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79
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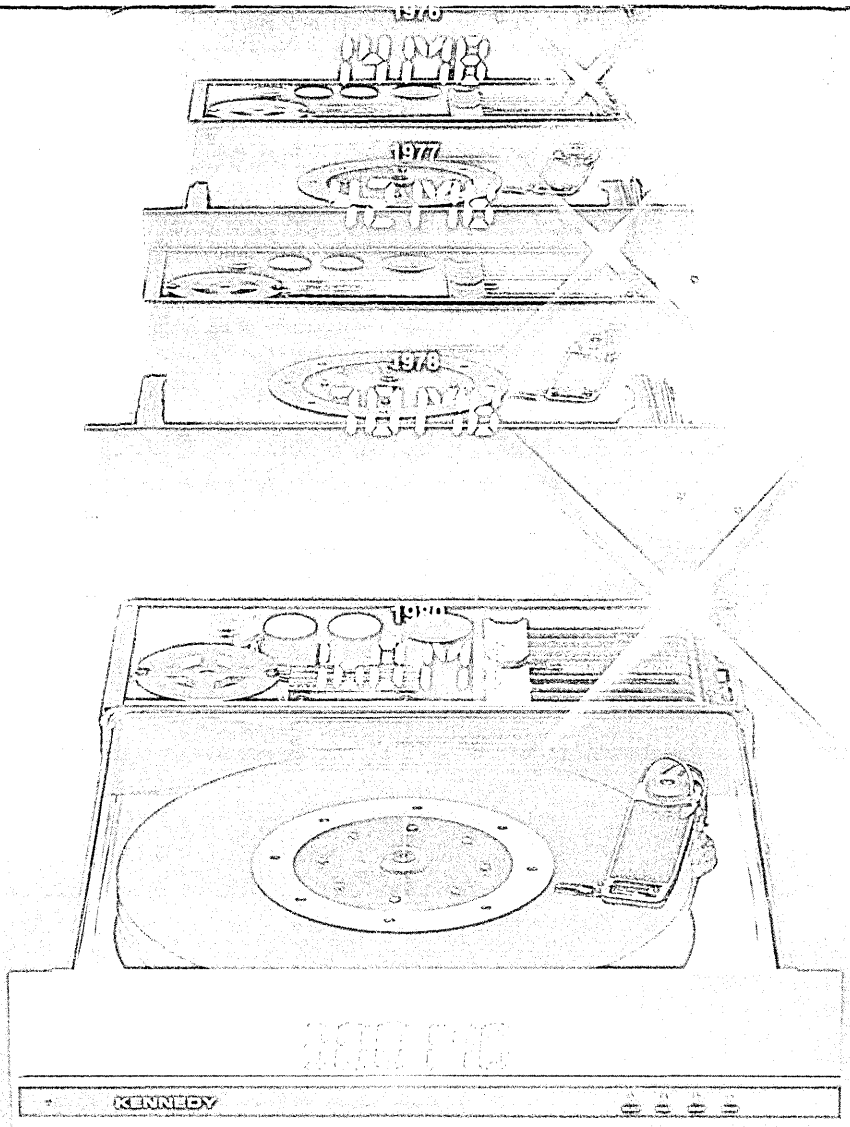


We've only just begun

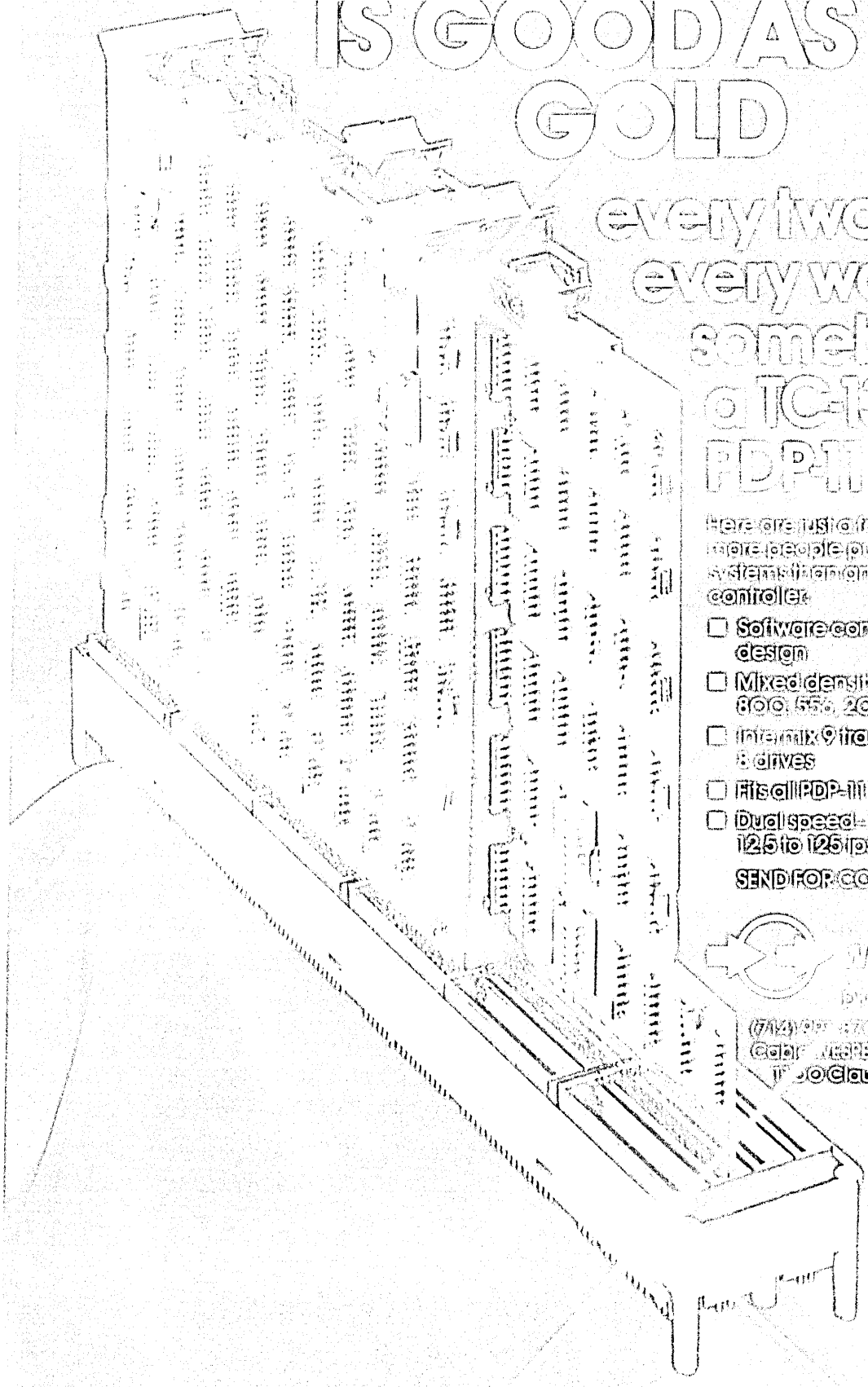
TECHNOLOGY

Since its introduction in 1976, Kennedy has successfully entered the disk e market with its Series 5800. Currently available in three configura- ns up to 70 Mbytes, Kennedy is committed in providing the industry with a family of devices growing to 300 Mbytes. Because the fixed media Series utilizes advanced Winchester technology it offers low cost of ownership and, of course, Kennedy Quality.

GROWTH

KENN

OUR PDP-11* MAGTAPE CONTROLLER IS GOOD AS GOLD



every two hours of every working day somebody puts a TC-30 on a PDP-11 controller

Here are just a few of the reasons why more people put TC-30's on their PDP-11 systems than any other magtape controller.

- ☐ Software compatible—embedded design
- ☐ Mixed density—1600 bpi PE and 800, 556, 200 bpi NRZ
- ☐ Intermix 9 track and 7 track, up to 8 drives
- ☐ Fits all PDP-11 Series Computers
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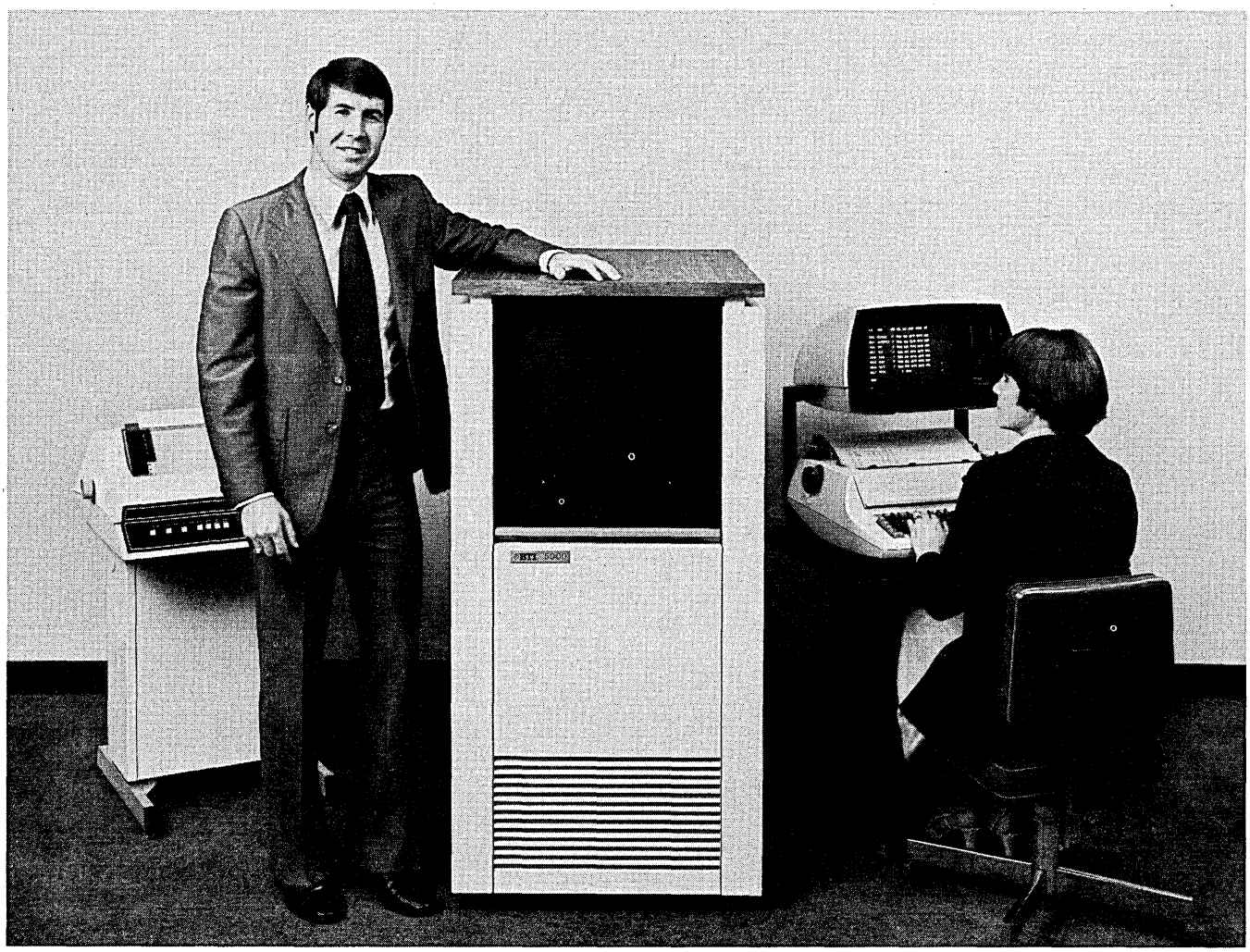

The BTI 5000 Interactive Computer System. An all-new system offering high storage capacity, fast response, superior operating flexibility and high reliability.

It's a multi-access system. The BTI 5000 supports up to 32 users at the same time. Because the operating system software is a true timesharing executive, users can perform any mix of independent or related tasks.

It's secure. Multiple levels of control prevent unauthorized access to the system. Security screens protect each user's library and his current activities.

Communication is simple. User terminals may be connected by direct cable, or over the telephone via dial-up or leased lines. Any ASCII, asynchronous, RS-232C compatible terminal can be used with the BTI 5000.

It's easy to program. BASIC-X is the BTI 5000's programming language, an extended version of BASIC continually augmented by BTI over the past 10 years. It retains BASIC's simplicity for the novice programmer, but has the features the experienced programmer needs.

Application software is available. The BTI 5000 comes with a library of contributed and factory-supported programs. Proven applications packages are also available for accounting, inventory control, order processing, text editing, mailing list management, and more, plus general-purpose data base managers.

It's easy to expand. User capacity can be increased from 8 to 32 ports. On-line storage can be expanded from 29 to over 500 megabytes. You can add multiple magnetic tape cartridge drives, industry-compatible 9-track magnetic tape, line printers from 300 to 900 lines/minute.

But it's not expensive. With 8 user ports, 29 megabytes of hard disk storage and a magnetic tape cartridge drive, the BTI 5000 costs just $38,950. A 58 megabyte system costs only $2,000 more. And if you want more than one system, the quantity discount is attractive.

The BTI 5000. Get all the information before you decide on your next computer. You owe it to yourself. Call us.

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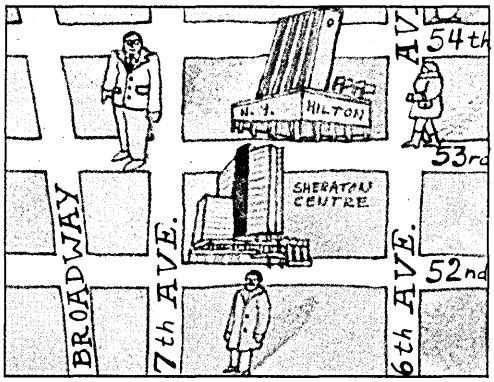

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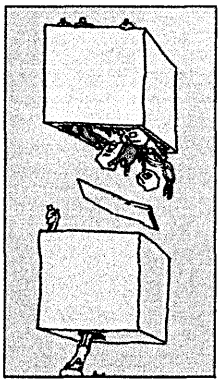
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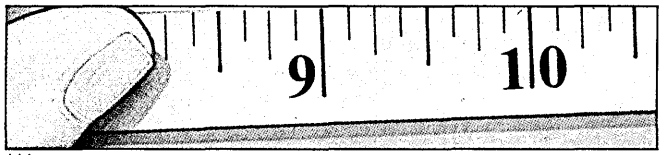

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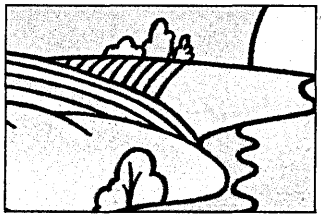
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FEATURES

COVER
Post card greetings from the Big Apple to all NCC attendees this year. Color painting is by Bob August: Photograph by Bob Reed. © 1979

ILLUSTRATIONS

NEWS IN PERSPECTIVE

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For example, Texas State Comptroller Bob Bullock's office is using SYSTEM 2000 to assist in recovering hundreds of thousands of dollars in delinquent taxes. (They very cleverly tied together their tax administration and statewide accounting systems with a SYSTEM 2000 data base.)

Some forward-thinking people at a leading manufacturer of nuclear pumps used SYSTEM 2000 to attack problems in inventory, purchasing, and quality control. As a result, they helped management increase the company's return on investment by increasing the turn on inventory. They solved in six weeks the purchasing problem that the company had been trying to solve with traditional methods for two years. They implemented a very thorough quality control program and a lot of other outstanding, cost-effective applications to make the company more efficient. More importantly, SYSTEM 2000 gave them the ability to expand these applications into their worldwide operations with only a very small increase in staff at the central site. And as for those central site staff members, their productivity—when compared to traditional methods—increased three to four fold! That's centsible.

There's still more. NASA is saving time and money in their space shuttle program by having SYSTEM 2000 handle tedious projects such as inventory control, problem reporting, documentation control, and other tasks which previously were labor intensive, cumbersome and inefficient.

Seven years ago, Ford Motor Company's Ford Parts and Service Division installed SYSTEM 2000 to track packaging specs and bill of materials information for over 200,000 different types of parts. (These parts are stored in the Ford Parts Redistribution Center which has over 3,000,000 sq. ft. of warehouse space and in 21 Ford Parts Distribution Centers which have 6,100,000 sq. ft. and are strategically located throughout the United States.) Imagine how incredibly costly and inefficient this would have been under the old paper file method!

These are just a few of our centsible customers. We'd like to tell you about the others and what SYSTEM 2000 can do for you. Just send in the coupon—we'll be right back with a penny for our thoughts.

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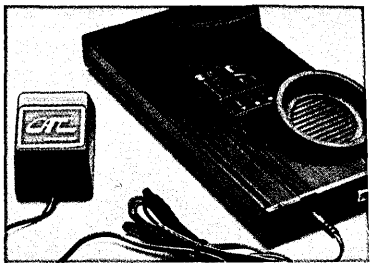

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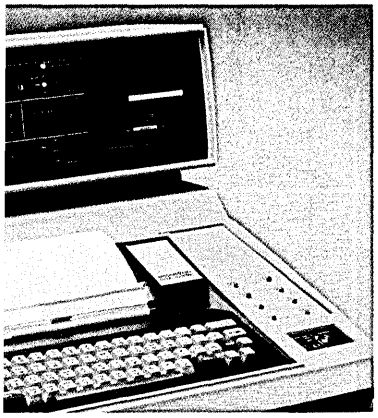
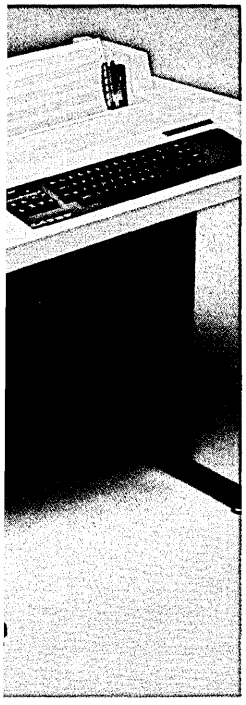
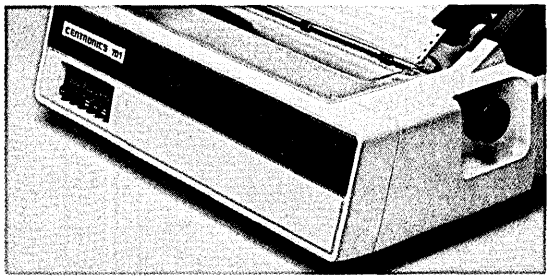


CRT's ?

Centronics?





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What can renting do for me ?

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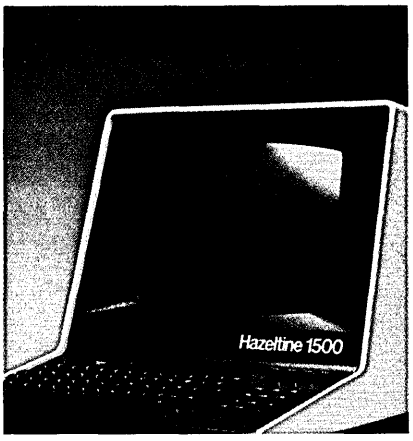
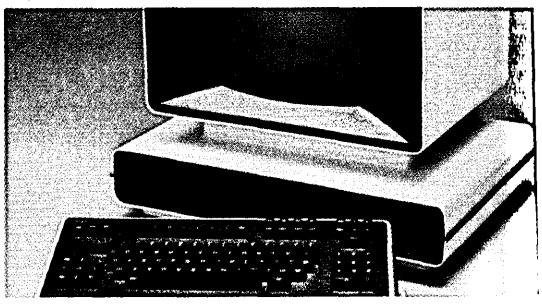


Texas Instruments ?



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It's Friday. You were looking forward to the weekend.

But a couple of your CRT's have whined and stopped in unison. By lunchtime, your 200 CPS printer began to crawl along at 10 CPM. Then suddenly, in comes the biggest stack of unprocessed data you've seen in weeks.
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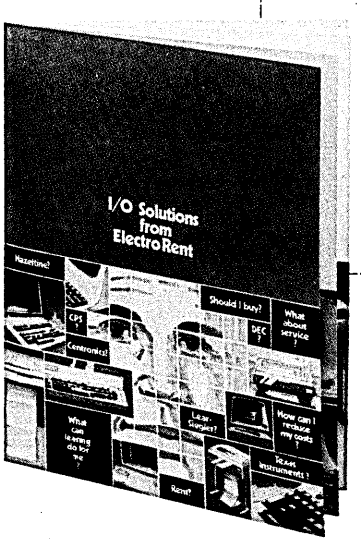

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TWENTY YEARS AGO/TEN YEARS AGO

LOOKING BACK

MAY/JUNE 1959

"One Compiler, Coming Up!" headlined a story describing the formation of Computer Sciences Corp. by Fletcher Jones, Roy Nutt, and Robert L. Patrick. Prior to opening its doors in Los Angeles on June 15, the firm already held a contract from Honeywell's DATAmatic Div. for the development of a "business oriented compiler twenty times more powerful (and economical) than ordinary programming methods." The FACT (Fully Automatic Compiling Technique, a name selected by Honeywell) was written for that vendor's 800 systems.

Later that year, founder Patrick left CSC to become one of a then-new breed, an independent dp consultant; Jones and Nutt remained with the company, which then consisted of a "handful" of people and posted first year earnings of $230,000.

Meanwhile, halfway around the world, China and the U.S.S.R. signed a joint agreement covering scientific and technological cooperation. The agreement promised to have a "direct effect on China's entry into computer development." At the time, China was working on "her first universal electronic computer," under Fan Hsin-pi and Wu Chi-kang, with assistance form O.K. Shcherbakov, "a Soviet electronic computer expert."

"Many of the smaller computers that have become available in the past two years have been designed to be operated by the man with the problem — rather than specially-trained computer personnel." While this sounds like a paean to personal computing, in reality it lead into a description of programming the Royal McBee LGP-30, an art which required only an elementary knowledge of algebra. Users also were spared the trouble of juggling the compiling routine, the computing routine, or the compiled program and data, to fit in the LGP-30's 4,096 word memory.

MAY 1969

Dr. Murray Turoff might have had a philosophical argument with the LGP-30 people. In an article, "Immediate Access and the User Revisited (stamp out non-programmer users)," Turoff patted the industry on its back for "the efficient and effective manner in which we have dealt with the situation." Five precepts regarding the user-programmer interface were identified: 1) the user is incapable of getting (by himself) meaningful work from a computer, 2) only the programmer knows what the user really wants, 3) the user can't explain his problem in concise terms, 4) all meaningful approaches to a problem's solution must be compatible with a computer system, and 5) the user must be forever grateful and satisfied with the programmer's interpretation and solution of his problem. Turoff concluded: "We can foresee, if we maintain our current direction, a glorious future in which the demand for members of the computer community will eventually exceed the population."

Three intermediate computers debuted in DATAMATION. The Univac 1106, described as a "detuned" 1108, could be had in a system configuration (including printer, card I/O, and mass storage) for $37,000 per month or $1,550,000 for outright purchase. Honeywell came out with its 3200, said to be about a third faster than an IBM 360/50; typically configured, a 3200 system rented for $21,460 per month on a five-year lease. And General Electric announced the 615, a direct 360/50 competitor, system-priced at $30,000 per month (versus $33,000 per month for a typical model 50 configuration).

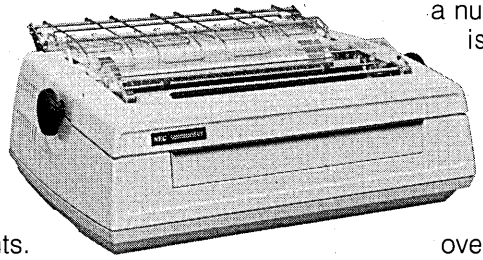
And Computer Sciences Corp. celebrated its tenth anniversary with earnings of $65 million and better than 3,000 employees. (Today the firm has grown to more than 10,000 employees, and projects this year's earnings in the neighborhood of $325 million.) ✲

The NEC Hammer.

It drives Spinwriter printers at 55 CPS with quiet precision.

NEC Spinwriter™ character printers run at up to a full 55 CPS for a number of reasons.

One key reason is the NEC print hammer. It is unlike any other print mechanism, and its differences make it better.



The Spinwriter hammer is controlled by a simple voice-coil rather than by complex mechanical links and springs. Special alloys in the hammer provide improved reliability and longer life. There are no moving parts, only the hammer itself. No periodic maintenance. No gap adjustments. No lubrication. Ever.

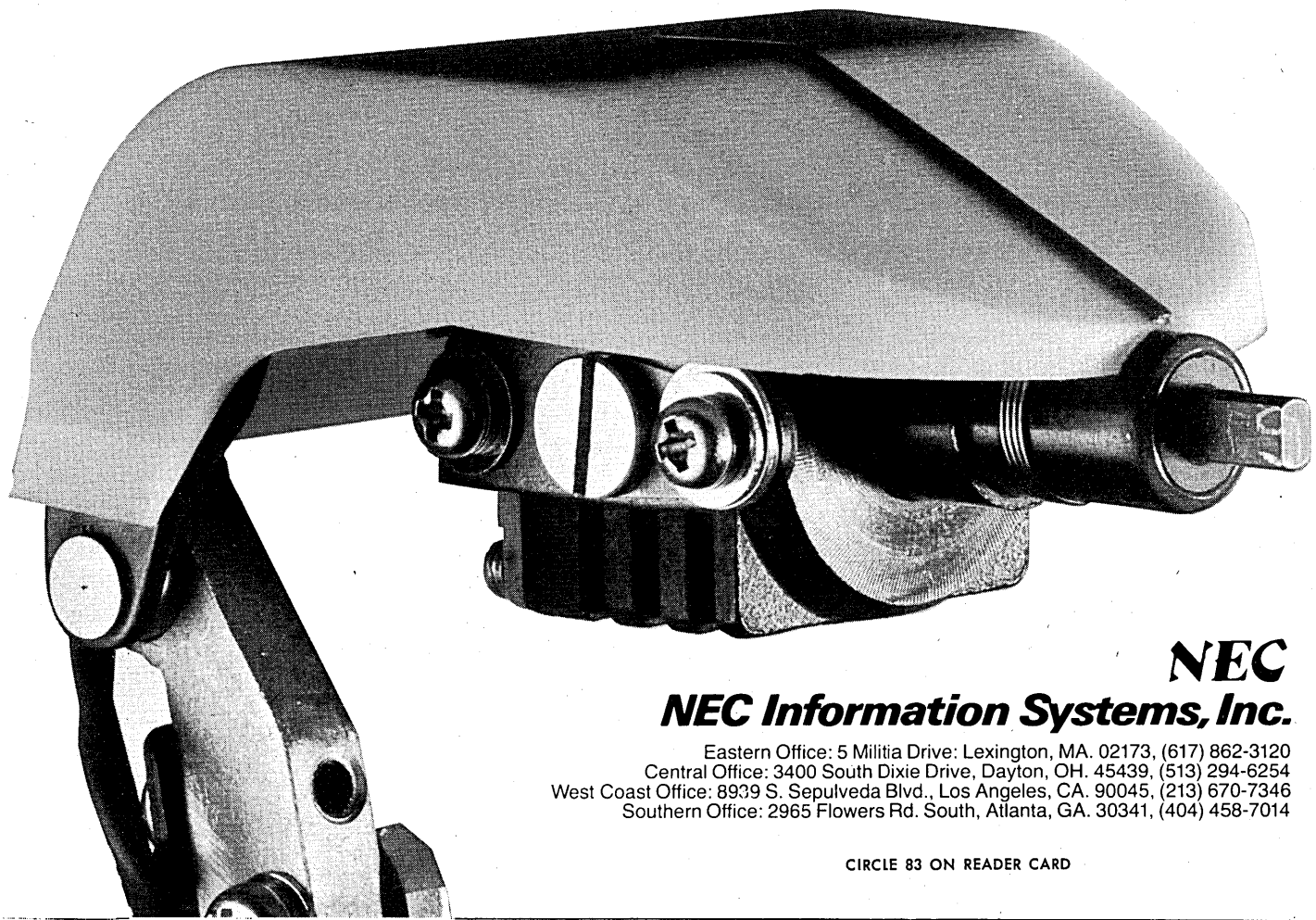
When it prints, the NEC hammer is driven automatically at one of seven preset impact levels, depending upon the size of the character being printed at that instant. An operator-controlled "impact scaling" switch modifies hammer energy to light, medium or heavy impact, depending on the form type and thickness.

This precision of speed, stroke and impact has a number of other advantages, too. One is print quality; Spinwriter printers produce superb correspondence-quality output. Another is quietness; at 62 dbA, Spinwriter printers are quieter than other character printers. And a third is durability; Spinwriter printers are rated at over 2000 hours MTBF, the new industry standard.

The NEC hammer. Its many technological innovations demonstrate NEC's commitment to making the perfect printer.

Send for our new printer brochures.

NEC. Going after the perfect printer.



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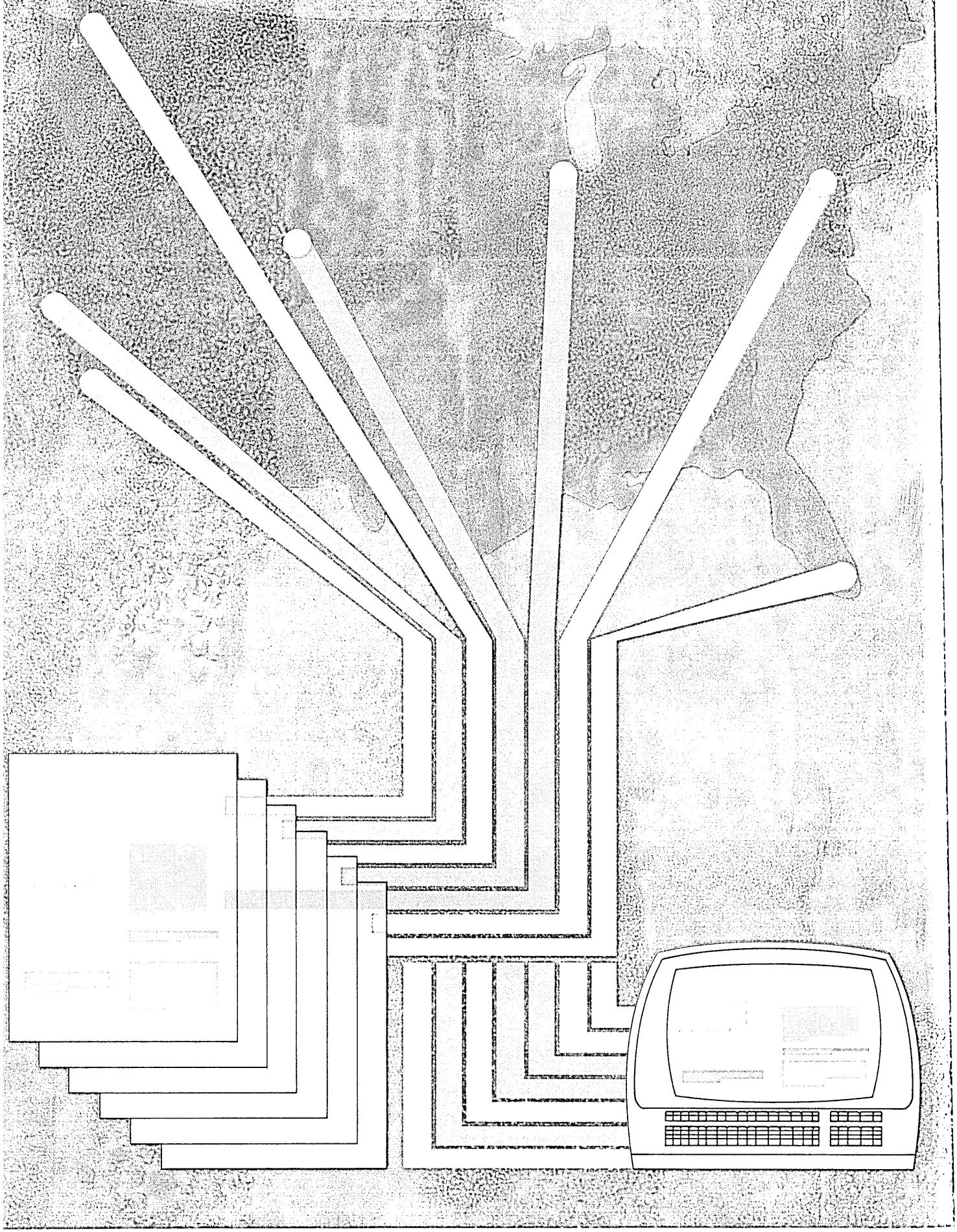

TANDEM ENFORM handles Queries and Reports from a distributed data base in one, powerful language.

What do you need to know about your business right now?

Access any file. From any location. In simple language. To any format which works for you. And you can change that format at will, without having to write or rewrite programs and without having to restructure your data base. From any terminal in the system, with proper security clearances, you can have any information in your files accumulated into a comprehensive report—at your fingertips. On CRT, print-out or spooled for delayed action.

The two important differences.

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.

It's one more advantage for the Tandem NonStop™ System.

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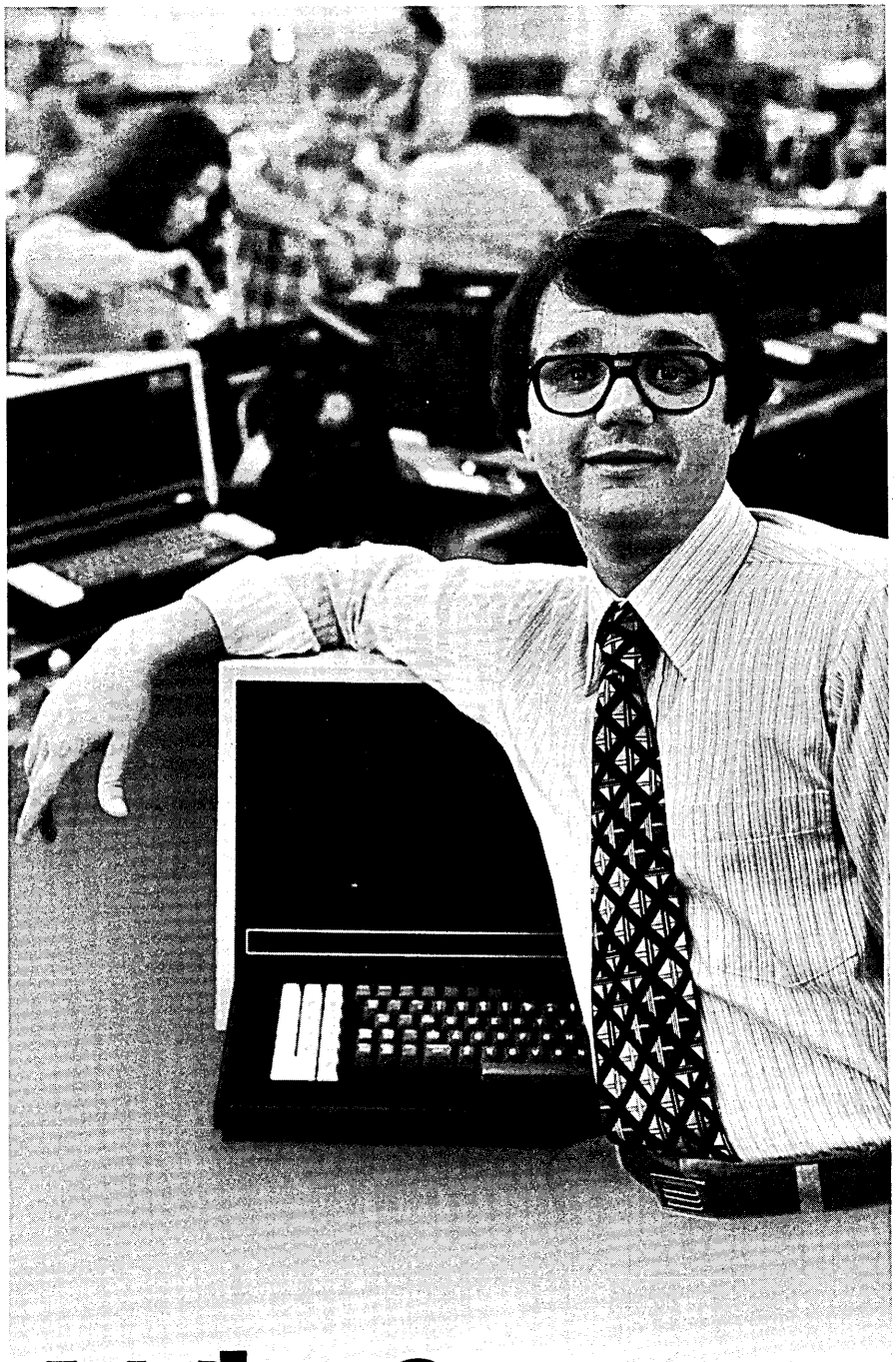
"With all the little companies peddling intelligent terminals these days, an OEM or a large EDP end user like me can't be too careful. Sure, they may be able to design a good terminal. But can they deliver it? Service it? Is the company's president also the service manager and the installer? So I did 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.



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Burroughs modular terminals give you the flexibility to match your precise requirements. And their advanced design allows you to expand at any time without disruption.

Burroughs Modular Terminals (BMT™) offer almost unlimited configuration flexibility. And greater economy in overall data communications costs.

Displays, keyboards, printers, magnetic card readers, memory subsystems and more can be structured into a network that matches the job at each work station with the exact terminal for that job.

Each BMT terminal system is driven by its own microprocessor, a tiny, but powerful, programmable computer with its own memory.

This microprocessor supplies processing intelligence for the terminals. And for application programs, data storage and peripherals.

It eliminates the need for separate communications controllers. And it allows the terminals to be programmed for alternate functions.

You can also incorporate new hardware without systems reprogramming. You can change and expand your network, and take advantage of new BMT developments, without having to revise programs or replace equipment.

And remember, when you buy a Burroughs system, you get more than just equipment. You get the bonus of dealing with a total capability company with 90 years experience. And the security of knowing the whole Burroughs organization is behind you.

We call it "Total System Support." Hardware, system software, application programs, customer training, maintenance—even the business forms and supplies you need.

For additional information, call your local Burroughs office or write Burroughs Corporation, Dept. DM-10, Burroughs Place, Detroit, Michigan 48232.

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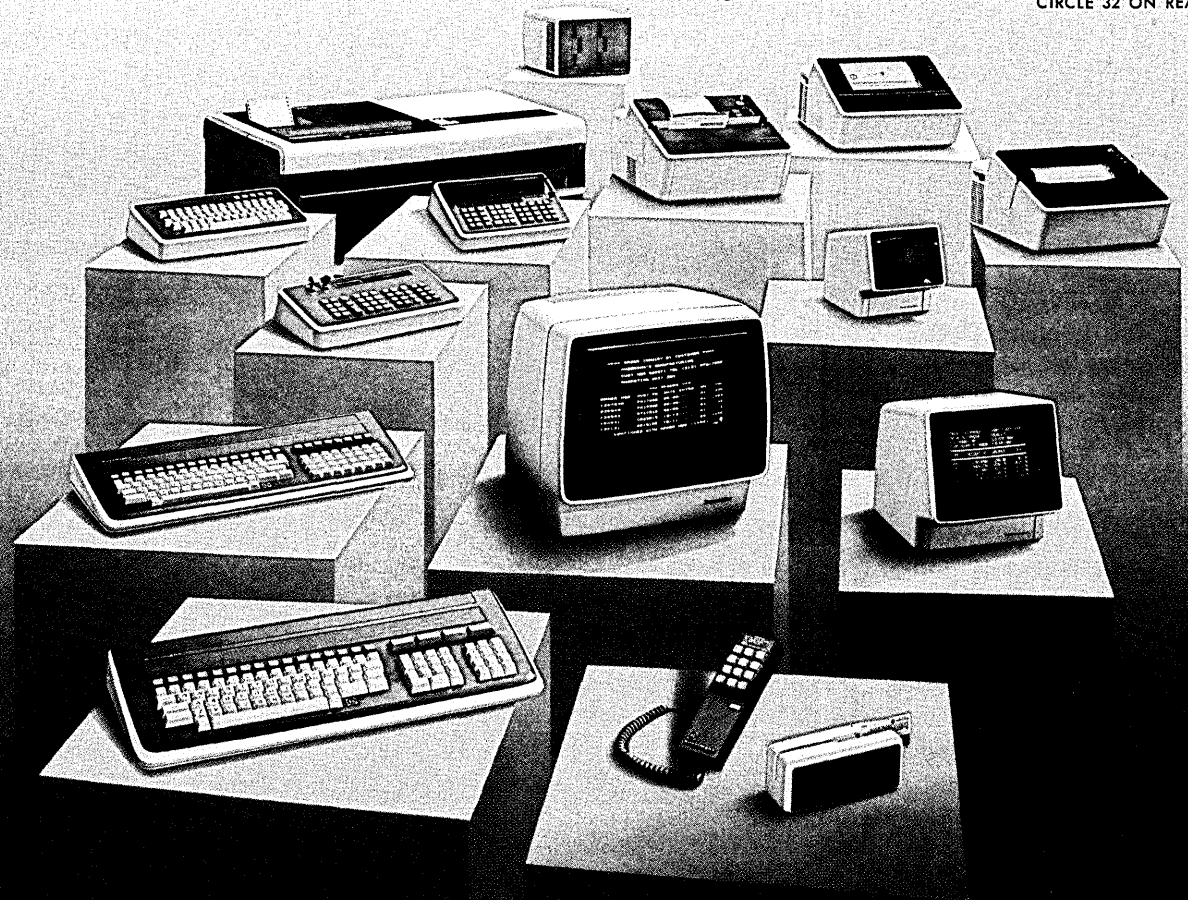
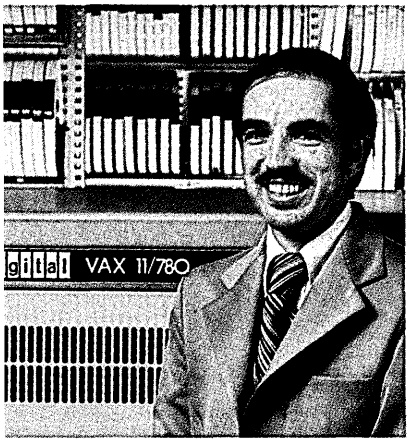


Burroughs

VAX Software. Ask any user.

"VAX puts us on the leading edge—with tremendous power and a full-blown operating system."



Dr. Herb Schwetman,
Assoc. Professor
Dept. of Computer Science
Purdue University
West Lafayette, Indiana

Purdue's Department of Computer Science is involved in researching operating system performance, programming languages, and computer system security.

Because their experimentation requires heavy interactive use, they needed an alternative system to augment time-sharing on a CDC 6500.

Dr. Herb Schwetman, Associate Professor, explains what made Digital's VAX-11/780 so attractive. "We were intrigued because VAX provided a lot of the features and performance of a central facility—but for a lot less money."

Since Purdue's research involves state-of-the-art technology, VAX's advanced architecture and software were especially appealing. "The operating system is set up very cleanly," says Dr. Schwetman, "Processes can operate independently. And that's a very good way to do it."

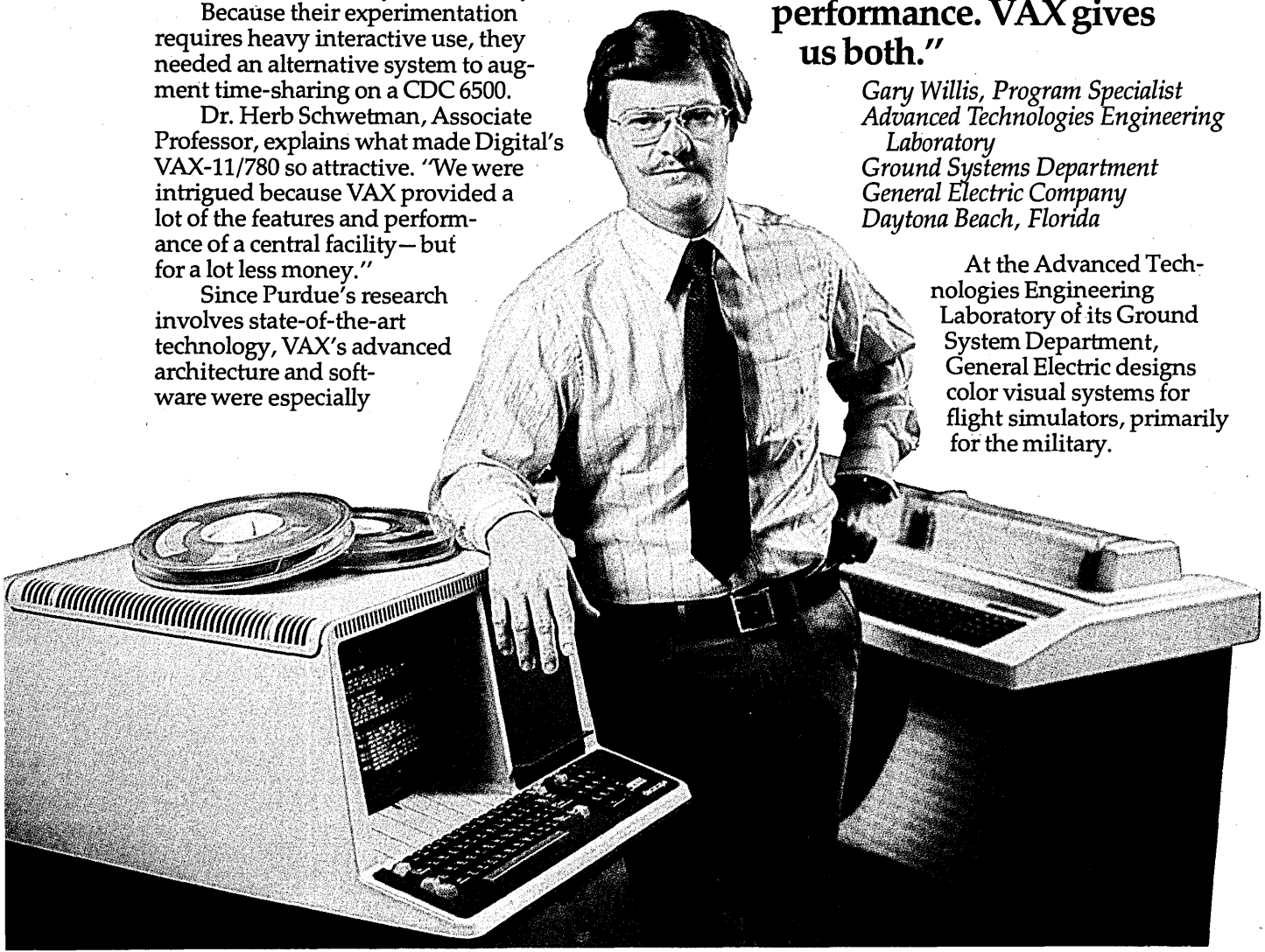
Also, VAX's 32-bit address space and large main memory give the Purdue researchers more flexibility. Dr. Schwetman says, "With VAX, we'll be able to double the size of the problems we can look at. In fact, VAX offers user programs more memory than is available on the big CDC 6500 downstairs."

"It's amazing," Dr. Schwetman concludes, "All this power—in a machine in this price range."

"We needed virtual memory software and fast real-time performance. VAX gives us both."

Gary Willis, Program Specialist
Advanced Technologies Engineering Laboratory
Ground Systems Department
General Electric Company
Daytona Beach, Florida

At the Advanced Technologies Engineering Laboratory of its Ground System Department, General Electric designs color visual systems for flight simulators, primarily for the military.



The application demanded operating system software that could handle static simulation; but real-time performance was important, too. After a number of tests and benchmarks, General Electric decided on VAX.

Gary Willis, Program Specialist, tells us, "If you can imagine emulating a roomful of simulation hardware, you can see why we needed a virtual memory operating system. But since we have to compute a new image every 30th of a second in our real-time application, we also needed a lot of number crunching. VAX gives us both."

The VAX/VMS operating system and real-time dynamic performance are only part of what impressed General Electric. Says Willis: "Most military contracts require FORTRAN, and we're very pleased with what VAX gives us—very fast, very efficient FORTRAN, with super execution times."

According to Willis, VAX software is also getting high marks on ease-of-use.

"Our people are very pleased with how easy it is to translate FORTRAN programs from the PDP-11 series to VAX. Also, our programmers like the HELP command—especially those who are just getting used to Digital equipment."

"We were very impressed with the maturity of the VAX operating system. Everything that's supposed to work, works."

Harry Hill, Program Manager
Ford Aerospace & Communications Corp.
Western Development Laboratories (WDL) Div.
Palo Alto, California

Ford Aerospace performs large double precision floating point scientific computing for a variety of government projects.

When it was time to move to a larger computer, WDL's Harry Hill, Program Manager, admits they were apprehensive about committing to a product as new as Digital's VAX-11/780.

"We were originally very leery of the new machine," says Hill, "Because it traditionally takes years to develop maturity. But the price was so good that we went ahead, and it's been very successful."

One feature that made VAX particularly attractive for Hill's application was the powerful virtual memory. He tells us: "By going to VAX, we were able to eliminate memory mapping and let the machine just sit there and crunch numbers. It saves time and cuts down on the chances of messing something up."

Hill is also impressed with VAX's interactive and batch capabilities. "The multi-stream, multi-queue batch is one of the best systems we've ever seen."

The programmers' reaction? Says Hill, "Everybody is amazed."

Digital's VAX-11/780 represents the first truly integrated approach to hardware and software architecture. The result is one of the most advanced systems on the market. Extremely powerful, yet extremely easy to use.

But don't just listen to us. Send for our new brochure. And listen to our customers.

☐ Please send me the new "VAX—Ask Any User" brochure and detailed Technical Summary.
☐ Please contact me.

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Digital Equipment Corporation International, 12 av. des Morgines, 1213 Petit-Lancy, Geneva, Switzerland

In Canada: Digital Equipment of Canada, Ltd.

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"WITH THE MODCOMP CLASSIC, WE DON'T HAVE TO TRADE PERFORMANCE TO GET RELIABILITY."

Bill Greene, Staff Engineer
Process Computer Systems Group
Chemicals & Plastics Division Engineering
Union Carbide Corporation

Bill Greene is a staff engineer for the Process Computer Systems Group which is responsible for designing, building, testing and installing process control computer systems in the company's manufacturing plants.

Because of their experience, we gave them our new Classic 7860 super mini to test. Their experience with it was summed up in three words. "We love it."

"It's a reliable machine. And reliability is the name of the game."

"We'll trade performance for reliability anytime," said Bill. "But with the Classic, we don't have to.

"The Classic hardware is very solid. Especially for a new product. "The performance characteristics of the Classic are impressive, too. With its extremely fast floating point processor, the Classic can run through a program more than 3.7 times as fast as a MODCOMP II."

"A working computer with software that doesn't work is useless."

"We've been running the MAX III operating system for five years and the MAXNET III network extension for the past two years. They've performed well under very demanding conditions. In fact, over the past year, we've had more than 99.5% uptime on more than 30 installed MAX III systems.

"However, we're installing larger process computer networks now with more and more satellites. So we need increased host computer hardware and software capabilities.

"Our tests with MODCOMP's enhanced MAX IV operating system in the Classic have been very encouraging.

"MAX IV and the new MAXNET IV will help us relieve bottlenecks so that we can add more links and do more work with the computer. We also expect that File Manager, which can create a new file anywhere on a disc, will be a useful tool."

"We install 15-20 systems a year, so ease of implementation is important."

"Even though the Classic is a powerful and sophisticated machine, it should be an easy system for our project teams to implement. MODCOMP provides plenty of documentation and they've always been very helpful in working with us to get our systems up and running.

"In fact, we think so highly of MODCOMP and the Classic, we've already ordered two MODCOMP Classic 7860's to be used as host computers in large process control distributed networks."

It takes a tough computer to satisfy a tough customer.

At MODCOMP, we specialize in building real-time computers. They work in chemical plants. In petroleum refineries. In steel foundries. In jet propulsion labs. In electric power plants. In some of the harshest industrial environments you can imagine. Nevertheless, independent surveys have rated MODCOMP computers the most reliable systems on the market.

If you want reliability, but you don't want to trade performance to get it, do what Union Carbide did. Buy a MODCOMP Classic.

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(305) 974-1380

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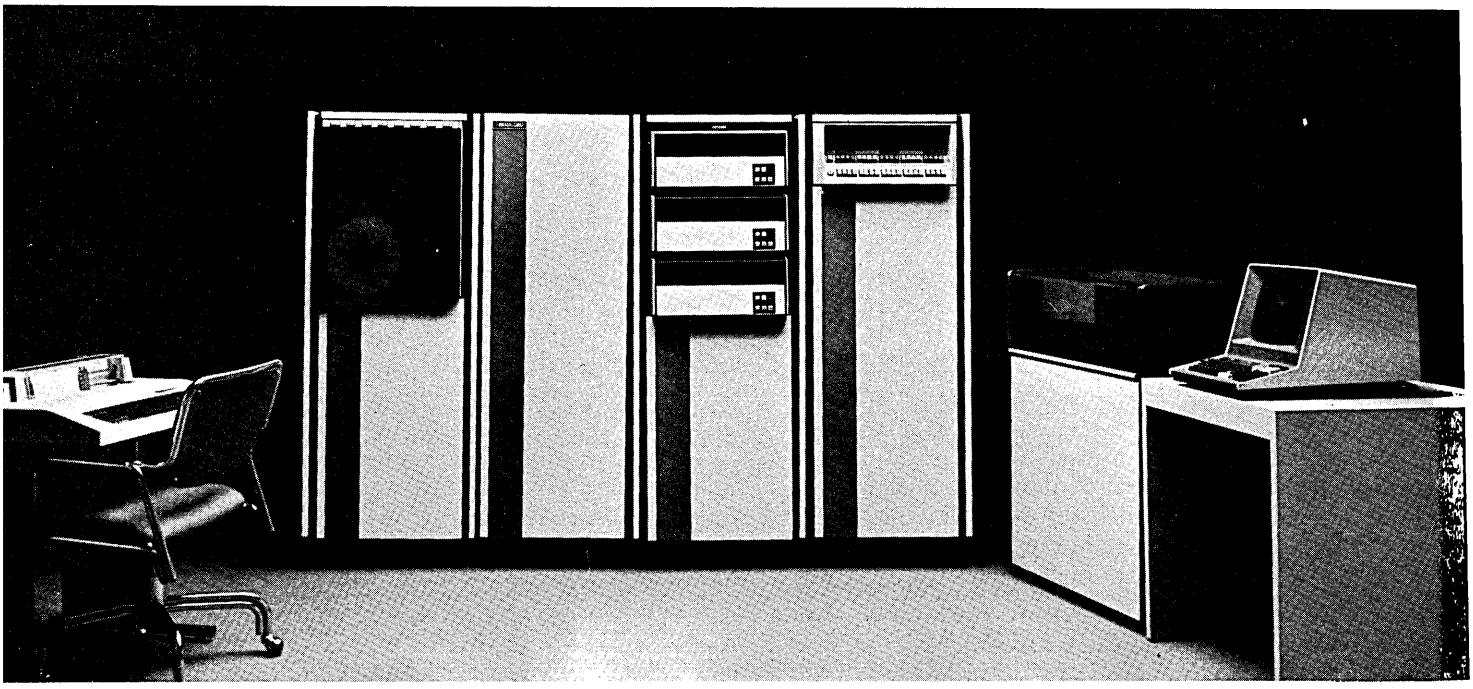


LOOK AHEAD

UNIVAC'S NEW GENERATION

Sperry Univac plans to unload a bombshell at the NCC, a spanking new architecture for its large scale processors. While other mainframers scrambled to respond to IBM's 4300 Series by slashing prices and changing model numbers, Sperry's computer arm will be unveiling a new generation of processors which has been secretly in the works for several years.

The machines will be compatible with -- and still be numbered in -- the 1100 Series, but will use multiple microprocessors as their basic building blocks. (The chips are thought to come from Motorola.) First off the line will be a cpu of about the same power as Univac's 1100/40, which it will replace. The big surprise will be in the price -- about one-third that of the 40.

... AND A DISTRIBUTED PROCESSOR, TOO

After years of stalling, Univac finally has decided to take the wraps off its Distributed Communications Architecture (DCA), announced with some fanfare in November 1976. At the NCC, the Blue Bell, Pa., mainframer is expected to unveil its Distributed Communications Processor (DCP), the first substantive produce release to come out of the company's DCA development drive. When it announced DCA two-and-a-half years ago, Univac touted a DCP which industry insiders claim was nothing more than the company's 3760 front-end processor with a new coat of paint. Also bundled into the offer was the Telcon software package.

The born again DCP is the real thing this time. The system is designed to function as a front-end processor, nodal processor, or as a terminal concentrator. The company hopes to demonstrate the new setup at the show and expects initial deliveries of the system and software to begin in July.

AND AGAIN FROM HONEYWELL

It probably won't happen at the June NCC but Honeywell, too, has an upcoming announcement. It's readying a replacement for its 66/85, ballyhooed as its biggest machine ever back in late '77, then dropped in the spring of '78. It will be in the 66 family, will be the family's biggest, and will support Honeywell's Distributed Systems Environment (DSE) but it probably won't use common mode logic (CML) technology. Honeywell blamed the expense of CML when it decommitted the 66/85.

FIVE MORE FOR NATIONAL CSS

National CSS, the information services company which may be acquired by Dun & Bradstreet pending approval by the Securities & Exchange Commission, plans to announce five new computers to extend and add depth to its 3200 series. One of the products will be a faster 3200 cpu; two others will be special purpose versions, one for back-end applications work, the other for heavy front-end communications loads. Both will be available, according to the

LOOK AHEAD

grapevine in normal and high-speed versions. No word yet on price or delivery schedules.

WANG HOLDS BACK OEM ACTIVITY

Sales execs at Wang Laboratories have been leaning on oem salesmen to be more selective in choosing accounts. First quarter sales were reportedly 71% end-user oriented, 29% oem systems house. "Dr. Wang (Dr. An Wang, president)," said a source, "wants oem sales at no more than 20%." Oddly enough, Wang apparently is attempting to hold back oem salesmen rather than beefing up the end-user force.

Wang's imminent introduction of a new integrated system for both dp and word processing -- reportedly built around a greatly enlarged 2200 VS--could entail a major reorientation and some disruption of Wang marketing. The WP sales force, Wang's big money maker,is reportedly disgruntled over the prospect of competition from their own dp salesmen with the new integrated system.

POINTING THE WAY IN PROMOTION

Every firm uses its logo for promotion purposes but few do this with the flair of Western Peripherals, a manufacturer of tape and disk drive controllers for DEC and Data General minis based in California's Orange County. Western will be moving soon into new quarters adjacent to the Orange County Airport. It will adorn a side of its building facing the airport with an enlarged version of its logo, a circle with two arrows, pointing the same way, going through the center. The arrows will be aimed toward a major runway and the airport's tower will be advised in hopes tower personnel, in giving directions to pilots, will include reference to "the Western Peripherals building.

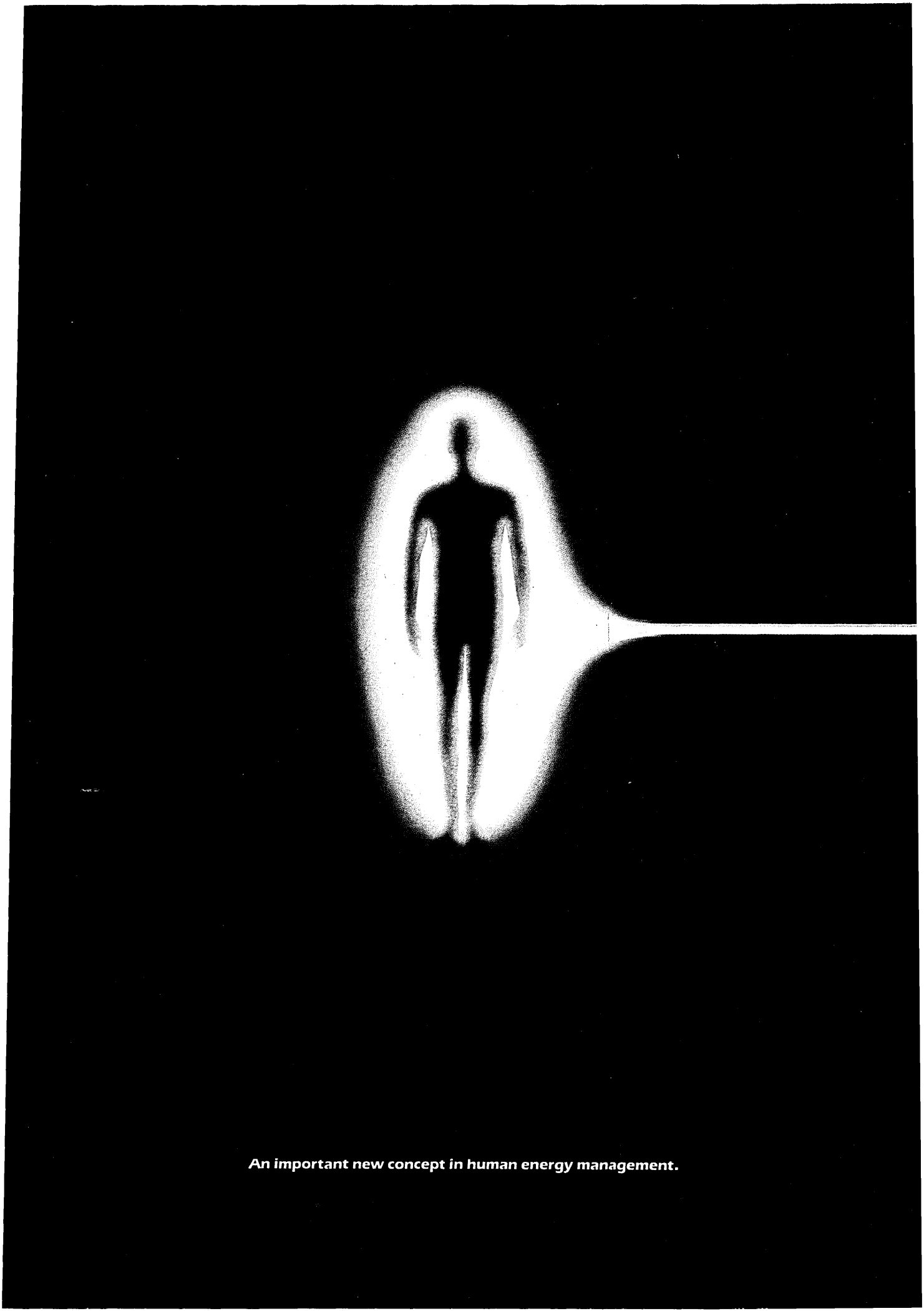
COPING WITH BLOATED BACKLOG ORDERS

DEC's 1979 contracts for terminal resellers contain a "prompt performance option" that gives resellers an additional discount of about 4% on LA 34 and LA 120 terminals--if they place firm orders 90 days in advance of scheduled delivery. The discount option was an apparent effort to develop more solid figures for production requirements. Speculative orders traditionally have bloated the component group's backlog figures.

DEC now worries, however, that many of the heavily leveraged high rollers among the independent reseller/lessors have taken the new option as just another gamble in the business, disregarding DEC's heavy penalty charges ($50 per unit on the 34; $100 on the 120) for cancellations and order changes. DEC has expected 50% of its reseller business would claim the prompt performance option; instead

RUMORS AND RAW RANDOM DATA

70% to 85% of new orders have reportedly been discounted. The need to move iron to avoid penalties could spur heavy price cutting, occasionally even sales below cost.



An important new concept in human energy management.

Implementation

The essence of man is his mind.

Brainpower is our most valuable natural resource. It is a precious *human energy.*

Today's highly refined computing machines offer extraordinary opportunities to put that energy to work.

To help achieve the maximum potential of that energy, Informatics created *Implementation Systems.*

Implementation Systems are *working tools* designed to let the application programmer, or the non-technical user, achieve their maximum productivity.

Implementation Systems can relieve the DP manager and his applications programmers of enormous and time-consuming work.

Implementation Systems thrust user activity out of the computer dark ages... and into step with hardware state of the art.

Focus: On the issues of the next decade.

We have seen only the tip of a great data processing iceberg. Vast new information management opportunities will surface in the next ten years, through powerful data-base and data-communications techniques.

The capacities of computers will become awesome.

New data base technologies will create unprecedented new problems.

Business will depend on computers more and more often... to perform more tasks than ever before. Increasingly complex applications will be required of computers... and programmers will have far less time to effect them.

Requirements for qualified data base specialists will increase dramatically.

Programming tools now used to interface with complex data bases will become obsolete.

The demand for data by non-DP people will continue to grow.

But new data base technologies will also create unprecedented new promise.

Information will become available where the work is done—in the user's office.

Decision makers will have rapid, easy access to the data they need.

Data base inquiries will be accomplished in conversational language, not complex codes.

Computer languages will become more solution oriented, less machine oriented.

Programming procedures will be far simpler.

We begin to fulfill the promise of these new technologies today, with Implementation Systems.

Information on the spot.

There is a problem. Increasing numbers of non-technical people need fast access to bits of information buried inside vast data bases.

Implementation Systems have a solution. Our new Inquiry line of data retrieval products provides a simple, effective query language for the non-programming user.

With Inquiry, the language for human/data base communication comes almost as naturally as chatting with a neighbor.

With Inquiry, clerical staff can find the data they need quickly, easily... without the interruption of programmers' more critical tasks.

With Inquiry, analysts can manipulate information to solve difficult "what if" problems.

With Inquiry, information is delivered instantaneously.

Yet data access must be authorized by DP managers. So data integrity is fully secured, and impact on computer resources is entirely controlled by the data base administrator.

A giant step toward bringing the power of the

Announcing our newest Inquiry product—INQUIRY IV/IMS Release 4. It's for use with IMS data base systems.

Accurate reports, generated simply.

There is a problem. Department managers need to draw information from various files and data bases, organize the data and write reports. DP managers' offices are backlogged with their requests.

Implementation Systems have a solution. Our Answer line of report writers is versatile and capable ...more powerful than a simple query language.

They are remarkably easy to learn by non-programmers. A few hours and a little practice is average.

And they are extremely easy to use.

DP staff can use them to produce error-free reports from files and data bases in a fraction of the usual time.

Or department managers and their trained staffs can produce the same documents themselves, conserving programmers' vital *human energies* for more complex tasks.

Users of data communication terminals can generate reports on-line or in batch mode with the Answer line.

Our newest report writer, Answer/2, is available at modest cost for most popular data base management systems and operating environments.

Applications built quickly.

There is a problem. The already large volume of applications to be implemented is expanding under the

Systems

pressure to keep up with new technologies.

Because of outmoded computer languages and application development methods, a lot of valuable *human energy* is wasted.

Implementation Systems have a solution. The powerful MARK IV® Application Development line can reduce the time and cost of programming and maintenance significantly over procedural languages.

These Application Development systems dramatically reduce programming work and facilitate problem solving.

For example, they automatically perform such housekeeping jobs as data access, file handling, and data conversion associated with programs written in procedural languages.

In short, they are powerful processing systems built to perform real application work.

Yet programmers say MARK IV is the simplest high level computer language yet developed.

We believe it's also the most economical.

Announcing MARK IV Release 8.

Several new high-performance models of an

computer closer to the problems of people.

enhanced MARK IV are now configured for specific EDP environments, including IMS and DOS/VS.

The new MARK IV offers capabilities like faster throughput. Enhanced on-line support. Scatter-diagram and bar chart graphing. Three dimensional array handling. And more.

MARK IV is the most successful application implementation software product ever sold. We intend to keep it that way.

Only the beginning.

Computer technology faces enormous growth in the next decade.

New, more powerful data base technology will be at the heart of that growth.

Computer software must harness that growth to solve the problems of people in the next decade.

Informatics is committed to the development of ever more powerful Implementation Systems, into the 1980's and beyond.

The greatest of all human energies—the power of the mind—must not be wasted.

With the right tools, the mind's only limit is its imagination.

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For a more intensive investigation of the challenge of the 1980's... and how Informatics' Implementation Systems can help you meet this challenge... call or write our headquarters.

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The Information Management Company

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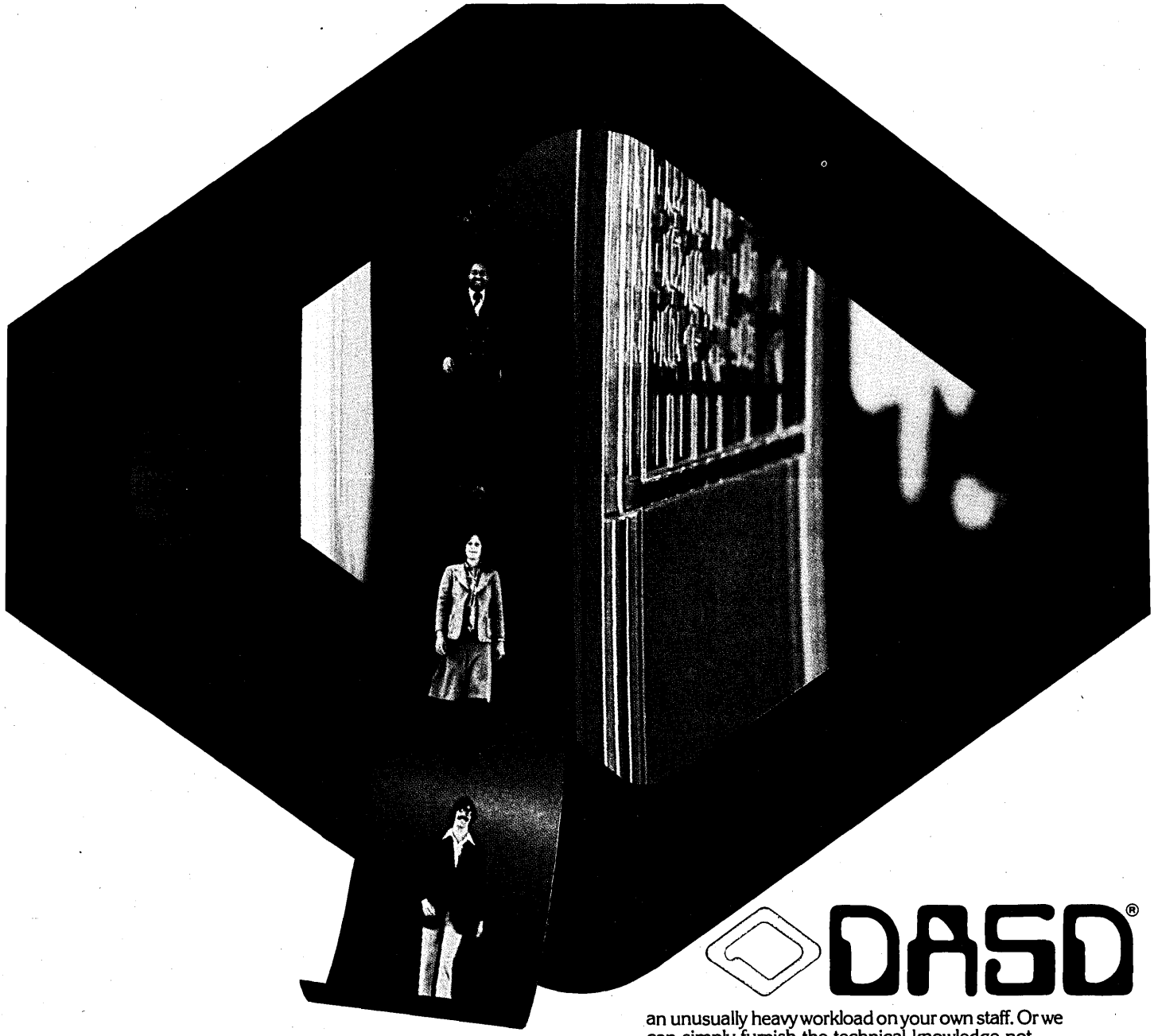

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See us at the NCC June 4-7, Booth 506.

CIRCLE 47 ON READER CARD

Xerox or Burst.

Bursting computer printout by hand is enough to make anyone explode.

But the Xerox 9400 duplicator, with its continuous forms feeder attachment, lets you make perfect two-sided copies without bursting. Or exploding.

It automatically feeds, reduces, copies and collates unwieldy computer printout into neat 8 1/2″ x 11″ sets. It even eliminates edge lines and sprocket-hole images.

And best of all, when it comes to feeding, it has the Xerox 9400 appetite. So you can copy up to 1200 fanfold sheets at a time. At the amazing speed of 2 copies a second.

The Xerox 9400 continuous forms feeder.

It means your office can spend less time waiting for information. And more time using it.

XEROX

CALENDAR

JUNE

1979 GMIS Conference, June 3-7, New Orleans.

GMIS stands for Government Management Information Sciences. The conference coverage will include computer contract negotiation, computer performance measurement, future projections from IBM, and mobile terminals. Contact Joseph R. Walker, Conference Chairman, City of New Orleans, Suite 3E09, City Hall, New Orleans, LA 70112 (504) 586-4315.

National Computer Conference, June 4-7, New York.

This year's NCC promises to be the biggest yet. Contact AFIPS, Inc., 210 Summit Ave., Montvale, NJ 07645 (201) 391-9810.

Seventh International ADABAS Users Conference, June 11-15, San Diego.

Contact Ann Todd, Conference Registrar, Software AG of North America, Inc., 11800 Sunrise Valley Drive, Reston, VA 22091 (703) 860-5050.

Tenth Transducer Workshop, June 12-14, Colorado Springs.

Contact Richard T. Hasbrouch, Chairman, Lawrence Livermore Laboratory, P.O. Box 808, Mail Stop L-218, Livermore, CA 94550 (415) 422-1256.

Syntopican VII, June 26-28, Chicago.

Contact the International Word Processing Association, Maryland Rd., Willow Grove, PA 19090 (215) 657-3220.

JULY

OCR Users Association Expo '79, July 15-18, Boston.

Contact the association at 10 Banta Place, Hackensack, NJ 07601 (201) 343-4935.

Harvard Computer Graphics Week '79, July 15-20, Cambridge.

Special sessions on technology transfer, remote sensing, the 1980 Census, standards, and the new nine-digit postal zip code are planned. There will be exhibits of hardware and software. Contact Kathleen Quigley, Center for Management Research, 850 Boylston St., Chestnut Hill, MA 02167 (617) 738-5035.

AUGUST

SUGGRAPH '79, August 6-10, Chicago.

This is the sixth annual meeting of the ACM Special Interest Group on Computer Graphics and Interactive Techniques. There will be an exposition, technical sessions, and tutorials. Contact Maxine D. Brown, SIGGRAPH '79 Exposition, Hewlett-Packard, 19400 Homestead Rd., Cupertino, CA 95014 (415) 326-7300.

The Society of Photo-Optical Instrumentation Engineers 23rd International Symposium and Instrument Display, August 27-30, San Diego.

Papers will be presented on 17 subjects, among them: laser applications in materials processing, advances in display technology, laser recording and information handling, optical pattern recognition, physical properties of optical materials, image understanding systems, and applications of digital image processing. Contact SPIE, P.O. Box 10, 405 Fieldston Road, Bellingham, WA 98225 (206) 676-3290.

SEPTEMBER

Engineering Software, September 4-6, Southampton, England.

Contact Dr. R. Adey, Engsoft, 6 Cranbury Place, Southampton, SO2 OLG, England.

Fourth International Conference on Software Engineering, September 17-19, Munich.

Contact Dr. L. Stucki, Boeing Computer Services, P.O. Box 24246, Seattle, WA 98124 (206) 576-5118.

International Conference on the Role of Computers in Society, September 24-28, Dubrovnik, Yugoslavia.

Contact R. L. Schiffman, Dept. of Civil, Environmental and Architectural Engineering, Univ. of Colorado, Boulder, CO 80309 (303) 492-7607.

WPOE, September 25-27, San Jose.

Word processing and office equipment show and conference. Contact Cartlidge & Associates, Inc., 491 Macara Ave., Suite 1014, Sunnyvale, CA 94086 (408) 245-6870.

MIMI '79, September 26-29, Montreal.

The ninth International Symposium and Exhibition of Mini and Microcomputers. The theme will be "The Evolving Role of Minis and Micros Within Distributed Processing." Contact MIMI '79 Montreal, P.O. Box 2481, Anaheim, CA 92804 (714) 774-6144.

Northeast Computer Show, September 28-30, Boston.

This show features small computers, with separate personal and business computing displays. Contact Northeast Expositions, P.O. Box 678, Brookline Village, MA 02147 (617) 522-4467.

Accessing datacomm networks can be a matter of trial and error.

With Extel's B31 TWX/Dataphone terminal, network accessing is fully integrated, fully automatic right to the remote station.

Extel's new B31 communications terminal will automatically relay switching protocol, dialing and addressing sequences. This is true for the TWX or DDD networks, or message/packet systems accessed by public or private networks.

No complex operator manipulations. No external accessories. So it's virtually error free. Far faster, too.

Its integral VF modem and dual line-access ports (FCC registered) connect directly into data or phone jacks. Extel also offers the Model B31 with RS232C interface.

Automatic accessing eliminates operator errors and frustrations, and can reduce line charges because erroneous signals are never transmitted. Computer time spent rejecting invalid sequences is also eliminated. And fully integrated design simplifies and speeds installation.

This is the kind of technological leadership that made Extel a pioneer in solid state teleprinters, expandable dot matrix printing, internal memories and integral selective calling systems.

To learn more about our complete line of electronic teleprinters, contact Extel at: Phone (800) 323-5470; Telex 72-4398; TWX 910-686-4782; or use the convenient coupon below.

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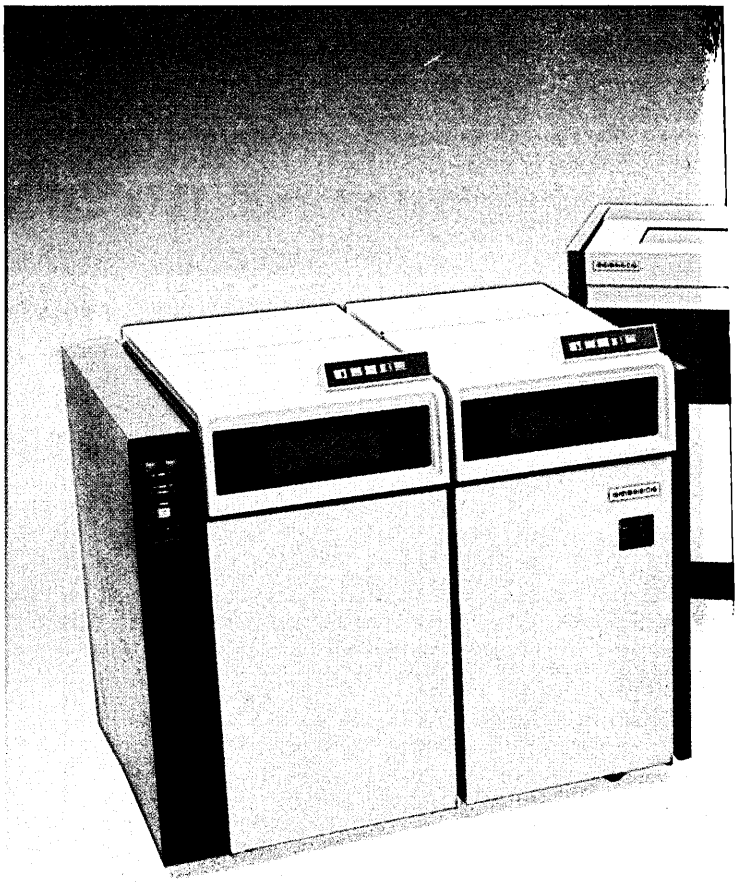
CALCOMP BECAUSE NO ONE LOOK SO GOOD.



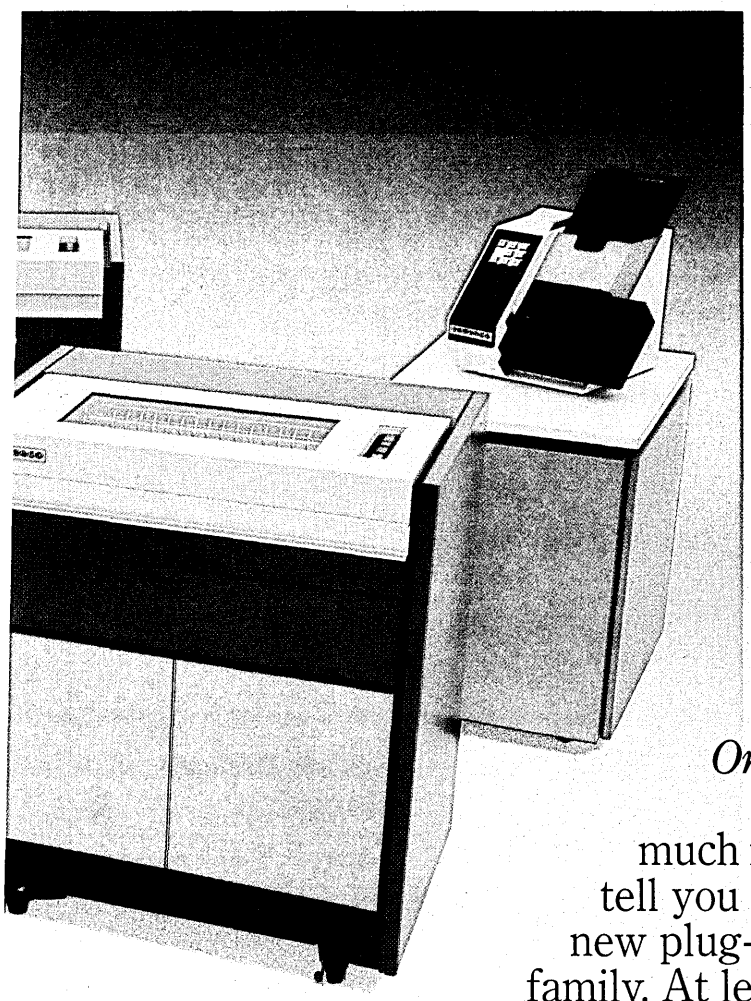
Here's some good news—and some bad news—for IBM users.

First, the good news. ☐ Which is simply that no one else offers a better selection of IBM plug-compatible peripherals than CalComp. ☐ And that means there have never been so many cost-effective ways to make your IBM 360/370 or 303X mainframe work harder. Or look better. ☐ Especially from a single source. ☐ We offer all the basics, too. Like high-speed, dual-access disk drives. Add-on semiconductor memory modules. Tape drives. Plus a compact new I/O set. ☐ Not to mention a peripheral or two that IBM doesn't even have. Like the CalComp Automated Tape Library. ☐ Thanks to CalComp, you've finally got a single, solid source for all your IBM peripheral needs. ☐ No matter how big. Or how small. ☐

And now, the bad news.

There's not much. But it has to be said. ☐ With so many attractively priced, performance-oriented CalComp peripherals to choose from, IBM peripherals have never looked less impressive. ☐ Take our 4800 I/O set for example. The set's controller is microprocessor-based and smaller than IBM's 2821. Our line printer is smaller than IBM's 1403N1, too, by almost 50%. And a full 100 lines-per-minute faster. ☐

PERIPHERALS: ELSE MAKES IBM AND SO BAD.



Or take our 4350 disk drive. It offers the same capacity as IBM's but you also get a 20% faster average access time and a dual-access capability in the bargain. ☐ We're even giving them a run for their money when it comes to service. With over 400 top-notch CalComp service specialists stationed in 55 key cities throughout the country. ☐ Best of all, with CalComp plug-compatibles, your peripherals budget will go almost twice as far as with IBM. ☐

Omni present. There's not much more we can tell you about our big, new plug-compatible family. At least, not without your help. ☐ So call Van R. Ramich or Jim Fleming, at (714) 821-2011 for more details. ☐ Better yet, if you're among the first 500 callers, we'll also reward your prompt inquiry with 3 free issues of Omni Magazine—one of the most intelligent and imaginative new "mind magazines" to ever come along. ☐ So go ahead. Call us right now. ☐ Because given a chance, we'll make more than just your mainframe look good. ☐

CIRCLE 17 ON READER CARD

CALCOMP

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Peripheral Products Division
3320 E. La Palma Ave., Anaheim, CA 92806
Telephone: (714) 821-2011 TWX: 910-591-1154

CALENDAR

OCTOBER

SIGSMALL '79, October 1-3, Dallas.

At the second annual Symposium on Small Systems, papers will be presented on business and industrial applications of microprocessors, small systems applications in entertainment and education, distributed processing with small systems, and mini and micro software advances. Contact Dr. Fred Maryanski, Computer Science Dept., Kansas State Univ., Manhattan, KA 66506.

1979 International Conference on Cybernetics and Society, October 8-10, Denver.

Sponsored by the IEEE Systems, Man and Cybernetics Society. The main theme is modeling and applications of world systems in areas relating to energy, environment, economics, technology, biocybernetics, pattern recognition, man-machine and system science. Contact Dr. James D. Palmer, (202) 426-4461.

INFO 79, October 15-18, New York.

The Sixth International Information Management Exposition & Conference. Attendance may reach 20,000. Exhibitors such as IBM, Basic Four, Xerox, Datapoint, NCR, Hewlett-Packard, Wang and Vydec have reportedly increased the size of their booths by an average 44% in comparison with last year's show. Contact Clapp & Poliak, Inc., 245 Park Ave., New York, NY 10017 (212) 687-7730.

Fifteenth Meeting of the Computer Performance Evaluation Users Group, October 15-19, San Diego.

Sponsored by the National Bureau of Standards. Papers, tutorials and case studies will be presented on, among others, the following topics: installation performance; workload forecasting; network performance; fraud, security and CPE; measuring user satisfaction; workload modeling; benchmarking; remote terminal emulation; performance prediction techniques; and CPE in auditing. Contact Judith G. Abilock, The MITRE Corp., Metrek Div., 1820 Dolley Madison Blvd., McLean, VA 22102 (703) 827-7072.

Computer in Aerospace II, October 22-24, Los Angeles.

Contact Richard R. Erkeneff, McDonnell Douglas Astronautics Co., 5301 Bolsa Ave., Huntington Beach, CA 92644 (714) 896-4975.

ACM Annual Conference, October 29-31, Detroit.

The theme is "Advances of the 70s—Challenges of the 80s." Contact Mayford L. Roark, Ford Motor Co., The American Road, Room 895 WHQ, Dearborn, MI 48121 (313) 323-1690.

Interface West, October 30-November 1, Anaheim.

Conference sessions are planned on small computers and office automation systems, word processing, distributed dp, and data communications hardware, software and services. Contact The Interface Group, 160 Speen St., Framingham, MA 01701 (800) 225-4620; in Massachusetts, (617) 879-4502.

MARCH

Federal Computer Conference, November 6-8, Washington, D.C.

Over 6,000 people attended last year. Contact the Federal Computer Conference, 349 Bogert Ave., Ridgewood, NJ 07450 (201) 444-0505.

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SERIES 2-2024: KEY-FILE MANAGEMENT SYSTEM AND QUALITY DATA ENTRY. SIMULTANEOUSLY!

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With communications protocols for most popular mainframes, including the recently announced Univac NTR, the KEY-EDIT 2024 is ideal for distributed processing networks. You'll begin saving money the day your KEY-EDIT goes on-the-air . . . and you can look forward to having the power, sophistication and reliability that will help you meet the challenges of tomorrow.

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CONSOLIDATED COMPUTER INTERNATIONAL INC.

CIRCLE 39 ON READER CARD

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.

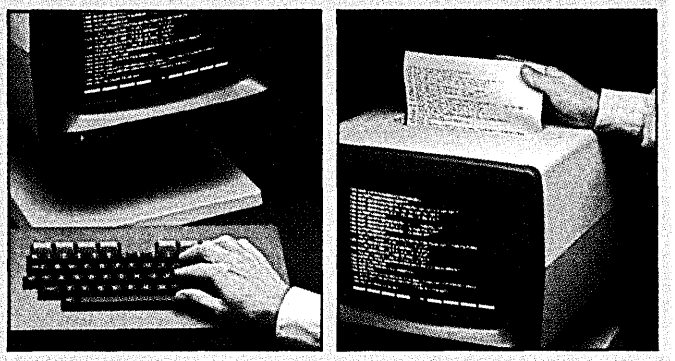
We designed the keyboard like the familiar typewriter, so you don't have to waste time relearning it. We built in eight function keys, too. These control the cursor, rolling and scrolling. And, to make life easier, they're labeled on the screen for self-test, configuration, display and editing.

