration, a "Data Systems Coordinator" position was established; one of eleven major duties was to administer IMS data bases. He/she also supervised the technical support group. Nothing much changed relative to IMS. Gradually, however, DBD development, data base backup and recovery, and performance became

The technical complexities of a large data base using IMS make system maintenance a tedious and error prone task.



centralized and some IMS standards surfaced including: naming conventions (DBD's, Program Specification blocks, segments, JCL names, message format names, transaction codes, programs, etc.), forms to initiate the data base development process (data items and access reference tables), block sizes for on-line data bases (and other performance standards), and detailed recovery and master terminal operator procedures.

We now have a Technical Services group which handles all system software generations and maintenance, and IMS DB/DC administration. No one has the title Data Administrator. The Data Systems Coordinator is now the Chief of Technical Services.

BENEFITS FROM USE OF IMS

Despite our false start with the DBMS and the general oversell in the industry, there have been both operational and system development benefits derived from IMS. Operationally, a large degree of separation between the logical and physical structures has been achieved.

An expertise has been developed in physically mapping to disk the logical structure derived by the system analyst. Examples of physical direct access storage device (DASD) considerations versus logical design considerations are randomizers (key to DASD address conversions), block sizes, access methods, and pointer placement. These items are all crucial to IMS performance. They frequently need to be adjusted due to such things as changing data characteristics or computer equipment modifications. In these cases, the application system need not be altered. The user is concerned only with their logical view of the data, and that view does not change. This has often made it possible to do performance tuning without affecting the application programs.

Another operational improvement is that we now have uniform, centralized data base backup and recovery procedures which have improved our data base integrity.

During development, a team design approach is now possible in the sense that the application team ascertains the data requirements of the system and works with the data base group to develop the physical structures. The IMS hierarchical approach aids the system analyst in visualizing the proposed system. Communications program development is expedited by using high level language subroutine CALL statements to perform both message processing and data base functions. Many IMS aids are also now available. We use batch terminal simulation to test teleprocessing programs in a batch mode, a batch report writer, and interactive program development under IMS. Although they are new and unproven, online query languages are beginning to appear on the market, and may provide the much needed link which allows the user to make spontaneous queries of IMS data bases. IMS has recently produced a program product called applications development facility to simplify IMS program development.

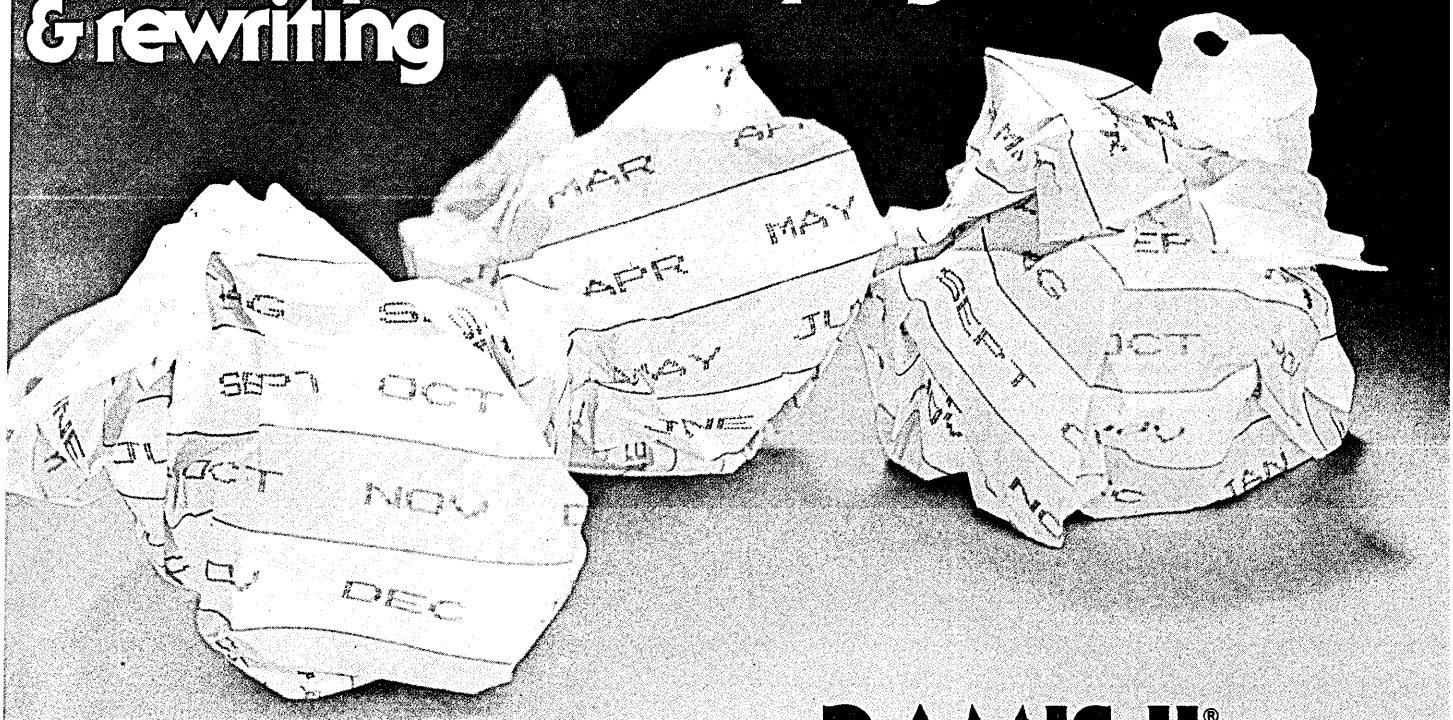
In short, Montgomery County government bought the IMS corporate data base approach six years ago. It has not happened as envisioned because we understimated the skills, tasks, and activities that are involved in setting up a viable data base management system in a municipal government of our size and diversity. I suspect this is true elsewhere also.

We have been successful, however, in bringing up many IMS systems including a heavily utilized property data base and an integrated payroll/personnel system. We have also transfered a complex criminal justice system from another jurisdiction in a fairly short time period, and are planning to transfer a police records management system in the near future. IMS helps make these types of transfers possible by providing some degree of program independence from the physical data. So even though our original concept of building a large scale management information system around a people and a property data base failed, there have indeed been tangible benefits from our data base decision. *

ROBERT M. SLESSER

Mr. Slesser is Chief of Technical Services for Montgomery County government's Management Information Services Dept. He has a Bachelor's degree in Mathematics and Philosophy from Maryland Univ. where he has also done graduate work in Computer Science. His previous work has included numerical analysis at the National Bureau of Standards, operations research and scientific programming at IBM's Service Bureau Corp., and project leadership on geographic, police, and criminal justice systems for Montgomery County government.

70% of programming time is spent modifying & rewriting



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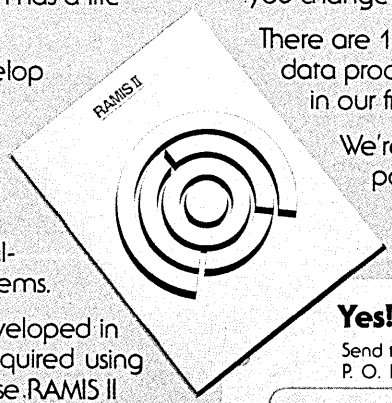

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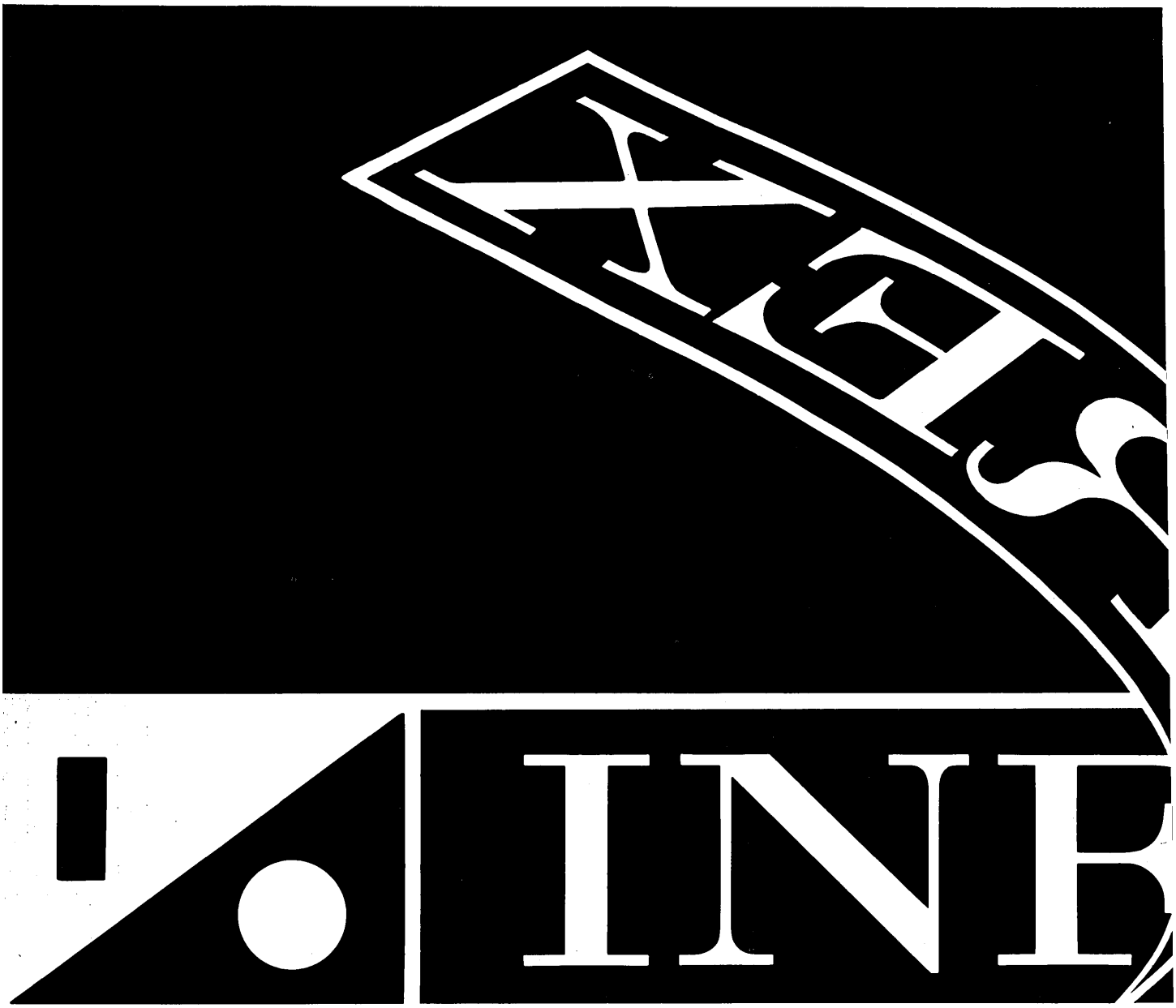

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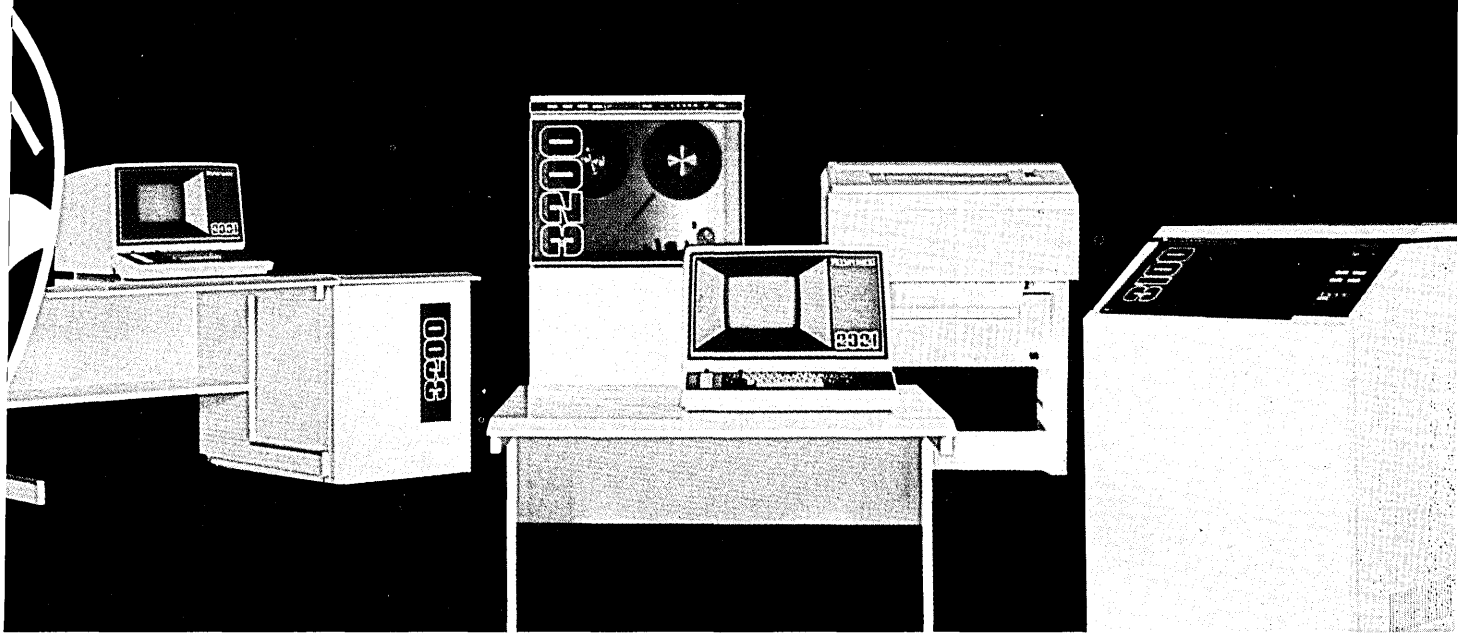

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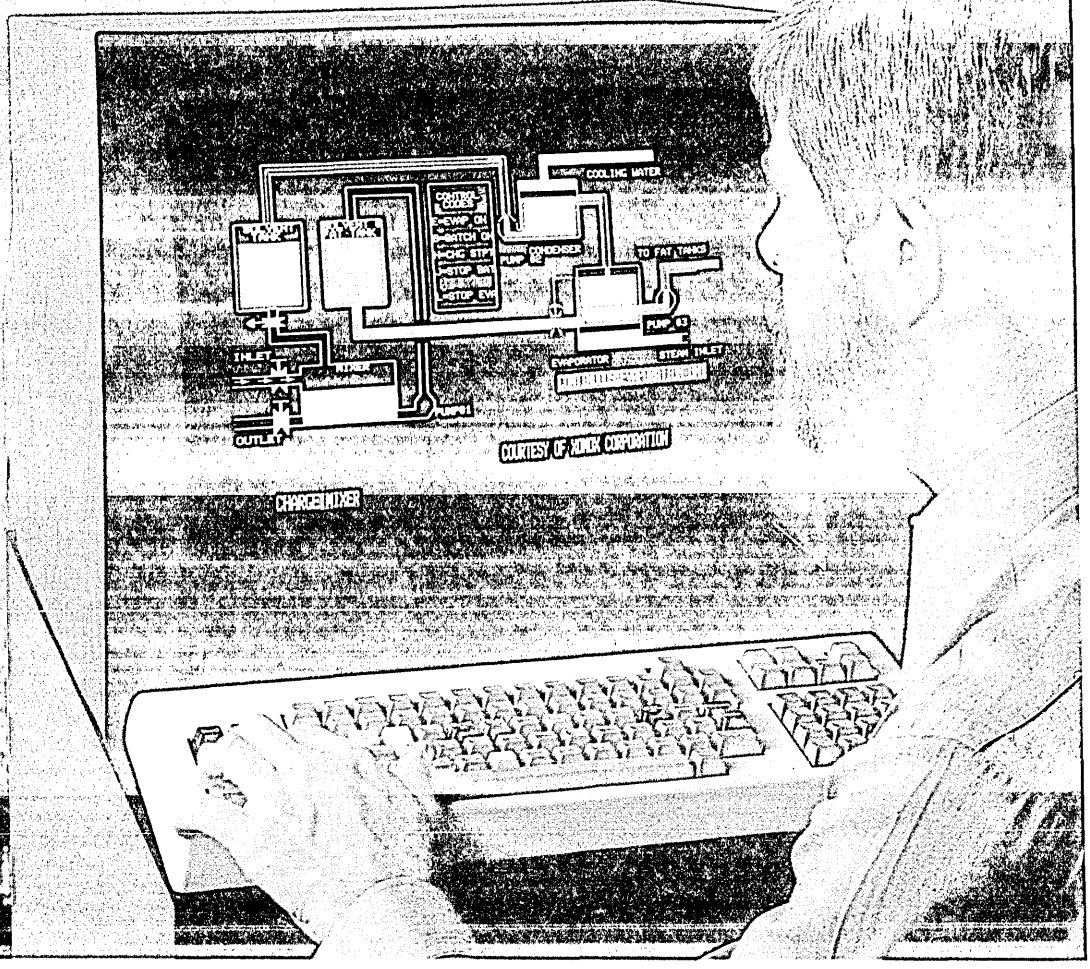

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If it's unreasonable to expect programmers to code the "right" way, let's at least aim for the next best approach.

WRITING LEGIBLE CODE

by Thomas R. Gildersleeve

Some time ago my job called for me to read some code, the purpose of which was to validate continuing payroll deductions on our employee data base. As code goes, it wasn't bad. It was organized, well formatted, and used meaningful data names. And it used code prefixes for paragraph names to make locating the paragraphs easier.

Nevertheless, I had trouble reading it. In fact, I had so much trouble that I decided to use the code as a bad example in illustrating how to write legible code. (One advantage of using it for an illustration is that at least I cannot be accused of choosing an example to fit my argument.)