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.

☐ I'd like to know more about HP's new 2621A and 2621P with built-in hard copy.
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CIRCLE 42 ON READER CARD

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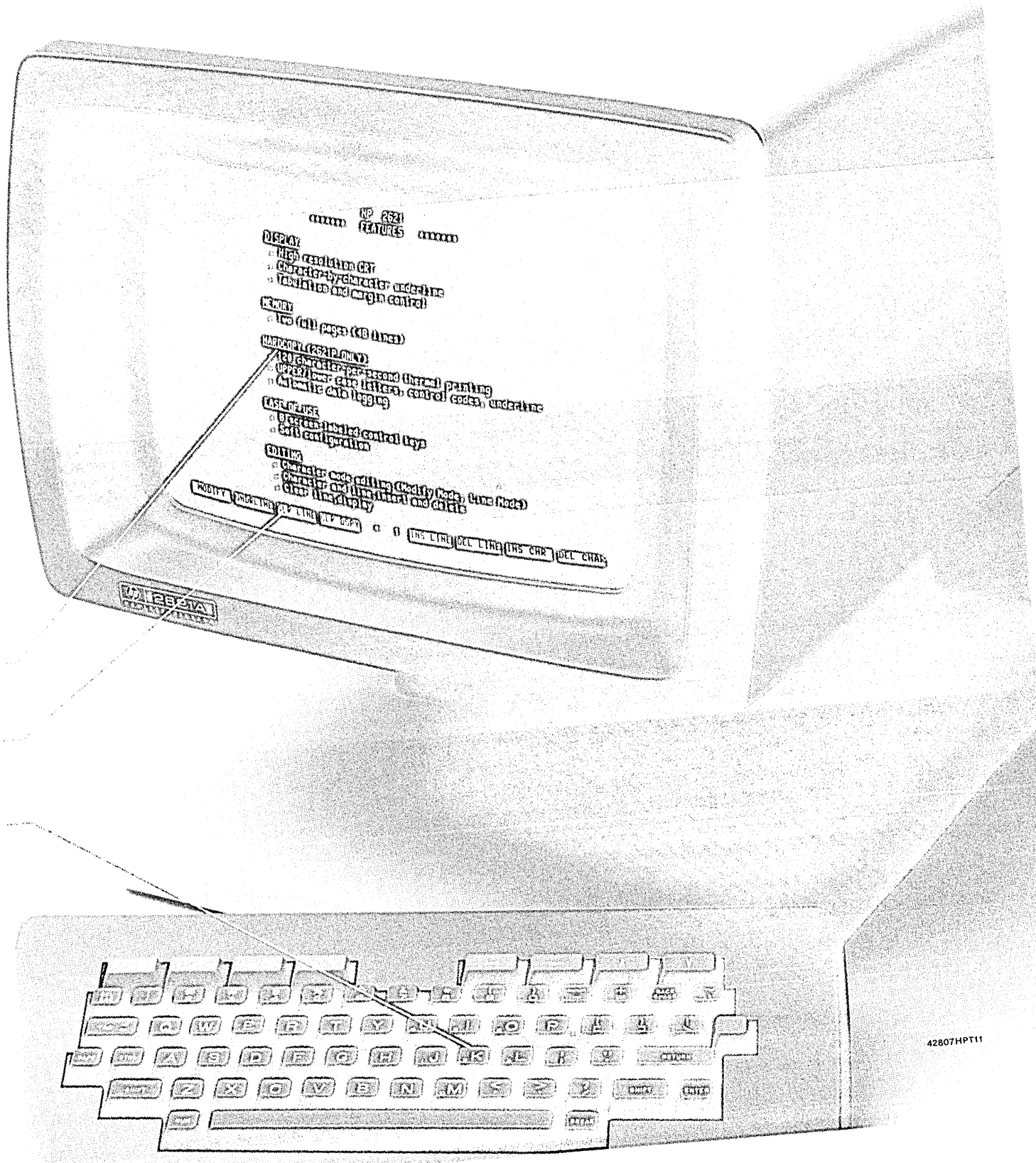

CALENDAR

INTELEC 79, November 27-29, Washington, D.C.

The International Telecommunications Energy Conference is sponsored by the IEEE Communication Society. Contact R. H. Jones, Publicity, 1979 INTELEC Committee, ITT North Electric Company, Power Systems Div., P.O. Box 688, Galion, OH 44833 (419) 468-8100.

COMPSAC 79, November 5-8, Chicago.

The third International Conference on Computer Software and Applications, sponsored by the IEEE. The first day is devoted to tutorials. Papers are being considered in the areas of software development methodology; software management; data base management systems; data communication and computer networking; transaction and information management systems; computers and biomedicine; business office automation; design automation; application-oriented languages; reliability, maintainability and security; software testing and tools, mini/micro software, distributed system performance, human engineering of software systems, legal implications of dp technology and others. Contact the general chairman, Dr. William Smith, Executive Director, Toll Electronic Switching and Operator Services Div., Bell Laboratories, Naperville, IL 60540 (312)690-2389.

Federal Computer Conference and Exposition, November 7-9, Washington, D.C.

Over 6,000 attendees were present at the first Federal Computer Conference last November. A seminar on federal adp marketing for vendors is planned for Wednesday afternoon, November 8. The seminar will cover procurement regulations; market and usage information about government use of hardware and software, as well as time-sharing and services; the role of the GSA; and the federal marketing structure, with emphasis on intra-agency relationships and key policy committees. Contact Charlie Asmus, Director of Marketing, Federal Computer Conference and Exposition, 349 Bogert Ave., Ridgewood, NJ 07450 (201)444-0505.

American Bankers Assn. Western Regional Workshop, November 14-16, San Francisco.

Contact the Meetings Coordinator, Operations & Automation Div., American Bankers Assn., 1120 Connecticut Ave., N.W., Washington, DC 20036 or call William Moroney at (202)467-4332.

Canadian Computer Show, November 13-15, Toronto.

Last year's attendance was 15,159. This year's show will celebrate the 10th anniversary of the Canadian Computer Show. Contact Reg Leckie, Show Manager, Canadian Computer Show, 36 Butterick Road, Toronto, Canada M8W 3Z8 (416) 252-7791, or Bill Robertson at (416) 444-0321.

CALLS

Papers are being solicited for the 1980 Summer Computer Simulation Conference, which will be held in Seattle July 1980. The theme will be the future of computer simulation. Three-to five-page summaries are due Dec. 1, 1979. Contact David R.S. McColl, 1980 SCSC General Chairman, Manager Military Spacecraft, Boeing Aerospace Co., P.O. Box 3999, MS 84-16, Seattle, WA 98124 (206) 773-1543.

The Thirteenth Hawaii International Conference on System Sciences, to be held January 3 and 4, 1980 in Honolulu, will emphasize medical information processing and computer-based decision support systems. Hardware and software topics will also be addressed. The deadline for submission of papers is July 13. For more information, contact Perry G. Patteson, HICSS-13, Office of Management Programs, Univ., of Hawaii, 2404 Maile Way, Honolulu, HI 96822 (808) 948-7396. ✲

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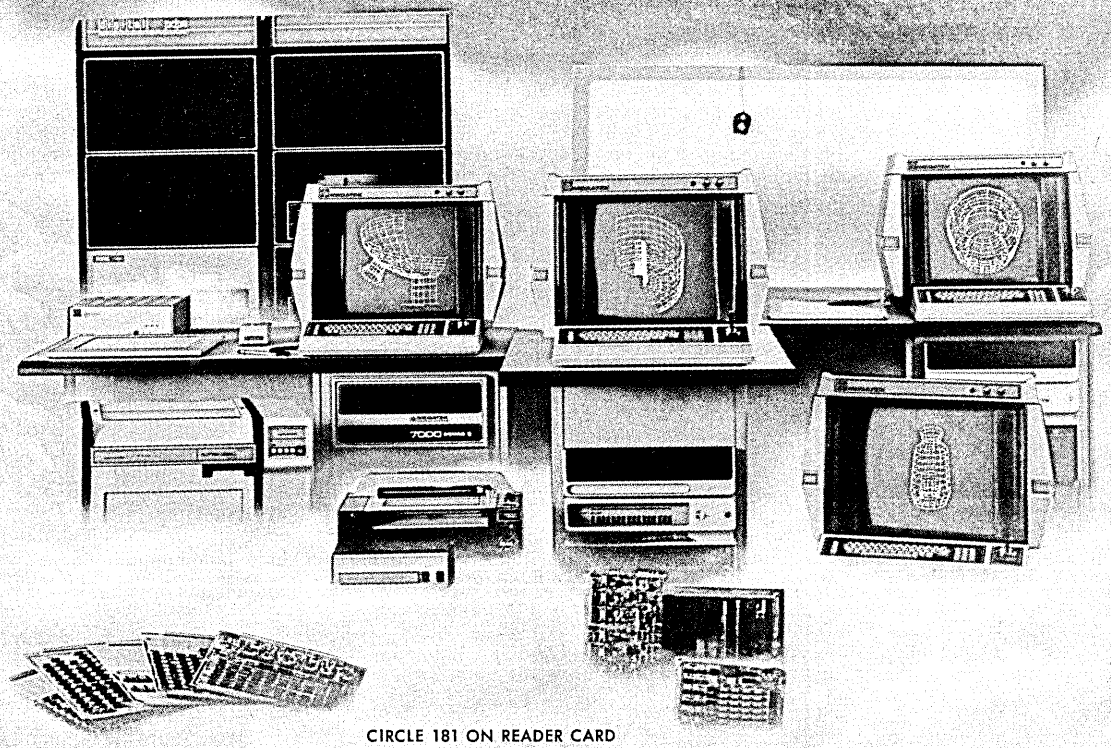

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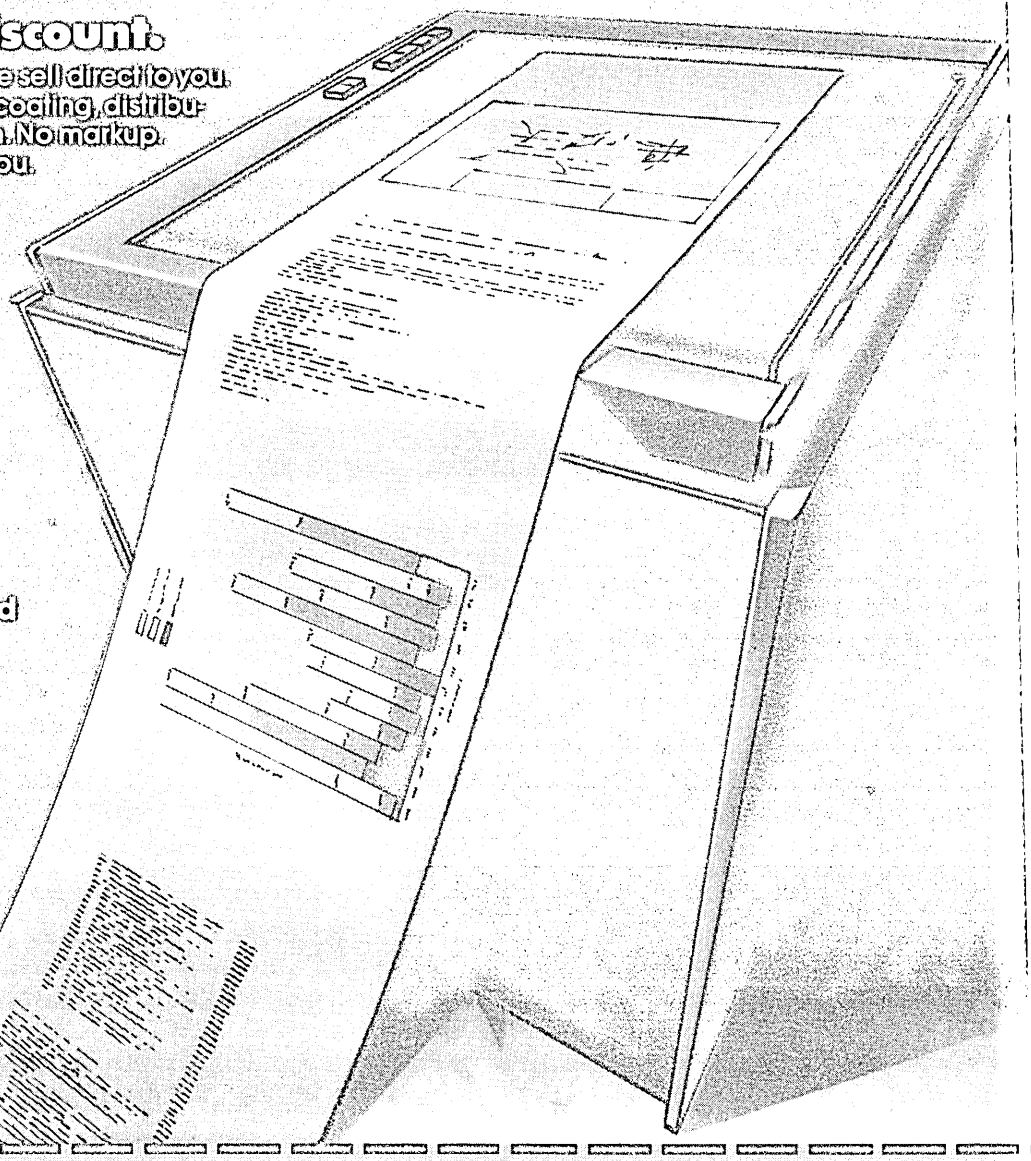

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CIRCLE 31 ON READER CARD

Dumb terminals – the end of an era

If you are an IBM customer, or you have a terminal network from Burroughs, Univac, or some other mainframe vendor, then this ad is probably not for you. But if you have a minicomputer and your terminals do not perform automatic retransmission-on-error, or if you use timeshare or interactive graphics terminals, you don't need us to tell you data transmission errors can really sour your attitude toward the phone company, your terminal, your computer, or maybe all three!

Life can be sweeter!

MICOM's Micro500 Error Controller takes care of those phone line 'glitches' automatically, on dial-up or leased lines, with no changes required to your existing hardware or software. It delivers error-free data on telephone lines with error rates worse and 1 in 10^4 and through total line outages of several seconds. It also lets you use your asynchronous terminals with high-speed synchronous modems operating at speeds to 9600 bps, and even lets you use them dial-up with *half-duplex* modems at 2400 or 4800 bps.

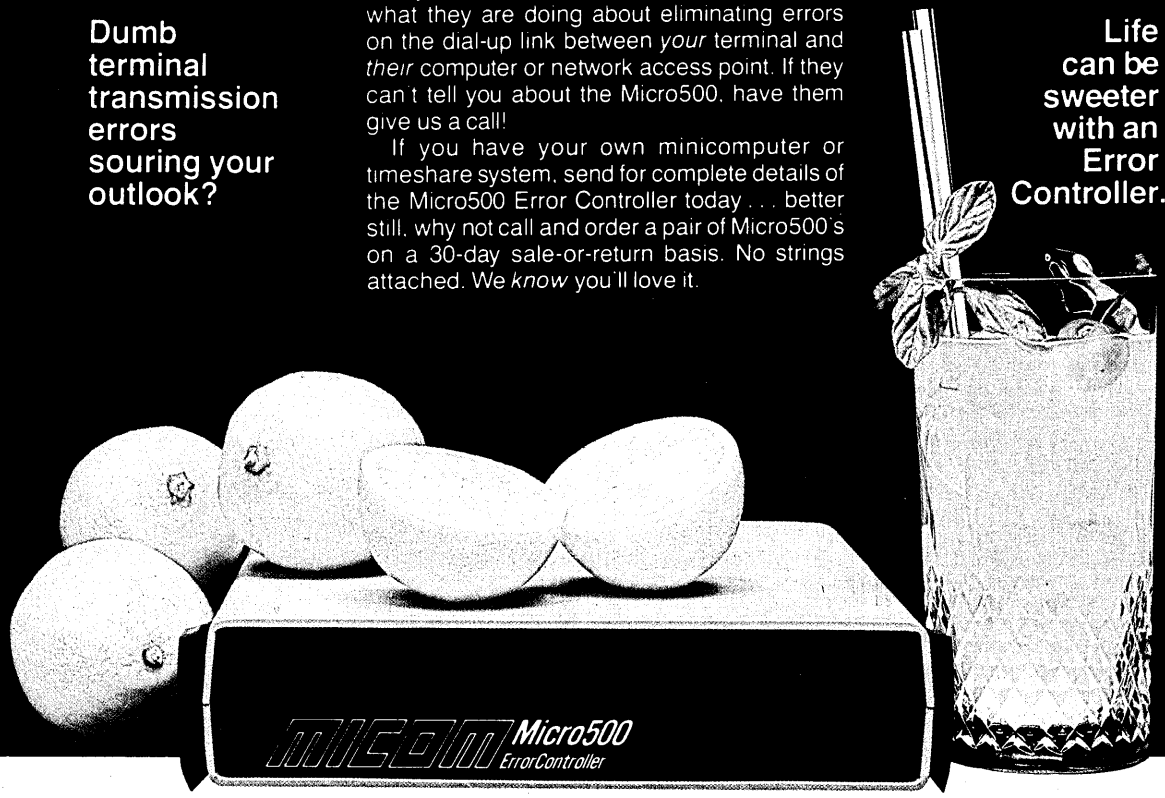
With MICOM's Micro800 Data Concentrator you can put several terminals on one line, eliminating phone line errors for all of them. Now, the Micro500 takes care of your single terminal installations at a price *you* can afford. No wonder they're saying MICOM just put an end to the dumb terminal era.

If you use a timeshare service, ask them what they are doing about eliminating errors on the dial-up link between *your* terminal and *their* computer or network access point. If they can't tell you about the Micro500, have them give us a call!

If you have your own minicomputer or timeshare system, send for complete details of the Micro500 Error Controller today . . . better still, why not call and order a pair of Micro500's on a 30-day sale-or-return basis. No strings attached. We *know* you'll love it.

Dumb terminal transmission errors souring your outlook?

Life can be sweeter with an Error Controller.



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CIRCLE 130 ON READER CARD

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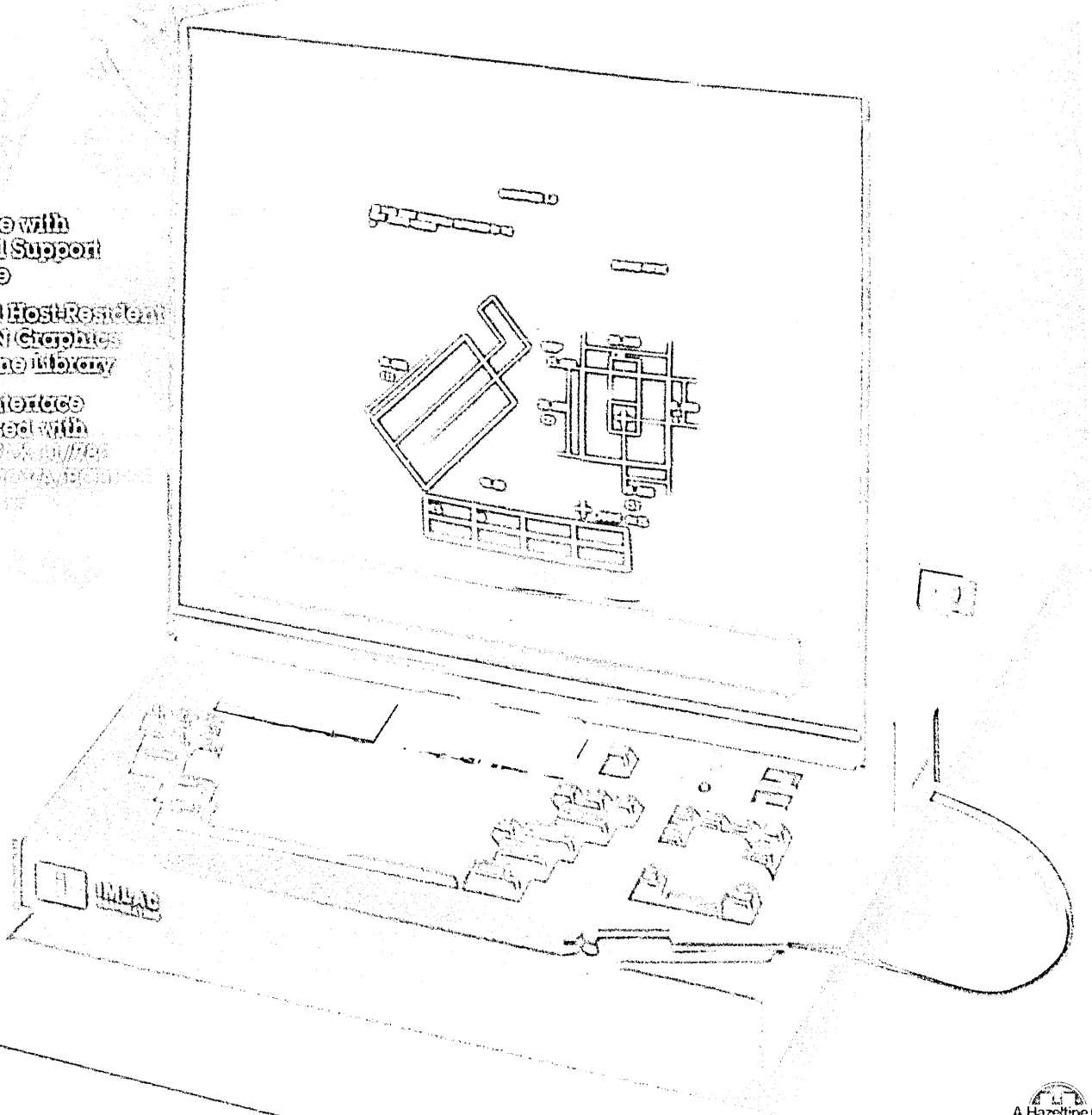

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CIRCLE 164 ON READER CARD

"Sorry to wake you, sir, but there's been a fire in the computer center...."

Right now, you'll find out how good your back-up and recovery plan is.

And, unfortunately, the emergency measures open to you may prove inadequate. New hardware could take weeks longer than you hoped. Likewise, a reciprocal agreement could mean days and days of downtime losses. Or worse, it could prove impractical to schedule at all.

Compare your plan with Sungard. The guaranteed alternative.

Sungard subscribers get guaranteed access to a fully operational center on 24 hours notice, with no premium. (Or even within four hours notice.) Your people running your pre-tested programs. For up to 7½ months. One day after the disaster. And the cost of Sungard can be reduced substantially by the purchase of pre-emptible time.

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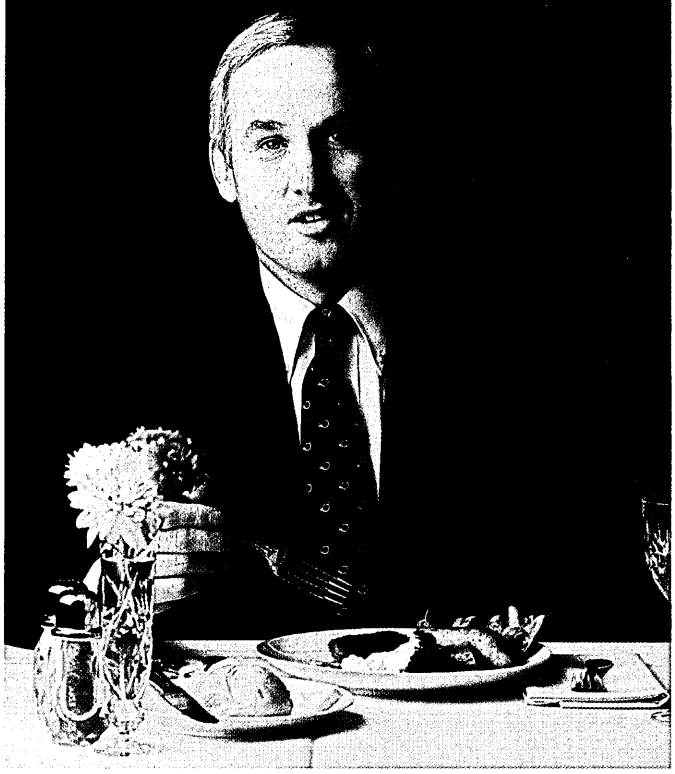
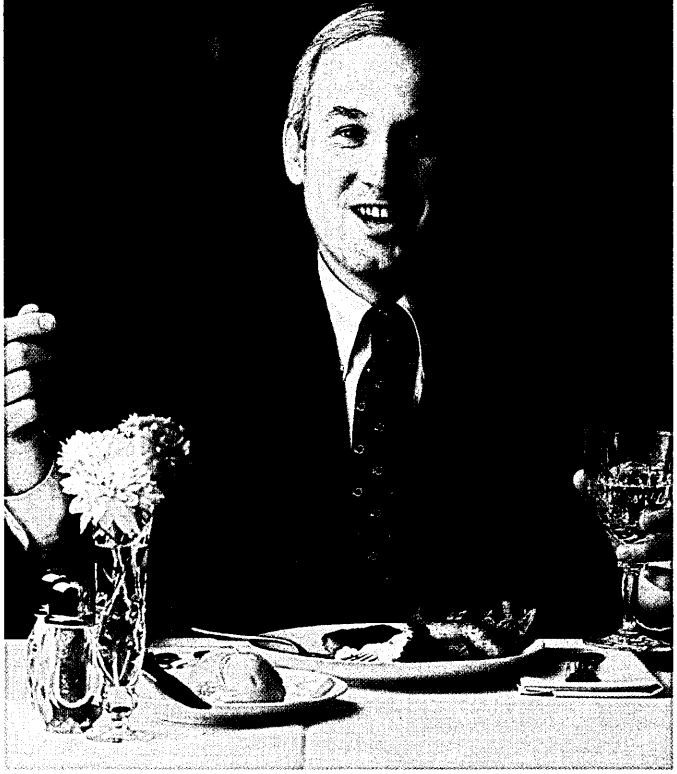
CIRCLE 148 ON READER CARD

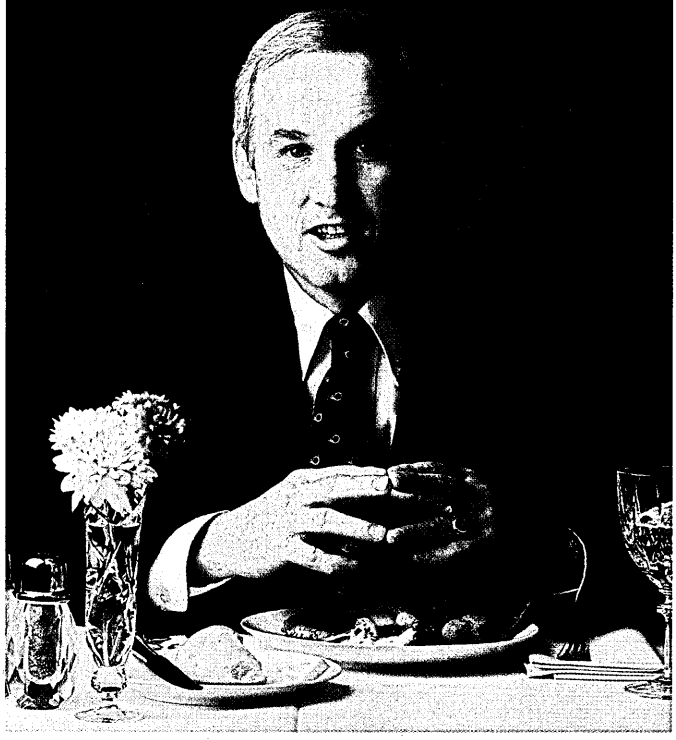
"DatagraphiX came in and showed us everything we needed to know."



"We were able to upgrade our operation with minimum conversion time and expense."



"We maximized COM's full cost saving potential by having the DatagraphiX equipment in-house."



"With the Mini-AutoCOM, we found we could have our cake and eat it, too."

"COMPUTER OUTPUT MICROFILM OFFERED US A LOT MORE CONTROL, SAVED TIME, AND LOOKED FANTASTIC ON OUR P&L REPORT."

DatagraphiX recently spoke with Mr. James Hamrick, President, Service Division of Datatel, Inc., Alexandria, Virginia, about his company's decision to move to an in-house COM system.

DATAGRAPHIX: "Jim, why did you decide on a DatagraphiX system instead of going to a COM Service Bureau?"

HAMRICK: "It turned out that an in-house operation was the most cost-effective solution to handling our COM requirements. With a DatagraphiX minicomputer driven COM unit we were able to upgrade our operation with minimum conversion time and expense. We ended up with excellent control, higher quality output and lower operating costs than we ever expected."

DATAGRAPHIX: "What do you mean by control?"

HAMRICK: "We're able to maximize COM's full cost saving potential by having the equipment in-house. It's here 24 hours a day, allowing immediate turnaround. Each day's data is processed onto fiche that night and returned the next morning."

DATAGRAPHIX: "By going in-house, what happened to your overall costs?"

HAMRICK: "We've found that the more we use our in-house system, the more we save. It costs next to nothing to add an entirely new job. So we've been using it for a lot more applications. Overall, our monthly savings have continued to increase even though we've greatly expanded our volume."

DATAGRAPHIX: "Are operator costs included in those monthly savings?"

HAMRICK: "No. Because DatagraphiX equipment is highly automated, our regular computer operators can now manage our COM production as well. We also have a DatagraphiX duplicator that simplifies the collation and distribution of microfiche copies."

DATAGRAPHIX: "Was operator training difficult?"

HAMRICK: "Not in this case. The Mini-AutoCOM is simple to operate. Our current staff picked it up in no time. DatagraphiX came in and showed us everything we needed to know."

DATAGRAPHIX: "Why did you buy a system instead of leasing one?"

HAMRICK: "We decided to buy for the immediate return on our capital investment, which, by the way, is good. The monthly lease payments were attractive, but for us, buying outright and taking advantage of the investment tax credit was the way to go."

DATAGRAPHIX: "Any regrets with the decision to go in-house?"

HAMRICK: "None at all. With the Mini-AutoCOM, we found we could have our cake and eat it, too."

For further information on how DatagraphiX COM systems can help you in a big way, call or write for our free brochure.
P.O. Box 82449, San Diego, CA 92138
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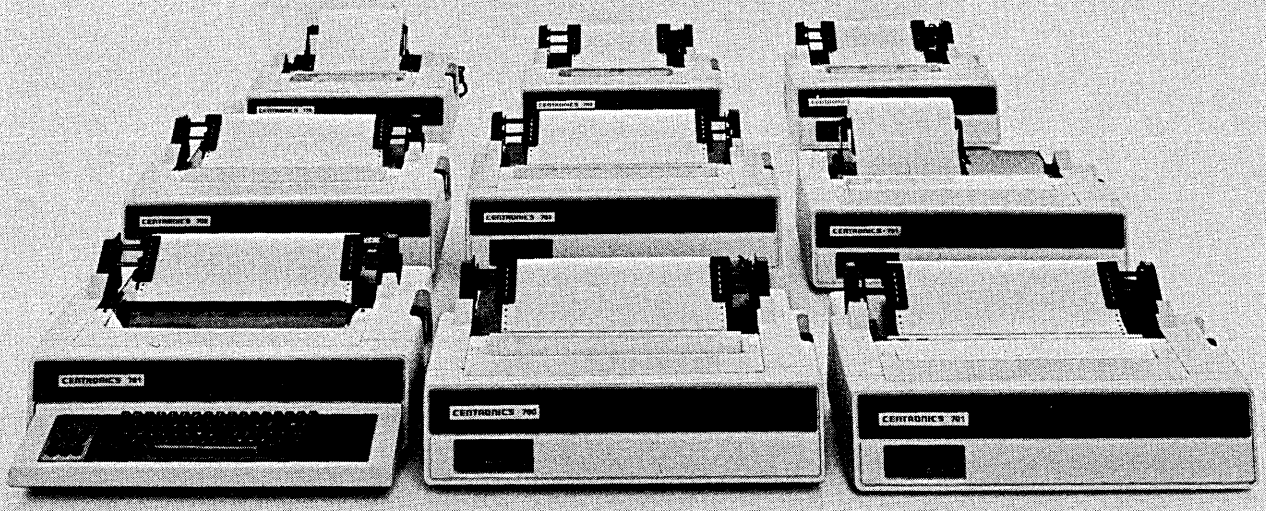
And like all Centronics printers, the 700 series is fully supported by the largest worldwide service organization of any printer company. For complete 700 series information write or call today. Centronics Data Computer Corp., Hudson, NH 03051, Tel. (603) 883-0111.



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LETTERS

BEEN THERE

It was most refreshing to read the letter you published that gave a simplistic view of federal government salaries (February, p. 46). Having worked for the federal government for 17 years as a "blue collar" (WG) worker and a "white collar" (GS) worker, nonprofessional and professional, I feel qualified to respond to the "Name Withheld" letter point by point.

The so-called *immediate* cost-of-living increase effective October 1, 1978 was in reality effective a week later, October 8, 1978, and was for white collar workers only. The 5.5% cost-of-living increase was dwarfed by about a 12% inflation rate.

The other salary adjustments mentioned in the letter that are available, such as "step" increases, are characterized as automatic. The truth is that the employee is given an additional performance evaluation by his supervisor three months in advance of the said increase. If the employee has not performed on the job the increase is withheld. The promotional opportunities also mentioned are deemed unrestricted and copious in number. Remembering the freeze on promotions imposed by President Nixon and the average grade level ceilings imposed by various military sites, many times arbitrarily, I say bull to unrestricted promotional opportunities.

Finally, as to the GS-12 programmer/analyst position with a "starting salary" of $23,087, readers should take note that this is not the entry level position but one attained after years of experience. I suggest that the "Name Withheld" letter writer be reminded of the fact that government workers have no recourse such as arbitration, strike, etc., to remedy any labor disputes.

JOSEPH L. CARISTO
Systems/analyst
Philadephia, Pennsylvania

CORRECTION

The article by Mary Bartholomew and Elinor Gebremedhin, "The PCM Vendors" (February, p. 104) incorrectly names IPL Systems as the manufacturer of the Cambridge Memories, Inc. plug compatible computers. CMI manufactures its own systems.

It should also be noted that the CMI 1638 is not upgradable to the OMEGA 1, manufactured by IPL for Control Data Corp.

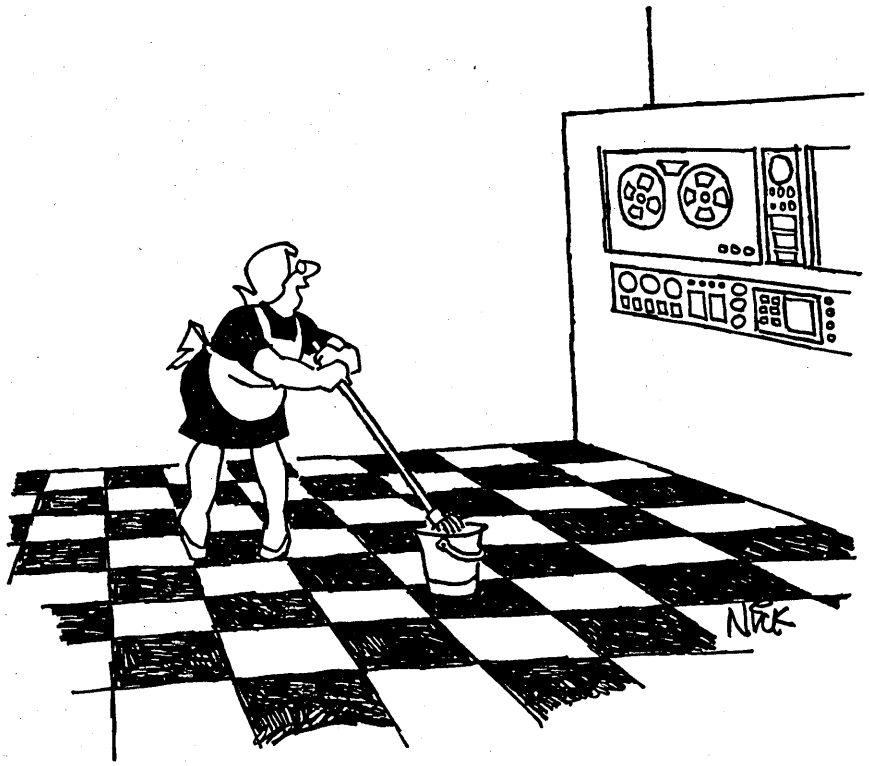
STEPHEN J. IPPOLITO
President
IPL Systems Inc.
Waltham, Massachusetts

THE LAND OF OS

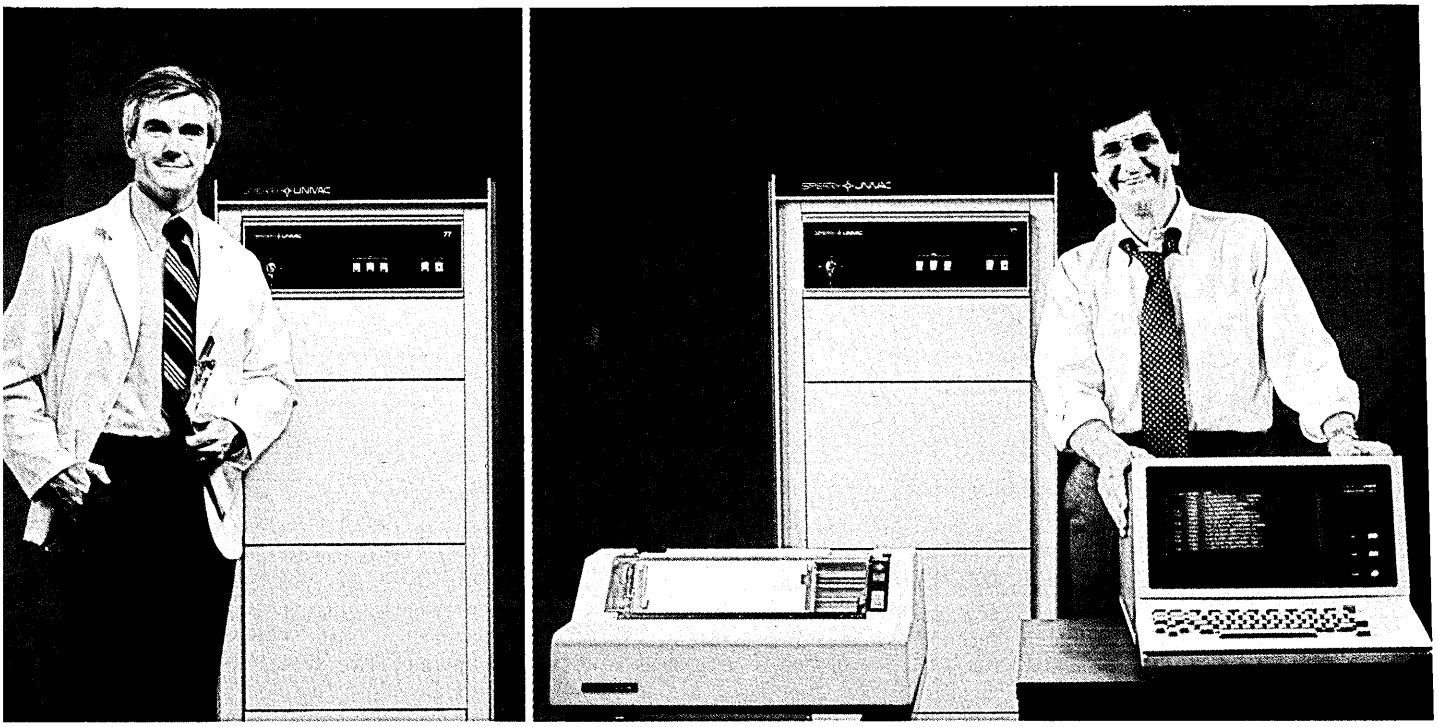
In the Personal Computing column of your February issue, Portia Isaacson asks "Would it be sufficient progress if your 1990 personal computer could run OS?" Even if the memory and disk storage required for OS are affordable by then (as predicted in the article), such a thought (OS on a micro) causes a fair amount of cringing.

OS is hardly the system of choice for a personal computer. One of the main problems is that it would take a fairly competent systems programmer to do anything with an OS system. An ordinary user would be bewildered by the pile of job control required for even simple tasks, the uninformative error messages (such as "system error code 80C"), and the numerous seemingly arbitrary restrictions imposed by the system. OS was not designed for interactive use, though such use is possible. Otherwise it is a huge, clumsy, card-image-oriented batch system, which is badly suited for program development, since much of the programmer's time is spent "fighting" with the system.

A microprocessor running OS is,



"Rook to King four."



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CIRCLE 68 ON READER CARD

perhaps, suitable for use by businesses if the exact software that they want is available. I think, however, that the existence of a large amount of OS/370 software will be much less helpful in lowering software development costs than some people might hope.

I will admit that a microprocessor that executes the 370 instruction set would be considered "progress." Running OS on such a processor would seem to be a giant step backwards in some respects. Instead, how about a microprocessor that runs UNIX or MULTICS? Or how about a 370 operating system similar to either of these? Such a system, running on a micro 370, or even on a conventional 370 mainframe, would really be progress!

JAMES R. HOWELL
San Jose, California

Ms. Isaacson replies: I couldn't agree more.

STYLE AND CLARITY

I was sorry to see so many examples of bad coding style in the article, "Writing Legible Code," by Thomas R. Gildersleeve (February, p. 191). I have been writing legible code for 18 years. In fact, I was preaching "structured programming" before anyone heard of Ed Yourdon.

Some of the bad practices illustrated in the article are:

- The proper way to "document" what you are doing is with comment cards. Don't screw up the structure of the program for "clarity." It seems so simple and obvious.
- Don't use GO-TO—at all. I thought everyone knew this by now.
- Write one statement per line and indent for each level of IF. Line up the ELSE under its corresponding IF. Nested IF statements are *not* difficult to understand if written properly.
- Don't write statements like IF DEDUCTION-TYPE GREATER THAN '39' AND LESS THAN '54' NEXT SENTENCE ELSE ... This is backwards logic. State the condition you want, not the condition you don't want. Also, on range tests use the first and last *inclusive* values. Don't use symbols for relational operators. The statement should be written IF DEDUCTION-TYPE NOT LESS THAN '40' AND NOT GREATER THEN '53' ...

As for the assertion that switches are necessary to indicate the end of file, that is wrong too. This is how the code should be written:

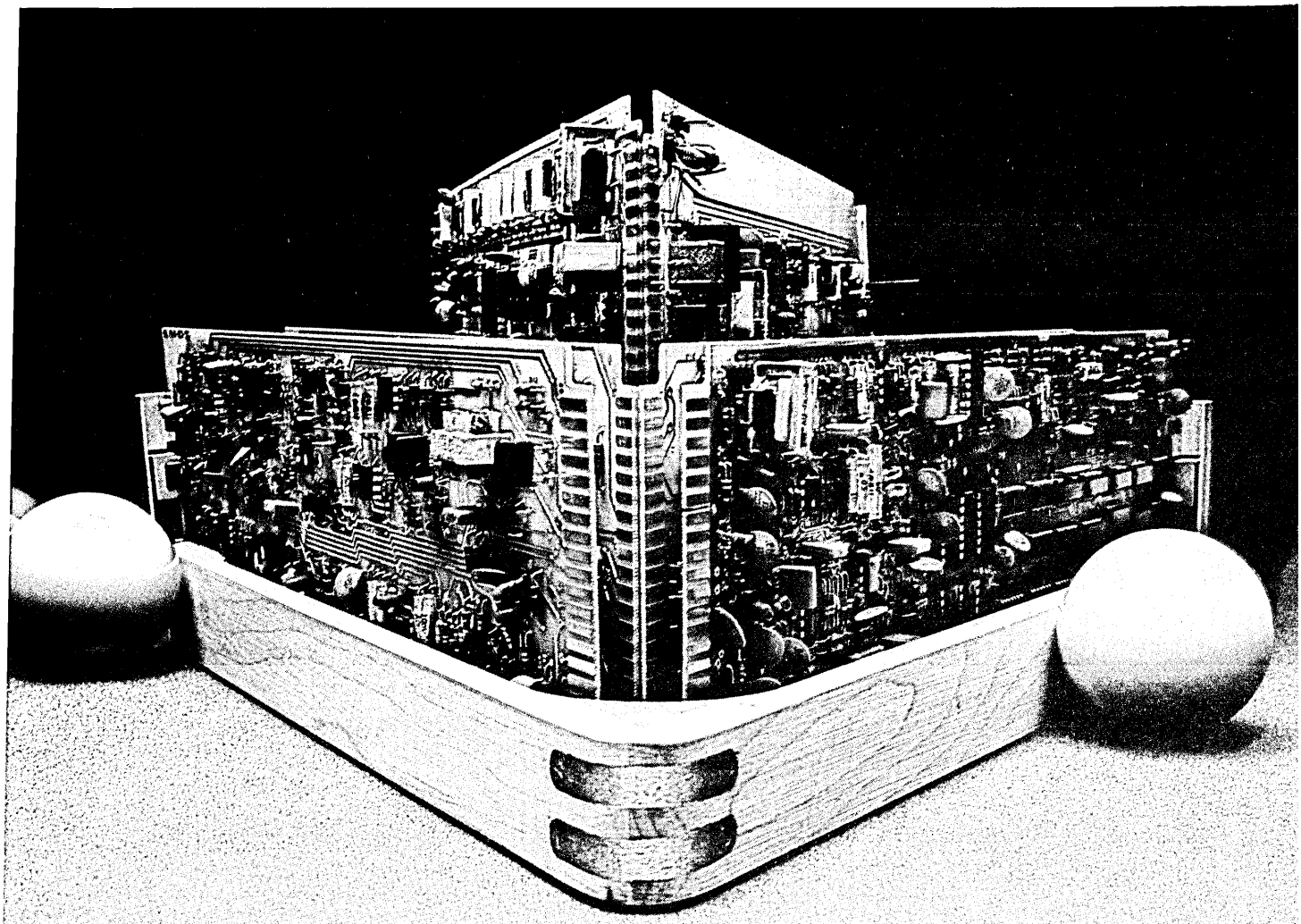
```
MAIN-LINE.
        OPEN INPUT MASTER-FILE.
        MOVE LOW-VALUES TO DATA-
          RECORD IN MASTER-FILE.
        PERFORM ONE-RECORD
          UNTIL COMPANY IN
            MASTER-FILE
            EQUAL TO HIGH-VALUES.
        CLOSE MASTER-FILE.
        STOP RUN.
ONE-RECORD.
        .
        .
        .
        READ MASTER-FILE AT END.
            MOVE HIGH-VALUES TO
            DATA-RECORD IN MASTER-FILE.
```

If the processing logic is writen properly, it should be able to handle the first nonexistant low-values record.

ROBERT WAGNER
Classic Chemical
Arlington, Texas

Mr. Gildersleeve replies: First, lets get end of file switches out of the way. The alternative is to use HIGH-VALUES, as Mr. Wagner has illustrated. Unfortunately, there's no guarantee that HIGH-VALUES work with all compilers. End of file switches always work. Therefore, end of file switches are preferred over HIGH-VALUES.

Nevertheless, swtiches contribute to illegibility. Therefore, when possible, they should be avoided. There are probably some other instances lying around, but the only place I know where switches are the least evil is in end of file situtations.



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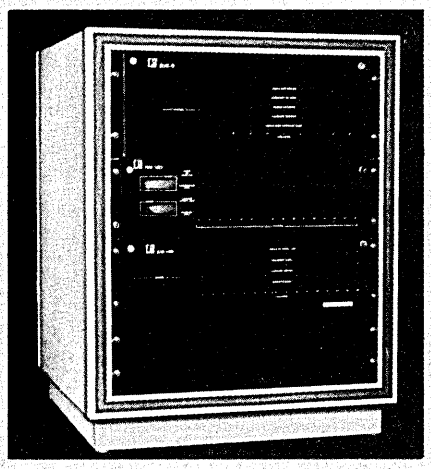

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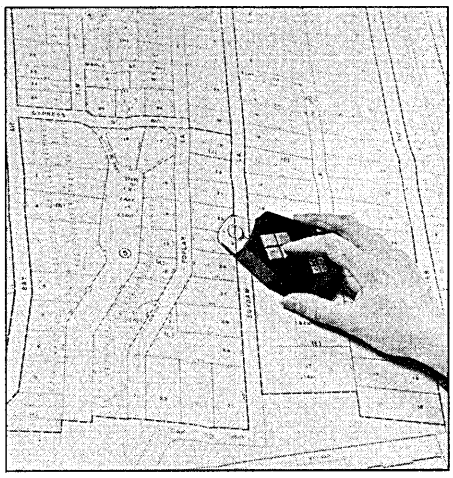

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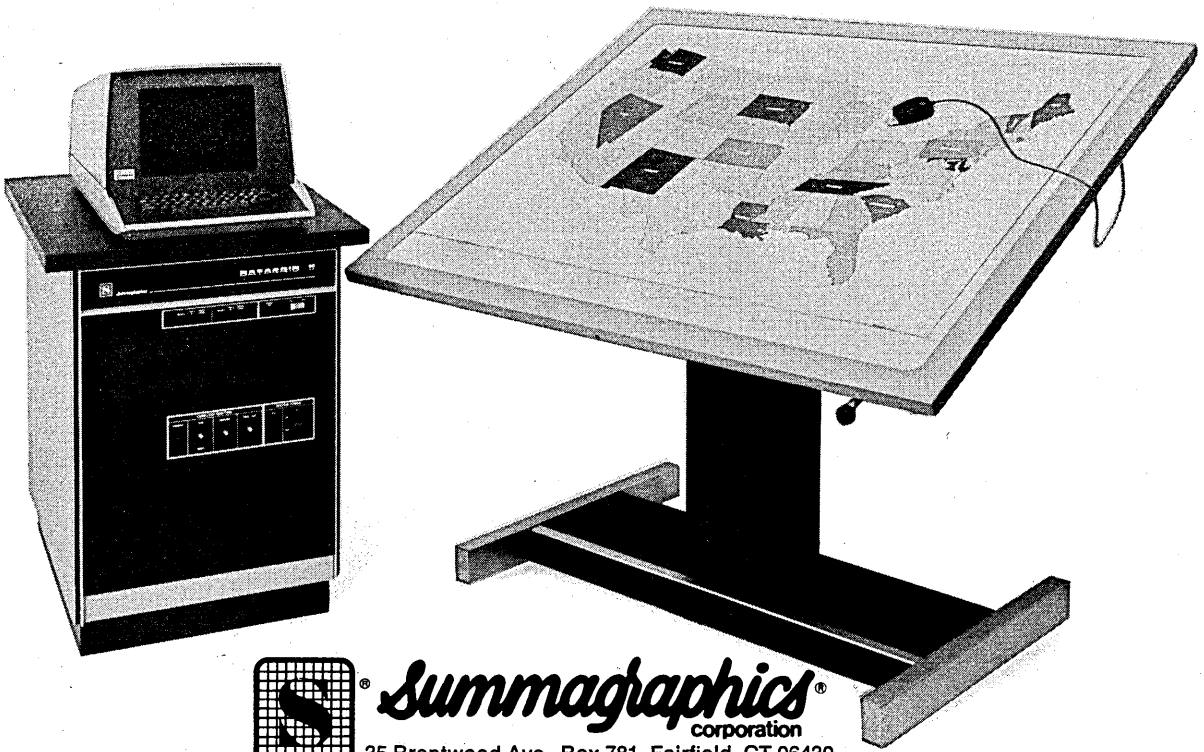

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CIRCLE 122 ON READER CARD

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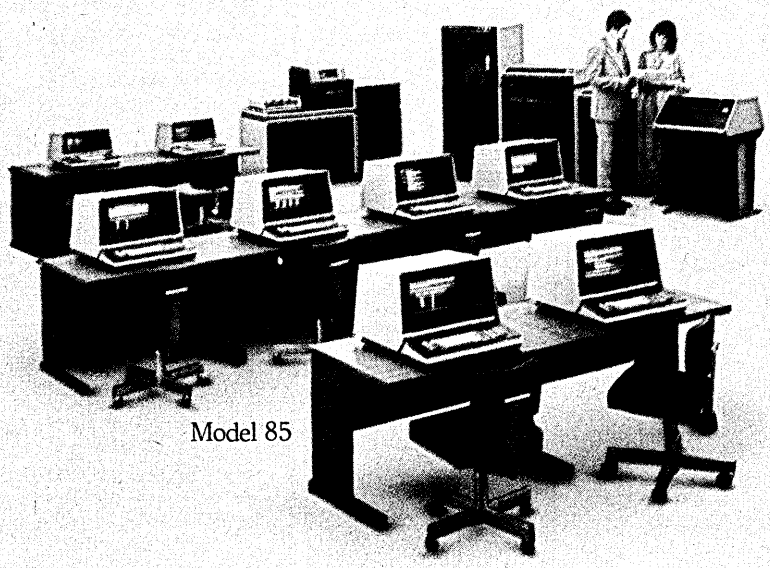

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CIRCLE 159 ON READER CARD

LETTERS

If switches are to be avoided, then strict adherence to the principles of structured programming often leads to the use of compound conditionals, of which Mr. Wagner's code makes liberal use. Some of us find compound conditionals hard to read. Localized GO-TO's are an alternative.

Mr. Wagner says we shouldn't screw up the code this way for the sake of clarity. He proposes comments as the alternative. Unfortunately, few programs get comments. Those that do get modified, but the comments are seldom updated. We then have incorrect documentation. Therefore, we continue to ignore whatever feeble documentation exists and instead go directly to reading code to find out what's going on.

However, we know that code is kept up-to-date. Therefore, my proposal is to make the code as legible as possible. I'd rather trust programmers to keep their GO-TO's local than badger them to comment in the first place and then keep the comments up-to-date when they modify the code.

VIEWDATA PRICING AND PREDICTIONS

The Personal Computing column entitled "Food for the Home Computer" (Nov. 1, 1978, p. 188) was intriguing and informative. However I would like to note an apparent error in the discussed price for Prestel encoder/decoder units and keypads. The discussed $1,000 price range seems a bit high in view of our projected volume-dependent estimates of $100 to $300 (small volume to lots of 10,000). This difference does, of course, affect the potential market for Viewdata type service.

It is also possible that the availability of Viewdata service could stimulate the market for dumb terminals. Given sufficiently high volume (in the 100,000 unit range) a Viewdata type terminal could realistically sell in the $100 range. (A terminal with intelligence would command higher prices.)

Of more fundamental importance than equipment cost is whether or not Viewdata (telephone) type services would be commercially viable in the United States. Quantum Science Corp. has found that such services would have limited market penetration. Prime reasons for this projected performance are:

1.) information services are more likely to occur by cable tv than telephone (greater than 50% of U.S. homes will have cable tv in 1985); 2.) cable permits greater bandwidth than is possible from wire pair (thus providing better quality video, which would be important for advertising; 3.) current heavy telephone traffic would inhibit circuit availability; 4.) government support of CATV, and 5.) potential regulatory impediments to offering Viewdata services.

DR. ROBERT S. BRAUDY
Quantum Consultants, Inc.
New York, New York

APPLE USERS UNITE

I am writing to inform you of a new computer user's group. ABACUS (Apple Bay Area Computer Users Society) meets the second Monday of each month at the Hayward BYTE Shop, 1122 B Street, Hayward, Calif. Phone (415) 538-2431.

We have an active membership of 40, and we have developed a club library of 200+ programs. Currently we are negotiating to trade libraries with several other clubs.

Membership is $12 a year, and includes a monthly newsletter. For information, call Ed Avelar, president (415) 583-2431, or myself at (415) 482-4175.

DAVID R. WILKERSON
ABACUS
Oakland, California

TERM TEAM

The Terminology Task Group of the Subcommittee on Software Engineering Standards is seeking volunteers to help compile a glossary of software engineering terminology. Members of the task group will be asked to propose terms for inclusion in the glossary, and to submit, review, and propose changes to draft definitions. Contact Ms. Shirley Gloss-Soler, IIT Research Institute, Box 1355, Branch P.O., Rome, NY 13440 (315) 336-0937, or Mr. Robert Poston, 19 Onondago Trail, Medford, NJ 08055 (609) 641-8200 ext. 3065.

AIRBORNE AUTOMATION

I found Raymond J. Stephon's letter in the December issue (p. 42) exceedingly disconcerting. The only appropriate adjective to describe his statement: "A computer is many times more complicated than an aircraft, and performs in a varied processing environment" is asinine!

I suggest Mr. Stephon update his knowledge of current commercial aircraft. To mention only two of the many flight control systems, the Boeing 767 autopilot and autothrottle systems will be implemented using computers (from Collins Radio and GE respectively).

Not only must the flight control system engineer be concerned with the basic aerodynamic characteristics of the airplane, various customer options such as choice of engine model (a "varied" processing environment), but also the functional capability (or lack thereof) of the computers used to implement the autopilot and autothrottle functions.

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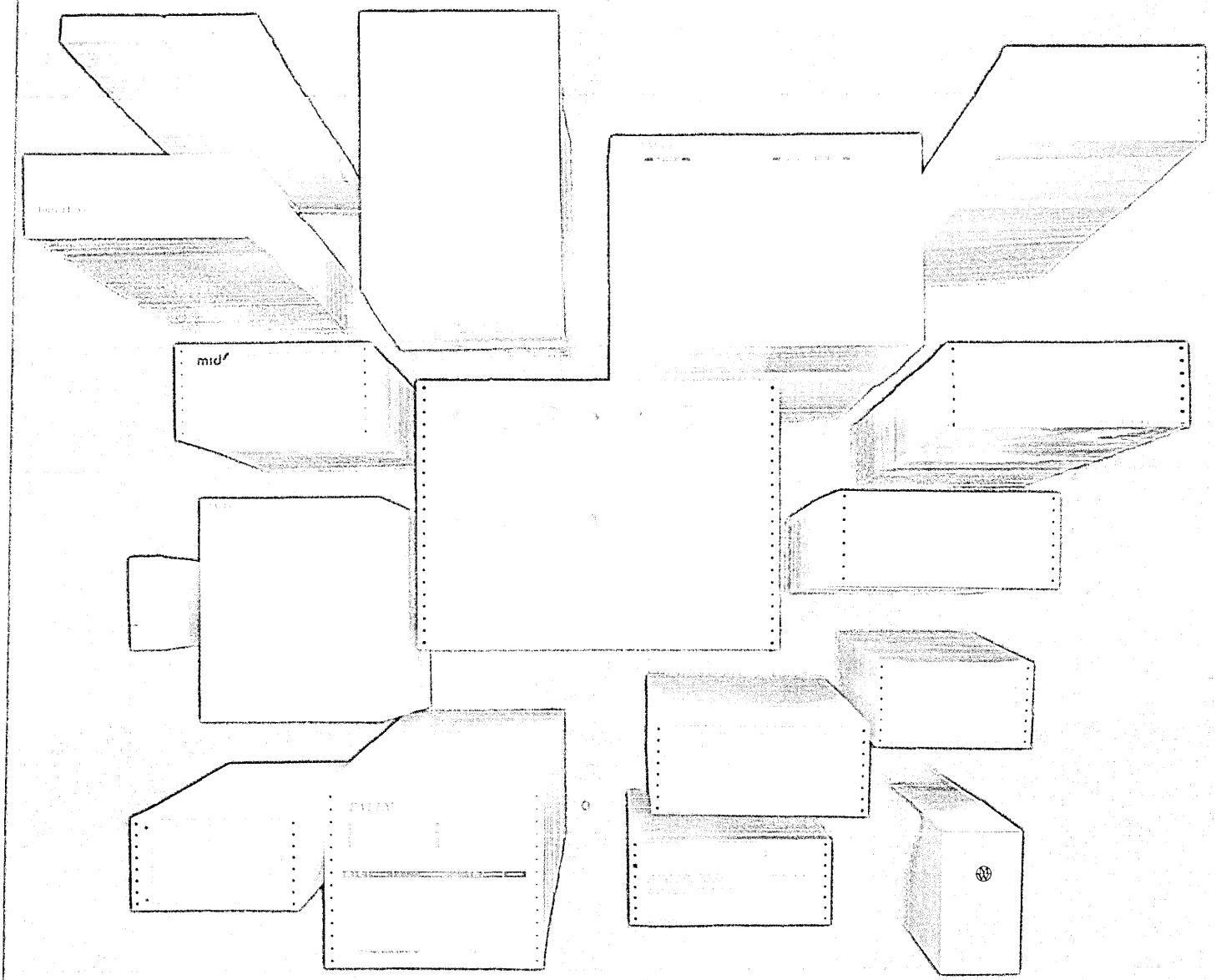

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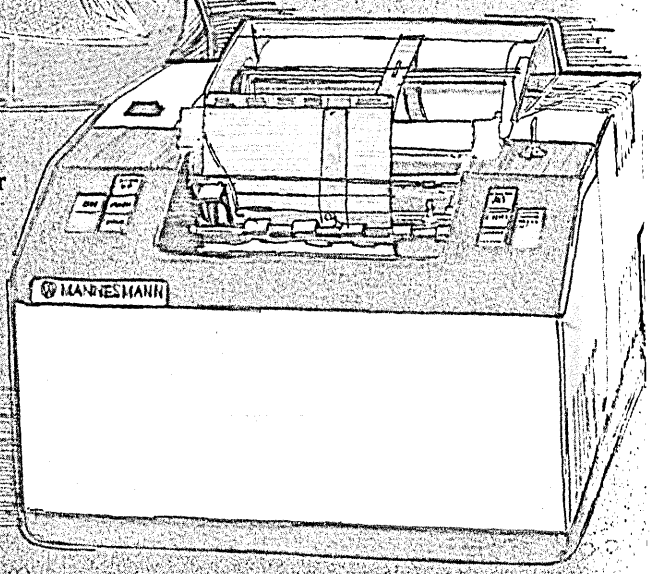
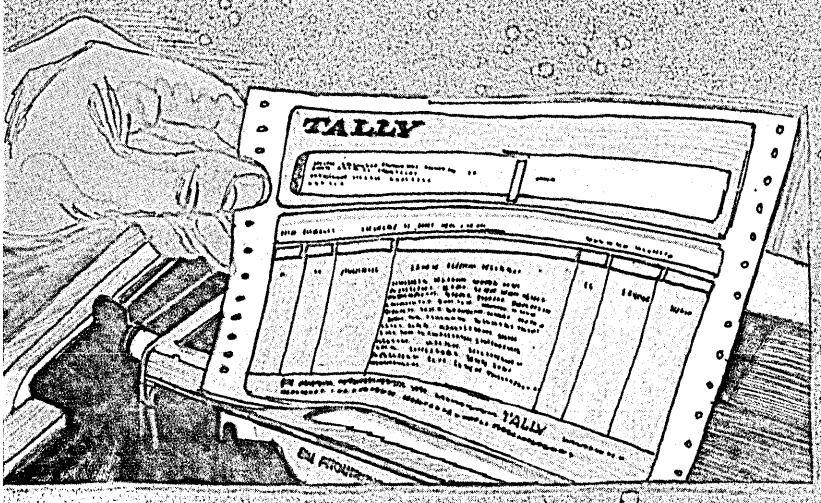
Developed to process more passengers faster and to minimize operator involvement, the Airline Ticket Printer prints standard multi-copy passenger passbooks at a fast 200 characters per second. It has a locking device to protect against theft, and it automatically prints validation characters for security. For forms handling convenience, an internal cutting mechanism automatically cuts the form to size. Different character styles and sizes provide flexibility for fitting print on the form. Use endless forms or print individual tickets.



M79-3 Pass Book Printer

Here's a problem solving printer targeted for banks that meets the challenge of printing entries in bulky passbooks. It simultaneously prints a separate journal for the bank's records. It has a locking device to protect the printed information. Designed to increase operator efficiency and customer convenience, the Tally Pass Book Printer operates at a fast 200 characters per second. It offers automatic forms thickness control and both expanded and condensed type size to meet various forms requirements.



T-1602 Quick-Tear Printer

Ideal for customer check-out counters, the Tally T-1602 serial printer combines high speed printing with fast and efficient forms handling capability. Featuring 160 character per second optimized bi-directional printing, this easy to use machine lets you tear off a completed form immediately above the print head—no wasted forms! The paper tractors adjust easily and quickly from either side of the carriage to accommodate different width forms. Printing is quiet and dependable.

LETTERS

MISSING AGENT

Wallace B. Riley's letter (December, p. 39) points out the confusion about the term "oem."

I once worked for an oem who was, indeed, a middleman (he sold turnkey systems with HP equipment). Yet, he insisted, he was an "oem." My question was why he is called the "original equipment manufacturer" when obviously HP should be called that?

The story I got was that the full term is "oem agent" and that the "agent" part got dropped in common usage—much to the befuddlement of anyone who knew what the acronym stood for.

GREGORY HILL
San Francisco, California

GETTING IN THE SPIRIT

Fletcher, Humphreys & Co., Ltd. is a wine and spirit merchant in New Zealand looking for names and addresses of users of on-line, real-time programs for order entry systems. Their inventory is made up of approximately 2,000 lines, some of which are held at more than one location. Orders are received through the mail, by telephone, personal attendance by the public, and through sales calls to retail outlets. The company wants to process these orders as quickly as possible with a minimum of writing and copying.

The system they seek must provide easy alpha access to files for a minimum of cross-referencing to schedules for customer and product code numbers. The company also desires a routing facility, because they deliver or arrange for the delivery of most sales.

"Our other data processing requirements," the company writes, "such as general ledger, accounts payable, accounts receivable and payroll are fairly standard, but we would be interested to find out how far these are integrated into an overall system. Although a relatively small, private company, we are agents for well-known brands, such as Bacardi Rum, Jack Daniels Whiskey, Galliano Liquers, Sichel Sohne German Wines (Blue Nun), Bollinger Champagne, and Remy Martin Cognac. It is partly because of our need to satisfy the requirements of these international principals for sales statistics and partly because of our own need to improve inventory management that we are looking for a sophisticated system. Although local computer suppliers do have systems, they tend to be package deals and very much in their infancy."

Any assistance readers can offer the company in making contact with users of such an order system would be appreciated. Fletcher, Humphreys & Co. Ltd. is at P.O. Box 946, Christchurch, 1, New Zealand. ✲

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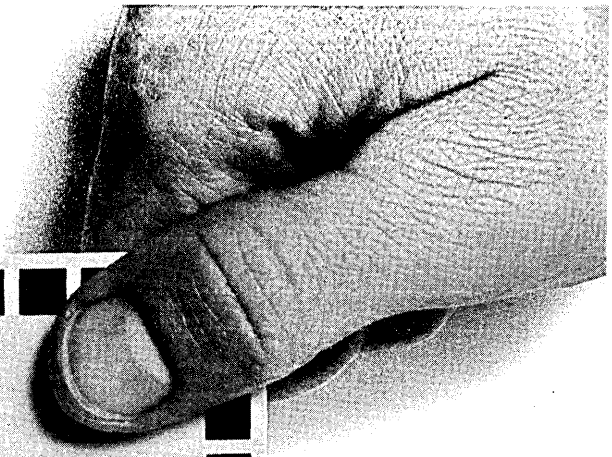

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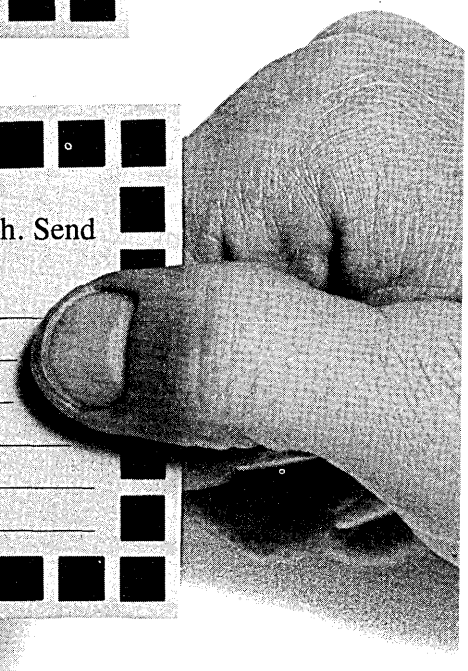

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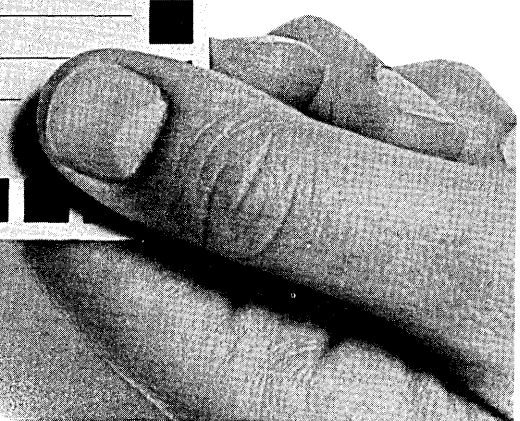

CIRCLE 15 ON READER CARD

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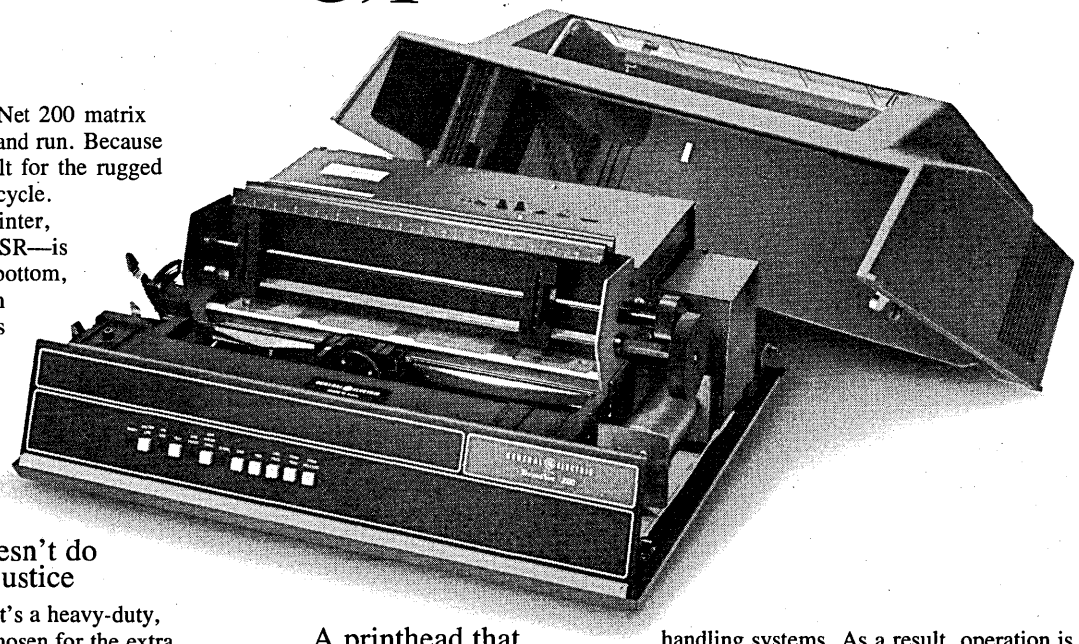
Every one—line printer, KSR, RO, ASR and MSR—is engineered from top to bottom, inside and out, with materials and components that will keep them on-line longer.

Take a look for yourself and you'll be just as convinced.



"Tough" doesn't do the design justice

Start with the base. It's a heavy-duty, thicker-gage metal base chosen for the extra stability it gives the entire printer. So no matter how often you move or handle our printers, printhead alignment and print quality will not be affected.

Notice how little hardware and how few moving parts there are. You know that means fewer problems, less downtime and more productive work time.

Check out the housing, too. It's molded from NORYL® thermoplastic resin. A material long recognized for exceptional impact strength, dimensional stability and heat resistance. All of which means TermiNet 200 printers are exceptionally resistant to scratches, stains, cracks and mars.

A printhead that won't quit on you

Everything about our matrix printheads says they won't have the problems most printheads do.

First of all, their head life is at least 100 million characters. Under test conditions, in fact, our matrix heads have even exceeded 300 million characters.

One reason: they're molded from a very tough plastic selected for its excellent dimensional stability and impact strength. The bottom line? Wires that won't wear out prematurely. And longer printhead life.

Another reason: a unique bronze-filled plastic insert that enables the printhead to maintain high print quality longer.

And, unlike ordinary printers, ours has a straight-wire printhead design. There are no curved wires or jeweled guides to create friction, impair character resolution or wear out quickly.

Servo motors cause fewer problems

That's why, instead of conventional steppers, we opted for individual D/C servo motors to drive the printhead and paper handling systems. As a result, operation is much smoother and more reliable. Plus, the motors last longer. In fact, test motors have undergone over 20 million reversals without a single failure.

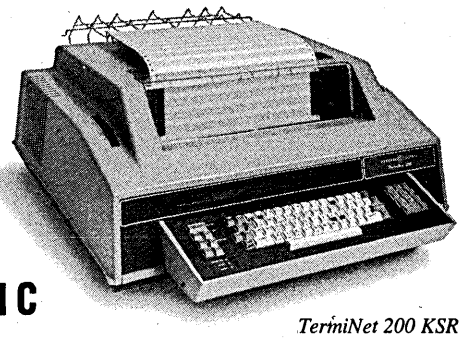
Need further proof?

Look at the printhead carriage. To prevent friction and lubrication problems, it's mounted on graphite bearings. Not ball bearings. Result: the carriage moves more smoothly and the life of the printing system is extended.

If you're still not convinced TermiNet 200 matrix printers are built from the inside out to keep on running day after grueling day, let us prove it to you. Write today to: General Electric Company, TermiNet 794-39A, Waynesboro, VA 22980.

TermiNet 200 MSR (ASR also available)

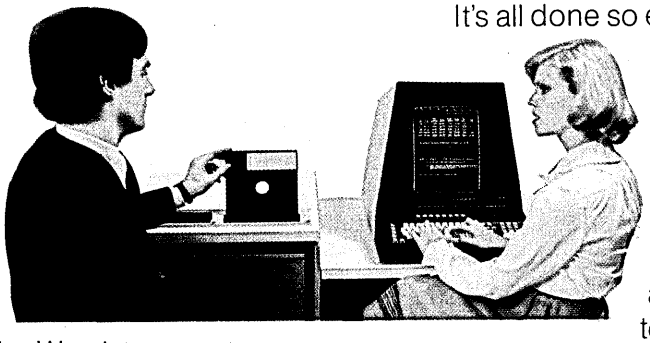
GENERAL ELECTRIC



TermiNet 200 KSR

The word processing system so advanced anyone can use it.

Everyone talks about features. Word processing is swamped with manufacturers offering all kinds of gimmicks. But nobody tells you that their systems are difficult to understand and operate.



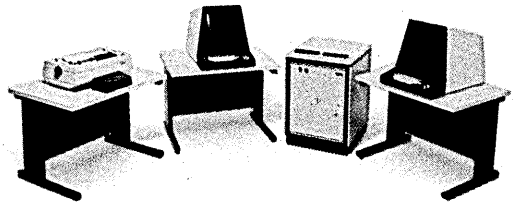
Forget all of the complicated jargon you've ever heard about word processing. The Wordstream system is different. Yes, we have the kind of performance features that warrant a standing ovation. But the whole point of Wordstream is that its advanced features actually make it easy to operate. We've combined the best elements of standalone and shared logic systems to give you an extremely powerful, computer-based managerial aid. It's technology in the service of efficiency. And it works.

The Wordstream system is a dramatically more efficient approach to the preparation, revision, updating, and printing of any kind of paperwork.

Operators view whole pages of copy on a TV-style viewing screen. As many as 12 operators at central, clustered, or remote stations can share the same computer intelligence to edit either the same or different documents. More accurately than ever before. Finished text is stored on compact, inexpensive magnetic diskettes.

It's all done so easily that people from any field—without computer training—can understand the system easily. This enables operators to concentrate on the problem at hand, rather than upon the computer technology being applied to solve it. We've proven it in installation after installation, in many diverse organizations across the country.

How can a Wordstream system help you? Write or call today. Not only will we get you information promptly, you'll understand it perfectly.



Wordstream Corporation
A Management Assistance Inc. Company
300 East 44 Street
New York, N.Y. 10017
Tel: (212) 557-3500
Marketed and serviced internationally by other MAI subsidiaries.

Wordstream

MAI

See Wordstream in action at the NCC, Booth No. 4400

CIRCLE 162 ON READER CARD

Wordstream

IBM Series/1

IBM has further expanded the range of modular hardware and software available in the highly versatile Series/1. These new features increase your ability to tailor the system you need today and extend that system for tomorrow's data processing requirements.

New Hardware

The 4952 Processor, the newest, lowest-cost member of the Series/1 processor family, utilizes new technologies to combine CPU, storage, address relocation translation function and a new clock/comparator on a single card. Storage is expandable to 128 KB with modules of 32 KB that are pluggable on the processor card.

A family of high performance, large capacity, full-function tape units has been added to the Series/1. The 4969 Magnetic Tape Subsystem comes in six models covering a range of speeds and formats.

The 5250 Information Display System stations (local only) can now be attached to the Series/1. The attachment feature provides for 4 ports and up to 8 stations per attachment.

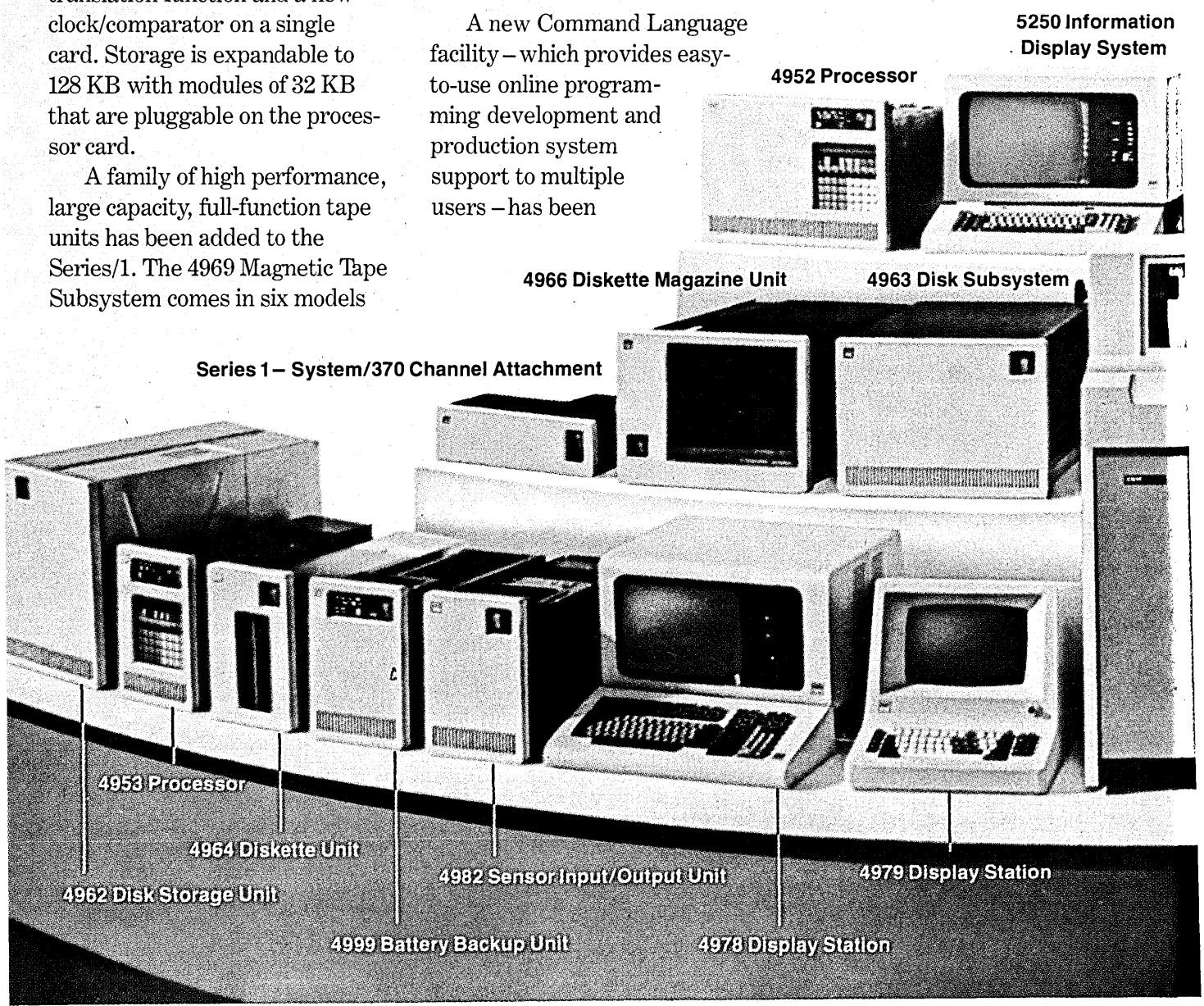
These new components have been added to a hardware menu that now includes 3 rack-mounted processors, matrix and line printers, standard and customized display stations and a wide variety of I/O devices.

New Software

A new Command Language facility – which provides easy-to-use online programming development and production system support to multiple users – has been added to the Realtime Programming System (Version 4).

Also newly available are an Indexed Access Method (IAM) program, which significantly enhances the data management capability of RPS, and a new version of the Program Preparation Subsystem, designed to increase customer program development productivity.

Series/1 also offers two additional operating systems. Event Driven Executive, which provides a powerful system for business and industrial users, has



Broader than ever.

been expanded and is now warranted as an IBM licensed program. And the independent modules of Control Program Support let you tailor a supervisor to your specific needs.

The full line of Series/1 hardware is supported by a comprehensive menu of programming languages which includes Fortran IV, PL/I, Assembler and COBOL. Available, too, are a variety of Series/1 programming packages to meet such needs as energy management, intelligent data entry and interactive processing.

More Capacity and Flexibility

Series/1 is powerful enough to be used in a stand-alone capacity and flexible enough for distributed processing. It can be programmed for a wide scope of tasks, including general business accounting, administrative applications and industrial automation for machine and process control, as well as power management, communications applications and scientific and engineering functions.

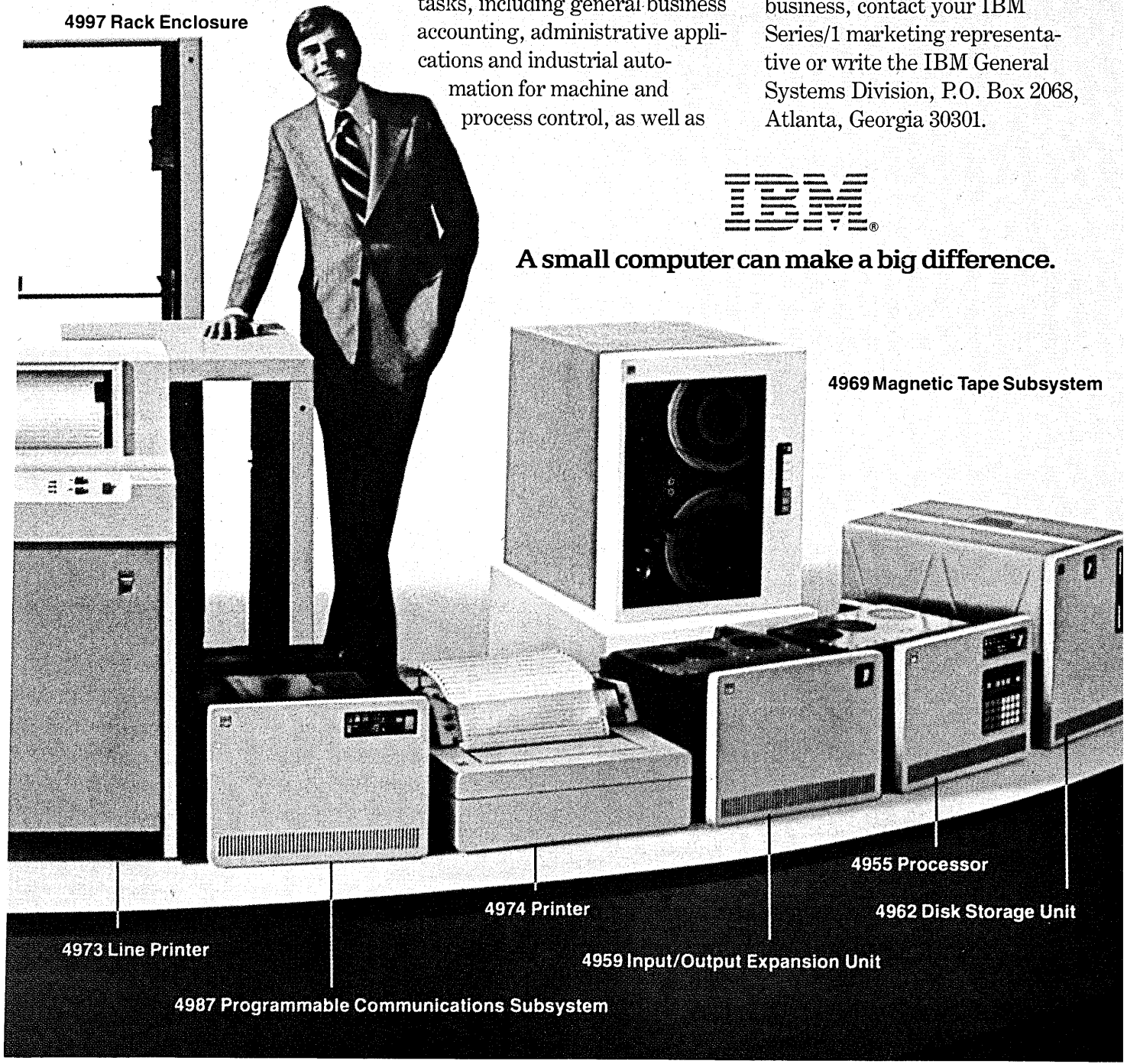
IBM Service Support

Series/1 is backed by IBM's extensive service organization. Ongoing IBM maintenance is available at a fixed monthly charge.

To find out how Series/1 can contribute to the growth of your business, contact your IBM Series/1 marketing representative or write the IBM General Systems Division, P.O. Box 2068, Atlanta, Georgia 30301.

IBM®

A small computer can make a big difference.



Relax!

We can get Lear Siegler's new ADM-31 Data Terminal on its way to you in minutes.

Whether your requirement is for a week, a month, a year or longer, there's one way to get the latest in Lear Siegler data terminals without waiting. Rent it from Leasametric.

Instantly, our nationwide on-line computerized inventory system will check our dozens of regional inventory centers to pinpoint the unit closest to you. Within minutes, your order will be processed and moving on its way. In most cases, your terminal will be in your hands in less than 24 hours.

Need only one terminal? A dozen? More? Don't waste time and energy calling everyone in the book. One phone call to Leasametric is the fast, simple way to end your equipment worries and start relaxing. And, rental means more than immediate possession. It's the one effective way to get the new equipment you need without going back to management for more money. There's no major capital investment with a Leasametric rental.

Leasametric, of course, means more than terminals. We stock the latest acoustic couplers, modems, development systems, communications and general-purpose test equipment . . . just about anything you might conceivably need. Our growing inventory includes over 23,000 items from 500 of the top electronic manufacturers—including almost the entire HP catalog.

Need it now? Why wait? To order, or for our latest rental catalog, pick up the phone and call one of the relaxing, nationwide numbers shown below. Or call your local Leasametric office. There's one in every major city.

Rent it and relax.

In the West
Call 800-227-0280
In California, call (415) 574-4441

In the Central U.S.
Call 800-323-2513
In Illinois, call (312) 595-2700

In the East
Call 800-638-4009
In Maryland, call (301) 948-9700

Leasametric

1164 Triton Drive, Foster City, CA 94404
A Trans Union Company

OHIO SCIENTIFIC DOES IT AGAIN

Ohio Scientific has taken its standard C3 computer and married it to the new Shugart 29 Megabyte Winchester Drive. The result is the C3-C. This new microcomputer now fills the vacuum that existed for computer users who need more mass storage capability than floppies can offer – yet until now, could not justify the additional cost of a larger capacity hard disk computer such as our C3-B 74 Megabyte disk system.

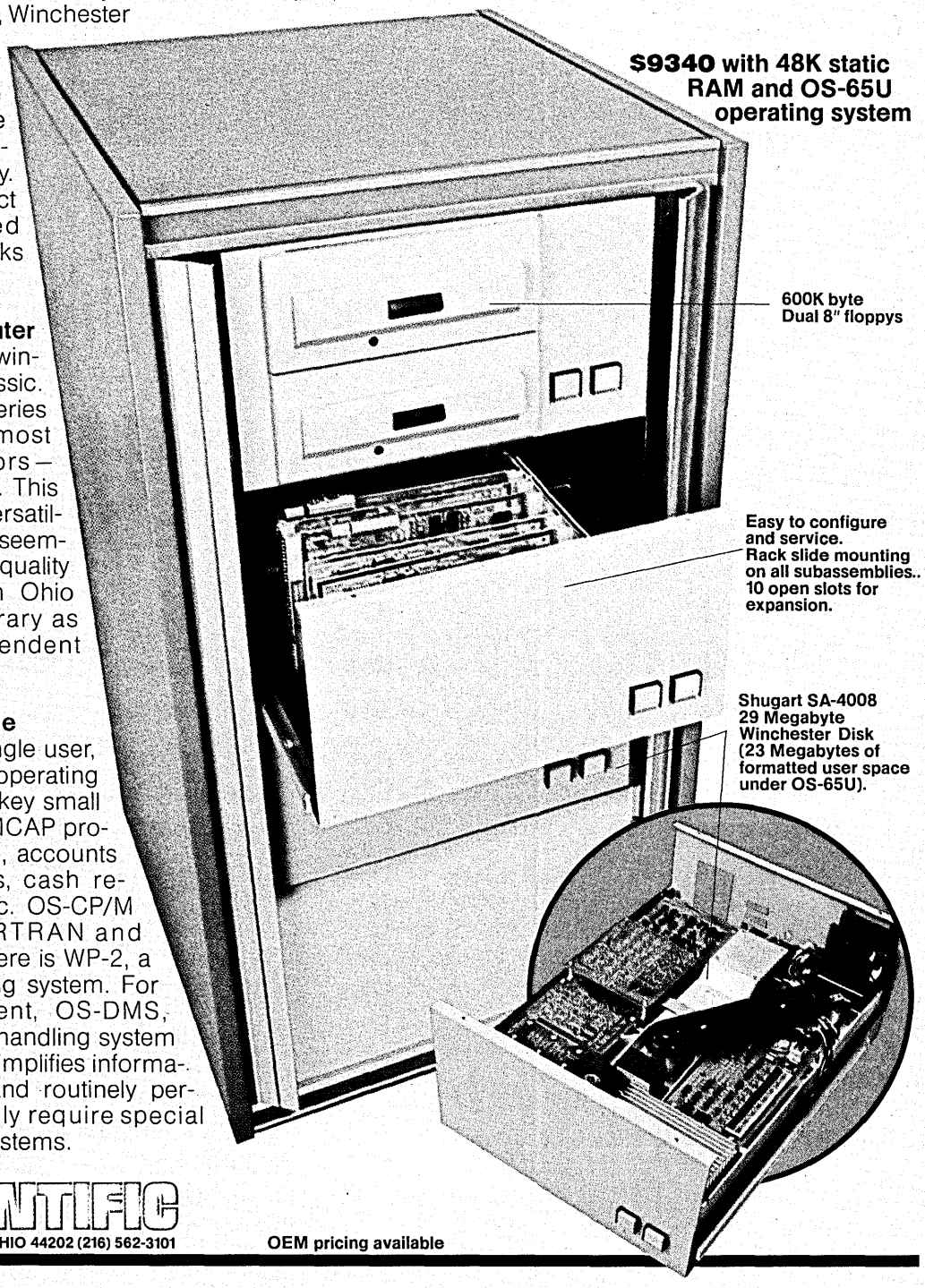
Winchester Technology
Winchester hard disk drives offer small business and professional computer users the logical solution to mass storage problems that are beyond the capability of floppy disks. In addition, Winchester disks feature a track seek-time that is much better than floppies and because they spin at eight times the rate of floppies, Winchesters have a shorter latency. Both of these points reflect one remarkable speed advantage Winchester disks have over floppies.

Coupled to the C3 Computer
Ohio Scientific's award winning C3 computer is a classic. It is the only computer series that utilizes the three most popular microprocessors – 6502A, 68B00 and Z-80. This tremendous processor versatility enables one to utilize a seemingly endless selection of quality programs available from Ohio Scientific's software library as well as from many independent suppliers.

And Advanced Software
For instance, there are single user, multi-user and network operating systems. A complete turnkey small business package, OS-AMCAP provides accounts receivable, accounts payable, disbursements, cash receipts, general ledger, etc. OS-CP/M offers a complete FORTRAN and COBOL package. And there is WP-2, a complete word processing system. For information management, OS-DMS, features an advanced file handling system and program library that simplifies information storage and recall and routinely performs tasks which usually require special programming on other systems.

Yields the Microcomputer of the Future
With an eye toward the future, the C3-C, like all other C3's was designed with provisions for future generation 16 bit microprocessors via plug-in options. There are ten open slots for lots of I/O and multi-user operation. Truly, the Ohio Scientific C3-C is a computer with a future.

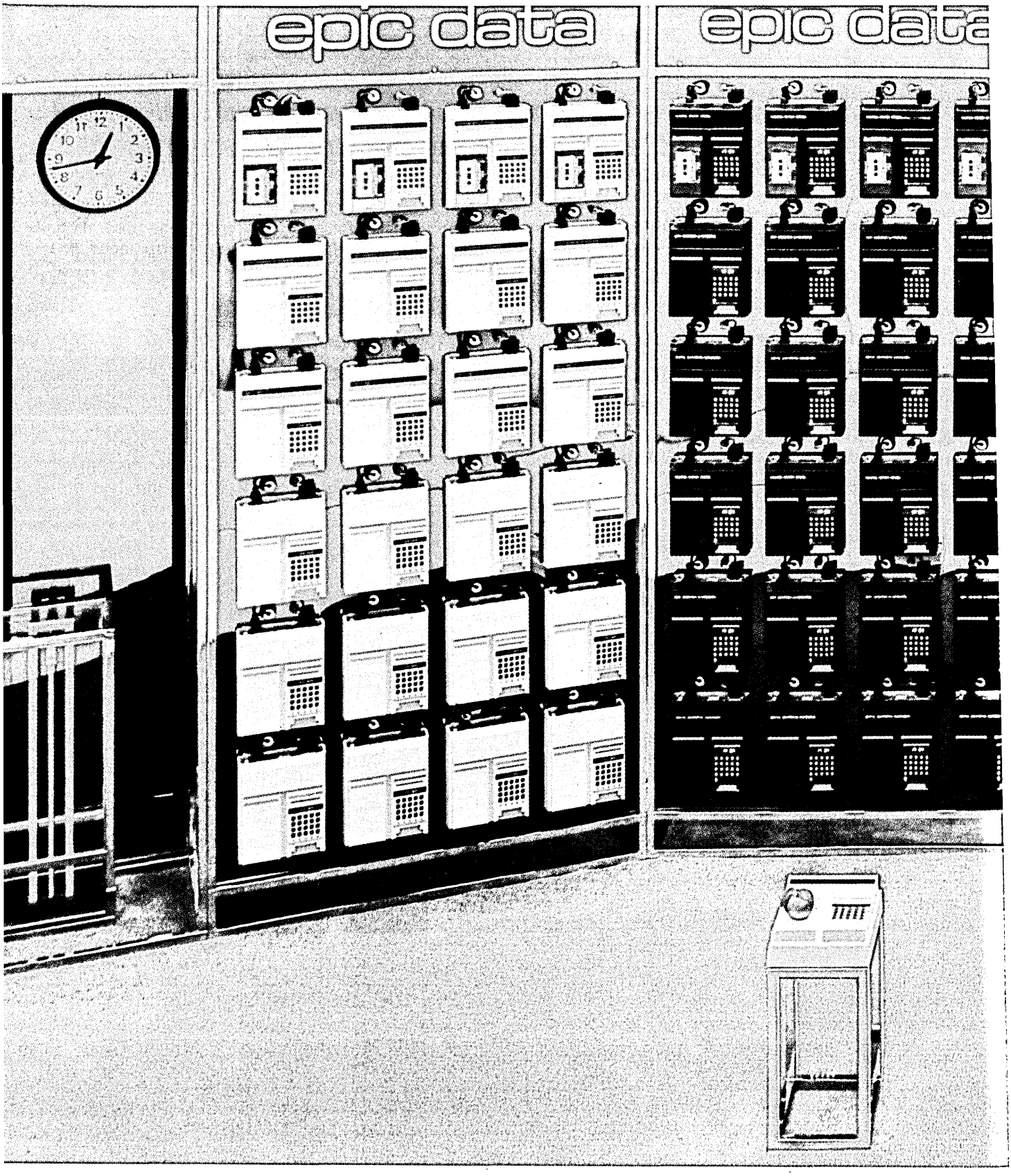
The new C3-C computer with 29 Megabyte Winchester Hard Disk.



OHIO SCIENTIFIC
1333 S. CHILLICOTHE RD., AURORA, OHIO 44202 (216) 562-3101

OEM pricing available

CIRCLE 123 ON READER CARD



At the N.C.C.!
96 WORKING TERMINALS!
All controlled by that little box out front.

The 96 terminals demonstrate Epic Data's powerful data collection system presently at work in **Factories, Libraries** and **Hospitals** across North America.

Among other applications to be demonstrated are:

A Standalone Terminal for data collection in remote locations;

A Moveable Weigh Scale Terminal for in-plant use.

That little box out front is the Epic Data System Control Unit (SCU) which controls the 96 terminals through four multidrop lines, as well as supporting 4 output peripherals and a host computer link. A new redundancy feature, providing automatic back-up by a second SCU, will be shown for the first time.

EPIC DATA terminals can be configured with any combination of these options:

Card Reader	Punched Badge Reader
Numeric Display	Alphanumeric Display
Keyboards	Magnetic Stripe Reader
Bar Code Reader	Special Interfaces
Prompting Lights	Simplex® Clock Control
RS-232C Ports	Memory Expansion

CIRCLE 64 ON READER CARD

epic data

ATLANTA	(404) 494-6763
CHICAGO	(312) 323-9674
HARTFORD	(203) 651-8724
HOUSTON	(713) 780-3230
LOS ANGELES	(213) 693-1273
TORONTO	(416) 494-6763
VANCOUVER	(604) 273-9146

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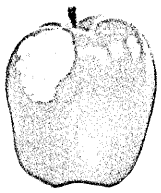
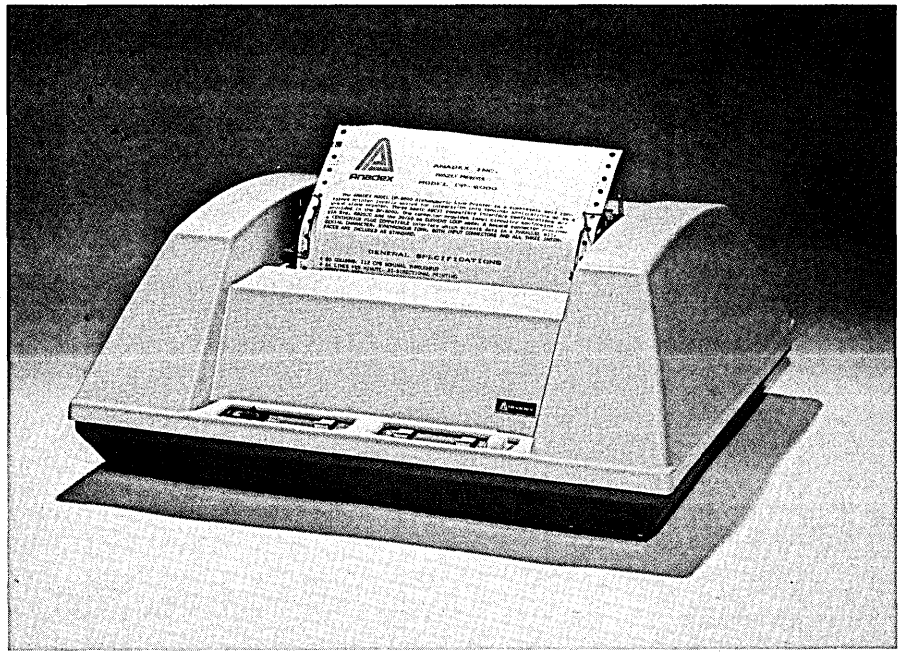
Richmond, B.C. Canada V6X 1X5



VISIT
N.C.C.
BOOTH
3114

The Anadex 80 Column Printer.



First check the specs. Then check the price.

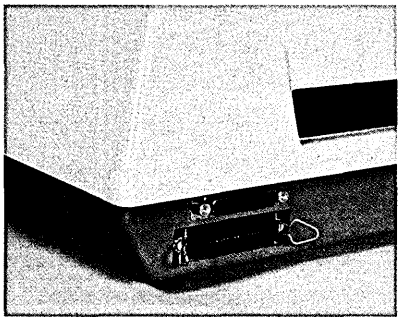
Our new 80-column dot matrix line printer – the DP-8000 – combines high performance and operating convenience with a low price that's worth checking into.

☐ **Check Performance**

The DP-8000 features a precision engineered, heavy duty printing mechanism that can print the complete 96 ASCII character set, bi-directionally, at 84 LPM.

☐ **Check the Interface**

Included at no extra cost, are two input connectors (see photo) that provide three basic ASCII compatible interfaces: EIA Std. RS232C, for interfacing at up to 96000 Baud with most minicomputers and modems; the 20/60 ma current drive mode required by Teletype® ASR33-35 printers; and the parallel-bit, serial character synchronous Centronics compatible interface.



The DP-8000 includes 12 lines of internal FIFO buffer storage and can accept data continuously or in bursts. Optionally, increased buffer storage of 2048 characters can be supplied for CRT dump and similar applications.

☐ **Check Printer Quality**

A 9 × 7 character font provides virtually half-dot resolution for clean crisp print quality on the original plus three copies.

Precise paper positioning is ensured by a sprocket-feed paper advance, user-programmable Top of Form control, and up to 8 vertical tab positions.

☐ **Check Convenience**

For operating ease, the DP-8000 accepts paper through the rear or bottom of the unit, provides programmable Skip Over Perforation control, and Out of Paper indication and logic signal.

☐ **Check the low Price**

The best news is the price. A complete DP-8000 is unit-priced at under $1000, with substantial discounts in larger quantities.

Once you've checked out the performance and price, we think you'll agree that the DP-8000 is definitely worth checking into.

Anadex®

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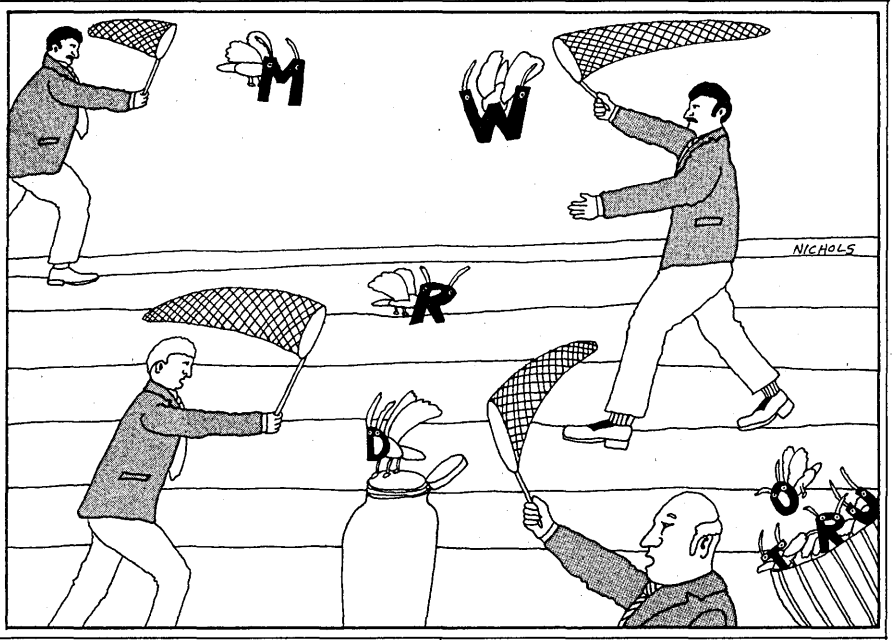
CIRCLE 24 ON READER CARD

EDITOR'S READOUT

ON FENCE BUILDING



Say the word computer to any moderately aware politician and he will immediately make a speech about entering the new Information Age.

Scrambling off his soapbox, he'll form a committee, or a subcommittee, or perhaps a task force, and then try for a mention on the Walter Cronkite news.

Although all this sounds harmless enough (your tax dollars at work), great dangers abide. Beneath the rhetoric lies the potential for the greatest triumph of the Age of the Clerk: the bureaucratizing of the Information Age.

There is an old saw which, roughly paraphrased, states that war is too important to be left to the generals.

To paraphrase the paraphrase, information policy is too important to be left to the policymakers.

Not that they aren't trying. Congress, sensing the public discontent with big government and prodded by Proposition 13, is inching toward deregulation.

Some notable efforts now on the Congressional treadmill are S611, principally sponsored by Sen. Ernest F. Hollings, chairman of the Senate communications subcommittee, and S662 from Sen. Barry Goldwater. Both call for the gradual deregulation of competitive common carrier services. Says Hollings, 'In effect, this bill creates a series of halfway houses, each with progressively less regulation, together with an orderly process for moving from one to another as competition develops."

Another nod to deregulation is the rewrite of the Communications Act, spearheaded by Congressman Lionel Van Deerlin.

Although we applaud these efforts, we feel there is little reason to be sanguine about major deregulation within the information industry. Or, at least, deregulation that is initiated by the government. And here's why:

Despite unreliable measures, we know there are more people employed in the information industries than there are in agriculture and manufacturing. We know, too, that, as computer and information technology spread, the number of information workers will swell tremendously. We know this, and so do the politicians and bureaucrats.

Their instincts are to corral this sector for their own ends—for power, personal gain, or just to perpetuate their existence. And this means more regulation, more agencies, more pyramiding of committees . . . what Norman Macrea, deputy editor of the London Economist magazine, calls "public sector imperialism."

Macrea writes, "It has . . . unsurprisingly become clear that the public sector (civil service) imperialism is not going to be curbed by electing politicians who promise to curb it . . . 'They' cannot be expected to curb 'them' . . . public-sector imperialism in democratic countries is not going to be rolled back by electing some monk to dissolve his own monasteries. . ."

What will happen, argues Macrea optimistically, is that "The competitive information marketplace in the computer age will allow small groups of people to decide for themselves how much of such (government-provided) services they want instead of having damn fool committees composed of people like me trying to think tank such decisions for them."

To achieve this we need more than half-way houses; we need fences . . . fences to create and preserve what John Diebold calls the privatization (awful word) of the public sector. We need to build substantial barriers between the public and private sectors and return to private enterprise the business of business.

But we cannot expect the move to less regulation and less bureaucracy to come from the regulators and the bureaucrats. Rather, the initiative must come from industry and from the individual. We must pass the propositions that limit the government's spending and taxing powers, and instigate the movements that delimit government's role. We must be the ones who think in new ways about the role of society and the economy or we will sink deeper into the morass. We in the private sector must assume responsibility for the freedoms and the constraints fueled by the computer revolution.

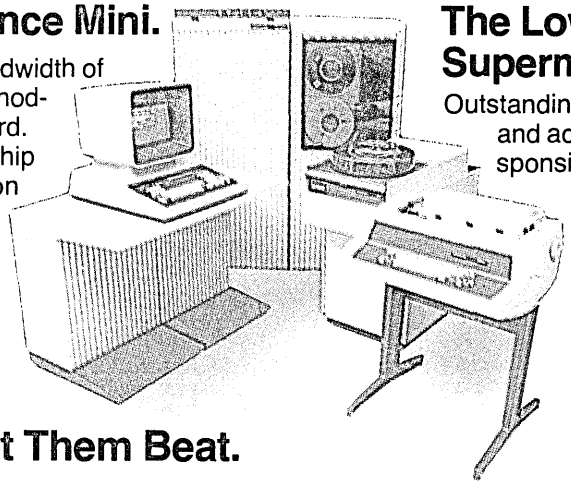
The efforts of Van Deerlin, Hollings, and Goldwater are not to be discounted. They ask a basic question—why regulation at all?

But the larger question is even more fundamental—what *is* the proper role of government in the Information Age? ✲

NTRODUCING THE PERKIN-ELMER 3220

The Highest Performance Mini.

Full 32-bit architecture. DMA bandwidth of MBytes. MOS memory in 256KB modules with error correction as standard. Memory error logging down to the chip level, if you want. Memory expansion to 4MBytes. Cache memory, 128 32-bit registers, number-crunching features no 16-bit mini can match. And, all for less than a PDP-11/60.



The Lowest Cost Supermini.

Outstanding run-time speed and accuracy. Fast, responsive program development. Easy, cost-effective program conversion. Check the comparison chart.

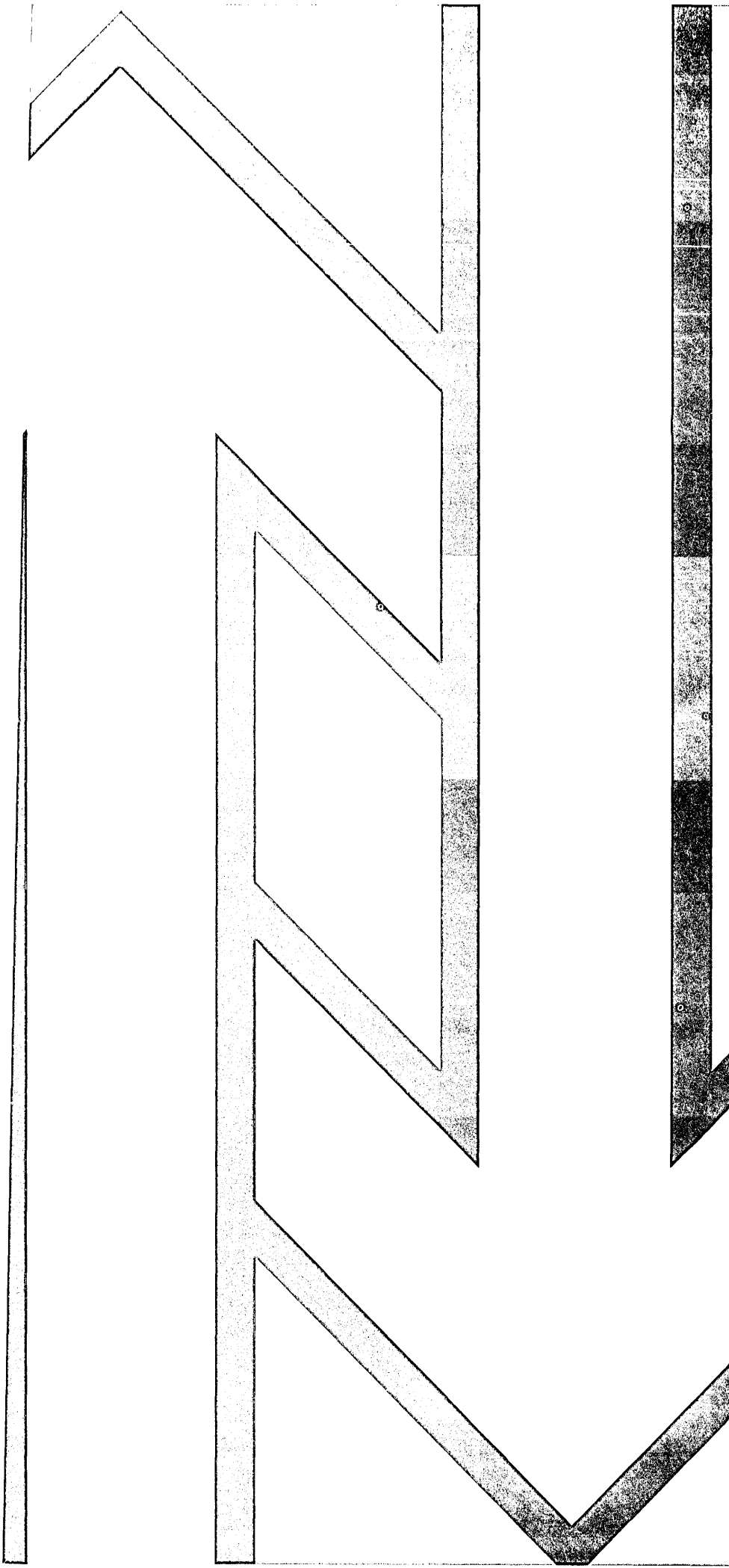
Either Way, We've Got Them Beat.

	DEC 11/34	DEC 11/60	P-E 3220	SEL 32/57	PRIME 550
Architecture	16-bit	16-bit	32-bit	32-bit	32-bit
DMA Bandwidth	2MB	6MB	8MB	26MB	2.5MB
Maximum Memory	256KB	256KB	4MB	1.87MB	2MB
Number of Registers	8	16	128	8	128
Direct Addressing	56KB	56KB	4MB	.5MB	32MB (virtual)
Writable Control Store	No	Yes (opt.)	Yes (opt.)	Yes (opt.)	No
Shared Memory Support	No	No	Yes (opt.)	Yes (opt.)	No
Pricing – Processor 256KB, PF/AR, Systems Console, Chassis and Cabinet	$29,700	$41,900	$33,500	$41,600	$70,000
256KB Expansion Memory	N/A	N/A	$10,000	$12,500	$15,000

	Optimizer Technology	Average Compile Time	Whetstone Benchmark	Matrix Inversion Program	Binary Search	Price *
3220 FORTRAN VII	Global	2000 LPM	2.25 Sec.†	3300 Sec.†	39 Sec.†	$ 88,600
VAX FORTRAN IV Plus	Block	1300 LPM	.85 Sec.	3700 Sec.	109 Sec.	$167,200

*Both 3220 and VAX configured with: 512KB, Floating Point, 10MB Disk, Dual Density Tape, OS, FORTRAN.
†Without cache memory option.

Visit Perkin-Elmer at the NCC, June 4-7, in New York.



Dynamic 32-Bit Software. Perkin-Elmer Quality.

The software available for the Model 3220 is exactly what you expect from Perkin-Elmer, a company whose reputatio was built on quality products. It's true 32-bit software, tuned and proven where it counts: in the field. And not just for months For years.

From the Inventors of the 32-bit Supermini.

When we introduced the first 32-bit supermini five years ago, we were known as Interdata. Now we are the Computer Systems Division of Perkin-Elmer, with ov 2000 successful 32-bit installations worldwide.

The Model 3220 is the first member of o new Series 3200 family, with more to com Advanced systems and software that will keep Perkin-Elmer the undisputed leader 32-bit performance and price.

Find out how we've got them beat any way you look at it. Call or write for a demo stration today. Perkin-Elmer, 2 Crescent Place, Oceanport, NJ 07757. (800) 631-2154, Or, in New Jersey, (201) 229-6800.

PERKIN-ELMEI

CIRCLE 141 ON READER CARD

You can buy financial software from a company that pretends to speak your language...

A software company can have computerese down pat, but not be fluent in accounting. Or vice versa. And a system that isn't based on real understanding isn't going to meet both your financial and data processing needs. ☐ At McCormack & Dodge, things are different. We're fluent in both ANSI Cobol and Generally Accepted Accounting Principles. Our general ledger, accounts payable, fixed asset, capital project accounting, purchasing and other software packages are designed by teams of both financial and data processing experts. So you get efficient, well-designed systems with all the comprehensive features and capabilities you need. ☐ It starts with a complete determination of the needs of financial people... by financial people. Like our CPAs, bankers and tax experts. Experts who are familiar with complex accounting requirements and understand the meaning of financial planning and control. They make sure you get the reports you need, in the form you need them. ☐ Then our data processing experts go to work to give you software that's flexible and easy to use. A streamlined system with top-down design, structured programs and efficient run times. A system that won't become a nightmare. ☐ Our software packages have been audited by the "big eight" accounting firms. Given top ratings in the 1978 Datapro Users' Survey. Selected by some of the world's most critical financial executives. And installed in over 800 companies, including dozens of the Fortune 500. ☐ In fact, 7 out of 10 companies we talk to end up doing business with us instead of somebody else. Because we understand both their financial and data processing requirements. You should talk to us, too. Because we speak your language.

or you can talk to McCormack & Dodge.

Talk to us. McCORMACK & DODGE CORPORATION
560 Hillside Avenue, Needham Heights, MA 02194, (617) 449-4012

Atlanta, Chicago, Phoenix, San Diego, Washington D.C. • United Kingdom/Netherlands, RTZ Computer Services, London • Australia/New Zealand, Adaps Software Ltd., Melbourne, Sydney

CIRCLE 60 ON READER CARD

TSO CRAZY?

A sanity test for all who have an interest in TSO.
Reading time: 1 minute, 10 seconds.

1. **Can you tell who is killing your response time by running games like STARTREK, HEARTS, or NFL STATS during prime time?** Yes☐ No☐
2. **Do you know when CLIST's go into a loop or when they are misused and severely impact other users?** Yes☐ No☐
3. **Do you try to convince your auditor that you can manage TSO without any consistent form of audit trail?** Yes☐ No☐
4. **Do you have a systematic way to summarize your monthly TSO usage on one page so that management can easily pinpoint problems and make trend projections?** Yes☐ No☐
5. **Do you know when users are "violating" the installation standards and security rules in using TSO?** Yes☐ No☐
6. **Is your only approach to TSO management the generation of ad hoc, one of a kind, special reports?** Yes☐ No☐
7. **If you use IBM's SPF, do you know which menus and functions your users are using?** Yes☐ No☐
8. **Are you trying to manage your TSO operation by an average response time measure only?** Yes☐ No☐
9. **Can you tell which users are using which commands, programs, and CLIST's, when, with what frequency, and at what level of resource consumption?** Yes☐ No☐

If you answered NO to 6 of the questions, (or you're just curious), we strongly recommend immediate consultation with those folks who have chased the TSO crazies. Call or write Mario, Tom, Doug, Lou Ann, or John today, tell them your test results and they will send you information that will start you on the road to full recovery. After all, 150 cures worldwide speaks for itself.

If you answered YES to 6 of the questions, you definitely pass the test (you are a TSO/MON program product user and know the answers).

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NEWS IN PERSPECTIVE

A GAME OF CATCH UP

Techniques for detecting computer frauds and for protecting systems against them are lagging behind computer technology.

"We're always working in a catch-up mode."

Edward H. Coughran, Univ. of California, San Diego, said this at a Honeywell Computer Security and Privacy Symposium in Phoenix last month. What he said was something of an echo—an echo of similar phrases spouted every time security people and/or auditors concerned with computers get together.

Larry C. Merich, manager, Price Waterhouse & Co., speaking last month at an all-day conference sponsored by the Los Angeles chapter of the EDP Auditors Assn., said essentially the same thing—"we're (he was talking about edp auditors) always playing catch-up ball."

And Robert E. Kukrall, Honeywell Information Systems, put it differently but said the same thing at the Honeywell symposium: "The sophistication of current technology and the explosive growth in the number of systems contribute unique control and access problems. Unfortunately, audit and control criteria have not necessarily kept pace with the technological growth."

He prefaced this statement with: "The minicomputer explosion and the geographic distribution of networks and terminal-based systems, also contribute to the problem of designing and implementing effective controls. Physical surveillance is difficult, if not impossible, in such an operating environment, and indicates an increased need for controls built into the application systems."

U. S. Sen. Abraham A. Ribicoff, (D., Conn.), author of the proposed Federal Computer Systems Protection Act which would make certain computer crimes federal offenses, sees a catch-up need in legislation and he thinks his bill could be it.

Today, said Ribicoff at the Honeywell symposium, "prosecutors must shoehorn or fit their computer cases into previously existing statutes. Sometimes the shoehorn approach works and convictions are won. But other times prosecutors lose cases—not on their merits but because of technicalities stemming from the lack of a computer crime statute. Judges have refused to allow certain exhibits as evidence because the law is unclear as to what is property in the computer field."

Sen. Ribicoff said he feels chances for passage of his bill by the Senate this year are "very good." He said he thinks the House will pass it next year. "There are no large groups against it. Justice is for it. There is no large price tag." He said the bill would "fill a void. It is the only potential criminal area not covered by law. It would fill a vacuum. It could act as a deterrent (to potential computer criminals)."

Joseph T. Woodall, special agent for the Federal Bureau of Investigation in Los Angeles, agreed with the last point. In a talk at the edp auditors' conference, he said he feels passage of Sen. Ribicoff's bill would give the FBI "legislative backing to investigate all computer crimes... it hopefully will be a deterrent."

In a question and answer session at the Honeywell meeting, an attorney in the audience asked Sen. Ribicoff why his bill didn't cover "crimes of a lesser nature. It doesn't allow for misdemeanor handling."

Ribicoff allowed as how "you've made a good point, one which we should and will consider." Ribicoff said his committee, the Senate Committee on Government Affairs, would be holding hearings to amend the bill. "We know there are bugs, and we'd like to hear from you," he told the Honeywell symposium audience.

Some who might contribute to the hearings are worried about the bill as it now stands. Among them are Coughran of UC

"There are no large groups against it. Justice is for it. There is no large price tag."

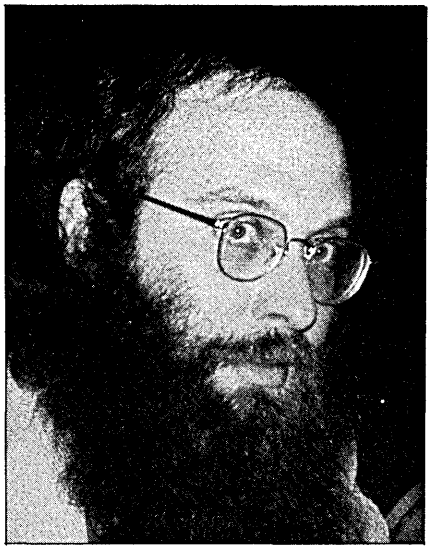
San Diego. Among other things, Ribicoff's bill would make "unauthorized use of a computer" a criminal act. "What's unauthorized use?" asked Coughran. "Is it using a computer you're authorized to use to run your church finance committee's mailing list, to tally bowling scores, or to do Snoopy calendars? What does it say in your job description cards? Probably zero. Sen. Ribicoff's bill fails to distinguish between crime and sin."

The Ribicoff bill would impose a severe penalty: 15 years or $50,000 or a fine of two-and-a-half times the amount of the fraud.

Coughran worried about a hypothetical situation. "It could cover not only action but attempt. What if I access a Univ. of Wisconsin computer via Telenet in the middle of another program being run and cause an abnormal abort. I could be eligible for 15 years in the slammer."

"Does the poor guy (who might violate provisions of the Ribicoff bill as it now stands) really know?" wondered Dennis Branstad of the National Bureau of Standards at the Honeywell meeting.

Another Honeywell speaker, Gary Rittenberry, an FBI special agent with the Phoenix Div., said the Bureau supports the Ribicoff bill officially but, in answer to a direct question as to his personal opinion, said: "Do you want the federal government in that area? If you do, then you need another bill but I'm not so sure that's the way



DAVID DOBKIN—"I'll take the undergraduates any time."

SEN. ABRAHAM A. RIBICOFF—He feels his bill will fill a void.

JEROME LOBEL—"There's a lack of vulnerability awareness."

to go. I think the states should do it but if they can't. . ."

"It's a basic jurisdictional problem," said William D. Holman, Fraud Div., Office of the District Attorney, San Diego, Calif. "It (the Ribicoff bill) creates more problems than it solves." The bill would cover any computer affecting interstate commerce and Holman believes "that could be stretched to cover a computer in your garage."

He would like to see "amendments to existing laws." He particularly would like "extension of the definition of property to bring in intangibles," such as computer time.

Holman talked about the "prosecutor's perspective" at the Honeywell symposium. He said a prosecutor faced with a computer crime case can do one of three things: get sick, run away, or pretend he knows what he's doing and botch it. "And if you get one, they gravitate to you as if you were flypaper."

Woodall, at the edp auditors conference, pointing out that one problem an investigator faces is explaining a computer crime case to prosecutors, urged dp people reporting a computer crime to "explain the case in layman's terminology."

He said investigation of computer crime faces many obstacles, high among which is lenient sentences. "But I think the pendulum is slowly starting to swing in the opposite direction." He cited the eight-year sentence imposed on Stanley Mark Rifkin, convicted of a $10.2 million swindle of Security Pacific National Bank, as an indication of this.

Jay Becker of the Los Angeles County District Attorney's Office (April, p. 65) talked about lenient sentences at the Honeywell meeting. "There seems to be more glorifying of the (computer) criminal than punishing him."

Woodall cited lack of reporting as another obstacle faced by the computer crime investigator. "I realize in a lot of cases there's a tendency to eat the loss," he told the edp auditors, urging them to "always notify the proper authorities when a computer crime is uncovered."

Sen. Ribicoff feels his bill will encourage this. "Unfortunately, all too often the victims of big computer crimes—insurance companies, banks, brokers, even the federal government—are so embarrassed by their misfortune that they do not report the offense to law enforcement agencies. My bill will serve as an incentive to encourage corporate victims of computer crime to report their losses to authorities."

"Because he was needed, the programmer was permitted to become weird."

It is one thing, Sen. Ribicoff said, "to be robbed at gunpoint. All of us can sympathize with the victim in that kind of crime. But to be tricked by a crooked computer expert is to admit vulnerability and a weak set of controls."

Many violators, he said, "originally set out to prove they could beat a machine. They turned to crime when they realized that in beating the computer they could make a lot of money."

David Bonyun, I. P. Sharp Associates Ltd., Ottawa, Ontario, Canada, offered Honeywell symposium attendees a "game theory. . . It's an antagonist situation and the computer crime perpetrator has to be presumed to be at least as smart as you are."

He was talking about threat analysis, particularly the analysis of threats of an intentional nature. "You can impact exposure (to intentional threats) by increasing realization costs." He defined realization costs as those costs a perpetrator has to expend to get what he wants. He said these could include cash out of pocket, equipment, personnel, education, and time.

Dana Richardson, Arthur Young & Co., talking to the edp auditors, also was concerned with threat analysis. "Always conduct a threat analysis of a system you're going to audit," he told them. "Find out what can go wrong, go wrong, go wrong."

Steve Moss of the Los Angeles office of the FBI, at the same meeting, worried about another kind of threat, that of white collar criminals learning from other criminals while in prison, He feels most of those caught made mistakes because they were amateurs at crime. "When they get out (of prison)," he said, "they'll have pumped them (the pros) dry of everything they know. They won't make the same mistakes a second time."

Coughran at the Phoenix meeting worried about the threat of the "weird programmer. Because he was needed," he said, "the programmer was permitted to become weird. Probably the first employee in your organization to wear sandals to work was the computer programmer. The first employee who had a stereo set in his office, or who had the gall to ask for one, was the computer programmer. It was considered normal that he came to work at two o'clock in the afternoon. After all, he was here until the wee hours testing the new system and that testing could not be done during the day because we need the computer for production on the old system. He had keys to everywhere since he had to check out the operation of the system from all our user locations."

He feels that late, overbudget and overrun development projects are "perpetuating the legacy of the weird programmer. I think the brightest hope lies in the increasing use of data base management systems if the designers of those software systems build in the controls and audit checks, hopefully not as an option which can be easily disabled."

Coughran expressed another concern, also people related. "We have a sociological

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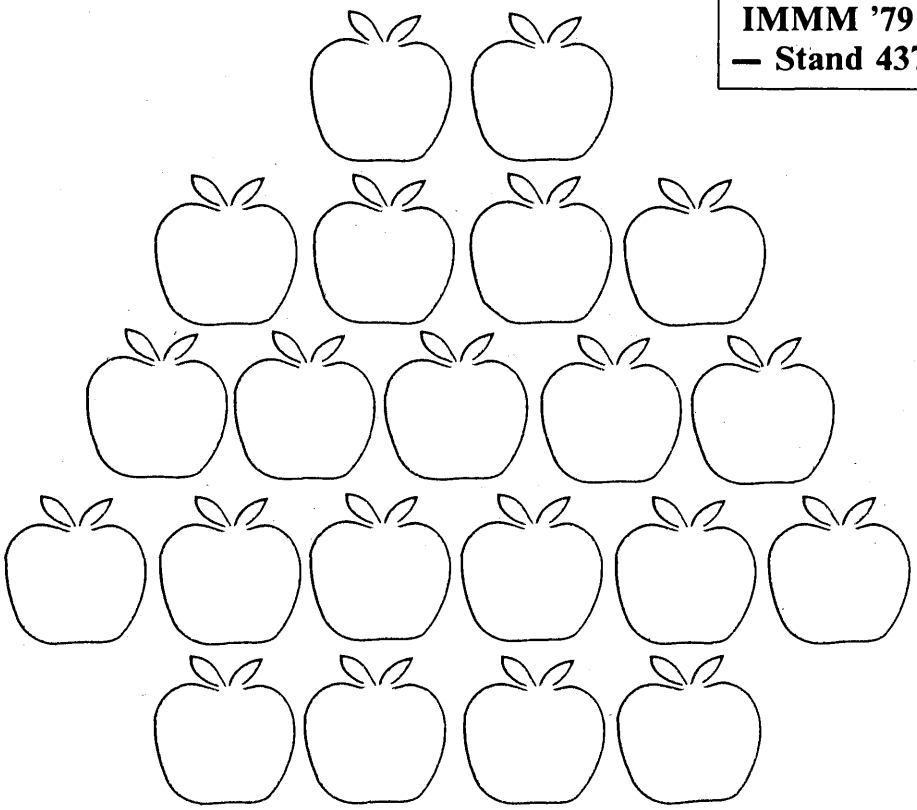

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time bomb ticking." He was talking about students who get so wrapped up in data processing that that is all they study; then they leave school knowing only dp. They get jobs in data processing and "we have careers that peak at age 30. What do they do next?"

Jerry Lobel, manager of computer security and privacy for Honeywell, talked about risk analysis and what he called "a lack of vulnerability awareness." He conducted a study of 250 computer users known to have been exposed to risks. Names were drawn from attendees of previous Honeywell security and privacy symposiums and were 60% Honeywell users and 40% users of other equipment. He asked them about risk analysis. He determined that there is a growing interest in formal risk analysis programs, but "if you're going to use one you'll probably have to customize for your own needs."

Hal Becker, Advanced Computer Techniques, worried about increased vulnerability with the move toward distribution of functions. "Front-ends, remote processors, data base processors, intelligent terminals—all represent areas where penetration can occur." He said ACT did a computer user study of issues of importance to various levels of personnel. Only

"The people most concerned with security are the people least able to do anything about it."

with top corporate management did security rank number one, he said. "The people most concerned with security are the people least able to do anything about it."

F.G. ("Buck") Rodgers, vice president, worldwide marketing, IBM Corp., told the edp auditors, "most of our customers have security sitting on the back burner."

Becker said there are three classes of security. First and highest is government and that kind of security is not available in an off-the-shelf product. Intermediate, he said, is the security needed by banks and financial institutions and he expects that will be available off the shelf in the future. Third listed was the kind of security available off-the-shelf today. He cited as an example, Honeywell's Multics system (March 1977, p. 152). "And other manufacturers are looking at Multics' functionality, thinking about how to design it into their systems."

Two Honeywell symposium speakers described a public key system developed by W. Diffie and M. Hellman as "the neatest thing to come along in years." This is an encryption system using two keys one of which can decrypt only. David Sykes, Honeywell, said such a system is being used in the monitoring of seismic tremors in the Soviet Union. The Soviets have the decrypt key to authenticate what is being sent, but they can't change it.

David Dobkin, Univ. of Arizona, while he considers the public key system "neat," believes "its absolute security can never be proved in a rigorous manner." In fact, he doesn't believe there is any foolproof method for verifying security. "Given the choice between formal models (for verifying security) and informal undergraduates, I'll take the undergraduates any time. Given time and resources they'll break any system around today."

And even as the Honeywell symposium was going on, at nearby Arizona State Univ. in Tempe, two ASU undergraduates were doing just that, penetrating that school's computer system.

—Edith Myers

PRIVACY

PRIVACY GUIDELINES

Presidential proposals, costs, how it's being done and the responsibilities of business.

President Carter last month asked for legislation designed to protect individual privacy.

He proposed new restrictions on the use of medical records and records of federally financed research projects. He promised to submit soon a bill that would expand privacy laws concerning banking, credit, and insurance records.

He said he is issuing new guidelines for federal agencies that use computers to detect fraud or abuse in their programs. He also said investigators would be required to notify the public before any new computer search of names was made. Disclosure of names of suspects would be restricted.

The President's proposed safeguards for medical records would limit government access to the records, give individuals the right to see their own medical records, make it a crime to obtain medical record information under false pretenses, and establish other privacy protections for information maintained by hospitals and other medical facilities.

Proposed legislation regarding research records would provide a legal standard of confidentiality that would allow researchers to release information for nonresearch purposes only in a medical emergency or to prevent physical injury to an individual. It also would require a researcher to tell research subjects that information about them might be used and it would provide criminal fines for unauthorized disclosure of research information.

Robert Ellis Smith, publisher of *Privacy Journal*, compared the proposed medical records restrictions to the Right to Financial Privacy Act passed by Congress toward the end of last year's session, during a Honeywell privacy and security symposium last month. "That bill was passed at 11 o'clock at night on a Saturday night and is hardly model legislation." He also called it inappropriate "to apply the same rules to a gallstone operation and to a balance in a checkbook."

Smith also took issue with a Presidential proposal to extend the Fair Credit Reporting Act, which now applies only to individuals, down to entities such as businesses and other organizations.

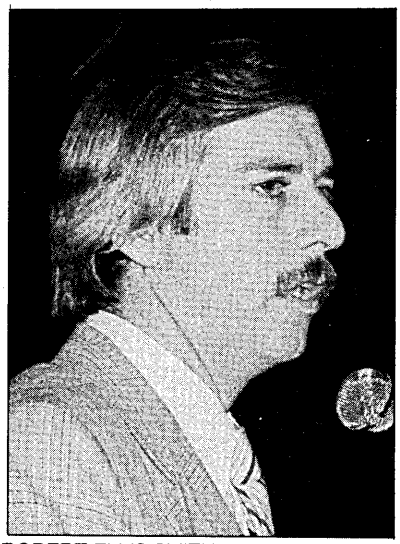
He also said proposed matching guidelines were not strong and would not prevent one government agency from matching its records against those of others.

Smith said technology, not legislation, should be used to protect privacy when possible. He talked about so-called junk phone calls. "You could have a mini attached to your phone programmed with all the numbers of your friends which would weed out incoming calls from other numbers."

At the same symposium, Dr. Robert C. Goldstein talked about the cost of complying with privacy legislation and the use of models to determine that cost. "The use of a model," he said, "tends to lend credence to the conclusions reached, and as is often said of statistics, it is possible to produce almost any desired result by proper manipulation of the input data and assumptions."

Different approaches to compliance will result in different costs, Goldstein said. "Just as it is possible to use the model to identify low cost compliance techniques for actual implementation, it could also be used to find high cost techniques for lobbying purposes. For example, it will nearly always be true that 'add-on' compliance measures will cost more than ones that have been designed into a system initially."

But models do have their place in estimating privacy compliancy costs, in Goldstein's estimation. He believes they can be put to good use to minimize cost of



ROBERT ELLIS SMITH—"It's hardly model legislation."

JACK OSBORN—"Voluntary compliance stands a good chance of succeeding."

"BUCK" RODGERS—"IBM has a very strict policy."

OLIVER R. SMOOT—"Privacy is up to us."

compliance. "This is a valid and potentially very productive use of the model. While it cannot be depended upon to give correct cost estimates for specific situations, it can be used to test strategy alternatives to see what their relative impact on costs would be. We can also identify the regulatory provisions that account for large proportions of the total cost. Attention can then be focused either on achieving modification of these provisions or on developing better technological approaches to complying with them."

An area of potential cost which has long bothered private business is compliance with privacy laws which might affect employee records. President Carter, in his guidelines, left this aspect to self-policing. He called for a "privacy policy" to be observed by industry and various levels of government which would allow persons to know what information is being collected about them and to see and correct their personal files. They would be informed when an adverse decision is taken based on personal data and would be allowed to prevent improper access to their files.

California State Senator David A. Roberti, at an edp auditors conference in Los Angeles last month, told of a report on employee privacy he'd heard at a conference on "Privacy in the States." "The panel on employee privacy felt that the increasing complexity and sensitivity of information maintained in an employee's personnel file poses a mounting threat to the employee's right of privacy. The potential for harm to the employee has increased dramatically because so much personal information is compiled in one place."

Jack Osborn, TRW Credit Data Div., at the Honeywell symposium, said he feels that voluntary compliance to voluntary standards in employee records privacy "stands a good chance of succeeding" in business and industry. He referred to a paper published last December by The Business Roundtable, a consortium of 180 corporations.

The paper, prepared by a Roundtable task force, summed up these beliefs: "The collection, use, and dissemination of employee information should be conducted in an open, understandable manner, with the rules and reasoning behind such collection, use, and dissemination being available to all employees and applicants.

"We don't use Social Security numbers as identification. We won't open our records for credit checks."

"That companies should establish formal policies outlining the proper handling of employee information and communicate these to their employees.

"That all employees should be permitted to inspect those basic personnel documents that directly impact their individual employment status except for those documents that have been specifically excluded from disclosure.

"That a formal means should exist for employees to point out and request correction of errors in those records they have been permitted to inspect. And, the opportunity to inspect and obtain corrections of one's record should be clearly available and communicated.

"That all releases of personal information within and beyond the boundaries of the employing organization should be strictly controlled by written procedures and closely monitored for compliance. Further, that releases beyond the boundaries of the employer should be carefully circumscribed and should, in general, take place only with the employee's consent."

F.G. ("Buck") Rodgers, vice president, worldwide marketing for IBM, told the edp auditors meeting that IBM has a strict policy regarding privacy in employee records. "We don't use Social Security numbers as identification. We won't open our records for credit checks. Employees are permitted immediate access to their own personnel files. No information is sent to outsiders unless the person is aware."

Oliver R. Smoot of the Computer and Business Equipment Manufacturers Assn. (CBEMA) told the Honeywell symposium that "the employee issue (in privacy) is up to us."

Smoot would like the term "information policy" to encompass privacy concerns, and he sees this as advancing into word processing and the linking of office subsystems in geographically dispersed office operations. "What we have to do is maximize fairness and the expectations of confidentiality."

IBM's Rodgers, at the edp auditors conference, had similar concerns and he would like to see that these are communicated to engineers. "We've got to tell the engineering organization to consider how to find a better way to address the end user and protect the data."

Rodgers had numbers to offer in his predictions for office automation. "By 1981, half the cost to do business will be in administration and clerical. By 1982, one half of all workers will be white collar. By 1985, 20 million more will join them."

Today, he said, blue collar workers show an 84% productivity rate increase for $42,000 in capital expenditures (yearly). For white collar workers, the productivity rate increase is 4% and the capital expenditures rate is $2,000.

"If there could be even a one percent increase in production (for white collar workers) the savings in management skills and time would be almost unbelievable."

Rodgers, who likes to talk about the future, did so at the auditors' meeting. "One

out of five homes will have a terminal device in five years."

And two of his fellow speakers at the meeting, Dana R. Richardson, Arthur Young & Co., and Larry C. Merich, Price Waterhouse & Co., could be living proof that he is right. Each has his own computer at home: Richardson an Apple II and Merich, a TRS 80 from Radio Shack. And they look forward to the day when edp auditors will carry around their own computers.

"Some aggressive hardware manufacturer will come up with one," said Richardson. "We'll be able to tell clients that we'll bring out our own machine. And we won't bring it in a van. We'll carry it in a pocket."

—Edith Myers

COMPANIES

HONEYWELL DOING WELL IN MINIS

What everyone thought was a blunder turned out to be "the best kept secret in the computer business."

Honeywell Corp. figures in one of the most memorable, poignant tales of missed opportunity in the history of the computer industry.

Years ago—and very briefly—Honeywell dominated the minicomputer industry when, in 1966, it acquired Computer Control Corp. of Framingham, Mass. With CCC, Honeywell had it all: the most advanced mini technology, products, and markets.

It lacked only vision.

That Honeywell chose to absorb CCC's instrumentation skills and bury the purchase within its diffuse dp group—virtually discarding the standalone mini market to the likes of little Digital Equipment Corp.—soon came to look like one of the classic blunders of American industry, particularly in the eyes of Wall Street.

Like stigmata, it scarred the company's image for a decade. And in recent years, as HIS vowed to reassert itself in the low end of the business, the fact that it made little effort to penetrate the high-volume OEM market was taken as further evidence of Honeywell's inadequacy in the mini business.

A year ago, when *Business Week* sang a dirge for Honeywell's mini operation, heads began to nod sagely—only to be brought up rather shortly as HIS launched a media blitz to publicize what it called "the best kept secret in the computer business." Minicomputers, terminals, and mini-based dp products were a $250 million business for HIS, the company claimed. And shipments for the new Level 6 minicomputer were expected to double in 1978.

In an ironic twist of history, minis have become the major growth area for Honeywell.

With 1978 results in, it's apparent that the growth of minicomputer and mini-based terminal sales are having a major impact on the company. Sales of Level 6 mini systems are an estimated $100 million after their first full year of production. And total sales of minis and mini-based terminal systems contributed an estimated $190 million—nearly 15% of Honeywell's dp revenues and one third of the company's total income from computer sales.

Honeywell's dp business, Honeywell Information Systems (HIS), reported revenues from computer sales, rentals and services of $1.29 billion (about 37% of Honeywell's total sales of $3.5 billion). An additional $990 million of dp sales were

NEWS IN PERSPECTIVE

STEPHEN G. JERRITTS—". . . strengths that even IBM doesn't have."

JAMES R. POMPA—He used children's building blocks to get a point across.

generated by Cii-HB, the French computer company in which Honeywell owns a 47% interest. The combined HIS and Cii-HB dp revenues rose 31%, from $1.6 billion in 1977 to $2.1 billion in 1978. Honeywell's net income from HIS and Cii-HB rose 39%, from $145 million to $201 million, and the company entered Fiscal '79 with its largest backlog ever.

"The outlook is bright, particularly in terminals, minicomputers and distributed processing applications areas," said chief executive officer Edson Spencer in the annual report. In an ironic twist of history, minis have become the major growth area for Honeywell. HIS sources report that Honeywell's internal five-year forecast—its so called Strategic Review—predicts 1982 income from minis and mini-based terminal systems will be fully 40% of the corporation's dp revenue.

Clearly HIS has something to boast about in minicomputers. Clearly, too, the company's momentum and growing market share in the field has been greatly underestimated until recently—so much so that its reemergence in the mini marketplace has about it the air of a resurrection.

Honeywell executives no longer try to bluster past questions about the CCC debacle. "There may have been—and certainly were—missed opportunities in minis for Honeywell because of its emphasis on large systems," shrugged U.S. Information System Group vp Stephen Jerritts. "Yes, we could have had a stronger position today had we concentrated on the CCC acquisition. But I think as the industry and the market has evolved, the way it was played has been very good for us.

"We have a strong position in large systems; we have a strong position in medium systems—and the emergence and congruence of minis and mainframes gives us strengths that even IBM doesn't have." Jerritts, who directs HIS's domestic computer operations from his Waltham, Mass., headquarters, argues that the potential inherent in the CCC acquisition was understandably enough soon dwarfed by the challenge of the GE-Honeywell merger of 1970. Even in hindsight, he said, the bias is justified. The GE merger brought about a marriage of talents—products from GE, marketing skills from Honeywell—that had a locus in the large systems.

Jerritts took over the USIS Group in Waltham in early 1977, amid considerable confusion. An 18-year IBM veteran—formerly IBM operations area manager for the Pacific, Canada, and Latin America—Jerritts left IBM searching for more independence. Moving to France, he became a consultant for Bull-GE, and eventually (after the merger of French and Honeywell interests had formed Cii-Honeywell Bull) a division general manager and member of the management committee.

After nearly six years in France, HIS asked him to take over its troubled U.K. market, where Scottish manufacturing plants were bleeding revenue and sales operation was in disarray. After guiding the U.K. business through a successful three-year turnaround, Jerritts—by now an established troubleshooter—was called back to Minneapolis to direct Honeywell's corporate product management operations for information systems. A month after he arrived, USIS Group vp Lee Sheehan died suddenly in the midst of a major group reorganization and Jerritts was tapped to replace him.

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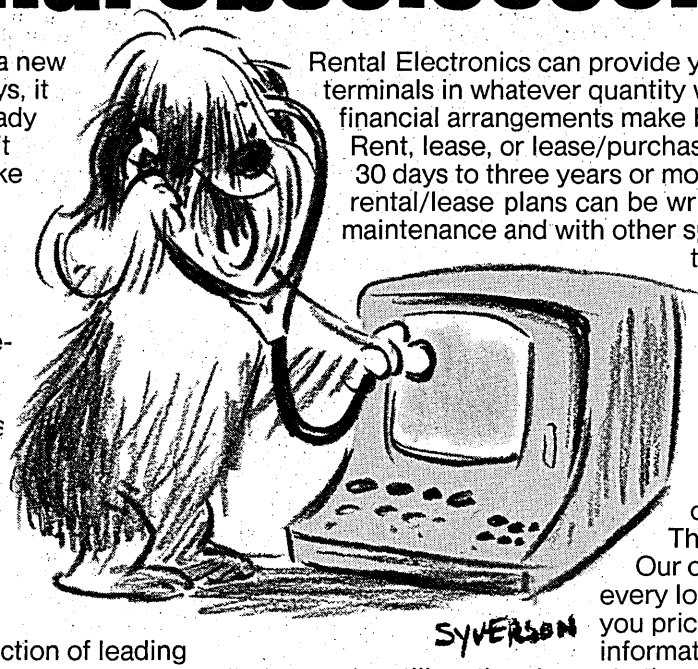

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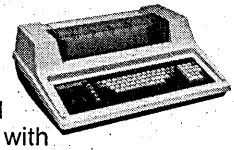
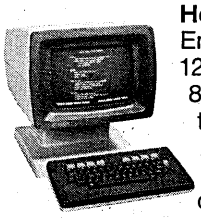
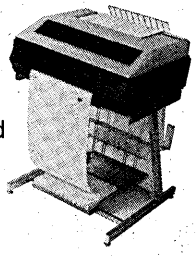


TI Model 820 Keyboard Send-Receive Data Terminal/Printer Printer operates at 150 cps on 9 x 7 wire matrix assembly printhead. Full ASCII Keyboard (ANSI-compatible) with N-key roll over. Operates in Asynchronous, USASCII, RS232C interfaces and is compatible with Bell 103, 113, 202 and 212 units. Selectable baud rates of 110 to 9600.

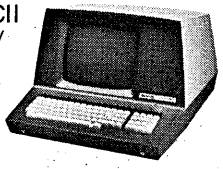


Hewlett-Packard 2621A/P Terminals Enhanced 9 x 15 dot character cell, full 128-character ASCII character set in 24 80-character lines. Two pages of continuously scrolling memory. RS232C and Bell 103A compatible. 110 to 9600 baud. 2621/P includes built-in printer operating at 120 cps.

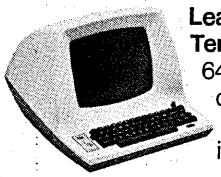


Tally T-2000 Hush-Tone Line Printer Acoustically designed enclosure. Operates at 125 (Model 2100) and 200 lines/minute (Model 2200) with standard 64 character USASCII. Line spacing switch selectable, 6 or 8 per inch.

ADDS Regent 200 Terminal 24 lines x 80 characters, 25th "status" line shows operating mode. 128 character ASCII. RS232C/CCIT V.24 communications interface operating 75 to 19.2 BPS, switch selectable. Buffered transmission, auxiliary ports.



Beehive Micro B 1A Terminal 128 ASCII character set; switch selectable scroll/non-scroll mode; X-Y addressing; 24 x 80 display format; single key memory lock; fully buffered communications to auxiliary peripheral device.



Lear Siegler ADM-3A Data Entry Display Terminal 12" diagonal, 24-line screen. 64 ASCII characters. Full or half duplex operating modes, switch selectable, baud rates from 75 to 19,200. RS232C interface, 20mA current loop.

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CIRCLE 145 ON READER CARD

The year before, 1976, Honeywell had brought the first of its new Level 6 minicomputer line into the market—the product of more than two years of joint development between HIS control system engineers, representing the company's big internal minicomputer market, and a small system development team. The synergy in the design effort reflected Sheehan's desire for a "technology engine," adaptable for terminal and control systems, and upward compatible for distributed systems configurations. Yet, the minicomputer operation—like the whole domestic group—was caught in the middle of a transition. When Sheehan died, James Pompa, whom Sheehan had selected to head up the small/medium information systems group, was still in Washington running the HIS federal systems operation.

A "technology engine" for terminal and control systems and upward compatible for distributed systems configurations.

Sheehan's reorganization plan was on paper in broad generalizations when he died—but he had been in the process of reassigning responsibilities, territories and people; instituting a brand new management structure with centralized marketing—and the detailed intent of the plan was lost. "It was like walking into a maze without a map," recalled Jerritts. "Oh yes, I had an organization chart. And that's about all."

Jerritts' first year in Waltham was largely occupied with fleshing out and implementing the new domestic organization structure. In Billerica, Mass., the nearby headquarters of the small/medium group, Pompa—a veteran GE marketing manager who had come to HIS with the merger—began to get a grip on his organization, to reassess the direction and potential of the Level 6 minicomputer effort.

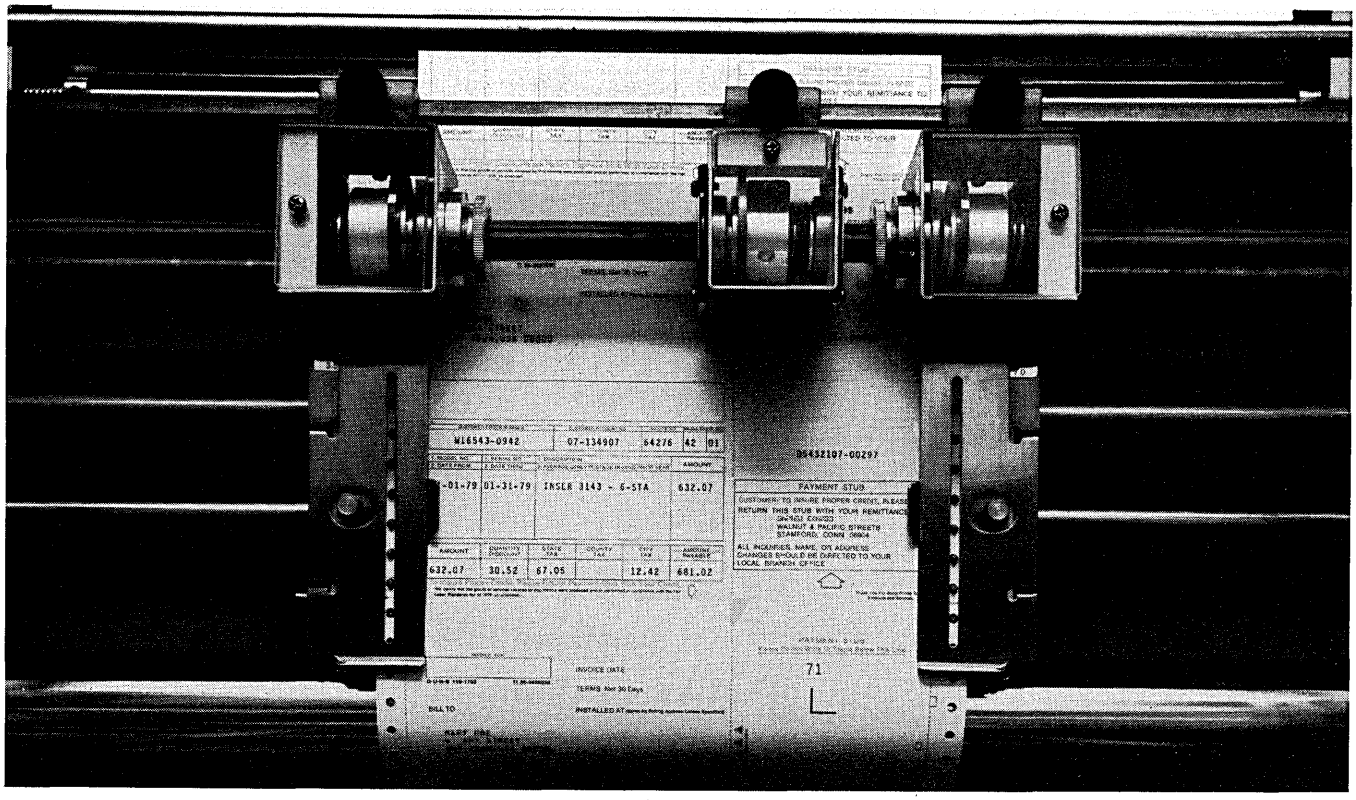
The Level 6 mini, designed around a 6-megabite asynch megabus, was designed for an oem market, as well as to be the keystone of the HIS data network and distributed systems environment. Now, for the oem market, Jerritts and Pompa had second thoughts.

"The initial approach was to aim it at the classic oem," recalled Jerritts, "but we eventually veered totally away from that, dramatically so, in our product and design approach as well as in our marketing approach." By mid-1977, they had decided that they wanted it to be a multifunction machine that also would be modular—"not only in hardware, but also in software, in the various elements of the software: the execution, the communications capabilities, data entry capabilities. We would add them modularly and overlay them on your basic operating system.

"We took a page out of our mainframe business," he said, "something those in the mini business as mini manufacturers would not do, or have not done very effectively. We said, 'Right! The mini we're going to sell to a customer, he'll never have to throw away! He can upgrade the thing—just as you can upgrade mainframes. On site. From whatever level he enters at, to the top of whatever level our product line he reaches. . . ."

"As another page out of our mainframe experience, we decided that it isn't really effective to do that unless your operating systems are compatible along your full line. Now, this is not an easy thing to strategically articulate and—with the constraint on future models, that they be field-upgradable from models announced earlier—it was a very difficult thing to put into practice. But we have done that! And it has been a hell of an exciting (period) since mid-'77, when we made that 180-degree change."

A reconsideration of the oem arena was key to the software redesign of the Level 6, explains minisystems chief Jim Pompa. Besides the obvious difficulties of trying to cut into a market in which the major oem users were already deeply committed to their suppliers, Pompa saw the whole oem busi-



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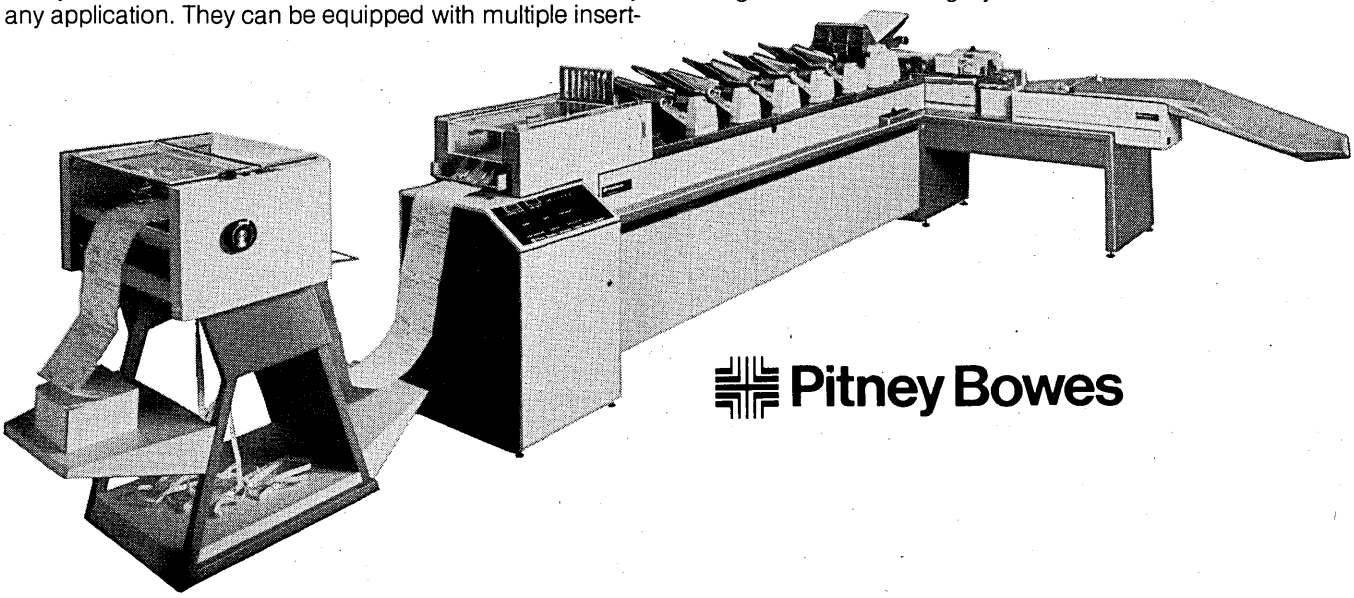


Pitney Bowes

ness—manufacturers who used minis to supply logic for larger machine units—being overtaken by the microcomputers, the computers on the board. The oem's who are still buying high volume from the mini vendors, he decided, are doing so largely because it's so expensive to retool and redesign for microcomputer system. Among newcomers, at the design level, boards are in.

"If he's smart enough to put a whole system together," said Pompa, "then he's smart enough to put power on a board that will provide his control functions. The traditional minicomputer oem business has given way to the system builder—at least in the design stage." It's a distinction not yet stressed among industry analysts, he explained, but the oem is quite literally an equipment manufacturer, one who uses a mini as a control component in a larger piece of equipment. The growth market is the system builder, the marketing system house, those who add value almost wholly in their software.

Truly modular software—an expandable operating system—would be Honeywell's lure for the system builders. Pompa, with a laugh, describes the day he brought several boxes of children's building blocks into the office to get the idea across to his designers. "The man wants to control a lumber mill's warehouse (*a blue block is added to a base*) ... later he wants to automate the pulp mill (*yellow block*)...."

Between February and May of last year, Honeywell capped two more years of R&D in minicomputers by introducing what in effect was a family of six new Level 6 minicomputers. With the exception of the low-end Model 23—which takes a modified bus structure—the entire line is hardware compatible and field upgradable. And the full line is completely software compatible. "Compatibility is something everyone talks about," said Jerritts, "but look closely—do they really have it? There's a lot of empty talk...."

"But this is where we are—with the evolution of the market and with this product orientation—and we're moving into a number of different markets."

A priority market, of course, is Honeywell's own mainframe base of users. "Our base is very important here," said Jerritts. "Currently it provides something like 40% of our minicomputer sales." And, despite other growth markets, he said he believes the base will continue to contribute about that percentage of mini revenues. "Of course we see the whole spectrum: people who are using it for dedicated applications, tying them together in networks, tying them together with mainframes, or going the full distributed environment route. The latter is obviously coming on more slowly; there's much more networking today than true distributed systems networking."

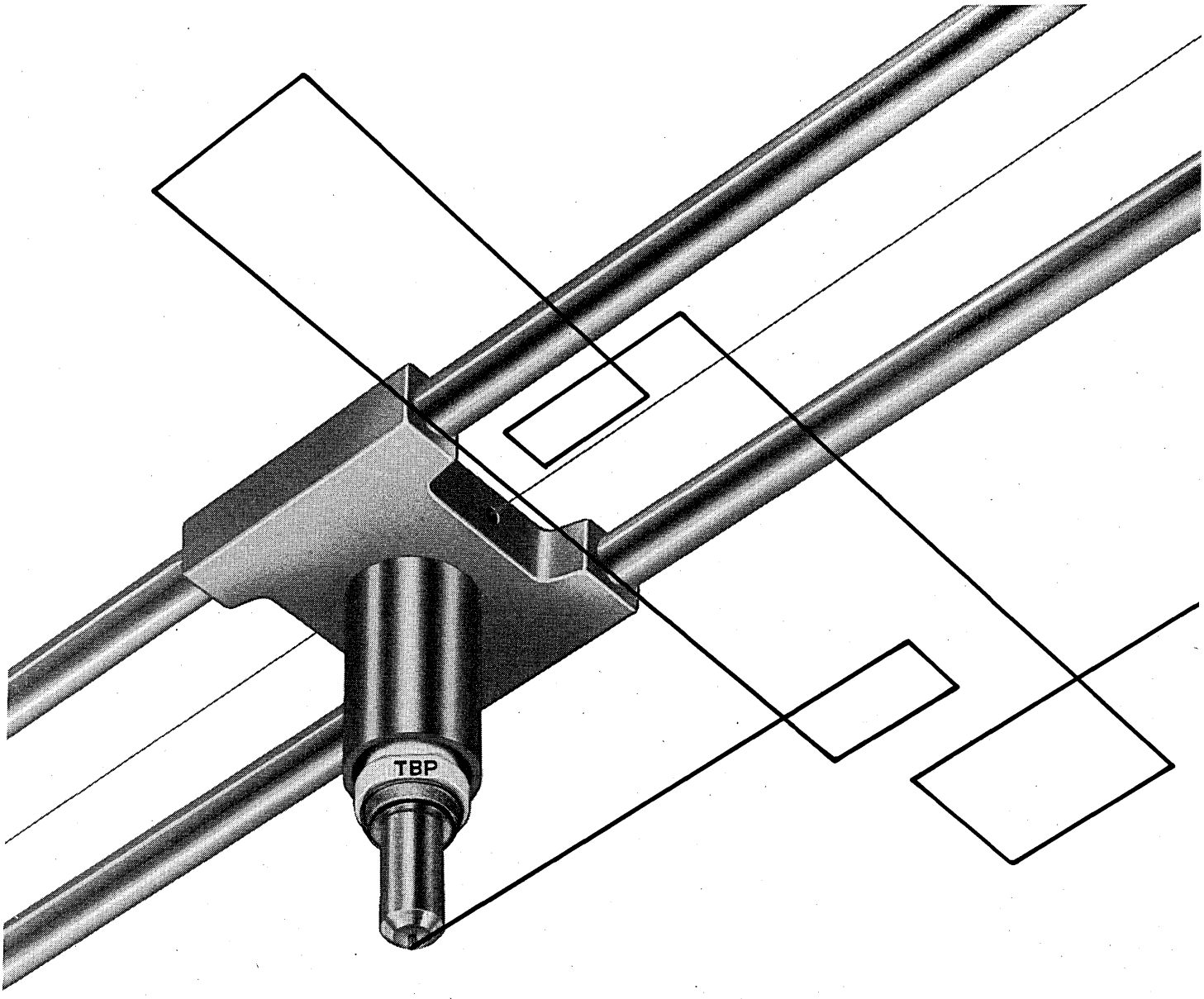
Outside the HIS base—among IBM and other mainframe users—there is another major market for Level 6, said Jerritts. "We have designed Level 6 to communicate with other mainframes as well as our own.... This, obviously, is going to develop a little more slowly," he smiled, "but we currently have dedicated salesmen throughout our field offices who are focusing entirely out of our base. And we anticipate that to be a major market."

Somewhere between the oem's and the system builders are Honeywell's internal markets.

The third market is among the system builders. "We have a completely separate mini sales and marketing group which sells to system builders—to the whole gamut—but we really have very few of what you would call true oem's, the people who make up a lot of the business for DEC and DG." As examples of the new breed of system builders, he noted Brunswick, a leading supplier of bowling center equipment, which is buying small minis upon which it will configure its Integrated Retail Bowling Information System (IRBIS) package for bowling centers; and General Computer Corp. of Macedonia, Ohio, which has developed an elaborate transaction-based system for drugstores to track inventory, patient histories, print labels and statements, and keep the variety of records now required by drug regulations.

Somewhere between the oem's and the system builders are Honeywell's internal markets. Its Avionics Div. has ruggedized the Level 6, and the unit has already been incorporated in the Honeywell page printing system, as front-end network processors for Level 66 and 68 mainframes, and it is being incorporated in a redesign of the INCOMATE factory data collection terminals, among others. Honeywell's various control system divisions—process control, avionics, test instruments, defense systems, commercial, protection services, and the traffic management center—are all redesigning or have redesigned major systems around the now-standard Level 6 minis.)

"We're not marketing the Level 6 to the first-time business user who wants to buy one," said Jerritts. "Our salesmen get no commission on those sales. We're going for the *Fortune* 500 multiunit end users. I'm not sure that a company like Honeywell—or a company like IBM, for that matter—knows how to make money selling minis to the first-time end user one by one. And we have a feeling that this market is probably going to be covered quite effectively, perhaps more effectively, by regional—and in some cases, national—organizations which are leaner and doing one thing only: selling minis to first-time end users.... particularly if they have something to offer in the way of unique applications to an industry."



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CIRCLE 80 ON READER CARD

NEWS IN PERSPECTIVE

Last year, Honeywell announced new overseas production facilities for the Level 6 in Angers, France; in Newhouse, Scotland; and in Nis, Japan, under license to NEC. In October, HIS reported a joint venture to manufacture minis in Yugoslavia for the Eastern European market; and Honeywell's French associate, Cii-HB, is currently negotiating with the Chinese to license production of the Level 6 and Level 64 in China. In 1978, HIS invested $30 million more in mini and terminal R&D (and Cii-HB, $15 million more), and launched major projects to refurbish the Massachusetts minicomputer production facilities.

It was only last March that Jerritts finally canceled Honeywell's ultra-large computer development program in Phoenix—sinking the Model 66/85, the prospective flagship of the HIS large systems group, and writing off a major long-term investment. It was a decision, said a corporate spokesman, that to many within Honeywell, "seemed to symbolize the end of big-computer dominance and the newfound balance between minis and large systems that is Honeywell's real strength."

—V.M.

TECHNOLOGY

DIGITAL IMAGES

New technology is finding a wide range of uses, from assassination studies to religion.

The assassination of President John F. Kennedy probably was the most photographed crime in history.

"There were at least 50 photographers in the area at the time," said Dr. Harry C. Andrews, vice president and director of advanced plans and programs, Comtal Corp., Pasadena, Calif.

Andrews has had a lot of exposure to the results of the work of those photographers. Before joining Comtal last Jan. 1, he was director of image processing at the Univ. of Southern California and, while in that job, he served on a panel of photographic experts for the Select Committee on Assassinations for the U. S. House of Representatives.

The committee "went out of business" last Dec. 31, at which time the secrecy lid surrounding its investigations into the assassinations of both John Kennedy and Martin Luther King was lifted. Its final report, due out late last month, includes the findings of the photographic panel which were, Andrews said, "that the Warren Committee was essentially correct and there there was no photographic evidence to support a conspiracy theory."

Andrews said his committee worked through three contractors: usc, Los Alamos Scientific Laboratory, and Aerospace Corp. Because he had served both Los Alamos and Aerospace as a consultant while he was at usc, he coordinated the work of the three. All three used Comtal digital image exploitation stations but had differing amounts of computer power and storage capacity.

The panel selected 400 frames of film to be digitized from the 2,000 available of the Kennedy assassination. This resulted in 25 magnetic tapes of digitized images. Andrews has one set of copies of the 25 tapes and a second is in the custody of the National Archives.

Andrews said digital image processing can be compared to filmless photography. He said putting images into digital form affords better manipulation and enhancement, making data inherent in an image more visible because electronic sensors make for a larger dynamic range than can be had with sensors responsive to photos on film.

He said the Comtal image exploitation stations are essentially digital computers but better for their purpose because "digital computers are too slow. We get a refresh rate of 10 megabytes per second."

In analyzing the Kennedy assassination photos, Andrews said, the panel zeroed in on those photographs that people he called "assassination buffs" had used in support of conspiracy theories.

"What we did could not have been done 15 years ago. The technology wasn't there.

"What we did could not have been done 15 years ago, at the time of the assassination. The technology wasn't there."

Among the frames analyzed by the panel were those from the 8mm film made by Abraham Zapruder which were the basis for a *Life* magazine article. One of these frames was alleged by "assassination buffs" to show a man in a bush with a rifle, Andrews said. Digital manipulation and image enhancement showed what might have looked like a rifle to have been a twig on a tree behind the bush.

A photo of the Dallas police chief holding up a gun supposed to have been Lee Harvey Oswald's was said by some "buffs" to be a picture of a different gun. Digital analysis showed nothing to prove it was not the same gun, Andrews said.

Another photo analyzed was a picture taken of Oswald in his backyard prior to the assassination, holding the gun. At the time of his arrest, Oswald claimed this was a composite picture—his face on another body. Analysis aided by computer disproved this, or at least came up with nothing to indicate it was a composite.

Pictures of the window of the Texas School book depository from which Oswald fired were believed by some to show other people in the window. Analysis didn't turn up any. And a picture of man some thought was holding a gun simply turned out to be a picture of a man in a black raincoat.

Andrews, while he found his work with the House committee "interesting," does not see this kind of use of digital image enhancement as among its more exciting uses. He sees as more exciting such uses as that by Jet Propulsion Laboratories to "clean up images from their spacecraft."

He sees "great potential" for the process in the printing industry particularly because of its ability to present on a display screen exactly what a printed page will look like without going through chemical, mechanical, or photo/optical procedures. And when it is displayed, he said, a user can correct, define, intensify, or reduce any primary color, and change tone values over all or any part of the image.

Andrews said IBM, which he called "the largest in-house publisher in the world," is a big Comtal customer for its publishing operation.

He said Comtals also are being used in Landsat stations to enhance images in real time. "Oem systems integrators for ground stations are big customers." In France the company is selling units for use in computer-aided tomography.

And back with the enhancement of photographs, law enforcement use is increasing. Andrews said the Law Enforcement Assistance Administration has funded image enhancement use in law enforcement through Aerospace Corp.

A Los Angeles company called Graphic Evidence enlisted Andrews' services to enhance some photos used in a football injury lawsuit. Bob Selzer of Graphic Evidence said the case ended with a hung jury and will be retried in 1980. He said acceptance by courts of such evidence is growing and

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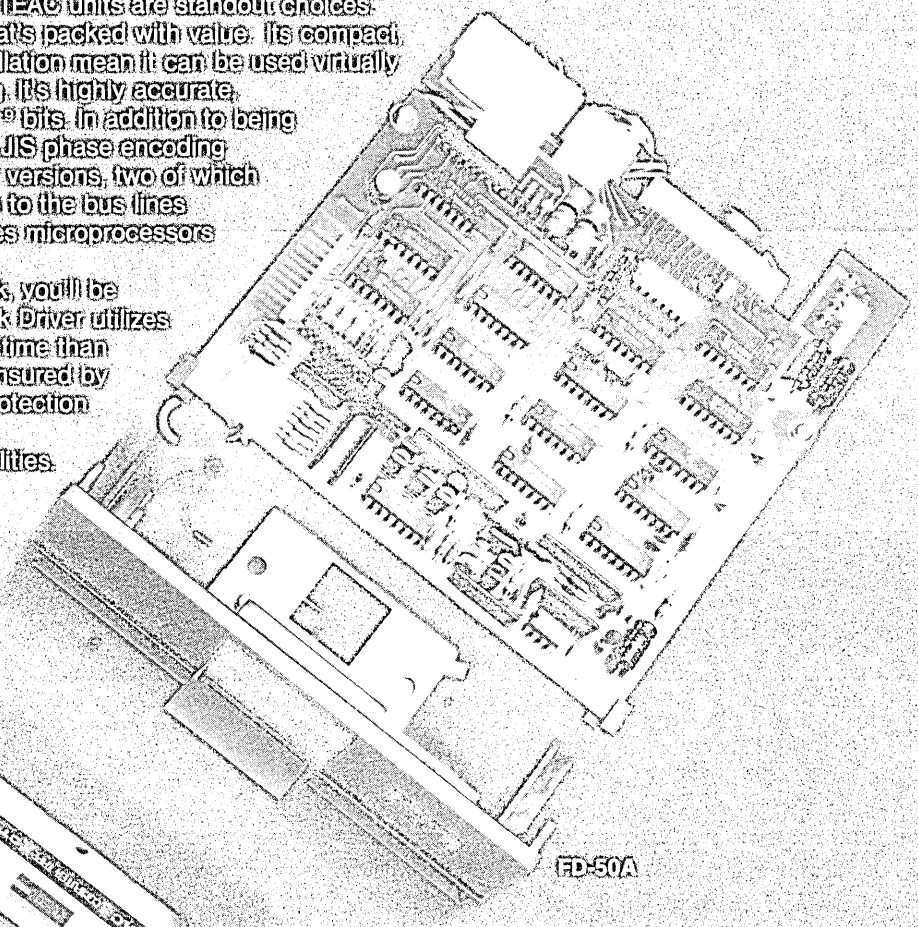
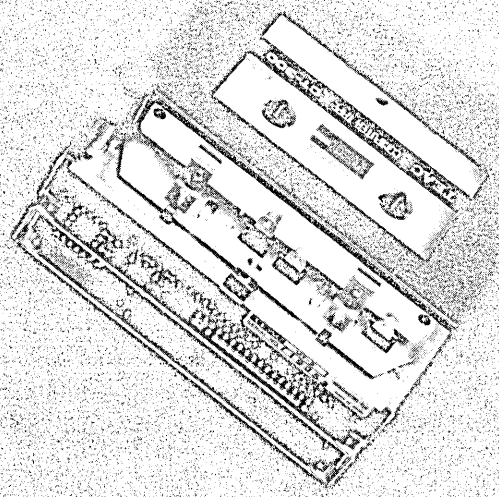


FD-50A



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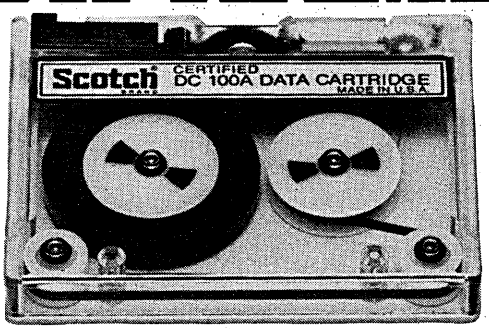

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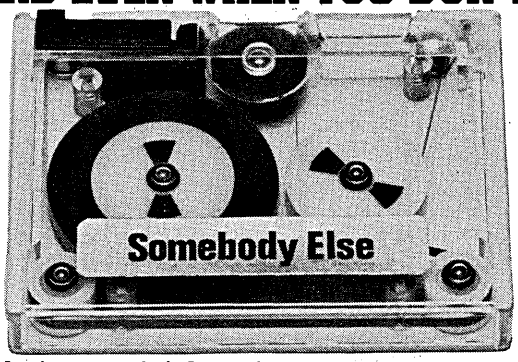

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CIRCLE 65 ON READER CARD

"as word gets out to more and more attorneys . . ."

Finally, it's religion. A team of volunteer scientists is using jpl image enhancement facilities to enhance new photographs of the Shroud of Turin, a piece of linen somehow imprinted with the faint image of a man and believed by many to be the burial cloth of Jesus. The enhanced photos will be used to look for details which are subtle and may be obscured somewhat by burns, water stains, and creases in the cloth.

The scientific team, which includes university, government and industry scientists, hopes to publish its findings in a book by October 1980.

—E.M.

COMMUNICATIONS

TELETYPE'S PRICING SCHEMES

Aggressive marketing efforts include a review of its traditional ways of doing business.

Teletype Corp., subsidiary of AT&T's Western Electric, has forever dominated the teleterminal marketplace. Yet, until fairly recently, inertia as much as ingenuity has secured its status. However, today, confronted by a wolfpack of hungry competitors, Teletype—seen by many as Bell's vanguard in the world of ACS and data communications—is learning how to fight for market share.

And necessarily so because Teletype's "captive" Bell market is protected by an ever more fragile barrier. Four months ago, AT&T itself announced a new high-speed terminal, the Teleprinter 1000, a 1,200cps serial printer available on tariff lease from the 23 Bell operating companies. Beyond the bubble memory and assorted bells and whistles, what was eye-catching about the announcement was that the Teleprinter 1000 was a customized version of the LA 120 DECwriter III, manufactured by Digital Equipment Corp., Teletype's leading competitor in the hard-copy terminal market.