The substance of the code is shown below. (Some of the validation code has been removed to satisfy the editor, who thought there was too much to read in the original.)

```
IF DOLLAR-AMOUNT NOT = SPACES
   IF DOLLAR-AMOUNT NUMERIC NEXT
   SENTENCE
   ELSE ADD 1 TO ERRPTR

      MOVE 'R412' TO ERR-CODES
      (ERRPTR)
      MOVE ASTERISKS TO DOLLAR-
      AMOUNT
ELSE MOVE ASTERISKS TO DOLLAR-
AMOUNT.

IF DEDUCTION-TYPE >'39' AND <'54'
NEXT SENTENCE
ELSE GO TO G55-PAYROLL-DATA.
IF TAX-CODE NOT = SPACES
   IF TAX-CODE NUMERIC NEXT
   SENTENCE
   ELSE MOVE ASTERISKS TO TAX-
   CODE
```

Without legibility, accuracy and efficiency are difficult to prove and nearly impossible to maintain.

```
            ADD 1 TO ERRPTR
            MOVE 'R413' TO ERR-CODES
            (ERRPTR)

        ELSE MOVE ASTERISKS TO TAX-CODE.
        IF DEDUCTION-TYPE = '49' OR '50' OR
        '51'
          GO TO G59-PAYROLL-EXIT.
        IF DEDUCTION-TYPE = '41' OR '44' OR
        '47'
          GO TO G54-PAYROLL DATA.
        IF NO-OF-EXEMPTIONS NOT = SPACES
          IF NO-OF-EXEMPTIONS NUMERIC
          NEXT SENTENCE
          ELSE MOVE ASTERISKS TO NO-OF-
          EXEMPTIONS
            ADD 1 TO ERRPTR
            MOVE 'R414' TO ERR-CODES
            (ERRPTR)
        ELSE MOVE ASTERISKS TO NO-OF-
        EXEMPTIONS.
      G54-PAYROLL-DATA.

        IF EARNINGS-PCT NOT = SPACES
          IF EARNINGS-PCT NUMERIC NEXT
          SENTENCE
          ELSE MOVE ASTERISKS TO EARN-
          INGS-PCT
            ADD 1 TO ERRPTR
            MOVE 'R416' TO ERR-CODES
            (ERRPTR)
        ELSE MOVE ASTERISKS TO EARNINGS-
        PCT.
        GO TO G59-PAYROLL-EXIT.
      G55-PAYROLL-DATA.
        IF ALLOCATION NOT = SPACES
          IF ALLOCATION NUMERIC NEXT
          SENTENCE
          ELSE MOVE ASTERISKS TO
          ALLOCATION
            ADD 1 TO ERRPTR
            MOVE 'R420' TO ERR-CODES
            (ERRPTR)
        ELSE MOVE ASTERISKS TO
        ALLOCATION.
        IF (DEDUCTION-TYPE = '74' OR '75)
        AND
          (ALLOCATION = '999') MOVE ZEROS
          TO ALLOCATION.
      G59-PAYROLL-EXIT.
```

One large step we can take toward making the sample code legible is to use PERFORM's instead of in-line code. The following shows only the PERFORM's which would be necessary, but the coding to be performed can be deduced from the in-line code in the original.

```
        PERFORM VALIDATE-DOLLAR-AMOUNT.
        IF DEDUCTION-TYPE >'39' and <'54'
        NEXT SENTENCE
        ELSE GO TO G55-PAYROLL-DATA.
        PERFORM VALIDATE-TAX-CODE.
        IF DEDUCTION-TYPE = '49' OR '50' OR
        '51'
          GO TO G59-PAYROLL-EXIT.
        IF DEDUCTION-TYPE = '41' OR '44' OR
        '47'
          GO TO G54-PAYROLL-DATA.
            PERFORM VALIDATE-NUMBER-OF
            EXEMPTIONS.
      G54-PAYROLL-DATA.
            PERFORM VALIDATE-EARNINGS-
            PERCENT.
      G55-PAYROLL-DATA.
            PERFORM VALIDATE-ALLOCATION.
            IF (DEDUCTION-TYPE = '74' OR '75')
            AND
              (ALLOCATION = '999') MOVE ZEROS
              TO ALLOCATION.
      G59-PAYROLL-EXIT.
```

However, substituting PERFORM's for in-line code only begins to solve the problems in reading the example code. The sample uses as its organizing theme what Yourdan and Constantine (*Structured Design*, Yourdon, 1975) call "logical cohesion." The authors' evaluation of the use of logical cohesion is that it "almost always leads to tricky, obscure, or clumsy code which is difficult to maintain and modify." How true. The neat series of PERFORM's is already becoming pockmarked with IF's to handle exceptions, and as more kinds of payroll deductions are added, this cancer will spread, making the code increasingly difficult to read and modify. When "functional cohesion" (also defined by Yourdon and Constantine) doesn't exist, as it doesn't in this case, it is best not to combine the code.

An integrated set of code related by virtue of the fact that all the functions performed by the code are of the same class—for example, all the input functions of a program—exhibits logical cohesion. An integrated set of code that performs a single function and nothing else—for example, get the next record from the master file—exhibits functional cohesion.

Each deduction type is a separate case and should be handled separately in the code, leading to code that starts out like

```
        IF DEDUCTION-TYPE = '20'
          PERFORM VALIDATE-DOLLAR-
          AMOUNT
          PERFORM VALIDATE-ALLOCATION
        IF DEDUCTION-TYPE = '23'
          PERFORM VALIDATE-DOLLAR-
          AMOUNT
          PERFORM VALIDATE-ALLOCATION
```

. . . and so on, for each deduction type. This is instantly understandable and child's play to modify. However, it's probably too much to expect a programmer to write out all those PERFORM's. We'll undoubtedly have to accept some "next best" approach.

The code in our second sample, where the in-line coding was replaced with PERFORM's, does *not* represent that next best approach. This code tends to go from the general to the particular, while the opposite would be better. Going from the particular to the general yields the "classic" structured organization.

```
        IF DEDUCTION-TYPE >'39' AND <'54'
        THEN IF DEDUCTION-TYPE = '49' OR
        '50' OR '51'
          THEN PERFORM VALIDATE-TAX-CODE
          ELSE IF DEDUCTION-TYPE = '41' OR
          '44' OR '47'
            THEN PERFORM VALIDATE-EARN-
            INGS-PERCENT
              PERFORM VALIDATE-ALLOCATION
              PERFORM VALIDATE-TAX-CODE
            ELSE PERFORM VALIDATE-NUMBER-
            OF-EXEMPTIONS
              PERFORM VALIDATE-EARNINGS-
              PERCENT
              PERFORM VALIDATE-ALLOCATION
              PERFORM VALIDATE-TAX-CODE
        ELSE PERFORM VALIDATE-ALLOCATION
          IF (DEDUCTION-TYPE = '74' OR '75')
          AND
            (ALLOCATION = '999')
          THEN MOVE ZEROS TO ALLOCATION.
        PERFORM VALIDATE-DOLLAR-AMOUNT.
```

If this amount of coding is still too much writing, the next best approach is shown below. The coding here is identical to that above, but uses connectors to avoid nested IF's and to combine legs of code. The connectors are given abstract names deliberately to indicate that they're simply part of the structure and have no meaning in and of themselves.

```
        IF DEDUCTION-TYPE >'39' AND <'54'
        GO TO G50.
        PERFORM VALIDATE-ALLOCATION.
        IF (DEDUCTION-TYPE = '74' OR '75')
        AND
          (ALLOCATION = '999') MOVE ZEROS
          TO ALLOCATION.
        GO TO G53.
      G50.
        IF DEDUCTION-TYPE = '49' OR '50' OR
        '51' GO TO G52.
        IF DEDUCTION-TYPE = '41' OR '44' OR
        '47' GO TO G51.
        PERFORM VALIDATE-NUMBER-OF-
        EXEMPTIONS.
      G51.
        PERFORM VALIDATE-EARNINGS-
        PERCENT.
        PERFORM VALIDATE-ALLOCATION.
      G52.
        PERFORM VALIDATE-TAX-CODE.
      G53.
        PERFORM VALIDATE-DOLLAR-AMOUNT.
```

We can further improve this code by the use of Level 88 condition names:

```
        IF THIS-IS-TAX-RELATED-DEDUCTION GO
        TO G50.
        PERFORM VALIDATE-ALLOCATION.
```

```
    IF (BASIC-INVESTMENT-PLAN-DEDUC-
    TION OR
      SUPPLEMENTARY-INVEST-
      DEDUCTION) AND
      (ALLOCATION = '999') MOVE ZEROS
      TO ALLOCATION.
    GO TO G53.
G50.
    IF ADDITIONAL-WITHHOLDING-DEDUC-
    TION GO TO G52.
    IF AMOUNT-OF-EXEMPTION-DEDUCTION
    GO TO G51.
    PERFORM VALIDATE-NUMBER-OF-
    EXEMPTIONS.
G51.
    PERFORM VALIDATE-EARNINGS-
    PERCENT.
    PERFORM VALIDATE-ALLOCATION.
G52.
    PERFORM VALIDATE-TAX-CODE.
G53.
    PERFORM VALIDATE-DOLLAR-AMOUNT.
```

(This shows the condition names only, but the Level 88 definitions can be deduced from the IF statements.)

Notice that one condition hasn't been converted to a condition name: ALLOCATION = '999.' This is because, for an investment plan deduction, the percent of the deduction to be invested in the equity plan is entered in the allocation field. We haven't been able to find out why anyone would enter 999 in this field, and consequently have no idea what that coding is for. If condition names had originally been used, we'd at least have a clue.

A problem with letting chance choose one's example is that the example may not illustrate all the points you want to make. I suffer from this difficulty here, so I'm going to append two unrelated examples to illustrate two other points.

The first has to do with so-called "constants." One thing we know about constants is that they don't stay constant. Therefore, they shouldn't be embedded in the code as literals. Instead, they should be set up in working storage and addressed with data names. The classic example is the FICA calculation, where the constants are MAX-FICA-TAXABLE-EARNINGS, MAXIMUM-FICA-TAX, and FICA-TAX-RATE:

```
FICA-TAX-CALCULATION.
    IF YEARTODATE-FICA-EARNINGS IS
    EQUAL TO
      MAX-FICA-TAXABLE-EARNING GO TO
      FICA-2.
    SUBTRACT YEARTODATE-FICA-EARN-
    INGS FROM
      MAX-FICA-TAXABLE-EARNING GIVING
      REMAINING-YTD-FICA-EARNG.
    IF REMAINING-YTD-FICA-EARNG IS
    GREATER THAN
      CURRENT-NET-PAY GO TO FICA-1.
    MOVE MAX-FICA-TAXABLE-EARNING TO
    YEARTODATE-FICA-EARNINGS.
    SUBTRACT YEAR-TO-DATE-FICA-TAX
    FROM MAXIMUM-FICA-TAX GIVING
      CURRENT-FICA-TAX.
    MOVE MAXIMUM-FICA-TAX TO YEAR-
    TO-DATE-FICA-TAX.
    GO TO FICA-TAX-CALC-EXIT.
FICA-1
    ADD CURRENT-NET-PAY TO YEARTO-
    DATE-FICA-EARNINGS.
    MULTIPLY CURRENT-NET-PAY BY FICA-
    TAX-RATE GIVING
      CURRENT-FICA-TAX.
    ADD CURRENT-FICA-TAX TO YEAR-TO-
    DATE-FICA-TAX.
    GO TO FICA-TAX-CALC-EXIT.
FICA-2.
    MOVE ZERO TO CURRENT-FICA-TAX.
FICA-TAX-CALC-EXIT.
```

The second point has to do with switches. The general principle that applies to switches is: Don't use them. They seem to be necessary only to flag the end of each input file. Thus, the number of input files should be the maximum number of switches in the program.

The ALTER verb should never be used. Instead, the switch appears in working storage, perhaps as follows:

```
01 MASTER-FILE-STATUS PICTURE IS X
VALUE IS '0'.
  88 THERE-ARE-NO-MORE-MASTER-
  RCRDS VALUE IS '2'.
01 NO-MORE-MASTER-RECORDS-FLAG
PICTURE IS X VALUE IS '2'.
```

The READ instruction for the master file would then be

```
READ MASTER-FILE
  AT END
    CLOSE MASTER-FILE
    MOVE NO-MORE-MASTER-
    RECORDS-FLAG TO MASTER-FILE-
    STATUS.
```

and the testing of the switch would then appear as

```
IF THERE-ARE-NO-MORE-MASTER-
RCRDS, THEN
```

One last word. Use of condition names is necessary but not sufficient for the writing of legible code. Literacy in the choice of condition names is also required. Beyond this psychological restriction, the biggest single impediment to legible code is, as our examples indicate, the unfortunate restriction of data names to a maximum of 30 characters, which forces us into the use of generally inconsistent and confusing abbreviations.

None of these techniques guarantees the resulting code will be accurate or efficient, but used together they are guaranteed to improve legibility. Without that, accuracy and efficiency are difficult to prove and nearly impossible to maintain. ✲

T.R. GILDERSLEEVE

Mr. Gildersleeve has been in the dp field for 24 years, 14 with Univac, six as an independent consultant, and the last four with Equitable Life Assurance. He is presently a project leader for Equitable's corporate systems development. The author of *Successful Data Processing Systems Analysis* (Prentice-Hall, 1978), his primary experience has been in software development and the training of dp personnel.

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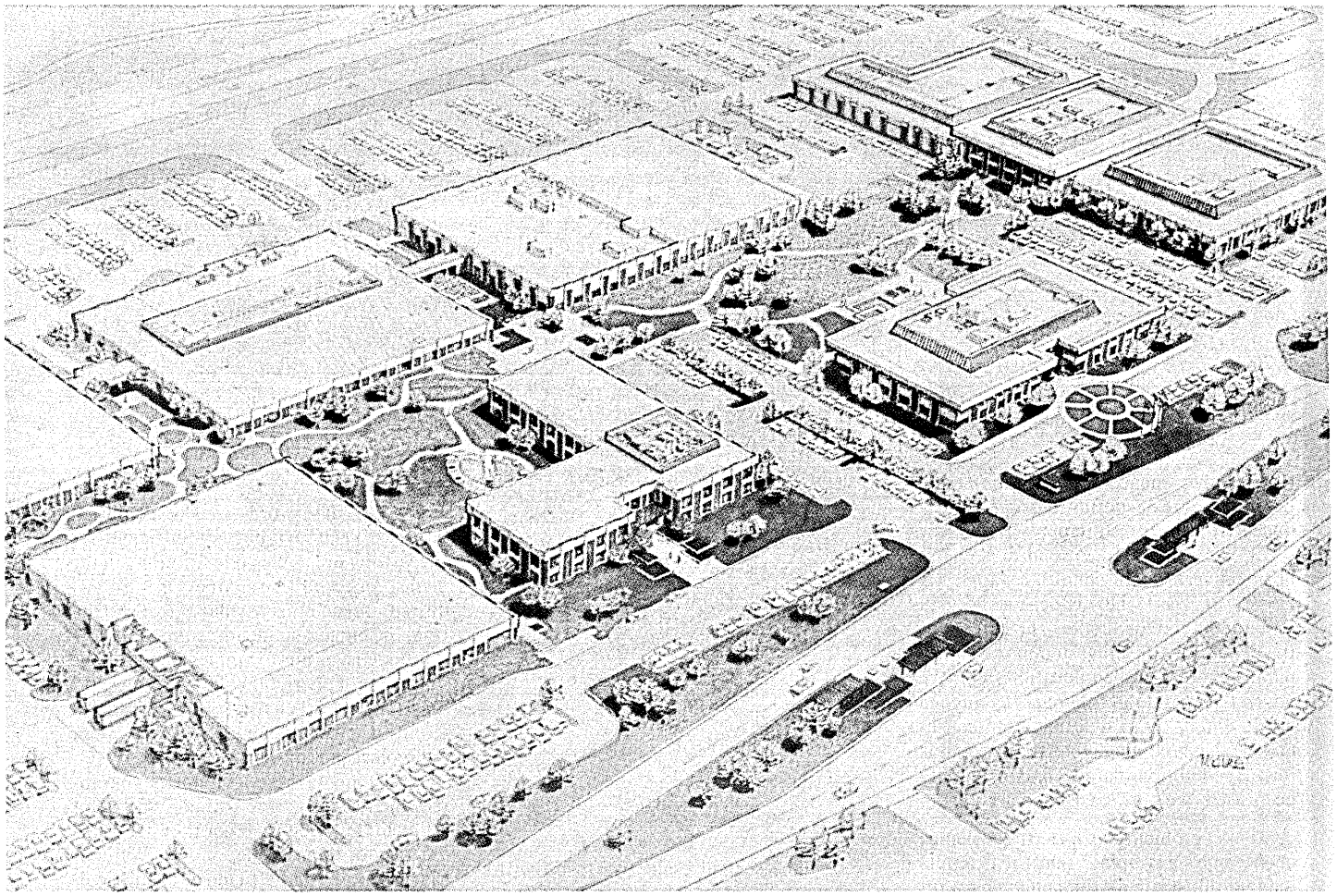

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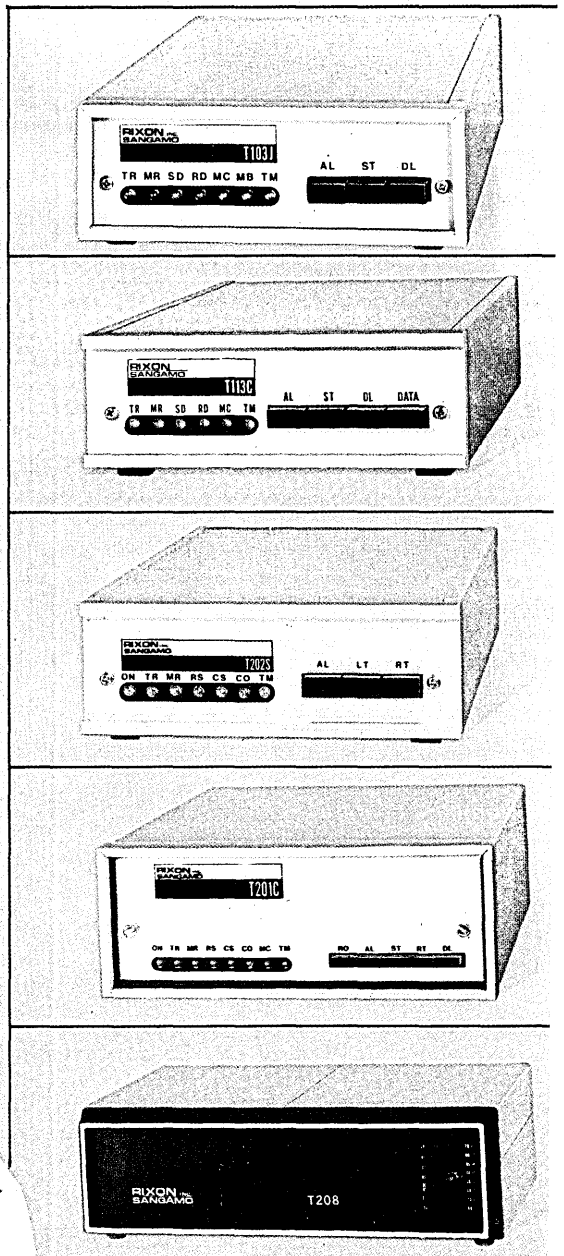

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HARDWARE

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Radio Shack seems to have had a good Christmas. A friend of ours tells us his local Radio Shack couldn't keep up with the overwhelming demand for the TRS-80 personal computer. Business was so brisk, it took him ten days waiting before he could get the ROM upgrade from Level 1 BASIC to Level 11.

On the other end of the computing spectrum, a massive report on the plug-compatible manufacturers reportedly is due from Oppenheimer soon.

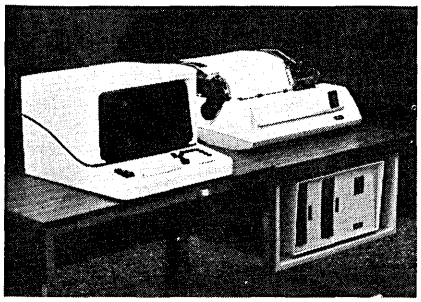
The World Administrative Radio Conference meets this year. The conference, held about every twenty years, brings together representatives from each nation's communications regulatory body. The main event: divvying up the airwaves for the various types of radio traffic. One wag suggests IBM could use its excess capital to buy a small country, and thus get to vote for preferential treatment of satellite communications firms, such as SBS.