Although some of the independent operating companies have previously marketed DECwriters and GE Terminets, the AT&T announcement marked a major step in Bell's internal development. "It is the first data product which is the result of a studied and stated customer need," explained AT&T product administrator Jay Burke. It was the result of a full marketing cycle—"a first at Bell," said Burke—in which AT&T market researchers explored customer needs, defined a market and the product to fill it, then went out with specs to find the product that could best be adapted to fill customer need.

JAMES D. ULASZEK—Just a competitive situation in which Teletype didn't win.

DANIEL M. PRINTZ—"Think of what we've done."

"It's aggressive marketing," said Burke of the new Bell System philosophy, "and it just so happens that they came up with a general trade product" as most appropriate to meet the market need. Yet, that AT&T should have to look beyond Teletype for a high-speed interactive terminal is itself significant. And, of course, that AT&T should

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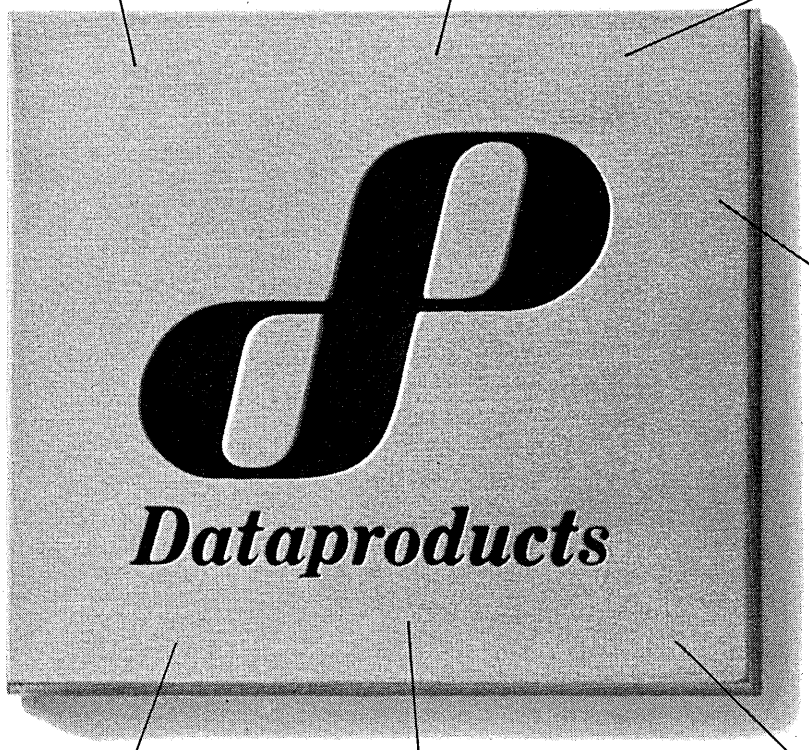

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CIRCLE 51 ON READER CARD

NEWS IN PERSPECTIVE

have a marketing team capable of such independence is indicative of Ma Bell's aggressiveness.

"It's just another case of a competitive situation; one in which we didn't win," smiled Teletype market planning manager Jim Ulaszek. "AT&T had a requirement that we could not fill. We have products as fast, in the Model 40 line, but they're line printers and not interactive. They asked us what our plans were and our plans did not meet their objective fully, so they went outside."

The story of the Teleprinter 1000 is symbolic, at least, of the sort of predictable dislocations and confusions that many expect to see as the Bell System attempts to fire up its competitive boilers. And, given AT&T's

"It's just another case of a competitive situation, one in which we didn't win."

new emphasis on data communications as the market of potential, Teletype seems to rest on a natural fault line within the system: committed to perhaps conflicting obligations, serving several masters, gingerly balancing multiple roles.

"They're a company and we're a company," shrugged Burke at AT&T. "They have their marketing force and we have our marketing force. In many cases, we're competitors—at least as far as lease versus sell bids." Teletype supplies the Bell operating companies with terminals for tariff lease, but it also sells outright to oem's, some end users, and many independent distributors who aggressively both sell and lease to end users. "Well, we don't *want* to compete with them," said Ulaszek, obviously uncomfortable responding to Burke's quote. "We supply a lot of our product to them and they are our owners, so it's obviously not a normal competitive situation, but I guess we can't help some competitive overlap."

According to financial analysts who closely follow AT&T, the extent and nature of that "overlap" is still a matter of "considerable dissension" among the management of the OTC's, the independent Bell Operating Telephone Companies. And two new sales initiatives at Teletype are likely to highlight the conflict of interests. Just as the OTC's are strengthening their marketing forces, Teletype is reorganizing itself to take a more aggressive posture in the market. One element of that reorganization, Teletype's decision to field its own end-user sales force to specialize in horizontal industry sales, is seen by some OTC managers as "an end run around the operating companies," said one analyst. Teletype, however, has given assurances that it will be a complementary marketing effort.

Moreover, a second arena of potential conflict, sure to upset OTC management, involves Teletype's discount policy for selling terminals to the independent reseller/

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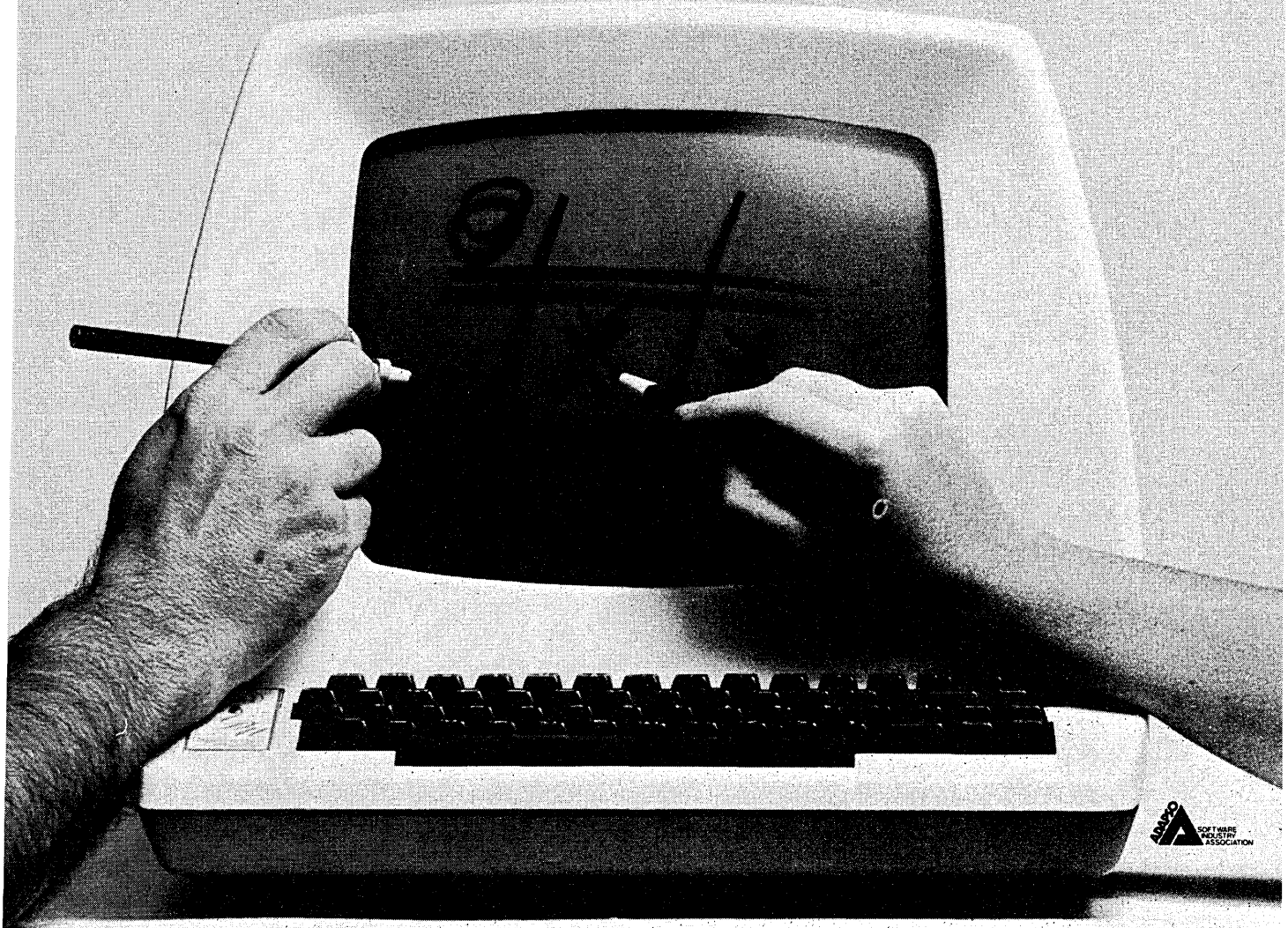

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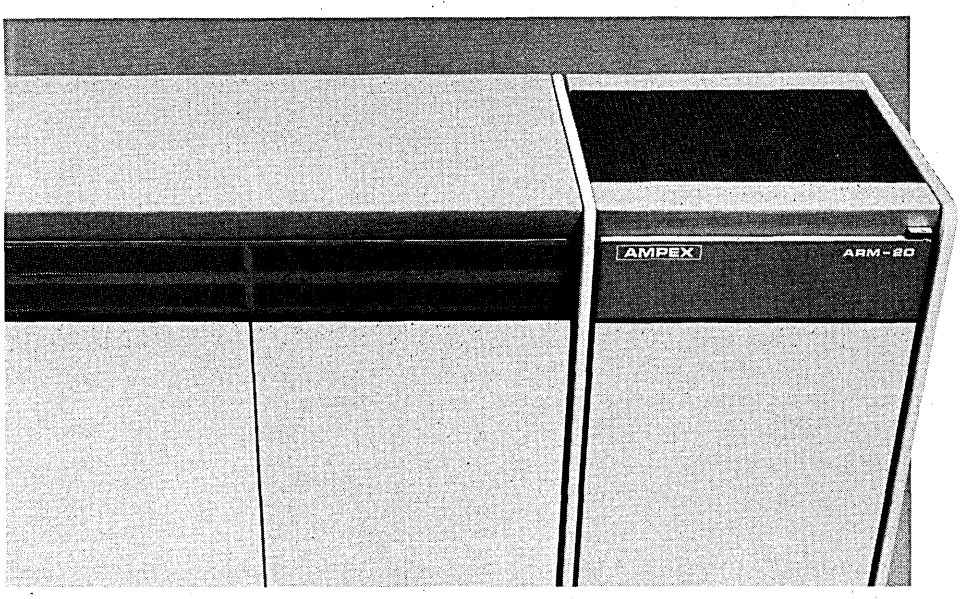

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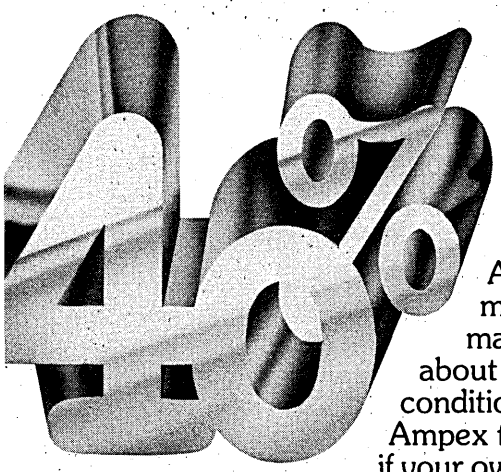

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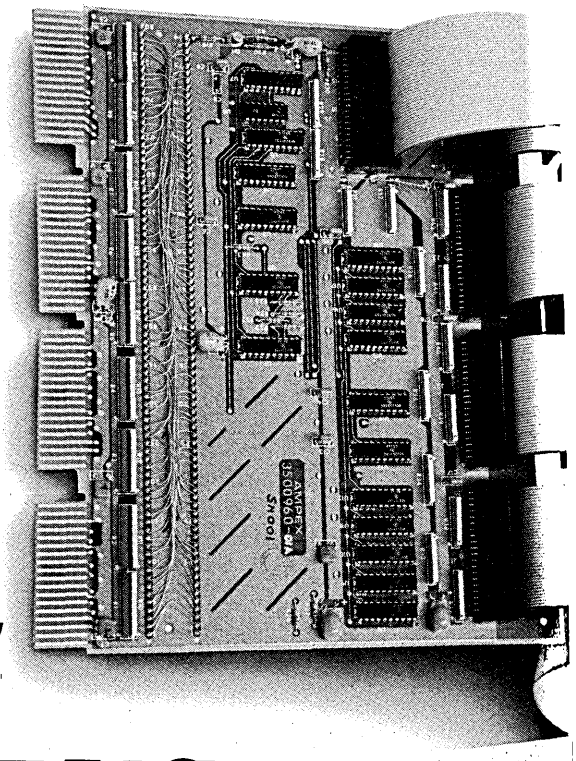

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CIRCLE 165 ON READER CARD

lessors who directly, and usually very successfully, compete against local Bell companies.

Teletype, like Bell itself, is a creature of politics as much as corporate economics. Teletype terminals midwifed the birth of the computer industry around the world. Into the late Sixties, Teletype controlled 90% of the teleprinter market until it was ambushed by competitors who used the new electronic technology to offer products that challenged Teletype's electromechanical units. In the face of attack, Teletype plodded along in an almost lethargic trance, still producing hundreds of thousands of its classic 33 KSR's, but seemingly unable or unwilling to adapt to the new technology.

Despite the enormous technical resources of the Bell System, AT&T corporate apathy, policy, and politics doomed Teletype to an outmoded technology just as data processing exploded as the new market of potential. The 1971 sale of the Teletype-based TWIX system to Western Union was made with the agreement that the Bell System would not market a new teleprinter that operated at speeds of less than 300 words a minute for five years, until April 1, 1976—effectively barring new Teletype products from the conversational terminal market during a crucial growth period.

Analysts estimate that between the mid-Sixties and the mid-Seventies, Teletype revenues actually dropped in real dollars. In the last five years, however, Teletype sales are estimated to have doubled from $150 million to more than $300 million.

Teletype operates under still another major restriction, one that further highlights its delicate relationship with the Bell OTC's. In 1956, AT&T signed a consent decree with Eisenhower's Justice Dept. to settle an antitrust suit. Under the terms of the decree, the OTC's were to be permitted to offer only regulated communication services—but Western Electric, Bell's manufacturing arm, and Teletype, a WE subsidiary, were left free to sell any products manufactured for use within the Bell System on the open market.

Justice Dept.'s latest attempt to challenge the Bell monopoly might substantially change Teletype's position.

Theoretically, the "communications" restriction is binding only upon the Bell operating companies, upon Teletype products tariffed through the Bell companies—not necessarily on all Teletype products, so long as those products were somehow used internally by Bell. In fact, however, the priorities in the relationship between Teletype and the OTC's have dictated that all Teletype products claim solely a communications function. In the era of the microprocessor, however, even the FCC has implicitly acknowledged that the distinction between communication and processing devices has become an issue for the court of Solomon. Nevertheless, given the ambiguity of the law, major court battles have been necessary before Teletype was allowed to market its Dataspeed 40 and 4500 series products, and resistance from independent vendors will undoubtedly accompany new introductions of sophisticated terminal systems.

The Justice Dept.'s latest attempt to challenge the Bell monopoly, four years old and expected to go to trial next year, might substantially change Teletype's position—but either the FCC, with Computer Inquiry II, or Congress, with its overhaul of the Communications Act of 1934, could change the ground rules first. Any change, so long as it finally clarified Teletype's mandate, would probably be welcome at Teletype's Skokie, Ill., headquarters (although the unlikely possibility of total deregulation of the OTC terminal market might raise goose bumps). The antitrust division at Justice seeks to divest AT&T of both Western Electric (including Teletype) and Bell's highly profitable Long Lines Division. With so much change, outside as

well as inside the company, Teletype may be at a historic crossroads.

Internally, Teletype is going through what most management employees call "revolutionary" changes; effectively transforming itself from a technologically-driven firm, the near monopolistic mindset of the past, into a more competitive marketing-oriented vendor, defining its product line by user needs. Teletype went through a massive technological transformation in the early Seventies, from electromechanics to electronics, from the classic 33 KSR to the Model 40, Teletype's first crt, and the model 43 in 1976. Then, in 1977, AT&T sent in a heavy-hitter, former IBM executive J. Roger Moody, late of Archie McGill's staff at Bell, to become executive vice president and build up some marketing muscle in what had become the industry's flabby giant. Moody has had enormous impact on Teletype's insular world: importing "outsiders," promoting aggressive marketing people inside, publicly scorning Teletype's traditional "not-invented-here" syndrome.

"Teletype has always been something other than an aggressive supplier of products in a competitive market," admitted Ulaszek, "but if you really want to be a businessman, you want to be all of those things." Under the influence of Moody's new executive cadre, he added, "in the next year, you can expect to see organizational, attitudinal, even stylistic changes—even in the way our executives think about doing business. Market driven? What does market driven mean? People are beginning to talk about it . . ."

"Think of what we've done," said Dan Printz, Teletype's new sales manager for commercial markets. "In 1973, we got into the crt business. That's our own crt design on that machine. We got into the MOS business. We, in effect, got into the electronic controller business . . . the electronic keyboard business. And there are companies, if you look out there, who make whole businesses just getting into any one of those segments. . . . We were getting into them all at once." Like Ulaszek, Printz is a Teletype veteran, a key figure in Teletype's product development effort, a man who fought to introduce marketing concepts into Teletype in the early Seventies.

Before his sales appointment in April, Printz directed the Teletype product development team that came up with the company's new modular terminal system, 4500 Series, a family of smart systems that is

Until the introduction of the model 43 in 1976, Teletype had virtually no discount program.

only now being shipped in quantity. In its earliest configuration, the 4500 will be used in a direct challenge to IBM, cutting into the still-bloated market for IBM's again-popular 3270 data entry terminal. Although now charged with carrying the 4500 into the market, Printz is still busy "planning future enhancements, selecting the communications functions" for the new product line—guided, of course, by "our data processing versus communications issue."

One of his initial tasks, stepping into the sales arena, said Printz, will be a thorough review of Teletype's pricing scheme. "I would say that all of our traditional ways of doing business will be under review," he explained, "but one of the first will be pricing. We've already started to look at it in different ways." One possibility under "serious discussion" is that Teletype may begin to offer the sort of sliding volume discounts to independent reseller/lessors that competitive terminal vendors have used to successfully boost shipment rates (if not always profits).

It's a sensitive area in which any change could have significant ramifications throughout the Bell System as the OTC's move into the data communications market. It was Teletype which originally spawned the independent reseller/lessors; a whole middleman industry developed just to offer the marketing skills and flexibility

that neither the OTC's nor Teletype was willing to offer. But in the last decade, this subindustry has grown to become a crucial distribution channel for the whole terminal industry. There are now perhaps 100 firms—local, regional, and national—in this field; experienced, aggressive marketing companies, skilled enough in the art of mixing competitive products and vendor discounts to bid successfully against individual terminal vendors, their own suppliers. Many, particularly the local and regional firms, offer support and maintenance of the sort that large companies find difficult to match.

Sliding volume discounts—higher discounts for higher volume dealers—have been for some the key to enormous success in the market. But for all, notably Texas Instruments, it has been an incredible headache that has seen manufacturers' end-user salesmen repeatedly outbid by their own distributors. Teletype has always stayed aloof from the fray; until the introduction of the Model 43 in 1976, Teletype had virtually no discount program. With Teletype's 43 announcement, Teletype offered a flat 30% discount to non-end-users, and later upgraded that to a flat 40% discount.

Teletype's recognition of the operating companies' ineffectiveness in the terminal market is undoubtedly a major factor in another Teletype sales initiative: the decision to set up a small independent end-user sales force within Teletype itself. Although Teletype's new vice president for end user sales, Michael Levokove, argues that his salesmen will not try to compete with local Bell marketing, analysts who follow AT&T report that there is "considerable dissension" among the operating company managers about "what many see as an end run around the OTC's."

"Our major thrust is to provide additional support for Bell's new effort in data communications," explained Levokove. Although Teletype sells versus Bell leasing, he pointed out, Teletype also benefits from Bell success in marketing Teletype terminals. "Our first objective is to help Bell operating companies tariff these units—if, as things go down, the prospect wants to purchase, we'll begin making independent offers." Local marketing control is conceded to the OTC, he said: "Our people won't call on a prospect without the concurrence of the local Bell account executives."

The realities of the marketplace—only 20% of the market is purchase-oriented, said Levokove; 80% of the market is rental or lease—may well soften any real conflict, and everyone in the industry seems to agree that Bell terminal marketing needs help. Nevertheless, Levokove's small sales force—now only 15 persons, all industry-targeted but due to double this year—is seen by many as perhaps the beginning of something new and important at Teletype.

—Vin McLellan

PROMISE OF THE FUTURE

Senator says Communications Act of 1934 must be revamped to meet the potential promise of a technology-dominated future.

Everybody in the communications industry likes to talk about the years 1934 and 1984—the one year representing an antiquated regulatory benchmark, and the other marking the potential promise of a technology-dominated future. But no one in the communications community seems to agree on how to reconcile the past with the present to get to that future.

To Sen. Ernest F. Hollings, the starting point toward a solution is to revamp the original 1934 Communications Act which set up AT&T as the entrenched industry monopolist. That simple bygone solution, Hollings believes, clearly won't work anymore. "In communications terms, 1934 was 1,000 years ago," he insists.

At the Data Communications Interface '79 conference and exposition in Chicago last month, the South Carolina Democrat put in an expected plug for a Senate version of a bill to rewrite the 1934 act. Speaking about the general need for such Congressional action, he explained that "legislation is necessary if we are to enable telecommunications policy to catch up with today's realities and tomorrow's potential."

"We must recognize," he stressed, "that the natural monopoly world of 1934 is no longer natural. In the future, telecommunications will be more ubiquitous, more important, more diverse. The inflexible regulatory mandates of the 1934 act," he said, "are incapable of generating and encouraging the diversity and the innovation that will be needed."

While Congress hopes to set up the appropriate policy framework for the future, it's still not clear who will be motivating this communications market diversity and innovation—the user or the vendor. Several other speakers picked up on this issue at the Interface '79 conference which the sponsors said attracted a turnout of some 12,000.

Discussing the various extended network services in the works for the '80s, data communications consultant Ralph Berglund of Berglund & Smith Consultants explored the trend toward intelligent networks. These intelligent nets, more broadly known as information systems networks, Berglund feels, "are going to be the vehicle for the

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The Model OLCRT 1011 plugs into the output connectors; Model 60 plugs into the EAI connector of the card reader. Both can be used to identify the status of all functions.

CIRCLE 174 ON READER CARD

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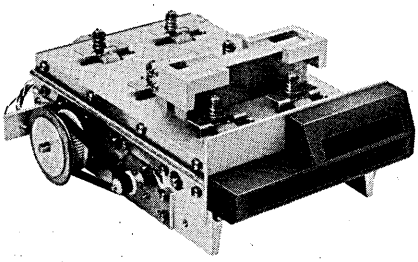

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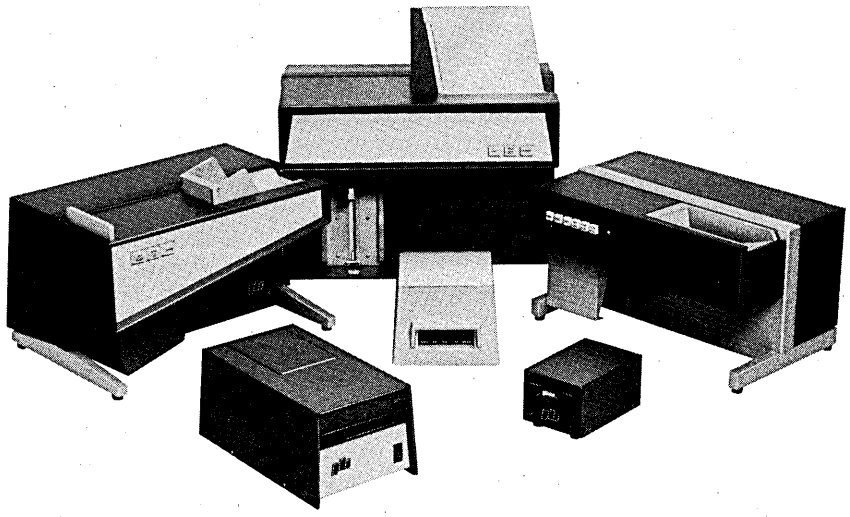

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information systems revolution of the '80s."

The move to distributed data processing, according to Berglund, will feed this intelligent network impetus. And that's mainly because users will need to integrate their ever-increasing proliferation of distributed systems. This integration of communications through intelligent networking, he explains, will be essential in order to provide for intercommunication for general business operations, and to enable a user to tap superior dp power and data bases. This integration approach will be crucial in providing a company with timely operational reporting and direction.

At another Interface '79 session,

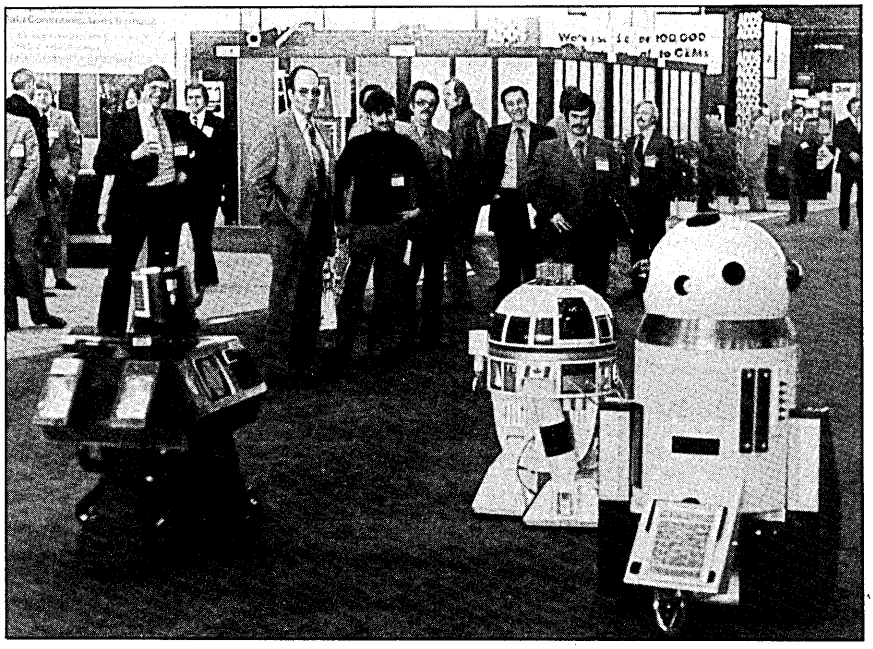
Complexity is getting to the point where it could sink us all.

Howard Anderson, president of a Boston consulting company called The Yankee Group, also pitched the user's need for intelligent devices and services. Today, declared Anderson, "the battle in data communications is basically over who will provide the intelligence." And all the data communications and dp vendors as well as the communications carriers are vying to supply that intelligence through various network services and products such as terminals, digital PBX's, controllers, mainframes and front-ends.

While users may recognize this need for intelligence in their telecommunications setups, it's really the vendors who capitalize on it as well as other data communications market trends. "The user out there today," Anderson said, "does little more than respond to vendor proposals. The user is really doing precious little innovating."

And the vendors, according to Anderson, aren't blazing innovation inroads either. "The vendor solutions," Anderson contends, "are almost always hardware-driven and frankly," he quipped, "they usually don't work." Anderson summed up by chastizing vendors for "creating highly overpriced solutions to basically trivial problems." And users are buying the vendor line, he charged, because they "rarely, if ever, do their homework in a systematic and logical manner."

Anderson's pessimistic view of the present data communications user scene was counterpointed in a more optimistic session which took a look at what's down the road for the user and the industry in the next 10 years. Exploring potential future developments, Terry Easton of Technology Marketing Analysis Corp. speculated that the marriage of electronic information processing with communications will result in "very consumer-oriented" products for the future. Citing calculators and the new language translators as current examples of this growing consumer trend, Easton predicted that "over the next decade, the consumer market will drive the business market" in computers and communications.



ROBOTS used by exhibitors to attract crowds seemed to succeed during Interface '79, held April 9–12 in Chicago.

These tools and devices, he said, will be "useful in the personal as well as business environments." One "challenge" for technologists, he added, will lie in creating appropriate programming systems. Computer circuit fabrication is another challenging chore for the future. By mid-1980, Easton said he foresees a new generation of semiconductors coming out of the space shuttle computer technology efforts.

Another speaker at that futuristic session, Ray Sanders, president of Tran Telecommunications Corp., sounded the call

for "simplification." The computer-communications environment is growing increasingly complex and will become even more so in the future as large numbers of diverse devices start "talking" to each other.

As more and more terminals become linked together, Sanders said, there will be a need for rules to simplify operations. These "system simplification issues," he emphasized, have to be resolved before the envisioned network and device usage can evolve. One way to reduce complexity is to peel away some of the layers of communications network protocols. "Complexity," he warned, "is getting to the point where it could sink us all."

—Linda Flato Runyan

INTERFACE '79 drew sparse crowds to McCormick Place in Chicago where sponsors estimated a turnout of about 12,000.

SOFTWARE

VALUE IN SOFTWARE

Financial Accounting Standards Board says not all software construction is research and development.

It took them three years but members of the Association of Data Processing Service Organizations (ADAPSO) Certified Public Accounting Committee is claiming a major victory in rulings on accounting procedures for what they call "software construction."

The battle started quietly in late 1974 when the Financial Accounting Standards Board issued Statement No. 2 dealing with treatment of research and development expenses and, later, Interpretation No. 6, relating computer software to the statement.

With the statement, the standards board ruled that outlays on research and development should be charged off as incurred, rather than deferred, and charged off only as income materialized from selling the resulting products. The interpretation detailed when software costs are deemed part

of R&D.

James Porter, vice president, finance/administration, software products group, Informatics, and chairman of an ADAPSO committee that got a new opinion from the FASB, said his committee received a letter from FASB that stated that Statement No. 2 "did not intend to classify all software construction as research and development. Each situation is a matter which should be determined between the company and its auditor."

He said the FASB would "announce this" via a status report to some 40,000 members of the auditing profession.

In a letter to ADAPSO, the FASB's J.T. Ball said the board's Statement No. 2 and Interpretation No. 6 "are not intended to require that all computer software production costs are research and development costs, as defined in paragraph 8 of Statement No. 2."

Ball's letter further stated that "a determination that software production costs are not research and development does not necessarily mean that those costs would be inventoriable or deferrable to future operations. Those decisions can only be made in light of all the facts and circumstances surrounding the particular situation."

So now it's all between software companies and their auditors.

Porter urged software companies to review the FASB letter with their auditors.

He first became concerned with the problems created with Statement No. 2 and Interpretation No. 6 when auditors came around telling him to take things off the company books. "It was as if they were saying software has no value."

"Do we want to be an assetless industry?" he asked at the time. "No. We have assets and they are of value."

So now they may be treatable as such. Jerome L. Dreyer, executive vice president of ADAPSO, said the FASB letter reinforces the association's position and "gives companies the opportunity to choose whether they want software construction to be expensed in the current period. Each situation is a matter between the company and its auditor."

ADAPSO, as an organization, wasn't all that concerned in the beginning. Informatics' Porter, when he became concerned because his company's auditors were "telling us to take things off the books," in 1975 took the problem to ADAPSO. "I was told to go home and shut up," he said. Later the problem came to the fore and was on the program of just about every ADAPSO meeting.

Porter believes terminology had a lot to do with the problem. The software industry tended to use the term software development. "The word development is inherently associated with risk, developing a form of prototype which may or may not ever be marketed." He advocated the term software construction and it seems the FASB is buying it. —E.M.

"Watch your step, Whitfield. You're beginning to sound competent."

TWO NEW NAMES: Pertec Computer Corp. changed the name of its CMC Div. to the Computer Systems Div. Its Pertec Div. was renamed the Peripherals Div. Ryal R. Poppa, PCC president and chairman of the board, said the CMC designation was retained "during a transition period following the acquisition of Computer Machinery Corp. in 1976." The Computer Systems Div., headed by vice president and general manager Daniel R. Carter, is the company's North American marketing organization for distributed data processing systems, data entry equipment, microperipherals and small business systems. The Peripherals Div., headed by Ralph Gabai, a senior vice president, manufactures and markets peripheral equipment including tape drives, rigid disk drives, and flexible disk drives for minicomputers and microsystems.

LOCKHEED IN MARKETING SWITCH: Lockheed Electronics has changed marketing strategy for its products, including the System III small business computer, from direct sales to a dealer network. The company said it will keep only two of its direct sales offices—in Bakersfield, Calif., and Pennsauken, N.J.—and that 24 or 25 sales personnel would be laid off along with a smaller number of clerical people. Field engineering people will not be affected. A company spokesman said the shift was "designed to bring about general economies so the firm could position its data processing products more competitively in the commercial and industrial markets and make greater resources available for the dealer sales programs."

RANDAL SALES AGREEMENT: Randal Data Systems, Inc., Torrance, Calif., will sell between $5 million and $11 million of its new desktop computers to a British General Electric Co. Ltd. subsidiary under a tentative agreement signed by the two companies. GEC Enterprises, U.S.-based holding company division of GEC, would, under the agreement, take delivery on the units over a 42-month period. GEC Enterprises last month merged with A.B. Dick Co., Chicago. A.B. Dick would serve as the retail outlet for the Randal computers. The agreement is subject to final performance testing.

UNITED TELECOM ACQUISITION: United Telecommunications, Inc., Kansas City, Mo., agreed in principle to acquire On-Line Systems, Pittsburgh, Pa., computer services company. Paul H. Henson, United Telecom chairman, said it is contemplated that On-Line Systems will operate as a subsidiary of another United Telecom subsidiary, United Computing Systems. Terms of the agreement call for United Telecom to issue 1.26 shares of its common stock for each share of On-Line Systems common stock. This would put the value of the transaction at about $34.7 million.

TYMSHARE PLANS BUY: Tymshare, Inc., Cupertino, Calif., said it has agreed in principle to purchase TRW's Validata operation. Warren Prince, Tymshare group vice president for financial and network systems, said the Validata credit card and check verfication service would be integrated eventually into Tymshare's Transaction Services subsidiary which performs credit card transaction processing services for financial institutions and merchants. Validata authorization terminals installed across the country are for use by counter personnel of airlines, car rental firms, hotels, and restaurants. They link users to a data base of negative credit information about stolen credit cards and airline tickets, as well as invalid driver's licenses and bad checks.

ACQUISITION ACCELERATION: Input, a Palo Alto, Calif., consulting company, has projected a sharp acceleration in acquisition activity in the computer services industry in the next five years. The firm issued a report indicating that companies with cumulative annual revenues of $3.5 billion will be acquired in the five-year period. The report projects the emergence of a group of leading computer services vendors with revenues in excess of $400 million per year by 1983. The market share of the larger companies, the company said, will increase significantly in this period due, in large part, to acquisition activity.

ITEL DISPOSITION: Itel Corp. said it will dispose of its Data Services Group's operations involved in providing general application financial and accounting data processing services. Peter S. Redfield, president, said the firm will continue to offer a number of high value-added specialized computer services which are believed to have above average growth and profitability potential. He said the operations to be disposed of had assets of approximately $60 million as of Dec. 31, 1978, amounting to less than 5% of Itel's total assets as of that date.

ADR IN EUROPE: Applied Data Reserch, Inc., has purchased marketing companies in Holland, Germany, Belgium, Austria, and Switzerland which have been representing ADR for three years. The companies were bought from the CAP-CPP group headquartered in London. The agreement, which became effective May 1, leaves unchanged the ADR license agreement and the product selling organization in the United Kingdom (CPP-UK). John R. Bennett, ADR president, said the purchase was prompted by the company's interest in establishing closer control of a significant part of its overseas operation.

ADAPSO CHALLENGES CITICORP: The Association of Data Processing Service Organizations (ADAPSO) has asked the Federal Reserve Bank of New York to deny an application from Citicorp to allow its Citishare subsidiary to engage in certain time sharing and computer services activities. ADAPSO also asked for a formal hearing on the Citicorp application which was published in the March 7 Federal Register. ADAPSO contends that the application misstates the nature and scope of the proposed business of Citishare. "Despite Citicorp's representation," said Jerome L. Dreyer, ADAPSO executive vice president, "the data to be processed is not financially oriented. Citicorp will transfer activities from Interactive Computer Center, which to this date has done general purpose data processing."

CODEX, CCI AGREEMENT: Motorola's Codex Corp. subsidiary signed a four-year agreement with Computer Communications Inc. under which Codex gains distributor rights to $25 million in CCI front-end processors in return for warrants to purchase 800,000 shares of CCI common stock. Codex will market the CCI products under its own name. The agreement also calls for the joint development of "a next generation of networking systems to serve the emerging distributed processing and public data networks of the 1980s." Codex gets exclusive marketing rights to the CCI product line in all international markets except Canada, and Eastern Bloc countries. In those countries and in the U.S., Codex will get nonexclusive distribution rights.

MORE GOVERNMENT COMPUTERS: The number of federal government computer installations, including general purpose systems and minicomputers, rose 9.6% from 11,124 in fiscal year 1977 to 12,190 in 1978, the General Services Administration reported. GSA set total value of federal computer installations in 1978 at $4.89 billion, up from $4.77 billion in 1977. The Department of Defense led in total number of computers with 5,513, compared to 2,981 for the Department of Energy, and 1,578 for the National Aeronautics & Space Administration. ✻

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People who depend on their data communications network.

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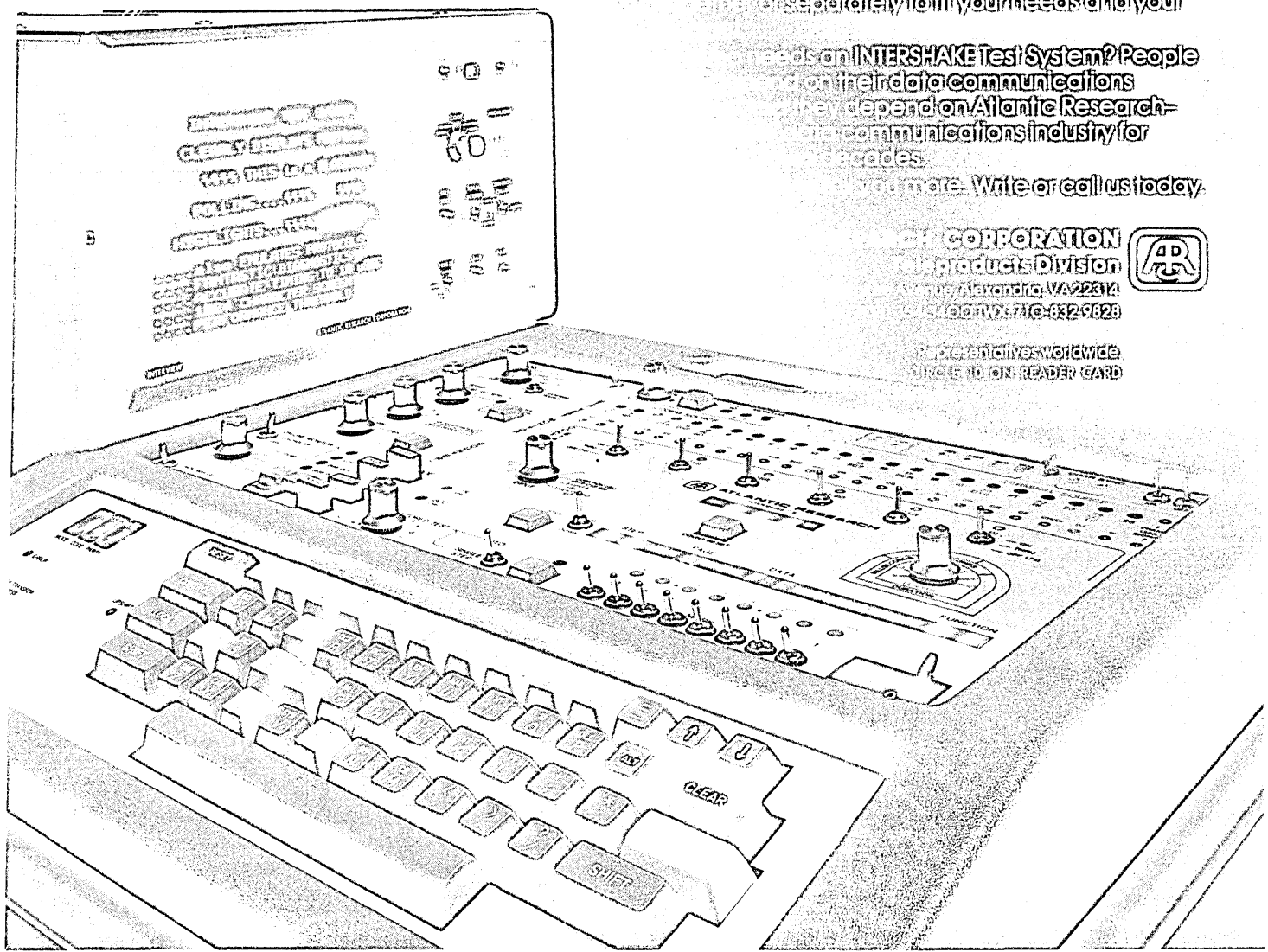

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And all of these features — both hardware and software — are available for *immediate installation.*

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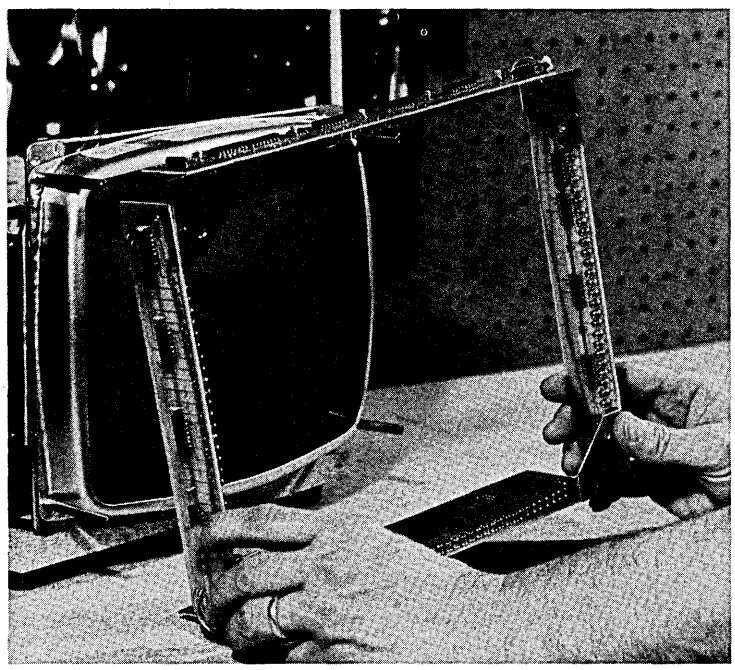

CRT Size	12"	15"	17"	19"
Matrix				
X Axis	40	40	48	56
Y Axis	24	32	40	48
Resolution				
X Axis	.225	.275	.275	.275
Y Axis	.275	.250	.250	.250
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Total System	$1200	$1400	$1600	$1800
Frame Only	600	800	1000	1200
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CARROLL, the leader in Touch Technology, now offers easy to use Touch Input System Kits for the System Designer who wants to experiment with the benefits of Touch Input.

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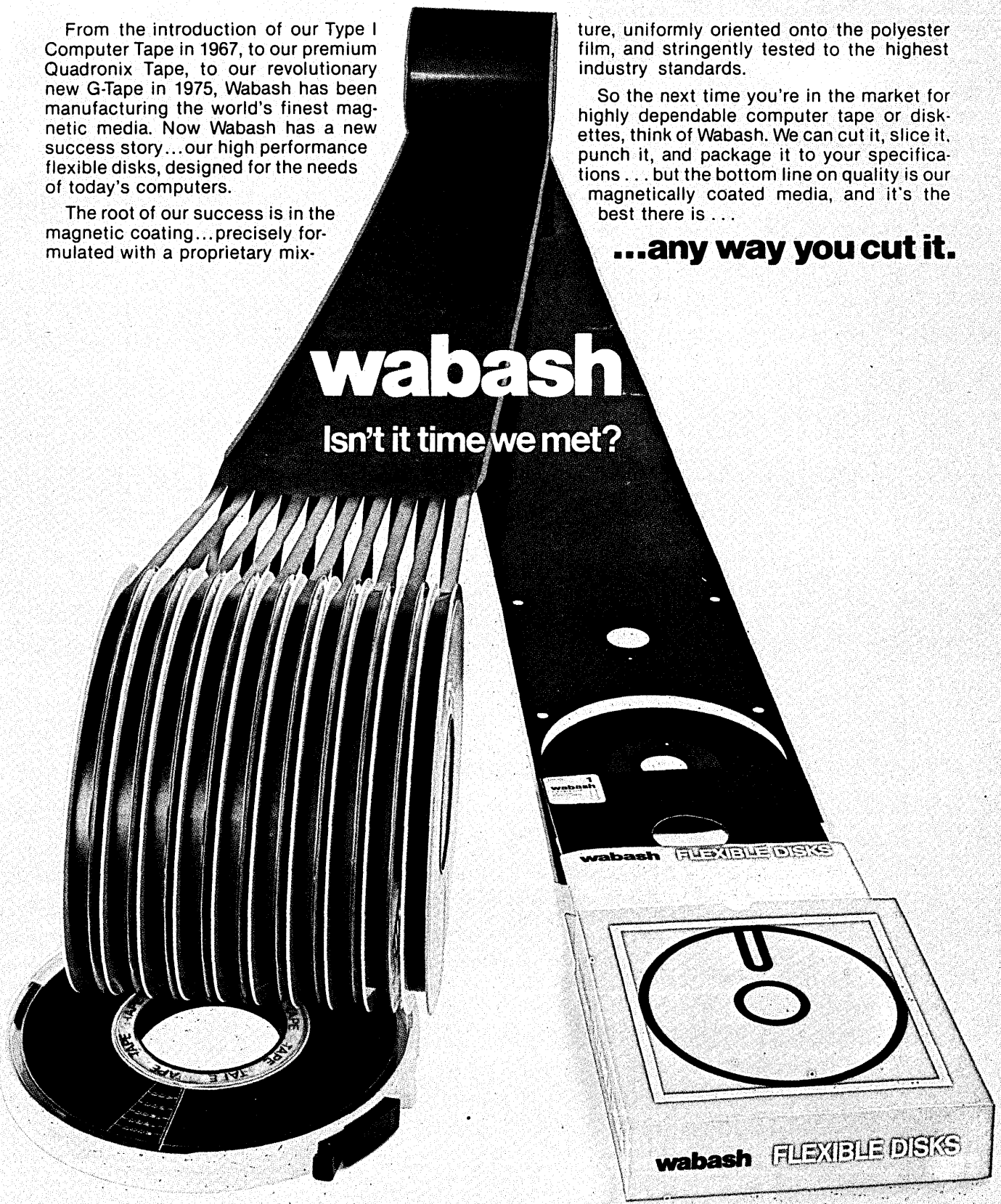
Isn't it time we met?



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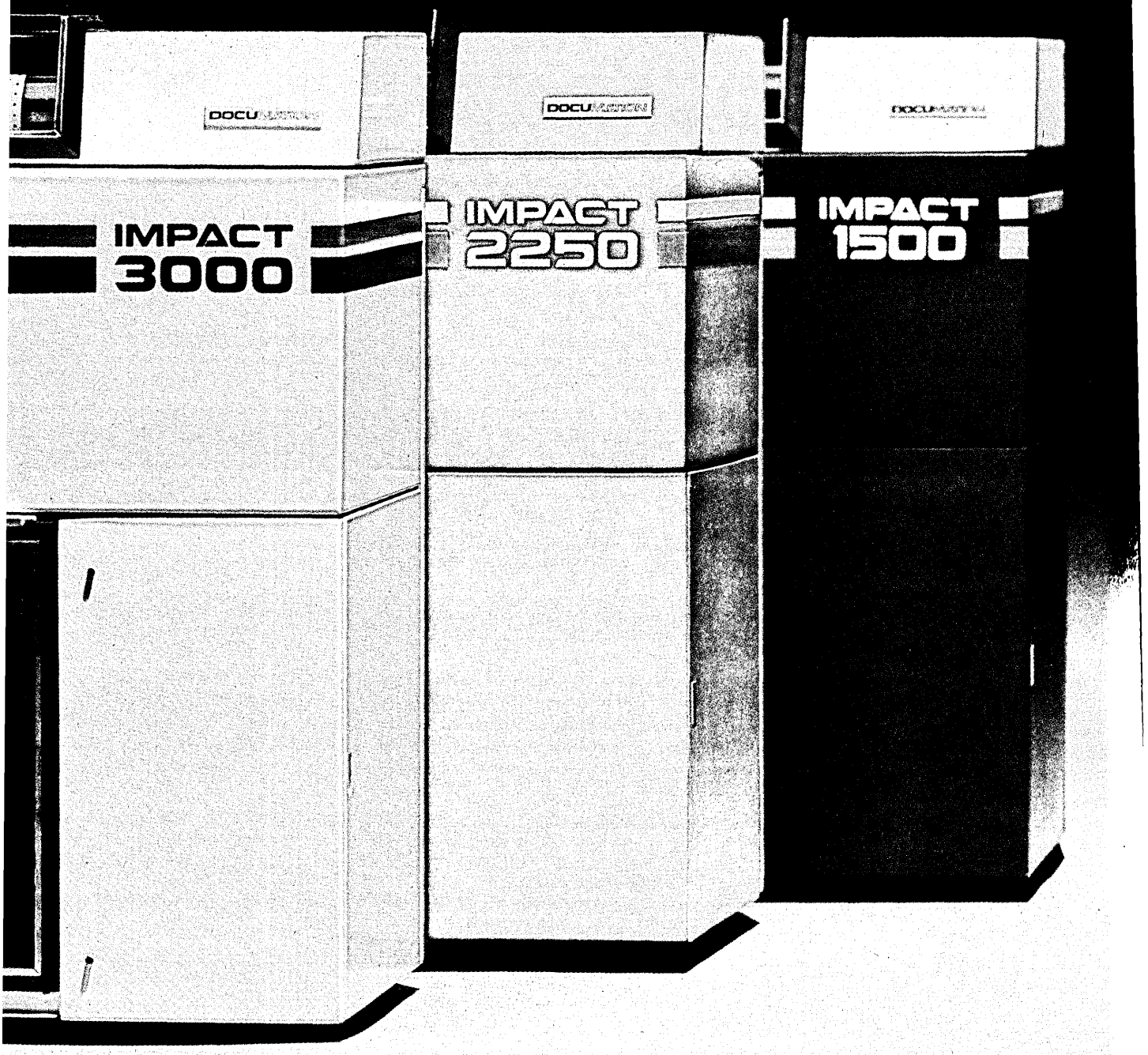

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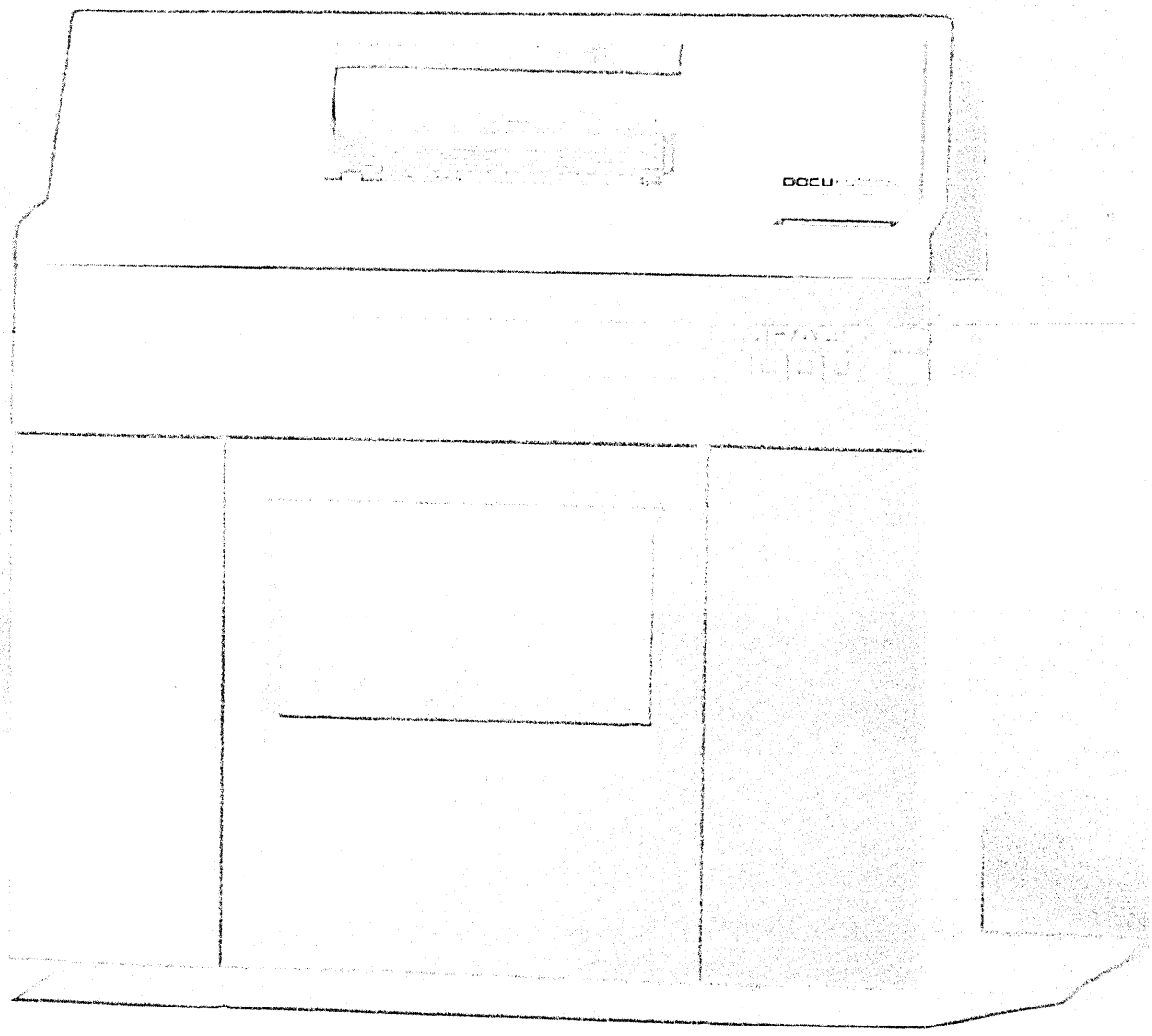

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Solutions to 1000 to 3000 LPM requirements

Documation's family of impact printers now include a variety of models and throughput speeds. Eight different printers, from 1000 to 3000 LPM are available for IBM and IBM plug-compatible systems. Burroughs and most minicomputer users can choose from five Documation printers, ranging from 1000 to 2000 LPM, to solve their printing requirements.

All of Documation's impact line printers are state-of-the-art. All are designed to give the best performance and lowest cost of ownership.

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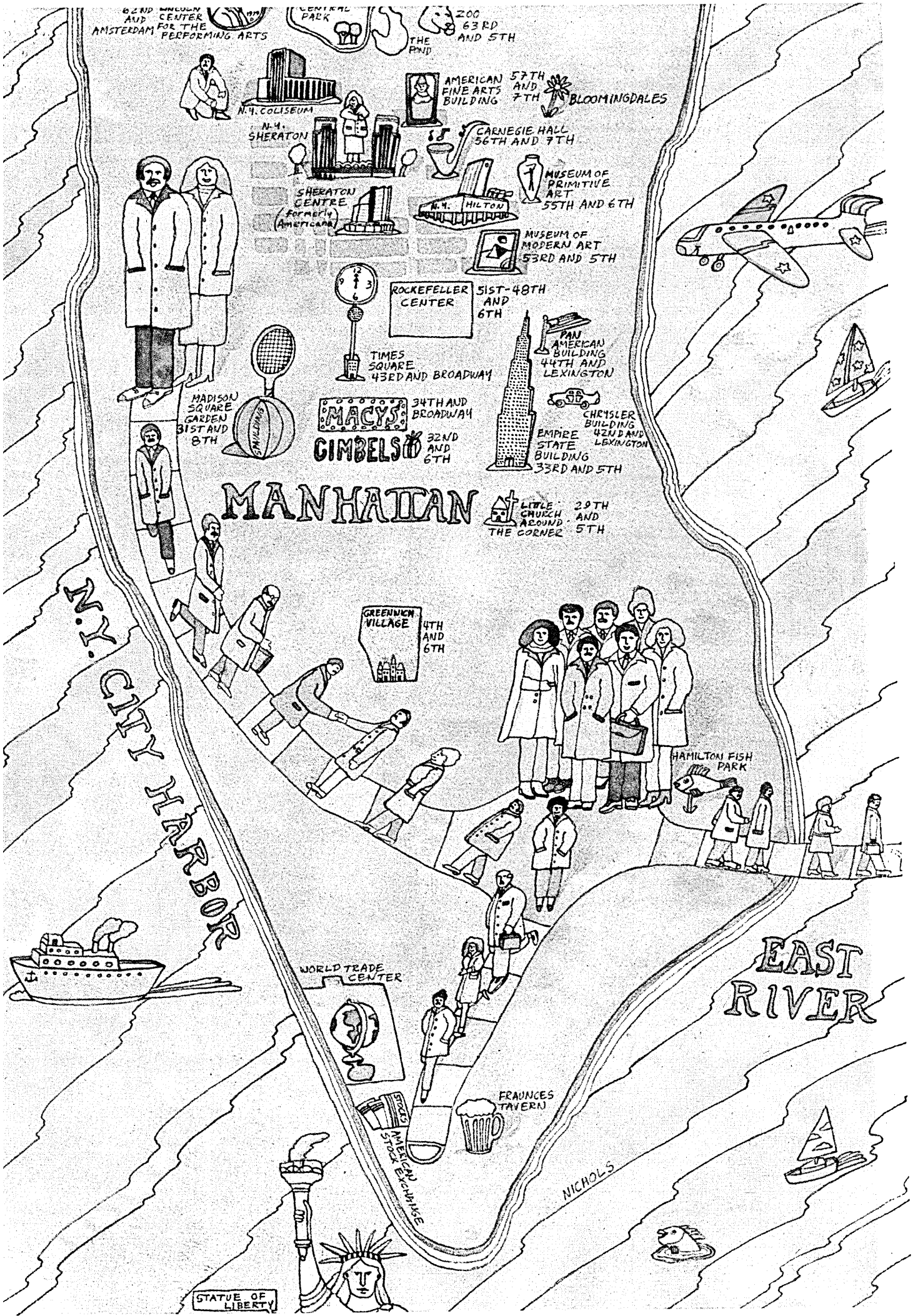
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With more exhibitors, papers, events and attendance than ever before, the NCC should be due for expansion. But nobody's taking that talk seriously.

THE NCC: TIME TO GO TWICE AYEAR?

Should the National Computer Conference be held twice a year as it used to be before 1973?

Consider the following, as the American Federation of Information Processing Societies prepares to stage its seventh NCC in New York next June 4–7:

- Exhibitors are jammed into all four floors of the New York Coliseum and another 75 had to be housed in the not-so-nearby Hilton Hotel. The turnout of 400 exhibitors is 50 more than last year when NCC was held in Anaheim, Calif.
- NCC no longer is only an exhibit and conference; it's that, plus a Personal Computing Festival and a week of sessions on professional development. And in New York it's spread across the city in four locations.
- The conference program consists of 160 sessions with more than 600 speakers. That compares with 107 sessions in Anaheim last year. And the program committee turned down an estimated 100 additional proposals for sessions, primarily because there's no more room.
- And last year's stunning attendance of 57,000—when only about 40,000 had been expected—this year should soar to at least 60,000, according to estimates by the NCC's exhibit planners. (They say exhibitors have been issued no less than 650,000 free invitations to customers, compared with the 500,000 issued last year.)

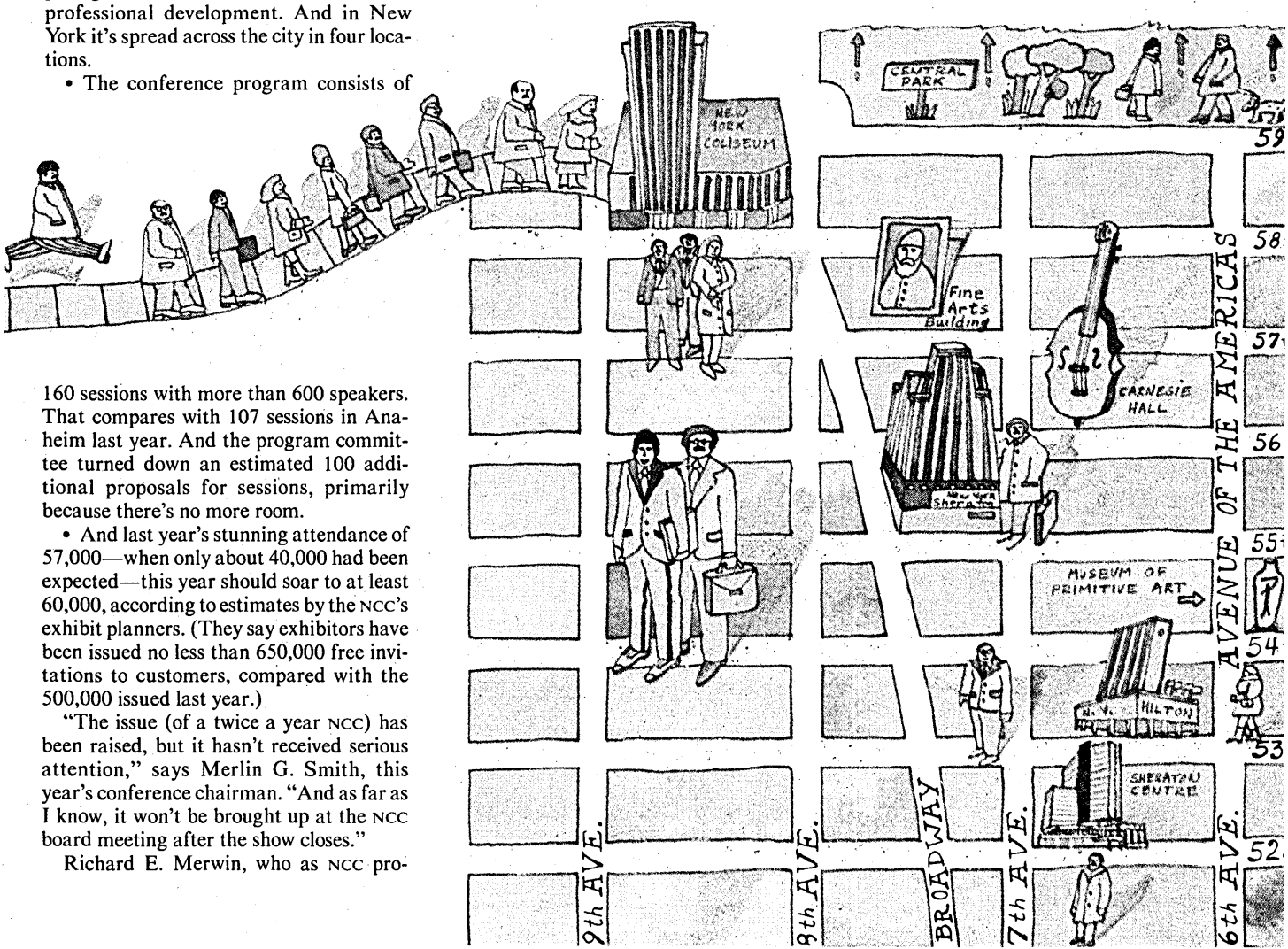
"The issue (of a twice a year NCC) has been raised, but it hasn't received serious attention," says Merlin G. Smith, this year's conference chairman. "And as far as I know, it won't be brought up at the NCC board meeting after the show closes."

Richard E. Merwin, who as NCC program chairman had the enormous task of setting up the huge conference and turning down the many session proposals for lack of space, says of the prospects for a twice a year conference, "it certainly is looking that way." Merwin wonders, though, if the volunteer help is available for two such large undertakings.

At least 150 persons helped to put on the NCC, all of them volunteers. And this doesn't include the 600 speakers, or the paid AFIPS staff. "Finding volunteers is a problem," says Merwin who is a research professor at George Washington Univ. in Washington, D. C., and a consultant on real-time computer systems and special purpose languages.

Smith is a member of the computer sciences department at IBM's Thomas J. Watson Research Center in Yorktown Heights, N.Y. Before taking the job, Smith asked for and received assurances from IBM of that company's cooperation. "I can preempt my IBM work for NCC business," says Smith who's been a member of the NCC board for three years and its chairman in 1976.

Smith and Merwin are the catalysts for the largest computer event of its kind where, as Smith puts it, "anyone who has



done something interesting and wants to talk about it or write about it" is able to do so before the largest computer forum in the nation.

The NCC technical and professional program, which opens Monday morning, June 4, with a keynote address by John R. Opel, president of IBM, should be "an extraordinary computing experience for all who attend," says Merwin who has been organizing it for more than a year. Merwin, who said he didn't want 160 sessions, says the pressure to speak from so many groups is extremely heavy. For instance for every panel session the committee accepted, another one was turned down. "We're also limited to publishing a proceedings of only 1,000 pages," he says. That means that of some 600 speakers, only 130 papers will be published in the proceedings, but tape cassettes of all talks will be made available to persons attending the conference.

Until recently the program was a relatively small part of the NCC—the exhibit drawing the lion's share of attention—but in recent years that has changed. Whereas the usual turnout hovered at around 4,000, last year more than 7,000 persons turned out for the sessions and this year the figure is expected to go higher. Possibly the admission of the Data Processing Management Assn. to AFIPS in 1975 has had something to do with the larger attendance, as it had with the content of the conference which now deals heavily in management subjects. "The challenges facing business and industrial users continue to change rapidly," says conference chairman Smith, "so you've got to address these questions." Topics address management, applications and social implications along with the traditional science and technology subjects. In addition, the program includes three "mini conferences" that will address issues on the use of computers for financial transactions, on law and public policy, and health care.

MERLIN G. SMITH—NCC conference chairman.

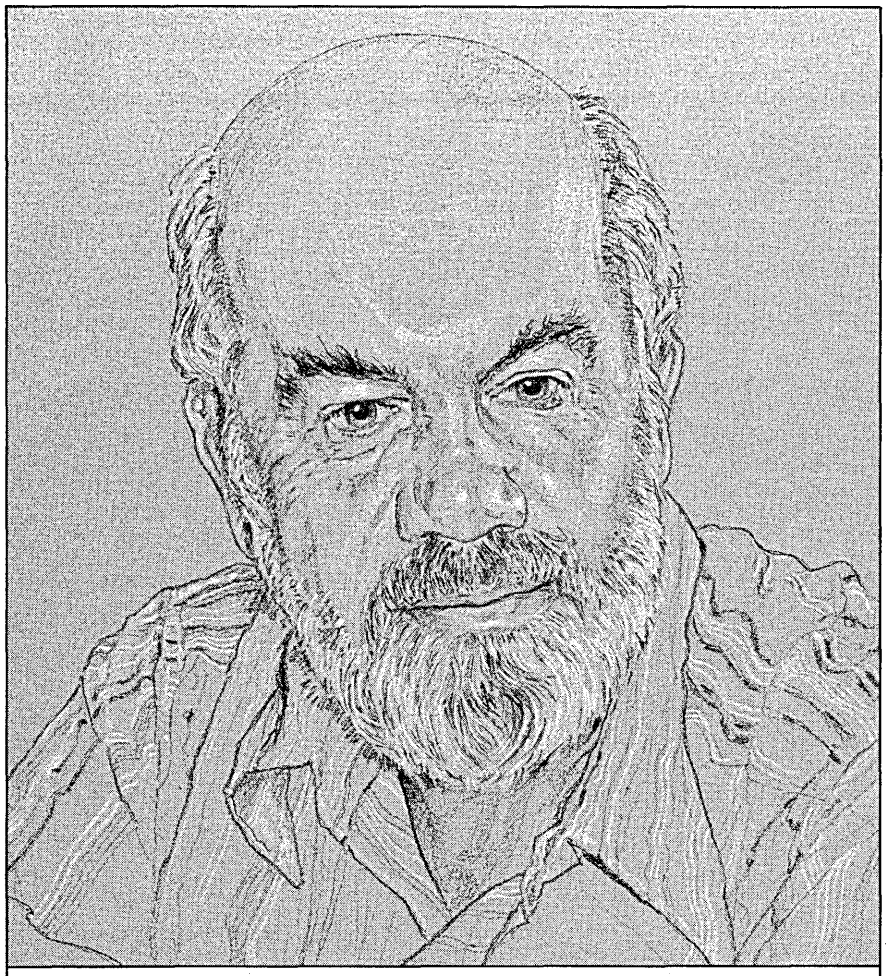
Merwin said Sinai medical school in New York will offer its doctors continuing education credits for attending the health care sessions. He also foresees persons interested in law, public policy and banking attending NCC for the first time.

Applications, such as simulation, are planned. Simulation, in fact, will receive particular attention, with sessions on emulation laboratories and their use in industry, government and universities. Other sessions will address the future of simulation languages and the use of computers in medical diagnosis and simulation. Another application—the use of computers by non-computer executives and their staffs without having to interface with programmers and systems analysts—will be covered in a session. Speakers will assess such new issues as easy-to-use planning and modeling languages, and an entirely new discipline—development of support systems. The speakers will present examples and prospectives of models that currently are being made. Other application sessions will cover computerized control systems for automated production facilities, graphics in the building industry and computer-based systems in complex organizations.

Data base technology will receive the most attention in the science and technology portion of the program, including data base machines, data base evolution and related management systems architecture. Other sessions will address computer architecture, networking, software reliability, distributed operating systems and modeling of program behavior.

ANITA COCHRAN—NCC assistant chairwoman.

ROBERT C. SPIEKER—NCC vice chairman.



DR. RICHARD E. MERWIN—NCC program

(Many of the management-related subjects are treated in a staff report starting on page 119).

A highlight of the professional and technical program is the Pioneer Day observance which this year will consist of a tribute to COBOL—the Common Business Oriented Language—with two sessions Wednesday June 6 marking the 20th anniversary of its creation by a committee of representatives from manufacturers and government agencies. The program is headed by Henry P. Stevenson, programming supervisor at the Analytical Support Center of AT&T in Basking Ridge, N.J.

The first session will discuss the origins of COBOL and the second will examine COBOL's present form and its original language and examine prevailing attitudes of the computing community toward the language.

Fifteen one-day professional development seminars, organized by William A. Baker of Aetna Life & Casualty, are to be held during the NCC at the New York Sheraton Hotel. Each seminar is limited to 100 attendees and the charge is $50. The subjects:

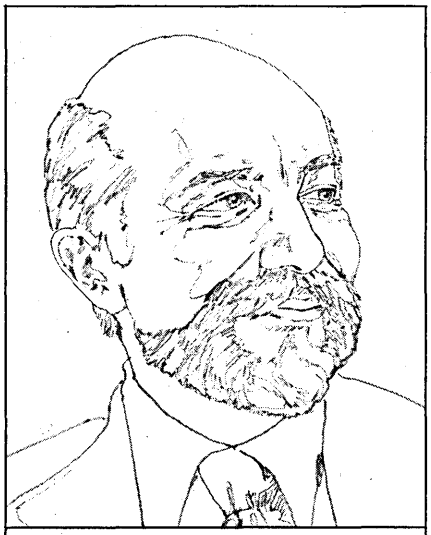
- An Overview of Distributed Processing;
- Data Base Machines;
- A Practical View of Computer Communications Protocols;
- Human Engineering in Teleprocessing Systems;
- An Introduction to Microprocessors;
- Recent Developments in Minicomputer Technology;
- An Overview of Automated Office Technologies and Equipment;
- Comparing Text Processing Packages and Systems;
- Implementing a Word Processing System;
- Structured Systems Analysis;
- Structured Systems Design;
- Managing Structured Methodologies;
- Day of Renewal (a seminar on human relations);
- Criteria for Selecting Processing Environments;
- Computer Systems Performance.

A workshop on hands-on microcomputers and software and hardware, organized by Eric R. Garen, Integrated Computer Systems, Inc., will be held as part of the Professional Development program on Tuesday and Wednesday, with the audience limited to 60 persons each day.

The Personal Computing Festival, being held in the Sheraton Centre (formerly the Americana Hotel) opens Monday afternoon with two sessions and continues through Thursday. The exhibit by 84 companies opens Tuesday morning. Under the direction of Richard A. Kuzmack of the MATHTECH Div. of Mathematica, Inc., Arlington, Va., it will examine the phenomenon of low-priced computing and provide individuals with the opportunity to gain hands-on experience with small systems. A video theater will run throughout the affair devoted to personal computing topics.

A statement issued by the program cochairmen, Russ Adams and Jay Lucas, both of the U.S. Patent & Trademark Office, says, "We want all attendees leaving our sessions to want to get back to their personal computers as quickly as possible to try out what they have learned. And if they don't have a personal computer, we hope they'll think about getting one." The statement reflects the variety of subjects to be discussed in the program, which in-

JOHN R. OPEL—NCC keynoter.



CHARLES PHILIP LECHT—Plenary session speaker.

cludes a day-long session on the use of personal computers as an aid to the handicapped and the chronically ill; presentations on robotics, including demonstrations of working robots for the home; four two-hour sessions analyzing the pros and cons of using personal computers for small business; a session on small computer maintenance; sessions relating to ethics and crime, protection and legal aspects of personal computers; and one on computer simulation, modeling and games. Twenty-five sessions are planned for the Personal Computing conference.

The Personal Computing exhibits will mainly consist of microprocessors, microcomputers, microprinters, speech synthesizers, floppy disks, cassettes, software packages, data base query systems and relevant educational materials and publications.

Other NCC highlights:

• Two plenary sessions to which attendance is free: On June 5, Charles Philip Lecht, chairman and president of Advanced Computer Techniques Corp., will discuss future directions in computing; and on June 6, Rep. Charles Rose (D., N.C.) will talk on computers, law and public policy.

• Science Film Theater presenting varied samplings of the latest films and videotapes from universities, industry, private film makers and distributors. They'll depict computer usage, computer art, graphics and animation.

• A daily one-hour television program, "Today at the NCC," that spotlights the day's events and previews upcoming activities. It will be aired Sunday evening at 9 p.m. in most hotels and daily at 7 and 8 a.m. It also will be shown throughout the day on tv monitors in the New York Coliseum and Hilton Hotel.

The exhibit in the New York Coliseum and the Hilton Hotel will be the largest in NCC history, with 400 companies taking up 1,700 exhibit spaces. It will be the third year in a row that the exhibit has broken the record that had stood since 1969 when some 970 booths were opened to exhibitors in Las Vegas. The 400 exhibitors compare with 351 last year, and the space is about 300 booths more than the 1978 show in Anaheim.

AFIPS officials emphasized that the 75 exhibitors that had to be sent to the Hilton Hotel, where about 200 booth spaces have been set up on the second floor, shouldn't feel left out because many are prestigious firms, such as General Electric, Fairchild, Fujitsu, ICL, Century Data, and Zenith.

There are newcomers and some no-shows. Hewlett-Packard, the huge minicomputer maker, won't be at NCC for the third year in a row and such regulars as

REP. CHARLES ROSE (D., N.C.)—Plenary session speaker.

Datapoint, Electronic Memories and Magnetics, and Modcomp are no shows for the first time in recent years. Burroughs is back for the first time in seven years.

And in April the waiting list was down to five or six companies, the result of a decision by AFIPS to rent all four floors of the Coliseum, whereas in past NCC's only three were used. The NCC sponsors also limited the maximum booth size to 2,400 sq. ft. to accommodate more exhibitors. At least 12 firms have bought up maximum booth space, including IBM, Xerox and Control Data Corp. Last year, CDC had the largest booth with 3,500 sq. ft. While this action, in part, solves the space problem, there are those who wonder whether the average NCC visitor can find the time to view 400 exhibits in the Coliseum and Hilton, and then go over to the Sheraton Centre to inspect the Personal Computing exhibit, and try at the same time to take in a session or more at the NCC program, attend the free plenary sessions and maybe a session or two at the Personal Computing Festival and probably a Professional Development Seminar at the Sheraton Hotel—provided, of course, the visitor is able to find a hotel room in New York or even to make a plane reservation to Fun City.

The NCC organizers say they've tried, at least, to alleviate the huge registration problem that first was felt in Anaheim last year by launching a public relations effort to get people to register ahead of time. This year, even exhibitor guests may send their reservations in before May 15 to receive admission badges in advance. In addition, attendees may register at either the Hilton or Coliseum or the Sheraton Centre and Sheraton Hotel. And the registration booths will open at 7:45 a.m. each day of the conference in all four locations and for the first time people will be able to register on Sunday at the New York Hilton from 4 p.m. to 8 p.m.

But the question of two or more conferences a year still comes up. "There even has been talk of a caravan, where we bring the NCC to several cities in a year," says Carol Sturgeon of the AFIPS exhibit staff. That suggestion, she said, immediately was written off for the same reason that the fall and spring joint computer conferences were merged into a single NCC in 1973—it's too big of a financial drain on the exhibitors.

Competition from other exhibits also had to be considered. Such vertical shows at the American Bankers Assn.'s Operations and Automation Exhibit, the supermarket and National Retail Merchants Assn.'s exhibits and such horizontal shows as Info, the Mini-Micro and the Interface communications exhibits include many of the companies that exhibit at NCC.

Another suggestion was to give every exhibitor a standard-sized 10-foot booth. "But then you would have something else," Sturgeon says. "It wouldn't be an NCC, which is something unique."

She added: "You hear a lot of complaints from exhibitors, but it's never for lack of crowds." Sturgeon thinks the economy will put its own limits on the size of the NCC.

"Perhaps the optimism of today would support a second conference, but would it be viable in the long run?" asks the conference chairman, Merlin Smith. In three or four years, he says, New York could have a convention center that would accommodate today's huge NCC's. The sponsors also are thinking of going to Houston and also back to Chicago, where the second NCC was held in 1974.

Smith said an alternative to a twice a year NCC is a conference the organization is sponsoring on Office Automation next March 3–5 in Atlanta. To be called the Office Automation Conference, it will be held in the Georgia World Congress Center and will be patterned after the NCC format with meetings and an exhibit. Smith said the new conference resulted from talks the NCC organizers held about the size of the NCC and whether a twice-a-year event would be feasible.

Meantime, though, for the NCC itself, it's back to Anaheim next year where the surprising turnout of 57,000 first led to those talks about finding alternatives to the once-a-year event. ✲

Computer use in government, communications, office automation, the role of women in computers and many technology oriented topics will be discussed at the NCC. Some of them are reviewed in this report by *Datamation* editors.

PROGRAM HIGHLIGHTS

Great Expectations in Local Government

"Great expectations never realized" has been a prime characteristic to date of use of computers in local government, said Barry Wellar, of the Canadian Ministry of State for Urban Affairs, Ottawa.

Wellar, chairman of an NCC Wednesday afternoon session titled, "More for Less With Computers in Local Government—a Challenge to Users and the Industry," hopes to provide a productive forum which could help to remedy this state of affairs.

But he has reservations. He feels sure anyone attending NCC who is involved in local government will want to attend as will those selling technology, but "the people responsible for decision making never show up. They complain that the technocrats are talking over but they don't debate them. We end up being technocrats talking to technocrats."

Wellar estimates there are some 70,000 local government entities in the U.S. and probably 3,000 in Canada, all spending lots of money on computer technology. "There are those who have doubts as to what we're getting out of it. They should find out. There's a lot of talk about enhanced productivity. It should happen and it could happen."

He believes that in local government the real results have been on the operations level, the "nuts and bolts and not so glamorous aspects of government like transportation and housing and not in decision making and planning."

He sees use of computer technology in local governments as being seriously challenged, particularly by elected officials and by senior appointed officials within the governments themselves.

They're concerned with two things, he believes. "They worry about the money being spent on computer technology and a lot of things which have been put onto a computer which shouldn't have, and they feel their authority slipping away."

He described a simulation project conducted in Vancouver, Canada, in which a computer technician could make a politician "look like a fool" by calling up facts on a display "right next to him (the politician)" which would make it obvious that promises and/or statements made by the politician were impossible.

"They (the politicians) are worried about their political license, their flexibility."

And as for the dollar aspects, Wellar said California's Proposition 13 "had precedents in Canada in the form of a number of initiatives. Everyone's concerned about money spent on government and a lot is spent on computer activity."

Wellar's highly credentialed panel members and their topics are Craig S. Caywood, National League of Cities, Washington, D.C., "Status and Trends in Computerized Applications in Local Government"; Wellar, "Institutional Requirements for Needs Responsive Computer Facilities in Local Government"; William DeGroff, American Management Systems, Arlington, Va., "Financial Information Systems and Fiscal Responsibility in Local Government"; and Myron Weiner, Univ. of Connecticut, Hartford, Ct., "Selecting and Adapting a Technology Appropriate to Local Government Needs and Capabilities."

How the Federal Government Makes Out with Computers

Computers have long been a way of life in the federal government. This move to machines has also taken hold in the upper echelons of government. It's there, says John Swearingen, "in the little backwater areas like the White House and Senate where computers have really been put to good use." Swearingen, who for the last five years has been director of technical services for the Senate, has put together a Tuesday morning session on some of the specialized dp applications at work in the Senate, White House and federal courts.

Aimed at the general NCC audience, Swearingen's session on "Computers at Work in the White House, the Senate and the Federal Courts," will pinpoint some of the more interesting usage approaches taken by these three branches of government. On the Senate side, Harry Littell, Senate legislative counsel, will describe a new word processing system set up in the Senate's legislative counsel's office. The terminal-based operation is designed to simplify the work of attorneys who must draft bills for Senators.

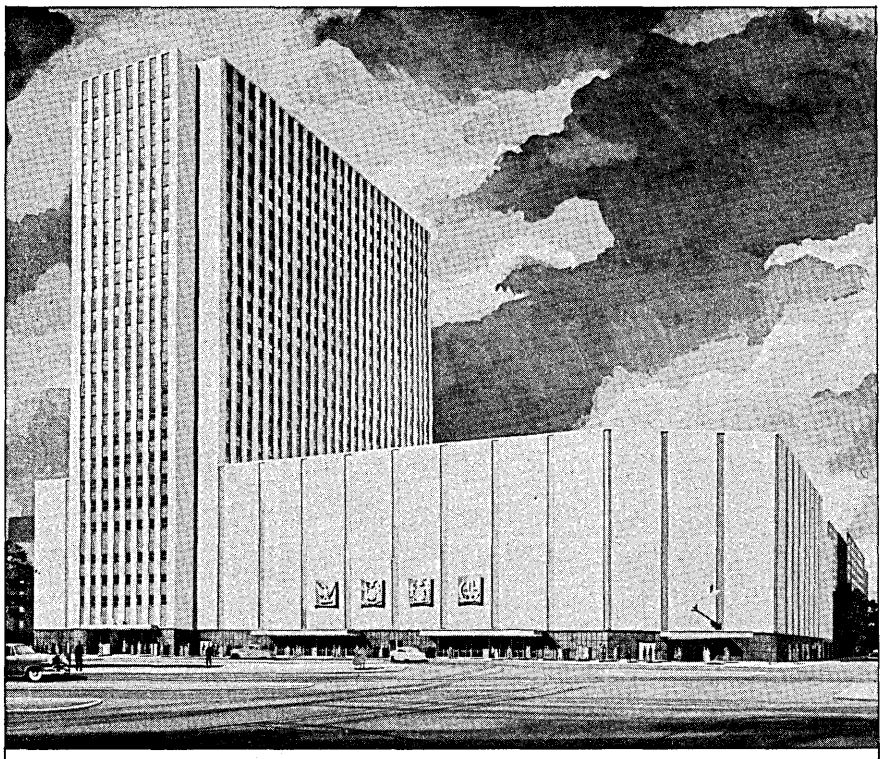
Speaking on the topic of "Court Management and Computers: A Marriage of Necessity," Charles Nihan, director of innovation and systems development at the Federal Judicial Center in Washington, will explain the benefits of a recently developed scheduling system for the courts. Another speaker will be Richard Harden, director of the Executive Office of the President's Office of Administration and special assistant to the President for information management. Harden will give an update on the wondrous automation adventures going on at the White House in his talk on information management in the EOP. Discussing the various ways computer technology is used to manage all the advice and data funneled through the EOP, Harden will detail some specific system applications in the areas of electronic mail, word processing and other advanced office automation setups.

The use of graphics technology as a decision-making tool in the White House and Congress is the subject of a related session scheduled for Tuesday afternoon. Chaired by Harden's special assistant, Edward Zimmerman, the session is entitled, "A Domestic Information Display System: Graphics for Decision Making in the White House and Congress."

For the session, Zimmerman has lined up four speakers, each having a different perspective on the graphics problem. Dr. A. Charles Buffalano, assistant director for administration at NASA's Goddard Space Flight Center, will discuss examples of the type of information technology the space agency has been developing to share space data resources with federal, state and local governments.

NASA, working with various federal agencies, has pioneered the use of satellite information for domestic purposes. The space agency also developed the technology for the Domestic Information Display System (DIDS) which has become a joint Census-NASA project. The White House is also keenly interested in this advanced graphics effort, reports EOPer Zimmerman.

Speaking from the point of view of a



FOR FIRST TIME in NCC history, exhibit will occupy all four floors of New York Coliseum in addition to 200 booth spaces in nearby Hilton Hotel.

THE NCC

Dates: June 4-7
Place: Four locations in New York City: New York Coliseum, Hilton Hotel, Sheraton Centre (formerly the Americana Hotel), Sheraton Hotel.
Conference Program: Monday, 2:30 p.m.-5:45 p.m.; Tuesday, Wednesday and Thursday, 8:30 a.m.-5:45 p.m.
Exhibits: Monday, 11 a.m.-7 p.m.; Tuesday and Wednesday, 10 a.m.-6 p.m.; Thursday, 10 a.m.-4 p.m. (Personal Computing Festival: Tuesday and Wednesday, 10 a.m.-6 p.m.; Thursday, 10 a.m.-4 p.m.)
Fees: Conference, exhibits, and proceedings for four days: $75. Exhibits one day, $10. Exhibits and conference for one day, $25. Four days of exhibits, $25. Students, $10 for entire conference and exhibits. Personal Computing Festival: $9 for three days; $8 for Personal Computing Festival proceedings; $15 for three days and the proceedings; $5 for one day, applicable to NCC registration.
Sponsor: American Federation of Information Processing Societies, 210 Summit Ave., Montvale, NJ 07645. Telephone: (201) 391-9810.

data provider, another session panelist, Dr. James C.T. Pool of the Energy Dept.'s Office of Energy Research, will detail how his agency uses graphics information technology to supply decision-making data to the White House and Congress. Taking the policymakers approach, Dr. Joseph Duncan, director of the Commerce Dept.'s Office of Federal Statistical Policy, will explain how federal statistical organizations will evolve to meet White House and Congressional decision-making needs. Wrapping the session up, Robert Chartrand, a senior specialist in information sciences at the Congressional Research Service, will examine ways information is shared with the executive branch.

Security: Design and Evaluation

"Look at how many sessions there are on security," said the chairman of one of the eight scheduled for the NCC.

Virgil D. Gligor, Univ. of Maryland, sees the number as indicative of the level of interest in computer security and as an acknowledgement of the need for information on the subject. "We're going to talk about the pragmatics of designing a secure system rather than presenting the state of the art," he said of his Tuesday afternoon session titled, "The Impact of Security and Protection on Computer Architecture."

"Security needs were uncovered 10 to 15 years ago," Gligor said. He referred particularly to Multics, now a Honeywell product but originally developed in 1965 by General Electric and the Massachusetts Institute of Technology as a secure time-sharing system, and to early Burroughs systems. "Why isn't secure architecture around today?" He hopes his session will answer this question.

Gligor, who has a Ph.D. in computer security, is a security consultant to Burroughs Corp. and helped design an as yet unannounced secure system for Burroughs.

Gligor feels his session should appeal to people involved in procurement of secure systems, those involved in design of secure systems, and users in general. "Why is industry so slow in becoming secure when the technology is there?" he asked.

He thinks there are three major aspects to secure computer systems: their security, their performance, and the compatibility of secure design with existing systems. "Any two of these," he said, "are easy to achieve but achieving all three is difficult." Costs associated with security, said Gligor, "come in two flavors: performance costs and costs to integrate security with existing systems."

Speakers at Gligor's session will be Edmund Burke, Mitre Corp., Bedford, Mass.; Richard Feiertag, SRI International, Menlo Park, Calif.; Richard Mills, Citibank, New York City; Peter Neuman, SRI International; Gerald Popek, Univ of Calif., Los Angeles; and Clark Weissman, System Development Corp., Santa Monica, Calif.

Robert G. McKenzie, General Accounting Office, chairman of another Tuesday afternoon security session, called his a "spin-off" of a workshop he conducted for the National Bureau of Standards on audit evaluation of computer security. It was invitational and involved some 75 top computer scientists and edp auditors in the U.S. and Canada. "I learned there are divergent views as to how to approach computer security and it comes down to computer scientists versus auditors."

He recalled attending a meeting opened by one of his session speakers, Clark Weissman, System Development Corp. "He was angry. He claimed auditors were blaming technologists for security breaches. He contended the technology is available and management has not seen fit to use it." McKenzie said the "public accountant side of the house likes to look at things tangible such as controls. They look at a lower threshold, at applications systems controls as opposed to operating systems controls. It's evaluation versus creativity."

McKenzie's session is titled, "Computer Security: Technology Vis-a-Vis Audit." In addition to Weissman, his speakers include Carl Hammer, Sperry Univac Computer Systems, Washington, D.C.; Leonard I. Krauss, Ernst & Ernst, New York City; and Richard Webb, Peat, Marwick, Mitchell & Co., New York City. Krauss and Webb, McKenzie said, will represent the auditor's viewpoint, and Hammer and Weissman that of the technologist. He said he deliberately sought out auditors "who know dp inside and out."

Computer Communications in a New Era

Imagine a world in which voice communications are subjugated to data transmission, where communications between adjacent cities in the same state is regulated by the federal government, and where the data processing services industry is collapsing into a few giant forms as the steel industry did in the 1880s and 1890s, and you'll have a mental picture of what tele-

communications in the United States might look like in seven or eight years.

Improbable as that scenario now seems, it can be projected from current events, says Dan O'Neil, whose session on the "Evolution of the Computer Communications Market in a New Technological Era" is scheduled to run at 10:15 on Tuesday morning.

O'Neil, who works at the National Telecommunications & Information Administration in Washington when not playing visionary, notes that the telecommunications industry is becoming extremely volatile, with great new stretches of bandwidth becoming available, and new services like ACS, SBS, and XTEN springing up. The companies in data processing will have to get into telecommunications, he thinks, and the communications companies are already beginning to see that data processing services aren't so tough.

One result may be that the line between data processing and data communications is left undefined (and thus the FCC's Computer Inquiry II comes to no conclusions) and that ATT and others are allowed to dive into dp. When that happens, the dp services firms may find themselves swimming in a sea of sharks—including ITT, Western Union, and GTE among others.

For the dp department all this may mean a wider choice of data services which are as transparent as today's voice network, the passing of the data communications analysts and engineers—for whom there will be no more need than now exists for voice communications analysts and engineers—and the inevitability of distributed processing.

How this will all unfold, when, and why, supposedly will be unraveled by O'Neil and his panelists.

Thoughts to Consider When Moving to Office Automation

What issues should be considered in moving toward office automation? The basic ones are cost, systems, organizations, competitive aspects and management challenges, says Fred Amport Jr., of A.T. Kearney, Inc., who's been spending a lot of time studying the question.

Kearney heads a session Tuesday morning, "Management's Challenge: the Office of the Future," in which a slide presentation will cover these issues. The presentation, designed for middle and top management people, with time for discussion, will serve as a basic primer. But for a technical audience, Amport says they can get into greater detail and address specific products that might be offered and the directions those products will be taking.

"The office automation issue in general will very specifically impact data processing," Amport says. He explains that the case study he's working on involves a lot of transaction processing that is moving from the dp center into offices. And other work previously performed in a computer center, either in a batch mode or submitted through a terminal, is now being done in the office environment. It is there that processing capabilities are being installed, those remote processors being in communication with central dp. "So it has all kinds of implications for the data processing profession."

New technologies and capabilities are indeed being placed into the hands of office personnel, this including not only document generation and processing, but also computational capabilities. So Amport says the presentation at NCC "focuses on the issues that have to be thought about and addressed by those companies who are entertaining moving into" the automated office.

Three Routes to Software Protection

There are three different routes to protection of software as an invention, said John W. Behringer, Sutherland, Asbill & Brennan, chairman of a Wednesday morning NCC session on this subject.

"You can somehow patent it. You can copyright it or you can treat it as a deep dark secret." Behringer said his session, titled "No Patents for Software?—If So, What Now?" will examine each of the three disciplines.

Allan M. Lowe of Lowe, King, Price & Becker, Arlington, Va., will look at patents, particularly the types of software inventions which might be patentable considering the limitations of the patent system as presently interpreted by the Supreme Court.

Lowe also will review the Supreme Court's reasoning in the case of Parker vs. Flook in which the high court upheld the Patent Office's denial of a patent to Dale R. Flook, an employee of Atlantic Richfield Co., for a computer program for readjusting the warning alarms used in hydrocarbon processing systems.

In that case, Justice John Paul Stevens, writing for the majority, said the only novel feature of Flook's method "is a mathematical algorithm. The court has consistently held that such formulas are like a law of nature or a principle and as such are not patentable."

"Copyright in Computer Programs: Authorship vs. Engineering," will be the topic of Roy G. Saltman, National Bureau of Standards. Saltman is the author of a 1977 NBS report on "Copyrights in Computer Readable Works: Policy Impacts of Technological Change," for which he last year received the Edward Uhler Condon award for "distinguished achievement in scientific writing."

He will review the recommendations of the software subcommittee of the National Commission on New Technological Uses of Copyrighted Works (CONTU) and will counter some of the arguments put forth in a dissenting opinion appended to the report by author John Hersey.

In his dissenting opinion, Hersey, a commission member, made such comments as, "It boggles the mind to think of magnetized disks and tapes, the punched cards and the silicon chips of programs in their object phase as 'literary works.' "

The majority report essentially recommends a specific provision in the copyright law for the protection of software.

The "deep dark secret," or trade secret protection aspect, Behringer said, will be covered by "a man recognized by the bar association as the country's foremost authority on trade secret law and author of the definitive work on trade secret law." He is Roger L. Milgrim, Milgrim, Thomaja, Jacobs & Lee, New York City, and his "definitive work" is appropriately titled, "Trade Secrets."

Most lawyers, said Behringer, seem to think that trade secret law affords the broadest protection available now.

Taxes on Software? Planners Take Heed

The subjectability of computer software and services to state sales and personal property tax has been an industry hotbox since the early 1970s.

A Wednesday afternoon NCC session will review existing state and federal taxes applicable to the development, ownership, sale and lease of computer programs and related products and services. "It is a subject which should concern people involved with planning both from software houses selling programs and customers who purchase them, and from insurance companies and the like which invest a great deal of money in in-house developed software," said John W. Behringer, Sutherland, Asbill & Brennan, Washington, D.C., session chairman.

Among the speakers will be Thomas Lynch, Commissioner, State of New York Department of Taxation and Finance. Lynch was instrumental in New York's effectively exempting software and related services from New York State sales taxes in an action taken in November 1977. Behringer said he will review what happened in New York. "I think this affects all states. I believe tax commissioners talk to each

MOVIES BY COMPUTER: NO ACTORS, NO CAMERAS

Will the day ever come, asks Rand Corp.'s Suzanne Landa, when movie films will be made totally by computer—without actors or cameras? Her answer: "An undeniable yes."

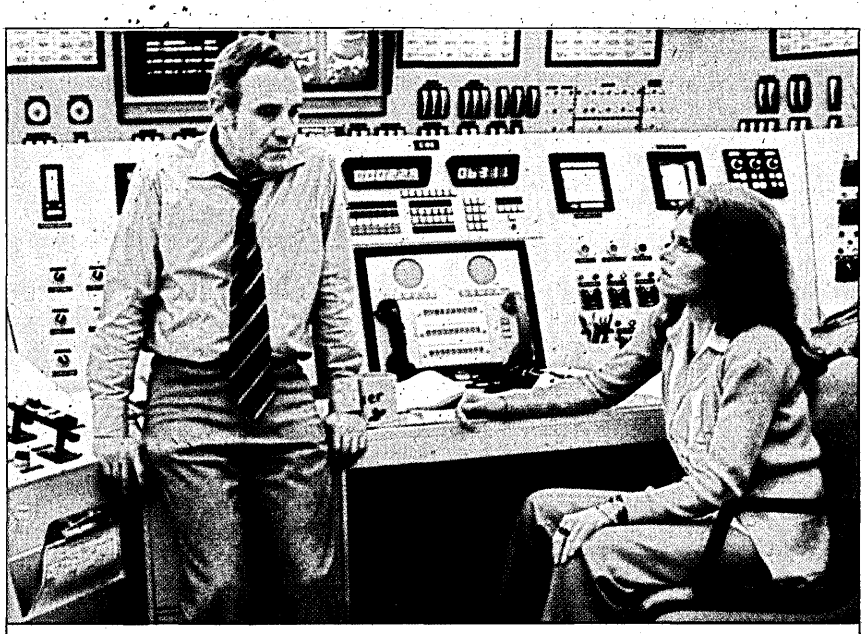
Landa, who has surveyed the use of computers in tinseltown, qualifies her statement by adding: "Whether movies produced by computer will be competitive in cost and quality with those produced by the traditional process, with computer aids, remains highly questionable." But she adds that with the use of computer technology it isn't too far-fetched to envision an actor speaking with another actor's voice, or an actor's head attached to another's body, where the body might be doing things that are totally unacceptable to the actor, but germane to the plot.

Landa leads a session at the NCC June 7 entitled, "Computer Technology in the Movie Industry," in which she will trace a study she's done of the movie industry's use of computers all the way from a movie's initial conception through exhibition, preservation, and redistribution. Her study wasn't done under a contract to the Santa Monica company, but Rand could benefit from it, she says, "because everyone in the movie industry wants to become a producer, but without having to get involved in busy paper work." Rand's knowledge of computers could help them.

For instance, she explains, the movie industry's payroll system is more complex than in any other industry because of changing regulations in the more than 60 unions and guilds to which their employees belong. And the employment figures vary widely. A studio that employs 3,500 to 7,000 persons permanently, easily could be paying 50,000 persons a year. She notes that Universal Studios, which employs between 50 and 2,000 extras a day, uses an interactive system to access a data base containing the names of available extras and information about their skills, attributes, costumes, and props.

Another studio uses computer graphic aids to help them determine the parts of each set which must be built to avoid the waste of building, say, a $3,000,000 set of which maybe only a third will appear in the final print. She says line drawn versions of sets and people are entered into an Evans & Sutherland Picture System 2 through a tablet. For each set, camera angles and moves are executed in a way that those portions of a set that need not be built because they will never be visible can be determined.

Production cost control also is being done with the use of a computer. For example at Disney Productions, a minicomputer system soon will be used to help the location auditor explore the costs of various courses of action when an unforeseen event occurs. "For example, should a storm break, with an expected duration of two weeks, the location auditor would like to determine the costs of keeping everyone on location versus sending them home, paying required penalties, and bringing them back later."



CHINA SYNDROME—Movie starring Jack Lemon and Jane Fonda used a microprocessor to control background instrument panel lighting in synchronization with live-action performances.

Not until this year, Landa says, have special effects been created with the aid of computer-controlled cameras and models. Such previous science fiction movies as "2001: A Space Odyssey," and "Star Wars" have used special-purpose, hard-wired machines, not computers, "depending of course on what your conception of a computer is."

The popular movie "The China Syndrome" required the precise duplication of the interior of a nuclear power plant during the various stages of an alert. This meant the operation of 131 circuits controlling 2,500 instrument panel lights in differing sequences and in differing states, such as off, slow-flash, fast-flash or solid-on for each stage of the alert. And these had to be synchronized with live-action performances. The task was compounded by the need to restart the sequences at any point for retakes and for daily continuity.

Landa says this was done by programming a microcomputer in assembly language to allow accurate, flexible and reliable operation of the panel lights in coordination with the actors' performances.

She says digital storage of films, once they're removed from distribution, should be feasible within five years. Today's data compression techniques aren't sufficiently advanced. To store a 90-minute, high quality, color film digitally would require tens of trillions of bits of storage, and data compression techniques would reduce this amount by only 20% to 30%.

The purpose of her session is "to provide the computer-oriented audience with an understanding of the movie-making process and where each panelist fits in." Two guest speakers are Al Jerumanis, director of corporate data processing at MCA, Inc. (Universal Studios), who will discuss the use of computer technology in filmmaking from a studio's point of view, and William Dietrick of Mini-Micro Systems, Inc., Anaheim, Calif., who has developed an automated sound editing system that is used in movies and television shows. Landa says the system is considered to be the biggest technical advance in sound editing in 50 years. A third guest panelist, Larry Elin, director of animation with Magi, a New York commercial animation company, will talk from the point of view of the user of computers in filmmaking.

Landa says in her research she talked to many persons in the movie industry who weren't aware of their own extensive use of computers. "They'd tell me, 'Oh, we don't really use computers much,' and two hours later we would still be discussing their applications." ✻

other, exchange views and are thinking in terms of a model state law."

Gordon O. Pehrson, Sutherland, Asbill & Brennan, will talk on "Tax Planning for the Software Developer: Existing Law, Emerging Issues," and John E. Haner, Arthur Anderson & Co., Boston, will cover the topic, "Deductibility of Software Costs."

Risky and Squishy

Risk, according to Steven Glaseman of The Rand Corp., "is a combination of 'threat'—which has human characteristics—and 'vulnerability'—the technical characteristics—merged by the catalyst of motivation."

In the classical definition, Glaseman explains, risk was a concept that could be assigned probabilities. For example, if you choose this alternative, it is probable, to some degree, these three events will be the consequence. Risk assessment, however, Glaseman adds, cannot be assigned probabilities. The best available techniques appeal only to educated judgment.

The session Wednesday afternoon will feature papers on two aspects of risk assessment: the theoretical underpinnings, in the paper "A Modular Approach to Computer Security Risk Management," by Robert Campbell and Gerald Sands, Dept. of the Army; and the pragmatic approach, security measurement through auditing, in a paper, "The Coordinated Use of Computers in Auditing."

Panelists Susan K. Reed, National Bureau of Standards; Erik Novotny, Computer Resources Controls; and Malcolm B. Greenlee, Citibank, will respond to the issues raised in the papers, and discuss current research in the field with which they are familiar.

Norman R. Nielsen, SRI International, Menlo Park, Calif., will be a special guest of the session, discussing the work that SRI is doing in measuring the vulnerability of computer system integrity and the potential impact of risk.

The session topic is, as Glaseman admits, "squishy." But then, he adds, "we currently don't know enough to invest our resources wisely toward the solutions of risk assessment problems; we don't even know enough to pinpoint what the real problems are. At this stage, each opportunity for discussion and debate is critical."

Can Associative Processors Be Made Less Expensive?

It's traditional for NCC programs to include sessions on computer architectures of the future, and such sessions are always well attended. This year's program will include several of that variety, including "Associative Processors—Why are they needed? What can we expect in the future?" It will be held Thursday under the joint emcee'ing of Tadao Ichikawa from Hiroshima Univ. and King Sun Fu from Purdue.

Associative processors have come to be viewed as very large, specialized, and expensive machines, and that's one of the problems with the concept, according to Professor Fu. We can reel off several fine applications for the systems—like pattern recognition, seismic data analysis, picture processing—all of which are now stymied by the current lack of machine power. That list adds to the conception of these processors as being super numbercrunchers. But great advances may be made by building less expensive versions, perhaps with multiple microprocessors, says Fu.

For example, he suggests, many medical applications like X-ray analysis, blood-cell counting, EEG and EKG analyses could benefit from increased parallelism. The problem today is that the hardware is so expensive that hospitals must opt for less analysis or at least much slower analysis.

Better hardware would lead to closer to real-time processing of satellite data as well, which now takes weeks to process. More cost-effective hardware would lead to commercial dp applications, too, including the development of data base processors—for which associative architectures hold genuine promise, especially with relational data bases.

Some of the above applications have been tried, including data base processing, with varying degrees of success. How and where and with what effect are the topics to be covered.

Computerized Conferencing Let's Try It Again

Rapid technological advances sometimes fool us into projecting rapid changes in social systems—in how we do business, for example, or how we interact with others. Thus automating office work, on-line conferencing, and other developments where the human parameter is intimately involved are thought to be easier than they really are, and "just around the corner" in terms of time.

Those who have experimented with such systems, including the participants in a session Tuesday morning on "Social Effects of Computerized Conferencing," soon find that the technical problems are not the only barriers to be hurdled. What has happened, according to panelists Elaine Kerr and Robert Bezilla, is that "early users of computerized conferencing have groped and fumbled their ways through communicating. Messages have been misdirected, humor misunderstood, anger has gone untempered, precision dissipated, emphasis misplaced, and verbosity has gone unchecked." All this from tools that are intended to streamline human interaction.

Murray Turoff, a panelist who is very familiar to those who have followed the field, suggests the same kinds of problems by subtitling his keynote presentation "Confessions of a Designer." His work with EIES (Electronic Information Exchange System), plus Valerie Lamont's experience with "Legitech" (a similar system for legislators), and that of the Institute of the Future with the system "Planet" will be shared in the session organized by Starr Roxanne Hiltz.

The Information Officer: Transition for Dp People

Career-minded NCC visitors may be interested in a session of panelists talking about the role of today's corporate information officer and what the universities are doing to train persons for this role. Called "The Information Officer: Fact or Fancy?" the session, headed by Dr. James C. Emery of Educom in Princeton, N.J., will introduce the new factor of how the information officer can cope with office automation, once outside the purview of the traditional data processing director, but now very much part of it.

"It makes a lot of sense to put this thing under the information officer," says Emery, who says he believes a lot of people in dp can make a good transition to take over office automation functions.

Other panelists at the session to be held Tuesday afternoon are Frank J. Carr, of the General Services Administration's automated data and telecommunications services commission; Professor J. Daniel Couger, Univ. of Colorado; Allen Z. Loren of INA Corp.; and Paul A. Strassmann of Xerox Corp. All are familiar in one way or another with the information officer's functions and will discuss how the nature of an organization influences the information officer's role, with emphasis on organizations in the private and public sectors and manufacturing or service, large or small.

Emery says the information officer's origins vary. They can be data processing people moving ahead or they can come from today's business schools. Whatever, they must answer one big question: Do they have the managerial point of view?

Information Is Power and a Lot of Politics

It's not a new concept that information in any organization means power. But in the computer era, some among the intelligentsia view information as a battle for information among corporate level people

Some of the problems stem from a woman's own attitude about herself and other women.

and divisional level people. And they see it as a highly disruptive factor in the way organizations work.

In a session with the intriguing title, "Power, Politics and Structure: Computers and Organizations," four persons from universities will present their views on how these factors can influence the success of computer systems. "Any vendor or manager is well aware of the politics involved in making a decision to buy a computer," says M. Lynne Markus of Case Western Reserve Univ. of Cleveland, who heads the session to be held Tuesday, June 5.

At one time the corporate accounting office operated only as a figurehead, having to go to the divisional groups for information. Suddenly they acquire their own computer system, into which the divisional people input data, but that data is turned into output for the corporate people and not for the divisional people. "People designing such systems see that they have all sorts of benefits for an organization and assume they therefore will be installed. But this is based on an incorrect assumption: that all people will receive the benefits equally. In fact, benefits are very unequally distributed," says Markus.

Markus bases her findings on a one-year study of two major unidentified manufacturing companies that are highly decentralized. She found that in one organization, the divisional people were indeed using the system to provide reports for the corporate people, but also were either running parallel systems on a different computer system or keeping their own manual systems. "And, in many cases, for the divisional people this made sense," said Markus, "because each user in the organization had a different expectation for the system."

Markus said her study, which will be presented this spring as a doctoral dissertation at Case, used three distinct descriptive models—rational, cultural and political—for determining the factors in selecting systems. The rational model determined the cost and benefits of a system, the cultural explored the user satisfaction with a system, and the political explored the power shifts within an organization as a determinant in acquiring a system. She believes many of the outcomes of organizational use of computing technology are neglected and will explore the implications as they relate to the systems designers.

Other speakers in the session will explore these factors as they apply to the manager of information systems. Daniel Robey of Florida International Univ., Miami, will explain how his recent research into information systems as practiced in five countries found factors that affected the manager's job. Margrethe Olson of the corporate applications and information systems group at New York Univ. will discuss the subject from the point of view of today's trends toward office automation. Peter Keen, professor of information systems at the Wharton School, will zero in on the politics of information systems.

A Computer for the Boss

Despite the visions of crystal ball gazers over the past several decades, computers don't occupy prominent positions in the offices of many chief executive officers (CEO's). A Wednesday session, "Computers for the Chief Executive Officer," chaired by Howard Lee Morgan of the Harvard Business School, will explore the computer support desired by, and provided to, CEO's. The topic will be considered in light of new technology, particularly office automation and personal computing. An example cited by Morgan is the case of a railroad executive who uses a personal computer at home to receive electronic messages and to perform modeling simulations.

Morgan expects an audience of CEO's, dp managers, and decision support personnel. The panelists represent a variety of positions. Neil Churchill, also of the Harvard Business School, will be on hand to present a skeptic's views. Two CEO's also will be on hand: James H. Carlisle of Office of the Future, Inc., and James C. Emery of EDUCOM. Herbert Z. Halbrect of Halbrect Associates, and president of the Society for Management Information Systems, will round out the panel. Halbrecht, on behalf of the society, has studied a number of CEO's who personally use computers.

Women in Dp: Touchy Subject of Earnings

The ever-changing role of women in the male-dominated world of data processing should be one of the hotter topics at this year's NCC. Anticipating the growing interest in this often touchy subject, conference planners have lined up a series of sessions all aimed at advising women on career paths and problems in the computer field.

Leading off on Tuesday afternoon, Carolyn Landis will head a session on "The Status of Women and Minorities in Computing." Landis, a corporation secretary at EDUCOM, a Princeton, N.J., research firm specializing in computers in education, has organized her session around two main speakers. Helen Wood of the National Bureau of Standards will be on hand to sum up the current status of women and minorities in computer professions. Another talk by Lynn Peterson from the Univ. of Texas Health Science Center will focus on "The Status of Women in Health Science Computing." A follow-up discussion will zero in on some of the problems women confront in seeking progressively better jobs in the dp field.

Some of those problems, according to TRW's Betty Niimi; may stem from a woman's own attitude about herself and other women. Niimi, a subproject manager on the Battlefield Exploitation & Target Acquisition (BETA) project at TRW's Defense & Space Systems Group, has put together a Wednesday afternoon session which explores how these attitudinal hangups hamper women from moving up the managerial ladder.

Designed to sensitize women to these professional pitfalls, Niimi's session, "Making Management a Women's Game," will feature five speakers. TRW technical staffer Alyce Jackson, who originated the idea for the session, will give a talk on "Opening the Door to Management." In this discussion, Jackson will benchmark the management game, analyzing the requirements and strategies women must have and use to move into their first management slot. Another session speaker, Ruth Brown of Detroit Transmission, will present her views on how women make the jump from technical to managerial jobs which require a whole different set of skills.

On the subject of "Adopting a New Personal Image," Jan Winston, an associate contract administrator at Aerojet Electro Systems, will delve into the feelings of risk, isolation and insecurity that women often face when switching into the managerial mode. Opportunities for women in upper management will also be explored by Linda Taylor, functional area manager of software development at System Development Corp.

Session leader Niimi, with the topic of "Playing the Political Game," will focus on how manager-minded women should deal with their subordinates, peers and top management. This calls for a new mindset. Niimi explains why: "Women have tended to justify their existence by being good in the technical environment. That's where, they believe, there's truer quality—in other words, brains talk. But when you get into managerial roles, you're really getting more into interpersonal relationships. You must know how to interact with people and how to motivate them and how to solve problems. And I think that becomes a more difficult role to transition into, mainly because you then have to deal with the fact that you are a woman and not a father image."

Niimi, who serves as chairperson of TRW's Women's Advisory Group, believes

women themselves have to "get used to dealing with other women." Traditionally used to working with male job superiors, many women, according to Niimi, have adopted "the daughter role." That role "ploy," she insists, "simply doesn't work anymore," particularly when a woman's boss is another woman. "And that," she declares emphatically, "is a healthy shakeup in the equilibrium."

To understand why this equilibrium has been the way of life of the working woman for so long, Ira Mason has planned a session on the "Sexual Barriers in Business and How to Overcome Them." This eye-opening session, scheduled for late Wednesday afternoon, will examine the psychological differences between men and women and how those differences impact professional women. Mason will also probe some of the classic facts and fallacies surrounding working women.

Mason, a data processing professor at Lehigh County Community College in Schnecksville, Pa., has been doing research on how boys and girls are raised and trained. Tracing adult behavior patterns back to their roots in childhood, she will cite studies which seem to pinpoint why women and men have been locked into roles both personally and professionally. A big booster of the "WOMANager" (a word she herself coined), Mason will discuss ways for women to revamp their traditional roles and achieve managerial muscle.

So far, very few women in dp have developed that muscle. Their career mainstays, Mason points out, have been programming and systems analysis. On the salary scene, women are also getting shortchanged when compared to men. "In the computer sciences field," she notes, "women earn 67% of what males earn." Those statistics, she affirms dismally, "are across the board in computer sciences, including data processing."

Maintenance: A Slower Response for Economy?

The traditional two-hour response time that computer service companies offer could give way to four hours or next day as maintenance costs continue to soar while hardware comes down in price. That's the feeling of George O. Harmon, vice president and general manager of Pertec Computer Corp.'s Services Div., who will lead a session Thursday on "The Expanding World of Service."

Harmon is past president of the three-year-old Association of Field Service Managers (AFSM), an organization of some 1,300 members representing 300 companies, which is presenting the session that Harmon said will be aimed at telling top management how critical service is to vendors and users. "Service for some vendors will be the difference in their success or failure," says Harmon, who will be joined by four panelists: Richard P. Cook, director of field engineering with Mohawk Data Sciences; William J. Herbert, vice president of Indeserv, Inc., an affiliation of independent service organizations; Charles T. Hutin, program manager with Xerox Corp.; and Wesley D. Tharsh, vice president of services with National Semiconductor Corp.

Topics will include designing reliability, availability and serviceability in product development, maintenance pricing techniques, impact of technology on service strategy, the role of third party maintenance in the industry, and diagnostics and support center concepts.

On pricing concepts, Harmon notes that the maintenance business which was a $4.8 billion business last year is beginning to find itself having to charge well beyond the traditional 3% to 5% of the purchase price of equipment. On some systems, notably the MITS Altair line that Pertec acquired three years ago, the rate is 20% to 22% of the hardware price. As that continues, he said, some customers may begin to opt for lower rates at the price of service response time. "From the traditional two hour response time, they may begin to go for four hours and maybe even next day service for reasons of economy," he says. The reason, of course, is that hardware prices are dropping dramatically while the cost of service, which is a labor intensive cost, are rising fast and that is seen chiefly in the smaller computer field. Harmon says he doesn't foresee "for at least several years" the time when the customer will opt do to his own maintenance with plug-in spare parts.

The session at NCC should attract other service people and the small systems houses who "have come to grips with how they will service their products." The rest should be users, Harmon said.

With Feds as Friends, Who Needs Enemies?

International conflicts concerning trade, telecommunications, and information flow will be discussed at several NCC sessions. If the panels and the audience are candid enough, these meetings could be roof-raisers since the topics have been rife with griping, sniping, and suspicion.

U.S. restrictions on trade will be the subject of "Foreign Policy and National Security Restriction on International Trade in Data Processing." From some views, this panel could be labeled, "With friends like our government, who needs enemies?" Chaired by Arthur T. Downey of Sutherland, Asbill, & Brennan, the panel will limit itself to restrictions imposed on exports to Communist countries and such other hotspots as South Africa.

A particular focus will be on revisions to the Export Administration Act, which expires Sept. 30, and the impact of controls to date on U.S. exports. Many firms have bitterly complained that American restrictions and embargoes for political and human rights reasons have accomplished nothing more than loss of business for U.S. companies. A case in point will be represented by David Anderson of Sperry Rand Corp. Last year, in retaliation for Soviet prosecution of dissidents, President Carter halted the export of a Univac system to news agency TASS. A few weeks ago, with none of the dissidents freed, the decision was reversed.

Unfortunately, new U.S. tax policies adversely affecting overseas operations and the closing of American trade centers around the world are not topics on the agenda. But Downey, Anderson, and William G. Barraclough of the State Dept. should be able to answer questions.

On the telecommunications side, L. Dan O'Neil of the National Telecommunications and Information Administration has assembled a panel to examine the conflict between the increasingly competitive communications services industry in the U.S. and the highly protected postal and communications monopolies abroad: "Computer Communications and the International Data Marketplace." The implications for multinational users and vendors are enormous, as foreign nations move toward elimination of private nets, increase the costs of transmission, and resist some foreign competition.

The U.S. services firms and users will not be sitting on this panel, but O'Neil and his colleagues—James Howard of NTIA, Kalman Shaeffer of the Federal Communications Commission, and Ron Edward of Martech Strategies—should be informative on the government's perception of the conflict and the reaction the U.S. is receiving from overseas authorities.

(U.S. entrepreneurs may want to ask about the government's position on entry to this market of foreign data base and other computer services—like Viewdata—if restrictions on American competition abroad continue.)

For those weary of the "International Privacy Debate: Laws, License, and Limitations," the session by this name will be hard put to shed much new light on how all the data laws proliferating around the world will affect the multinational users and vendors—or the U.S. in general. It's not that the speakers will not be knowledgeable, but that everyone is still jockey-

Hopefully, the session will present debates, not one-sided views.

ing for position and most laws are just being passed or implemented.

For the untutored, however, the session will outline the legal happenings to date by country and in organizations developing treaties and guidelines (Alexander Roth of AFIPS). Control Data's Hugh Donaghue, chairman of the government's task force of multinationals studying the subject, will detail the work and findings of that task force. And Lucy Hummer of the State Dept. will explain the U.S. government's current position, which has been to oppose any legal treaty and support the voluntary guidelines being developed by the Organization for Economic Cooperation and Development.

At writing, this panel was looking for a good representative of the European view, so hopefully it will present debates, rather than a one-sided view.

The session on the "Technical Aspects of Privacy Protection in Transnational Data Systems" will take a crack at describing the legal requirements and security procedures that the multinational organization will have to follow in complying with the foreign data laws and treaties. Chaired by Dr. Rein Turn, who heads up the afips Transborder Data Flow Panel, the session will have Philip Tankhoff of Computer Sciences discussing the impact on services companies and M. Blake Greenlee of Citibank examining the demands on the multinational computer user. The prospects for international scientific information exchange will be discussed by George I. Davida of the National Science Foundation.

Integration of Analog and Digital Circuitry

There are important systems ramifications in a newly developed ability to combine large amounts of logic and memory on a chip alongside analog functions, such as a-d and d-a converters, commutators, and operational amplifiers—the traditional linear circuits. It's now possible to buy a microprocessor with an 8-bit a-d converter, its own oscillator, and some other special circuitry. Thus all the circuits that formerly were on the periphery have been pulled inside, and that means lower costs.

This chip, a first generation product, can be used as an automobile carburetor controller, for example, or to control both a microwave and conventional oven. It can be interfaced directly with a keyboard, display, and thermocouples, and will provide time of day and accommodate the programming of the oven.

"As we all know, the amount of digital circuitry you can place on a chip has been growing," notes Rob Walker, chairman of a session Wednesday, "The Impact of New A/D LSI Technology on Systems." "Every year it has doubled, or close to it."

Indeed, semiconductor memories have become more closely packed and microprocessors are handling longer word lengths, and the cost of these devices continues to plummet. But there are systems where most of the cost is in analog circuitry. And the pressure to reduce those costs have led to the integration of analog and digital circuits on one chip.

This panel, then, will have representatives of the significant and major technologies, people who will describe their capabilities and latest products in order to indicate their thinking about systems. And Walker says he's hopeful that systems folks in the audience will question their approaches to system design.

Walker of Intel Corp., Santa Clara, Calif., uses the example of a data acquisition system design to show how things are changing. As represented by a circuit design, he observed, someone might question whether the latest thinking is to have a computer at each strain gauge. Such a design, he acknowledges, sounds ridiculous. "And yet it's absolutely true." So it means the architecture of that system is changing. Instead of low-level signals and a shielded wire going into commutators, into a-d converters, or into a transmission modem, the interface will be over a two-line twisted pair or a modem directly. And the transducer will have associated with it a microprocessor and all the signal conditioning. All this for a mere additional $10, say, which represents a savings over the things it replaces.

"So that's where we think there will be systems ramifications, both large systems and small."

A product not yet out but likely to be mentioned is the analog microcomputer. It accepts analog signals, outputs an analog signal, but every step in between is digital. Since the processor is programmed like any microcomputer before, it means the analog folks will be learning programming, much as the digital circuit and logic designers before them have done.

But the emphasis on this session will be on what's possible now, what the panelists think will be possible in the future, to ask what they should build, and to indicate how these capabilities will change future systems designs.

How Users, Programmers Interact with Systems

With personnel and software becoming the dominant cost in systems, the marriage of psychology and software deserves thought. An experimental approach with a controlled format would lead to a better understanding of how users and programmers interact with their systems. Ben Shneiderman, an associate professor in the information systems management department of the Univ. of Maryland, became interested in the psychological aspects of computer science about five years ago. In New York, he'll chair a Tuesday session entitled "Software Psychology: Exploring the Human Factor." The session, intended for practitioners and researchers, will look into experimental psychology and psycholinguistics (how we learn language, is it innate or cultural?).

Panelists have been chosen from both computer science and psychology. General Electric, which has studied, for the Office of Naval Research (ONR), how programmers debug and comprehend programs, will be represented by two speakers: Bill Curtis, and Tom Love. Psychologist Anthony Norcio of the Catholic Univ. has researched how programmers comprehend their code. John Gannon, also of the Univ. of Maryland, kept and analyzed all of the runs 33 programmers made while developing and debugging code. He analyzed mistakes, and investigated why some bugs took little time to find, while others remained elusive. John C. Thomas of the IBM Research Group will take a look at how people design systems.

Faster Searches Seen With Array Processors

The "next" machines in dp's evolution will be large and small versions of array processors, says Sue Eilers, who heads the session on Associative Languages on Thursday. Many users are already working with small array processors and don't realize it, she says, including those processors which are imbedded in large machines for purposes like paging.

"It's going to happen, if only because it's one way of speeding things up. We're reaching limits with our present architectures. We can get an order of magnitude faster searches of data bases, for instance, with array processors."

One obstacle to widespread use of such systems now is the lack of languages, but the situation is changing. A few associative languages are on-stream now, or at least close. When they do come, the languages will look a little different from those we're used to. They still may be procedural, but they won't be sequential. They will have no need for DO loops and other mechanisms to step through data, since array processors do that automatically. And the new languages will be particularly right for data base applications, especially those involving relational data bases.

According to Eilers, it's time to get ready for them. They're almost here.

Market Confused About Minicomputer Software

"The hardware is there," says Marvin Golland, a manager in the consulting and data management group of Peat, Marwick, Mitchell & Co., New York. "But there's a confused market out there regarding software."

Golland, who will be heading an NCC session Monday on the "State of the Art of Minicomputer Hardware/Software and Distributive Processing," believes that the uncertainty users feel about minicomputer software selection stems from the fact that minivendors—manufacturers, oem houses and software houses alike—may be promising more than they can deliver. "People believe that in selecting and installing a mini system they simply have to flip a switch and everything will work fine. But that's simply not the case."

Golland believes that it's almost as difficult for a user to get a minicomputer system up and running as it is to make a big mainframe system operable. "You can't cut corners on system implementation whether you've got a mini or not. There are no shortcuts."

Another panelist, Norman Schibuk, director of programs and systems, Multiple Funding, New York, intends to talk about some of the ways his firm's clients are using minis in a distributive mode. Multiple, which sells software and remote processing capabilities to insurance companies over the Service Bureau Corp. network, provides clients with a centralized data base of their own records. An increasing number of these companies are concurrently putting minis in regional offices where they're being used for local dp applications.

"The minis may handle such local back office functions as payroll," says Schibuk, "but at the same time the regional offices are tied into the central data base which is controlled and maintained by the home office of the insurance company."

With this approach the home office maintains complete control of its files, Schibuk says, since none of these records can be changed except by corporate headquarters. The centralized files themselves include proprietary and general information on some 200 different forms of life insurance policies and pricing and marketing information. This can be released selectively to different branch offices if, for example, the parent company wants to attempt an experimental marketing project. And it could be pulled away just as easily, says Schibuk.

Until recently most of Multiple's clients used terminals to access the central files. However, now half a dozen have installed distributed mini operations and one large insurance firm is in the process of installing a 118-minicomputer network which will be tied into the Multiple data bases. Accessing the data bases remotely is less expensive than maintaining complete files on site, Schibuk maintains. ✲

Four hundred exhibitors, an NCC record, will display their wares on all four floors of the Coliseum and at the Hilton Hotel.

PRODUCT PREVIEW

Somewhere in the New York phone book, some helpful soul explains how to relate street addresses to cross streets. "Take the square root of the street address, add the largest prime number less than or equal to this, then divide by pi. The whole number part of the quotient is the cross street, while the fractional part represents your composite biorhythm on a scale of zero to one." If all this fails, you can always ask a cab driver.

Unfortunately, the cab drivers probably won't be up to speed on the booth numbering scheme used at this year's NCC. Not to worry: it's easier than finding an address. Booths with four digit numbers are in the Coliseum; the first digit indicates the floor. Three-digit booth numbers greater than or equal to 300 have been assigned to booths in the Hilton Hotel. And those remaining three digit numbers go to the Personal Computing Festival, located in the Sheraton Centre (formerly, the Americana Hotel). ✲

AM INTERNATIONAL, INC., BRUNING DIV.

Tustin, Calif. **Booth 2510**

MICROGRAPHICS

The CSR 2001 Camera/Processor can be configured with automatic document feeder, and internal and external processing (or both). With the auto feeder, the CSR is speced to process better than 1,200 documents per hour. The unit has a base price of $13,800; auto feed adds $2,900, and processing capability is an additional $2,400 (internal) or $2,800 (external).

FOR DATA CIRCLE 400 ON READER CARD

APPLIED DATA COMMUNICATIONS

Tustin, Calif. **Booth 356**

FLOPPY DUPLICATOR

The Floppy Copy IC-450 Programmable Media System is a tool for testing, initializing, and duplicating both standard and mini diskettes. An automatic stacker/loader holds up to 50 diskettes; diskettes, fed one at a time, can be tested, initialized, and then loaded with data for subsequent mass distribution. Diskettes failing the test phase are ejected into a reject hopper. The Floppy Copy is said to handle all IBM formats, as well as most other formats; formats supported include single and double density and one or two sided drives. Both

hard and soft sectoring can be accommodated. The basic Floppy Copy, with cpu, stacker/loader, crt console, and workstation desk, sells for $19,950 for standard or minifloppy, and $29,950 for both (double density is priced separately).
FOR DATA CIRCLE 401 ON READER CARD

APPLIED DIGITAL DATA SYSTEMS, INC.
Hauppauge, N.Y. **Booth 1322**

SYSTEM AND TERMINALS

A small system and a range of terminals, from simple display to clustered intelligence, will grace this vendor's booth. The System 75, a small system targeted at the oem market, speaks BASIC and FORTRAN. ADOS, the System 75 operating system, supports sequential and random files. In lots of 25, a System 75, including 52KB of memory, three dual-sided floppy disk drives, parallel printer interface, communications hardware, and software, sells for $7,645.

The Regent 20 is a basic 24-line by 80-character crt display terminal. The terminal has EIA and current loop interfaces, as well as a printer port. It sells for $995, in quantities of one to 24. The Regent 40 adds a 25 status line to the display screen, as well as line drawing capabilities, to the functions of the model 20. The model 40 sells for $1,400 in quantities of less than 25. Moving up the line, the Regent 60 is a smart buffered terminal that is upward compatible with the 20 and 40. It sells for $1,795 (one to 24 unit price). Finally, the Regent 300 is a clustered intelligent terminal comprising a microcomputer with 52KB of RAM, dual diskettes, and asynchronous or synchronous communications at speeds of up to 9600bps. In lots of 25, the Regent 300 sells for $8,080, which includes four terminals, printer interface, cpu, diskettes, communications equipment, and software.
FOR DATA CIRCLE 402 ON READER CARD

BDT GMBH
Rottweil, W. Germany **Booth 3206**

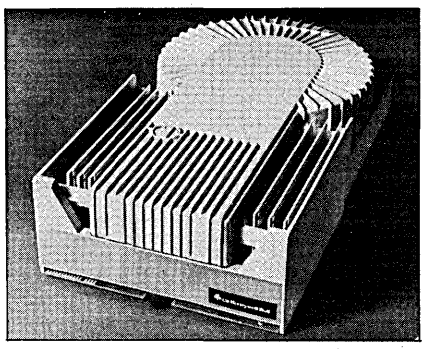
AUTOMATIC SHEET FEEDER

Last year, this vendor showed up with a pair of paper handling devices for daisy-wheel printers; this year they've brought out a fancier device, ASF 170, a sheet feeder for Diablo and Qume printers. The ASF 170 differs from last year's units in that it has two paper trays, either of which can be selected under program control. An optional feature allows tray selection based on a special character imbedded in the output text, eliminating the need for software changes. An obvious application is to put letterhead in one tray, and bond paper in the other. The ASF 170 sells for $1,595. MQI Computer Products of Fountain Valley, Calif., represents BDT in North America.
FOR DATA CIRCLE 403 ON READER CARD

BULL CORP. OF AMERICA
Waltham, Mass. **Booth 347**

DISK DRIVES

The D100 series of disk drives CII Honeywell Bull brought to Anaheim last year has grown; the D160, newest member of the family, will be on hand in New York. Available in three versions, with two, three, or four nonremovable platters, the D160 can pack away as much as 120MB in a package small enough to allow the vertical mounting of three units in a standard 19-inch rack. The drives are compatible across the family, and can be intermixed on the same

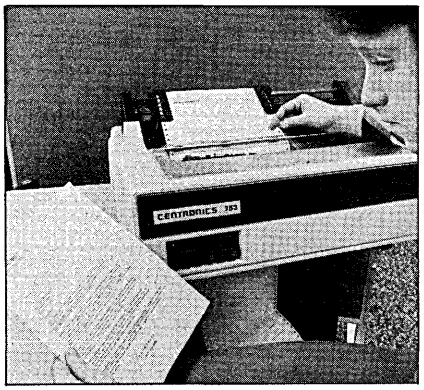


controller. The D160's sealed disk modules contain two platters for 60MB capacity, three platters for 90MB, or four platters for the maximum 120MB; the modules also contain four, six, or eight heads, respectively. Servo data, interlaced in each track, are used for head positioning. Oem pricing, for annual quantities of 100, runs $3,085, $3,355, and $3,625 for 60MB, 90MB, and 120MB versions, respectively.
FOR DATA CIRCLE 404 ON READER CARD

CENTRONICS DATA COMPUTER CORP.
Hudson, N.H. **Booth 1121**

PRINTERS

A 1200bps receive-only printer and a dot-matrix printer intended for word-processing applications will highlight this vendor's booth. The model 704 receive-only data communications printer can print from 70 lpm to 400 lpm with its 180cps dot-matrix print mechanism. The 132-column 704 uses the 96 character upper and lower case



ASCII set. Reverse channel, XON/XOFF, and Data Terminal Ready protocols are switch selectable, as are parity, number of stop bits, and data rates ranging from 110bps to 9600bps; the unit has a standard buffer size of 256 bytes (2KB is optional). The 704 has an RS232 interface. Available in three models, the 704 is priced from $2,350 to $2,665 (end user pricing).

Intended for word-processing applications, the model 753 prints at 130cps to 150cps using proportional spacing. The dot-matrix printer uses an n x 9 dot matrix (common across the 700-series) to form characters; with overlapping dots, the 753 is capable of forming characters as wide as 18 horizontal dots. The microprocessor-controlled printer also is capable of right justification under host computer control. Print lines may contain as many as 132 print positions when fixed spacing (as opposed to proportional) is used; fixed spacing throughout is rated at 100cps. Data input is via a parallel interface using seven or eight-bit ASCII codes. End user pricing for the 753 ranges from $2,895 to $3,195, depending on options.
FOR DATA CIRCLE 405 ON READER CARD

CHERRY ELECTRICAL PRODUCTS CORP.
Waukegan, Ill. **Booth 1022**

KEYBOARDS

For systems builders, this vendor offers to show two capacitive keyboards (along with other members of its product line) at the Coliseum. The CB80-07AA and CB80-12AA, in secretarial and communications layouts, respectively, require only a 5-volt power supply; scan time can be adjusted from 10msec to 80msec per key. Character codes are a mask option and can be selected from a number of codes, including ASCII and EBCDIC. In lots of one to nine, the keyboards sell for $135.
FOR DATA CIRCLE 406 ON READER CARD

CIPHER DATA PRODUCTS, INC.
San Diego, Calif. **Booth 3311**

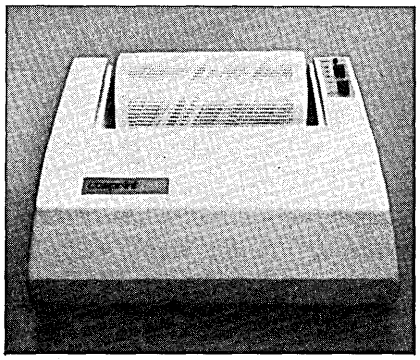
MAGNETIC TAPE UNIT

Systems integrators should find this vendor's Low Profile Streaming Tape Drive a useful component. IBM and ANSI compatible, the drive reads and writes data at 1600bpi in phase encoded format. In conventional start/stop mode, the drive runs at 12.5ips. But the drive really shows its colors when it's used in "streaming" mode: the drive takes data in large blocks and runs at 100ips. While streaming, the tape unit automatically inserts interrecord gaps. High speed streaming should take much of the drudgery out of backing up disk packs. The Low Profile Streaming Tape Drive, including formatter and controller, sells for $1,780 in quantities of 750.
FOR DATA CIRCLE 407 ON READER CARD

COMPUTER PRINTERS INTERNATIONAL, INC.
Mountain View, Calif. **Booth 60**

PRINTER

The model 912 is this vendor's initial entry into the inexpensive, nonimpact printer market. Priced at $560 ($599 with RS232 interface), the 912 is intended for use in small business systems, in the home, as a crt terminal copy device, in message networks, and in data logging applications. The unit can print the 96-character ASCII set, with characters formed on an overlapping 9 x 12 dot matrix. Printing 80-column



lines on electrosensitive silver (well, actually it's aluminum) coated paper, the 912 runs at 170 lpm. IEEE-488 and strobe/acknowledge parallel interfaces are standard on the basic printer; the RS232 and 20mA current loop interfaces are combined as a $39 add-on. The microprocessor-based printer includes self-test capability and automatic pagination (subject to override).

FOR DATA CIRCLE 408 ON READER CARD

DATAGRAPHIX, INC.
San Diego, Calif. **Booth 4422**

WIDE-SCREEN CRT

The latest of this vendor's 132-column crt terminals, the model 132-1, will be on hand in New York. The terminal displays 24 lines of 132 characters, and it has a 25th line for a status display. Other features include 132 tab positions, cursor control with host computer sensing and addressing, 11-key numeric pad, RS232 interface, and the use of the full 96-character ASCII upper and lower case character set. Single units sell for $2,150, with discounts offered on volume purchases.

FOR DATA CIRCLE 409 ON READER CARD

DATARAM CORP.
Cranbury, N.J. **Booth 1506**

MEMORY PRODUCTS

A 128K-word add-in memory for DEC's LSI-11/23 microcomputer (see this month's Hardware section) and a semiconductor mass memory subsystem will be on hand in this vendor's booth. The DR-113S 128K x 18 semiconductor add-in is packed on a single quad-size card that plugs into the LSI-11 backplane. The memory cycle time is 500nsec; access time is 325nsec. Refresh circuitry is on-board, and there is provision for battery backup. A DIP switch allows selection of address offset in 4K increments. Nonparity and 64K-word versions are offered. Parity versions (18 bits) are $3,315 and $2,250 for 128K-word and 64K-word capacities; nonparity boards are $3,150 and $2,145, respectively.

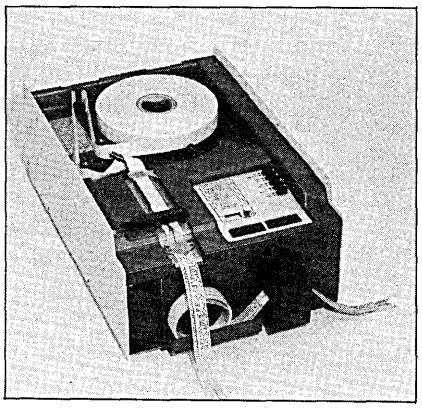
The Bulk Semi memory system can be configured with 0.5MB to 8MB of error correcting semiconductor memory. The subsystem comprises a Bulk Semi controller (BSC) board, and from one to 16 512KB memory boards. Intended for use as a disk emulator for DEC, Data General, and Interdata minis, the Bulk Semi memory can be configured in two or four byte words. Cycle and access times for a 36-bit word are 500nsec and 350nsec, respectively. A typical 1MB subsystem sells for $17,000, including chassis, power supply, BSC, memory, fans, and off-line tester. The BSC board is $1,000 and 512KB memory boards are $6,500.

FOR DATA CIRCLE 410 ON READER CARD

DATA SPECIALTIES, INC.
Northbrook, Ill. **Booth 1528**

TAPE READER/PUNCH

Combining both punched tape reader and punch in the same unit, the SRP-750 operates at standard speeds ranging from 110bps to 3000bps; reader and punch



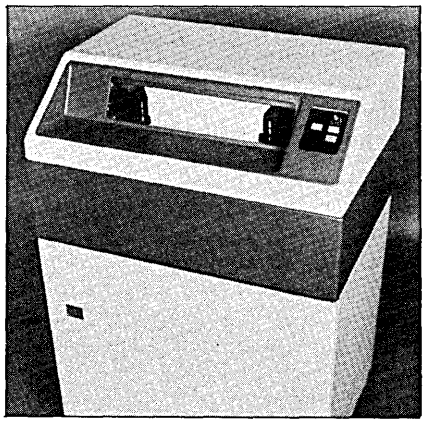
speeds are independent of each other. The dual-ported RS232 peripheral includes a 4KB buffer, automatic diagnostics, full- or half-duplex operation, and editing and duplication functions. Optional plug-in boards allow addition of more buffer memory or code conversion capabilities. The SRP-750 sells for $2,695.

FOR DATA CIRCLE 411 ON READER CARD

DIGITAL ASSOCIATES CORP.
Stamford, Conn. **Booth 1106**

LINE PRINTERS

Targeting current users of serial printers or 300 lpm and 600 lpm impact printers, this vendor will show its B-series of line printers. Using band printers manufactured by Control Data Corp., the vendor offers 300 lpm, 600 lpm, and 900 lpm versions with plug-compatible interfaces for DEC's PDP-8, PDP-11, and DECsystem-20s, Data General Novas and Eclipses (with DMA attachment), Hewlett-Packard minis (including the HP-3000), IBM Series/1, Interdata (now known as Perkin-Elmer's Computer Systems Div.) minis and data communications interfaces (RS232, etc). The ASCII printers have 132-print position lines, a forms length selector switch, and 48- and 96-character set capability. A



swing-out yoke and in-line paper tractors simplify forms loading, and 69 interchangeable type bands, covering 22 languages, are available. A 300 lpm model sells for $5,995, a 600 lpm model is $8,995, and a 900 lpm unit goes for $12,995.

FOR DATA CIRCLE 412 ON READER CARD

DIGITAL COMMUNICATIONS CORP.
Gaithersburg, Md. **Booth 500**

CONCENTRATOR/MULTIPLEXOR

The microprocessor-based CM 9100 uses statistical multiplexing techniques to concentrate four to 32 data streams onto a single high-speed line. Incoming lines may be a mix of synchronous and asynchronous, operating at speeds ranging from 50bps to 19.2Kbps; the high-speed link connecting CM 9100s uses CCITT X.25 level II protocol, and can operate at speeds ranging from 1200bps to 19.2Kbps. Electrical interfaces are RS232 all around. Character codes can use 5, 6, 7, or 8 data bits. The CM 9100, which is compatible with the vendor's larger CM 9000 product offering, has built-in diagnostics, per-line status indicators, and the ability to accept down-line loading of line characteristics. Input lines can be expanded from a base of four, up to 32, in four line increments; a second high-speed link can be added for increased reliability. A basic CM 9100, with four asynchronous/synchronous ports and one high-speed line, plus 16KB of buffer memory (expandable to 48KB), sells for $1,990 in quantities of five and up.

FOR DATA CIRCLE 413 ON READER CARD

DISTRIBUTED LOGIC CORP.
Garden Grove, Calif. **Booth 351**

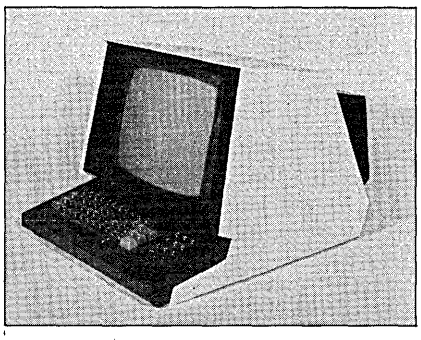
TAPE CONTROLLER
The DU120 magnetic tape controller emulates DEC's TM11 controller, and can attach up to four tape drives to a PDP-11. The controller includes diagnostic and self-test indicators, and all electronics, on a single quad-size module that occupies one slot in the PDP-11 chassis. Seven- and nine-track tapes can be accommodated, and the controller conforms to ANSI and IBM standards for NRZI recording. Tape speeds can range from 12.5ips to 112.5ips. The unit is software compatible with the RT-11, RSX-11, RSTS, IAS, and MUMPS systems software. A single DU120 sells for $2,295, with quantity discounts available.
FOR DATA CIRCLE 414 ON READER CARD

EDGE TECHNOLOGY, INC.
Portland, Ore. **Booth 365**

TERMINAL BUFFER
The Tinybuffer, available with memory capacities of 1KB or 4KB, plugs into a Teletype model 43 terminal, providing buffering and local editing capabilities. The boards offer switch-selectable data rates of 110bps and 300bps, as well as strappable rates of up to 9600bps. Capable of recognizing standard paper tape control codes, the Tinybuffer allows off-line data preparation and subsequent transmission in ASR mode. The unit also has top-of-forms control, automatic answer-back message, and support for variable margins. A Tinybuffer with 4KB of RAM sells for $550; a 1KB unit is $435.
FOR DATA CIRCLE 415 ON READER CARD

GENERAL ROBOTICS CORP.
Hartford, Wisc. **Booth 4221**

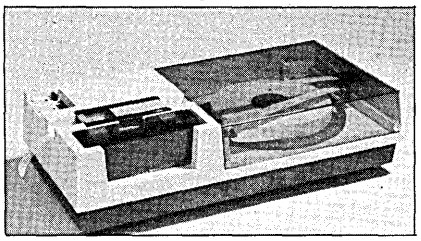
MICROCOMPUTER SYSTEMS
LSI-11-based microcomputer systems and peripherals will grace this vendor's booth. The Hercules system consists of an LSI-11/2 cpu with 60KB of RAM, EIS/FIS arithmetic hardware, a serial I/O port, and a dual-drive disk subsystem with a 132MB capacity. Software support is provided by RT-11. Hercules lists for $30,000. The Pulsar crt, a DEC VT52 emulator, also will be on hand. The RS232 terminal sells for $1,250, including numeric key pad. The vendor offers



oem discounts on annual orders of two or more units; at the 20 to 49 unit level the discount is 25%.
FOR DATA CIRCLE 416 ON READER CARD

GNT AUTOMATIC, INC.
Waltham, Mass. **Booth 2004**

TAPE PUNCH
The model 3601 tape punch handles both paper and mylar tape. Microprocessor based, the unit can punch 5-, 6-, or 8-hole



codes. The punch operates bidirectionally at speeds of up to 75cps. A self-test program is integral to the unit. The 3601 price schedule starts at $1,495 (quantity one); an RS232 interface is an additional $195.
FOR DATA CIRCLE 417 ON READER CARD

GOULD INC., INSTRUMENTS DIV.
Cleveland, Ohio **Booth 3015**

OFF-LINE GRAPHICS
A multiple-microprocessor-based vector information processor (VIP) provides the brains in this vendor's VIP Off-Line Plotmaster system. As many as eight of the vendor's 5000-series electrostatic plotters and printer/plotters, of mixed types, can be included in a Plotmaster system. VIP input on standard IBM-format tapes (labeled or unlabeled) can be vector plot, raster plot, or print data. The VIP can reduce cpu overhead by converting vector data into raster format for the plotters. Double buffering allows the VIP to overlap data input, processing, and plotter data transfer; the unit's standard buffer size is 16KB, expandable to 64KB (for a total of 128KB). VIP systems pricing ranges from $25,750 to $36,250, depending on tape drive and memory options.
FOR DATA CIRCLE 418 ON READER CARD

INFORMER, INC.
Los Angeles, Calif. **Booth 2005**

TERMINAL
The D304 crt terminal allows the user to select, from the keyboard, among display formats of 80 characters by 24 lines, 64 characters by 16 lines, or 32 characters by 16 lines. The upper and lower case ASCII terminal has 14 function keys, providing 28 functions using the shift key. A numeric keypad is included. Communications, via an RS232 interface, can be in full or half duplex at speeds ranging from 50bps to 19.2Kbps. In lots of 100, the D304 sells for $800.
FOR DATA CIRCLE 419 ON READER CARD

INNOVATIVE ELECTRONICS INC.
Miami Lakes, Fla. **Booth 2037**

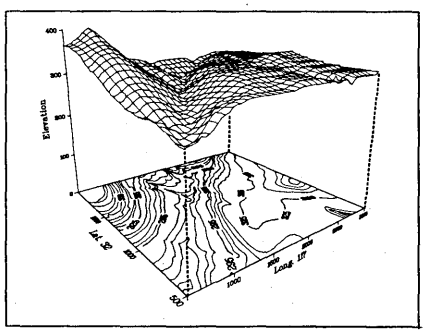
PRINTER
Intended for printing applications where the document is needed immediately after printing (airline ticketing, invoicing operations, etc.), the Innovator 250 Demand Document Printer offers immediate access to the printed form. The impact printer uses fully-formed ASCII characters; the tractor-fed printer can print 80 characters per line at a rate of 300 lpm. The controller board, located with the printer's cabinetry, can be configured in the field using switch strapping. Centronics, Data Products, 20mA and 60mA current loop, and RS232 compatibility are standard. Other interfaces—serial and parallel—are available as options. The Innovator 250 sells for $4,450; quantity discounts are offered.
FOR DATA CIRCLE 420 ON READER CARD

INTEGRAL DATA SYSTEMS, INC.
Natick, Mass. **Booth 4440, PC 93**

IMPACT PRINTER
The model 440 Paper Tiger is a tractor-fed oem impact printer capable of printing in 80- and 132-column formats. The upper and lower case ASCII matrix printer includes software selectable character sizes (on a character-by-character basis). Features include adjustable form width, forms control over eight standard forms lengths, six or eight lines per inch vertical spacing, multiple line buffering, and both RS232 serial and Centronics-compatible parallel interfaces. Transmission rates—from 110-bps to 1200bps—are switch selectable. An optional 2KB buffer/graphics option allows full dot-plotting graphics. The microprocessor-based Paper Tiger senses the end of each print line, providing throughput rates ranging from 42 lpm to better than 300 lpm, depending on line length. A single Paper Tiger sells for $995.
FOR DATA CIRCLE 421 ON READER CARD

INTEGRATED SOFTWARE SYSTEMS CORP.
San Diego, Calif. **Booth 3102**

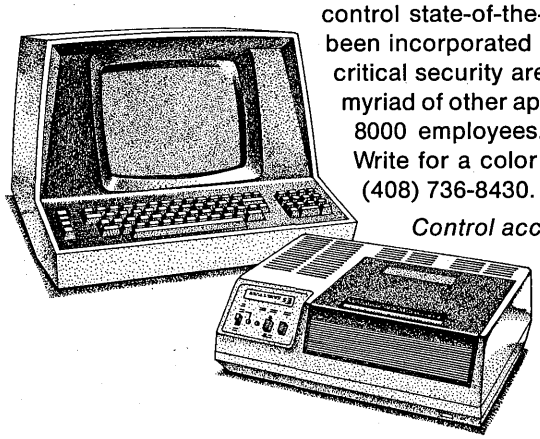
GRAPHICS SOFTWARE
Three newly added features for this vendor's DISSPLA graphics software will be demonstrated at the NCC. Extended Device



Where there's a need for improved security control...

...Consider the Schlage 732 Access Control and Alarm Monitoring System

Schlage made the card slot obsolete with the introduction of the "proximity" concept of access control. The simple act of placing an electronically coded card within close proximity to a hidden sensor literally "opened new doors" in access control state-of-the-art. Now those same proven advantages of the proximity system have been incorporated with microprocessor technology to improve monitoring and reporting in critical security areas, personnel identification, fire alarms, parking, fuel monitoring, and a myriad of other applications. The SE/732 system effectively controls up to 32 entrances and 8000 employees. It also monitors, programs and reports in easy-to-read English text. Write for a color brochure on the SE/732, or **call toll-free (800) 538-1755.** In California, (408) 736-8430. Telex 910-339-9398 Schlage Suvl.



Control access by "proximity" and take the nightmares out of access control, alarm monitoring, personnel identification and reporting with the SE/732

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Interfacing takes advantage of the intelligence in many graphics terminals. The software checks with the terminal to see what tasks it can handle, then splits the workload accordingly. The contouring option ($2,000) devises constant elevation contour lines such as those used in mapping applications; it can also be used in math or physics applications to show the relations between sets of data. The $5,000 business features option is geared to financial and administrative applications. It supports generation of bar charts and pie graphs (pie segments can be exploded to highlight significant details). DISSPLA, written in hardware independent FORTRAN, carries a base price of $24,500.

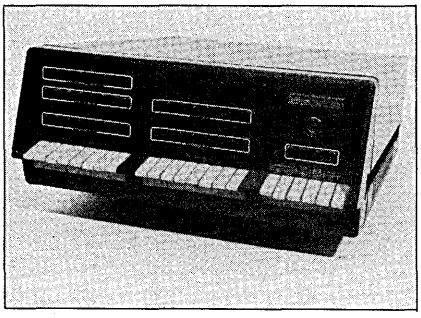
FOR DATA CIRCLE 422 ON READER CARD

INTERSYSTEMS INC.

Ithaca, N.Y. **Booth 338**

MICROCOMPUTER

Currently in the process of changing its corporate identity from Ithaca Audio to Intersystems, this vendor uses its existing S-100 compatible boards to build its DPS-1 microcomputer. The basic unit, priced at



$1,145 (quantity one) sans memory, consists of a 4MHZ Z80A cpu board with room for on-board ROM, 25 amp power supply, 22-slot shielded motherboard, forced fan ventilation, and removable front panel. Static memory can be had in 8KB increments for $165 (450nsec cycle time) or $195 (250nsec cycle).

FOR DATA CIRCLE 423 ON READER CARD

INTERTEC DATA SYSTEMS CORP.

Columbia, S.C. Booths 1237, 2538, 4218

CRT TERMINAL

The InterTube II upper and lower case ASCII terminal provides a 24-line by 80-character display, keyboard with 18-key numeric pad and 14 user defined function keys, and a graphics mode for displaying forms. Full cursor addressing, and editing functions are standard. The terminal communicates via an RS232 interface at speeds ranging from 50bps to 9600bps; an RS232 printer port (also standard) also runs to 9600bps. A single InterTube II sells for $995; quantity discounts can bring the price as low as $598.

FOR DATA CIRCLE 424 ON READER CARD

KMW SYSTEMS CORP.

Austin, Texas **Booth 436**

VECTOR-TO-RASTER CONVERTER

The VP series of random vector processors accepts random vectors and symbols from a host, and converts this input into raster scan output for printing on electrostatic (e.g., Houston Instruments, Gould, etc.) or matrix plotters (e.g., Printronix). Available in four models, the VP series also accepts text in line printer format and passes it on to printer/plotters. A machine-independent FORTRAN driver, which is integrated into the user program, reformats the random vectors and symbols from the host's floating point representation to the VP's format; the driver does not sort the vectors, nor does it use any files. A full FORTRAN graphics package, compatible with Calcomp software, is offered separately. Input options include asynchronous RS232, IBM 2780 EBCDIC, Honeywell GRTS 115, as well as parallel seven- and eight-bit ASCII (Centronics, Dataproducts), and 800/1600bpi mag tape. Prices on the four models range from $9,900 to $18,000.

FOR DATA CIRCLE 425 ON READER CARD

MANAGEMENT SCIENCE AMERICA, INC.

Atlanta, Ga. **Booth 4706**

SOFTWARE

The Alltax Reporter, a companion to this vendor's existing Alltax taxing system, prepares magnetic tapes and printed reports for federal, state, and local tax authorities. It also provides state quarterly unemployment reports and tapes. Audit reports are provided. The Alltax Reporter interfaces with the user's payroll system and allows the user to define report sequencing in a number of orders, including employee name or number, or zip code. The Alltax Reporter currently runs on 360s and 370s; versions for Burroughs and Honeywell mainframes are expected. The package goes for $4,750; annual maintenance is $600.

FOR DATA CIRCLE 426 ON READER CARD

MCCORMACK AND DODGE CORP.

Newton Upper Falls, Mass. **Booth 4807**

FINANCIAL SOFTWARE

Written in COBOL, the Plus series of financial applications runs on 360s and 370s, as well as Burroughs and Honeywell mainframes; the series consists of five packages. G/L Plus On-Line allows on-line entry and editing of all journals. Inquiries can be made of the general ledger master file. The package includes budgeting, modeling, and planning capabilities. Prices range from $38,500 to $42,500. A/P Plus is a multicorporate, multibank accounts payable system that allows processing of multiple and selective corporation and bank processing in the same run. The package includes an employee travel module and cash management reporting. A/P Plus goes for $25,000. P/O Plus can be interfaced with A/P Plus. It prints purchase orders, projects long-term cash requirements, and evaluates vendors within user-specified ranges on price, quality, and delivery. A matching module automates the process of linking purchase order to receipt and invoice. P/O Plus carries prices ranging from $6,000 to $18,000. F/A Plus is a fixed-asset analysis and accounting system capable of maintaining multiple tax books. It is priced between $18,000 and $25,000. For investment analysis and project tracking, CPA Plus, the capital project analysis and accounting package helps evaluate potential projects and keep track of those under way. The package is priced at $12,000.

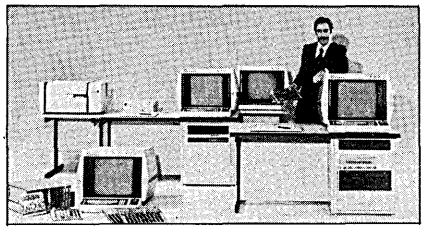
FOR DATA CIRCLE 427 ON READER CARD

MEGATEK CORP.

San Diego, Calif. **Booth 3319**

DYNAMIC GRAPHICS SYSTEMS

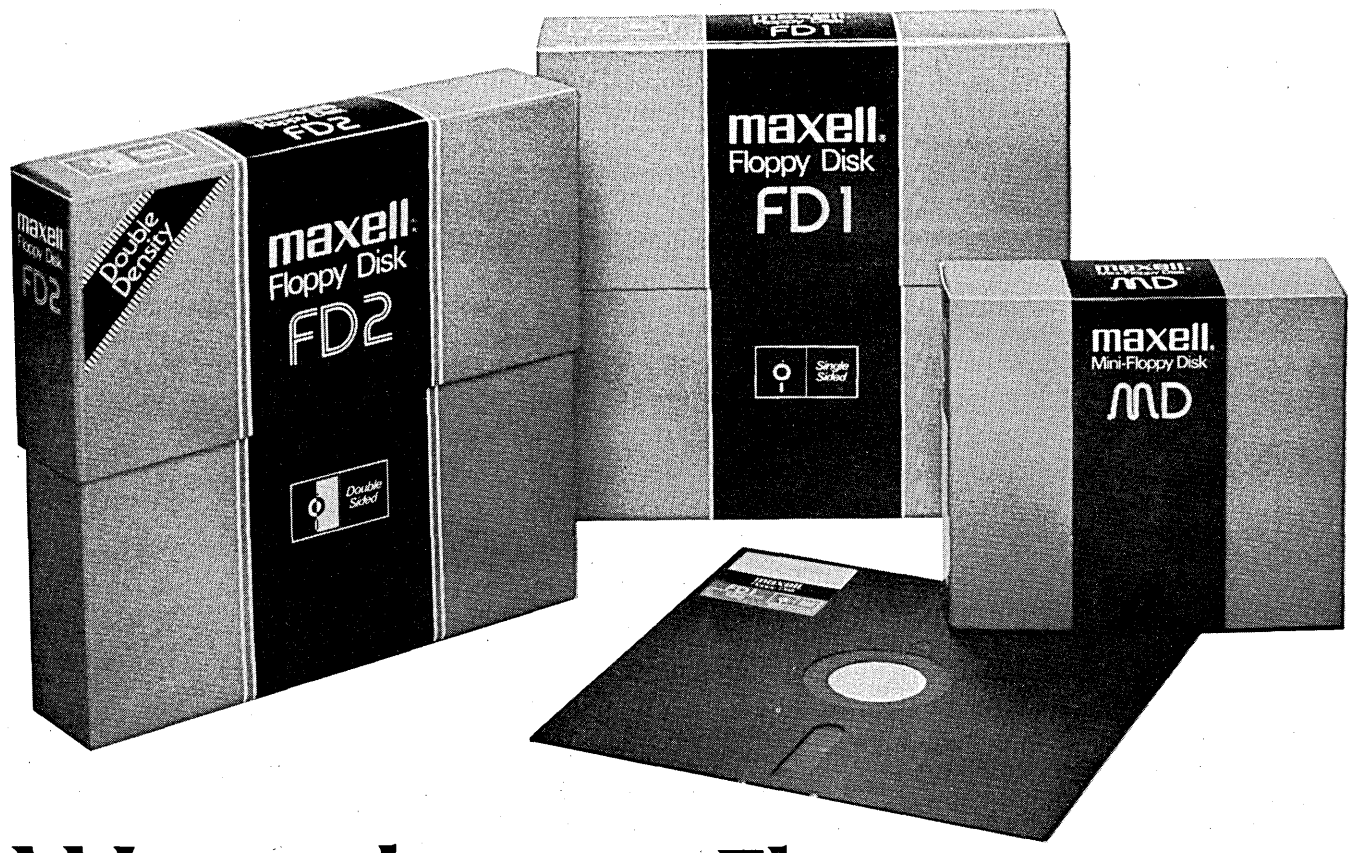
Comprising graphic peripherals, graphic terminals, and standalone graphic process-



ing systems, the Whizzard 7000 and 5000 families provide a range of building blocks for the systems integrator. The Whizzard 7000 uses the vendor's Adaptive Timing technique in its vector generator, said to produce fine vector control and high vector capacity. The units use a proprietary 32-bit bipolar microprocessor, and feature three-dimensional rotation and an optional color monitor. For enhanced throughput, users can work in 2D mode, switching to 3D when necessitated by the user's application. The color monitor supports four colors, with a fifth color optional. A complete Whizzard 7000 system, including graphics processor, monitor, and peripherals, ranges in price from $30,000 to $40,000.

The Whizzard 5000 family offers a Tektronix 4014 upward compatible system to Data General Nova and Eclipse users. The refresh graphics system has selective erase, translation, rotation, scaling, and zoom capabilities. Offered as a standalone processor, an RS232 communicating terminal, or a dual-board MG552 processor for embedding within the customer's minicomputer, the Whizzard 5000 family pricing ranges from $6,400 for a graphics processor up to $35,000 for a complete standalone system, including peripherals.

FOR DATA CIRCLE 428 ON READER CARD



We make our Floppys as if your job depends on them.

Because it does.

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MICROPRO INTERNATIONAL CORP.
San Rafael, Calif. **Booth 42**

WORD PROCESSING SOFTWARE

Written for any microcomputer running the CP/M operating system, Wordstar provides on-screen formatting, instant screen updating, and block moves. Other capabilities of the word processing software includes word wrap, forward and reverse scrolling, text markers, global search and replace, complete cursor control, and print spooling. A single copy of Wordstar retails for $495; dealers can buy the software for $297 per copy in lots of more than five; the oem price for 100 or more copies is $148.50.

FOR DATA CIRCLE 429 ON READER CARD

MRI SYSTEMS CORP.
Austin, Texas **Booth 3306**

DATA BASE MANAGEMENT

The System 2000 data base management system (release 2.90) for IBM mainframes has a Universal Software Interface (USI), Query/Update Extension to System 2000 (QUEST), and an enhanced Programming Language Extension (PLEX). Additionally, a multimedia training package and "completely revamped documentation" are available with release 2.90. The USI provides an interface between the DBMS and other software. The USI is being used in current efforts to integrate System 2000 with a graphics package, a dynamic allocate/deallocate facility for data bases in an MVS environment, a table translator, and a data encryption facility. QUEST is an enhanced version of the vendor's existing Immediate Access feature. PLEX includes new verbs and capabilities said to reduce data base contention, and improve throughput. The base price of System 2000 is $35,000.

FOR DATA CIRCLE 430 ON READER CARD

PRENTICE CORP.
Palo Alto, Calif. **Booth 404**

CONCENTRATOR/MULTIPLEXOR

The SNP-1000 statistical network processor is an intelligent concentrator and statistical time division multiplexor. A multipoint option allows polling of a number of remote sites along a single communications line. Two-, four- and eight-channel versions are offered. Input lines can run at asynchronous speeds ranging from 110bps to 4800bps; the output line can run to 9600bps synchronously or asynchronously. RS232 interfaces are used all around. Character codes can contain from five to eight bits. An optional command port can be added to the four- and eight-channel SNP's; the command port allows monitoring of system functions, and altering operating parameters. Downline loading, error checking routines, and continuous self-testing are provided. The SNP-1000 is said to be completely transparent to terminals, computers, and software. A four-channel SNP-1000 sells for $1,500.

FOR DATA CIRCLE 431 ON READER CARD

RANDOMEX, INC.
Rancho Palos Verdes, Calif. **Booth 3104**

DISK INSPECTOR

The model 745 Disk Pack Inspector is said to inspect all pack types, including 3336s, 8418s, Data Storage Modules, and others. The inspector has a power-driven, clutched spindle that rotates the pack at optimum viewing speed, leaving the user's hands free; the clutch allows manual isolation of any disk sector. A fixed illumination tower provides 15,000 candlepower, flooding every disk surface. A radial-axial tolerance comb-gauge gives a "go/no-go" indication with a single pack revolution. Pricing is still under discussion; the range under consideration is $2,750 to $2,850.

FOR DATA CIRCLE 432 ON READER CARD

STORAGE TECHNOLOGY CORP.
Louisville, Colo. **Booth 3614**

BIG DISK

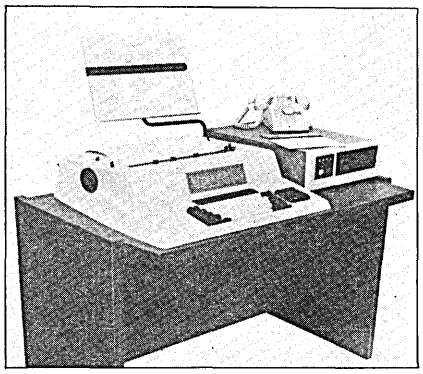
This plug-compatible mass storage maker will show its 8650 dual-density Winchester disk drive. With two spindles per unit, the 8650 can store as much as 1,270MB. Designed as plug-compatible replacements for IBM 3350s, the 8650 appears—to the cpu—as four logical 3350s (two per spindle). The 8650 transfers data at 1,198KBps. Its access time ranges from 7msec to 50msec, with an average of 25msec. Latency averages 8.4msec. Dual porting and fixed-head storage are optional. An 8650 A2 sells for $68,400, and an 8650 B2 is $58,200. The two models lease for $1,565 per month and $1,354 per month, respectively, on a three-year lease. Dual porting an A2 adds $4,800 to its price; on a B2, dual ports add $3,600. The fixed head option is $12,150. The vendor's existing 3350 replacements (the 8350) can be field upgraded to dual density.

FOR DATA CIRCLE 433 ON READER CARD

TRENDATA CORP.
Sunnyvale, Calif. **Booth 1213**

TERMINALS

The Trendwriter 350 is a 120cps bidirectional matrix printer capable of burst printing speeds of 165cps to avoid buffer overflow and consequent data loss. The microprocessor-based terminal works at transmission speeds of up to 4800bps. Features include double-width characters, horizontal and vertical, forms handling, adjustable forms tractor, and an optional APL character set. The Trendwriter 350 sells for $2,990; an upgrade kit for converting a Trendwriter 300 to the 350 level sells



for $995.

For applications requiring fully-formed characters, the model 4000B uses a daisywheel print mechanism. The 45cps terminal has an 8080A microprocessor in its controller, and can handle ASCII, ECBD, or correspondence codes. A 14-key numeric pad is standard. Peripherals, including the vendor's model 500 floppy disk, optionally can be added to the model 4000B. The basic terminal is priced at $4,395.

FOR DATA CIRCLE 434 ON READER CARD

TRILOG, INC.
Irvine, Calif. **Booth 426**

COLOR PRINTER/PLOTTER

With the addition of multicolor ribbon, this vendor's printer/plotter (a modified Printronix unit) becomes the Colorplot 100. The vendor's proprietary ribbon tech-

nology is said to put lengths of the various colors end-to-end on an inch-wide 60-yard reversible ribbon. Each color is printed in its own pass; a bidirectional paper drive allows backing up for the next color. An average three-color plot takes about three minutes (for an 11-inch long page); each color's pass lasts about 45 seconds. In print mode, the Colorplot 100 can run at 150 lpm using the 96 character ASCII set, with characters formed on a 7 x 9 overlapping dot matrix. Higher speed printing (250 lpm) can be done using a 7 x 7 dot matrix. The Colorplot uses a parallel interface compatible with those used by Data Products, Centronics, and Printronix. The Colorplot sells for $9,980.

FOR DATA CIRCLE 435 ON READER CARD ✲

UPSMANSHIP
It's the art of being up when everyone else is down.

UPSMANSHIP is having the only bright computer room on a dark night. It's staying in control through a major power failure. It's getting the better of a July brownout.

UPSMANSHIP is an acquired skill. You get it by acquiring an Elgar UPS (Uninterruptible Power System). With an Elgar UPS between your equipment and your power line, you're protected from all kinds of problems.

In case of power failure, Elgar takes over where the utility leaves off—no switching, no momentary loss of power. In addition, the incoming voltage and frequency are constantly regulated to protect sensitive electronics.

If you have a process, a computer, a communications network, or any other critical system, think what UPSMANSHIP could do for you. More important, think of what the lack of it could do to you.

Elgar Uninterruptible Power Systems are available in output ratings from 0.5KVA through 45KVA. We are also a leading producer of High Isolation [illegible], AC Line Conditioners, and AC Power Sources. Contact us for details. In California, call (714) [illegible]. Out of state, call 800-854-2213 toll free.

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CIRCLE [illegible] ON READER CARD

OUTPUT PERFORMANCE.

How Honeywell's Page Printing System consolidates the work of as many as six impact printers.

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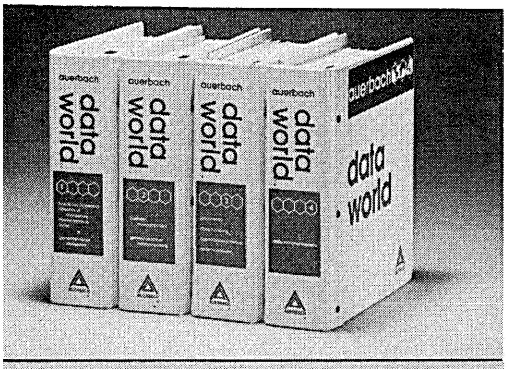

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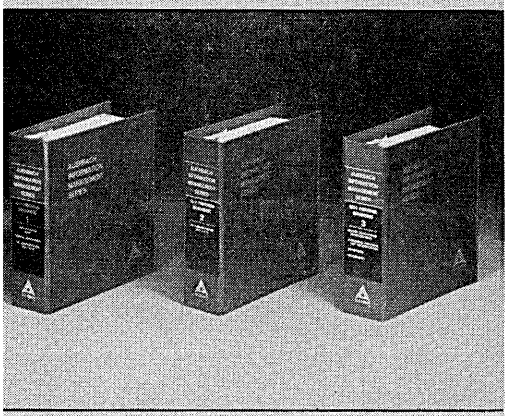

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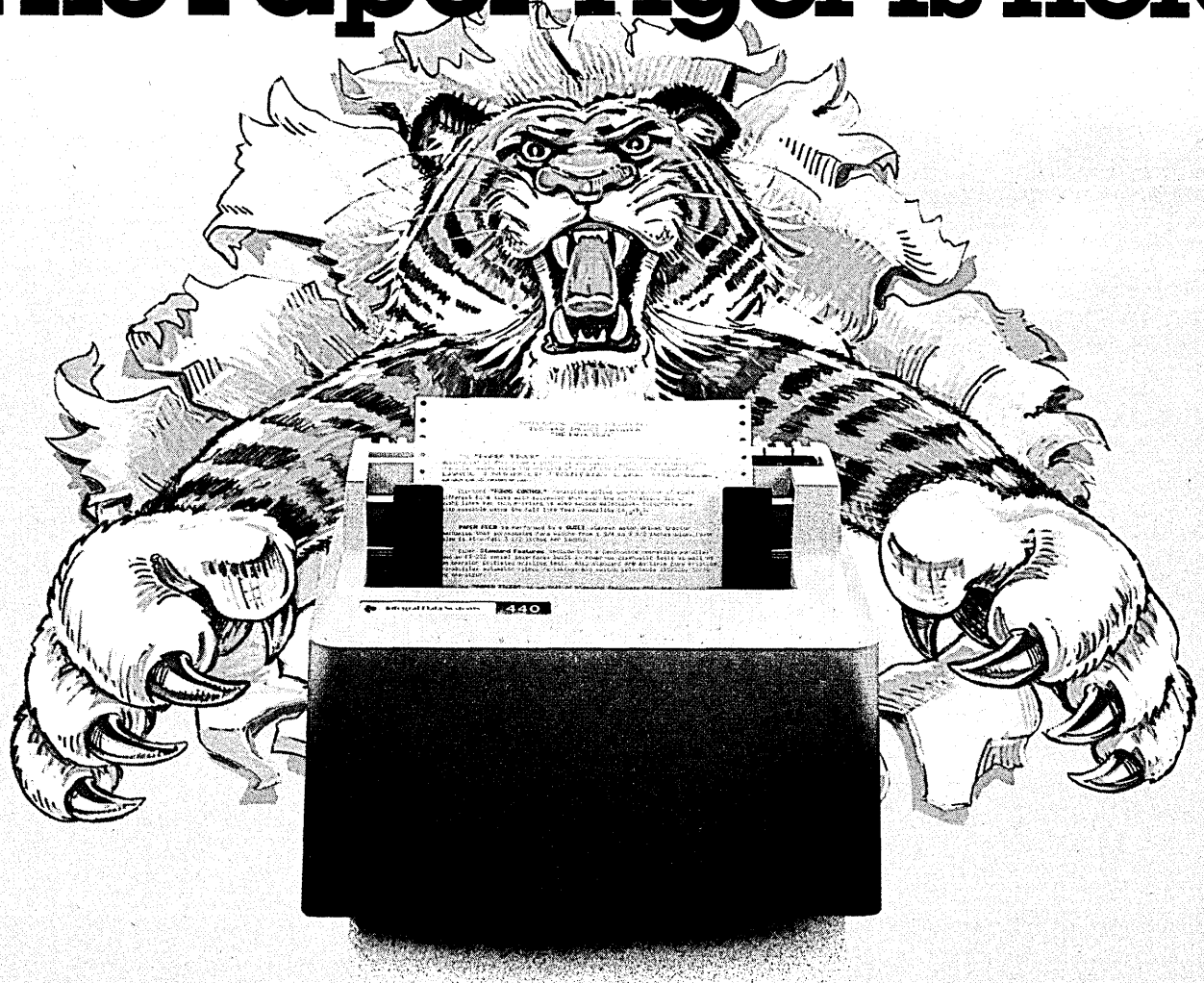

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Feature \ Printer	Integral Data 440	Tally 1200	Lear-Seigler 300	Texas Instruments 810	Centronics 779-2
96-character ASCII set, upper and lower case	YES	OPTION	YES	OPTION	NO
Software-selectable character sizes	YES	NO	NO	OPTION	NO
Throughput, lines per minute @ 10 char./line @ 132 char./line	275 42	100 40	Data not available	440 64	130 21
Parallel and RS-232 serial interfaces standard	YES	NO	NO	NO	NO
CRT screen buffer	OPTION	NO	OPTION	NO	NO
Footprint (W x D = sq. ft.)	1.37	3.45	3.18	3.58	2.44
Weight (lbs.)	20	64	50	55	45
Forms length control	YES	OPTION	YES	OPTION	NO
Full dot plotting graphics	OPTION	NO	NO	NO	NO
Unit Price	$995	$2500	$1995	$1895	$1350

Comparison data from manufacturers' current literature.