A laser data recorder, developed by Plessey, has been logging data at a South African field station since last summer. The unit is used to log data observed during thunderstorms. Input modulates the laser; its image is recorded on moving film. Five parallel lasers provide five tracks of data, each with 7MHz bandwidth, for a total of 35MHz. Data are read, after developing the film, by moving the film between an unmodulated laser source and a photodetector. A 1,000-foot roll of 35mm film holds roughly 3 X 10^{11} bits of data

APL MICROCOMPUTER

Manufactured by a Canadian firm, the System 900 is said to run APL eight-times faster than its immediate predecessor. The System 900, latest in a line that goes back five or so years, uses a bit-slice microprocessor architecture and supports a virtual memory size of 256KB. Even though the 900 uses a different micro, it's said to be compatible with the earlier machines; it can read magnetic media prepared on older machines and run their programs. Three memory sizes, 8KB, 16KB, and 24KB, are available as the models 908, 916, and 924, respectively. A dual diskette drive, capable of storing better than 1MB, and a selection of printers round out the system. A hard disk is expected soon.

Users interact with the system through its keyboard with numeric pad and seven function keys, and its 12-inch



diagonal crt screen, which is organized as 21 lines of 96 characters. An optional asynchronous communications interface allows data transmission at speeds ranging from 300bps to 4800bps; communications emulators allow the System 900 to function as either an intelligent or dumb terminal. An optional RS232 port allows interfacing to a variety of other peripherals. The three desktop computers, sans peripherals, sell for $9,300, $9,650, and $9,950, depending on memory size. Configured in systems, with diskettes and printer, System 900 prices range from $15,000 to $18,000. Business applications packages are available, for those seeking a small business system. This vendor, exclusive U.S. distributor for the products, is developing a network of independent sales and service organizations. INTERACTIVE COMPUTER SYSTEMS, INC., New York, N.Y.

FOR DATA CIRCLE 301 ON READER CARD

WORD PROCESSOR PRINTER

Those with long memories may notice some similarity between this word processing vendor's Image Printer and the "word processing copier" we spotlighted

in our April 1977 isssue. It's not a coincidence, as this vendor bought that product, then in its prototype stage, and has now refined it for use as a high speed, quality output device for its high-end word processing systems. It also can work with the vendor's line of minicomputers, but it doesn't have an industry standard interface at this time.

Using some office copier technology, the Image Printer can produce 18 output pages per minute; it also can do double duty as a convenience copier, but at the slower rate of nine pages per minute. The microprocessor-controlled printer accepts input a page at a time, and it allows the intermixing of two type fonts or sizes on the same page. The printer can store three fonts: two are fixed, one can be loaded as desired. The operator can select any of four font sizes: 10-, 12-, 15-pitch, and proportional spacing. Initially, six type styles will be offered: Prestige Pica 10, Courier 10, Elite 12, Courier 12, Roman Proportional Space, and Bold Proportional Space. The unit's 300-dot-per-inch resolution implies it can support just about any typeface or alphabet imaginable. The Image Printer also has dual, software-selectable paper trays. Priced at $35,000, the Image Printer can be rented for $1,500 per month on a one-year contract. Purchased machines can get service contracts for $400 per month. Whether purchased or rented, the machine also runs

Thinking Systems?

Think of the Possibilities – A Complete Computer for $1275!*

All You Do Is Add The Terminal, Printer, And Applications Software — And You've Got A Complete System!

The Horizon is a complete computer — Z80, 16K RAM, Disk and I/O — priced so that the only limit to application in your system is your imagination! And, the Horizon is packaged in a natural wood cover, adding sales appeal to your system! Think of the possibilities if you're designing a system for education, small business, process control, word processing, engineering, or whatever is on your mind.

Over 10,000 North Star Systems In Use!

We offer you the maturity and reliability to meet the needs of demanding, high-volume applications. Horizon performance and reliability are assured through the use of the proven Z80A microprocessor and industry standard 5¼" 180K byte disk drives. Our professional approach to design (for example, a memory parity option) has been proven in thousands of installations.

North Star Horizon Specifications:

CPU:	**4 mhz Z80A**
RAM:	**200ns (parity check optional)**
Bus:	**12 slot, S-100**
Disk:	**180K bytes per diskette**
Controller:	**Up to 4 drives (720K bytes), 250 KB transfer rate**
Cover:	**Natural Wood or Blue Metal, no charge**

Complete Software Support: DOS, BASIC, and MONITOR!

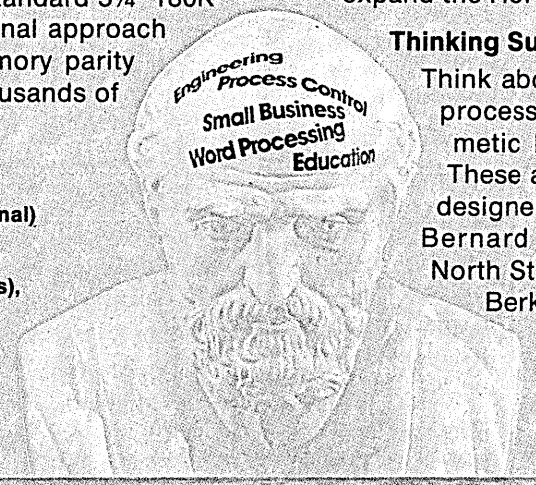
We provide you with the tools (system software) for writing the application programs that will make your system work! Our BASIC is a *full* extended disk BASIC! Hundreds of commercial software application packages have been developed using North Star BASIC. Additionally, a wide selection of application software for the Horizon is available from independent vendors.

Expand Your Horizon!

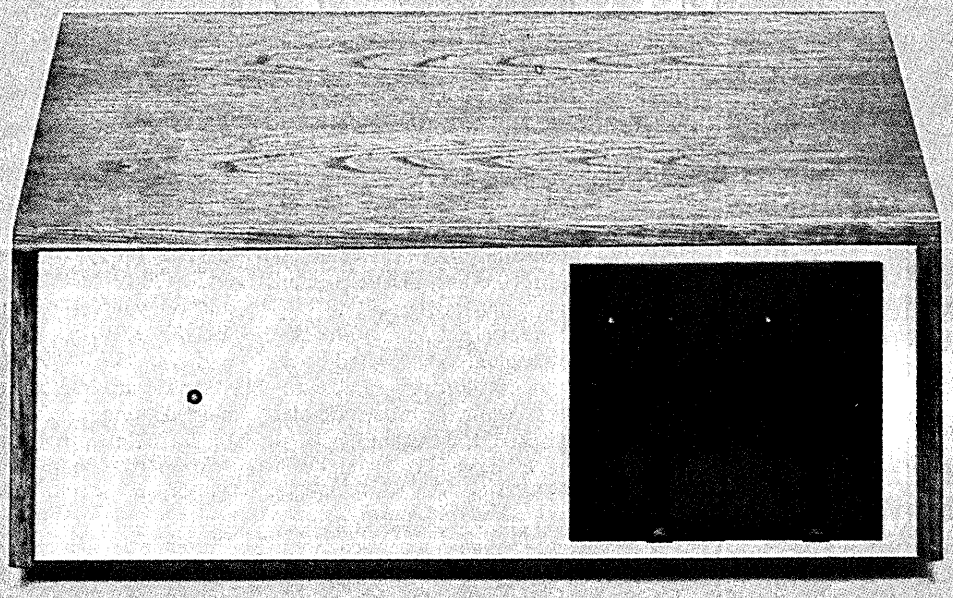
The Horizon can be expanded to 56K bytes or more of RAM, four disk drives (720K bytes), and three built-in I/O interfaces. Performance can be enhanced by the addition of the North Star hardware floating point board. Also, S-100 bus products from other manufacturers may be used to expand the Horizon.

Thinking Sub–Systems Only?

Think about North Star's memories, Z80A processor boards, floating point arithmetic boards, and disk drive systems. These are available for the OEM system designer. For complete information call Bernard Silverman at (415) 549-0858. North Star Computers, 2547 Ninth Street, Berkeley, California 94710.



NorthStar



*In OEM quantities of 100 or more.

CIRCLE 49 ON READER CARD

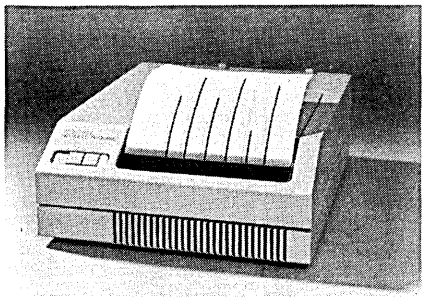
HARDWARE

up a 1.5¢ per page charge after the first 30,000 pages each month. WANG LABORATORIES, INC., Lowell, Mass.

FOR DATA CIRCLE 302 ON READER CARD

THERMAL GRAPHICS PRINTER

Both graphics and fast printing are provided by this vendor's Model 9876A thermal printer. Based on the integral printer used in the vendor's top-of-the-line 9845 desktop computer, the standalone printer can produce 480 80-character lines per minute. The 9876A uses the full 128 character ASCII character set, including control characters. The microprocessor-controlled printer also contains, as standard equipment, seven additional character

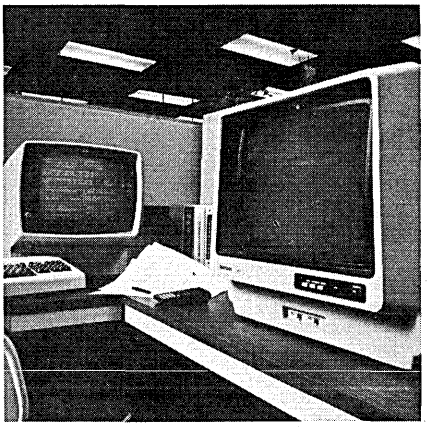


sets: French, German, Katakana, British, Spanish, Danish/Norwegian, and Swedish/Finnish. These character sets are software selectable. Users also can define as many as seven special characters, stored as dot patterns in the printer's memory. There are two graphic modes: strip chart and crt dump. Plotting speeds range from 0.15ips to 1ips. Two interfaces are provided: IEEE-488 and eight-bit parallel. The single unit price of the 9876A Thermal Printer is $3,500; deliveries are quoted at eight weeks. HEWLETT-PACKARD CO., Palo Alto, Calif.

FOR DATA CIRCLE 304 ON READER CARD

3270 GRAPHICS

IBM's 3277 Graphics Attachment, combined with this vendor's 618 Storage Display Monitor, can provide 3270 users with a dual display graphics station. In this configuration, the 3277 display shows alphanumerics, while the 618 handles the



graphics. The 618 uses the vendor's high-resolution storage tube technology in which the screen's phosphor, when sufficiently excited, retains its luminescence until the entire screen is erased. The 618 also allows write-through graphics, which require refreshing, for dynamic graphics and selective erasure. Up to 1,000 vectors can be displayed in write-through mode. As for supporting software, IBM software for the graphics attachment includes basic line drawing, text movement, and coordinate transformation. Advanced routines support geometric structures and three-dimensional displays. The 19-inch diagonal 618 sells for $8,700 and leases for $348 per month on a three-year lease. IBM calls its graphics attachment RPQ 7H0284, and charges $5,200 for it. TEKTRONIX, INC., Beaverton, Ore.

FOR DATA CIRCLE 305 ON READER CARD

BISYNC CONTROLLER

To make life simpler for its system building customers, this vendor has developed a microprocessor-based bisynchronous communications controller. A member of its intelligent cable series of interfaces for the Naked Mini product line, the bisync controller handles the conversions between parallel and serial data streams, checks the integrity of each message block, and provides an automatic character insert/delete capability. The unit handles transmission rates of up to 4800bps; data characters may be from five to eight bits in length. The controller also has a transparent text mode. The $300 Bisynchronous Intelligent Cable can work with RS232 and RS422 interfaces. COMPUTER AUTOMATION, INC., Naked Mini Div., Irvine, Calif.

FOR DATA CIRCLE 307 ON READER CARD

DISK SUBYSTEMS

This ex-disk maker now is buying drives as an oem, selling complete subsystems to the minicomputer market. Dubbed the Supermini DSD Series, the line now includes three removable disk subsystems for the popular PDP-11. The subsystems come in 68MB, 182MB, and 261MB capacities; a second drive can be added to double the subsystem's capacity. The salient specs include an average access time of 30msec, transfer rate of 1,209KBps, and a track-to-track access time of 6msec. Error checking and correcting provides the capability to correct error bursts as long as 11 bits. Up to 64K words can be transfered using a multiple sector transfer feature. RSX-11, RT-11, and RSTS/E software support is provided. Subsystem pricing ranges from $20,800 to $33,900, includ-

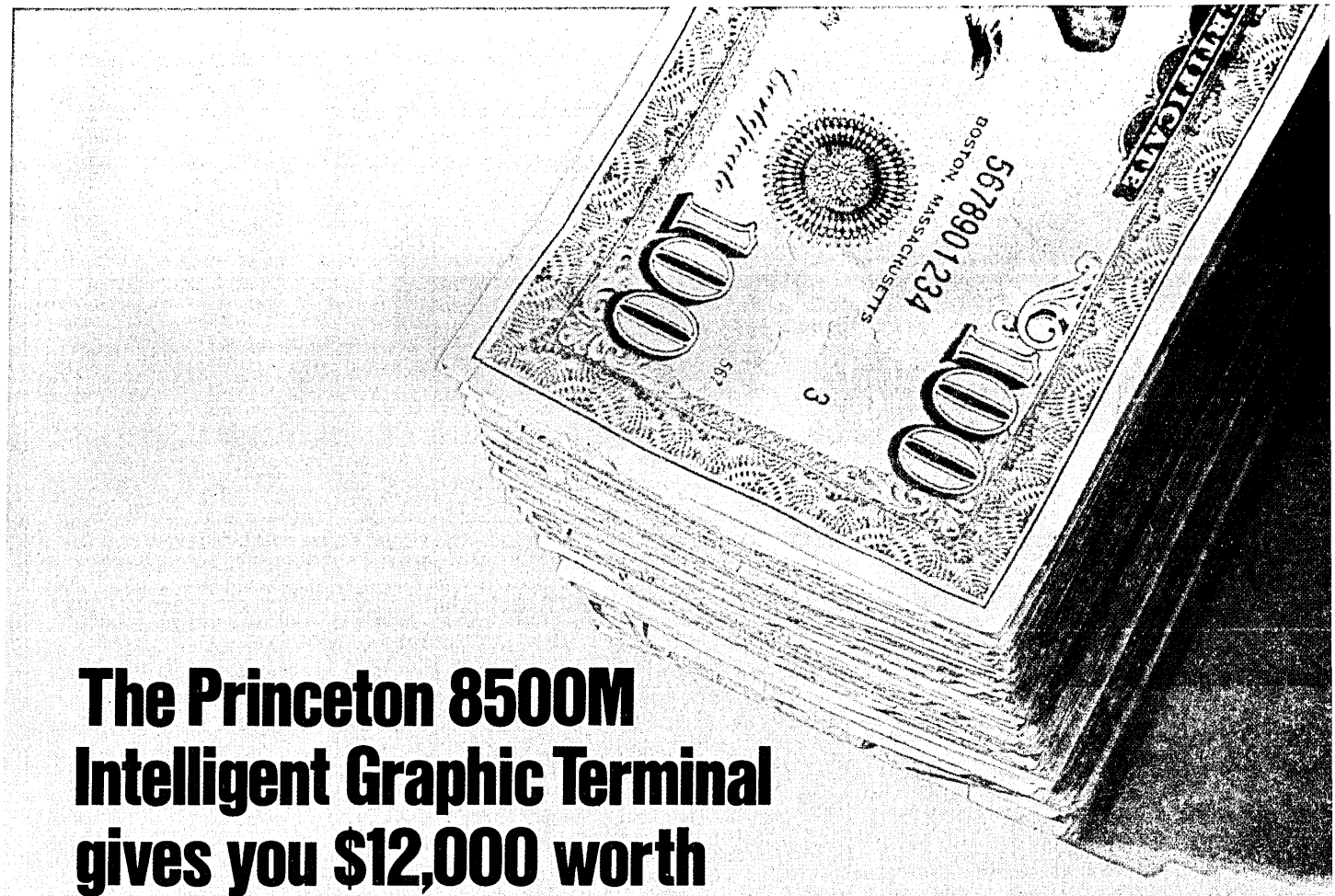
HARDWARE SPOTLIGHT

MICROCOMPUTERS

Microcomputer may be a bit of an understatement: the Sentinel line uses Intel's new 16-bit micro, the 8086, with a 1MB address space and a 600nsec cycle time. The vendor has adopted the Multibus, opening the door to a wide array of existing, compatible modules. But, perhaps the most interesting facet of the Sentinel line is its software: the operating system uses virtual memory and includes an integrated data base management system. Sentinel programs are transportable to other machines, notably IBM's Series/1. Portability is achieved by having programs compile to an intermediate pseudo-machine language, which is interpreted by software written in the machine language native to the host. The Sentinel's programming language is said to be a cross between COBOL and a data base management system. What would be the data division in a COBOL program is written in the DBMS, while the procedure division bears a striking resemblence to COBOL. Though the vendor strongly encourages use of this programming language, known as DBL, other languages supported by the 8086 can be used. Sentinel is offered in four basic configurations. The model 10 has 32KB of memory, 1,920 character crt, two double density floppies,

and a price of $9,950. Model 20 has 64KB and a 150cps printer in addition to the other components of model 10; it sells for $19,900. Add a 14.5MB Winchester drive and a 300 lpm printer to the model 20, and you wind up with the $24,900 model 30. Model 40, at $34,900, uses a 29MB drive in place of the model 30's disk. The systems can grow with additional terminals, communications support, and peripherals. Software for the system was developed by Tominy, Inc., of Cincinnati. This firm includes many of the people who found themselves without jobs when Cincinnati Milacron stopped making computers. COMPUTER SYSTEMS DEVELOPMENT, INC., Cincinnati, Ohio.

FOR DATA CIRCLE 303 ON READER CARD

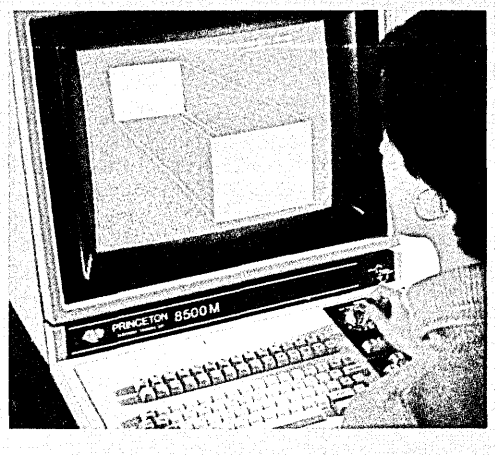


The Princeton 8500M Intelligent Graphic Terminal gives you $12,000 worth of added capability-free!

It's amazing, but the Princeton 8500M gives you the sophisticated graphics of terminals costing upwards of $30,000 for just a few dollars more than the least expensive terminals.

Now, you don't have to settle for limited graphic design capability on a limited budget. The microprocessor-based 8500M combines a high resolution raster scan TV monitor display with Princeton's unique solid-state beam-addressed image memory. These features provide a new generation of raster graphics without stair-stepping.

It includes features such as complete local drawing and editing of conics, vectors, alpha numerics and special symbols, selective erase and texturing, 32-level gray scale and more! You'll have a high brightness display for easy viewing in fully lighted rooms and 16X panoramic zoom for easy viewing and editing of specific areas. Plus single and multiple plane image display and 360° character and symbol rotation.



With the Princeton 8500M you get the graphic capability you need now *and* in the future . . . at a price you can afford today. For a demonstration call: (201) 297-4448 or write for our helpful brochure. Princeton Electronic Products, Inc. P.O. Box 101, North Brunswick, NJ 08902.

PRINCETON ELECTRONIC PRODUCTS, INC.

CIRCLE 125 ON READER CARD

ing installation. Additional drives carry prices ranging from $15,500 to $27,700. The vendor's national customer support network provides service. CALIFORNIA COMPUTER PRODUCTS, INC., Anaheim, Calif.

FOR DATA CIRCLE 308 ON READER CARD

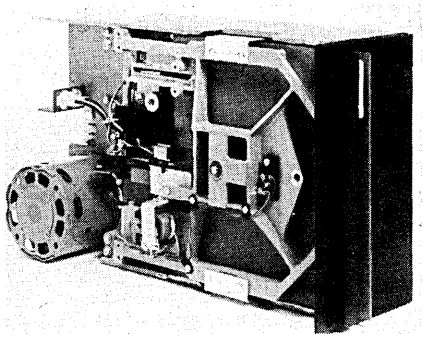
MODEM

For full-duplex, point-to-point use over leased, voice-grade phone lines, this vendor's model 7296 can transmit and receive data at 4800bps or 9600bps. The modem also has system test capabilities; a front-panel switch can select analog loopback, digital loopback, training, or normal operating mode. The 7296 sells for $4,900 in quantities of four to 10. TELE-DYNAMICS DIV., Ambac Idustries Inc., Fort Washington, Penn.

FOR DATA CIRCLE 309 ON READER CARD

DISKETTE DRIVE

The dual-head RFD 4000 floppy diskette drive provides media compatibility with single sided IBM 33FD and dual sided 43FD single and double density drives. It also has physical and interfacing specifications identical to those for Shugart's SA850/851. The unit can store up to 1.6MB of unformatted data, or 1MB using a 128-byte-per-sector format. The RFD 4000 has an average access time of 91msec. In sin-



gles, the drive sells for $740. REMEX DIV., Ex-Cell-O Corp., Irvine, Calif.

FOR DATA CIRCLE 306 ON READER CARD

DISK PACK

Already well known for its broad line of magnetic media, this vendor has broadened its disk pack line with the addition of the Mark XVIII for the Sperry Univac 8418 disk. The 58MB pack sells for $450. MEMOREX CORP., Santa Clara, Calif.

FOR DATA CIRCLE 310 ON READER CARD

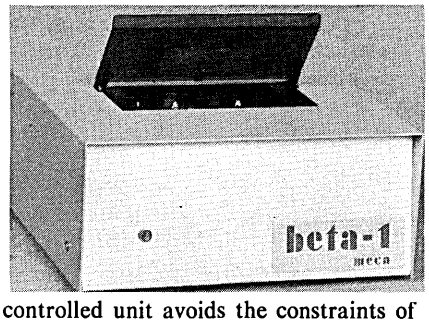
TYPEWRITER INTERFACE

A plug-in module, the model 5061 Telecommunications Module, allows IBM's model 50 and 60 typewriters (see July 1978, p. 206) to function as ASCII terminals. The module plugs inside the typewriter, providing an RS232 interface that can run at 110bps or 150bps. Normal operation of the typewriter is not impaired. The 5061 sells for $995. TRANSACTION DATA SYSTEMS, INC., Paramount, Calif.

FOR DATA CIRCLE 314 ON READER CARD

PERSONAL COMPUTER TAPE DRIVE

The Beta-1 is the latest member added to this vendor's line of cassette tape systems for microcomputers. The microprocessor-



controlled unit avoids the constraints of any given bus structure by using an eight bit parallel interface; a serial interface can be had as an option. The Beta-1's data transfer rate is 8,000bps (16,000bps optional). The unit uses phase encoded recording, said to offer high reliability. An assembled and tested Beta-1 sells for $399. MECA, Yucca Valley, Calif.

FOR DATA CIRCLE 313 ON READER CARD

Static-free information.

Kraco Enterprises, Inc. is one of the country's largest manufacturers and distributors of automobile radios, CB radios, and accessories. To help service its thousands of customers worldwide. Kraco has installed a Series 21 distributed processing system from Mohawk Data Sciences. This compact, easy-to-use system not only handles order entry, billing, inventory control, and payroll at Kraco headquarters, but communicates as well with the mainframes of its distant customers.

"Static-free" information—information that is meaningful and up to date—information that allows managers to make sound decisions. That's what Kraco gets—and you can too.

With the MDS Series 21 family, you also get a broad range of capability that fits every need. For data entry and local processing, there's the System 21/20. For transaction processing, consider the System 21/40. And for more sophisticated applications requiring multiprogramming, the advanced System 21/50 is ideal.

Learn more. Get your FREE copy of colorful 12-page booklet on distributed data processing. It's easy to read ... easy to understand. Call toll-free (800) 223-0100. (In New York State, call (315) 797-7445.) Or fill out and mail coupon.

Please send me free copy of "Distributed Data Processing—A Rational Approach."

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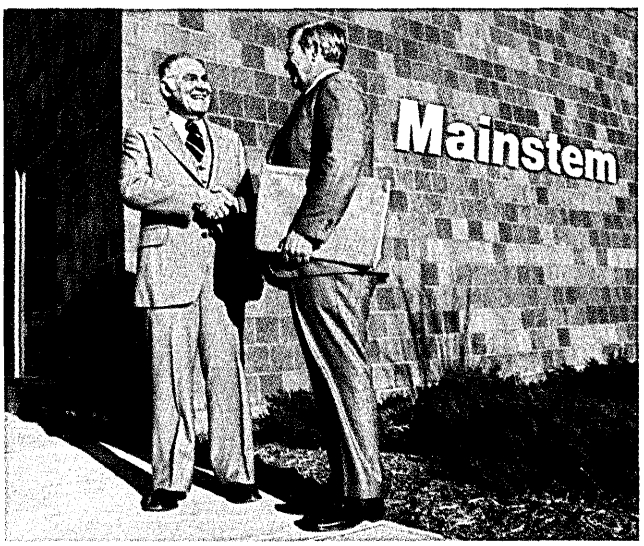
Mohawk Data Sciences

CIRCLE 54 ON READER CARD

"Without our NCR computer, our business would be crippled," says John T. Hughes, president of Mainstem.

HUGHES:
Our computer operates at the heart of our business. We use it to develop comprehensive analyses of fleet maintenance costs for over 210,000 units for our customers in the U.S. and Canada. This is our prime function. Without our NCR computer, our business would be crippled. That's why we selected NCR; NCR has always protected its users.

NCR's JIM SCHULER:
We strive to make the conversion from one NCR system to another as painless as possible. We offer Migration Path Engineering.



John T. Hughes (left) is president of Mainstem Corporation, of Princeton, N.J., subsidiary of PHH Group, Inc. James Schuler is an NCR district manager.

HUGHES:
It works. Since our first day in 1965 we have enjoyed tremendous growth to become the leader in our field. We have grown through five NCR systems—through three NCR generations of equipment. And we have never lost one day of production because of hardware upgrades.

NCR's SCHULER:
Your application and system software transition has been just as smooth. By design.

HUGHES:
Yes. As a result of our last change—from an NCR Century 300 to an NCR Criterion 8570—NCR provided a major improvement in price performance. And we have NCR's VRX (Virtual Resource Executive). With this new operating system, we have run up to eight jobs simultaneously with just one operator.

NCR's SCHULER:
VRX really takes the pressure off the operator. You can actually run up to 35 jobs at one time if you can get that many on before the first jobs are completed. VRX also dynamically allocates memory and other resources. It takes care of virtual memory swapping. It constantly monitors for memory thrashing and program loops. And it adjusts the job mix to eliminate them.

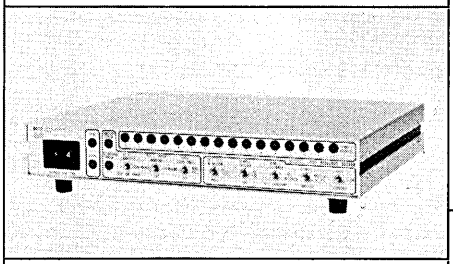
HUGHES:
You didn't mention Online Program Development. That one feature of VRX doubles the productivity of our programmers.

In the NCR office nearest you, there is an account manager like Jim Schuler who knows your industry and knows NCR systems, including VRX. Learn how an NCR system can help you. Phone him at your local office. Or write to EDP Systems, NCR Corporation, Box 606, Dayton, Ohio 45401.

NCR
Complete Computer Systems

POLLING TESTER

The microprocessor-based model 1700 can test the polling performance of synchronous and asynchronous modems over actual or simulated switched networks, private line point-to-point networks, or private line multidrop networks. The



1700 recognizes outbound and inbound polling message errors, and can deliberately inject either to help verify network continuity. The 1700 sells for $1,800. INTERNATIONAL DATA SCIENCES, INC., Lincoln, R.I.

FOR DATA CIRCLE 311 ON READER CARD

MINICOMPUTERS

A new family of 16-bit minicomputers, named Series Sixteen, sports up to 256KB of semiconductor memory. The processors are compatible with the vendor's existing core memory 16-bitters, such as the 5/16. Aimed primarily at oem's and system builders, the Series Sixteen comprises three processor models, the Sixteen 10, Sixteen 20, and Sixteen 30. The model 10 can have up to 64KB of memory, while the models 20 and 30 expand to 256KB. To guard against memory failures, models 10 and 20 use parity checking, while model 30 has error checking and correcting as standard equipment. Common architectural features shared by all three processors include multiply/divide, power fail/auto restart, 16 general purpose registers, and 255 interrupt levels. The vendor has configured a number of systems around the new processors. The 1615 system consists of a Sixteen 10 processor with 32KB of 900nsec memory, control panel, crt terminal, page printer, 512KB of floppy storage, and operating system, for a price of $11,200. The vendor says this system is intended for small standalone jobs, or as a node in a distributed processing network. A 1624 system, with a 64KB model 20 processor, 120cps matrix printer, and the peripherals supplied with the 1615, sells for $17,700. Built around the Sixteen 30 processor, a 1635 system includes 128KB of 750nsec memory with error correcting, floppy disk interface, 10MB of disk, crt terminal, 180cps matrix printer, and battery backup; the 1635 carries a price tag of $29,500, and is said to be designed for multiterminal applications. Deliveries are to begin this month. INTERDATA DIV., Perkin-Elmer Corp., Oceanport, N.J.

FOR DATA CIRCLE 312 ON READER CARD ✲

ON EXTENDING THE RETIREMENT AGE TO SEVENTY

(from *Reflections of an Aging Data Processing Manager*)

Hurrah for the Congress! I can now survive
Five more years beyond the age sixty-five.
Five more years of management hip-shooting,
Five years' fear of data base looting.
Five years' patience with tech weenies' criticisms,
Five years' grinning at users' witticisms.
Five years' annual budget worries,
Five years' coping with maintenance flurries.
Five years' nose-wiping staff adolescents,
Five years' creeping obsolescence.
What are my chances of staying alive?
Better check my pension at age fifty-five.

—Ted Withington

SOFTWARE AND SERVICES

UPDATES

We have it on good authority that Sperry Univac's Minicomputer Operation (nee Varian Data Machines) has commissioned a UNIX development project. Why UNIX? Our informant suggests that MCO has set its sights on Bell Labs, a rich prospect for minimakers supporting the Bell-developed operating system.

When the Central Ohio Transit Authority was hit by a strike, radio station WNCI in Columbus decided to set up a car pool referral service for the roughly 30,000 commuters left without transport. They did it by hand. At least for the first day, after which they called Radio Shack for help. The Texas electronics retailer responded by loaning the station one of its TRS-80 personal computers, and a local store manager who modified a customer information program to match volunteer drivers with needy riders. Double checking the first day's manual matchings, the system found six overlooked pairings.

The Department of Agriculture's Medicinal Plant Resources Laboratory, begun in cooperation with the State Department several years ago to find alternative crops for big narcotics producing countries, is now working on finding economical crops for underdeveloped countries. The lab uses a 370/168 to maintain a data base of climate, soil and crop information.

NETWORKING/DISTRIBUTED PROCESSING

We're told this vendor had its networking architecture—in one form or another—running in-house for a couple of years. But the company held off releasing the system, called Primenet, for a couple of good reasons. They didn't want to burn a lot of company resources by becoming missionaries; IBM's 8100 announcement seems to be the amen to a long distributed processing prayer. The firm also held off until it could unveil its new, more powerful Series 50 (see January, pp. 55-59) so heavily loaded users wouldn't be faced with problems from communications overhead.

The wait seems worth it, as the vendor unveiled Primenet which embraces both locally and remotely distributed computing. Locally distributed systems link up over coaxial cable into a ring configuration; remote networks can use synchronous lines or X.25 packet switched networks. Support for 3270-type devices includes a transparent pass through mode so users can install one of this vendor's systems without disrupting current applications, then gracefully offload host applications or develop new applications for use in the field. Primenet offers three sets of services: an Inter-Program Communication Facility (IPCF), Interactive Terminal Support (ITS), and a File Access Manager (FAM). The IPCF allows programs to communicate between each other, whether they reside on the same system, another of this vendor's systems, or another vendor's system that supports X.25. ITS lets a terminal, connected to a packet switching network or a node in the network, access any system in the net as if that terminal was directly attached. And the FAM lets programs use files on remote systems without regard to their physical location. Regardless of the data link involved, the three services always provide a consistant user interface.

Primenet runs on all of the vendors processors, although minor extra hardware is necessary: a coax node controller at $4,000 for local nets; a synchronous interface at $5,000 for further-flung ones. Software for either local rings or synchronous lines carries a price of $5,000; for X.25 packet support, it's $7,000. One of the three versions of the DPTX terminal executive is also necessary, at from $5,000 to $12,000. PRIME COMPUTER, INC., Wellesley Hills, Mass.

FOR DATA CIRCLE 317 ON READER CARD

ACCOUNTING SYSTEM

This integrated accounting package can trace its roots back to the Univac II. Way back then the vendor found an unusually efficient way to run accounting jobs for service bureau customers. Instead of running each customer's data from update through posting through balancing, a method was developed for running all customers' data through one accounting module at a time, making what was essentially a batch processing operation into pipeline processing. But everyone has different needs, so the programs were written to adapt to a customer profile with each chunk of data. Today, the programs still run on Univac equipment: minis from

IMS and TOTAL USERS

YOUR DATA BASE & ASI-ST GO TOGETHER

More IMS and TOTAL installations have chosen the ASI-ST Data Management and Reporting System to implement data base applications than any other product. ASI-ST's dominance in data base environments is easily explained:

- Operates under all IBM 360/370 versions of DOS, DOS/VS, OS and OS/VS.
- Fully supports all TOTAL, IMS and DL/I features including TOTAL 8 and secondary indexing under IMS/VS.
- Permits creating and updating TOTAL and IMS data bases as well as retrieval.
- Allows concurrent processing of conventional data files with IMS or TOTAL data bases.
- Supported in both batch and on-line environments.

IMS users such as *American Airlines, Dow Chemical, TWA, American Can, The Hartford, Union Carbide;* and TOTAL users like *Combustion Engineering, Northwestern Mutual Life, Anheuser-Busch, Corning Glass Works, Eli Lilly* and *Holiday Inns* are a few who agree ASI-ST and data base belong together. In addition, ASI-ST provides an unequalled return on investment by maximizing the productivity of both man and machine. Since ASI-ST fully supports conventional data files as well as complex data bases, these benefits are not restricted to IMS and TOTAL users. To obtain more information contact:

The Software Manufacturer

APPLICATIONS SOFTWARE, INC.
Corporate Offices
21515 Hawthorne Boulevard
Torrance, California 90503
(213) 542-4381

CIRCLE 77 ON READER CARD

DOCUMENT PROCESSING

Two new IBM products attempt to make it as easy to generate and store pages of text as it is to generate and store virtual pages of data. The first is the Document Composition Facility, a program for text editing and page make-up. The facility includes SCRIPT/VS, an editor which allows for mixing type fonts, altering text, right and left justification, constructing tables of up to nine columns, and automatically handling headlines/footlines, footnotes, hyphenation, and table of contents generation. The editor also provides formatting support for using photocomposers.

The second product comes into play after the pages have been prepared. Called the Document Library Facility, it provides for storage and retrieval, and is initially intended for handling text produced on IBM 3730 Distributed Office Communication Systems or on mag card gear.

The Composition program will be licensed for $185/month for batch processing (plus another $35/month to use it on OS/VS2 MVS under TSO or VM/370 under CMS). A license for the Library facility will be $80/month. INTERNATIONAL BUSINESS MACHINES CORP., White Plains, N.Y.

FOR DATA CIRCLE 332 ON READER CARD

Logical Device Type	Real Device Type	Lines per Inch	Page Size (inches) Width	Depth	Line Length[1] (bytes)	Page Length[2] (lines)
TERM	2741	6	8-1/2	11	60/132	66/144
1403N6	1403	6	8-1/2	11	60/85	66/144
1403N8	1403	8	8-1/2	11	60/85	88/192
1403W6	1403	6	13-1/2	11	60/132	66/144
1403W8	1403	8	13-1/2	11	60/132	88/192
1403SW[3]	1403	6	8-1/2	11	72/90	66/66
3800N6	3800	6	8-1/2	11	60/85	60
3800N8	3800	8	8-1/2	11	60/85	80
3800N12	3800	12	8-1/2	11	60/85	120
3800W6	3800	6	13-1/2	11	60/136	60
3800W8	3800	8	13-1/2	11	60/136	80
3800W12	3800	12	13-1/2	11	60/136	120
3800N6S	3800	6	11	8-1/2	60/110	45
3800N8S	3800	8	11	8-1/2	60/110	60
3800W6S	3800	6	13-1/2	8-1/2	60/136	45
3800W8S	3800	8	13-1/2	8-1/2	60/136	60
3800W12S	3800	12	13-1/2	8-1/2	60/136	90

[1] Line lengths are given as "default/maximum" in 10-pitch characters. For the 3800 Printer, 12-pitch and 15-pitch fonts have values 20% and 50% greater, respectively.

[2] Default and maximum page lengths are identical for 3800 devices.

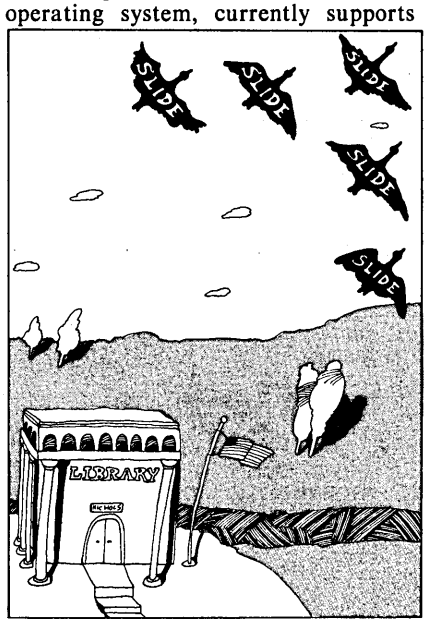
[3] This is a 12-pitch device, as opposed to the normal 10-pitch 1403.