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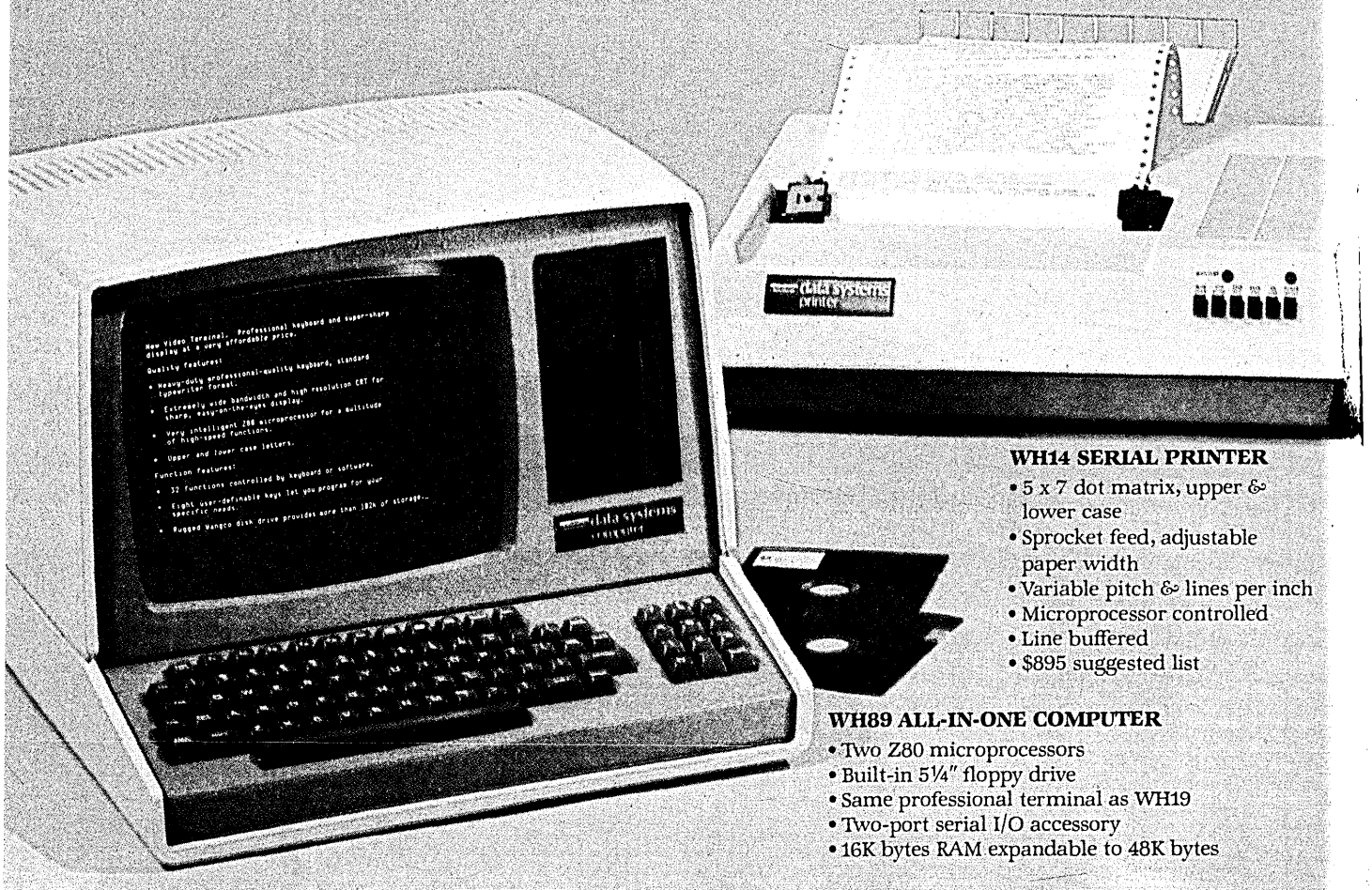

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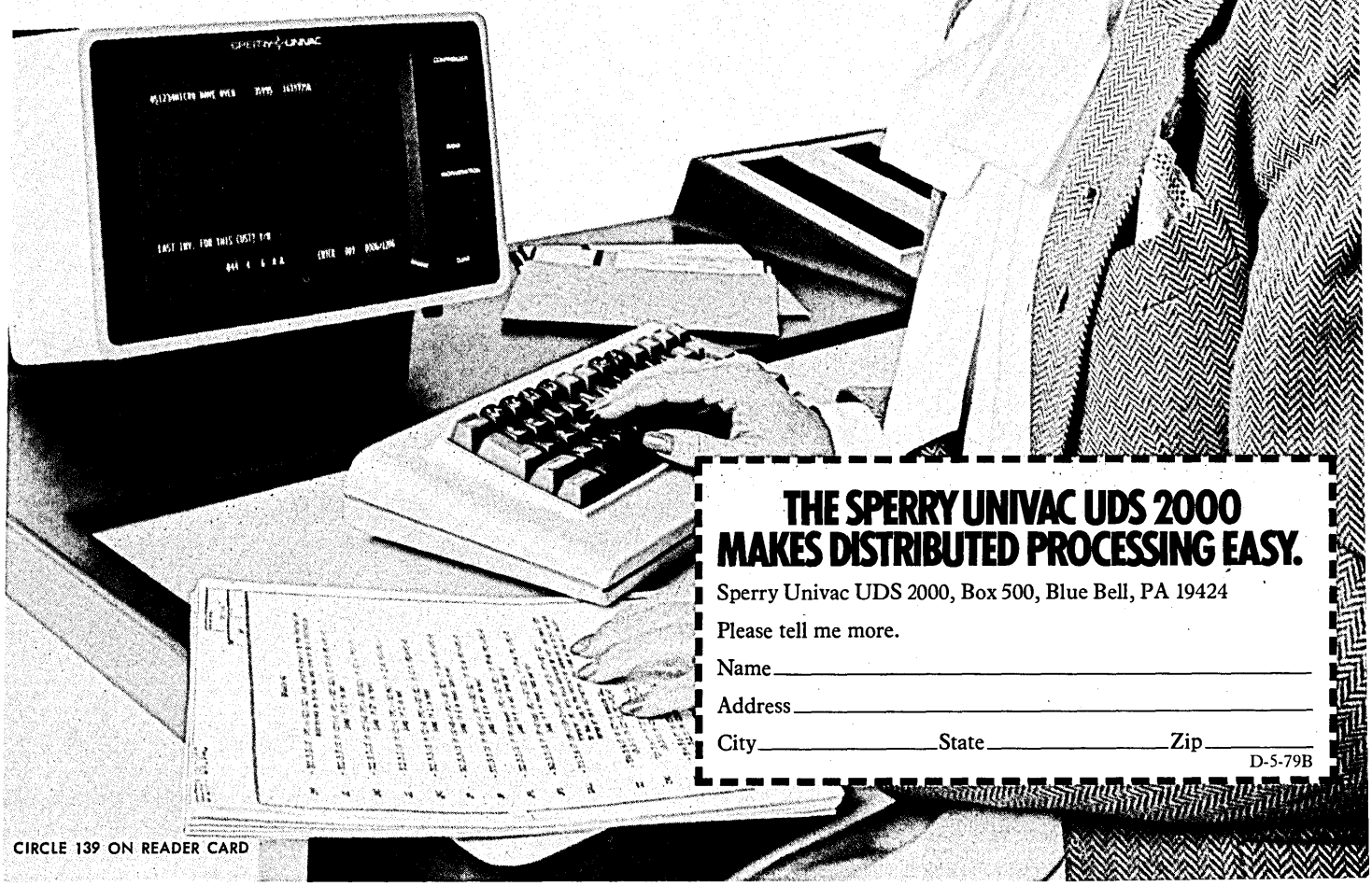

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CIRCLE 139 ON READER CARD

Getting an accurate line on programmer efficiency is a complex task at best. It may even be impossible. Still, here's an approach that offers some hope.

TAKING THE MEASURE OF PROGRAMMER PRODUCTIVITY

by Trevor D. Crossman

If we really don't want to do something, we can usually find perfectly valid reasons why we shouldn't, but if we really want to do something, we can't always find a way of doing it.

If we don't want to measure the productivity of our programmers, it is possible to find reasons—all of which sound valid—for saying that it's impossible anyway. If we do want to measure programmer productivity, finding a way is a complex task. It may be impossible. Even if we try, we often get no further than being aware of the implications of not really knowing how well our programmers are performing. That's a step in the right direction, but this awareness does not solve the problem.

Programmer productivity is a dilemma. On the one hand, we want to control projects by knowing exactly when and where slippages occur, we want to know if our programmers are working efficiently, we want to know if using a new methodology really is beneficial. We despise estimates that are based on "gut feel," but it appears that if we are to measure the productivity of our programmers we have to identify project variables and calculate their influence on our programming staff, make subjective assessments of the envisaged complexity of programs and the predicted ability of programmers, clarify terminology that has no industry-accepted definitions, measure the quality of our programmers' work, and base programmer performance on project estimates (which are arrived at unscientifically, anyway).

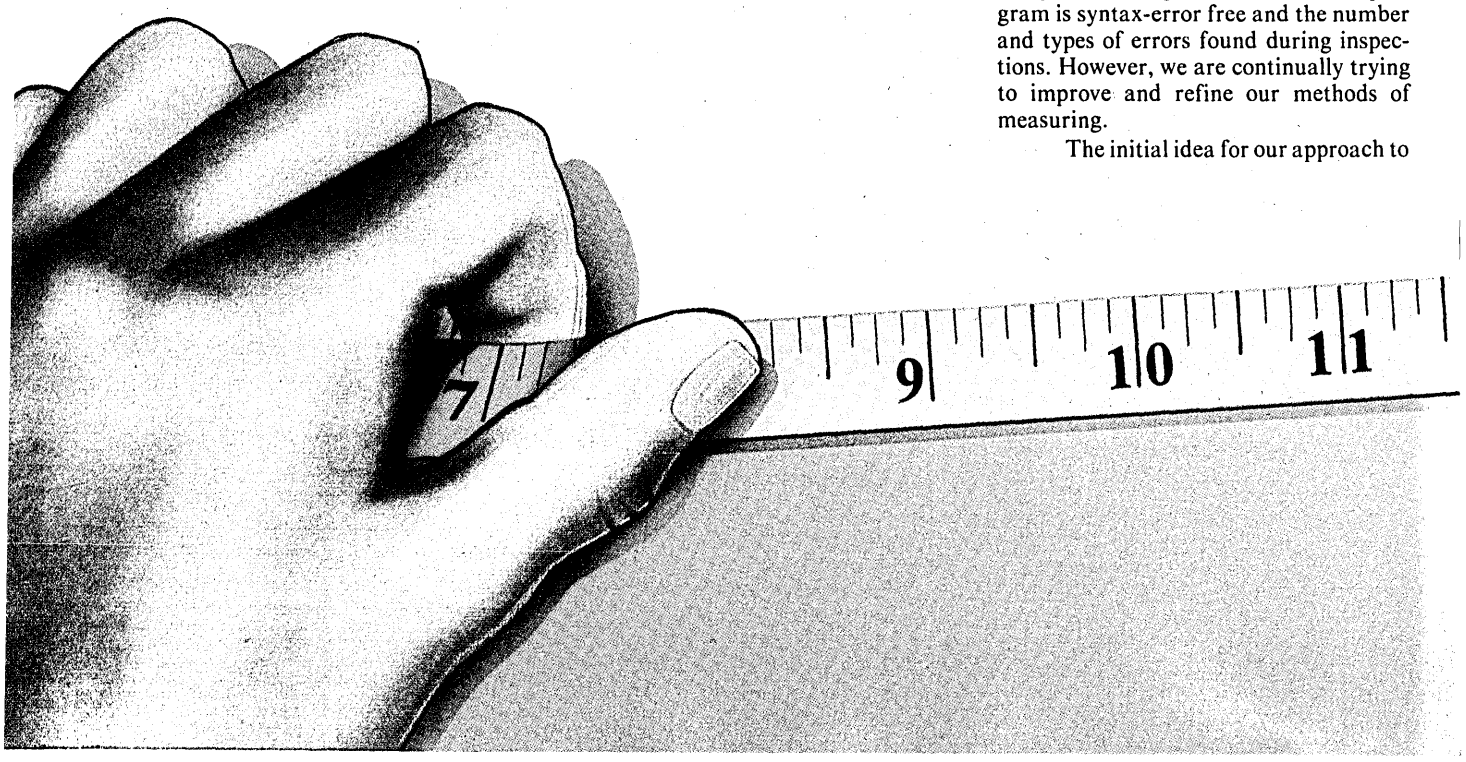
It may be easier to say it just cannot be done.

We at the Standard Bank of South Africa found this dilemma while doing the background of our research on how to measure programmer productivity. Details of the rest of the environment in which we work may help to put the suggestions we make into perspective.

We have a programming department of about 70 technical people. We develop a mix of batch and on-line systems for a financial corporation. All projects are developed by programming teams, using COBOL and COBOL-like languages for both Data General minicomputers and IBM mainframes. Only the logic structures permitted in structured programming are allowed in program design, and all code is reviewed by inspection teams to ensure that high-quality products are shipped from the department (see M. E. Fagan's "Design and Code Inspections to Reduce Errors in Program Development," *IBM Systems Journal 15*, Number 3, 1976, pp. 182-211).

In trying to measure productivity, we keep records of, among other things, the number of lines of code produced per programmer man-day, the number of compilations required to ensure a program is syntax-error free and the number and types of errors found during inspections. However, we are continually trying to improve and refine our methods of measuring.

The initial idea for our approach to



programmer productivity arose during an informal discussion at the August 1977 GUIDE meeting in Boston. Roger van Ghent of Chase Manhattan Bank mentioned that he had decided to measure programmer productivity in terms of the number of functions within a program, a function being defined as that section of the program that performs only one activity, such as initializing fields, computing values, setting up a print line, validating a record, etc.; has one entry point and one exit point; conforms to the permitted logic structures of structured programs; and has about 5 to 50 source statements.

We explored this idea of measuring productivity in terms of program functions. We took statistics from a selection of six systems developed in our department during 1977 (see Table 1). For each system, we divided the number of man-hours spent on system development (called development time) by the number of functions in all the programs in the system. (Development time is all the time spent by all the members of the project team on design, coding, inspection and unit testing. While it may seem an omission that system test is excluded, we have increasingly found that it is not the system test that provides that cataclysmic day when the whole world collapses around the project team!)

The ratios resulting from this division of development time by functions were either very close to 2 or very close to 4. We found that the common factor in those systems with a ratio very close to 4 was that they were all developed using either a new language, a new operating system, new transaction processor software, or new data base software—any technology being used for the first time by a project team we decided to call breakthrough technology. For example, the first time we designed a CICS systems using an ADABAS data base, we regarded this as using breakthrough technology. It appears that systems developed under breakthrough technology conditions take about twice as long to implement as they would have using a technology with which the project team is familiar. When those ratios were divided by 2, the results were striking. The ratios for all six systems ranged between 1.7 and 2.1 man-hours per function. This suggested that further work should be done on developing the idea.

We were fortunate in being able to discuss the concept and our initial results with personnel from the National Productivity Institute (NPI) in South Africa. With them, we looked at another set of data. We took details of 14 programs developed by one project team. These programs comprised 348 functions, which took 364 man-hours to develop. The NPI suggested we take the number of functions within a program as the basic unit of programming activity which must be measured. It also made a further suggestion that we determine whether these functions need to be classified into groups based on levels of complexity.

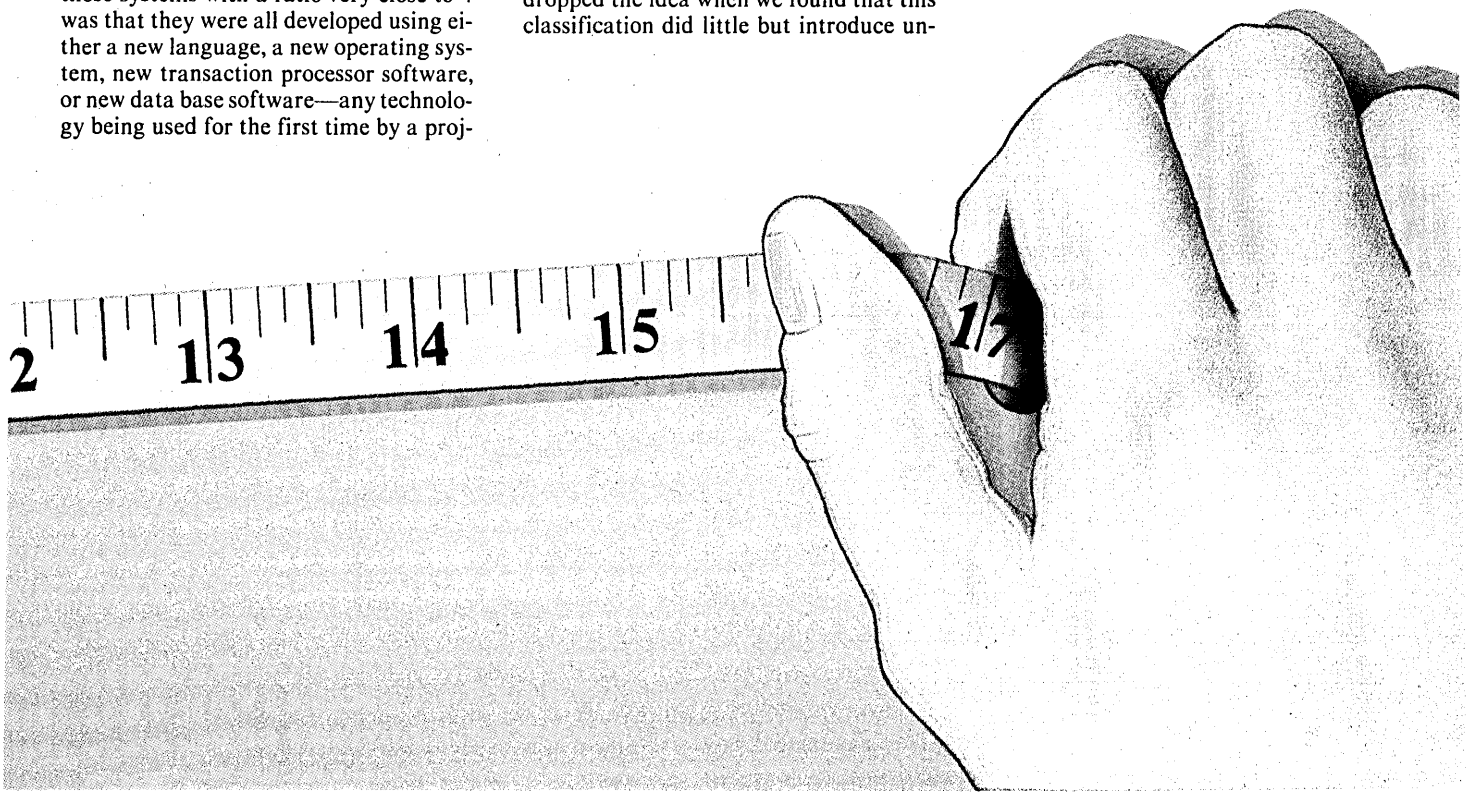
Initially we tried to classify program functions into five groups: functions that *copy* existing data; functions that *calculate* results from data which already exists; functions that *compare* sets of data; functions that *write* data. However, we dropped the idea when we found that this classification did little but introduce unnecessary levels of complexity into our calculations. The NPI also recommended that we isolate as many factors as possible that influence the time it takes to write a program. Because the environment in which the sample programs were developed was stable, we were able to disregard any project variables at this stage. (R. F. Scott and D. B. Simmons listed 35 such variables in their DATAMATION article "Programmer Productivity and the Delphi Technique," May 1974, pp. 71-73.) The only factor that significantly affected the length of time it took to develop a program was the number of functions within the program. The surprise was that when we expanded our research, we still found it was possible—in our environment—to disregard all project variables, except the use of breakthrough technology.

The results from this initial research were sufficiently encouraging to suggest that once the number of functions within the program is known, it is possible to calculate the number of man-hours a program should take to develop.

IDENTIFYING A PATTERN

As we collected more data, we identified what appeared to be a pattern. This pattern encouraged us to continue the research based on the following assumptions:

• That the crucial time-consuming activities of programming are identi-



System type	Number of functions	Man-hours	Man-hours per function	Adjusted ratio
Minicomputer On-line	784	2616	3.3*	1.7
Minicomputer On-line	1320	4581.5	3.5*	1.7
Minicomputer On-line/batch	1250	4908	3.9*	2.0
Mainframe On-line/data base	895	3752	4.2*	2.1
Mainframe Batch	1259	2255	1.8	1.8
Mainframe On-Line	578	1124	1.9	1.9

*Adjusted for breakthrough technology.

Table 1.

fying the functions the program must perform, and ensuring the interfaces between these functions are logically correct.

- That the time required to identify, define, and develop a function within a program is not dependent on the number of executable source statements within the function. In relation to total program development time, it is not significant whether there are 5 or 50 lines of code in a function.
- That, with the exception of breakthrough technology, we could disregard all other project variables.
- That it is an advantage to calculate productivity in terms of man-hours per function, rather than cost per function because changing costs and inflation make the comparison of figures difficult.

Since this initial work was done, we have spent a year gathering more data (from our department) to test the methodology. Following an additional NPI suggestion, we tested the data for a linear relationship between the number of functions within the program and the development time. Collecting this data is a simple process. To calculate the number of man-hours, the amounts of time spent on the various facets of program development are recorded daily by the programmers and accumulated weekly by a project accounting package. The total number of man-hours spent on a program is simply extracted from printouts produced monthly by this package.

In a structured programming environment, the number of functions within a program can be counted physically without much difficulty. However, we have found that usually the number of functions in a program is identical to the number of paragraph names in that program, so arriving at this figure offers no problems.

The data making up the sample on which this article is based includes the following:

Number of systems	4
Total number of programs	68
Total number of functions	3,480
Total man-hours	8,391.5
Largest program	313 functions
Smallest program	5 functions
Average functions/program	51 functions
Median	28 functions

None of these systems was part of our original research. The procedure we followed was the same for each of the two passes through the data (see Table 2):

Step 1. We tested the data for the existence of a linear relationship between the number of functions within a program, and the number of man-hours the program took to develop. This resulted in our being able to express this relationship in the form:

$$y = mx + b$$

where y = CALCULATED TIME
x = Number of functions
m and b are constants.

Step 2. To help substantiate the hypothesis, the correlation coefficient for each pass was recorded.

Step 3. By applying this formula back to the observed data, we calculated the expected development time for each program. This is called the CALCULATED TIME, which equals (1.06 functions + 14.9) man-hours.

Step 4. We calculated the DEVIATION of the actual time the program took to develop from the calculated time by using this formula:

$$\frac{To - Te}{Te} \times 100$$

where To = observed time and Te = calculated time. This figure was positive when the actual time was greater than the calculated time, and negative when the actual time was less than the calculated time (see Table 3).

Step 5. Allowing for accuracy limits of 5% over a period of 750 man-hours (the number of man-hours a project team of 3 will work in a month and half, plus 33 working days), we calculated the acceptable deviation using the formula.

$$5\sqrt{\frac{750}{Te}}$$ where Te = calculated time

Step 6. Where the deviation, with the sign ignored, was less than the acceptable variance, the program was regarded as having been developed within an acceptable time frame (lines 1 and 5 of Table 3).

Step 7. When we found that the deviation, again ignoring the sign, was greater than the acceptable variance, then the sign became significant. A minus sign indicated good performance (line 4 of Table 3). A plus sign indicated that the program had taken too long to develop (lines 2 and 3 of Table 3). Where it was possible, we discussed these deviations with the project teams. In this way we had valid reasons for refining our samples for the second pass through the data, which resulted in a higher correlation factor for this loop.

	Number of programs	Number of functions	Man-hours	Correlation	Programs with deviation high	Programs with deviation low	Programs with acceptance deviations
Pass 1	68	3480	8391.5	.86	20	26	22
Pass 2	52	2648	5975.5	.93	15	16	21

Equations:

Pass 1 Calculated Time = 1.1 Functions + 15.4 man-hours

Pass 2 Calculated Time = 1.06 Functions +14.9 man-hours.

Table 2.

	Program	Number of functions	Actual man-hours	Estimated time	Deviation	Acceptable variance	
1	One	118	150.5	135	11.5	11.8	
2	Two	40	63	52.6	19.8	18.9	xx
3	Three	73	101.5	87.5	16	14.6	xx
4	Four	36	36.5	48.4	-24.6	19.7	x
5	Five	265	301.5	280.8	7.4	8.2	

x = good performance
xx = development time too long.

Table 3.

There was the temptation to drop from further processing only those observations where the actual man-hours for development was higher than calculated time. However, when we were able to identify valid reasons for a large variance between actual time and calculated time, we could have dropped some data where the actual time was too long, and other data where the actual time was too short. This gave us a formula for the "average" performance of our project teams. At this stage of our research, the formula is:

CALCULATED TIME = (1.06 FUNCTIONS + 14.9) MAN-HOURS.

ADVANTAGES TO THE APPROACH

Indications are that if this hypothesis is valid, it can be of value to the programmer and to the project manager. This approach to measuring productivity avoids having to make subjective assessments of the complexity level of programs (complex, difficult, average, simple) or of the ability of the programmers (very good, good, average, weak). This method also limits the project variables that influence the work output of programmers to breakthrough technology. When programmer productivity is measured this way, there is the possibility of making meaningful comparisons of productivity across projects and even between installations. The programming manager also has a method of confirming the estimates of program development time.

At any stage during or after the project, the project team can identify those programs with a development time outside the acceptable variance. Reasons can be identified for each program that has either taken too long to develop (i.e., some bad method has been used) or been developed very quickly (i.e., high level of productivity).

The project team's level of performance for the whole project can be calculated at the completion of the project. Table 4 gives examples of how three project teams could be assessed. (These are actual figures recorded for projects developed in our department.)

From the outset we have been aware that the value of the research is limited. We acknowledge that our sample size is small and is taken from one programming department, and that the accuracy of the data may be suspect because it was not recorded with the idea of measuring productivity in mind. Although this approach does not measure the quality of the products, it is felt that this shortcoming is offset by the use of inspection teams. Another point that should be recognized is that our research was confined to development work, and no effort has been made to look at the program maintenance activity. Also, the value of this method of measuring productivity may be confined to installations in a commercial environment where programs are developed in high-level languages by projects teams using the structured programming disciplines.

We do feel that this approach could be another step toward programming becoming a full-fledged profession. It may offer programmers the opportunity of assessing their own ability and performance in a disciplined and controlled environment. To programming managers it may provide the possibility of measuring the productivity of their staff, knowing when reasons for deviations from expected performance must be given, confirming estimates of cost and time, providing an environment in which realistic project control can be achieved, and having an objective basis for rewarding and promoting staff.

We look forward to collecting data from other installations, and other countries, to test the hypothesis that it is possible to measure programmer productivity in man-hours per function. Perhaps the concept can be extended to measure the productivity of designers and business analysis. Perhaps there's hope. ✲

System	Number of programs	Number of functions	Actual man-hours	Calculated man-hours	Variance
One	38	784	2616	2802 *	-7.1%
Two	20	1259	1600.5	1634.5	-2.1%
Three	32	1094	3376	3279.3*	2.9%

* Adjusted for breakthrough technology.
The following formula was used:
x = 1.06.f + 15.p
where f is the number of functions in the system
p is the number of programs in the system
x is the calculated man-hours.

Table 4.

PROJECT TEAM'S COMMENTARY

Typical comments from the project team explaining why the actual development time of a program deviated from the calculated development time:

—We were able to copy large sections of this program from a similar program developed earlier in the system.

—One of the members of our team resigned at that stage of the project.

—This program was written by an individual and not the project team.

—That was the first program written by the programmers as a project team.

—The user requested a change to the system which resulted in a partial rewrite of the program.

—Some of this development time was charged to research and development.

—In an effort to speed up project development, two new programmers were introduced to the project team.

TREVOR D. CROSSMAN

Mr. Crossman is a consultant within one of the development departments of the Standard Bank of South Africa's Data Processing Div. He was invited to present a paper on his department's use of Inspection Teams at the August 1977 ACM Computer Personnel Research Conference in Arlington, Va.

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The smart buffered display terminal

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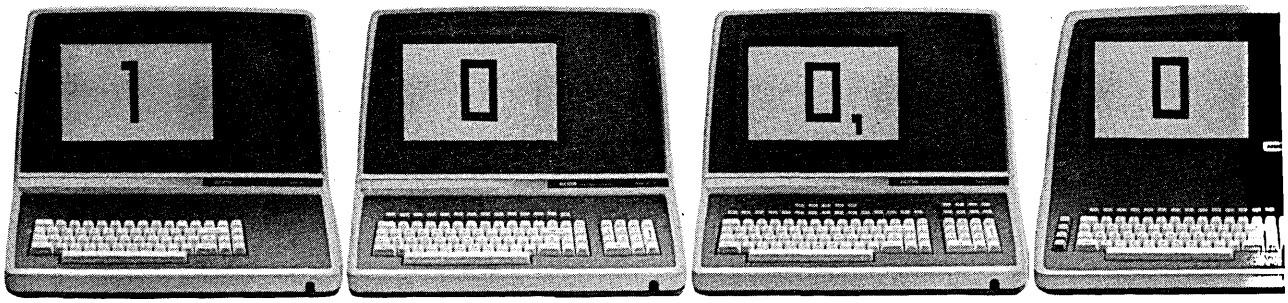
Regent 60's editing keys allow the insertion or deletion of characters or lines in the screen display. Characters can be inserted or deleted in either the line the cursor is on, or from that line to the end of the display.



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CIRCLE 11 ON READER CARD

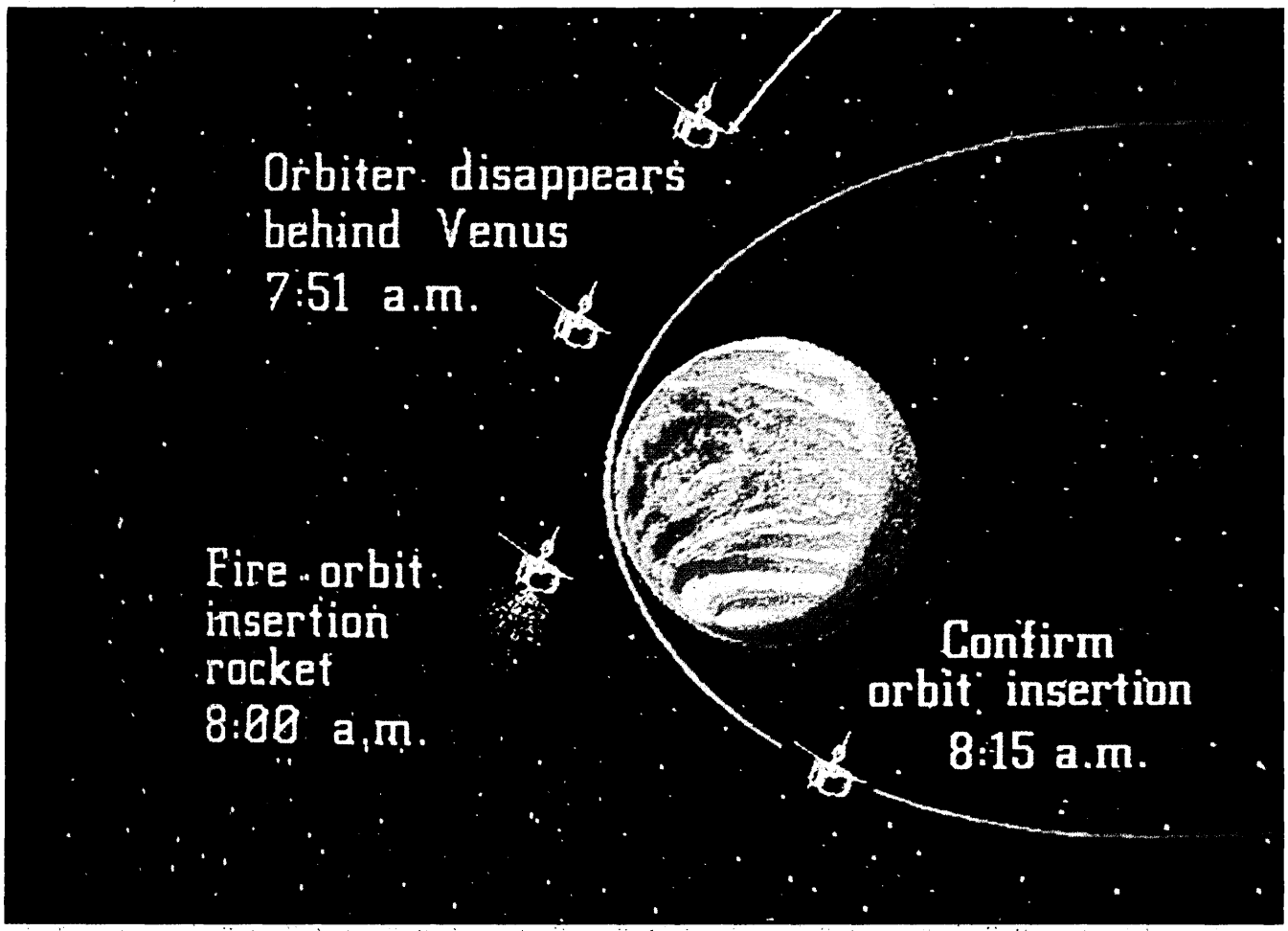
Developed as a computer graphics research tool, this experimental videographics system got nationwide tv exposure with its live, and lively, animation of NASA's Venus mission.

"SUPERPAINT" ... THE DIGITAL ANIMATOR

by Richard G. Shoup

An experimental digital video system which can be used for interactive creation and manipulation of simple, cartoon-like graphics and animated imagery was designed and built at Xerox in 1973 as an experiment in computer imaging and digital picture composition. Since then, the videographics system (known informally as "SuperPaint") has been further developed as a computer graphics research tool and used for a variety of experiments in television graphics and imaging.

Most recently (December 1978), the system was used extensively during the NASA Pioneer Venus mission for visualization of spacecraft maneuvers during



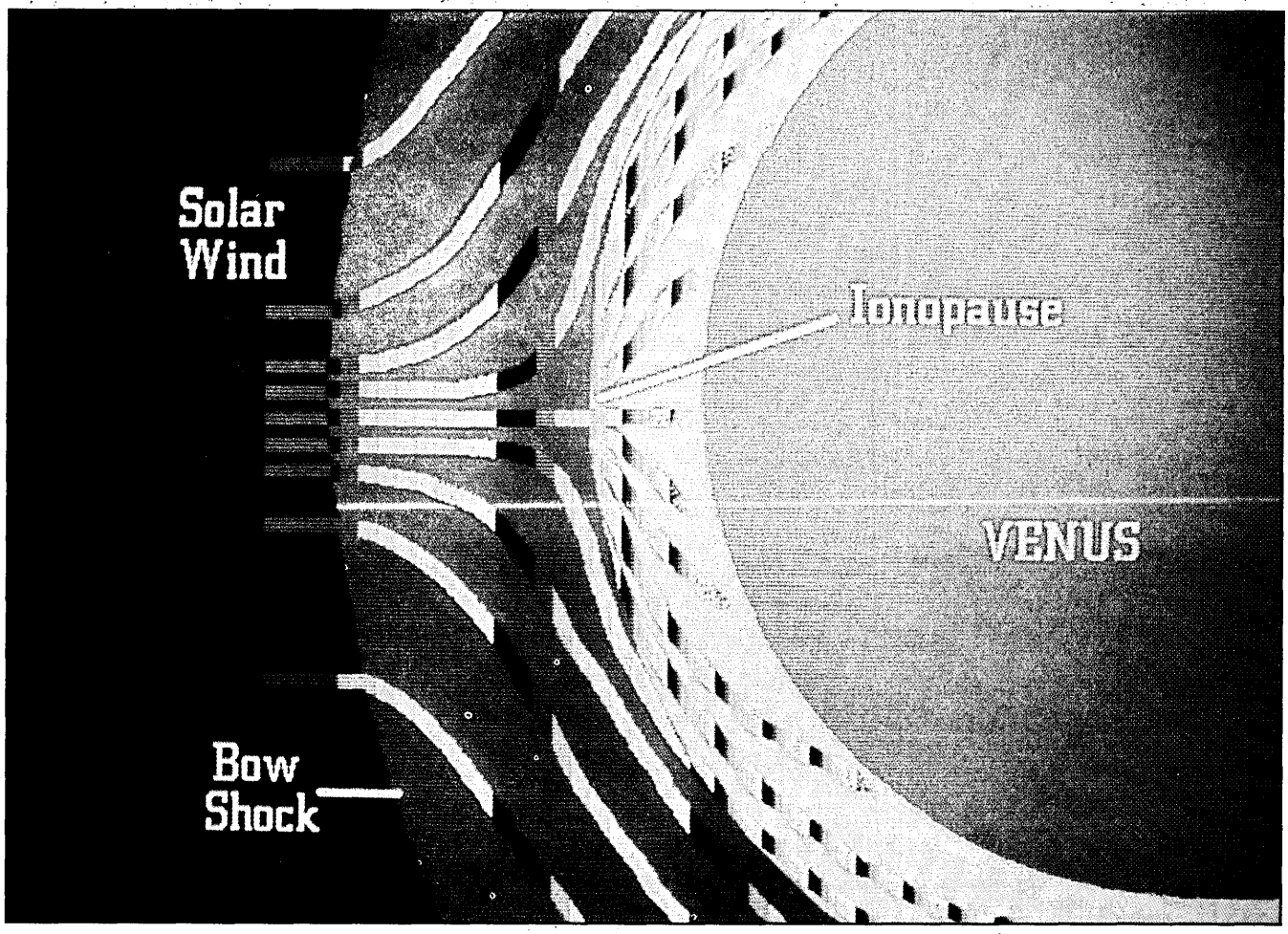
the encounter with Venus, for showing activities of the scientific experiments on board and for illustration of early results obtained. A live video feed from the system was provided during the mission for closed-circuit viewing by the press at NASA Ames Research Center. Graphics and animation created on the system were also used in numerous network and local television news broadcasts.

The system consists of a digital *image memory* (frame buffer) which holds 480x640 pixels or picture elements (8 bits per pixel), a data tablet and pen, a minicomputer and several digital disk drives for picture storage. Fig. 1 shows an overall block diagram. When viewed at this level, the system is quite similar to more recent frame buffer drawing systems. However, a novel image memory architecture and user-oriented software provide considerably more graphical power and flexibility than the typical frame buffer configuration.

Output from the system is via separate red, green and blue (RGB) video components, encoded in standard broadcast video form. Hard copy output on ordinary paper is also available via a laser-driven xerographic color printer.

All drawing, editing and animation are done and all commands are given to the system via the pen and tablet. The operator (often, but not necessarily, a graphic artist) need not have any programming or computer experience. On a standard RGB color monitor directly in front of him, the operator sees the picture on which he is currently working (the "canvas"). On another monitor to his left, the operator sees a second picture (the "control panel") showing a palette of available colors, a variety of brush shapes and sizes, and icons representing various picture editing operations he can invoke (Fig. 2). Colors and brushes are selected and operations are initiated by pressing down lightly on the pen when it is positioned over the desired item—much like pressing a button. At the top of the control panel are three slider scales indicating the hue, saturation, and brightness of the currently selected color.

On an adjacent computer terminal screen to his right, the operator is occasionally prompted or advised with messages such as "Please specify a window . . ." or "Touch color to be replaced . . . ." By using these messages, a naive operator can safely explore the system and easily discover many of its features for himself. There are no other buttons or keys and the operator is required to type on the terminal keyboard only when a name is needed to reference a stored picture.



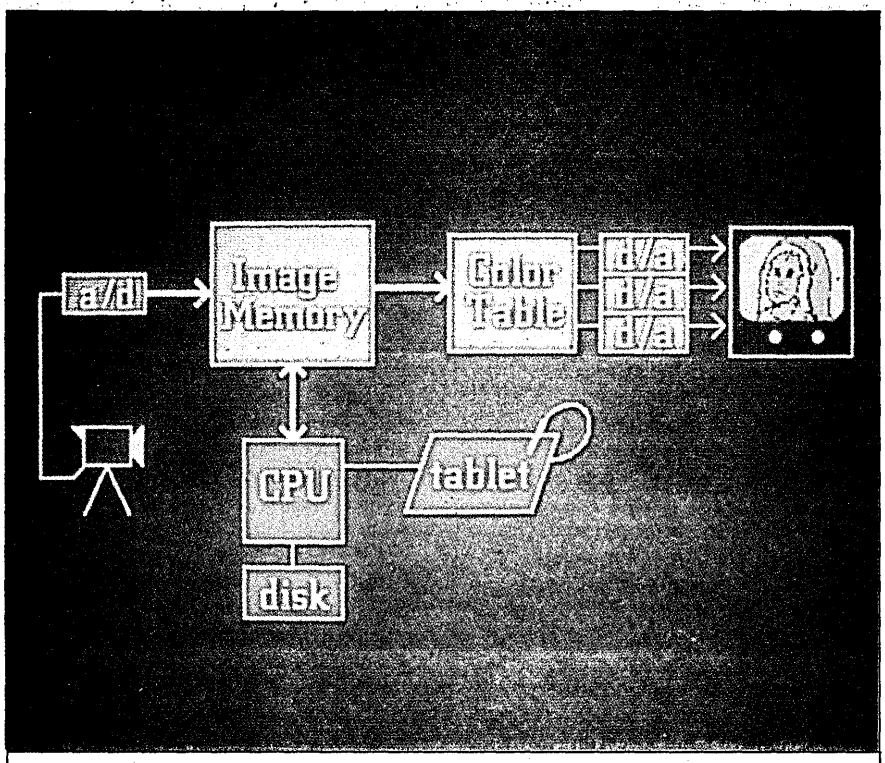


Fig. 1. Overall system block diagram.

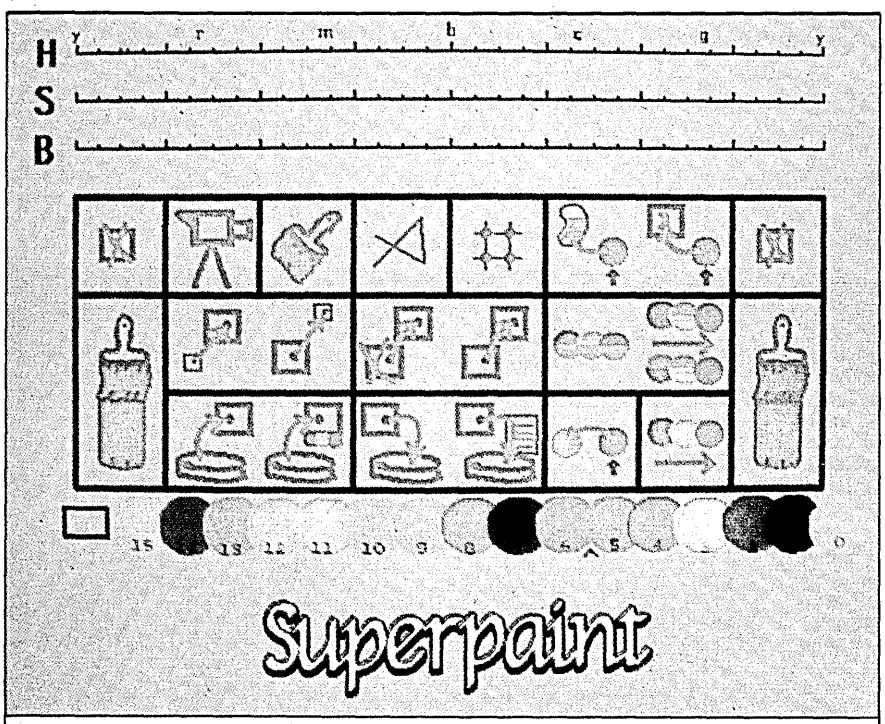


Fig. 2. Control panel.

Graphics and animations may be composed in a variety of ways. Items may be drawn ("videopainted") by the user directly into the canvas picture. Prepared art work or other material may be input to the system via a conventional vidicon camera or other video source. The incoming video can be masked with a rectangular window and automatically reduced to two-colors for a high-contrast version. The resulting subimage can then be used just as if it had been drawn. Text can be added using digitally-stored fonts. Parts of previously created pictures can be recalled and inserted, as can computed or synthetic imagery from other computer programs.

Objects or areas in the picture may be scaled up or down in size, moved, copied, overlaid, combined or changed in color, and saved on disk for future use or erased (see Fig. 3). Also provided are automatic drawing of straight lines of variable width and filling in of closed outlines with a selected color. Line endpoints and positions of moved or copied objects may be automatically constrained to grid points of a specified spacing. This allows easy creation of charts and graphs, etc., and alignment of items in a picture.

Each of the 16 available colors in the palette may be independently adjusted in terms of its hue, saturation, and brightness using the slider scales at the top of the control panel. As the operator adjusts a color, the palette and all areas in the canvas picture containing that color change simultaneously on the displays. By selecting the label to the left of the sliders, the operator can change the meaning of the scales to represent the red, green, and blue components of the color.

HOW IT WORKS

The image memory is arranged in two identical banks (corresponding to the control panel and the canvas pictures), each 480x640 pixels by 4 bits per pixel. MOS shift registers are used and the memory continually recirculates in synchrony with the scanning of the raster. Fig. 4 shows one of these two banks with the recirculation path highlighted. Every memory cycle is a read-modify-write cycle. Thus, the contents of the memory are changed by switching multiplexor 1 at an appropriate time during scanning of the image.

In addition to controlling the disks, the tablet and other peripherals, the cpu (presently a Data General Nova 800 16-bit minicomputer) can also provide a data stream to the image memory. This stream is supplied in synchrony with the raster scanning and usually represents a paintbrush image or a cursor. Data from the

cpu is run-length encoded in X (along the scan line) and is expanded by hardware in the image memory. This enables the relatively slow cpu to provide this stream in real time for simple brush shapes and cursors. Overlaying the brush image on the canvas picture is accomplished by simply switching only multiplexor 2 at the appropriate pixel times. Note that since an overlaid cursor is never stored in the memory, no rewriting is necessary when the cursor moves.

Storing (painting) into the picture is done similarly by switching multiplexor 1. In order to accomplish the real-time brush overlay and painting functions, the multiplexor switching must be controlled at every pixel time by the value of the brush pixel. If the incoming brush pixel value is 0 (the background or "transparent" value), then the canvas pixel value is taken. If not, the brush pixel value itself is used. Thus a brush or cursor can have arbitrary shape and will appear correctly over any background.

Digitized incoming video can be entered into the memory by switching multiplexor 1 to input 2. This is also under pixel-by-pixel control via the cpu data path, so that a brush or other image from the cpu can be used to "paint" parts of the incoming video into the canvas picture.

When a picture is loaded from a disk file into memory, it is transferred similarly by the cpu at a rate of about one runcode per scan line each frame time, with (optionally) only nonzero pixels being stored. Thus simple cartoon pictures can be brought into memory in only a few frame times, while very complex ones can take more than 30 seconds.

In the design of the software, considerable attention has been paid to making the system natural and comfortable for the user. Note, for example, that fully half of the image memory is used solely to hold the control picture, thus giving it a similar visual appearance to, and equal stature with, the image being created. A symbolic visual interface is more appropriate to this graphical medium than giving commands by text item selection or by typing or button pushing. The control panel is, of course, itself a picture created and edited on the system. The "buttons" on the control panel can therefore be easily changed to accommodate improvements.

Also, the control picture dims to one half brightness whenever the operator is expected to be directing his attention to the canvas. When selection of a control panel item is expected, a cursor appears and the control picture returns to full brightness as an added cue to the operator. If the operator changes his mind or

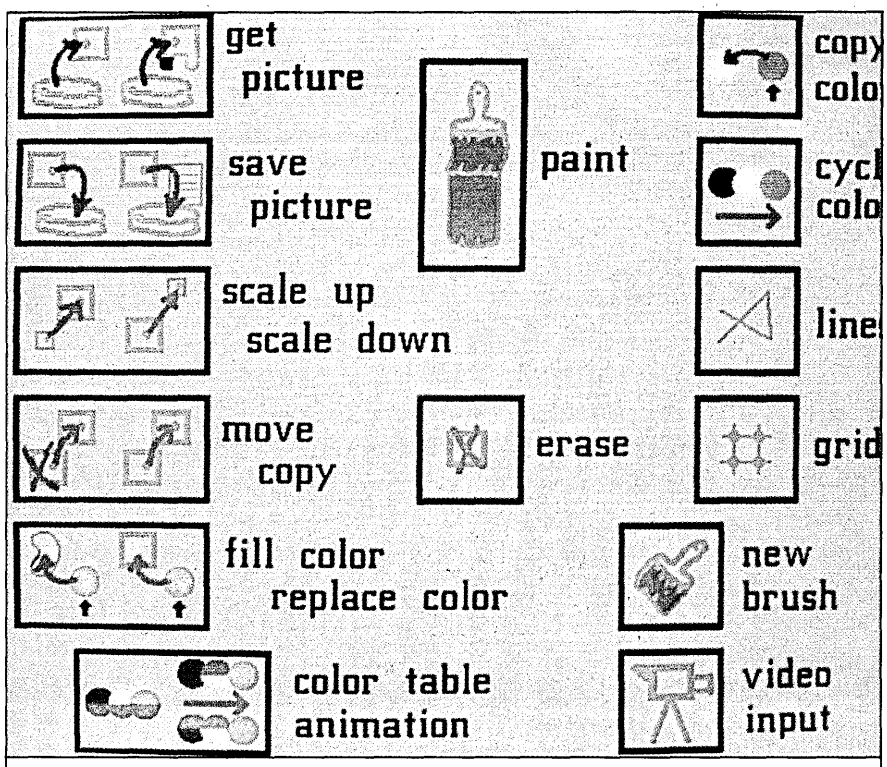


Fig. 3. Control panel icons.

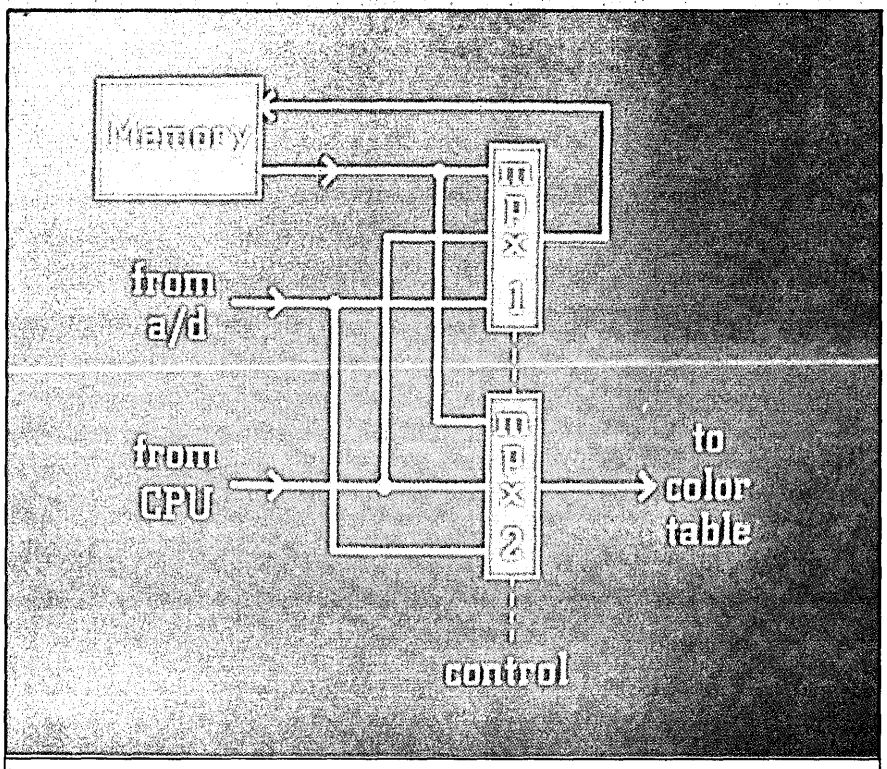


Fig. 4. Image memory block diagram.

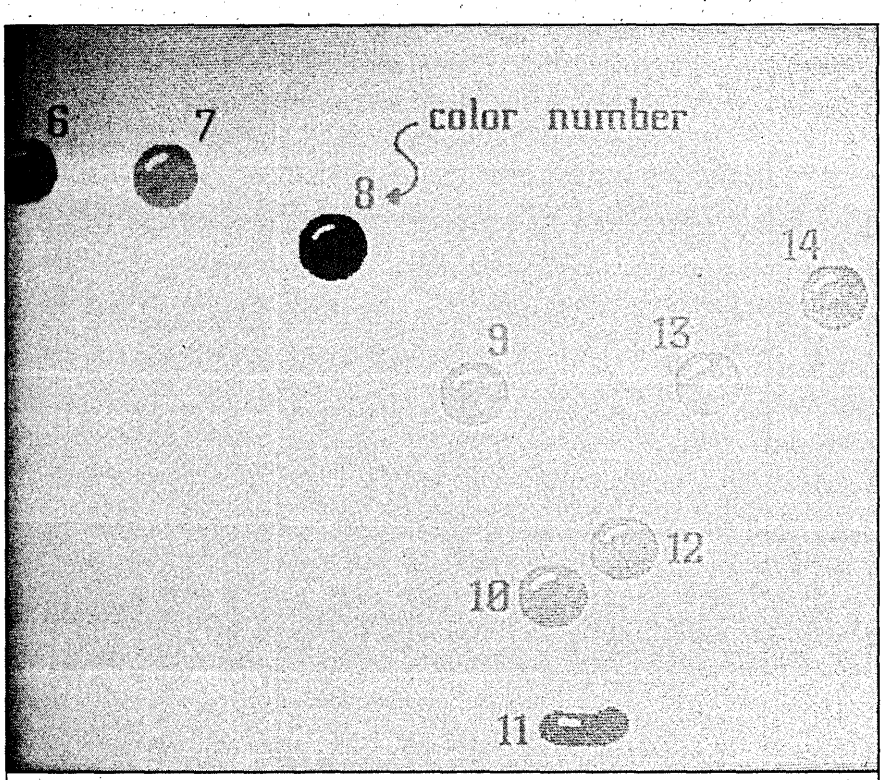


Fig 5. Color table animation.

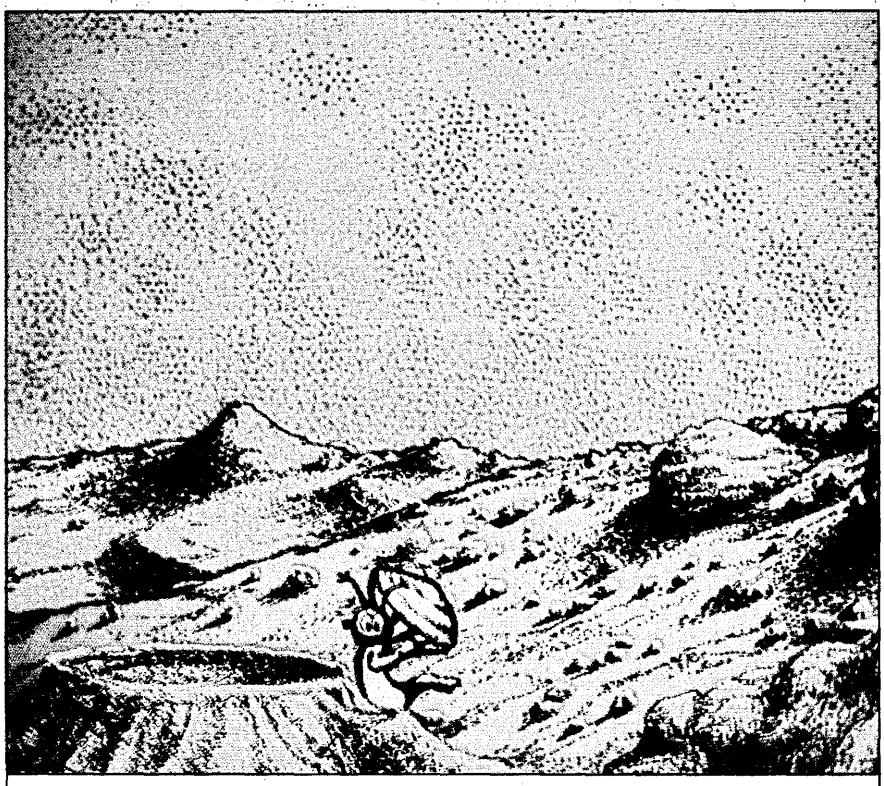


Fig 6. Pioneer Venus videographics.

acts inadvertently, any operation which has been invoked can be aborted and control returned immediately to the control panel by a single tablet stroke.

The value of movement in visual communications is great. Fortunately, even very simple motion in an image can produce a vastly more effective visual communication than a still image. If we do not require elaborate or complex motion in our images, then a simple, highly interactive form of animation can be effected using the color table hardware often included in frame buffer systems.

The *color table* is a small fast memory (usually a bipolar RAM) that holds the red, green and blue values associated with each possible pixel value (Fig. 1). During scanning, each pixel value is used to address the color table and the resulting color component values are passed to the digital/analog converters. The cpu can change the color definitions stored in the color table during vertical or horizontal blanking times.

In the present system, a form of limited but very effective animation is provided which relies on changing the colors of objects hidden within a single picture. Several views of an object are placed at successive positions along its path of motion, each in a different color number or pixel value (see Fig. 5). Initially, all the views are hidden by setting the color table so that each of these pixel values displays a color identical to the background color. The animation effect is then created by manipulating the color table definitions so as to turn on or reveal the hidden objects one at a time in sequence. Notice that successive images can be different in shape and size so that much more than just simple translation of the object is possible. Furthermore, several objects or areas can be in apparent motion simultaneously. Successive images cannot overlap, however.

The operator can manually step through the animation or he can set a speed via the tablet and allow the cycling to proceed continuously. Instead of suddenly changing from background to foreground color, smooth transitions are made between steps in the animation by interpolating in RGB color space over several frame times. The degree of interpolation depends on the speed of the animation. This softening is essential for a pleasing visual effect at all but the fastest speeds. The software also makes it possible to paint into the picture while the animation is running.

Currently, only 10 colors are used for cycling and animation and 6 are static or background colors. (It is worth noting that 10 animating colors are quite suffi-

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cient for a wide variety of simple cartoon-like animated graphics.) This means that motion in the image must be effected in 10 or fewer steps. Our application here is not continuous, story-telling animation, but rather simple self-contained graphics such as shown below.

A GRAPHIC AMPLIFIER Artists and nonartists alike have responded positively to using the system. Most people quickly adapt to the videographic medium and are able to create interesting drawings and graphics with only a few minutes of experience. The medium acts somewhat like an amplifier—it expands greatly the range and scope of both the trained graphic artist and the nonartist.

The illustrations on the opening pages of this article and below show examples of animated graphics by artist Damon Rarey for use during the Pioneer Venus mission. Like all the figures shown here, these pictures were created on the system and can be printed by a laser xerographic printer.

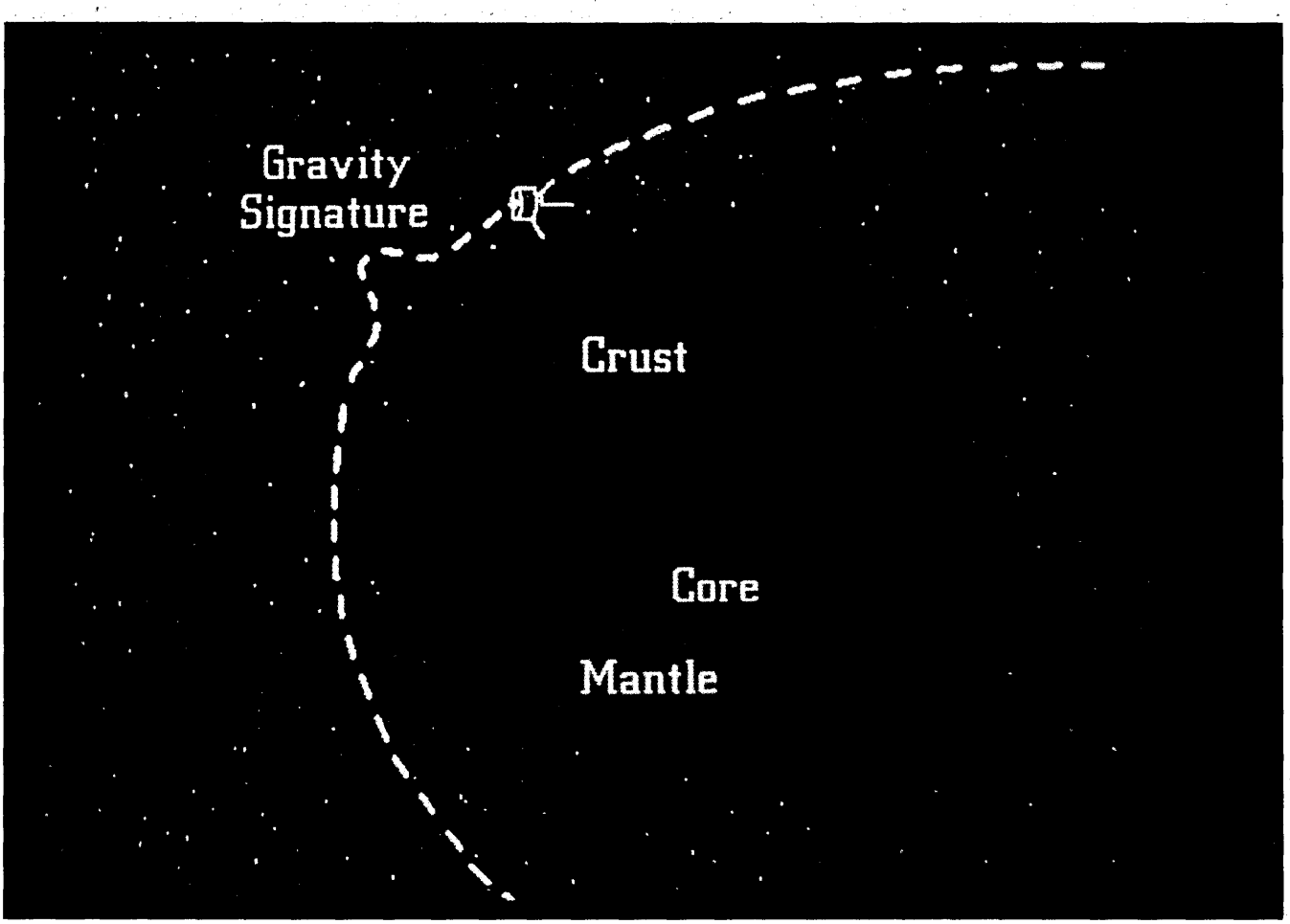
Limitations of the system are numerous and apparent after some use. Most annoying, of course, are the jagged edges often present in the picture due to the limited resolution and lack of softness of the digital medium. Techniques now exist for eliminating these quantization effects, but using them fully in a highly interactive system is beyond the capabilities of this hardware. Other desirable features not present in the current system include: multiple overlays (like a cartoonist's cels), the ability to deal with full-color natural images as well as flat color, smooth scaling (zooming), and a more general animation capability. ✲

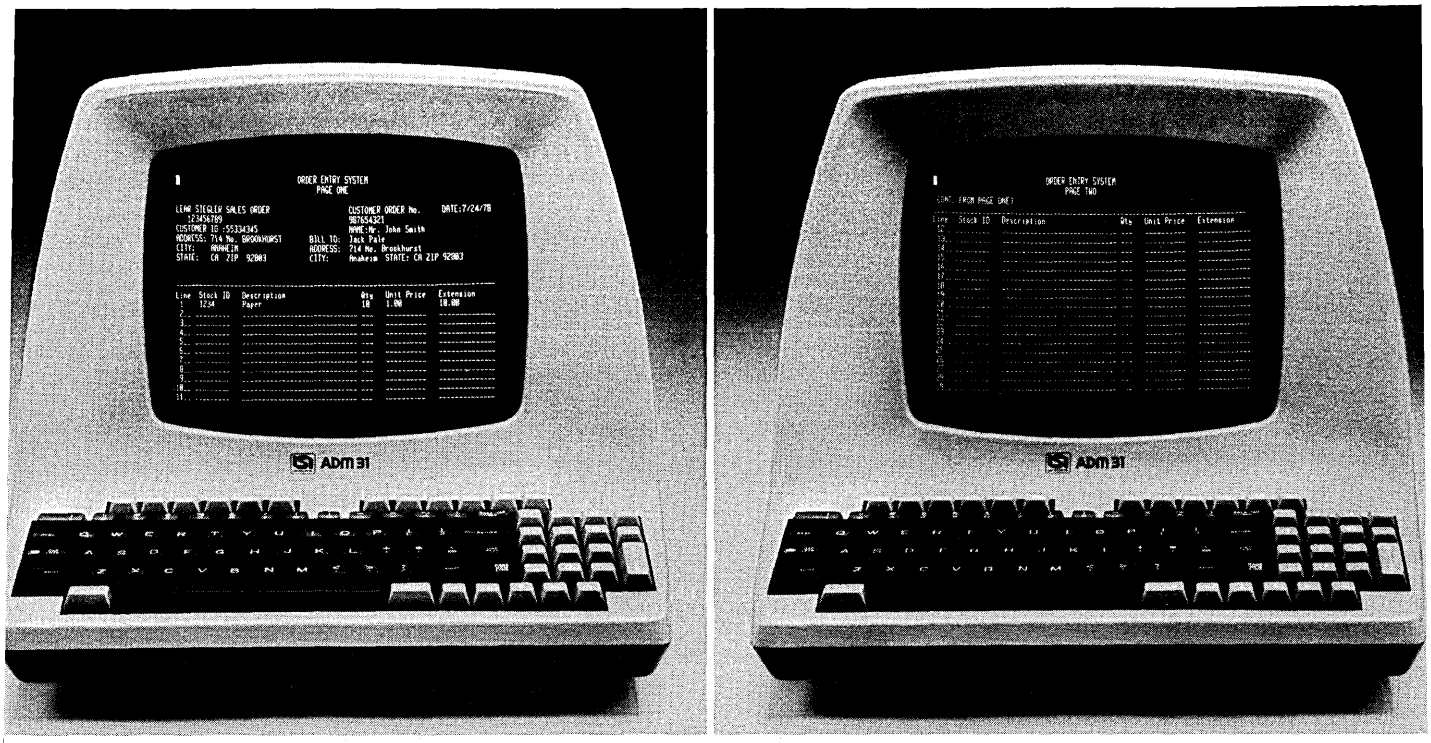
AUTHOR'S ACKNOWLEDGEMENT

The author would like to thank Damon Rarey for his enthusiastic use of the system and for many important comments and suggestions. Thanks are also due to Bob Flegal and Alvy Ray Smith for their early work on this system and for numerous useful ideas and discussions.

RICHARD G. SHOUP

Dr. Shoup is a member of the research staff at the Xerox Palo Alto Research Center. He has been with Xerox since 1970 and was previously at Berkeley Computer Corp. He has a PhD in computer science and a BSEE, both from Carnegie-Mellon Univ.





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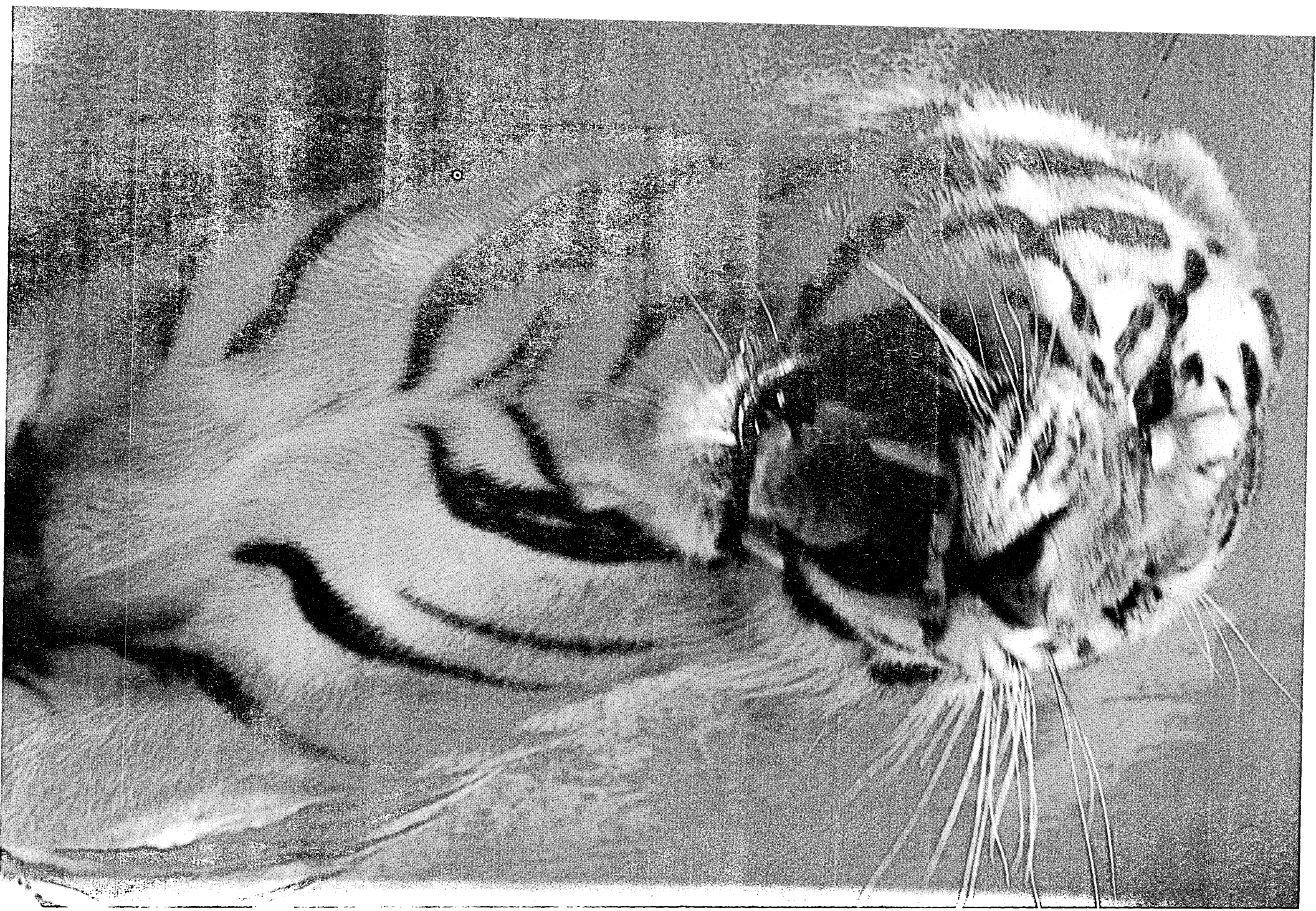

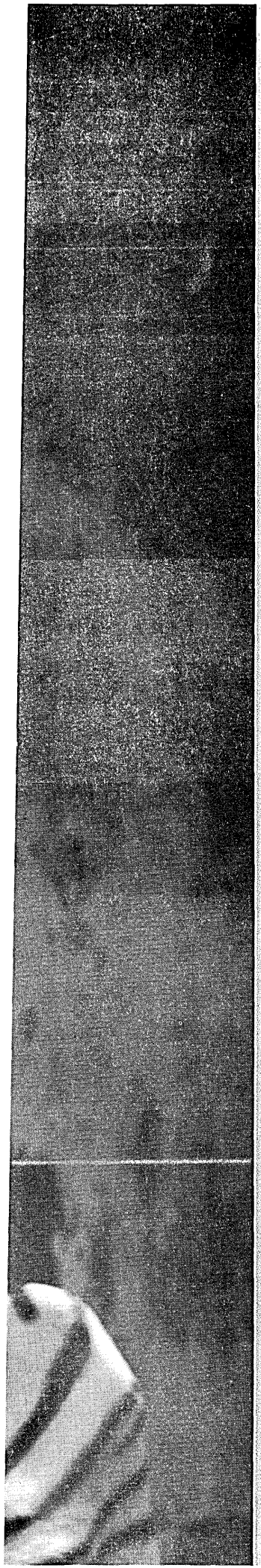

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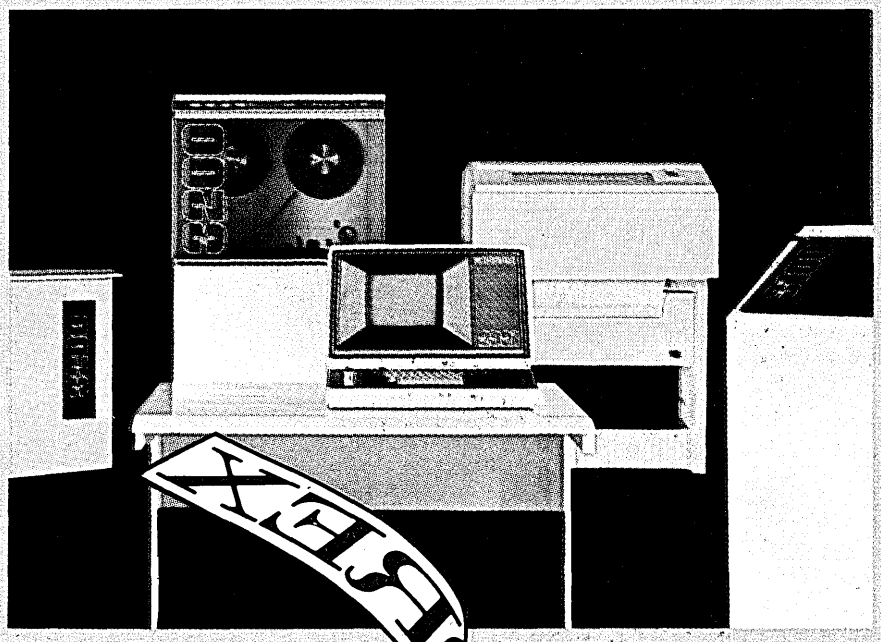

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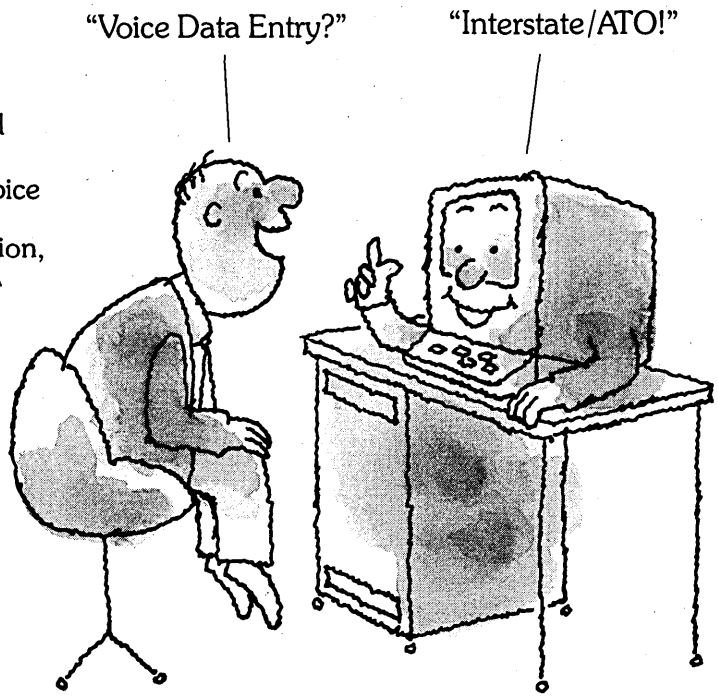

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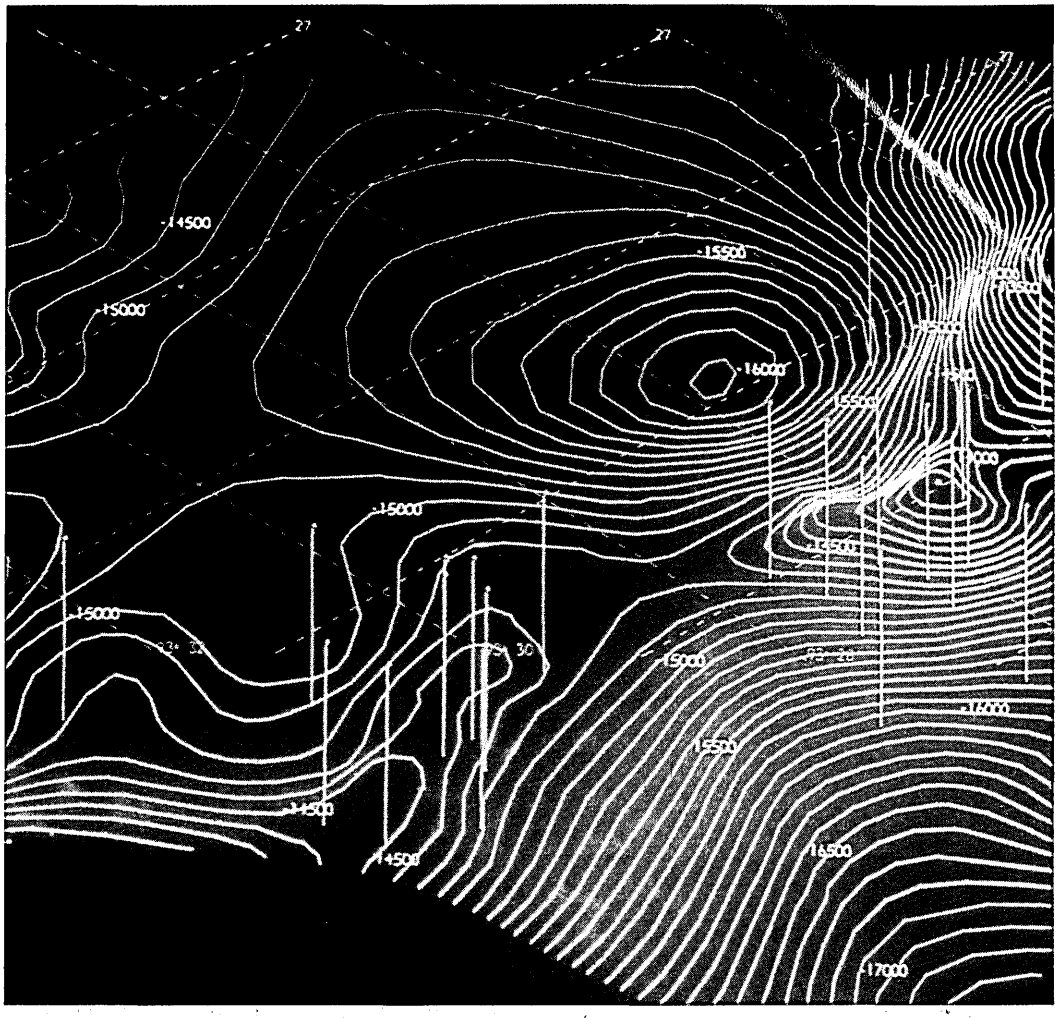

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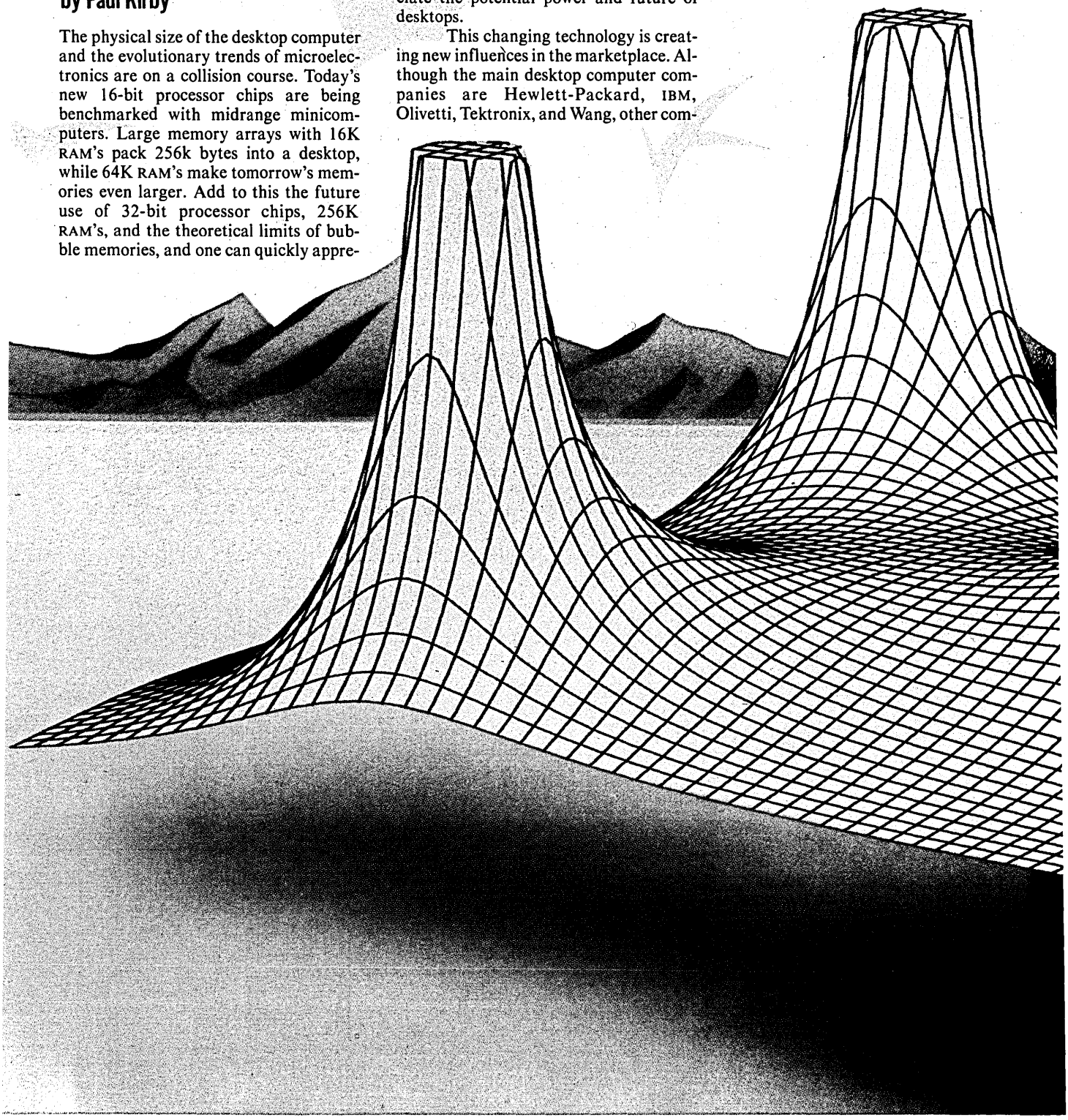
Computer graphics has been around for years, but only recently has it become quick, inexpensive, and friendly on a desktop.

DESKTOP GRAPHICS

by Paul Kirby

The physical size of the desktop computer and the evolutionary trends of microelectronics are on a collision course. Today's new 16-bit processor chips are being benchmarked with midrange minicomputers. Large memory arrays with 16K RAM's pack 256k bytes into a desktop, while 64K RAM's make tomorrow's memories even larger. Add to this the future use of 32-bit processor chips, 256K RAM's, and the theoretical limits of bubble memories, and one can quickly appreciate the potential power and future of desktops.

This changing technology is creating new influences in the marketplace. Although the main desktop computer companies are Hewlett-Packard, IBM, Olivetti, Tektronix, and Wang, other companies, that can attain a competitive advantage by reacting quickly to technological change, are entering the market. Two such companies, both of which offer color art desktop systems, are Intelligent Systems Corp. and Chromatics. Improved raster and color tube technology along with the availability of inexpensive R/W memory and microprocessors have made market entry by these firms possible. In-



terestingly, none of the major desktop computer companies mentioned offer a color desktop system, although Tektronix does offer a color crt terminal.

Another impact of the microprocessor is the increasing amount of intelligence found in on-line terminals. For example, HP's new 2647A intelligent terminal is programmable in BASIC and can automatically create graphic displays at the press of a single function key once the data has been entered into the tables.

Microprocessors are also found in desktop peripherals, such as plotters and digitizers. Graphics peripherals are becoming more intelligent, easier to use, less expensive and offer users cost-effective graphical solutions to their problems.

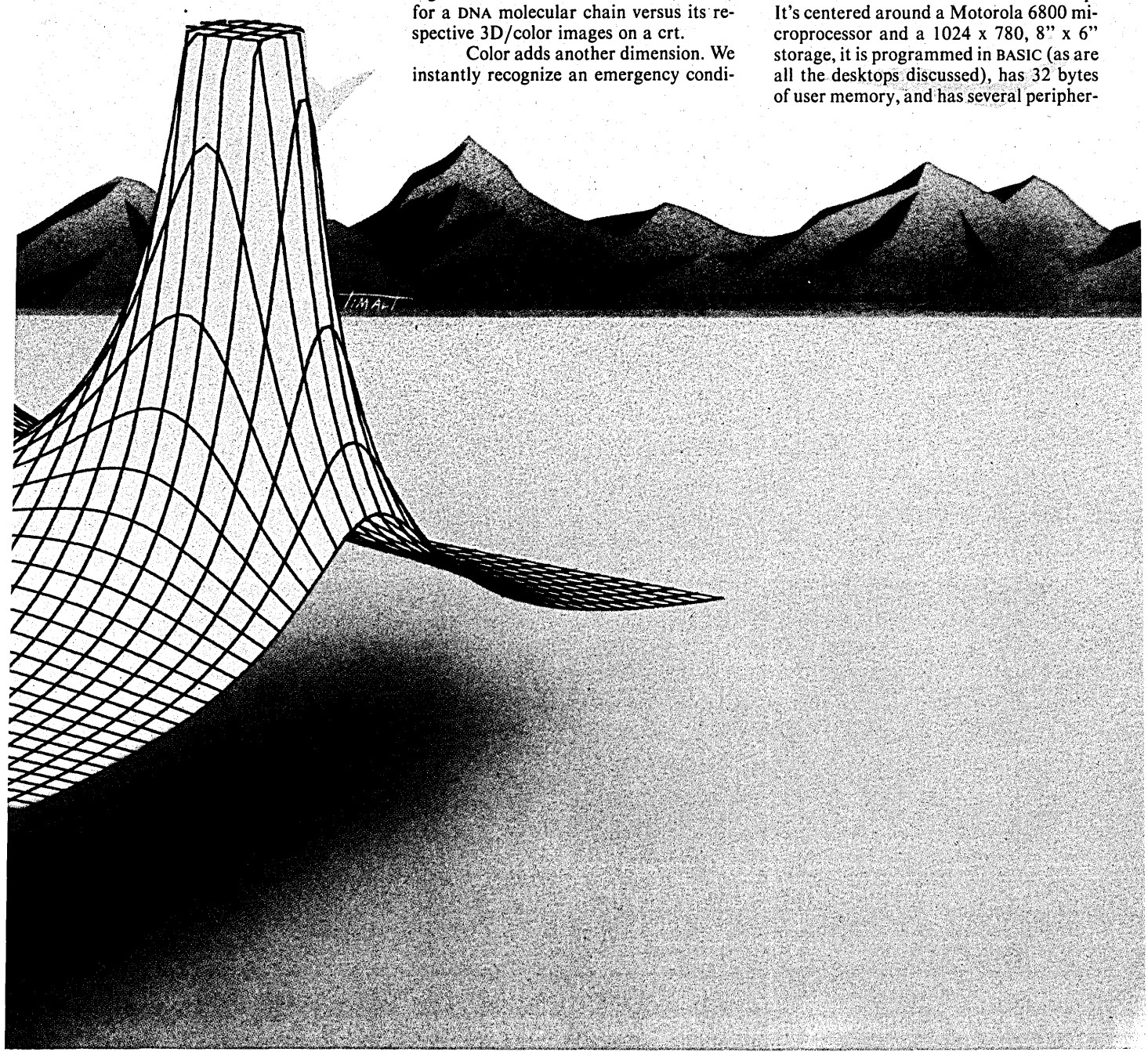
Computer graphics has been around for years, but only recently has it become quick, inexpensive, and friendly via a desktop and optional peripherals. Man does not think naturally in strings and arrays of numbers, but rather in images. Thus, it is easy to understand the increasing demand as graphics become more cost-effective.

To illustrate the usefulness of graphics, compare the amount of information gained per initial amount of time while viewing numerical tables of data with their respective graphical representations of charts and diagrams (e.g., the bar charts and pie charts of corporate annual reports). Or, as an extreme example, compare the information gained by viewing massive tables of coordinates (X,Y,Z) for a DNA molecular chain versus its respective 3D/color images on a crt.

Color adds another dimension. We instantly recognize an emergency condition while watching a crt diagram of a process control system if one of the high pressure valves pictured turns a vivid red. (Blinking adds yet another level of input.)

It is no longer necessary to devote large capital expenditures and manpower resources to have graphics, since desktop computer systems now offer a level of graphics capability, and with the additional benefits of being a dedicated, results-oriented, friendly machine. Also, software that offers turnkey solutions to problems in many areas of business statistics, engineering, and science is now commercially available.

Perhaps the best known company in the graphics industry is Tektronix. This dates back to the first days of storage tubes. Tektronix offers the 4051 desktop. It's centered around a Motorola 6800 microprocessor and a 1024 x 780, 8" x 6" storage, it is programmed in BASIC (as are all the desktops discussed), has 32 bytes of user memory, and has several peripher-



als. These include two types of printers, a plotter (with digitizing capability), a magnetic tape unit, a joystick, and a data tablet. Tektronix's BASIC language has extensions for graphics and they also offer perhaps the most complete software library available for graphic applications.

Hewlett-Packard's System 45 is centered around two custom 16-bit processors. The dual processor system offers certain throughput advantages. While the language processing unit is running, the peripheral processing unit can be used for capturing data or displaying results. The System 45B has a 560 x 455 raster, 12" diagonal crt and a maximum of 450K bytes of user memory. Two cassette units and a thermal printer are part of the mainframe system. Peripherals include printers, plotters, floppies, hard disks, and a digitizer. It should be noted that many bus compatible (IEEE-488) peripherals that have the necessary software drivers are available to desktop computers.

IBM offers the 5110 desktop. Although it cannot perform graphics directly via its 5" diagonal crt, data can be outputted serially to a vector crt or plotter. Two programs available for this purpose are called PRINT/PLOT and APL GRAPHPAK. The 5110 is programmable in both APL and BASIC. The available application software is quite extensive but is mainly business (as opposed to engineering and scientific) oriented. Both tape and diskette systems are available. The 5110 uses an IBM custom microprocessor.