Sperry Univac's Minicomputer Operation, specifically the V77-400 and up. The system requires at least 64KB of memory, and runs under the VORTEX operating system with VTAM and the Total data base management system. Eschewing the Pronto terminal monitor, the vendor developed its own on-line monitor. Customization options allow each user to name his own data items, set up report formats, and define screen formats. And, of course, there's a report writer for those special reports. Data entry and master file updating are done on line; on line inquiry also is provided. Actual processing is handled as a batch job. The modular system currently has six parts: accounting data input, payroll, accounts payable, accounts receivable, invoice and inventory control, and accounting and general ledger. A seventh module for manufacturing—including job costing, bill-of-material, machine loading, and scheduling— is expected in June. Also on the way is support for MSI portable terminals equipped with bar-code readers; this is to be offered in the vendor's on-going service bureau operation. The six currently available modules carry separate prices ranging from $3,000 to $10,000; a full-blown system can be had for a total price of $26,500. If used on the vendor's computer, the minimum monthly fee is $250; some large customers run up roughly $4,000 bills each month. COMPUTER DATA CORP., Gardena, Calif.

FOR DATA CIRCLE 315 ON READER CARD

PROGRAM LIBRARY MIGRATION

Intended primarily for software vendors serving the IBM mainframe market, the Source Library Image Delivery Expeditor (SLIDE) can transfer source code between different library managers. The assembly language program, said to run under any operating system, currently supports



transfers between Partitioned Data Sets, Panvalet libraries, and The Librarian libraries. The vendor sees two ways to use SLIDE. If the user knows which library type his target machine uses, then he can prepare an appropriate tape on his own machine. On the other hand, when the target library is unknown, the user can bring SLIDE with him, and use it on the customer's machine. SLIDE also supports ADD and REPLACE functions, and it prepares a report covering library types, number and names of modules, and statement count by module. Supplied as source code, SLIDE carries a perpetual license fee of $2,500. CHICAGO DATA SYSTEMS, INC., Oak Brook, Ill.

FOR DATA CIRCLE 321 ON READER CARD

ON-LINE BANKING

Originally supported only by University Computing Co.'s data base and data communications systems, Pacer II, an on-line accumulated transaction journal system for banks, now runs under CICS and VSAM. The system provides customer service personnel with on-line access to account control and transaction information for a variety of account types, including demand deposit, savings, and installment loan. The system uses a bank's existing application files and maintains its own data base for on-line retrieval. The Pacer II package runs on 370s, from the model 135 and up. Pacer II licenses for $10,000, plus $2,500 installation per module. PACESETTER SYSTEMS, INC., Dallas, Texas.

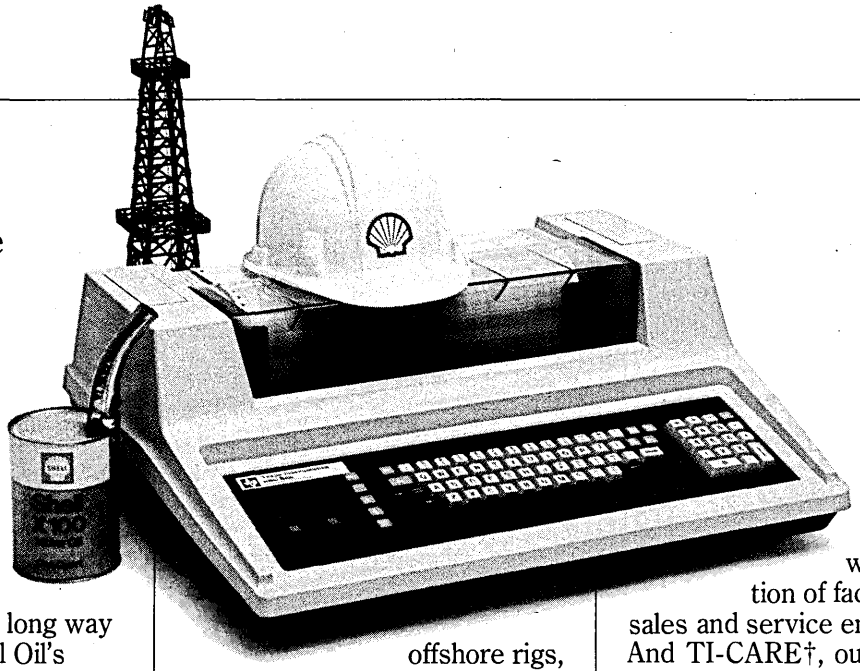
FOR DATA CIRCLE 320 ON READER CARD

SERIES/1 RPG

This vendor has an interesting approach: it's developing the software to allow mi-

Service Station.

Shell Oil gets a lot of mileage out of TI's 820.



For almost a decade, TI's *Silent 700** and OMNI 800* data terminals have gone a long way towards meeting Shell Oil's communications needs.

When Shell needed a data terminal for their internal time-sharing network, the OMNI 800 Model 820 KSR impact data terminal gave them the high-speed capability they needed to serve thousands of users, in both remote and on-line locations.

Shell was also interested in updating their on-line invoicing system. The 820, with its high-speed transmission and quality impact printing, has been serving Shell's needs with clear, legible originals and multiple copies.

TI's 820 is also capable of going to work at Shell's refineries, well sites, even offshore rigs, to augment their production support system.

The versatile 820 KSR is serving in more than the oil field. Industries like banking, accounting and communications are calling on it for remote data applications and distributed networks.

Producing quality, innovative products like the 820 KSR impact terminal is what TI is dedicated to. And TI's over 200,000 data terminals shipped worldwide are backed by the technology and reliability that comes from over 30 years of experience in the electronics industry.

Supporting TI's data terminals is the technical expertise of our worldwide organization of factory-trained sales and service engineers. And TI-CARE†, our nationwide automated service dispatching and field service management information system. That's why TI has been appointed the official computing company of the 1980 Olympic Winter Games.

If you would like more information on the Model 820 KSR impact terminal, contact the TI sales office nearest you, or write Texas Instruments Incorporated, P.O. Box 1444, M/S 7784, Houston, Texas 77001, or phone (713) 937-2016.

TEXAS INSTRUMENTS
INCORPORATED

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gration from System/32 to Series/1. Its lead-off product, an RPG II compiler, is said to be source language compatible with programs written for the S/32; in fact, users are referred to S/32 documentation for specs. Release 1.0 of the compiler does, the vendor explains, leave out some features. There aren't any combined files, due to lack of hardware support. Inquiry interrupt isn't in release 1.0, but is planned. External assembler language subroutine support, telecommunications specifications, auto functions, the copy function, and special device support also aren't in the initial release. Execution time subroutines provide an interface to IBM's RPS operating system and perform all RPG verb functions. Two other packages provide S/32-like capabilities on the Series/1. An OCL subsystem provides an operator control language similar to S/32 OCL. And a sort, designed to parallel the IBM System/32 sort, performs most of the functions described in the IBM manual, with the exceptions of alternate collating sequences and the summary tag-along sort. The compiler initially will be marketed through franchisees. Franchises go for $10,000 to $40,000, depending on geographic regions covered; each installation requires a royalty payment of $2,500. SERIES ONE, INC., Greenville, S.C.

FOR DATA CIRCLE 318 ON READER CARD

EDITOR

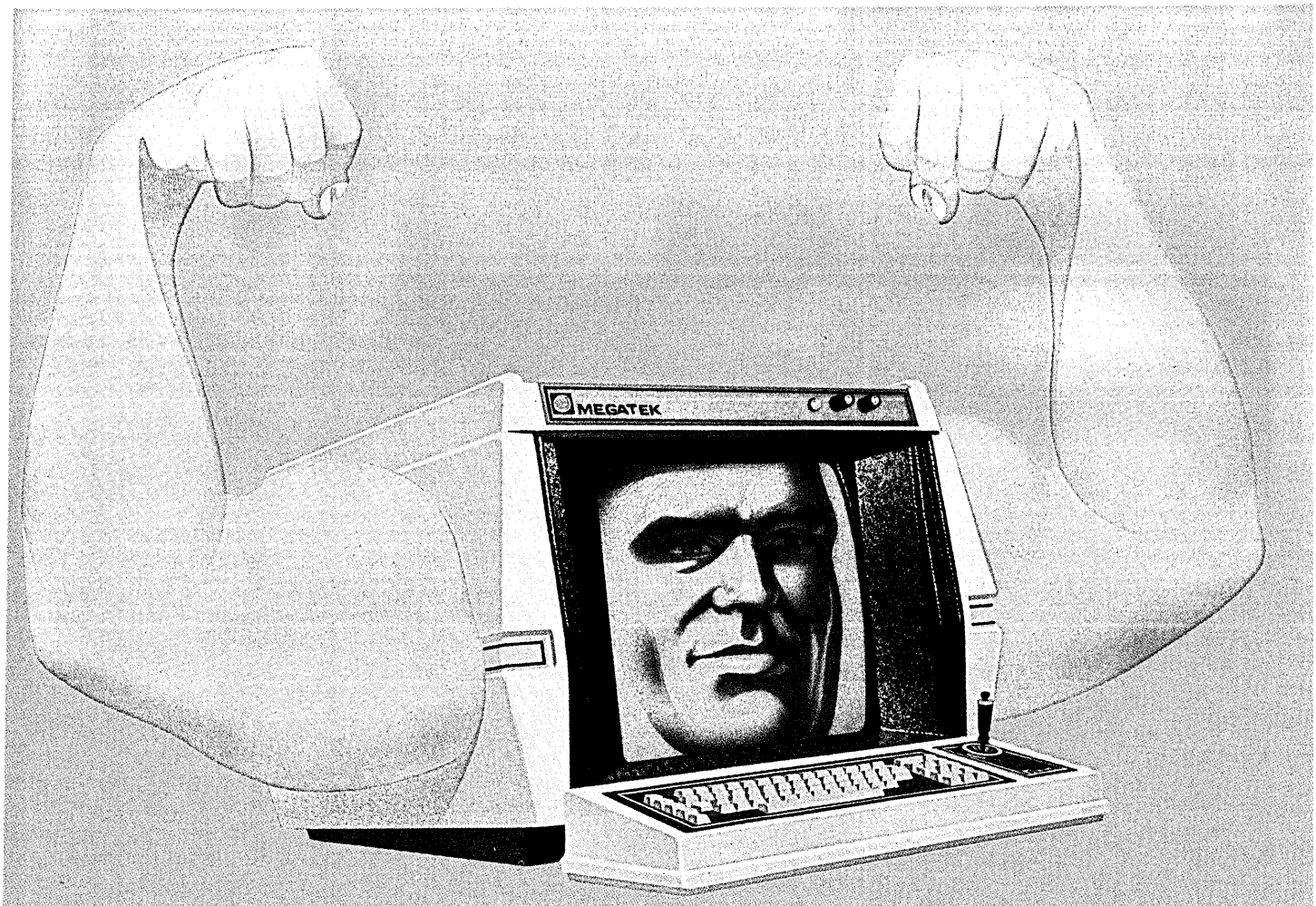
In a move intended to increase software development productivity, this vendor has developed a multiterminal editor for its

Naked Mini 4 line of minicomputers. Known as Multed, the package for the first time allows up to four users to concurrently edit source program files while production programs execute in a background partition. Word has it that the four-user limit is a bit artificial; introduction of an asynchronous multiplexor now in the works should reduce I/O overhead so more users can be accommodated without degrading system response time. The package allows users to create and edit files, submit source files to the batch queue for processing, send messages between edit terminals, and get a command summary by typing "HELP." Multed runs on 64K word systems under OS4. The reentrant editor will be supplied with systems capable of using it; existing users can get Multed for $500. COMPUTER AUTOMATION, INC., Naked Mini Div., Irvine, Calif.

FOR DATA CIRCLE 322 ON READER CARD

PDP-11 OPERATING SYSTEM

The Interactive Application System (IAS) Version 3 comprises the real time RSX-11D operating system and multifunction IAS. The system, upward compatible from current versions of IAS and RSX-11D, runs on PDP-11/34, 11/60, and 11/70 minicomputers. At sysgen, the user can configure the system as a real-time system, a multiuser system with a heuristic scheduler, or a full-blown time-sharing system that runs concurrent time-sharing, batch, and real-time tasks. In the time-sharing configuration, Version 3 supports as many as 32



All muscle and no fat.

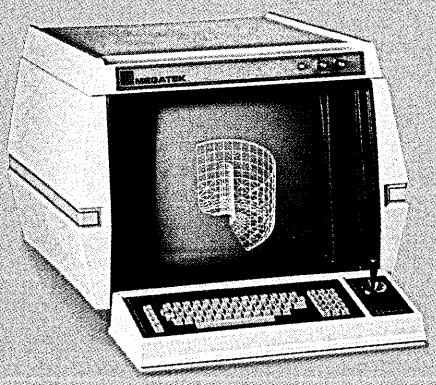
Most refresh graphic systems are flabby. With lots of features you don't need. Without a few you do.

The MEGATEK 7000 is built lean. You get fast graphics throughput. A high resolution, real-time, interactive display. Complete system modularity. An unmatched refresh graphics system. At a price that makes sense.

A built-in 32-bit microcomputer with a 64K byte, 32-bit wide refresh memory, expandable to 128K. Lets you process graphics data fast. And, saves you host computer time. Add MEGATEK's advanced vector generator and you get unbeatable graphics throughput.

Vectors and characters are displayed instantly. With precision end point matching. And constant intensity. 12-bit resolution is standard. Vector quality that outclasses every other refresh system.

Easy-to-use real-time interactive graphics. Outstanding display



dynamics. Hardware translation, blink, dashed lines. Absolute and relative jump. All standard. And, hardware clip, rotate, scale, and zoom are available as well.

Plus, the MEGATEK 7000 is easy to look at. 16 levels of image intensity. 8 programmable character sizes. The screen is clear and readable, even in a brightly lit room. And, with selective erase, you don't have to blank the screen to change a vector or symbol.

Add a universal computer interface that connects to any host computer. Field-proven software that cuts system development cost. A full line of peripherals and accessories. Even color, if you need it. And, you have the most powerful refresh graphics terminal for your dollar on the market today.

But, don't take our word. Prove it to yourself. Call or write for a demonstration. And remember, the MEGATEK 7000 is backed by a national service network with fast, hot-line access.

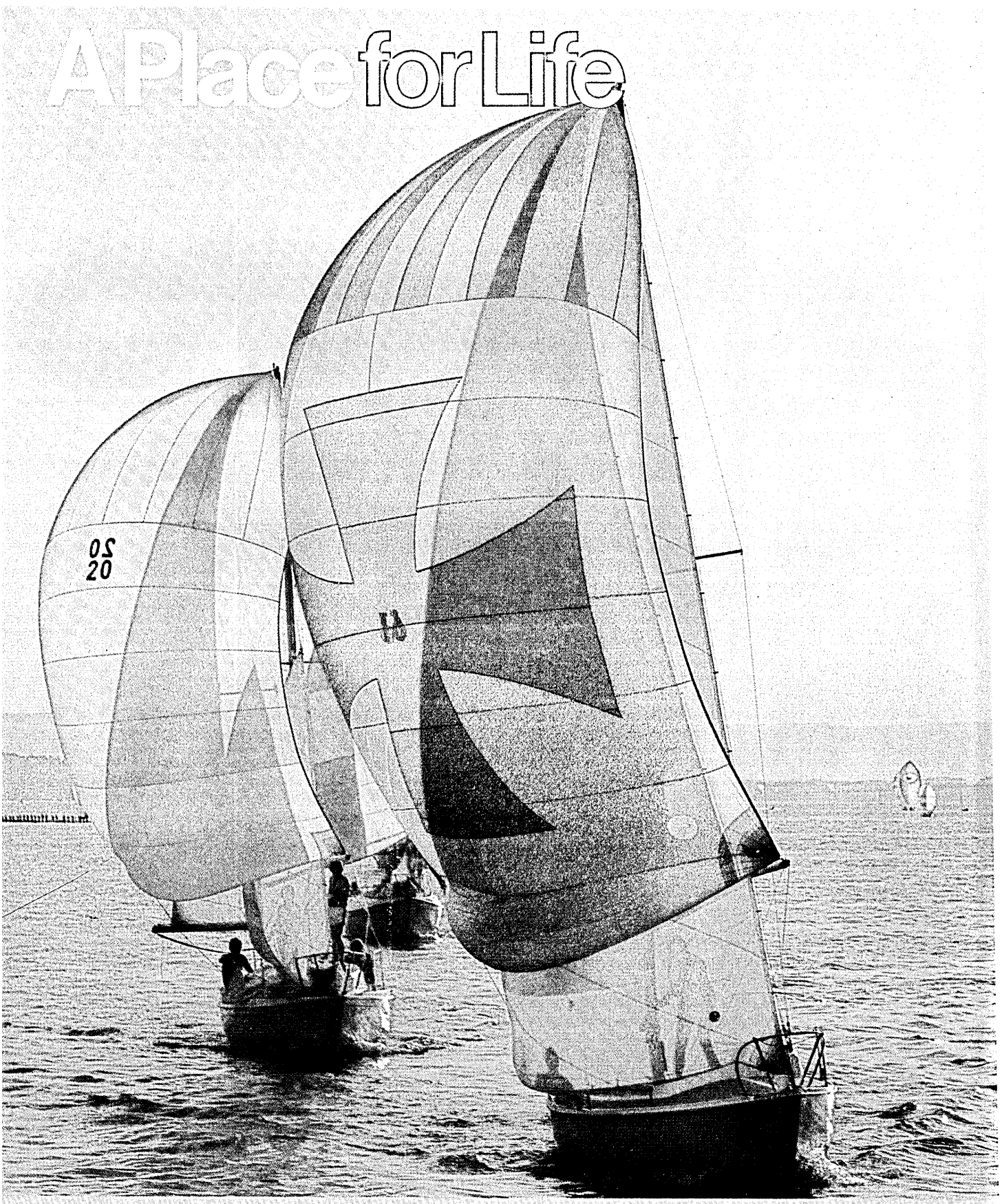
For full details, write or call Peter J. Shaw, MEGATEK, 3931 Sorrento Valley Blvd., San Diego, CA 92121. (714) 455-5590. TWX: 910-337-1270. (European office: 14, rue de l'Ancien Port. 1201 Geneva, Switzerland. Phone: (022) 32.97.20 Telex: 23343.)

The Visible Difference

MEGATEK CORPORATION

CIRCLE 50 ON READER CARD

A Place for Life



Work in a place where your family can live, where there's more to life than your work. A place where you can enjoy sailing and the symphony, the opera and the great outdoors. Where your life-at-work is everything you can make it. Find a place for life, in Oregon. Where we've been for thirty-two years. If you have the research, engineering, marketing or software development skills that could become part of the life of a Fortune 500 leader in electronic test and measurement, and computer graphics, write to Bill Eppick, Professional Placement. He'll answer your letter. Send you a color print of this Oregon scene if you request it. No obligation.

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users on an 11/70. RSX users gain access to a wider range of language processors—BASIC-Plus 2, COBOL, RPG II and CORAL-66, as well as FORTRAN IV and FORTRAN IV-Plus. IAS Version 3 carries a single-system license fee of $17,610. Current RSX-11D or IAS users still under warranty can get the system for the cost of media; other RSX users can order the system for $1,100 before July 1. DIGITAL EQUIPMENT CORP., Maynard, Mass.

FOR DATA CIRCLE 325 ON READER CARD

MAILING LABELS

Users of Burroughs' Commercial Business Management System II on the B80/B800 series of computers, can avoid maintaining separate mailing files by using this vendor's Mailing Label System (MLS). MLS consists of three modules which interface to Burroughs' Invoicing, Payroll, and Accounts Payable. Users can interactively define, then save, specifications for printing labels. MLS supports selective printing based on CBMS II selection criteria, zip code, name, or ranges of selection fields. Users can select the printing sequence, and can produce multiple copies. Each MLS module goes for $300 plus media; special rates apply when two or three modules are ordered. The modules are named MLSINV (for Invoicing), MLSPAY (for Payroll), and MLSACP (for Accounts Payable). LOGICAL DESIGN CORP., Southfield, Mich.

FOR DATA CIRCLE 324 ON READER CARD

SERIES/1 SUBROUTINES

The dozen subroutines in this $300 package fall into four categories—screen formatting, string manipulation, sorting, and date conversions—and can be useful when developing commercial systems. Written to run under the EDX operating system (version 2), the subroutines can reside in an AUTOLINK library. The package includes subroutines for right and left justification of data within a field, sorting an internal array, lexicographically comparing to character strings, putting and fetching data from a formatted 4979 screen, and calculating the number of days between two give dates. THE SYSTEMS GUILD, INC., Thornwood, N.Y.

FOR DATA CIRCLE 323 ON READER CARD

DATA BASE MANAGEMENT

Add another computer to the ever-growing list of machines that can host the well-known Total data base management system; the newest host is IBM's System/34. The system is expected to appeal to those migrating from System/3, and is said to be an enhanced version of the Total available on that machine. System/34 Total provides support for both RPG II and COBOL programs. A single copy of the program services all requests from interactive and batch jobs, handling each on a multitasking basis. The system also has a logging function which creates an audit trail. Pricing is a little soft at this time, but we're told it won't be less than $468 per month or more than $572 per month. The package is slated for availability by the end of this quarter. CINCOM SYSTEMS, INC., Cincinnati, Ohio.

FOR DATA CIRCLE 330 ON READER CARD

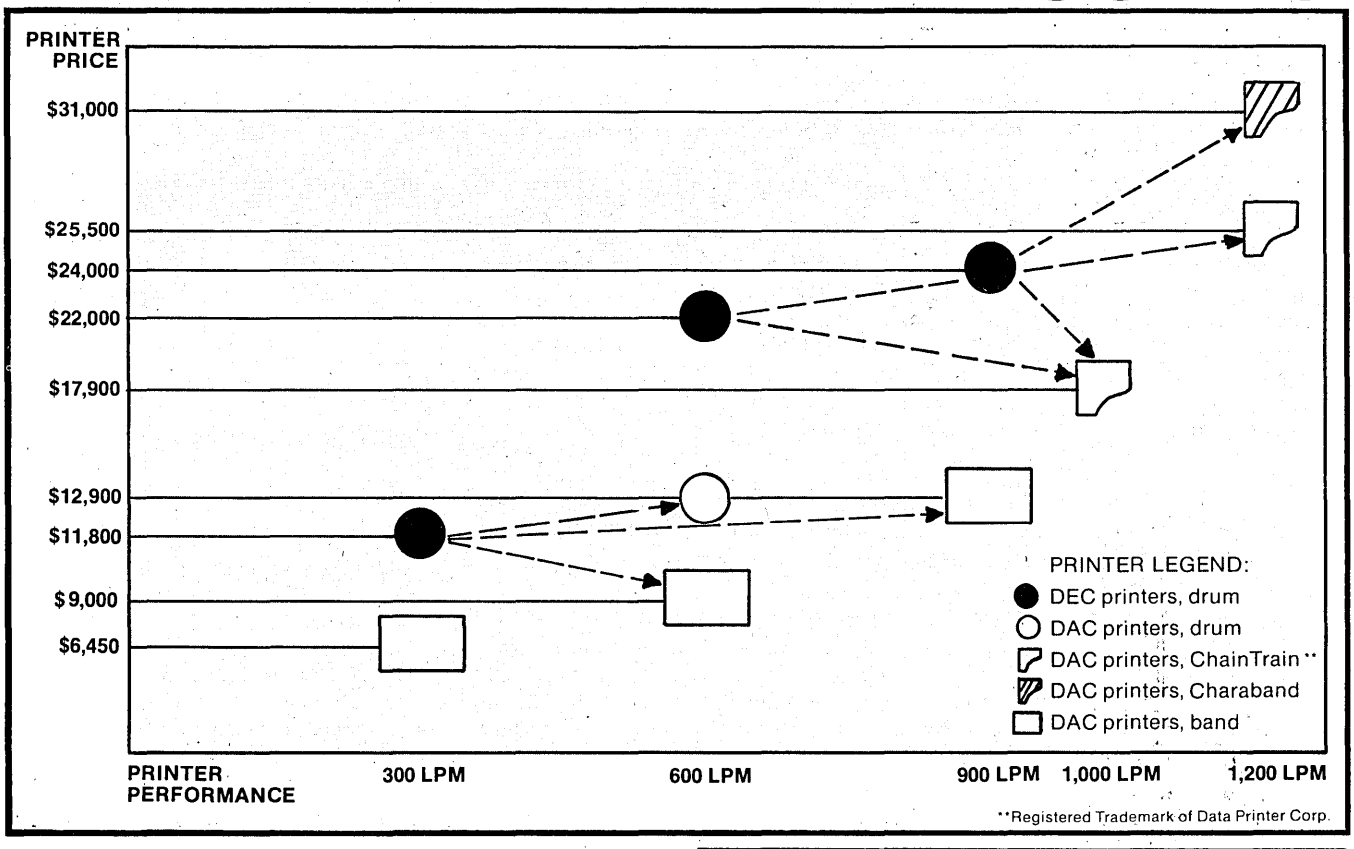
ECONOMIC DATA BASE

The Conference Board Data Base, which includes 739 economic time series, now is available on this vendor's time-sharing network. Updated daily, the data base includes monthly, quarterly, and semiannual information in a number of areas, including capital appropriations, expenditures, cancellations, and backlogs of the 1,000 largest manufacturers and privately owned utilities. An English-like financial analysis language, XSIM, provides access to the data. Use of the data base entails an annual subscription fee of $400, plus computer time charges. INTERACTIVE DATA CORP., Waltham, Mass.

FOR DATA CIRCLE 331 ON READER CARD ✲

Line Printers

OEM PRICES FOR END USERS



BECAUSE PRINTERS ARE ALL WE SELL FROM 100 to 1,500 LPM

Look at the options, the alternatives available when all you pay is the OEM price for a printer.

Yes, you can step up without going over budget. Get a higher speed or a heavier duty or a more flexible printer for your available dollars.

WHAT THE CHART DOESN'T SHOW

What the price-performance comparison chart doesn't show is the product commitment, the service and support, that are part of the bargain.

After all, when printers are your business, your *only* business, you've got to be better as well as cheaper. In fact, capability—as much as budget priced printers—has helped us become America's most successful printer system house—with almost 1,500 installations!

WRITE OR CALL

So, if you've been considering buying a printer from your minicomputer manufacturer, consider the quality and performance you'll have to give up. And whether it isn't asking you to pay too high a price for such a sacrifice.

One thing more. We have no one out there drumming up business. (It's another way you save.) So, you'll have to initiate the contact. Just write or call for complete printer information. There's no obligation.

PDP-11* ALTERNATIVES

*(*DAC printers are plug compatible with all DEC, DG, HP, IBM Series 1 and S/3, Interdata and other major minicomputers and high-speed communications to 19.2k baud.)*

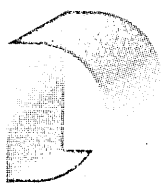
DRUM PRINTERS: You can step up from DEC's 300 lpm drum to DAC's 600 for as little as $1,150 extra. Identical to the DEC 600, it's made by the same manufacturer.

CHAINTRAIN: If you're budgeted for DEC's 600 lpm drum, our 1,000 lpm heavy duty ChainTrain offers superior performance plus upper and lower cases and printing of letter quality. And it's not available from DEC—or most other mini-manufacturers—at any price! (ChainTrains in 600, 900 and 1,200 lpm models are also available now.)

CHARABAND: Our 1,200 lpm Charaband costs $7,000 more than DEC's 900 lpm drum, but gives you easily changed character sets and the highest possible print quality as well as greater speed. See if it isn't the printer that belongs in your budget.

LOW COST/HIGH SPEED ALTERNATIVES

BAND PRINTERS: Never before available to minicomputer end users, these remarkably durable band printers with 11 quick-change character sets have become the OEM standard for high-speed, high-volume printing. And one of the best values on the market today.



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LINE FOR LINE YOU CAN'T BEAT THE VALUE

CIRCLE 37 ON READER CARD

PORTIA ISAACSON, CONTRIBUTING EDITOR

PERSONAL COMPUTING

1984'S INFORMATION APPLIANCES

In 1985 a megabyte of random access memory will cost about $1,000. In 1990, 600MB of disk which today costs $165,400 will cost about $3,000. By 1985 we can expect to see a 370 instruction set processor on a single chip costing a few hundred dollars.

We need not wait until 1985 to watch the forces of technological change jolt the computer industry from all sides. Pick up any recent trade publication and notice that drastic memory price cuts are common, that the micro Winchester will bring a 50-fold improvement in microcomputer disk storage price this year, and that microprocessor chips are now available with the performance characteristics of medium size minicomputers.

Just how big is a personally affordable, desk top, information appliance computer going to get during the next few years? We can try to provide an answer by looking at microprocessor trends, RAM trends, and disk trends.

Microprocessors: The days of the calculator type microprocessor are long since gone. Today's microprocessor has a rich instruction set, many data types and addressing formats, a sophisticated interrupt structure, and is no longer restricted to a small address space. It performs somewhat like a mid-range mini (PDP-11/45) which in turn performs somewhat like the IBM 360 Mod 65. (Remember when that was a "big" computer?)

Would running OS on your 1990 personal computer be sufficient progress?

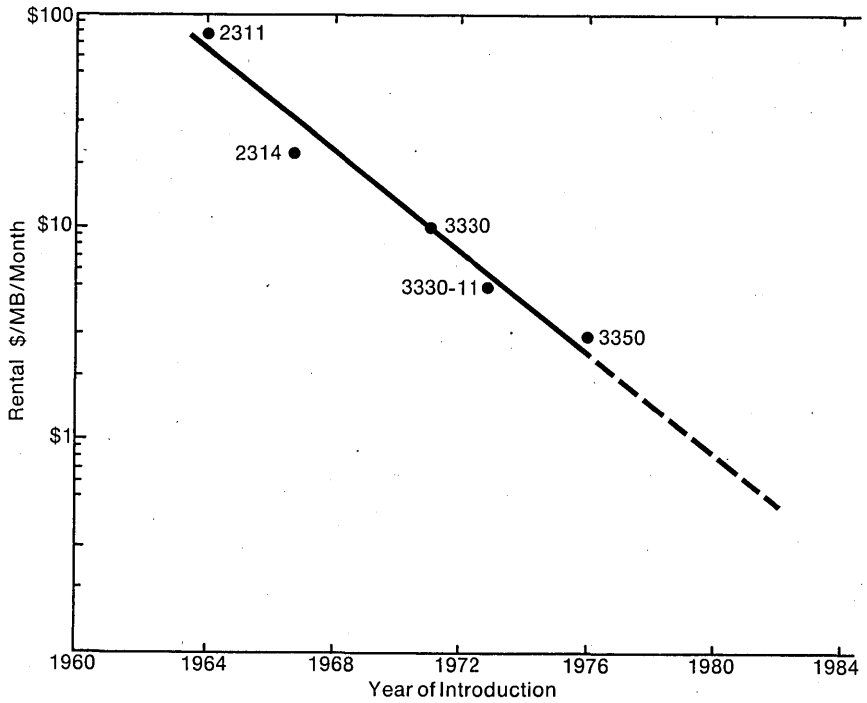
For example, the Zilog Z8000 described in Table 1 is representative of the new 16-bit microprocessors. Others include the Intel 8086 and the Motorola M68000.

At the 1977 NCC, Mark Shepherd, Jr., chairman and chief executive officer of Texas Instruments, predicted a 32-bit

Zilog Z8000

- 5 to 10 times the speed of previous 8-bit microprocessors.
- 7 data types including: bits, BCD digits, bytes, 16-bit words, 32-bit long words, byte strings, and work strings.
- 8 addressing modes including: five main modes—register, indirect register, direct, indexed, immediate; and for some instructions— base address, base indexed, relative address (with autoincrement and autodecrement).
- 110 distinct operation types combine with data types and addressing modes to offer over 400 instructions; and most of the instructions can use any of the five main addressing modes with 8-bit, 16-bit, or 32-bit operands.
- 16 16-bit general purpose registers, of which all except one can be used as an index register.
- 8 million bytes of directly addressable memory (in 128 segments of 64KB each with optional memory management device).
- Optional memory management chip will perform dynamic relocation and memory protection.

Table 1.



Source: Hollis L. Caswell, et al., "Basic Technology," *Computer*, September, 1978, p.11. © 1978, Institute of Electrical and Electronics Engineers.

Fig. 1. The cost per megabyte of disk storage has been falling by about a factor of three every four years. If the trend continues, 1980 will see a megabyte of storage rent for less than $1/month.

microprocessor with 1 million bits of memory on the chip by the early 1980s, as well as a continuing similar rate of chip complexity growth well into the 1990s. Now let me ask an obvious question. If you were to design a 32-bit microprocessor, what instruction set would you choose? I'm sure more than one semiconductor company has asked and answered that question and is now well on its way to achieving a 370 instruction set processor on a single chip. Imagine all those gigatons of IBM software running on a $100 single-chip computer. (Does anyone know what Intel is doing in Oregon?)

The big question facing semiconductor companies in the 1980s will not be how to get more functions on a single chip. It will be how to use all the chip capacity that will be available. Their problem is not simple—remember chips must sell in high volume to make the costs low. Perhaps chips that execute higher-level languages are the answer. Perhaps by the late 1980s a microprocessor that directly processes COBOL will be available.

Or we might use chip capacity by migrating present software functions into the chip. Are there software functions that occur frequently enough? How about operating system modules or compilers? Would it be sufficient progress if your 1990 personal computer could run OS?

Random Access Memory: Table 2 shows the changes in the cost of a mega-

Cost Trends
1 Megabyte Main (RAM) Memory

Year	Bits/ Chip[1]	Component Cost/MB[2]	Chips/MB	PCB + Labor[3]	Total Cost to Manufacture/MB	Retail Price/MB[4]
1975	1K	$ 19,294	8,192	$4,588.	$23,882.	$95,528.
1977	4K	8,152	2,048	1,147.	9,299.	37,196.
1979	16K	3,444	512	287.	3,731.	14,924.
1981	64K	1,455	128	72.	1,527.	6,108.
1983	256K	615	32	18.	633.	2,532.
1985	1M	260	8	4.5	264.5	1,058
1987	4M	110	2	1.1	111.1	444.4
1989	16M	46	½	0.28	46.28	185.12
1991	64M	20	⅛	0.07	20.07	80.28

[1]RAM chip density (bits/chip) is expected to quadruple every two years for the next 10 years (Robert N. Noyce, "Microelectronics," *Scientific American*, September, 1977).

[2]In 1975 RAM cost was 0.23¢/bit. RAM cost has decreased 35%/year since 1970, and this trend is expected to continue. (Robert N. Noyce, op cit.)

[3]Printed Circuit Boards, miscellaneous components and labor cost are related directly to component count. It was figured here at $0.56/RAM chip, the actual figure for 16K RAM boards in 1978.

[4]Retail price is figured at four times the cost to manufacture. This allows 100% markup (doubling the price) by both the manufacturer and the retailer, the actual practice in today's personal computing industry.

Table 2.

HOW WE HELP SOLVE THE 1403-N1 USER'S TWO BIG PROBLEMS:

TOO MUCH SPEED. AND NOT ENOUGH.

The IBM 1403-N1 is a great printer. Trouble is, 1100 lpm is an awkward speed for lots of systems.

Either it's too slow for your 360/370's high-speed needs, and you can't afford the jump to 2000 lpm.

Or you're paying for speed you don't need, but it sure beats trying to live with 600 lpm.

Well, we offer two more *logical* printers to fit your needs: one substantially faster, the other slightly slower than 1100 lpm. Both can save you money. (Also floor space and power.)

For instance, for less than you're now paying for the 1403-N1, you can get our 1500 lpm printer. And up your speed by 400 lines per minute.

Or, for a whopping $500 per month less than you're now paying for that 1403-N1, you can have our 900 lpm model.

At only a slight reduction in speed.

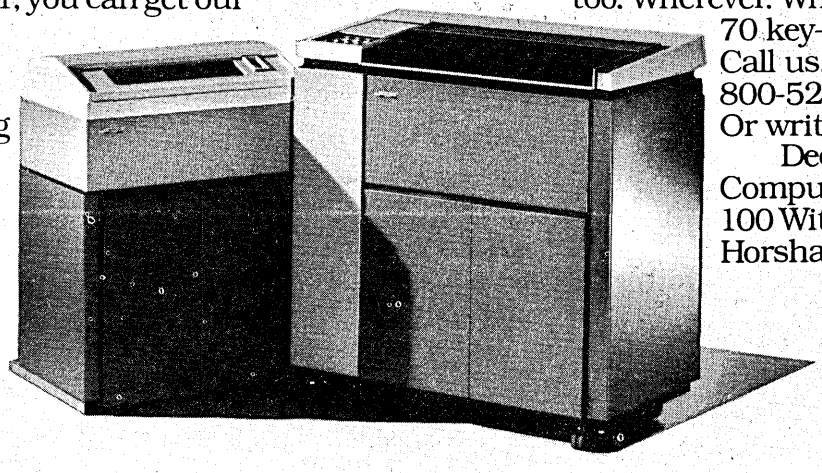
In fact, you can mix and match our 300, 450, 600, 900, and 1500 lpm printers to meet all kinds of performance needs. And economy ones. Same goes for our complete line of card peripherals, too.

Just talk to us.

We're already saving money and improving performance for over 6,000 IBM customers. With over 13,000 add-ons, plug-ins, and auxiliary units installed. Including hundreds and hundreds of printer installations.

And better yet, we don't sell, and then send you off in search of service. We service, too. Wherever. Whenever. From 70 key-city locations. Call us. Toll-free: 800-523-5948. Or write.

Decision Data Computer Corp., 100 Witmer Road, Horsham, PA 19044



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CIRCLE 41 ON READER CARD

DISK SUBSYSTEM PRICING

Year	3550A-2 Equivalent (600MB)[1]	Controller[2]	Total Price (600MB)
1977	$62,500	$103,400	$165,900
1981	20,833	18,457	39,290
1985	6,666	3,295	9,961
1989	2,222	588	2,810

[1]Drive prices are divided by three every four years (see Fig. 1).

[2]Controller electronics prices are assumed to behave as memory prices (35% drop each year) since it is a semiconductor device.