Olivetti's P6060 desktop can plot data via an internal line printer or serially to a plotter. There is no mainframe crt, but it does have a 32-character 5 x 7 dot matrix plasma display.

The APPLE II personal computer should be mentioned because it can be interfaced to a color tv for a 280 x 192 color cell display. The system is centered around a 6502 microprocessor, has a maximum of 48K bytes RAM, and is programmable in either BASIC or 6502 assembly language. The firmware includes some graphic commands and 15 different colors are available.

Intelligent Systems Corp. offers a complete line of color terminals. Within this line are two crt's that also include a built-in programmable microprocessor. The intercolor 8090 desktop, its deluxe system, is centered around an 8080 microprocessor and offers a 13" or 19" 8 color display. Resolution is 160 x 192 cells. The 8090 is programmable in BASIC and has a maximum of 64K bytes of RAM. A light pen is optional, as are a disk and printer system. ISC's color display systems have become very popular in process control applications where it is important to have color.

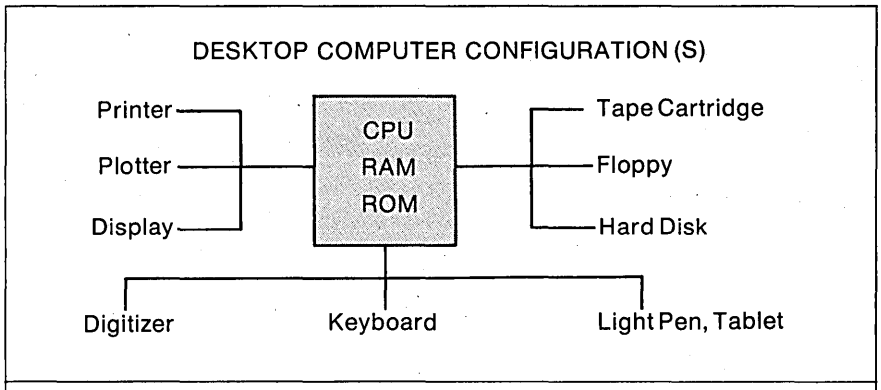


Fig. 1.

Chromatics also offers a color desktop system. Centered around a Z80 microprocessor, it has a 13", 15", or 19" color crt with 512 x 256 or 512 x 512 raster resolution. Models include up to 64K or 128K bytes of memory. Peripherals include a floppy, light pen, and X-Y digitizer tablet. Chromatics offers some interesting keyboard accessible graphics which include commands like vector, circle, arc, and rectangle. Available colors include eight foreground and one of eight background colors at a time.

Fig. 1 shows possible configurations for output, input and memory devices. Table 1 summarizes some vendor data. It should be pointed out that there is a danger in Table 1, for although many of these systems seem similar, there is actually a wide range of performance, "friendliness," and human engineering in the hardware and software. A revealing benchmark for a system would be how long it takes a user to write, debug and execute a program for a variety of problems.

Often what a user gets is a function of what he pays. For example, at one end of the spectrum is the Apple II home computer which uses 8K bytes ROM for the BASIC interpreter and monitor system. At the other end of the spectrum is the HP System 45 desktop computer which uses 100K bytes of system firmware, 8K bytes of system R/W, and an additional 70K bytes of optional ROM.

A good example of how microprocessors have been used in peripherals to help increase performance at prices not possible before is the Hewlett-Packard 9874 digitizer. It incorporates a custom HP 16-bit processor with 16K bytes of ROM. The microprocessor allows axis extension beyond the physical limits of the platen (the x axis can actually extend for 53 kilometers), axis alignment to the orientation of the paper, relocatable origin, special function keys and display, programmable sampling rates, programmable auditory tone response, and a built in system self-test.

The HP 9872 digital plotter with four color pens is another example. (Fig. 2 was produced on this plotter.) The 9872 also uses a custom HP 16-bit processor. The microprocessor provides real time control of the X and Y microstepped motors with the required 16-bit resolution plus enough power for I/O functions and features such as five character sets, digitizing capability line types, axes tick marks, programmable plot speeds and system self-test.

Large scale integration has made it possible to have single chip controllers between the desktop processor and many of the I/O memory devices. LSI controller chips are available for keyboards, crt's, floppies, tape cassettes and disks, and certain plotters.

CHANGES IN GRAPHIC DISPLAYS

In talking about desktop computer graphics, some mention should be made of crt displays. Here, also, changes in technology are having an effect. Once the storage tube was the most common type of graphic crt, but now the raster type display is coming into its own. Because the raster display uses the same

COMPANY	CPU	MEMORY SIZE	LANGUAGE	GRAPHICS	ALPHA	AVERAGE PRICE FOR TYPICAL SYSTEM
Apple II	6502	48K	BASIC & assembly	280x192	40x48	$ 1,000-2,000
Chromatics	Z80	64K	BASIC	512x512	85x51	6,000-12,000
HP System 45B	Dual Custom 16-bit	450K	BASIC	560x455	80x24	12,500-34,000
HP System 35	Custom 16-bit	256K	BASIC & assembly	Plotter	80x24	10,000-23,000
IBM 5110	Custom Processor	64K	BASIC & APL	Plotter	64x16	8,500-28,000
ISC 8090	8080	64K	BASIC	160x192	80x48	4,500-12,000
TEK 4051	6800	32K	BASIC	1024x780	72x35	6,000-12,000

Table 1.

type of tube found in home tv sets, manufacturers' cost/volume ratios have made them very inexpensive. For certain quality levels of graphics no special deflection amplifiers are needed. Refresh display memory prices have also dropped dramatically, and character generators are inexpensive LSI chips.

However, some warnings are in order. Just as home tv's have flicker if one sits close to the screen, so also will the low priced raster crt's. The use of a higher persistence phosphor tube helps eliminate this. The number of addressable points in the X and Y directions also are important. Some systems offer graphics displays with similar addressable cell structures to those for alphanumeric representation. In this case, obtrusive jagged diagonal lines called jaggies can be seen, resulting in lower resolution.

For persons unacquainted with the software of desktop computer graphics, the following examples will lend a flavor for how graphic images are created by the user. If, for instance, we wanted to create a bar chart showing sales per year since 1970, the following commands could be used:

MAT READ A
(The MAT READ statements fills a previously declared array with the sales numbers we'll be using for the eventual plot.)
VIEWPORT (or LOCATE) 20, 80, 20, 60
(VIEWPORT (or LOCATE) defines the plotting area of the screen the actual plot will occupy. The four parameters are for the Xmin, Xmax, Ymin, and Ymax boundaries.)

WINDOW (or SCALE) 1970, 1978, 0, 30
(WINDOW (or SCALE) defines the range of the X and Y axes in user units. In this case, the X axes will be from 1970 to 1978 and the Y axes from 0 to 30.)

AXES 1, 1, 1970, 0
(The AXES statement will label appropriate X and Y tick marks for us. In this statement, we have declared the marks to appear at every unit for X and Y and declared the origin to be at 1970, 0 for X, Y.)

LINETYPE n
(LINETYPE signifies the desired type of line for the plot, e.g., dashes or dots, etc.)
MOVE X, Y
(The MOVE statement lifts the pen and moves it to the specified X, Y coordinate position.)
PLOT X, Y
(PLOT draws a line from the current pen position to the position specified by X, Y.)
DUMP GRAPHICS
(DUMP GRAPHICS creates a hard copy of the crt's graphics on a printer.)

Thus, through a sequence of commands such as these, one can quickly create a histogram chart as seen in Fig. 3. Although companies use a variety of commands for graphics, there is an effort throughout the industry and by SIGGRAPH (an ACM special interest group on computer graphics) to standardize graphics commands.

Graphics software can be described as a structured hierarchy. At the bottom level of this hierarchy are device drivers and primitives that interface the software to graphic devices. At the top level are the user's application programs. In between are application subroutines and graphic subroutines. These deal, for instance, with the construction or manipulation of figures and objects. For example, an application subroutine could have the necessary coding for the user to simply call that subroutine to plot a bar chart or a given mathematical function. In turn, a graphic subroutine could then be called to move pens and draw parts of the plot. This process, then, makes it unnecessary for the user to program at the lowest levels of graphic software. Thus the user can become much more productive with his time.

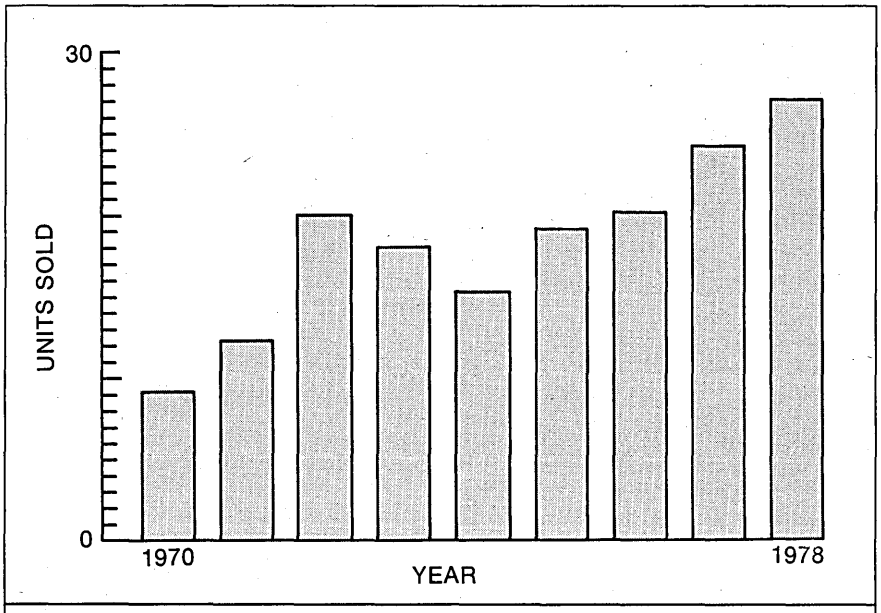


Fig. 2.

The following examples give an idea of the variety and extent of applications for which desktop graphics may be used today.

Civil engineering: One structural engineering company is using a desktop for stress analysis and the interactive design of beams, columns, and slabs. Graphics is also used to verify structural geometry. Loading combinations are analyzed by the computer and deformations can be plotted.

Another civil engineer is monitoring the effluent from a waste treatment plant into a local bay. After measurements are taken at various locations over a period of time, the results are plotted for further environmental impact analysis.

Mechanical engineering: One manufacturing company designs and fabricates its own machinery for its highly specialized product line. A desktop graphic system assists in the design of this tooling.

Another company, also involved with the mechanical design of parts, combines the use of a digitizer with a desktop to represent the desired object in three dimensions. The digitizer inputs data points from three orthogonal views of an engineering drawing. The desktop then transforms these data points onto the screen as a 3D image for study and further development by the design engineer.

Electrical Engineering: One engineer uses a desktop and plotter for modeling of an AC filter circuit. Another uses it for modeling frequency response in a new microwave preamp circuit. Often a desktop is used to collect and plot empirical data for optimization of a circuit design.

Medical: Clinical laboratories use desktop computers to do Radioimmunoassay data reduction and to plot the data transformations using logit-log, spline, and four parameter logistic curve fits. They also use desktop computer graphics to plot quality control data on Levy-Jennings charts and Youden plots to monitor the consistency of all testing and to identify systematic errors.

Statistics: A biologist with the State Fish and Game Dept. is using an Andrews plot to help him gain insight into four-variable data he had collected via a fishing creel census at the State Park entrance.

An anthropologist is investigating the length of bones of prehistoric man. He uses a probability plot to see if the lengths are normally distributed. If they are, he proceeds with further parametric analysis.

Business: A marketing department uses several variables in a regression analysis for its yearly sales forecast. A planning department uses a desktop and plotter to draw PERT and critical path charts for a new manufacturing facility they are building.

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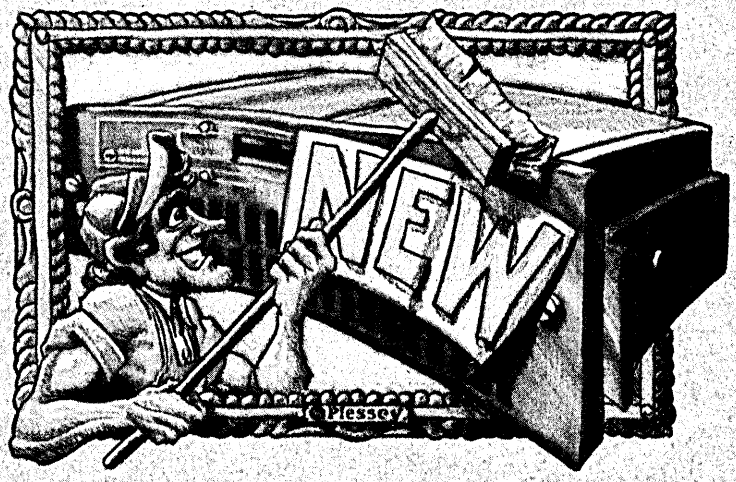

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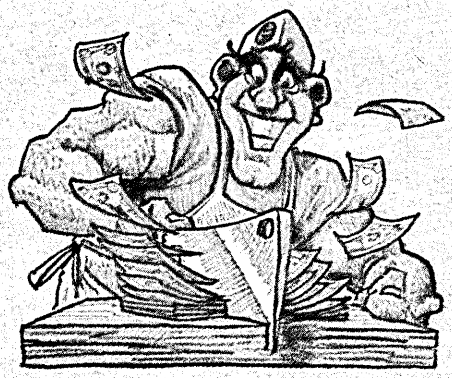

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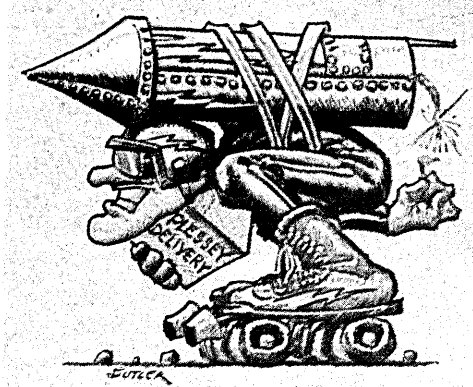

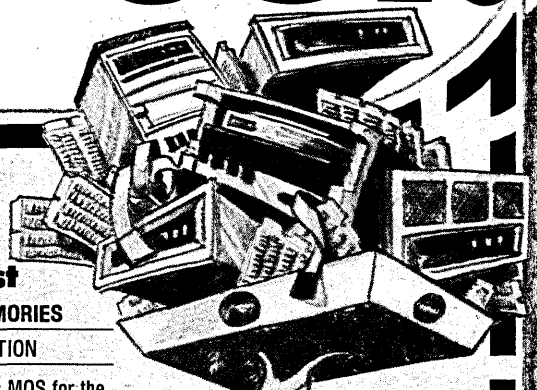

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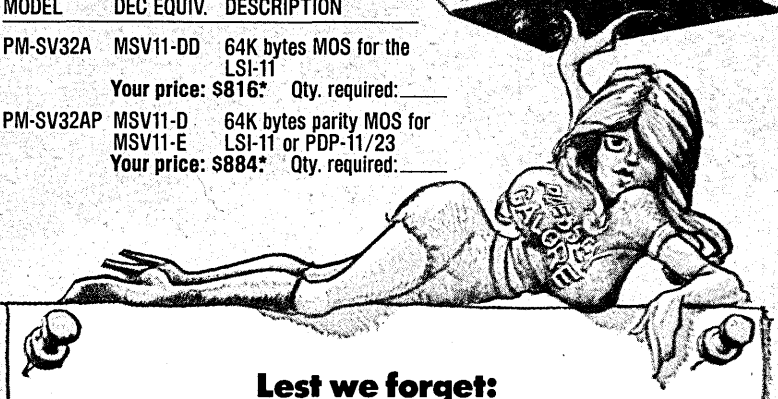

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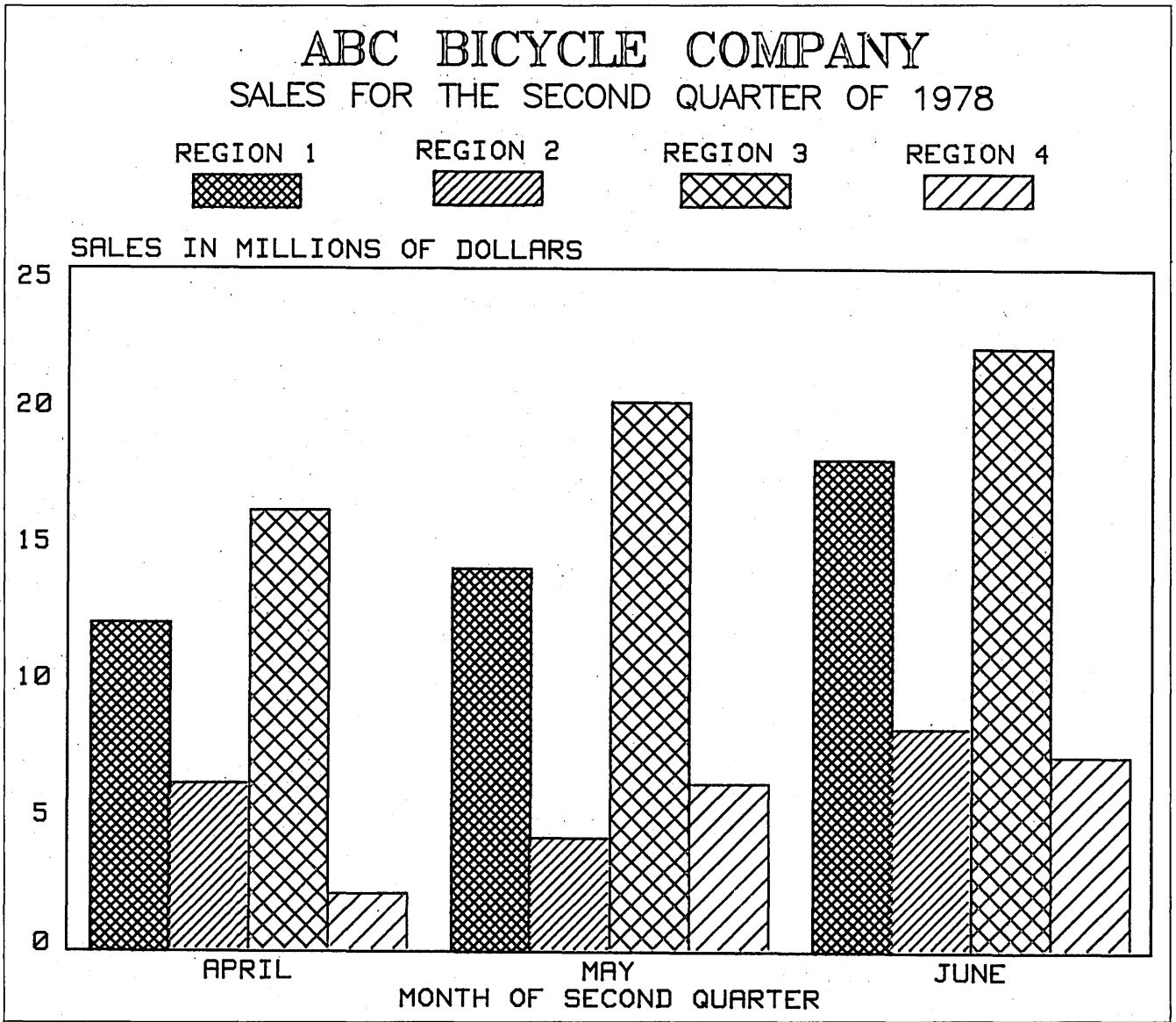


Fig. 3.

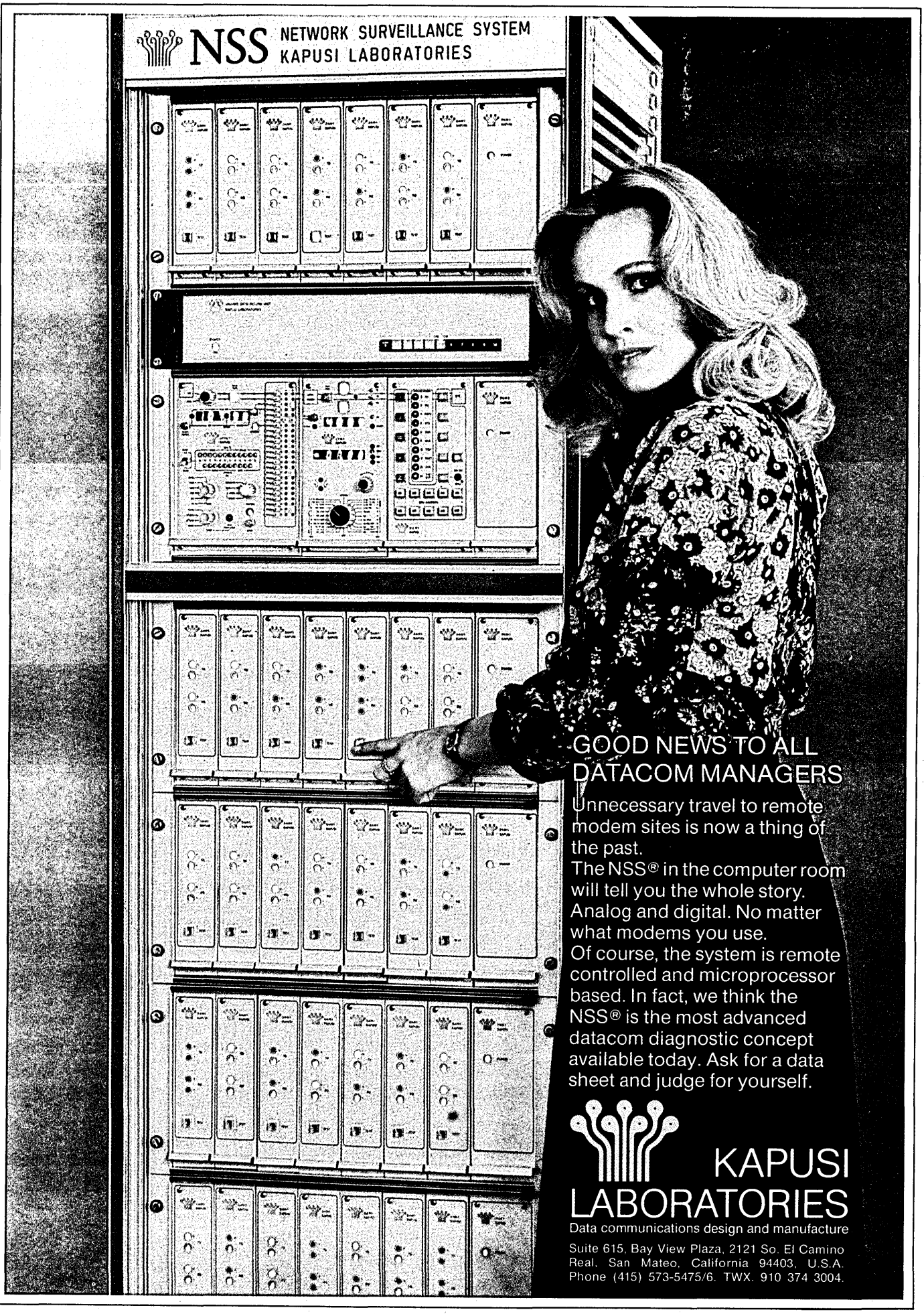
Graphics can be seen as having three levels of increasing complexity. Level 1 consists of simple 2D charts and graphs (e.g., bar charts and function plots). Level 2 has 2D line and polygon drawings (e.g., a process control "plumbing" diagram or a schematic layout). Level 3 consists of 3D, hidden surfaces, and images (e.g., aeronautical design). The divisions between levels need only be conceptually approximate.

Presently, most desktop graphic applications can be characterized as Level 1 with some overlap into Level 2. Typical applications include business charts as found in annual reports and engineering plots of functions. Some Level 2 work is being done, as in simple circuit design work or a process control diagram. Level 3, however, requires a desktop to have a more computational power to be effective and perhaps a higher performance display system. (Note, however, this categorization of complexity or sophistication refers only to the type of graphics being used and not to the type of problem being solved—a Level 1 application, for example, could incorporate a very sophisticated mathematical problem.)

In the future the standard 8-bit processors found in Table 1—the Z80, 8080, 6800, and 6502s—will be replaced by the newer 16-bit versions. With this change, the computational power of desktops will increase accordingly. Raster graphics and color are the in thing in the graphics industry, as became apparent at SIGGRAPH. Expect to see this carry over to desktops, as Chromatics and Intelligent Systems Corp. have done. Because of larger and cheaper RAM's and ROM's, increased computational power and the ever rising cost of labor, expect more emphasis placed by vendors on software, both application packages and a user/results orientation to programming and graphics. The microprocessor will have an increasing effect on graphic peripherals where they will provide more intelligence and performance. The number of desktops will increase, as will their applications for graphics. ✲

PAUL J. KIRBY

Mr. Kirby is product manager of present and future desktop computer graphic products, Desktop Computer Division at Hewlett-Packard in Fort Collins, Colorado. His M.B.A. is from Harvard. Previous employment includes a summer with Gnostic Concepts, Inc., during which he assisted with two multiclient studies on analysis of the competitive environments of the computer and telecommunication industries. Mr. Kirby has also worked at the Electronic Research Laboratory of Hewlett-Packard's corporate headquarters in Palo Alto.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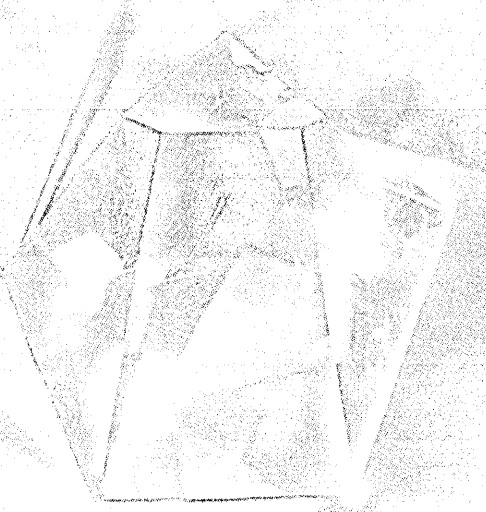

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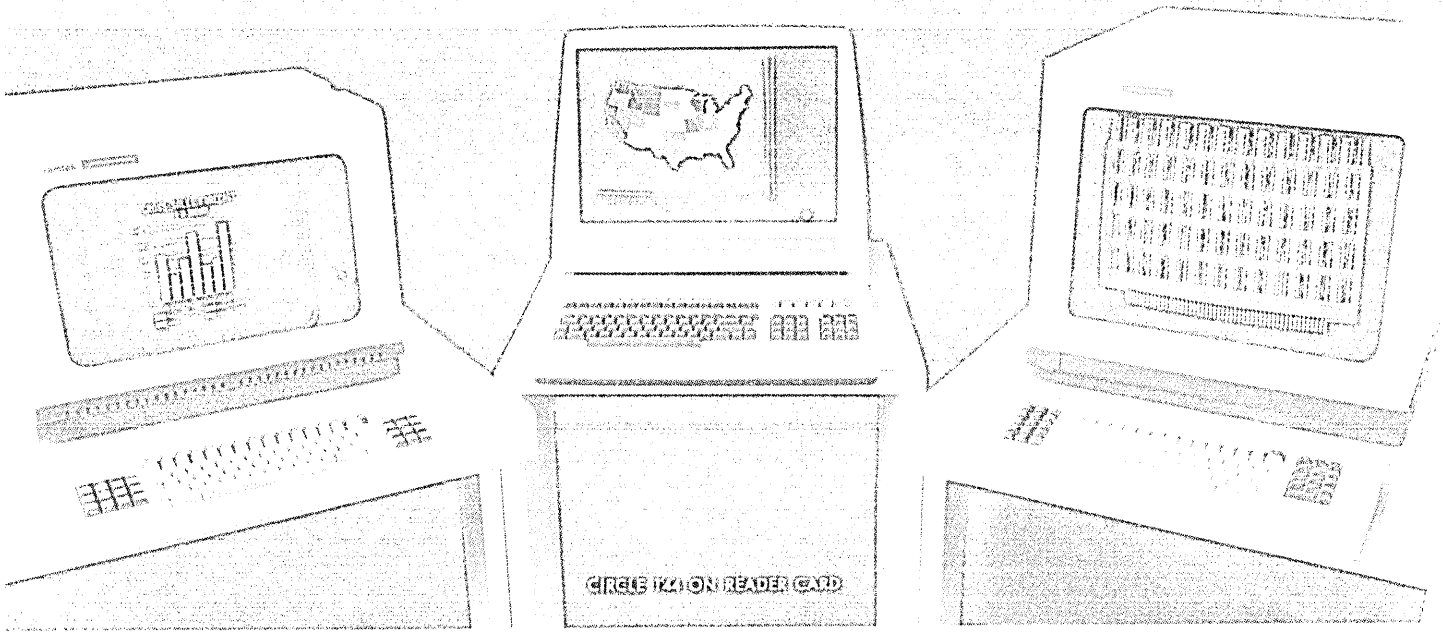

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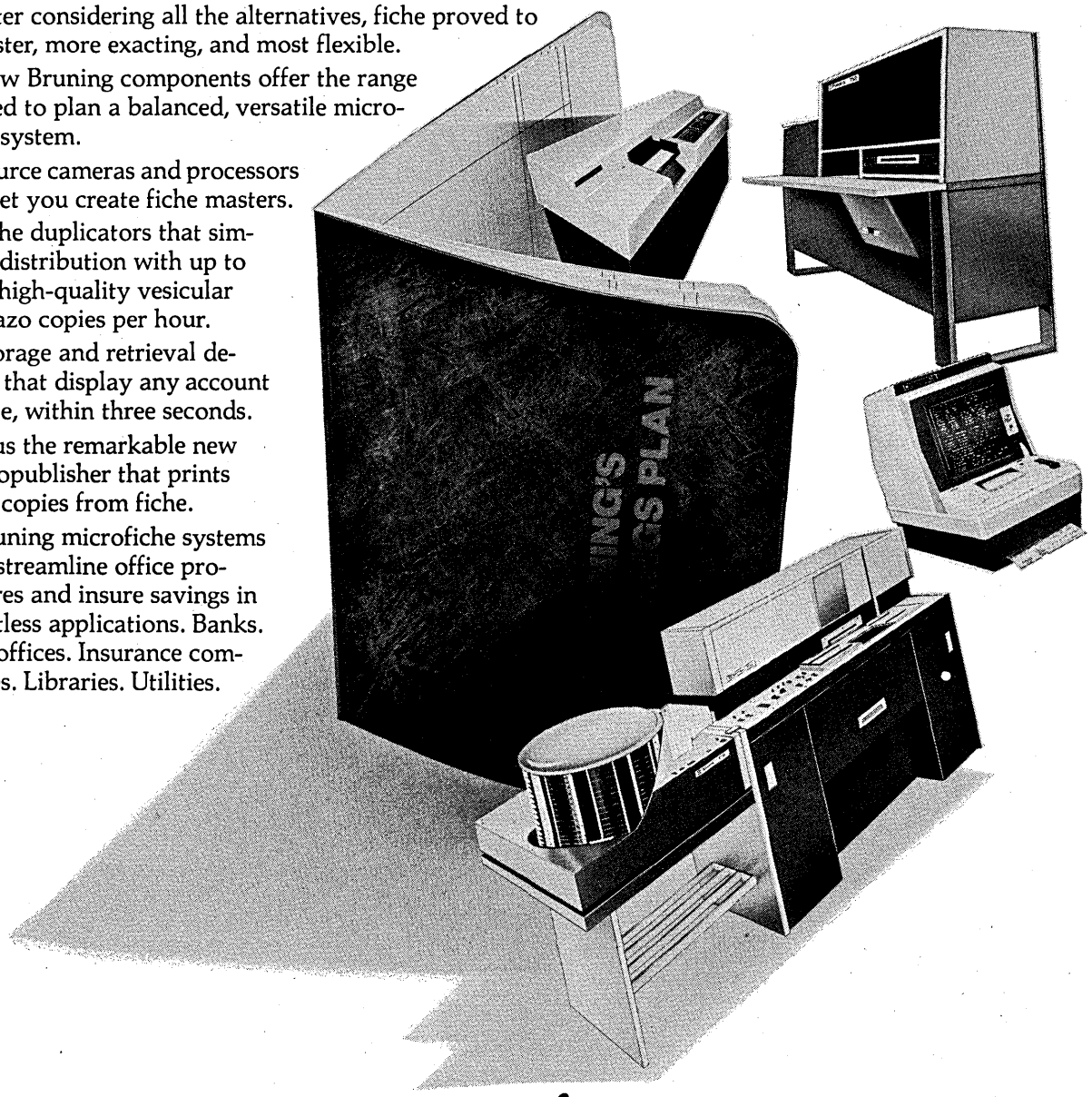

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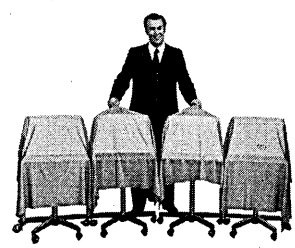

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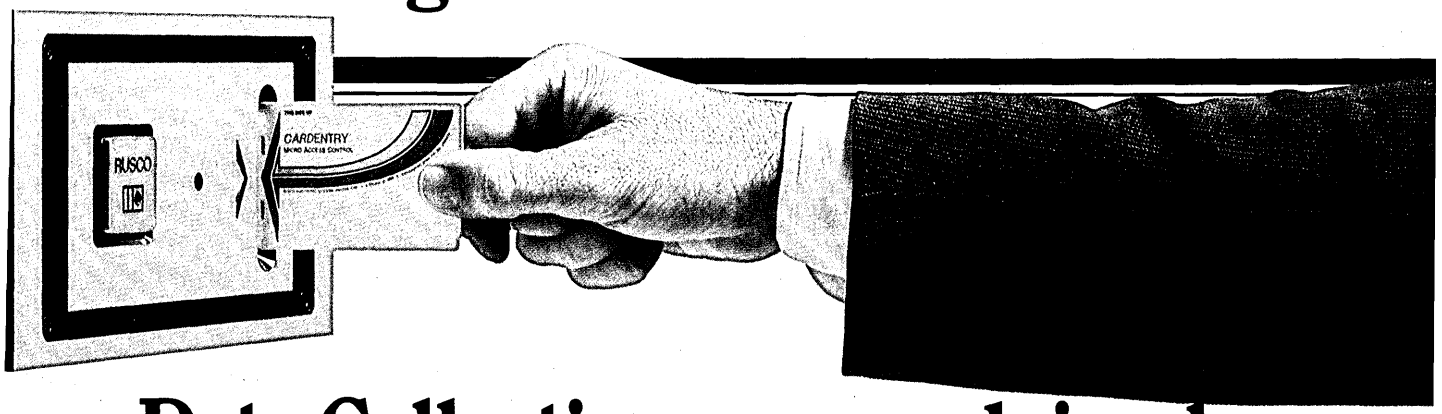

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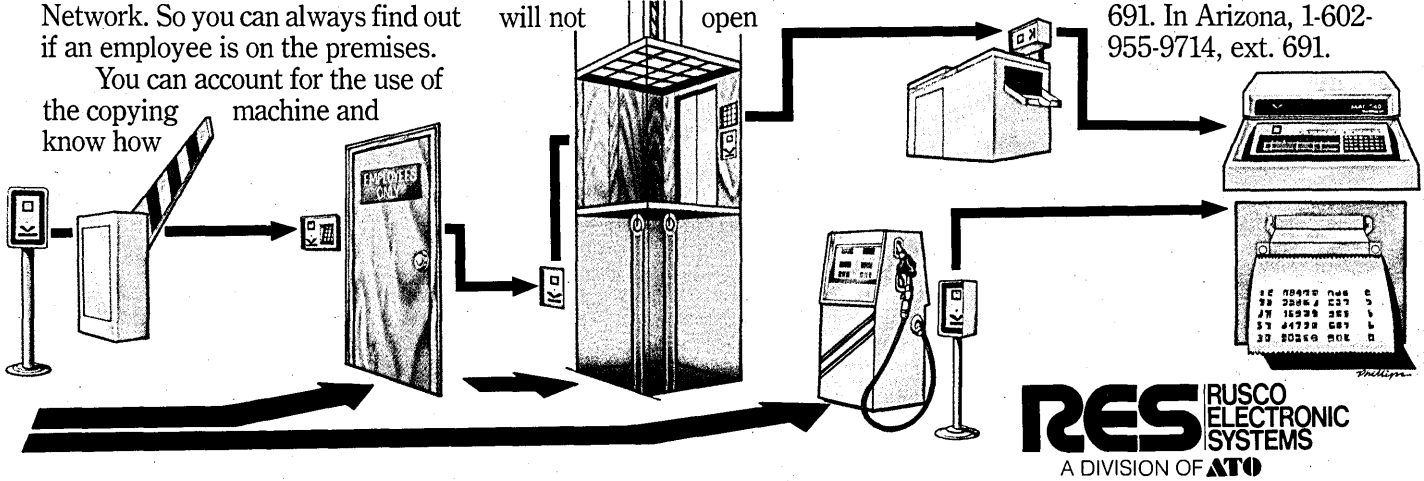

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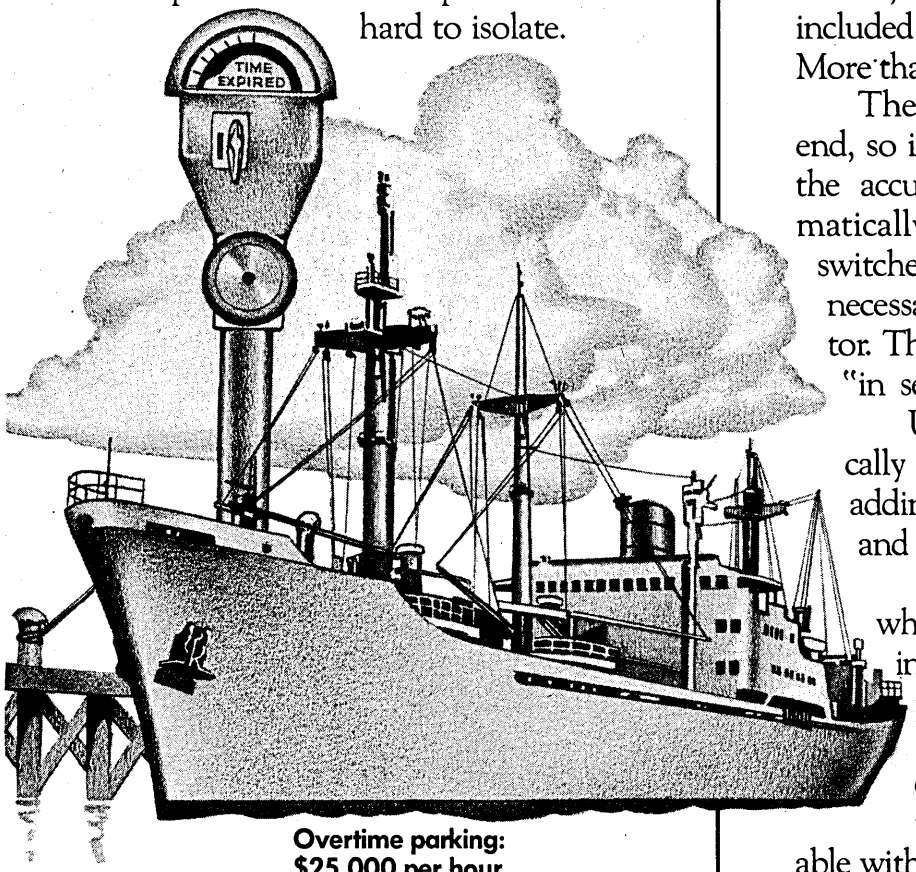

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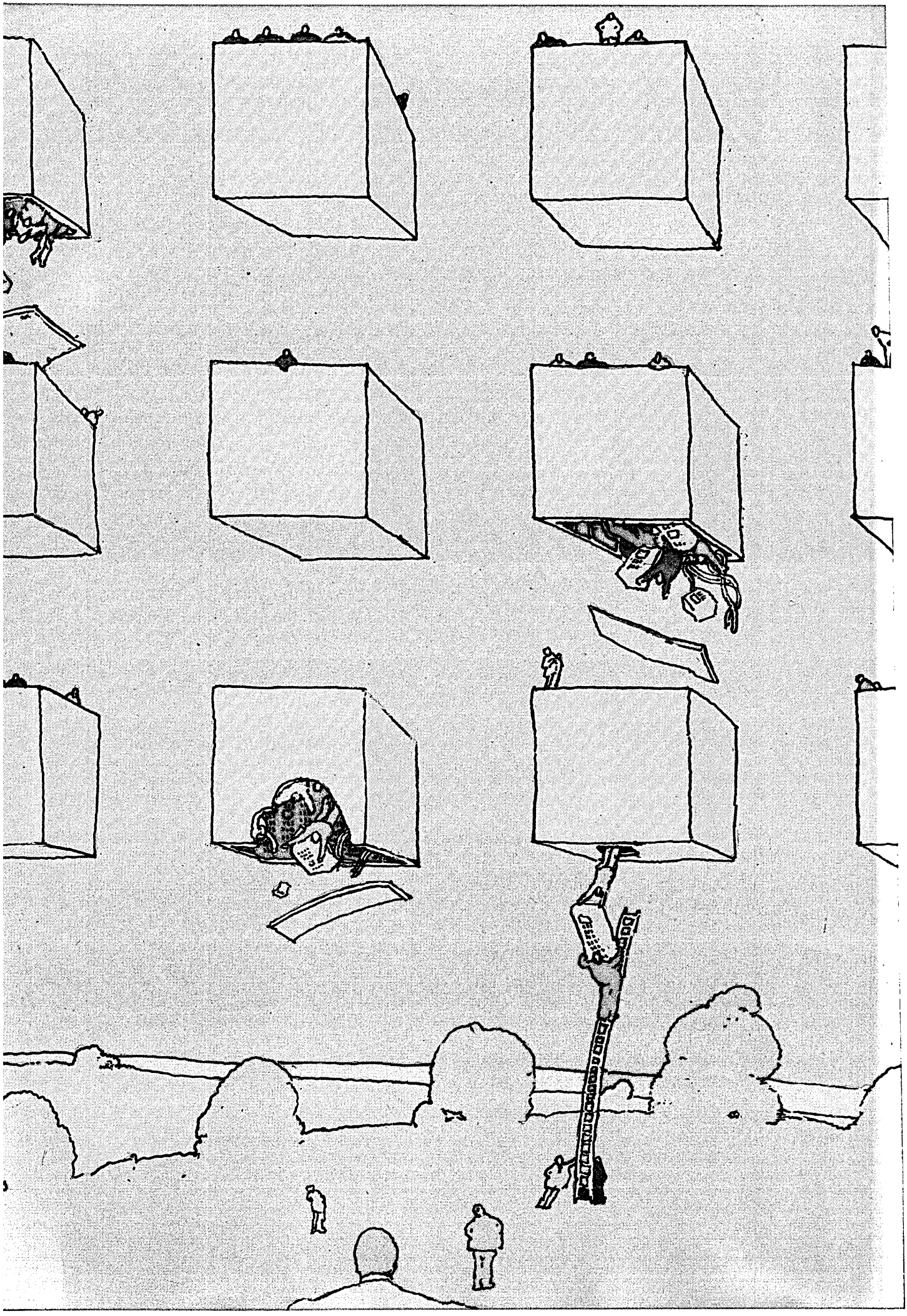

There's no such thing as one right way in manufacturing systems planning . . . and that's the problem.

A MANUFACTURING SYSTEMS COOKBOOK, PART 1

by Dan Appleton

At last count, there are over 80 different manufacturing systems available on 15 to 20 different minicomputers. The large mainframes, of which there are 15 different models, support over 130 manufacturing systems of various capabilities and complexities. And there are more to come because these products will be sold to a market that will spend more than $6.1 billion on manufacturing automation in 1981.

Needless to say, the suppliers are ecstatic. Not only is there plenty of money to be made, but the costs continue to go down. Vendor problems are an economist's dream: "How many should I produce to maximize my profits?"

While the suppliers are concerned about managing their growth, consumers do little but mumble: "Why the hell did we buy that system? We outran its capacity before it was completely installed. What do you mean our new turnkey material requirements planning system doesn't work—just because we don't have part numbers?"

The scramble for more automation in manufacturing, as inept as it may currently be, has reached the point where it cannot be ignored. Automation is no longer being driven simply by management's unquenchable needs for cost reduction, improved productivity, and gimmickry. It is becoming a matter of pure survival in the marketplace. Following are some of the results of two Delphi studies conducted jointly by the Society of Manufacturing Engineers and the Univ. of Michigan which demonstrate this point. These two forecasts, one on the future of "Manufacturing Management" and the other on the future of "Assembly," dramatize the future synergy between manufacturing and the computer.

By 1982:

- The computer will become a major factor in assisting at least 50% of manufacturing managers in inventory control and materials management.
- The computer will be used to assist manufacturing management in expense control of at least half of all companies.
- Better and simpler computer systems will be developed for use in smaller industrial plants.
- Five percent of the assembly systems will use robotic technology.
- Group technology concepts will be used on 25% of the assembly operations.
- Computer-aided design techniques to aid in designing parts that can be readily handled by automatic means will become available.

By 1985:

- Part feeding/orienting devices capable of working with families of parts rather than specific parts will become practical and reliable.
- Parts storage and retrieval will become integrated automatically with the assembly systems.

By 1987:

- Computerized management information systems suitable for use by at least two-thirds of all manufacturing companies.
- Fifteen percent of assembly systems will use robotic technology.
- Computer-aided design techniques to aid in the designing of parts and products that can be assembled economically will be adopted by 20% of the companies.

By 1988:

- The production control function will be automated to the point that 80% of all in-process and finished technology is controlled by a central computer.
- Computers will automatically generate processing plans and 30% of all manufacturing.
- Fifty percent of the direct labor in small component assembly will be replaced by programmable automation.
- Fifty percent of the work force on the floor will be highly skilled and trained engineers and technicians

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The quality of the manufacturing systems plan will relate directly to the business plan's portrayal of the business, its markets, and its competition.

keeping automated plants operating.

It is evident that the future of manufacturing and the future of automation are interwined. The dilemma evolves around how to automate competently. With computer technology exploding at nuclear intensity, the probability of being wrong (and the competitive death could accompany that) is just as high as is the probability of being right. What manufacturing management needs is a hedge that will swing the odds in its favor. That hedge is an architecture—a framework for automation—which it can use to improve its decision making.

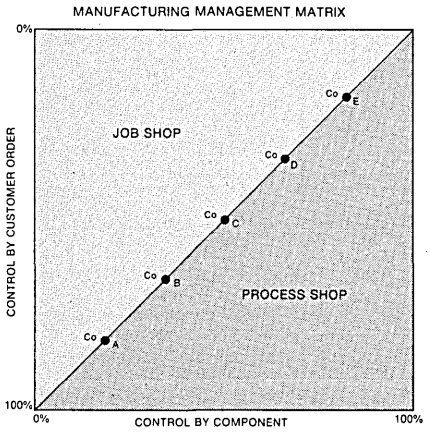
The quality of management's automation skills is directly reflected in its manufacturing systems plans. *Quality plans* show understanding and concern and these, in turn, will almost always result in success. *Mediocre plans* which are continually changing and never implemented are evidence of lesser skills coupled with good intentions. Companies that have *no plans* beyond those of individual department managers are doomed to fall farther and farther behind their competitors and their customers, as the Delphi scenario implies. Only managers of businesses in the latter two categories need read any further.

In the rest of this article, the first of three parts, I will explain what a good manufacturing plan is. Next month's article will tell how to develop one, step by step. Part three will address how to gain commitment and control of the systems plan from the people side of the business.

The reader should recognize that even though I have tried to build a cookbook for manufacturing systems planning, I fully recognize that there is no such thing as one right way. There are many right ways—that's the problem.

FIVE PLANNING KEYS

There are all kinds of planning methodologies floating around the computer world today. Most of them are metaphors of "proper" management and derive their credibility from what is purportedly common management sense. If they were common sense, though, it seems only reasonable that they would also be common. But they are not. Why? Because general business metaphors are too general for specific businesses, and it takes a great deal of skill (and time and money) to translate common sense into specific actions which can be learned and executed with some confidence that they will consistently produce a desirable or useful or quality product. General systems planning strategies, such as Business Systems Planning (from IBM) or Functional Decomposition (from Booz, Allen and Hamilton), are far too metaphorical for planning manufacturing systems. What is needed is a simple planning algorithm geared specifically to manufacturing businesses. The product of this algorithm should be an *intelligent systems plan which provides management with flexible automation strategies and which everyone in the company understands and is committed to implement.*



The question is how to develop this manufacturing systems plan; but even that question may be a bit premature. Some manufacturing managers wouldn't recognize a good manufacturing systems plan if it bit them on the nose. Before answering "How?" we must ask "What?" The first question becomes, "What tests can we apply to determine whether a manufacturing systems plan is sound?" If we first understand these tests, then we can develop a planning process—the "How?"—which will produce a product —the "What?"—that will pass them.

I believe that there are five of these acid tests. They can be posed as questions:

1. Were the objectives of the manufacturing systems plan derived from a good long-range business plan that provides an intelligent picture of the company's strategic future?

2. Was the systems plan constructed based on a comprehensive manufacturing systems model rather than being developed completely from scratch?

3. Does the systems plan separate systems planning from planning for automation, recognizing that though all automated systems are indeed systems, all systems are not necessarily automated?

4. Does the plan integrate the traditionally separate worlds of technical computing and business data processing?

5. Does the manufacturing systems plan use a functional (data base) approach to automation, instead of an applications approach, to provide a flexible automated systems structure?

If the answers to all of these questions are affirmative, then the systems plan stands a good chance of success. Let's examine each in more depth so we can understand why this is true.

LONG-RANGE BUSINESS PLAN

One of the traditional problems with systems and automation is that they always lag behind (and, as a result, hinder and complicate) organizational change. This is because strategic business planning, the prime mover behind major business change, is used to key investment (asset) decisions, such as building, machinery, land, pricing and orgnizational structure. These decisions are, in turn, used to key expense-level decisions, such as travel, stationery, office supplies, furniture and, traditionally, systems and computers. The time frame for implementation, evaluation and adjustment of investment decision is usually three to five years. For expense decisions, one hour to one year are the usual time parameters.

The problem is that in a manufacturing or distribution business, system automation decisions should not be expense-level decisions. Rarely can we effectively implement them within the expense time frame. Nor can we measure their impact solely by using the P&L. In reality, manual and automated systems are assets. Maybe they are not assets like cash, accounts receivable, inventory or machinery (which appear on the balance sheet); rather, they are assets like "people" which for some strange, esoteric, back-room accounting reason are not considered important enough for the balance sheet and only barely make the expense ledgers.

We must make manufacturing systems decisions based on overall business strategy. They must become part of the product because they directly affect the ability to compete and to serve markets. They are primary factors in establishing and controlling *financial efficiency* and *(production) structure.* In addition, they are one of only two tools that a business has to affect and react to *competition,* the *market environment* and the *business life-cycle.*

Not all long-range business plans are equally useful for manufacturing systems planning. The most useful plans are those developed using the "served market" strategic planning approach. This technique, originally developed by General Electric, is now promoted by the Boston Consulting Group, the Strategic Planning Institute, and the Harvard Business School, among others. The approach keys

asset management to market imperatives such as market share and return on investment.

A "market" is a source of demand. It is defined by customers and their product and service needs. A market which is "served" is one in which competitors allocate resources to satisfy the market. General Electric defined a served market supported by a set of identifiable resources (either allocated or dedicated) as a "strategic business unit (SBU)."

Systems, like other business resources, must be directed toward strategic objectives such as achieving dominant market share, maintaining a lucrative cash flow, or preparing for divestiture. Coordinating investment, pricing, distribution, product development, production, and other business strategies toward long-range goals is the role of a good business plan. Without a good plan, manufacturing systems plans have no overriding purpose.

To further clarify this relationship between business and systems planning, suppose that all things are equal between two competitors (e.g., market share, pricing, quality of people, etc.), except that one has better, more advanced manufacturing systems. This one will eventually win out because these systems will increase product quality, reduce direct product costs per unit, reduce production lead times and inventories, improve delivery predictability, and so on. These manufacturing advantages will eventually increase market share and, ultimately, return on investment.

By gearing the manufacturing systems plan to the long-range business plan, management can at least assure itself that the impact of automation on investment decisions (e.g., organization change, new factories) will be evaluated and that appropriate changes can be synchronized. It must be recognized, however, that the quality of the manufacturing systems plan will relate directly to the business plan's portrayal of the business, its markets, and its competition.

USE SYSTEM MODELS

Why reinvent the wheel? Manufacturing businesses, once you've stripped away the self-serving "not-invented-here" and "we're different" cliches of managers seeking to establish the perfection of their own wisdom, are mostly variations on the same two themes: make-to-inventory, and make-to-order. Manufacturing systems are fundamentally hybrids of two mutually exclusive management prototypes: process (part) control, and job (customer-order) control. Their system problems come from the inflexible or improper fusion of these two mutually exclusive control philosophies into hybrid management systems.

There is no need to build a manufacturing system "from scratch" or "top down" or by "functional decomposition." Not only are these methods costly and lengthy (and unnecessary), they have one overriding and fatal flaw: Because they extrapolate the manufacturing systems plan from a point-in-time snapshot of the organization, the resultant plan *can never be implemented*—unless the organization is frozen in time. Why? Because of the following paradox: *The organization structure is the most dynamic structure in a business, while the system structure is the least flexible.* This paradox underlies most all of the system problems (and uncontrolled costs) in business today.

The alternative is prototype development. The use of a model, whether procured or self-developed, implies greater flexibility and better control. This is because the model itself can be controlled independent of its implementations. This concept of *dual control* is central to the success of the prototype approach. Control over the prototype itself provides a stable, practical foundation on which to build manufacturing systems. The model, of course, provides both a standard systems architecture (system standards) and the maximum systems technology that the business can implement. The model functions as a company asset because we can increase its value by changing its architecture or technology, regardless of any specific implementation. It also gives us flexibility because the model can have many different implementations. These implementations can be either manual or automated—the model itself should assume no predetermination—and they can reflect various stages of evolution of a company's products or businesses.

There is no reason prototype systems such as IBM's COPICS (Communications Oriented Production Information Control Systems) or Plossl and Wight's MRP (Material Requirements Planning) cannot become effective models for a good manufacturing systems plan. They are good places to start, but as textbook models they must be modified to represent the systems structure an individual company wants to implement. It is clear that given most of the models that currently exist, job shops will have to make more modifications than will process shops.

SEPARATE SYSTEMS & COMPUTER

The third key to manufacturing systems planning is that management must keep the plan for automation separate from the manufacturing systems plan. Though ultimately investments in automation turn out to be systems investments, all investments in systems are not necessarily investments in computers. The basic strategy of manufacturing systems planning is to develop a manufacturing systems plan and then a mechanism to automate it.

The strategy for systems automation must be treated independently from the systems themselves because it marches to a different drummer—and rightly so. Systems strategies support the long-range strategic business plan. Dp strategies are formulated based on existing or newly developed computer technologies. Their integration must be controlled such that each can be changed to maximize its benefits without impacting the other. The two should not constrain each other.

Systems support the company and computers support the systems, but the technology and the costs of computing are so dynamic that a company must maintain its flexibility by keeping its hardware/communications architecture (centralized, decentralized, or distributed) as independent as possible of its business system structure. Too many companies fail to make this fundamental and absolutely critical separation in their manufacturing systems planning, and as a result their systems and dp structures become inextricably intertwined, rendering them not only inflexible, but downright counterproductive.

INTEGRATE CONTROLS

Traditionally, manufacturers keep their administrative systems (shop floor control, inventory control, order entry, master schedule, etc.) and their technical computing (computer-aided design, computer graphics, group technology, computer-aided manufacturing, numerical control, robots, etc.) separate, as if they were distinct or unrelated. For manufacturing planning, they must be considered different ends of the same spectrum, and the target of the plan must be the area in the middle of that spectrum, where management will find the maximum benefits of both.

The whole key to the integration of administrative and technical computing is *part geometry*. Part geometry is the basic common denominator needed to optimize and control part design, production quality, form/fit/function, process planning, machine operations, shop loading and scheduling, inventory control, material movement, product distribution, and so on. Once the computer understands what a part looks like, it can, through concepts

Applications tend to control information needs, often to the relief of, but certainly not the benefit of, management.

such as group technology and part families, strike directly at the real manufacturing nemeses: noncutting and idle time (sometimes up to 95% of the total time between the raw material and finished part stages), cost and low productivity (value added).

The successful integration of administrative and technical systems is a key to gaining flexibility in production and distribution. Why? Because the computer is the only tool we have that can handle the inexorable reduction in volumes of repetitive parts and processes. It does so by optimizing on *variations to standards or norms*, rather than by dealing with individual small lots as unique problems. The ability to deal with this problem is critical to manufacturing and distribution efficiency and to the selection of optimum investment strategies. For example, should large lot manufacturing plants use transfer lines or conventional machine tools, machining centers or variable mission manufacturing systems (standalone machines linked together by part handling devices under total computer control)? How about a company that has small lot sizes? Or one whose lot sizes tend to change from year to year based on market fluctuations? Or a business that is planning to implement a major product standardization project in order to gain increased economies of scale and economies of cumulative volume?

At the bottom line is a manufacturing systems plan that effectively integrates the administrative and technical aspects of manufacturing automation and systems. Any plan that ignores either end of the spectrum or deals with each as completely separate will, in the long run, be ineffectual.

AUTOMATE BY FUNCTION The fifth, and in many ways the most important of all manufacturing systems planning tests, deals specifically with the issue of how systems should be implemented and controlled. There are two alternatives: 1) build independent computer applications such as shop loading, accounts payable, shop floor control, inventory control, etc., based on the needs of individual departments, and integrate them as required; or 2) use a functional, or data base, approach, concentrating first on identifying the key data needed to support dynamic information needs of the company, then on building functional control systems for the input of that data to the data base and for the output.

Application systems are not control systems; they are filing systems. Designed to satisfy specific, usually carefully defined, output requirements (such as payroll, accounts payable, etc.), each application is set up with its own information input and information storage controls. These systems are developed for individual managers and departments, and they reflect the organization structure of the company and the information requirements of the decision problems at a given point in time. They also reflect the individual management styles, good or bad, of the managers and analysts who build them. Changes in organization, management philosophy or style, or decision problems tend to have significant impacts on applications system structure, including all of its input controls, computer processes and procedures, hardware, software, etc. The system structure of the application is by definition geared to satisfy specific, predetermined information needs. If these information needs change, we reset to zero.

One thing is for certain, the most dynamic and unpredictable need in the manufacturing business is the need for information. The manufacturing systems planning process must accept that information needs will be constantly changing. Does it stand to reason, therefore, that some of these needs should be frozen in time and encased in a computer application? Applications tend to control information needs, often to the relief of, but certainly not the benefit of, management. Should we not be automating the ability to respond efficiently and cost effectively to changing information needs? Is this not the better concept of information control? It is the whole purpose behind the data base approach to automation.

Data bases do not store information as information. They store data which can be used to generate information. They are, in effect, data models of the business. Data base "systems," unlike applications systems, either provide data to the computer or take it out, not both. Also unlike application systems, they are oblivious to how data, or information, is stored and processed. Rarely, in a properly developed data base, should changes in output requirements cause changes in the data base input control system or in the data base itself. Why? Because the information required to satisfy 80% to 90% of management's decision-making needs is, in most manufacturing companies, developed from combining, arranging, analyzing, sorting, and reporting some subset of between 4 and 800 basic elements of data. From 400 elements of data, some 10^{896} different demands for output can be supported. Thus, by manipulating the input and output structures in a functionally defined data processing environment, a basic manufacturing data base can be adapted to the dynamic information needs of the manufacturing business without major costs of modifying the data base itself.

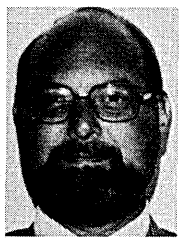
I have taken some time in describing five tests management should apply to their manufacturing systems plan to determine how good it really is. I have just skimmed the surface in each area. At the risk of restating what is now obvious, each of these tests is a piece of a puzzle. None of them, even in the interest of expediency, should be left to stand alone. A manufacturing systems plan can score either 100%, assuming it meets each requirement, or it must be scored as zero, and called something other than a manufacturing systems plan.

Why be so stringent? Remember the myth of Sisyphus, who was eternally doomed to push a boulder up a mountain and never reach the top. Each time he neared the top, some incomprehensible force caused the boulder to slip from his grasp and roll back down the mountain. What went on in his mind each time as he trudged down after it was probably similar to the thoughts manufacturing managers have about automation. Why even start pushing the rock if it's obviously flat on one side? Or if it is intuitively evident that it will never reach the summit?

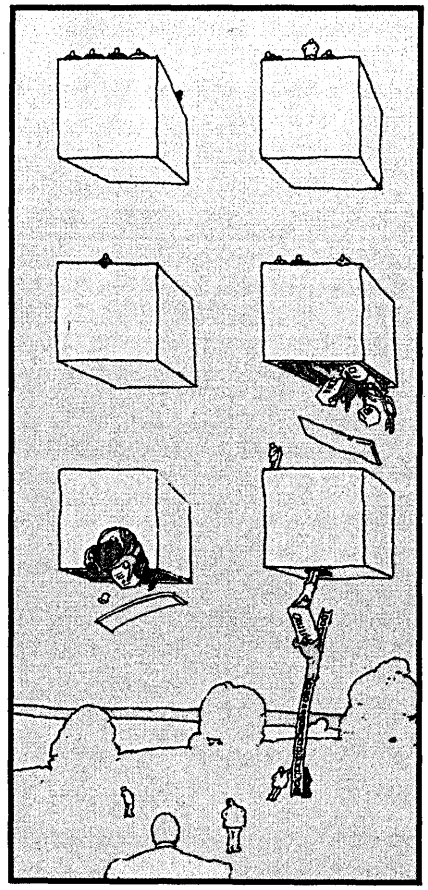
If we are not going to build good plans, we had better modify our cost-benefit studies and our charts of accounts to include accounting for the costs of failure, as in, "Account #20: Travel, back down the hill." ❋

(This is the first of a three-part series, to be continued in June and concluded in the July issue.)

DAN APPLETON



Mr. Appleton is director of systems and planning for the Byron Jackson Pump Div. of Borg Warner Corp. He was previously manager of systems development for Litton Ship Systems, has been a manufacturing systems consultant, and was an operations research analyst for the Assistant Secretary of Defense, Comptroller. His specialty is data base for manufacturing.



It may be the most cost-effective concept yet for production and inventory control software, but implementation can put a tremendous strain on dp and user department budgets and manpower.

MRP— WHO NEEDS IT?

by William S. Donelson II

The advent of modern production and inventory control software has brought about significant changes in the way manufacturing inventories are planned, ordered and managed. While MRP (Material Requirements Planning) may be the most cost-effective concept yet introduced to this discipline, its implementation can have a severe impact on other computerized applications, principally inventory valuation and product cost accounting systems.

In fact, MRP is literally incompatible with some cost accounting systems. This is particularly important because no manufacturing company can sustain a prolonged disruption to its cost accounting system, for this is the system that calculates cost of goods sold and inventory value, two major categories in the financial statement. In addition, the high initial investment in prerequisite software and hardware capacity, conbined with relatively long processing times (see "MRP Highlights") can place a tremendous strain on the dp and user-department budgets and manpower. Finally, the extreme operating discipline placed on inventory managers and material planners by MRP may cause cultural shock to the point of passive or active resistance by these groups—the very same people MRP is supposed to help.

Before we explore these problems and possible solutions, let's take a look at the principal features and background of MRP.

MRP is a technique of managing production inventories that takes into account the specific *timing* of material requirements, with the objective of minimizing the investment in this type of inventory consistent with meeting a given production plan. MRP begins with a time-phased Master Production Schedule of end-items (a list of items and quantities to be produced by time period, such as day, week, month, etc.), as determined by management in response to customer orders (both firm and anticipated). MRP then explodes these top level material requirements down the product structure tree one level at a time to determine component material requirements. This is accomplished with the aid of the Bill of Material files which describe each product in terms of its components, usually in the inverse sequence in which the product is fabricated and assembled.

For example, a V-8 automobile engine might be described at the first bill level as consisting of 1 block, 2 head assemblies, 2 valve covers, 2 head gaskets, 8 pistons, 8 connecting rods, etc. At the next level, a head assembly would be described as consisting of 1 machined head casting, 1 camshaft assembly, 4 intake valves, 4 exhaust valves, etc. At the third level, a camshaft assembly would be described as consisting of 1 machined camshaft forging, 1 timing gear, 1 lockpin, 1 spacer washer, 1 nut and 1 cotter pin.

MRP then combines the gross requirements of like components by time period at the given bill level and calculates net requirements by deducting inventory currently in stock and/or due to be received by the time it is needed. This process is usually termed *gross-to-net*. The net requirements of each component by time period may then be adjusted to reflect purchasing or manufacturing economies (price break quantity, minimum quantities, etc.). This process is usually termed *lot-sizing* and can employ several well-known optimization techniques, such as economic order quantity (EOQ), part-period balancing (PPB), least unit cost (LUC), least total cost (LTC), and others.

The adjusted net requirements for each component item by time period are termed *planned orders*. That is, planned orders are the quantities of each component item by time period that should be ordered by material management personnel at the appropriate time to meet the production plan, provided there are no changes in the master production schedule, current inventory levels, product structure or expected delivery date of materials already on order. MRP assigns a *release date* to each planned order, which is calculated by subtracting purchasing or manufacturing lead time from the date the material is actually needed. For example, if an item is needed May 10, and it takes 90 days lead time to produce, its procurement order should be released on or before Jan. 8 to assure its timely arrival. However, it should not be ordered too much earlier than Jan. 8, otherwise it will be received before it is needed, thereby increasing inventory levels and investment. This is the major message of MRP.

If a required item is an assembly, then the planned order is exploded to the next product structure level. The net required quantity at the prior level is used as the multiplier for the quantity of each component on the assembly, resulting in the gross requirement of each component at the next level. The above-described process (gross-to-net, lot-sizing and calculation of release date) is repeated for each level in the product structure. Planned orders at each successively lower product structure level are assigned suc-

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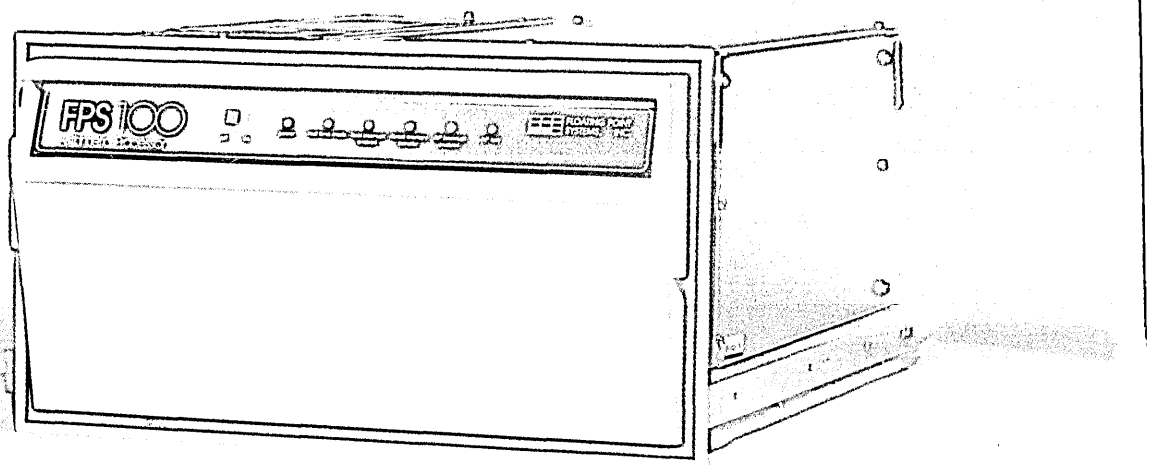

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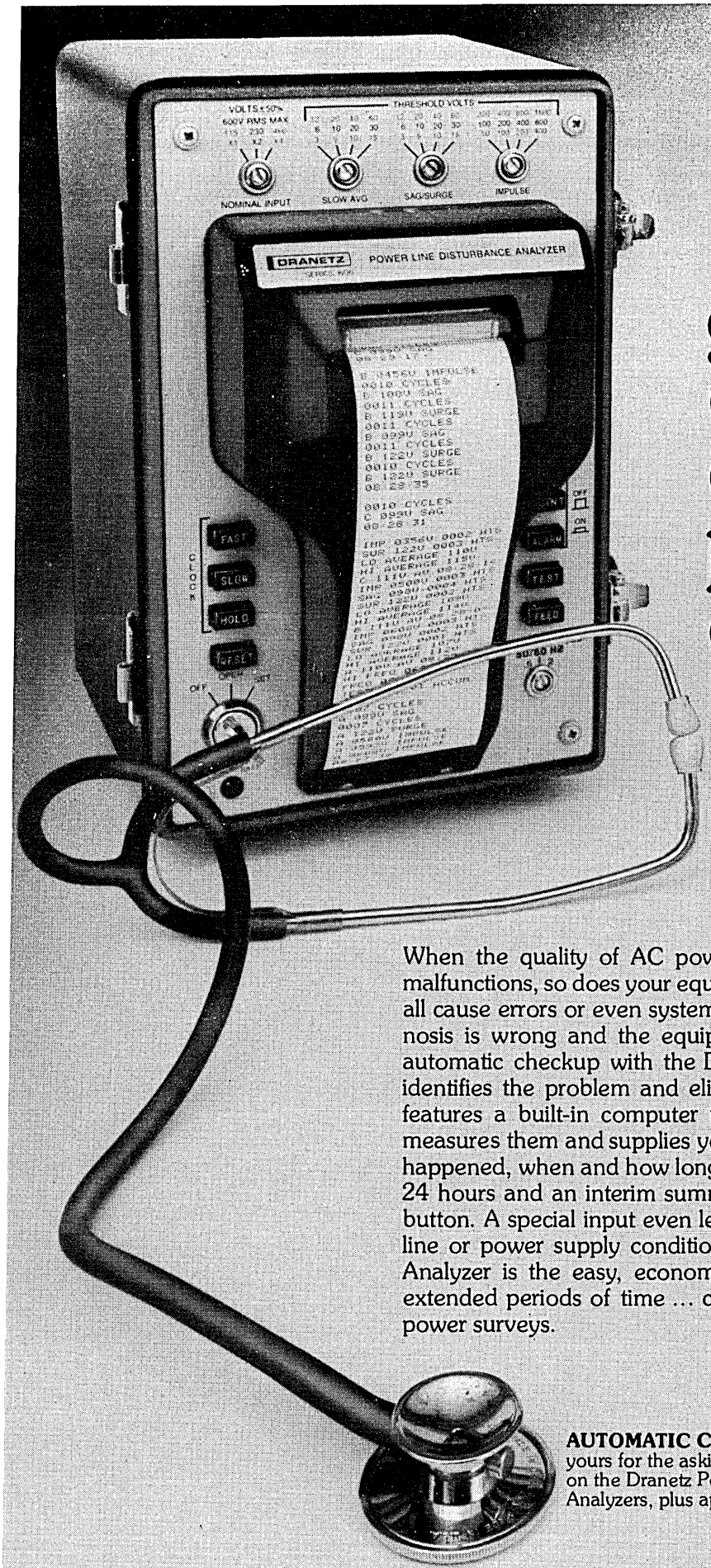

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cessively earlier release dates reflecting the cumulative lead time of the end-item.

MRP also detects situations where the demand and supply of items have fallen out of equilibrium due to changes in the Master Production Schedule, changes in the product structure, unexpected material scrap and shrinkage, and late material receipts. These items are replanned by MRP. If the MRP system replans only the changes to the Master Production Schedule, the system is termed a "net change" system. If the MRP system must replan the entire changed Master Production Schedule, the system is termed "regenerative."

TWO BASIC REPORTS

Basically, MRP produces only two reports, the first of which is a status report showing the *demand and supply schedule* of each item by time period. The second report is a *planning action report*, which highlights planned orders ready for release, together with other orders that should be rescheduled, modified or canceled. This second report is the heart of MRP, because it guides material management personnel in their use of the system. It is this report that enables MRP users to order material at the proper time, to expedite certain orders and to reschedule or cancel other low priority orders, all in a optimum fashion.

The result of MRP is, or should be, not only an improvement in the timing and flow of materials (having the right part at the right time), but also a reduction in inventory investment accompanied by an improvement in inventory turns (having the right part *only* when it is needed).

MRP HIGHLIGHTS

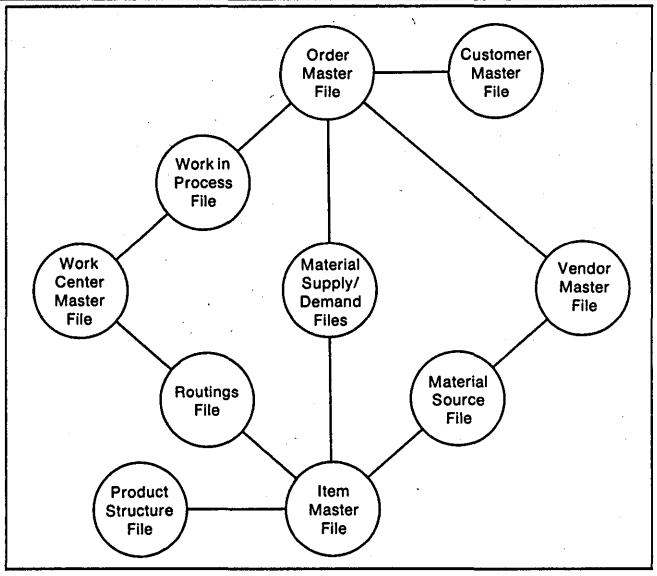
A. **Objectives:**
To minimize the investment on production inventories and to assure the supply of materials at the time when needed.

B. **Principal methodology:**
Balances ongoing production requirements against on-hand and on-order materials to determine net material requirements, and schedules new material order releases so that the materials are available **when** needed, not **before** or **after**.

C. **Typical environment:**
Manufacturing company with multilevel product structure. Includes manufacturers of machine tools, large electromechanical capital goods, automobiles, aircraft, computers and other electronic systems, office equipment, home appliances, mobile homes, prefabricated buildings, etc.

D. **Prerequisites to automated applications:**
1. **Mandatory:**
   a. **Bill of Material System**—item master amd product structure maintenance. Must be manufacturing or "as built" bill of material as opposed to engineering bill. Maintains Item Master and Product Structure files (see diagram). Typical computer processing time is 10-20 hours per month.
   b. **Inventory Accounting System**—maintaninence of on-hand and on-order inventory levels by item. Processes orders, receipts, issues, scrap, returns to stock and shipments transactions. Maintains Item Master and Material Supply files. Typical computer processing time is 40-80 hours per month.
   c. **Master Production Scheduling System**—consolidates customer orders, stock replenishment orders and *sales* forecast into schedule of quantities of items to be produced by time period. The schedule represents the "independent demand" for materials placed on the MRP System. Maintains Order Master and Material Demand files. Typical computer processing time is 20-40 hours per month.
2. **Optional:**
   a. **Shop Floor Control System**—monitors and tracks the status of internal fabrication and assembly orders, usually referred to as shop orders or work orders. Maintains *W*ork *C*enter, *R*outings and *W*ork-in-*P*rocess files. Typical computer processing time is 40-80 hours per month.
   b. **Procurement System**—monitors and tracks the status of purchased material orders. Maintains Order, Vendor and Material Source files. Typical computer processing time is 30-60 hours per month.
   c. **(Customer) Order Entry System**—enters and tracks customer and other independent type orders for subsequent processing by the Master Production Scheduling System. Maintains Customer and Order Master files. Typical computer processing time is 30-60 hours per month.

E. **Typical file structure:**



F. **Filed needed:**
1. **Mandatory:**
   a. **Item Master File**—usually contains one record per inventoried part. Type of data maintained includes part number, item description, on-hand quantity, on-order quantity, bin locations, cost data, selling price data, accounting category data, etc. Typical file size is 10,000-50,000 records of 100-500 bytes each. May exceed 100,000 records in some industries such as aircraft and automotive.
   b. **Product Structure File**—links component items in Item Master File to parent items and vice versa. Usually specifies quantity of component required per parent item. Typical file size is 2-4 times number of Item Master records, at 40-100 bytes each.
   c. **Material Supply File**—links items in Item Master File to purchase orders and shop orders in Order Master File and vice versa. Usually specifies quantity ordered, due date and quantity received for each item on each order. Can share same physical file as Material Demand file. Typical file is 4,000-40,000 records of 100 bytes each.
   d. **Material Demand File**—links items in Item Master File to customer orders, stock replenishment orders and master production schedule in Order Master file and vice versa. Usually specifies quantity required and date needed. Can share some physical file as Material Supply file. Typical file size is 4,000-40,000 records of 100 bytes each.
   e. **Order Master File**—contains customer orders, stock replenishment orders, shop orders, purchase orders and

In many cases, MRP is being installed as a replacement for Job Lot Ordering, or Lot Requirements Planning, an older but nevertheless viable production and inventory control concept whereby production requirements for end-items are expressed in terms of job lots. Each job lot is then exploded into a gross requirements list from which discrete-quantity purchase orders and shop orders are prepared and released, sometimes with little or no regard for across-lot commonality and specific timing of component requirements. (The better Lot Requirements Planning Systems do take these factors into account.)

In most cases, Job Lot Ordering is accompanied by Job Lot Costing, a method whereby purchased materials, direct labor, other direct charges and factory burden associated with a particular job lot are booked directly to the job lot, sometimes summarily without any degree of detail on unit costs at the component level. In this manner, one knows what the end-item costs, but not necessarily what each of the components and subassemblies used in the end-item costs.

The specific problem is that MRP is incompatible with Job Lot Costing. This means that a company currently using Job Lot Costing that is planning to install MRP will have to redevelop or extensively modify its product costing and inventory valuation systems. Since there are many companies both large and small that presently use Lot Requirements Planning combined with Job Lot Costing, but that will be moving to MRP as the cost of computing decreases and the capability of computers increases (and MRP very definitely works the pants off a computer!),

master production schedule. Linked to Item Master file via material Supply and Demand Files. Typical file size is 2,000-20,000 records of 100-200 bytes each.

2. **Optional:**
   a. **Routings File**—contains routing steps for each fabricated item, showing operation number and work center. May also contain standard setup and run times. Needed for Shop Floor Control System. Typical file size is 2-4 times number of Item Master records, at 100 bytes each.
   b. **Work Center Master File**—contains one record for each work center in the factory. Used to accumulate actual setup and run hours versus earned hours on periodic basis for performance evaluation. Needed for Shop Floor Control System. Typical file size is 200-2,000 records of 100-200 bytes each.
   c. **Work In Process File**—contains routing steps for each open shop order. Contains standard and actual setup and run hours by operation by work center. Used to track status of open shop orders. Needed for Shop Floor Control System. Typical file size is 2-4 times number of shop orders, at 100 bytes each.
   d. **Vendor Master File**—usually contains one record for each vendor, showing name, address and performance rating. Used to track open purchase orders. Needed for Procurement System. Typical file size is 1,000-20,000 records at 200-800 bytes each.
   e. **Material Source File**—links purchased items to supplying vendors, and vice versa. Usually contains current price and delivery quotations. May also contain prior price and performance history. Needed for Procurement System. Typical file size is 2-4 times number of vendors, at 80 bytes each.
   f. **Customer Master File**—usually contains one record for each customer, showing name, address and credit data. Used to track open customer orders. Needed for Order Entry System. Typical file size is 2,000-40,000 records at 200-800 bytes each.

G. **System software requirements:**
   1. **Data Base Management System (DBMS):**
      Any DBMS which will support a network structure or multiple-parent-multiple-child data structure. Examples are DBOMP and CFMS by IBM, TOTAL by Cincomm Systems, IDMS by Cullinane. Others which may be adapted include IMS/DB by IBM, ADABAS by Software a.g., System 2000 by MRI, FORTE by Burroughs, IDS by Honeywell, etc.
   2. **Teleprocessing Monitor (TPMS):**
      Needed only if *on-line* data entry, inquiry or file update is required. Examples are CICS and IMS/DC by IBM, ENVIRON I by Cincomm Systems, Shadow II by Altergo, Betacomm by PMI, etc.
   3. **Operating System:**
      This should be obvious. Typically includes programming language compilers, linkage editors, sorts, library maintenance, basic data access methods, utility routines and supervisor routines. Processing supported can be single partition, multiple partition, virtual memory, single-thread on-line, multithread on-line, remote job entry (RJE), etc.

H. **Hardware requirements:**
   1. Computer Time Per Month:
      MRP: 50-150 hours; Mandatory Prerequisite Systems: 70-140 hours; Optional Prerequisite Systems: 100-200 hours.
   2. Partition Size:
      Application Programs: 50-250K bytes
      System Software: DBMS: 50-250K bytes
      TPMS: 100-500K bytes
   3. Online Disk Space:
      Mandatory Files: 20-200M byte
      Optional Files: 20-200M byte

I. **Suggested reading:**
   (*) = Highly Recommended

   1. *Computer Oriented Production Information and Control System*
      Publication nos. G320-1974 through G320-1978 IBM Corp., Armonk, N.Y., 1972
   2. *Computerized Cost Control Systems(*),*
      by Jerome H. Fuchs
      Prentice-Hall, Inc.
      Englewood Cliffs, N.J., 1977
   3. *Computerized Inventory Control Systems(*),*
      by Jerome H. Fuchs
      Prentice-Hall, Inc.
      Englewood Cliffs, N.J., 1978
   4. "Designing and Implementing a Material Requirements Planning System,"
      by George W. Plossl and Oliver W. Wight
      Proceedings of the 13th International Conference of APICS
      American Production and Inventory Control Society Washington, D.C., 1970
   5. *Material Requirements Planning(*),*
      by Joseph Orlicky
      McGraw-Hill Book Co.
      New York, N.Y., 1975
   6. *Material Requirements Planning by Computer (*)*
      American Production and Inventory Control Society
      Washington, D.C., 1970
   7. *Production and Inventory Control,*
      by George W. Plossl and Oliver W. Wight
      Prentice-Hall, Inc.
      Englewood Cliffs, N.J., 1967
   8. "Structuring the Bill of Material for MRP,"
      by Joseph Orlicky, George W. Plossl and Oliver W. Wight
      Production and Inventory Management Journal
      American Production and Inventory Control Society
      Washington, D.C., Vol. 13, No. 4, 1972

the impact of MRP on the manufacturing industry over the next decade is estimated to be quite large.

EXAMINING ALTERNATIVES

Let us now explore the reasons for this incompatibility and examine the alternatives. With MRP, the Master Production Schedule is a period-by-period statement of production needs to meet external and stock replenishment requirements (i.e., the independent demand), and it is not necessarily lot oriented. The gross requirements of each end-item by time period, as stated in the Master Production Schedule, are than exploded on a level-by-level basis to determine gross component requirements (the dependent demand). At each level, the gross requirements of common components are combined by time period, and then a check is made against quantity on hand and quantity on order by time period to determine time-phased net requirements—the additional quantities needed by time period to meet production demands. At this stage, MRP usually applies one or more lot-sizing techniques or ordering rules (fixed quantity, EOQ, PPB, least unit cost, etc.), which have the effect of modifying the net quantity required by time period and/or combining the requirements of several time periods. The resultant time-phased net requirements then become planned orders after they are scheduled to allow for lead time. For manufactured items, these net requirements become gross requirements at the next lower level, and the process of gross-to-net, lot-sizing and lead time offsetting continues on level-by-level to the lowest level of the bill of material.

The underlying assumption of Job Lot Costing is that all material and labor costs associated with the gross requirements of a lot can be directly traced and charged to the lot. In many MRP systems, there is no capability of tracing the source of item demand from lower to higher product structure levels because this trace information, otherwise known as "pegging," is not retained in accessible form within the data base after the planning steps have been completed. In most of the remaining MRP systems, there may be a single level pegging or tracing capability; however, this only enables a level-by-level tracing, and a succession of analyses must be made of the supply and demand schedule report to associate component item orders with end-product demand in the Master Production Schedule. In his book, *Material Requirements Planning*, Joseph Orlicky pinpoints the problem in the following passage:

> In order to link item demand to that (master production) schedule by means of a single inquiry, the so-called full-peg capability would be required. Under the full-peg approach, each individual requirement for a component item is identified with a specific product lot or customer order listed in the master production schedule.
>
> This principle can be extended to orders and even on-hand quantities of the component item so that it may always be known which group of parts "belongs" to which product lot. It is rarely practical to program a full-peg capability, however, because in most manufacturing environments it is intended that individual requirements for a component item stemming from multiple parents be combined, that an order cover multiple net requirements, and that parts on hand or in process be commingled. Lot sizing, safety stock, scrap allowances and the level-by-level planning process itself tend to obscure (or even erase) a clean path connecting noncontiguous levels.
>
> This explicit reasoning points out the incompatibility between MRP and Job Lot Costing. Because of the impracticality of a full-peg system (file maintenance and planning run times would not be affordable) and the inherent obscurity between noncontiguous levels, it does not seem feasible to relate the material and labor charges associated with the component requirements of a lot directly to the lot, particularly for a multilevel product.
>
> MRP tracks quantities of individual items as they progress through the multiple stages of conversion from raw materials to finished goods. The implicit assumption is that materials flow from common stock inventories at one level into work-in-process and then back to common stock inventories at the next higher level, and so on to become end-items. These features of MRP point to the need for a costing system that will track the cost of items through each stage of the physical flow of goods.

Since MRP maintains a unit ledger of on-hand and on-order quantity by item, the most obvious alternative for a costing system is to maintain a unit cost ledger for on-hand and on-order quantity by item. This would provide a valuation of on-hand inventory at any point in time. It would also provide for costing of material issues to work in process and for cost of goods sold. The system should also provide a WIP (Work In Process) valuation module to capture the cost of materials issued to each work order, to accumulate labor costs and factory burden added, and to transfer the resultant finished cost back to the on-hand cost ledger when the item is completed. This module would, in essence, be the cost ledger for the on-order inventory and would provide a perpetual valuation of WIP inventory. Both modules should provide the capabiltiy of reconciling book value to a physical count and to process inventory valuation adjustments (lower of cost or market, scrap, shrinkage, etc.).

The cost accounting system described above is a *perpetual inventory valuation system* that can operate in accordance with one or more cost flow assumptions—FIFO (first in, first out), LIFO (last in, first out), weighted moving average, etc. It can also be the foundation for a standard cost system.

The perpetual type costing system is entirely compatible with MRP because it uses the same transactions as are used by MRP (receipts, issues, returns to stock, shop order completions and shipments), and it flows the cost of goods in discrete steps as the goods progress up the product structure tree through the multiple stages of conversion from raw materials to finished goods.

The design of such a costing system is then dependent upon the cost flow assumption the user makes. Usually, this choice has already been made by a company, and IRS approval is required to change it. For example, if a company uses FIFO or LIFO, then it becomes necessary to maintain a detail ledger of unit costs by supply order (purchase order or shop order) to represent the value of quantity on hand. This would mean keeping track of one or more supply orders per item, posting new cost entries to the appropriate order record upon receipt of material, and flowing the costs to jobs in a FIFO or LIFO manner as materials are issued. In an integrated cost/MRP system, the logical repository for FIFO or LIFO cost data would be in the supply record that links each supply order to each item to be supplied. This record already identifies the supplying shop or purchase order, the quantity required and the due date. Upon receipt of the item, this record can then store the unit cost and can track the consumption of unit costs on a FIFO or LIFO basis as issues are processed.