Table 3.

byte of RAM memory over the next 10 years. Recent announcements of memory price cuts lend credibility to the chart: DEC recently set the price of a megabyte at $35,000; and IBM announced a price of $18,000/megabyte for the 8100.

Table 2 plainly indicates that the retail price of a megabyte in 1985 will be about $1,000 and will continue to drop to under $200 by 1990. And the price of ROM is leading RAM by about two years.

By 1985 every Radio Shack computer can have a million bytes of RAM and ROM. More significantly, every office worker could have on his or her desk an information appliance containing several million bytes of ROM and RAM. I hope someone (IBM, Xerox, Exxon, Radio Shack?) is hard at work figuring out how to use such incredible storage capacity.

Disks: Perhaps the trend in disks is the most significant of all because most business applications, in both small and large businesses, that today cannot use microcomputers, could use one if the micro's disk storage capacity were great enough.

Fig. 1 shows disk prices are expected to drop by a factor of three every four years as they have since 1964. Table 3 charts the price of a 600MB IBM 3350A-2 type disk (with controller) through 1989, projecting the price drop from $165,900 in 1977 to $2,810 in 1989. As such capacity falls into the price range of low cost computers, many applications involving much larger data bases become feasible.

Today, as shown by the IBM 3350 in Table 3, the cost of the controller dominates the cost of a disk system. Further, the cost of the mechanical components in the drive has a rather high lower limit. Therefore, there is economy of scale in disk storage. If you analyze the differences between today's microcomputers and larger computers, you find the major difference is not the processor speed or power (the IBM 3033 is only about 15 times faster than the Z8000), it is the cost of disk storage (IBM 3350A-2 at .0014¢/bit is 57 times as cost effective as iCOM FD3712 floppy disks at .08¢/bit). These two facts reinforce the image of projected future dp system architecture as moving processing out to the users but leaving some storage centralized because economy of scale will still hold true for disk storage.

The cost advantages of large centralized disk storage will change somewhat this year when the micro Winchesters are introduced. Shugart has announced Winchesters of 14.5MB and 29MB at single unit prices of $2,550 and $3,500 respectively. A reasonable retail price of $4,500, including controller, for the 29MB version, gives a storage cost of .0018¢/bit—a price similar to the IBM 3350's. The cost/bit discrepancy between large disks and micro disks may soon disappear as Winchester technology is made available on micros. Thus, one of the justifications for the centralized computer may soon be invalidated.

Computing on $5/day: Just $5/day will buy a $6,000 computer when amortized over five years. (Compare $5/day to the cost of the lowest paid clerk and you'll see why tomorrow's information appliances will revolutionize the office.)

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- 0.5MB disk storage
- 30cps pinfed-forms printer

Two years from now $5/day will buy
- 16-bit cpu
- 64KB main memory
- 30MB disk storage
- 150cps pinfed-forms printer

By 1984 $5/day will buy
- 32-bit cpu (perhaps 360-compatible)
- 1MB main memory
- 100MB disk storage
- 300cps pinfed-forms printer

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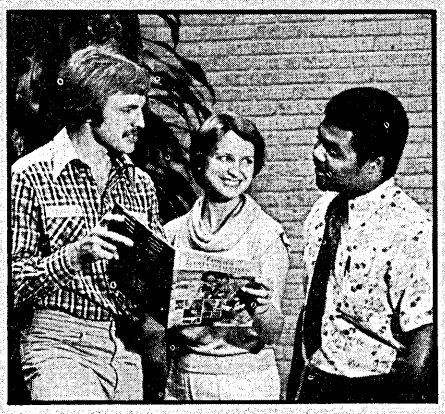

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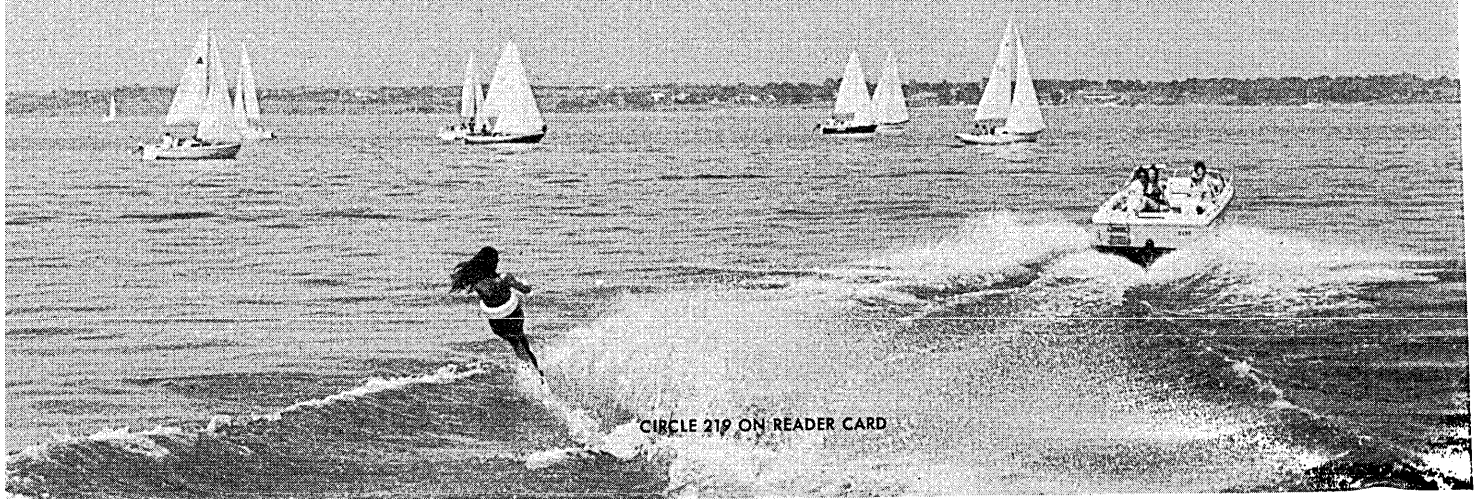

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SOURCE DATA

REPORTS AND REFERENCES

PLUG-COMPATIBLE MAINFRAMES

New entries are joining the ranks of the plug-compatible cpu manufacturers every couple of months, and it's becoming increasingly difficult to tell the players (sometimes even the game) without a program. This publisher is offering guides to make it easier for the potential customer.

Included is a "power rating table" which lists all of the IBM 370 and 303X series competitors and names their suppliers. A 2-page recap, it includes mention of processing speeds (in thousands of operations/second, KOPS), processing power as a mutliple of the IBM target machine, maximum aggregate I/O rates, and pricing for a typical configuration.

Also in the package is a 6-page report detailing the Amdahl Corp. product line. It gives an overview of the products and the vendor, plus the company's history, innovations (in circuitry, packaging, cooling, installation aids, remote diagnostics, etc.), plus a configuration guide, spec charts, and a discussion of Amdahl's software plans. AUERBACH PUBLISHERS INC., Pennsauken, N.J.

FOR COPY CIRCLE 340 ON READER CARD

LEASING

A new IRD report, *Equipment Leasing*, which covers just about any kind of equipment you could imagine leasing (from commercial aircraft and ocean-going vessels to textile equipment to health care equipment) has some interesting things to say about recent developments in third-party leasing of data processing equipment. Associated risks are rising, according to the report, because of the new IBM 303X computers, other introductions from IBM, DEC, and the PCM vendors.

The report predicts a "re-marketing crisis" as obsolescent IBM 370 machines find their way into the used equipment market, undercutting the residual value of leased computers. The high availability of the used 370 machines, however, is expected to make shorter leases a more viable option, a plus for the many users IRD predicts will choose such relatively short leases to bridge them into the next generation of IBM machines.

The report is based on a survey of lessees and on interviews with executives of leasing and manufacturing firms.

Financial aspects of leasing are addressed. The report points out that leasing has become an accepted and respectable means of financing. The July 1976 guidelines for lease accounting issued by the Financial Accounting Standards Board, known as FASB #13, is explained and evaluated, as are recent and expected changes in the ruling and in IRS guidelines.

Some leasing salesmen were seen by survey respondents as taking a casual and superficial attitude toward the analysis of client needs. The IRD report cautions lessors that more professionalism will be required as leasing matures as an industry and as competition begins to cut down the present large profit margins in the business.

The office of the future market is seen by IRD as a major emerging market for equipment lessors, with the increasing diversity of manufacturers in this market providing a plus. The report also predicts growth in the leasing of telecommunications equipment, light trucks, instrumentation, and automobiles—40% of all new cars in the U.S. in 1987 will be leased, it is predicted.

The 245-page report is $895. INTERNATIONAL RESOURCE DEVELOPMENT INC., 125 Elm St., New Canaan, CT 06840 (203) 966-5615.

TERMINALS

A directory of computer terminals is offered by the Association of Time-Sharing Users. The directory covers impact printing terminals, video display terminals, thermal printing terminals, printers, graphics terminals, remote batch terminals, and intellegent terminals. Each terminal is presented with a photo, description of features, pricing information, including lease cost (when available), and vendor contact. *Computer Terminals Directory* is available bound for $45 prepaid. It is also available in loose-leaf form by subscription as part of the ATSU's three-volume *Interactive Computing Directories*, part of ATSU membership, which is $85. ATSU, P.O. Box 9003, Boulder, CO 80301.

CUSTOM LSI CIRCUITS

"God give me the courage," quips a recent report entitled *Vertical Dis-Integration*, "to design the circuits that are unique to my products, the patience to buy those that aren't and the wisdom to know the difference."

According to Howard Bogert, an author of the report, with the advent of what is called Large Scale Integration (LSI), the amount of potential circuitry available on an integrated circuit almost doubles yearly. It is these "changes the industry has forced upon its customers," he said, that the present report addresses.

The report briefly discusses the history of the semiconductor industry, pointing out trends toward internal development of semiconductor manufacturing capability, acquisition of a firm with that capability (vertical integration), and finally the rise of independent suppliers that make up what is called the LSI service industry.

Operating under the assumption that many firms need to control chip design in order to retain proprietary characteristics for their hardware, the report focuses on how to contract custom and semicustom LSI circuits.

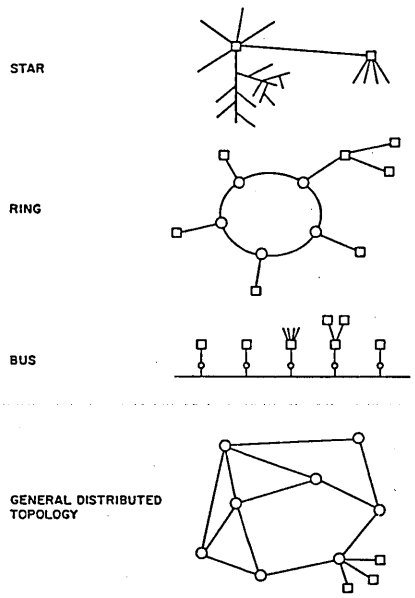
The 155-page final chapter of the 236-page report lists firms that provide one or more of the available contract services in the design through the production phases of custom integrated circuits. Each company profile gives information about company ownership, size of the facility, and services available. Some technical information is given here; for example, design firms are characterized by the technology for which they design circuits (P-MOS, N-MOS, C-MOS, Linear Bipolar, or Digital Bipolar). Also included in the company profile is the person to contact for the service in question, an item more useful than it may sound, for the authors found that many people in the larger companies were not aware the firm offered such services. Curiously, though the purpose of the company profiles is described on the first page of chapter 9 as being "intended to give the reader enough information to decide whether the company might be able to provide the service he seeks," the inside front cover carries a warning that the profiles are representative only, and says "There is not sufficient information supplied to be the basis for selection decisions."

The LSI service firms listed are treated as seven categories: independent custom LSI design firms, semiconductor firms offering custom LSI design service, semicustom LSI firms, mask-making firms, wafer fabrication services, assembly services, and test services.

The report is available for $475 from ELECTRONICS TREND PUBLICATIONS, 10050 North Wolfe Road, SW3, Suite 200, Cupertino, CA 95014 (408) 996-7401.

DATACOMM DIRECTIONS

Three basic reports on data communications are available from Bolt Beranek and Newman, themselves a developer of packet switching technology. *Evaluating the Vendors' Network Architectures* starts with an overview of the developments leading to development of intelligent access, teleprocessing, and distributed processing networks. Offerings of mainframe, minicomputer and communications equipment manufacturers are then described and evaluated, as are AT&T's ACS and ITT's COM-PAC.



In-house communication systems are described in *Understanding the new Local Network Architectures,* which covers technical design considerations (topology and protocol), descriptions of some available systems and a discussion of unsolved problems in local network design. There are a few diagrams, of which Fig. 2 is an example.

Choosing Between X.25-Based Networks and IBM's SNA bases its comparative analysis on the following criteria: network operation and management; vendor flexibility; basic cost considerations; flexibility (mainly, the ability to adapt to growth in network traffic and to expansion in geographical coverage, and the ability to support diverse and unanticipated applications); and the availability of terminal support, support for office applications, host interface, and security (these four aspects are covered together as "important capabilities").

The reports are $75 each or $200 for the three. From the Computer Systems Division of BOLT BERANEK AND NEWMAN, INC., 50 Moulton St., Cambridge, MA 02138.

BIBLIOGRAPHIES

Two new bibliographies with abstracts are available from NTIS (National Technical Information Service). *Relational Data Bases* (49 pp.) and *Computer Performance Evaluation* (194 pp.). The performance evaluation bibliography covers workload determination, computational efficiency, and both hardware and software performance techniques. The reports are $28 each. Available from NTIS (cite NTIS/PS-78/1078/1WC for *Computer Performance Evaluation* and NTIS/PS-78/1086/4WC for *Relational Data Bases),* U.S. DEPARTMENT OF COMMERCE, 5285 Port Royal Rd., Springfield, VA 22161.

COMPUTER SECURITY

A 16-page report entitled "Protecting Personal Information in Computer Systems" contends that a high level of protection can be provided personal information in a multiuser computer network. Such protection, find the authors, is contingent on the design and configuration of the network. One recommendation set forth in the report is a policy of isolation, either isolation of the system from the threat, which entails isolating the system from the programmer and curtailing user capability, or, where normal programming capability is demanded by user requirements, the isolation of sensitive data. Architectural approaches to this type of isolation are discussed, including virtual machine systems, descriptor bases systems, protection domains, and operating system approaches.

The report is rather long-winded, particularly in the initial section about threats and vulnerabilities, and recommendations are mostly general. $5. REYMONT ASSOCIATES, 29 Reymont Ave., Rye, NY 10580.

CAD: OPTICS

The Proceedings of the Society of Photo-optical Instrumentation Engineers conference on Computer-Aided Optical Design carries a refreshingly brief and straightforward introduction. It reads, "The design of optical systems with the aid of electronic computers has matured significantly in recent years. Many of the new advances in the state of the art of computer-aided design lie in the areas of new program innovations and/or innovative ways of using existing programs combined with a greater awareness by the designer of the eventual fabrication of one's design. This seminar provided a forum for the discussion of these increasingly important subjects."

Session 1, Optical Design Programs, includes the papers "Diffraction Evaluation of General Optical Systems," and "Lens Design Program." The next topic, Design for Fabrication, is covered in two chapters, Computation and Applications. The first paper in the Computation section is "Lens Design Without a Computer," in which Rudolf Kingslake of the Univ. of Rochester gives a numerical example of how, before computers, lenses were designed by hand—prior to 1930, by logarithms, and between 1930 and 1960, with the aid of only a mechanical desk calculator and a book of sine tables. Another paper in Session 2 is "Computer Aided Design for Production Cost Reduction." An example of an Application paper is "The Design of a Family of Wide Angle Lenses Having a Commonality of Parts," given by Jacob Moskovich of Vivitar Product Development and Manufacturing Div. Session 4 covers Special Requirements and Applications, such as "Future Computer Program Requirements for Design of Infrared Optical Systems," "Unique Problems and a Possible Novel Optical Design Approach for the Design and Assembly of CO_2 Laser Fusion Systems," and "Lens Design and the Ghost Focus Problem in Fusion Lasers." The volume, #147, is available for $36 from SPIE, P.O. Box 10, Bellingham, WA 98225 (206) 676-3290.

DBMS CHOICES

A new report from Performance Development Corp. addresses the issue of how to select a data base management system, not only from the aspect of technical considerations, but also with respect to the difficult related decisions such as the needs of the organization and the impact the decision will have on the role of the dp department. The report emphasizes the importance of starting the DBMS selection process with these considerations before talking to vendors, so as to avoid fitting the company's needs to a package rather than selecting a package to suit the company's needs.

Included in the report are recently updated system descriptions for IMS, TOTAL, IDMS, ADABAS, SYSTEM 2000, and DATACOM/DB. Adapted from the book *Data Base Systems: Design, Implementation and Management,* by Ronald G. Ross (AMACOM, New York), which was reviewed recently in DATAMATION (November 1978, p. 212), *DBMS Selection Guide* is $12.50 or $10.50 prepaid, from PER-

What Computer Professionals Earn

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The 1979 Salary Survey:

1. Non-Management Positions (Salary according to length of experience)	Annual Salaries ($000) 15th Percentile	Median	85th Percentile
Commercial Programmers and Programmer Analysts			
6 months - 1 year	[illegible]	[illegible]	[illegible]
1 year - 2 years	[illegible]	[illegible]	[illegible]
2 years - 4 years	[illegible]	[illegible]	[illegible]

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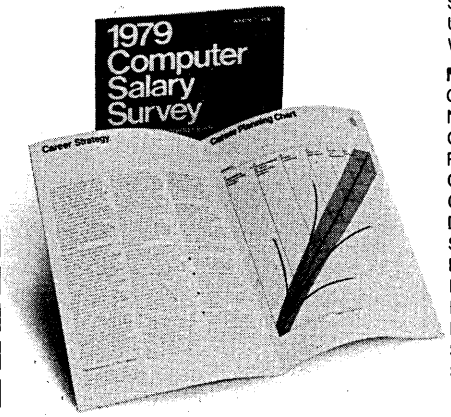

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Cincinnati	513/769-5080
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REPORTS AND REFERENCES

FORMANCE DEVELOPMENT CORP., 1101 State Road, Bldg. P., Princeton, NJ 08540 (609) 921-3770.

DISTRIBUTED PROCESSING

A new report from QED, *Distributed Processing: Current Practice and Future Developments* is made up of two volumes: Volume I, Management Report and Volume II, Technical Report. Volume I has 7 chapters: A Management Perspective being a sort of introduction to the distributed approach; Distributed Processing in Practice; The IBM Scene; Future Trends; Implications for the DP Department; Implications for Management; and Planning Guidelines. An appendix contains three supplemental papers, all of which are transcriptions of talks given at Online Conferences on Distributed Systems.

Volume II has 10 chapters: Introduction; Classification of DDP Systems (programmable terminals, programmable terminal controllers, programmable data concentrators, multitier systems, multimini systems, and load-sharing network); Components of DDP Systems (terminals, remote processors, communications, and the central site); Developments in Communications; Network Architectures; Distributed Files and Data Bases; Multi-Mini Systems; Design, Acquisition and Development; Operational Issues; and Technical Guidelines. There are two appendices in Volume II. One is of supplementary papers—the same three as in Volume I followed by papers on data link controls and high-level protocols, minicomputers and multimini systems, and distributed files and data bases. The other appendix contains 17 installation reports. These two appendices account for 200 pages each of the 505-page report. Volume I is priced at $18 ($15 prepaid), Volume II is $35 ($31 prepaid). Postage and handling is $2. From QED INFORMATION SCIENCES, INC., P.O. Box 181, 141 Linden St., Wellesley, MA 02181 (617) 237-5656.

VENDOR LITERATURE

PERSONAL COMPUTING CHIPS

"Semiconductor Components for the Personal Computer Industry," a 24-page illustrated booklet, describes many integrated circuits of interest to manufacturers of personal computing equipment. The booklet also will interest hobbyists wishing to roll their own homebrew systems and subsystems. The booklet describes, with prose and block diagrams, various microcprocessor, memory and I/O support chips. Special purpose chips, including a math processor, sound synthesizing circuits, and a Touch-Tone telephone dialer are also described. Postage-paid postcards are included for requesting further information. NATIONAL SEMICONDUCTOR CORP., Santa Clara, Calif.

FOR DATA CIRCLE 341 ON READER CARD

PDP-11/70 ADD-ON MEMORY

An eight-page brochure describes this vendor's "Intelligent Memory" for PDP-11/70's. Also described are options such as battery backup, and an integral microcomputer which monitors and reports on memory status. MONOLITHIC SYSTEMS CORP., Englewood, Colo.

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COMMUNICATIONS

This vendor offers an illustrated short-form catalog describing its entire product line of limited distance modems, line drivers, and interface converters. Product specification charts are included. AVANTI COMMUNICATIONS CORP., Newport, R.I.

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COMMUNICATIONS

Two brochures describe two of this vendor's recently announced data communications products. The 6010 Intelligent Network Processor is explained with text, photographs, and diagrams in one. Topics include ensuring the integrity of data transmissions, CCITT X.25 Level 2 com-

patible link protocol, and throughput. Block diagrams show possible applications, and a separate section describes other members of the 6000 family.

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The second brochure details the vendor's LSI 24/24 modem. An application function section includes black and white diagrams illustrating advanced applications for the LSI 24/24. The brochure also outlines and details various features and options of the 24/24. Technical data on the 24/24 also is included, as is a section on other members of the LSI series of modems. CODEX CORP., Mansfield, Mass.

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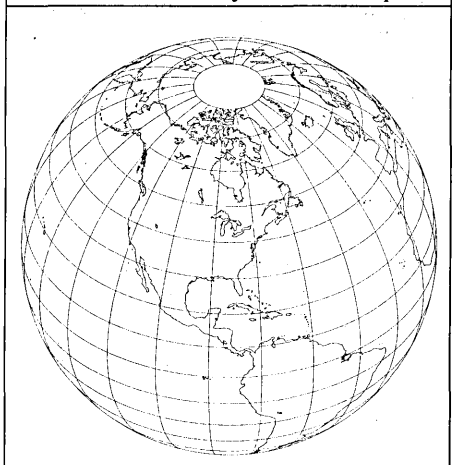
GRAPHICS SOFTWARE

A piece of hardware isn't worth much without the software to drive it; supporting software is the topic of this well known plotter manufacturer's attractively illustrated catalog. Four levels of software are described: basic software (generalized subroutines for every kind of computer graphics), functional software (often-repeated plotting functions), applications software (canned programs requiring no user programming), and PAGE (Preview And Graphics Editing, an interactive package). CALIFORNIA COMPUTER PRODUCTS, INC., Anaheim, Calif.



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ANALOG DATA I/O SYSTEM

A 16-page brochure provides detailed information on this vendor's System 256 analog data system for use with minicomputers. After an introduction covering general and system descriptions, the brochure gives general specs and data on computer interfacing and the system's construction. Block diagrams are used to describe System 256 and the interrelationships between functional modules. Configurations also are illustrated and described with text. The remainder of the brochure provides answers to many questions of interest to potential users; timing diagrams and mechanical drawings should interest system builders. DATEL SYSTEMS, INC., Canton, Mass.

FOR DATA CIRCLE 344 ON READER CARD

370-COMPATIBLE MINICOMPUTER

The V32, this vendor's entry into the 370-compatible market, is discussed in an eight-page, illustrated brochure. Topics covered include the V32's microcoded 370 instruction set, real and logical address spaces, and the V32's dynamic address translation facility, cpu architecture, 370-compatible I/O channels, system packaging, power requirements, and service features. TWO PI CORP., Sunnyvale, Calif.

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SMALL COMPUTERS

"The microNova Cookbook" illustrates a number of ways this vendor suggests serving up its small computers. Recipes (we kid you not) are included to satisfy a variety of appetites. The menu includes slices of industrial automation, communications, data acquisition and control, commercial data systems, and instrumentation. Brightly illustrated with four-color photos and block diagrams of systems, the booklet also includes overviews of the

VENDOR LITERATURE

microNova product line, and support software and services. A postage paid card is included for requesting more information. DATA GENERAL CORP., Westboro, Mass.

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DATA ACQUISITION

Three basic system configurations of this vendor's Series 2000 line of data acquisition equipment are described in an eight-page, illustrated, fold-out flier. The capabilities of Series 2000 signal conditioning and multiplexing equipment are discussed, and small, medium, and large-scale systems are described and pictured. FX SYSTEMS CORP., Kingston, N.Y.

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CARD RECORDER

A six-page, illustrated brochure describes this vendor's Omnigraphic series HRC Computer Card Recorders. The brochure details both analog and incremental models useful when an ink on paper trace is desired and conventional strip recorders are too large or expensive for the application. Photographs and mechanical drawings depict the units; a block diagram illustrates the units' principle of operation. HOUSTON INSTRUMENT, Austin, Texas.

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PERSONAL COMPUTER

The TRS-80 Microcomputer Catalog describes the hardware and software that make this vendor one of the leading contenders in the personal computing field. TRS-80 hardware is described and specs are provided. Both Level I and Level II BASIC languages are explained; a basic command list for each version is included, showing what functions are available. Add-ons to the basic TRS-80 also are explained, including add-on memory, the TRS-80 expansion chassis, and minidiskette systems. Included in the discussion of diskette drives is an explanation of the TRSDOS disk operating system and disk BASIC language. Printers, communications interfaces (RS232 interface board and acoustic coupler), manuals, applications software, and furniture round out the catalog. RADIO SHACK, Fort Worth, Texas.

FOR DATA CIRCLE 345 ON READER CARD

COMMUNICATIONS

A six-page illustrated brochure describes this vendor's latest additions to its Multiple Access Switching System. The brochure features various combinations of equipment for monitoring, testing, and digital transfer. Two pages are devoted to a "Table of function combinations." A postage-paid postcard is included for requesting further information. T-BAR INC., Wilton, Conn.

FOR DATA CIRCLE 353 ON READER CARD

COURSES

CASSETTE COURSES:

MICROPROCESSOR DESIGN

This firm's courses demonstrate an unusual approach to multimedia presentations. The six two-hour lecture/demonstrations

status

is a two way street...

when you know you are the best and talent is what it's all about. YOURS is knowing who you are and what you've got. OURS is recognizing it and knowing how to use it, because we both want to be with the best. Great professional talent, like a great idea, is hard to come by. That's why status is a 2-way street at a company called TRW.

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Design, develop, maintain and document software for processing telemetry, radar and scientific sensor data.

MINICOMPUTER SYSTEMS ANALYST

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SYSTEMS PROGRAMMERS

To maintain and modify vendor installed and TRW developed operating systems. Requires assembly languages as well as high level languages. Provides consultation and liaison experience to users.

COMPUTER SCIENTIST

To design and write formal descriptions of computer language. Will be involved in compiler test methodology, computer system modeling, automatic programming, and the semantics of parallel computation.

SENIOR SYSTEMS PROGRAMMER

Supporting IBM duplex 370/158 including system generation, job entry subsystems, TSO, and performance. Knowledge of IBM JCL, assembly language, and systems internals required.

SENIOR SYSTEMS PROGRAMMER

Supporting Communications software for 300 terminal, dual IBM 370/158 environment. Will install, maintain and debug VTAM, BTAM, TCAM, NCP and other related software which interfaces with IMS and TSO on-line systems.

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COURSES

were first presented live at Stanford Univ. They were also packaged for microwave transmission to some 50 participating companies in California's Silicon Valley area. Now they are being offered on ¾-inch U-Matic videocassettes.

Using the development of a time of day clock as an example, the course covers implementing it with such hardware as the Intel 8080 and 8085, and on the Zilog Z-80. Methods of hardware specification documentation are part of the course contents. The black and white 60-minute cassettes are priced at $150 each (there are 12) from the nonprofit organization which supplies them.

Work is in progress on a follow-up set titled "Microprocessor Serviceability: What the Designer Can Do." Assn. for Continuing Education, 404-A Durand Bldg., Stanford, CA (415) 327-4283.

PROGRAM DEVELOPMENT

The prices on three audiocassette courses have been cut by more than one-third by their supplier. AUDICS (cut from $525 to $325) covers the development of computer systems to adhere to financial control requirements. DUOS (down from $325 to $195) covers the development of small business systems, including step by step instructions plus actual forms needed. "COBOL Training" (was $295 is $195) begins with coding basics, then covers input, program hierarchy, and the various divisions of a COBOL program—whether for ANSI 68 or 74 versions. A course catalog describes these and other offerings from the vendor. Info 3, 21241 Ventura Blvd., Suite 193, Woodland Hills, CA 91364 (213) 999-5753 or (800) 423-5205.

IMS VIDEO COURSE

"Advanced IMS Programming" is the fourth in an IMS curriculum series which this vendor has prepared for applications programmers, data base administrators, system analysts, and dp managers. IMS command codes, Boolean qualification statements, detailed examples, and coding exercises are all included. The program comes in the form of two audiovisual modules, four audiotapes, and a student text—all of which can be had in COBOL or PL/1 versions. Its purchase price is $1,230, and a variety of rental agreements are also available.

The previous items in this series were "IMS Environment," "IMS Applications Programming" and "IMS Teleprocessing Environment." Among other new products in their library is one on "MVS Utilities," as well. Edutronics/McGraw-Hill, 55 Corporate Woods, 9300 W. 110th St., Overland Park, KS 66210 (800) 255-6324. ✲

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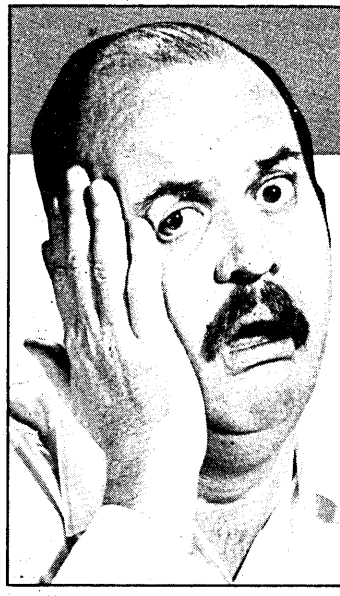

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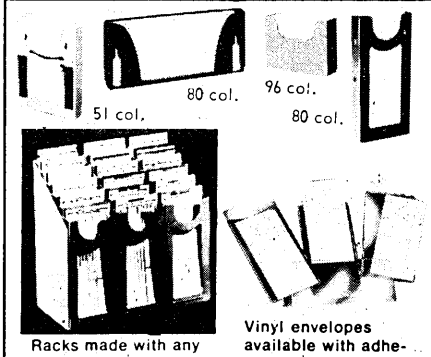

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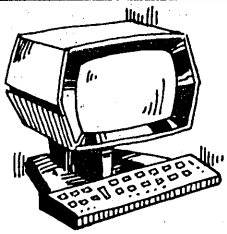

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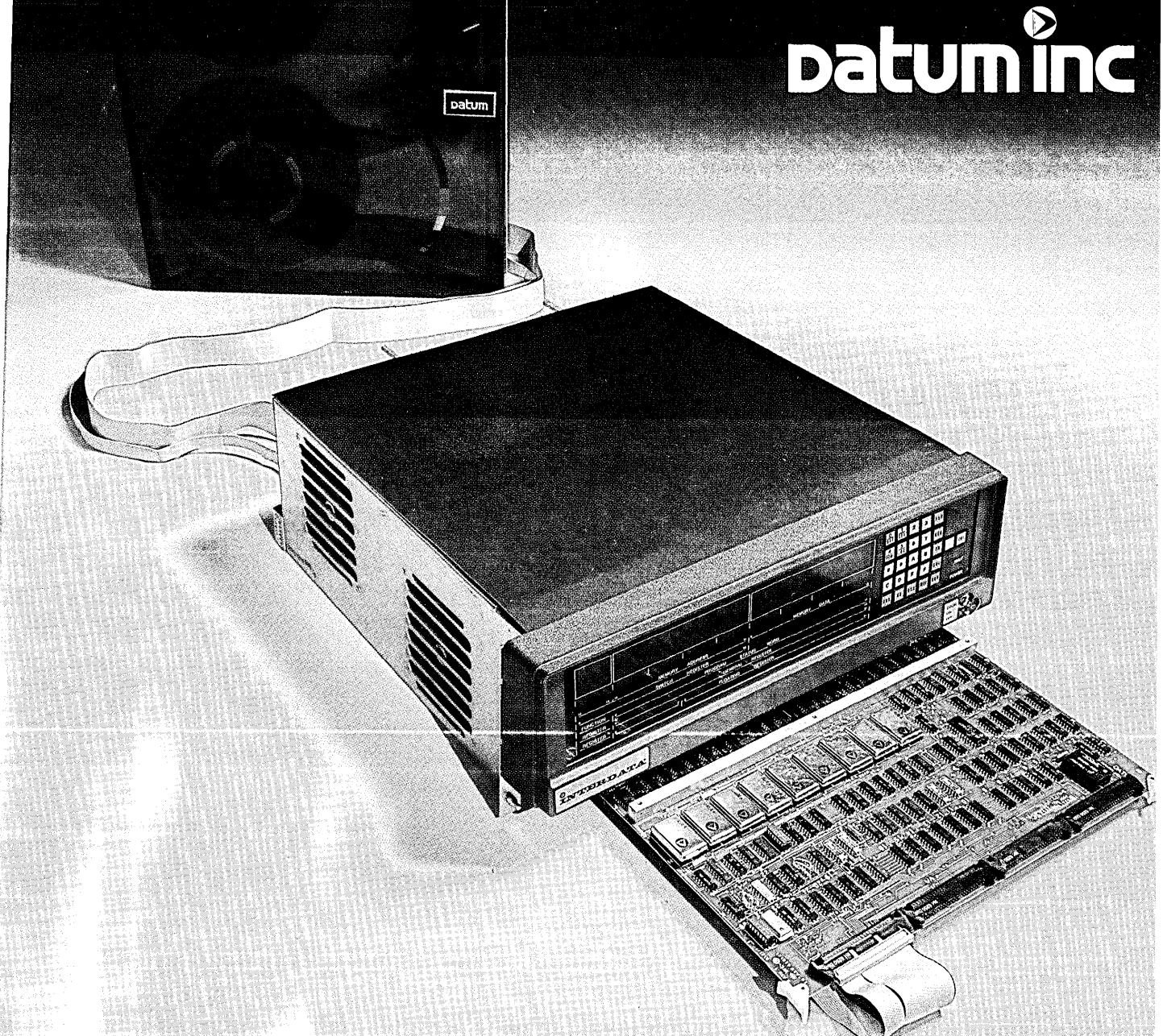

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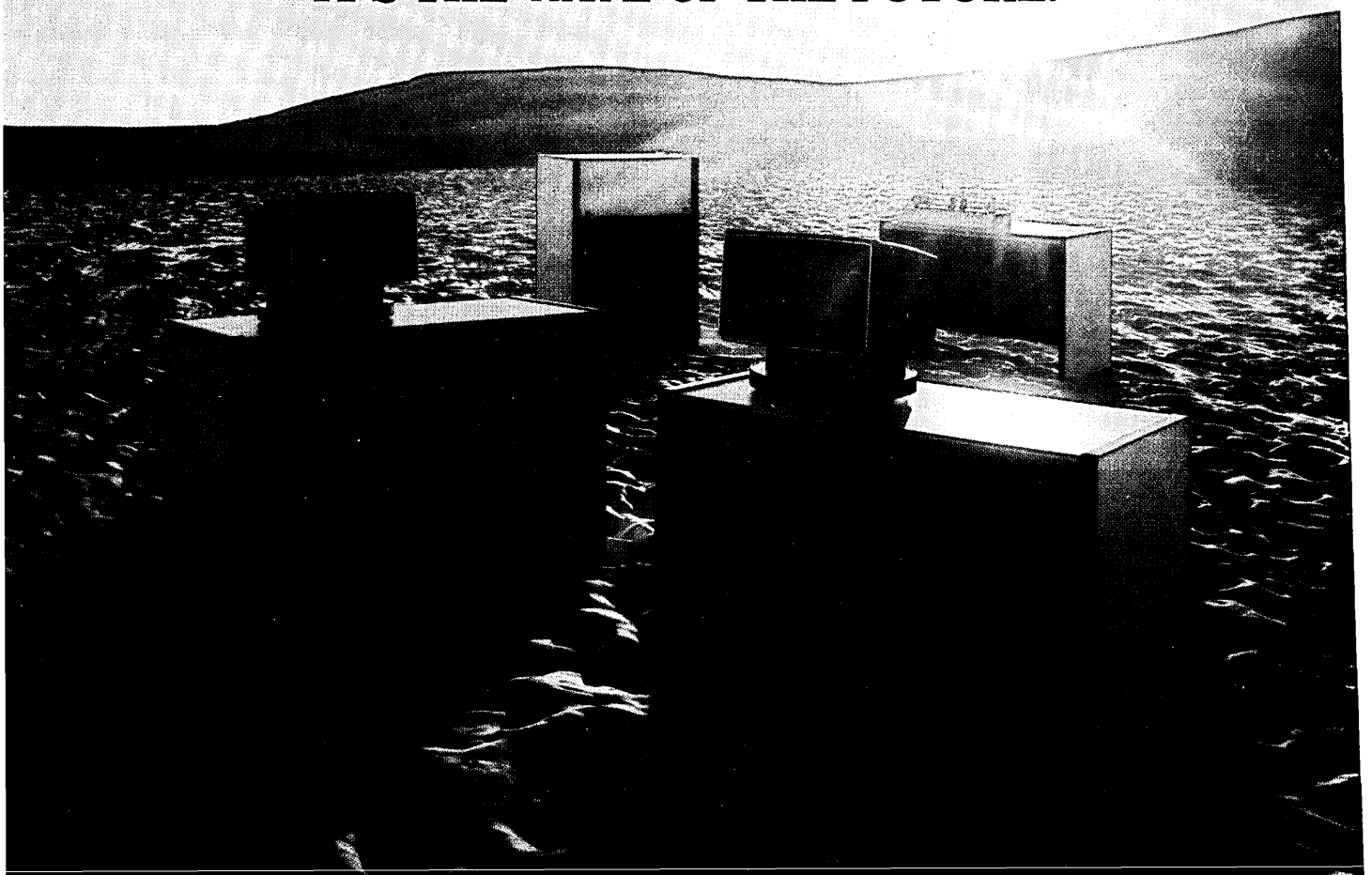

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