A *moving weighted average cost system* can streamline file space and processing time considerably because the cost data may reside directly in the item master file. The minimum file space requirement per item would be two data fields, total quantity and total value. Material receipts would be processed by adding the quantity received to the total quantity on hand and adding the cost of the receipt to total value on hand. Material issues would be costed by computing the average unit cost (total value divided by total quantity), deducting the quantity

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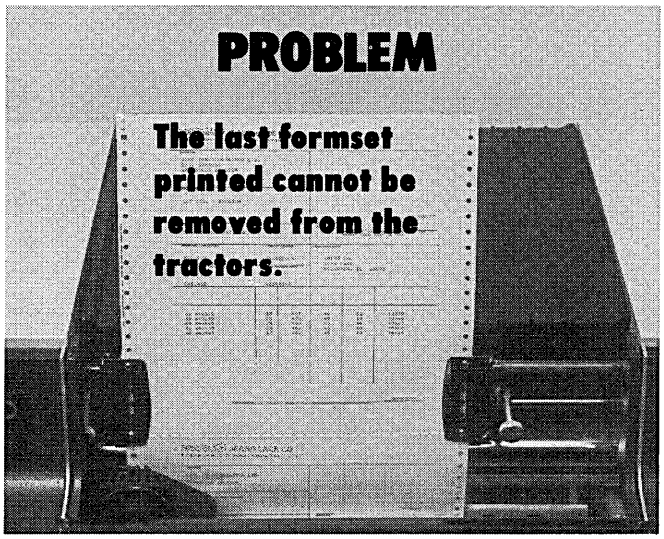

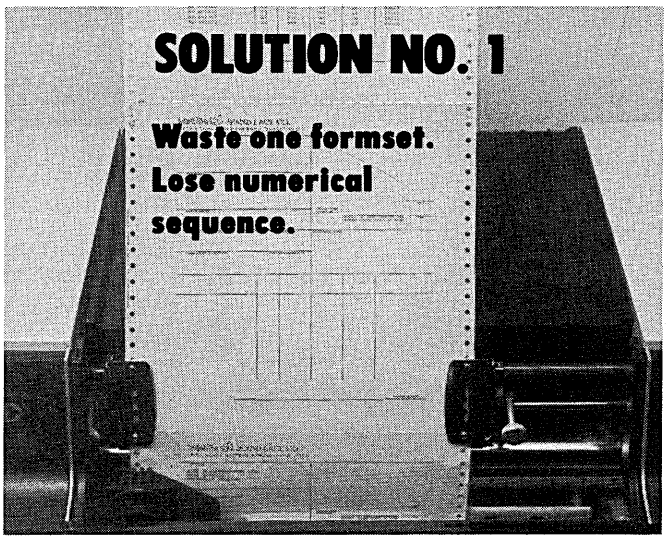

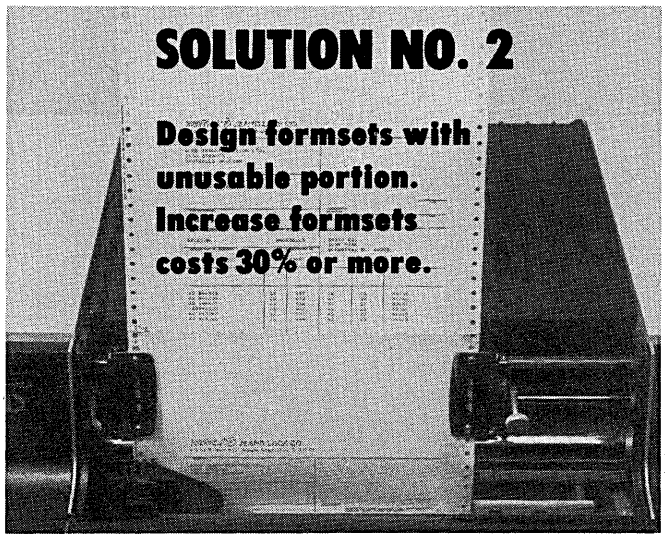

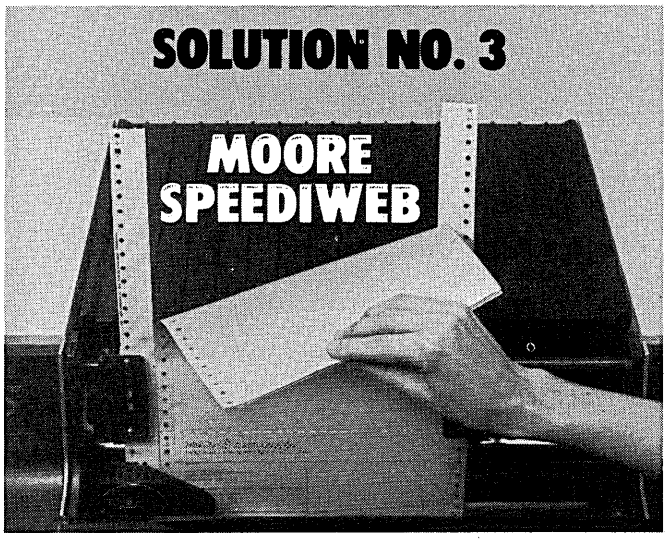

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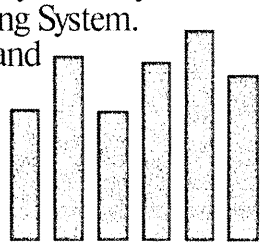

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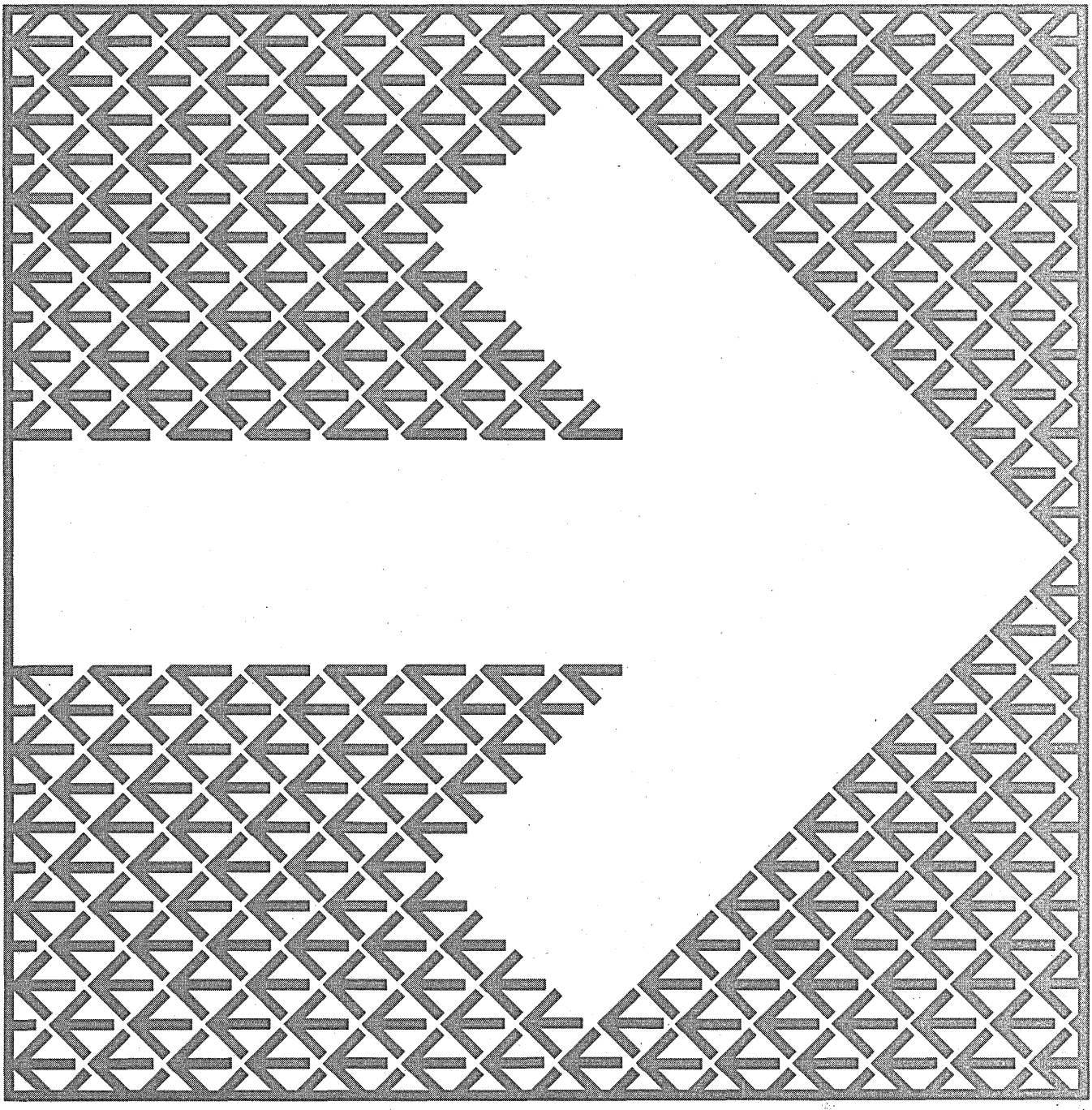


BECAUSE MANAGING DATA MEANS MANAGING CHANGE

Computer Corporation of America

issued from total quantity on hand, and deducting the cost of an issue (average unit cost times quantity issued) from total value on hand. The moving weighted average system can produce a FIFO-like audit trail of receipts and issues to afford the user the traceability of a FIFO system.

Another alternative is to implement *standard cost*. For the uninitiated, this may seem the easy way out. However, there are three attributes of a standard cost system that make it quite difficult and expensive to install. First, a standard cost system requires an actual cost system in order that the actual cost can be measured against the standard cost as the basis for performance reporting, which is what standard cost is all about. Second, a standard cost system requires standards —standard quantities, standard hours per operation, standard labor rates. To be meaningful, these standards should be engineered standards rather than trends or averages taken from historical data. Third, the computation of variance presupposes that someone in the organization is going to understand and analyze the variance, separate the controllable elements from the exogenous elements, and take corrective action in a timely manner. The nature of the production line will probably determine the feasibility of standard cost. If the product line is characterized by a finite number of high volume end-items accompanied by long runs of component fabrication and assembly with predictable yields, standard cost may be a worthwhile endeavor. However, if the product is subject to a high degree of customization, and component fabrication and assembly runs are short, or component runs are long but with unpredictable yields, standard cost may not be feasible. Ultimately, it makes sense to implement standard cost only if variances are controllable. For example, a manufacturer of semiconductor circuits might as well forget about standard cost because of the uncontrollable fluctuations in yields, whereas a manufacturer of electronic toys that use purchased semiconductor circuits could possibly benefit from standard cost.

WHAT TO TAKE INTO ACCOUNT

In planning for MRP, one must take into account the high initial investment in prerequisite software and hardware capacity, the lengthy computer runs, and the impact these factors have on the dp and user-department budgets and manpower. MRP must be preceded by a Bill of Material System, an Inventory Accounting System and a Master Production Scheduling System. In addition to the software effort required for these prerequisite systems, much user-department effort must be expended in structuring the bills of material for use by MRP, loading the bills, increasing the integrity and accuracy of the inventory accounting system, and designing the Master Production Schedule System so that it can assimilate the several factors of independent demand—firm customer orders, stock replenishment orders and forecast demand. And twice this effort will be required if the optional prerequisite systems —Shop Floor Control, Procurement and Order Entry—are to be implemented.

In a typical manufacturing environment with annual sales of $50 million, it would not be too unusual to end up with a $300,000 investment in mandatory prerequisite systems, another $300,000 investment in optional prerequisite systems, $100,000 or more in MRP software, $100,000 or more in a (new) Cost Accounting System, a monthly processing bill of $30,000 or more, a monthly dp systems support bill of $5,000, plus the requirement for half a dozen or more highly trained user-support clerks. Using an eight-year life for the software, the annual cost for MRP might run well over $500,000, and the initial investment in hardware and software might exceed $2 million. While this in itself is not overwhelming, it begins to illustrate the order of magnitude one should strive for in a cost-benefit analysis to justify implementation of MRP and ancillary software.

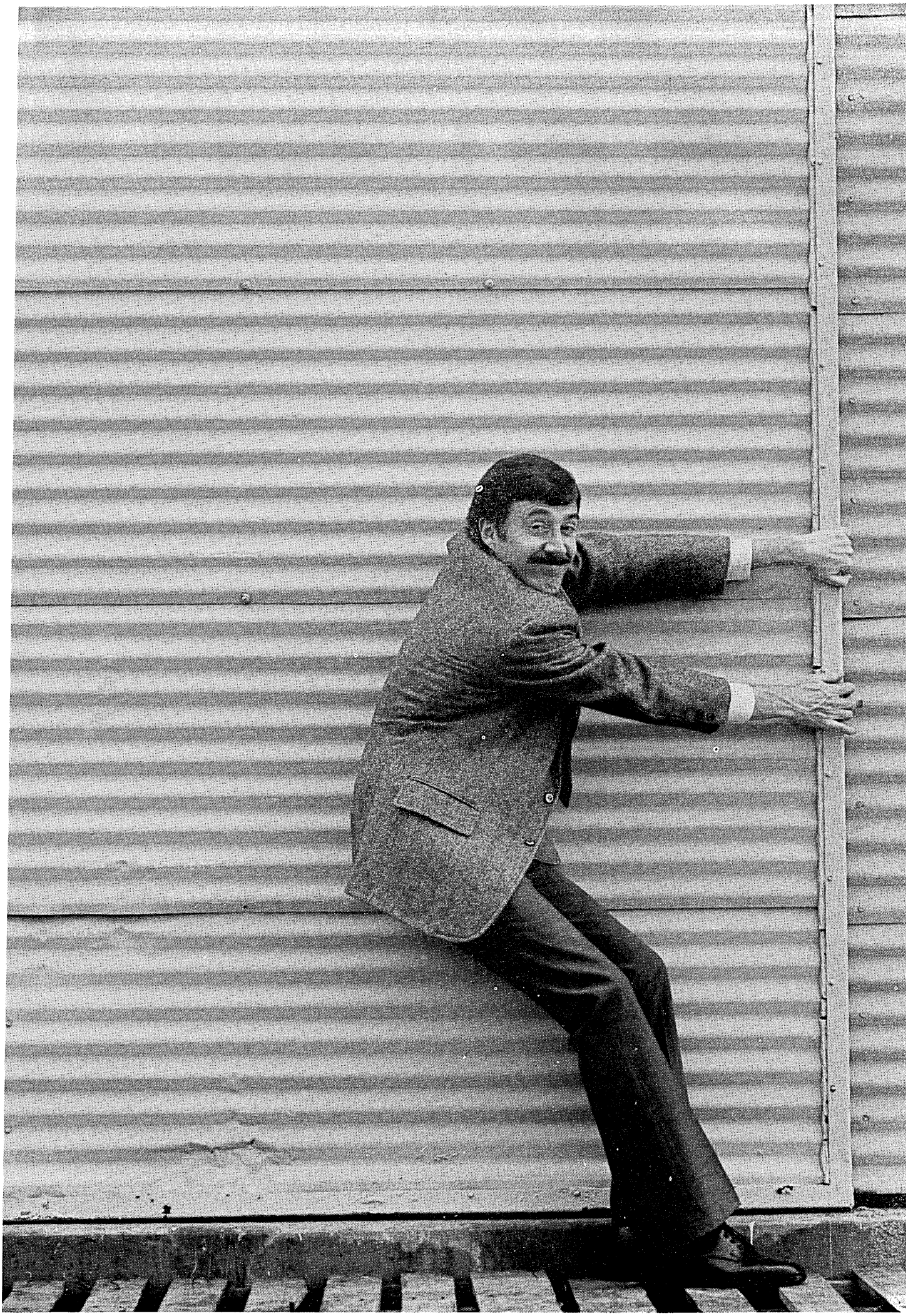
On the more philosophical and psychological side, MRP imposes a rather strict discipline on managers and planners associated with the production and inventory control functions, which may come as a severe shock after many years of loose, "seat of the pants" methods. For MRP to be effective, the bills must be kept accurate, the inventory counts must be kept accurate, the supply orders must be kept accurate, the lead times must be kept accurate, the lot-sizing rules must be kept applicable, and the material planners must respond promptly to changes in material requirements dictated by changes in the Master Production Schedule and/or late material receipts.

The real intelligence of the overall materials management process has been usurped from middle level planner/managers and dispersed throughout the MRP software, with control concentrated at the top level—the Master Production Schedule. With MRP, he who controls the Master Production Schedule controls the production and material coverage processes, and has a truly challenging and rewarding job. Also, the inventory technician may discover a gold mine of a job—maintaining the lot-sizing rules. However, the middle material managers now find themselves in a different role of *reacting* to the dictates of MRP rather than *planning*. These people must possess the education and intelligence to understand and cope with MRP, but they are no longer called upon to use their intelligence in a challenging and creative manner. Their new role of following instructions provided by MRP ("change this due date," "release this order," "cancel this order," etc.) is perhaps more suitable for a new class of employee, the *superclerk*, or an *automaton*. Who was it that once said, "People should think... machines should work"?

It is in vogue these days to pay lip service to the *participative management* concept. But, like it or not, the computer in general, and MRP specifically, are the tools of *scientific management*. We computer people pride ourselves in increasing the efficiency of (other people's) work. But, the social philosophers are telling us that we are likewise diminishing the meaning derived (by others) from this work. This is a dilemma in which we are inexorably intertwined, but one we must eventually address and solve. Instead of remaining just software engineers and efficiency experts, we must increase the dimensions and scope of our jobs to take into account the subtle aspects of human aspirations and organizational behavior. Otherwise, I suspect somewhere down the road we will begin to witness the emergence of assembly line mentality within the hallowed halls of corporate middle management. ✲

WILLIAM S. DONELSON II

Mr. Donelson is president of Donelson and Associates, an MIS consulting and systems development firm based in Cleveland, Ohio, and Nashville, Tennessee. His 16 years in MIS include positions as manager of systems and manager of MIS quality assurance at Harris Corp. He has previously been with General Electric, Glidden-Durkee Div. of SCM, and National Life & Accident Insurance Co. His B.A. is in Business Administration from Vanderbilt Univ. and his M.B.A. is from Case Western Reserve Univ.

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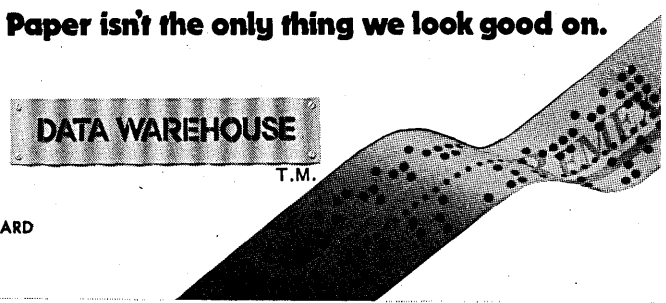

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CIRCLE 58 ON READER CARD

Many of the changes represent subtle tunings of the 370/168 design; a few are much more than that.

THE IBM 3033: AN INSIDE LOOK

The IBM 3033 Processor was conceived and designed to provide a performance level significantly better than the System 370/168-3, reduce space and power requirements, and provide enhanced availability and serviceability, at a cost/performance level better than that of the 168-3.

To do this, the designers made use of an improved semiconductor technology, which allowed greater packaging density and lower power requirements. They also studied carefully the interaction of the processor, the primary operating system (MVS), and user demands placed on high performance systems. Potential bottlenecks in a large, complex system were carefully examined, including the study of instruction execution sequences as well as instruction frequencies.

The final design, while building from the 168-3, also incorporated improvements to enhance performance and serviceability. Thus the 3033 has different design in the storage, cache, instruction preprocessing, and execution function, as well as a different arrangement for channel and operating/service console

As the logo on its console proclaims, the 3033 is marketed as a member of the System 370 family. This is appropriate in an age when processors are plugged into configurations just as easily as peripherals are, but the new machine is different in technology, design, and components; not long ago, that would have been sufficient to define a new "system."

attachment and use. The improvements combine to provide the IBM 3033 with an instruction execution rate of about 1.6 to 1.8 times that of the IBM 168-3 running identical programs and configurations under OS/VS2 Release 3.

In addition, the 3033 includes as standard the 370 Extended Facility: the added mechanisms to support the program product MVS/System Extensions. These mechanisms include changes in the E-Function (instruction execution) microcode, added storage protection for the first 512 bytes of processor storage, and improved management of the Translation Look-aside Buffer. The combined effect of the Extended Facility and MVS/System Extensions is to improve system throughput by about 14%, and reduce time spent in control program supervisor state by approximately 20%.

The internal performance of a processor is determined by the interaction of the technology and machine design (see Fig. 1). Actual instruction execution rate is a function of those two variables plus the instruction mix, which is characteristic of the workload.

In comparison with the IBM 3168, the 3033 technology offers improved speed and packaging density, both of which are augmented by improved packaging which reduces intermodule delay (see Table 1).

Briefly reviewing the 3168 design will help put the 3033's enhancements into perspective.

The 3168 processor is composed of four basic elements:

1. the Instruction Pre-Processing Function (IPPF), where instructions are decoded and prepared for execution;

2. the Execution Function (E-Function), where logical and arithmetic operations take place;

3. the Processor Storage control Function (PSCF), which contains system buffers and the address translation mechanisms, and

4. the processor storage, or main memory.

Interaction of the four basic elements of the 3168 is shown in Fig. 2A.

A LOOK AT THE PROCESSOR

The Instruction Pre-Processing Function (IPPF) is the work scheduler which sets up the necessary registers for the E-Function to execute an instruction. The preprocessing function fetches instructions from the cache, attempting to keep one of the instruction buffers full of instructions to decode.

The decoder removes one of these instructions, decodes it, generates the operand addresses, assigns the operand registers, and issues fetches for the operand data. If the decoded instruction is a branch, the IPPF then begins fetching instructions along the branch path into the inactive instruction buffer, and for a conditional branch designates (by means of a guess) which of the instruction buffers is now active and which is inactive. Thus both buffers are kept filled with instructions, but only the active one continues to be decoded.

This branch guess, based on designer experience, allows the machine to continue decoding instructions along the most probable path. If this guess is determined to be wrong at execution time, then there is a high probability that the correct instructions are already fetched into the instruction buffers. In spite of the risk of being wrong, guessing the outcome of a branch generally enhances the performance over that attained when no guessing takes place.

To sustain a high instruction exe-

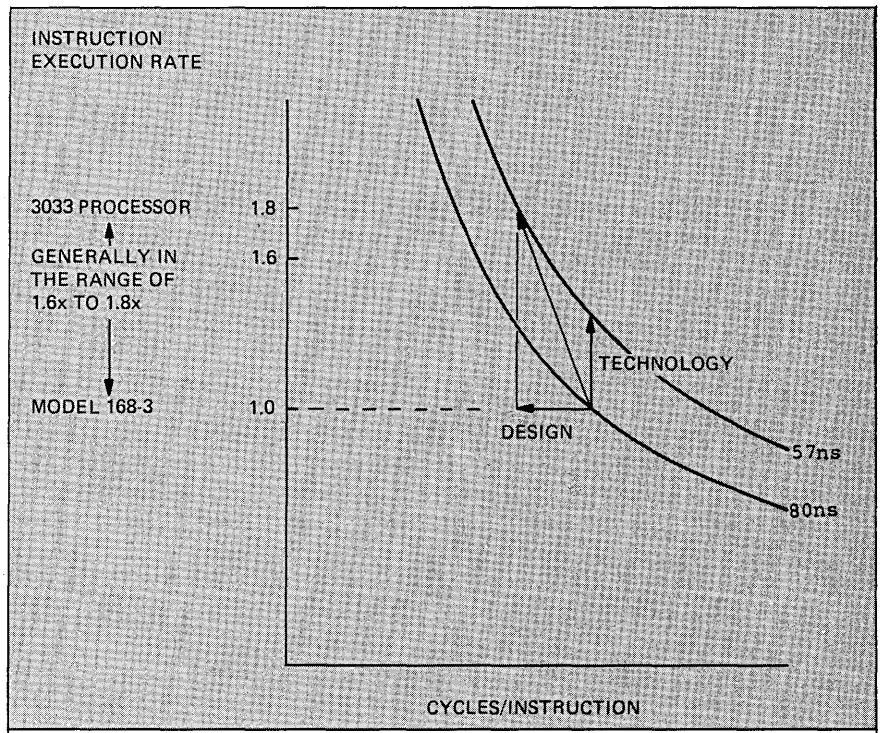

Fig. 1. A processor's internal performance is a funciton of technology and machine design. Thus the performance improvement of the 3033 over that of the 3168 is due partially to technology (reduing the cycle time from 80nsec to 57nsec leads to an increase in instruction execution rate of about 40%) and partially to design improvements which act to reduce the number of cycles per instruction.

cution rate, even when instruction execution times may vary, another buffer is placed between the instruction preparation area and the execution function. This buffer is called an instruction queue. Instructions are decoded, the data address computed, and then the instruction is placed on the instruction queue to await execution. In this way, the Execution Function can continue to operate if there is a delay in decoding, or decoding can continue if an instruction takes several cycles to execute.

Decoded instructions are placed in the instruction queue until the E-Function can service them, one at a time. The objective of the IPPF, the work scheduler, is to anticipate and fulfill the needs of the E-Function—keep it busy doing useful work.

The Processor Storage Control Function (PSCF) is the control link between the IPPF, the E-Function, and the cache or processor storage. Like the IPPF, the PSCF may be viewed as a supporting facility for the Execution Function. It is designed to move data efficiently. Instructions and operands are fetched from storage in 8-byte units called doublewords. Each doubleword fetched from storage is found in the cache in about 92% of the cases.

A cache miss results in four doublewords being fetched from processor storage. Each of these four is obtained from one of four separate Logical Storage Units (LSU), providing interleaved access to storage. Thus 32 bytes of data are transferred to the cache from storage in four consecutive machine cycles. The target doubleword which caused the cache-miss is always directed to both the cache and to the IPPF, or E-Function as appropriate, and is the first of the four doublewords transferred. This minimizes processor delay for the necessary data. The remaining 24 bytes are stored in the cache in order to improve the probability that succeeding fetches will be satisfied from cache-resident data.

Data stores from the processor use a "store-through" technique with cache. This technique assures that processor storage always has the most recent copy of data. If the doubleword being stored is also cache-resident, then the new data will also be stored into the cache. If the data being stored is less than 8 bytes, then an LSU merge operation occurs which requires a doubleword fetch from main storage, an overlay/merge of the new data, and then a doubleword store operation. All of these storage operations are usually overlapped with the IPPF and E-Function operation.

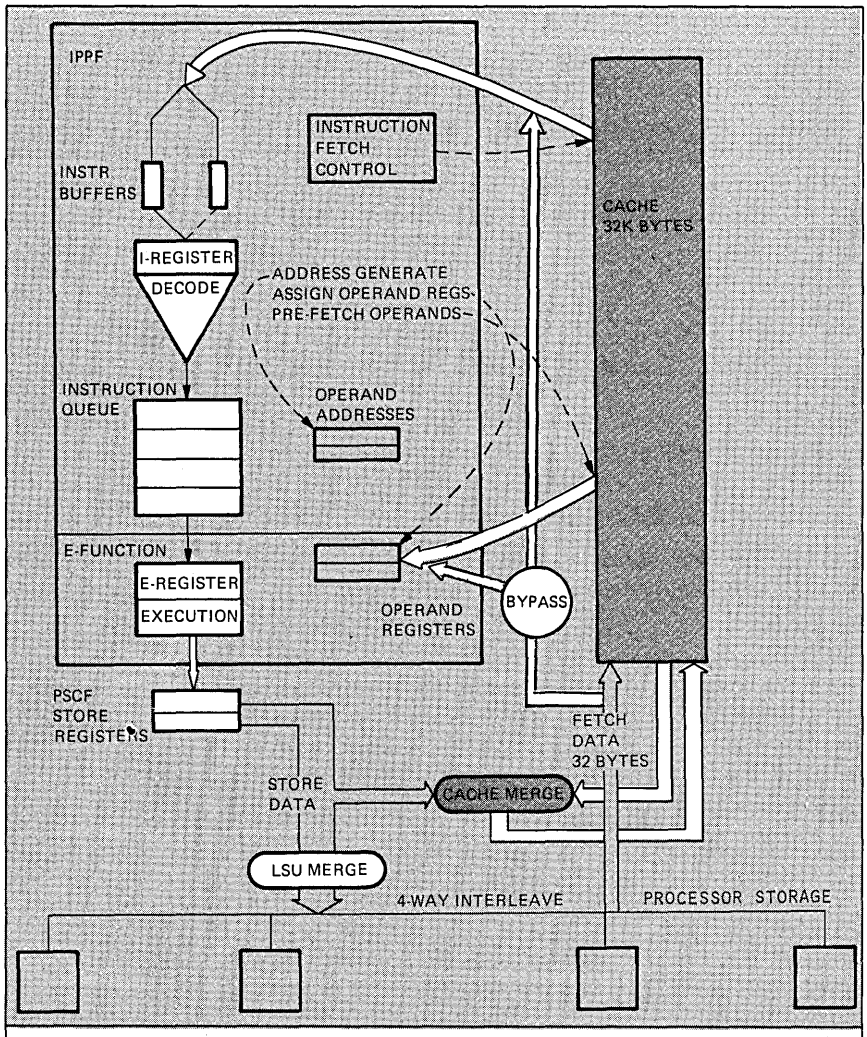

Fig. 2A. The 3168 processor has four basic elements: Instruction Pre-Processing Function (IPPF), Execution Function (E-Function), Processor Storage Control Function (PSCF), and processor storage (main memory). Buffers, registers, cache, and interleaving all are appropriate to the processor's speed.

Two principal factors contribute to E-Function delay: data necessary for execution may be unavailable, or the next instruction to be executed may be unavailable.

Unavailable data can be due to insufficient buffering on the inbound (fetch from cache) side or on the outbound (store) side when the result registers are occupied with data from a previous instruction, or can result from a cache miss.

An unavailable instruction can be due to several factors:

First, there may be no decoded instructions in the instruction queue awaiting execution. This may be the result of insufficient buffering. For example, when several storage-to-storage (SS) instructions occur in the execution sequence, both operand registers are assigned to the

CIRCUIT TECHNOLOGY COMPARISON

Processor Logic	3168	3033
Circuit delay*	1.7msec	1 nsec
Average circuit density	5.5 circuits/module	10.5 circuits/module
Maximum circuit density	12 circuits/module	37 circuits/module
Cache/Writeable Control Store		
Card size	2K x 18 bits	4K x 18 bits
Access time	32nsec	27nsec
Processor Storage		
Card size	64K x 8 bits	32K x 8 bits
Access time	210nsec	185nsec

* Average circuit delay excluding effects of packaging

Table 1. Technology alone has led to a 41% reduction of processor logic circuit delay, a 90% better packing density for logic, a 100% better packing density for cache, 16% reduction in cache cycle time, and a 12% reduction in processor storage access time.

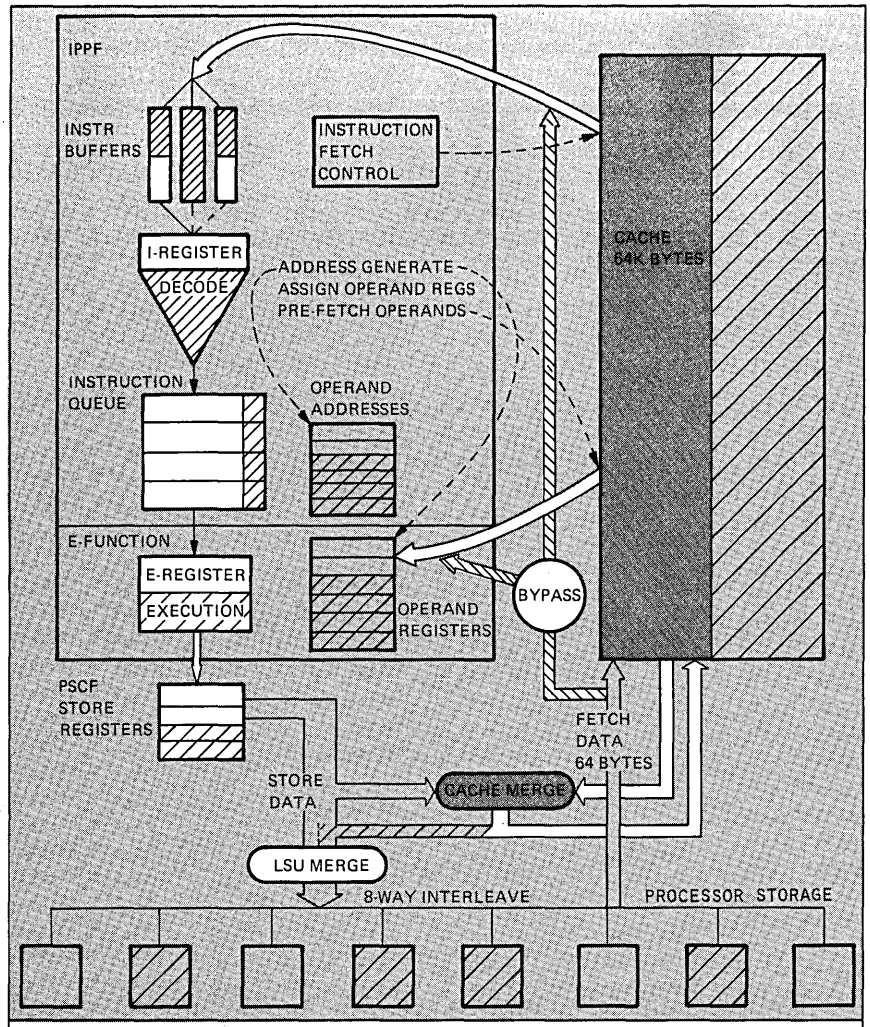

Fig. 2B. Changing the speed forces changes in the other elements as well, including adding to or lengthening buffers, registers, and cache for the 3033 (shown with crosshatching). Changes in instructions led to others in decoding and instruction execution as well.

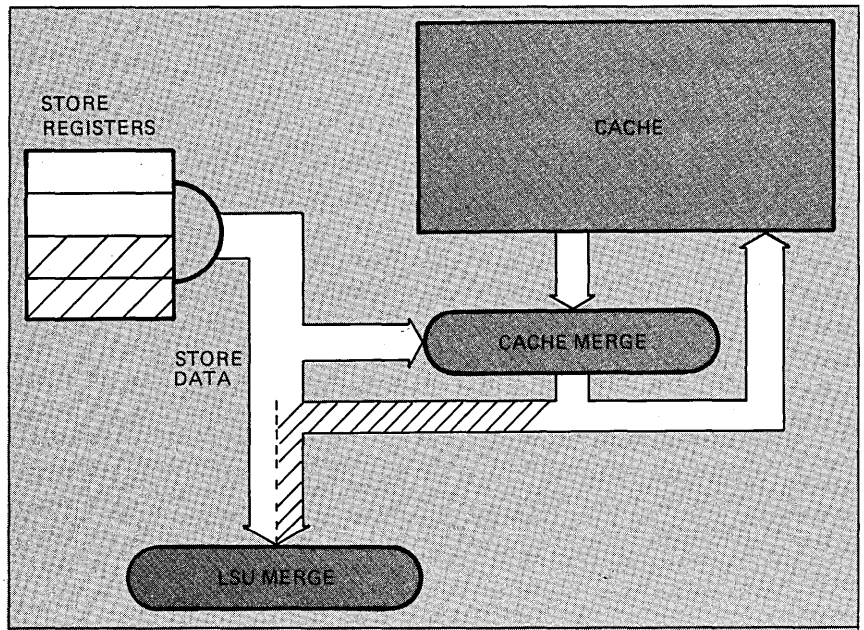

Fig. 3. On the 3168, when the data to be stored was less than a full 8-byte doubleword, the new data had to be merged with the old twice: once for main storage and once for cache. On the 3033, only one merge is necessary when the data is in the cache; the results of that operation are simply stored twice.

first SS instruction and any subsequent SS instruction is held up in decode until the first has completed execution. This is a limited operand register delay; other delays also occur when an instruction in decode needs data which is still being processed in the E-Function.

Second, there may be no instructions to decode, due to insufficient instruction buffer depth.

Third, when a branch is taken, the alternate instruction buffer may have insufficient depth. Also, encountering a second decoded branch before the resolution of an earlier branch can cause instruction decode delays because both instruction buffers then are occupied.

The rate of execution of code containing only ordinary branch instructions is improved by the addition of instruction buffering. However, when a new Program Status Word (PSW) must be loaded, which may alter the control state (storage protect key, privilege/program status, etc.), all prior instructions must be completed before the new PSW becomes effective. Thus the degree of buffering has no effect on interrupts or on the Load PSW instruction.

In general, these delays are data and instruction-sequence dependent, and can occur even if the data or instruction is resident in the cache. Cache misses further contribute to data and instruction unavailability.

In addition, the effect of the cache's size, structure, and replacement algorithm, and their interaction with the workload—including the operating system—must be considered. A well-behaved, high cache hit-ratio workload will be processed with the E-Function's maximum capability. The performance of a poorly behaved, low cache hit-ratio workload will be limited by the quantity of operand registers, the priority that store operations are assigned over fetches, and the relative speed of the storage.

Analysis of the E-Function indicates simple, yet fundamental design objectives. The key objective is to keep the execution function busy doing productive work. This can be accomplished by providing sufficient hardware so that instructions and their data are fetched and decoded faster, and then are queued with sufficient buffering so that the E-Function is not delayed waiting for an instruction to be decoded. This will improve the flow of work through the E-Function (which, in turn, requires that the operation of storing results must also be improved). Finally, the instruction execution can be improved by algorithm improvements which make efficient use of the improved data flow.

CHANGES FOR THE 3033

Design objectives for the IBM 3033 processor resulted from analysis of the IBM 3168 processor performance. This analysis is based on measurements of running systems, as well as on results of a detailed, simulative model. This simulative model permits evaluation of many design alternatives with various operating systems and job streams.

The principal data flow and organization of the 3033 processor are shown in Fig. 2B. Key changes are listed in Table 2.

IPPF changes: The Instruction Pre-Processing Function has been enhanced in three respects: (1) instruction buffering, (2) operand address and data buffering, and (3) instruction decode speed. These enhancements provide a greater number of decoded instructions to the E-Function. The depth of the instruction buffers also has been increased from two to four doublewords.

A third instruction buffer has been added for the situation where a second branch instruction is encountered prior to the resolution of a previously encountered branch. This allows instruction prefetching along three potential paths instead of two as in the IBM 3168. These enhancements increase the amount of work queued for the instruction decoder which should result in fewer delays in the decode process.

The size of the operand address and data buffer has been increased from two to six doublewords. This permits up to three SS instructions to be decoded and waiting in the instruction queue for execution.

The decode process also has been significantly enhanced by performing the decode and address generation in one cycle, instead of two. Some specific instructions such as load multiple (LM) and store multiple registers (STM) are decoded in one cycle as well. Some SS format instructions can be processed with as few as two decode cycles when their operands do not cross 2KB boundaries.

To maintain architectural integrity, the decode process is disabled when certain instructions are in execution. Additional hardware and design enhancements have minimized this decode-disabled state for a large number of task-switching related instructions and character manipulation instructions.

The IPPF processes off-boundary operands at high speed and, for most of the SS-logical instructions, two doublewords of destination operand may be fetched, and three doublewords of source operand may be fetched and aligned *before* the instruction begins execution. Some SS instructions may prefetch more operand data, and, in particular, the move character operation (MVC) can prefetch up to five doublewords of source operand. (The 3168 operand prefetch is limited to one doubleword per operand, unaligned.)

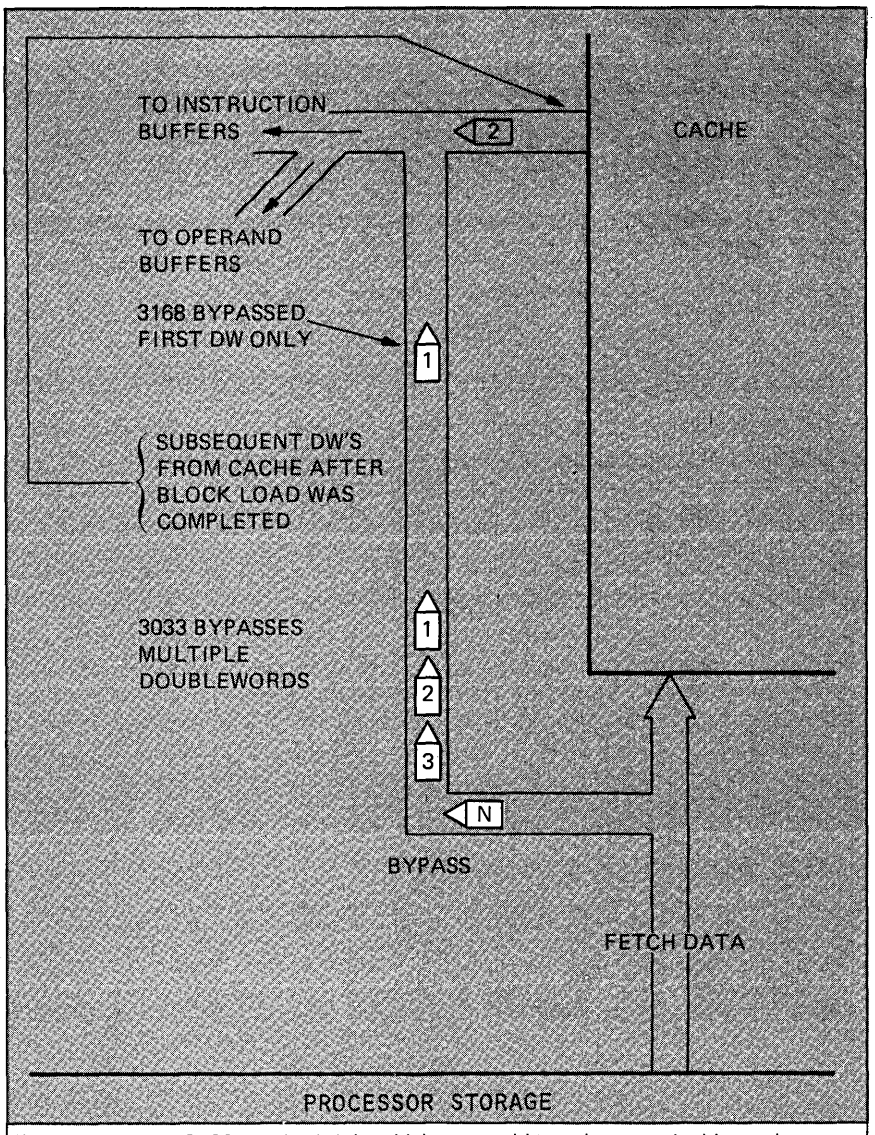

Fig. 4. When the 3168 required data which was not in cache, one doubleword was fetched directly from storage into the processor's buffers. The 3033 fetches several doublewords.

All of the above enhancements are useful when fetches are made to data resident in the cache. Further, enhancements make the data available directly to the IPPF and E-Function as it is fetched from processor storage when cache misses do occur.

PSCF changes: The Processor Storage Control Function has been enhanced in three main respects: (1) data accessibility with a larger cache, (2) processor storage accessibility with interleave, and (3) faster data movement.

Cache associativity, block size, and capacity have all been doubled, respectively, to 16-way, 64 bytes, and 64KB. Associativity (A) is the number of legal cache locations into which a block or line may be stored. Block size (B) is the number of bytes in a cache data element. The Columns (C) is the number of addressable positions each having A blocks of size B. Thus the cache capacity in bytes is obtained from the simple product: AxBxC.

Analysis of current operating systems and application programs indicates that these larger values are more effective in maintaining the active working set of cache data. These cache changes, then, make more of the most recently used data accessible to the processor.

The processor storage interleave also has been doubled to 8-way so that more individual storage requests can be accepted and operated upon in parallel. The interleaving, plus a faster access time, increases the effective processor storage data rate.

Movement of data has been improved by giving *fetch* operations priority over nondependent stores to processor storage. This reduces the input delay to the processor for a cache miss. The output delay to the processor has been reduced by providing twice as many result buffers and providing the capability to store up to

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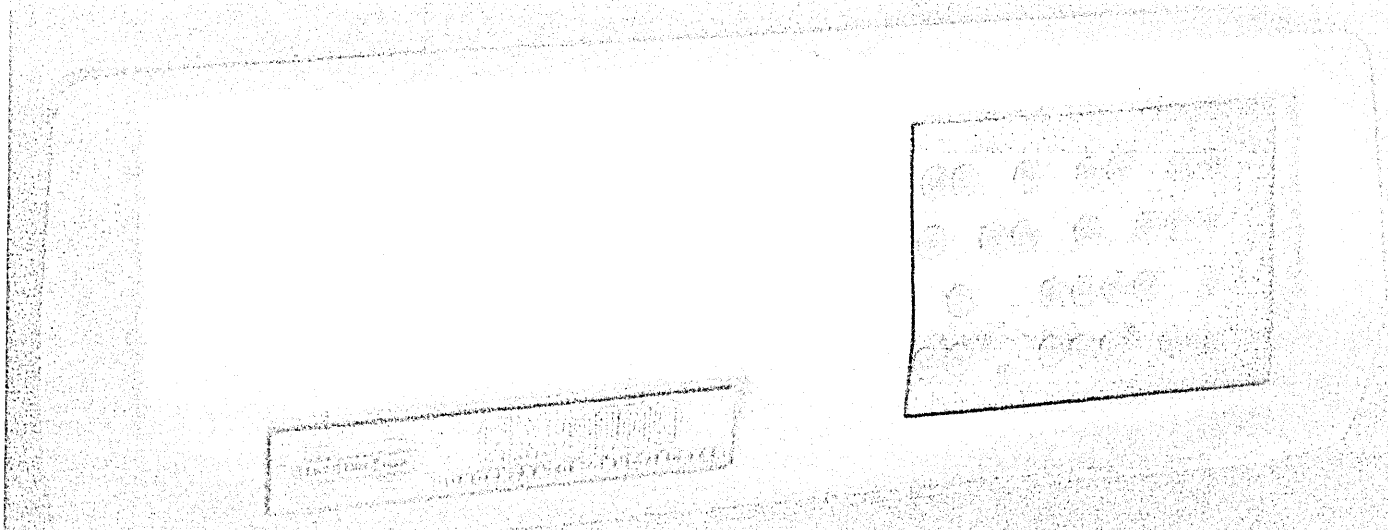

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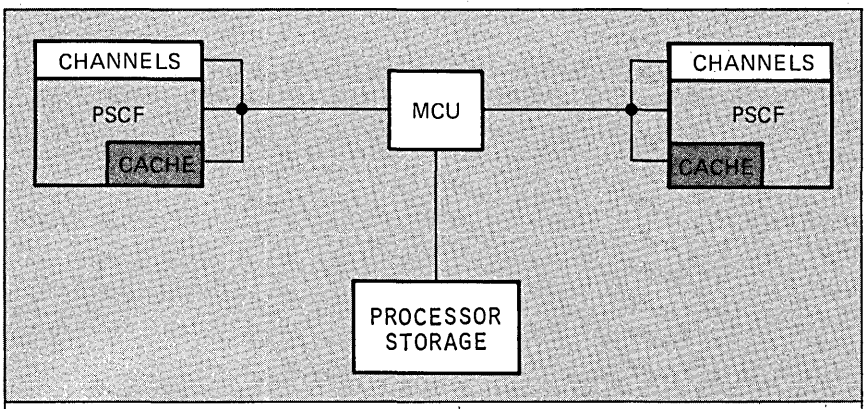

Fig. 5. Both the Multiprocessor (MP) and Attached Processor (AP) configurations employ a Model 3038 Multiprocessor Communications Unit. The MCU lashes processors and main memory together with 8-byte wide data paths.

one doubleword (8 bytes) per cycle. The output delay in the special case of a partial store operation (less than 8 bytes) has also been reduced.

Finally, the Segment Table Origin stack size has been increased, and the Translation Lookaside Buffer (TLB) algorithm always replaces the least recently used 4K page entries. The time to purge the TLB has been reduced by 48 machine cycles. These enhancements contribute to more efficient hardware/software paging support in dynamic task-switching environments.

Partial store merge: In large processors such as the IBM 3168 and 3033, data is stored in 8-byte elements called doublewords. When the data to be stored is other than a full doubleword, the doubleword must first be read from storage, then merged with the new data before the entire new doubleword is stored, as shown in Fig. 3.

Formerly this operation required a read of the doubleword, merge of the new bytes into the doubleword, and finally a full doubleword write into storage. If the doubleword were also resident in cache, then a similar merge was performed and the full doubleword was written into cache.

The 3033 provides a path from the cache merge facility to the storage so that whenever the doubleword being partially modified exists in the cache, the partial store can be converted to a full doubleword store at the Logical Storage Unit (LSU) by reading the doubleword from cache, merging the new bytes, then doing a full doubleword write. As a result, extended LSU busy time is not required and the LSU is available sooner for another access.

Block data bypass: The block data bypass path is similar to that provided in the IBM 3168, where the requested doubleword is gated directly to the processor as it is being loaded into the cache (see Fig. 4).

The intent here is to minimize the time that the processor must wait for instruction or operand data not found in the cache. Since the 3033 has more operand and instruction buffers, it can accept the multiple doublewords which now return from processor storage on the bypass bus, as the block (of 64 bytes) is being loaded into the cache. The advantage is not obvious until we consider the requests for data from the second and subsequent doublewords in the block. These requests were delayed in the 3168 until the block load was completed and the data was available from the cache. We are now able to minimize the delay not only on the first request but also on sequential fetches to the same block.

E-Function changes: The Execution Function has been enhanced to capitalize on IPPF and PSCF enhancements. For example, algorithm improvements have been made in character manipulation instructions widely used in commercial application programs. Task switching instructions have been improved so that dynamic workload installations run more effectively. Also many commonly used instructions, especially branches, have been improved. In addition, high speed multiplication hardware is standard.

Some examples of algorithm improvements are:

- The operand preshift and alignment function are removed from the E-Function. Alignment is now performed by the Processor Storage Control Function.
- The Instruction Pre-Processing Function now prefetches more than one doubleword of source and destination operands. This permits the changed E-Function algorithm to operate faster.
- The PSCF now can store a doubleword per machine cycle. This too permits the changed E-Function to operate faster.
- The IPPF provides more information when decoding maskable instructions so the E-Function can handle mask instructions in one machine cycle when the masks contain only contiguous bits.

Finally, a group of functions, collectively called the System/370 Extended Facility or Feature have been made standard on the 3033 Processor Complex. These functions enhanced the performance of the control program MVS/SE (Program No. 5740-XE1). Included are:

- Common-segment bit
- Low-address protection
- Invalidate Page Table Entry instruction
- Test Protection instruction
- Twelve additional instructions that depend on specific MVS conventions, fields, and control-block formats.

The common-segment bit in the segment-

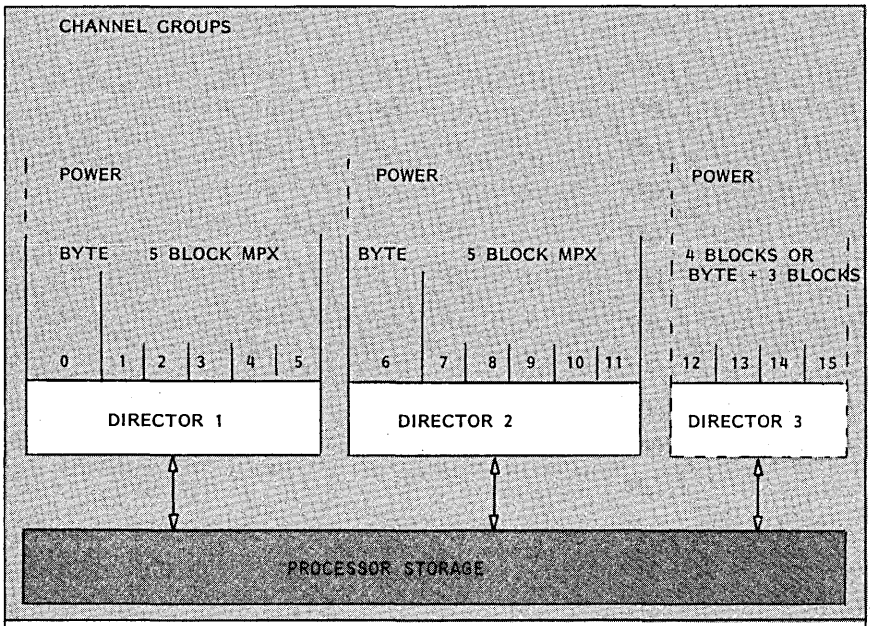

Fig. 6. Two groups of six channels each are standard on the 3033, and a third group of four channels may be added. Each group is controlled by a new element called a channel director, and, also unlike earlier processors, the channels are directly accessible by the service facility.

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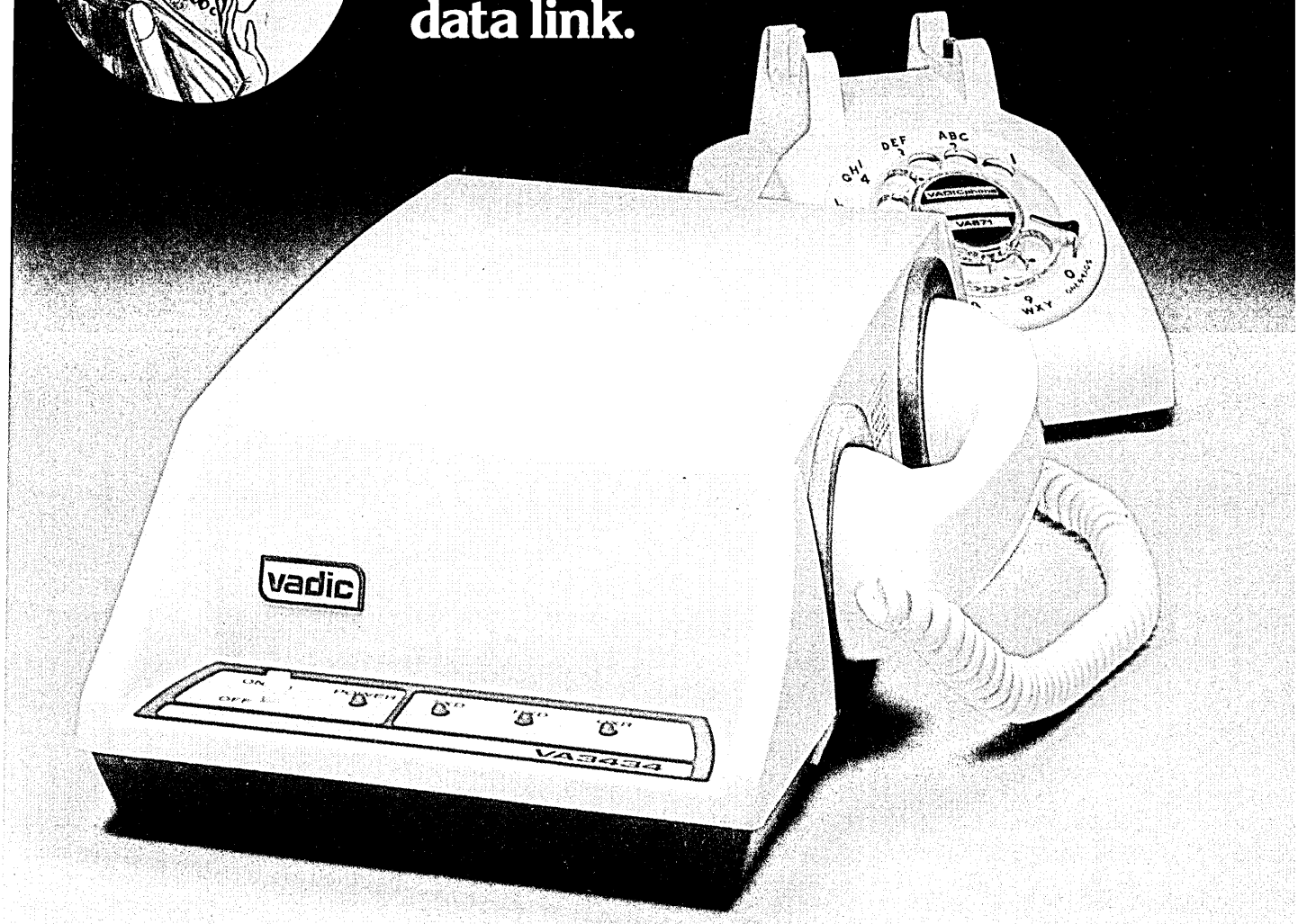

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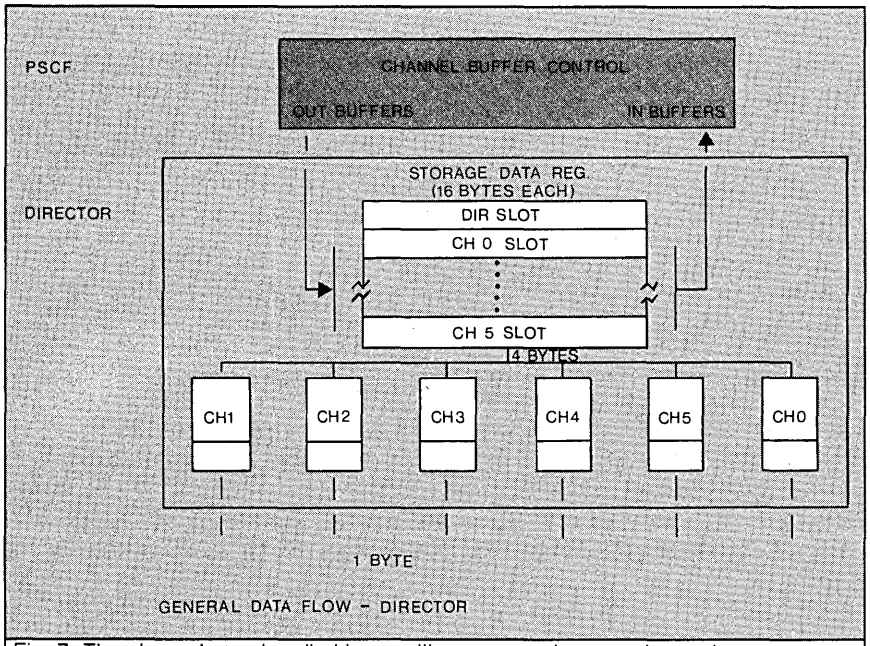


Fig. 7. The channels are handled in a multiprogrammed manner by a microprogram within each director, with the block and byte multiplexor channels being handled by different subprograms. The path width from storage to channels is 8 bytes, from channels to storage 4 bytes, from the director's registers to channels 4 bytes, and those to the outside world are 1 byte (although the first block multiplexor of any group may have a 2-byte wide path).

table entry indicates that the associated segment is common to all segment tables. Low-address protection, when active, prohibits instructions from storing into the first 512 storage bytes. The remaining 14 privileged instructions enhance the performance of MVS/SE functions, including permitting a virtual machine to execute any of the 12 MVS-dependent instructions directly, not through simulation or an interrupt. The combined hardware and software (MVS/System Extensions) improvements have resulted in approximately a 20% reduction in supervisor time.

IBM 3033 PROCESSOR ENHANCEMENTS

Instruction Pre-Processing Function
- Size of instruction buffers doubled (from 2 to 4 doublewords)
- Third instruction buffer added
- Number of operand registers tripled (from 2 to 6)
- Decoding and address generation overlapped in one cycle
- Decoding of Load Multiple and Store Multiple instructions speeded
- Decoding of certain storage to storage instructions speeded
- Reduced amount of time that decoding is disabled
- Boundary alignment delay reduced
- Increased amount of operand prefetching

Processor Storage Control Function
- Cache associativity doubled (from 8 to 16)
- Cache block size doubled (from 32 to 64 bytes)
- Cache columns halved (from 128 to 64)
- Cache capacity doubled (from 32KB to 64KB)
- Main memory interleaving doubled (from 4-way to 8-way)
- Fetch given priority over nondependent stores
- Storage registers doubled and speeded (from 2 to 4, 1 doubleword/cycle)
- Process for storing partial doublewords speeded
- Segment Table Origin stack expanded from 6 to 29 entries
- Operation of Translation Lookaside Buffer improved (FIFO changed to LRU replacement, purge time reduced, two protect keys per entry provided)

Execution Function
- Algorithm improvements in character manipulation (MVC, MVCL, NC, OC, CLC, XC)
- Algorithm improvements in task switching (LM, STM, PTLB, LCTL, STCTL, RRB, and System Mask operations)
- Algorithm improvements in common operations (floating-point short, branches, high speed multiply)
- Preshifted operand data improves SS format instruction processing
- Prefetch of more than one doubleword improves processing of LM, MVC, etc.
- Doublewood store every cycle improves STM, MVCL, etc.
- Providing more decoded information improves ICM, STCM, etc.

Table 2. Changes incorporated in the 3033 processor (as compared to the 3168).

MULTI-PROCESSORS

The 3033 Multiprocessor complex consists of two 3033 Model M processors, two 3036 consoles, and the 3038 Multiprocessor Communications Unit (MCU). Fig. 5 shows a conceptual relationship between the MCU and processor functions. The 3033 Attached Processor complex consists of a 3033 Model A processor, the 3042 Attached Processor, two 3036 consoles, and the 3038 MCU.

The MCU for the Multiprocessor/Attached Processor models provides prefixing, interprocessor communication, cache (high-speed buffer) and storage update communication, sharing of processor storage, configuration/partitioning control, synchronization facilities, and communication of changes to the storage protection keys.

The MCU also enables both processors in an MP configuration to access all of processor storage while maintaining the overlap capability in storage operations permitted by 8-way interleaving. This means that both processors can have concurrent storage operations in progress with a varying degree of overlap depending upon the particular sequence of LSU accesses.

The configuration and partitioning control in an MP system provides a variety of storage configuration options which can apportion the storage independently to each processor for uniprocessor mode or shared between the two processors for multiprocessor mode.

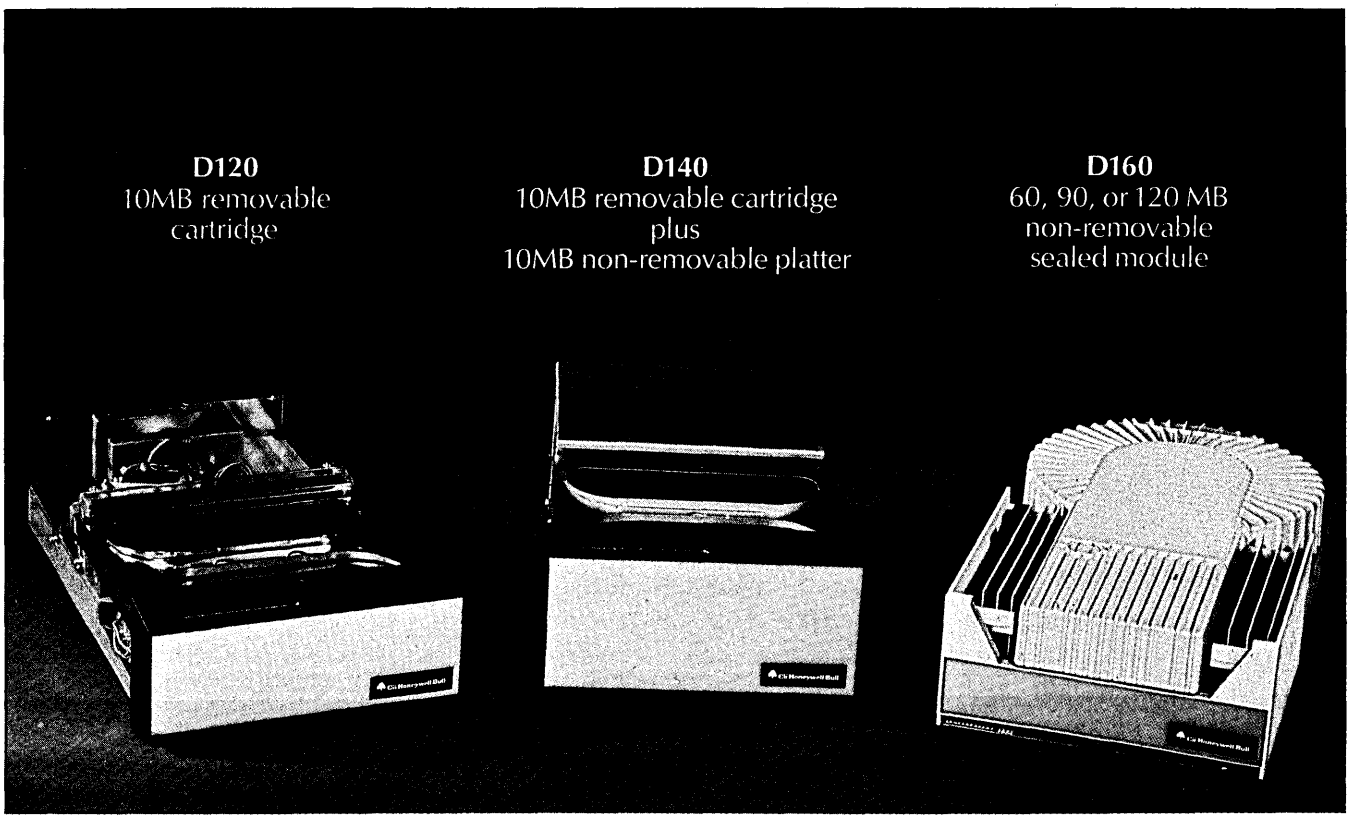
The 3033 MP complex is similar to the 3168 MP. The key areas of concern for performance considerations are: (1) interprocessor communication, (2) cache and storage protect communication, and (3) access to shared processor storage.

Interprocessor communication has been enhanced by the addition of a new instruction, Invalidate Page Table Entry (IPTE), which permits selective removal of Table Lookaside Buffer entries from the TLB. Also, the time to completely purge the TLB has been reduced by 48 machine cycles. Consequently the control and protection of shared storage is now more efficient.

The IPTE further enhances MP performance since it is broadcast to the other processor without the need for a Signal Processor (SIGP) instruction. This technique eliminates the instructions that were necessary to handle the SIGP interrupt, accomplish the TLB purge, and redispatch the interrupted task.

The cache and storage protect communication has been significantly enhanced for environments with high storage activity. The enhancement is related to the mechanism which supports the

Pack 10 to 120 megabytes in a unit one-third the size of conventional disk drives.



For OEMs and system builders, the D100 family of compact disk drives offers a surprising list of advantages. Two new models, D140 and D160 add capacity and flexibility to the proven performance of the D120. The D140 includes a 10MB fixed platter in addition to the 10MB removable cartridge as used with the D120. The D160 uses a sealed (non-removable) module which includes low pressure heads and carriage.

Small Size: Occupying approximately one-third the volume of conventional drives, models D120 and D160 measure 5.6″ × 12.2″ × 21.8″. Model D140 is slightly taller at 6.7″.

Innovative Cartridge: Both D120 and D140 models use a flat, thin (11″ square by .9″) self-ventilated cartridge weighing only 2.8 pounds.

Common Interface: The same controller handles D120, D140, D160, or any combination of the three models. One or more D160's in conjunction with a D120 provide a fixed data base with a high-throughput-10MB load-dump yielding twice the operating flexibility at half the size of conventional single-spindle drives.

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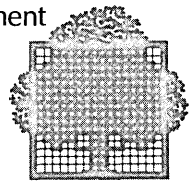

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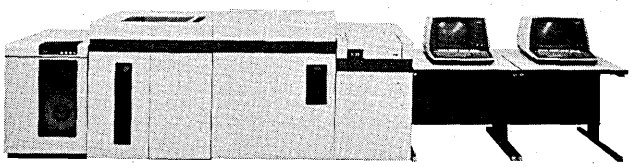

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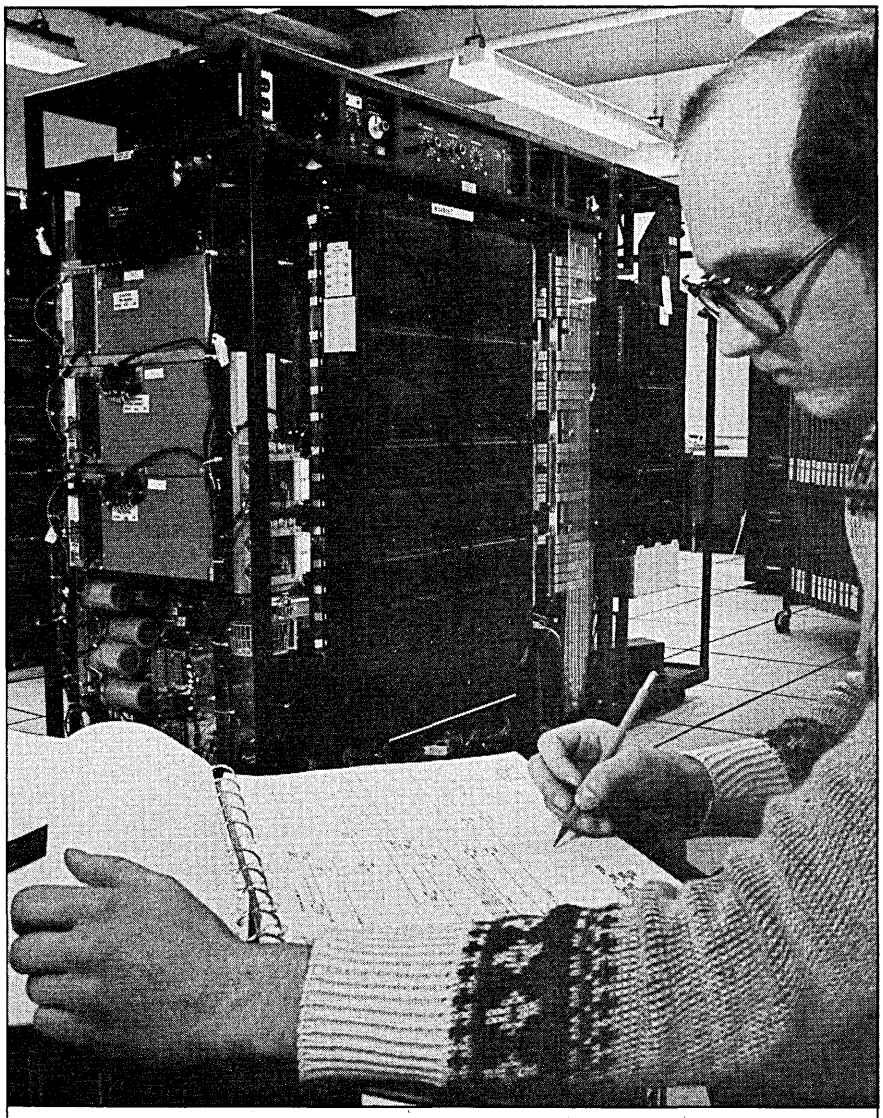
"store-through" design of the 3168 and 3033 cache. A store-through cache lends itself well to multiprocessing designs, since processor storage is kept updated with the latest information as data is stored "through" the cache. If the data happens to reside in other processor's cache, then it must be deleted to ensure that the latest data which now resides in processor storage is used the next time that location is referenced by either processor.

It was observed that many of these invalidation requests were redundant as would be the case, for example, if one processor moves data through a block that exists in the other processor's cache. The 3033 embodies a mechanism that remembers that the cache line or block has been deleted by the first doubleword stored into the block and may therefore ignore subsequent invalidation requests within that block. Thus, the number of PSCF cycles required by one processor to delete a block as a result of a series of stores by the other processor or channels, is substantially reduced.

The access to processor storage is improved in three ways: (1) eight-way interleave, (2) partial-store merge, and (3) the processor storage priority access mechanism. The eight-way main storage interleave simply distributes the storage activity over twice as many storage elements. Consequently, for a given activity rate and storage speed, the storage units are 50% less busy. Thus accessibility to an arbitrary interleave level is improved, which reduces processor storage contention in an MP configuration. Processor storage contention is further reduced by the Partial Store Merge technique described earlier.

The processor storage priority access mechanism must ensure that a processor does not become "locked out" by the other processor while still maintaining storage integrity. The 3033 Multiprocessor embodies a floating priority storage access control which grants access to storage in bursts. Once a processor gains priority, it will keep it as long as it can sustain a continuous string of storage requests, as in a 64 byte block fetch, for example. If the string of requests is broken, and if there is a request from the other processor, then the priority switches to the other processor.

The 3033 MP contains a further enhancement over the implementation in the 168 MP and AP, in that the priority bid mechanism has two levels. Low level bids compete with low level bids and high level bids compete with high level bids but, as might be suspected from the names, a high level bid can preempt a low level bid. The 3033 with its enhanced buffering can at times sustain an exceptionally long string of storage requests, and so this facility prevents a high priority request on one processor from being unnecessarily delayed by low priority activity on the other.



Good information on the channel directors is just now coming to the public, and this is one of the first photos to be released. Shown is frame five, which contains directors one and two (for the standard ration of channels). As can be seen, although the directors are logically "integrated" into the cpu, they are physically separate.

Channel set switching on the 3033 MP and AP allows a set of channels to be switched from one processor to the other, provided the data path, power, and storage of the processor which will operate the channels are working. Thus the MVS operating system can switch channel controls from a failing processor to either the Attached Processor or the second 3033 without an Initial Program Load (IPL). If the Attached Processor fails, there is no direct effect on the channels because they are all attached to the host and generally controlled by the host. Similarly, the Virtual Machine control program, VM/370, uses the same facility when a failure occurs that prevents continued operation of a virtual machine. In general, VM/370 will terminate the virtual machine that was running on the failed processor, but the others will continue executing on the host processor. Channel controls can also be switched manually (using the 3036 console). This will permit an IPL on the Attached Processor if the host's Instruction Preprocessing Function (IPPF) or Execution Function (EF) is not operational.

CHANNELS AND THEIR DIRECTORS

The IBM 3033 provides 12 channels as standard, plus 4 optional channels. The first 12 are configured in two groups of 6. Each group, operating under an element called a director, has 1 byte multiplex and 5 block multiplex channels; the third (optional) group contains either 1 byte multiplex and 3 block multiplex channels, or 4 block multiplex channels (see Fig. 6).

Each director is a microprogram controlled processing element containing storage for its own control program, local storage used by both the director and its channels, and a Unit Control Word

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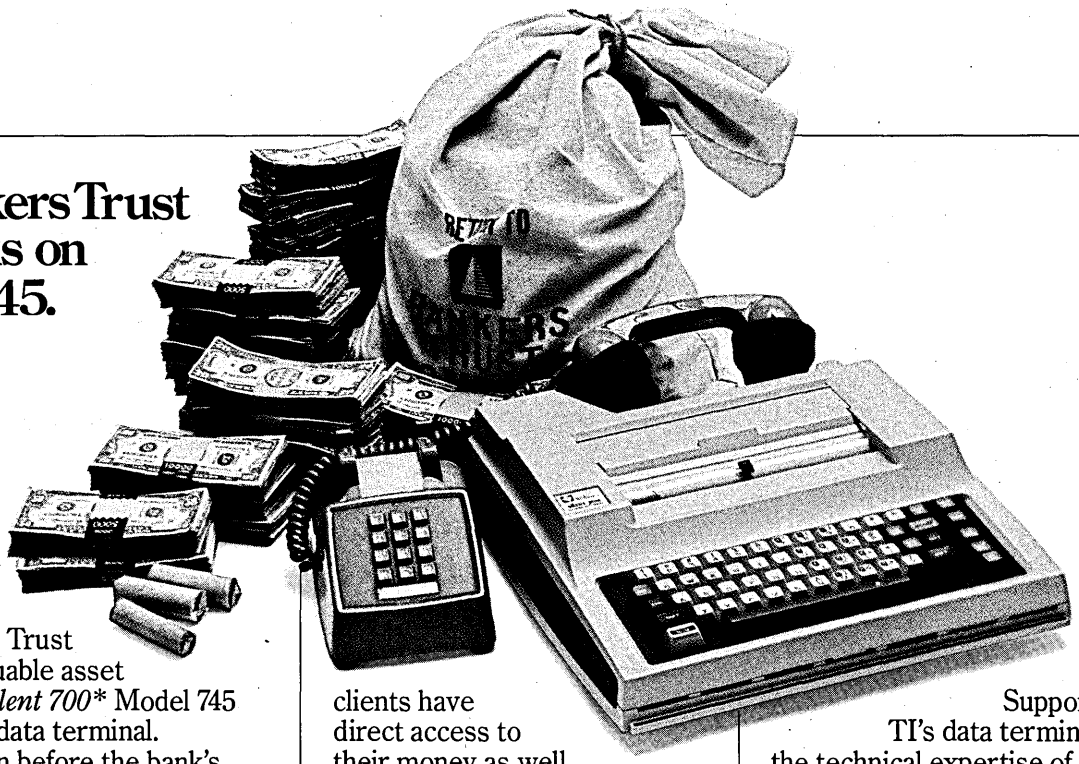

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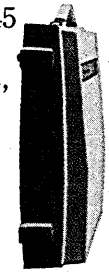

Model 745

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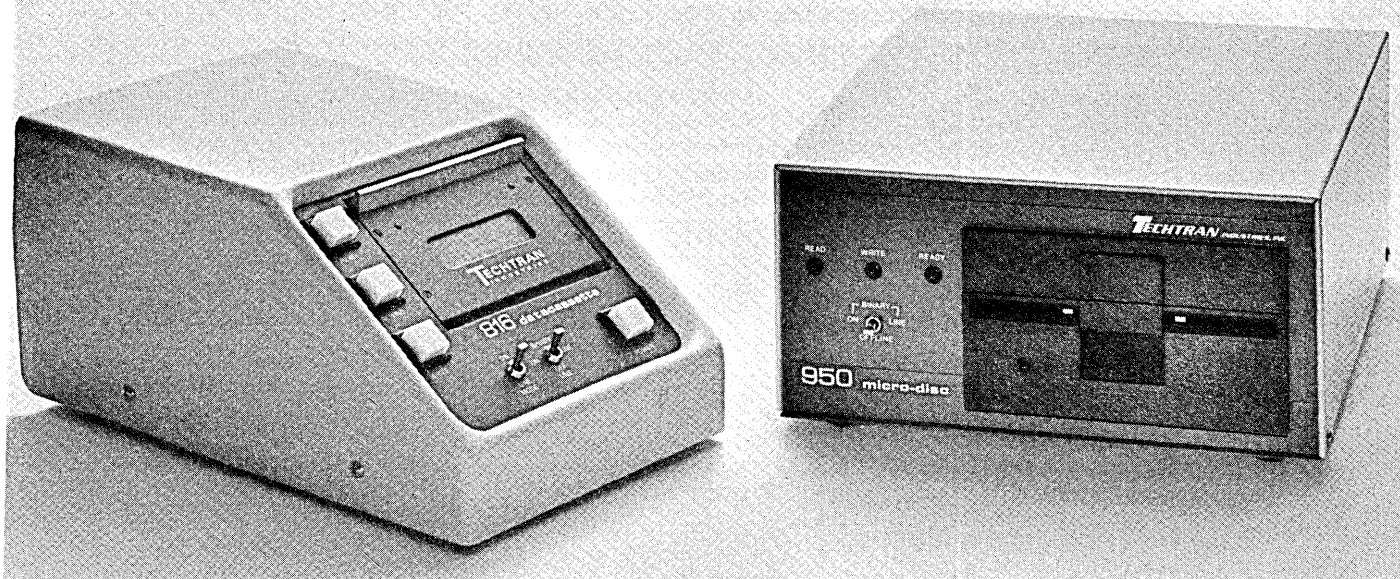

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CIRCLE 117 ON READER CARD

(UCW) storage area. Each also contains an arithmetic logic unit for manipulation of data and channel control information, plus buffers and control logic for the channels.

Block multiplex channels in a director are controlled by a microprogram that is multiprogrammed to manage more than one channel, but each channel has some dedicated hardware buffer. Thus one channel's data transfer to and from I/O devices does not significantly interfere with the microprogrammed operations on any other channel.

The byte multiplex channel microprogram, which handles everything except device selection, can be interrupted when a block multiplex channel needs service. Fig. 7 shows the general flow of information in a director.

The integrated channels available on the IBM 3033 offer enhanced serviceability and the potential for improved availability while requiring substantially less space than the standalone channels on the IBM 168.

- The microcoded channel processor, along with its associated channels, may be separately powered down for maintenance. Unlike the 168's channels, those of the 3033 are accessible by the service processor, and the group concept allows maintenance, including microdiagnostics, to be performed on one group of channels while the other group is being used for customer work.

- Intermittent channel errors are now recorded on the console file. The ability of a customer engineer to review intermittent error statistics should increase his ability to spot failing components before system downtime is incurred, resulting in increased channel availability.

- The 3033 I/O error handling capabilities are similar to those provided in the other System/370 processors. These include instruction retry, command retry, and channel retry facilities. The automatic channel retry capability has been enhanced under MVS. In a number of cases, this will prevent the loss of the channel and even of the system when an error occurs. However, this may not prevent a task from being abnormally terminated.

- Each byte multiplex channel is capable of a data transfer rate of from 40KB to 75KB; a block multiplex channel is capable of up to 1.5MB maximum data transfer rate.

- Other optional channel features of the 3033 include up to two channel-to-channel adaptors per system, and a 2-byte wide channel interface providing a data rate of up to 3MB, which can be installed on the first block multiplex channel of a group.

THE CONSOLE

The IBM 3036 console provides operator and maintenance functions for the IBM 3033, 3032, and 3031 systems. It offers several new features which provide improved availability and serviceability. For example, there are displays for system console messages and system activity information, as well as a function which monitors and controls system power.

The dual displays on the console are individually addressable. Accordingly, either one may be used by the operator, or by an IBM customer engineer. If one display is inoperative, the other may be used to continue operations. Similarly, while the operator runs the system from one display, the customer engineer can run channel and console microdiagnostics from the other display. If desired, both consoles may also be used as operator stations, using Alternate Console Support in MVS, for example.

- The duality evident in the displays reflects a design intended for maximum availability. Each display has its own keyboard, associated console processor, channel interface, and console file.

- In addition, the console provides the system with an interface to a remote service facility through an integrated modem. By means of this modem, the IBM 3036 can transmit to a support center the failure-related maintenance information which has been collected on the service support console file. It can also transmit selected logouts and trace records to a remote specialist for analysis; the remote specialist can also operate the 3036 through a terminal.

- The console trace facility, through 191 fixed and 8 movable probes, monitors certain control points in the processor each cycle. A buffer accumulates this information. When an error is detected, a snapshot dump of the error cycle and the prior 31 cycles is recorded on the console file.

- The console also monitors and controls system power. Significant enhancements have been made in power supplies, power monitoring and control, and power maintenance. New power supplies (Phase Control Regulators) have been used with the 3033 processor complex. These regulators are capable of sensing and reacting to temporary, out of specification conditions in processor storage and channels without causing a system crash.

A "Power System Microdiagnostics" package is available to assist the CE in reducing the impact of power outages. The console processor can also distinguish between a transient and permanent failure by entering a timing loop when an out of specification condition occurs. Only if the condition persists does the system shut down.

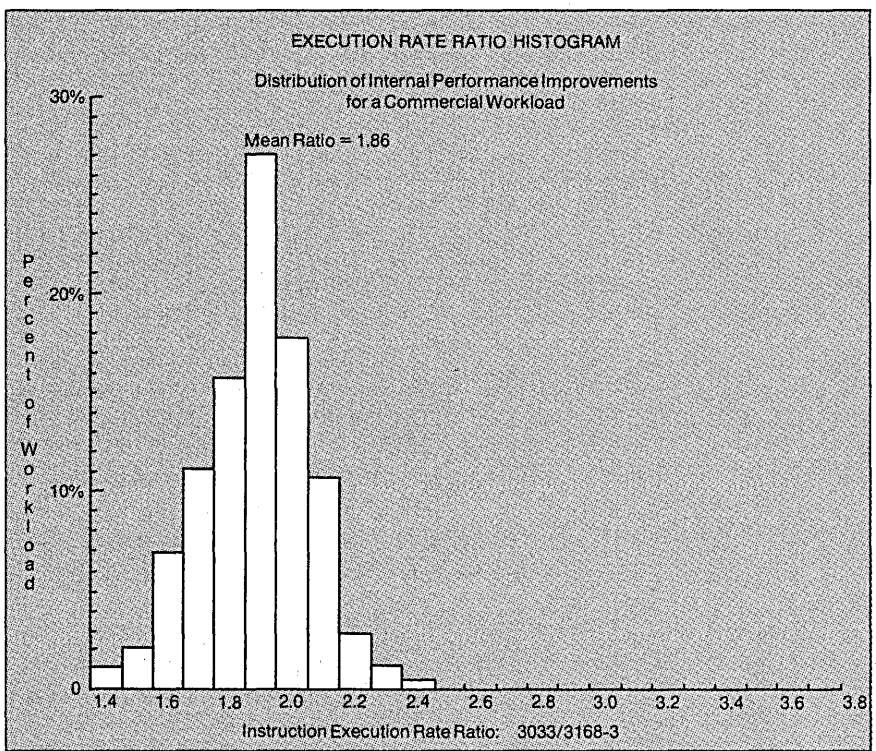

Fig. 8. According to a cycle by cycle simulation, the 3033 will run anywhere from 1.4 to 2.4 times as fast on a commercial workload as a 370/168-3 with the fast multiply feature.

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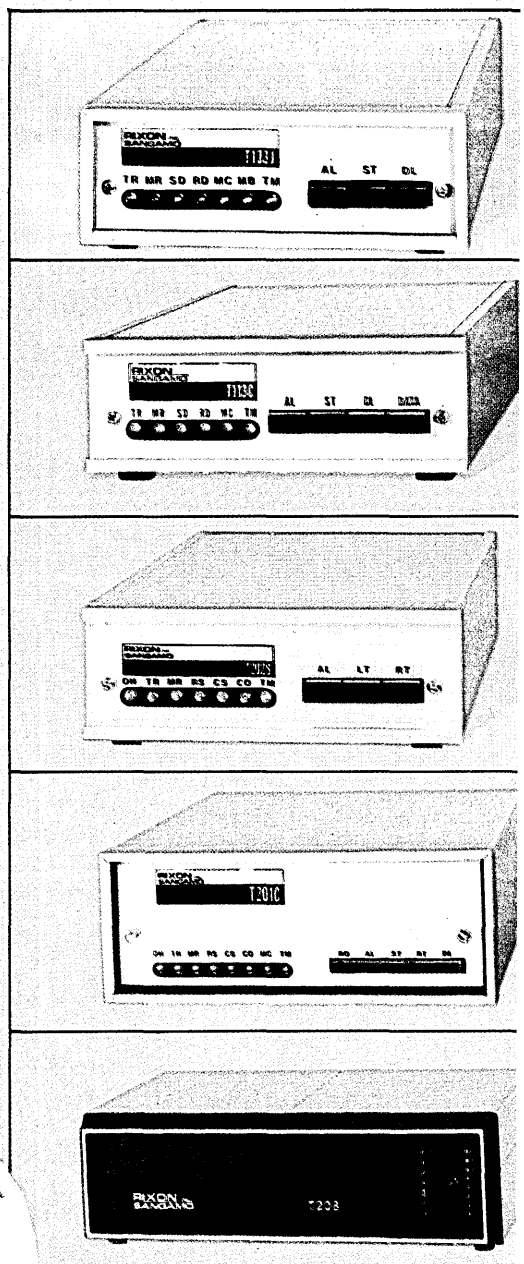

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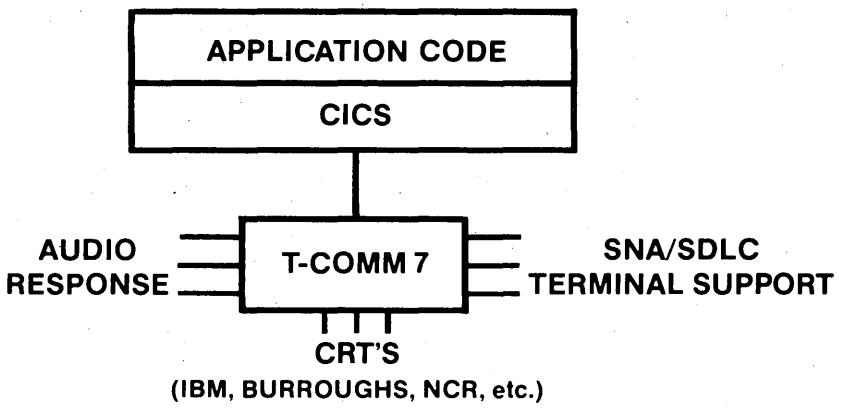

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Manager of Data Processing
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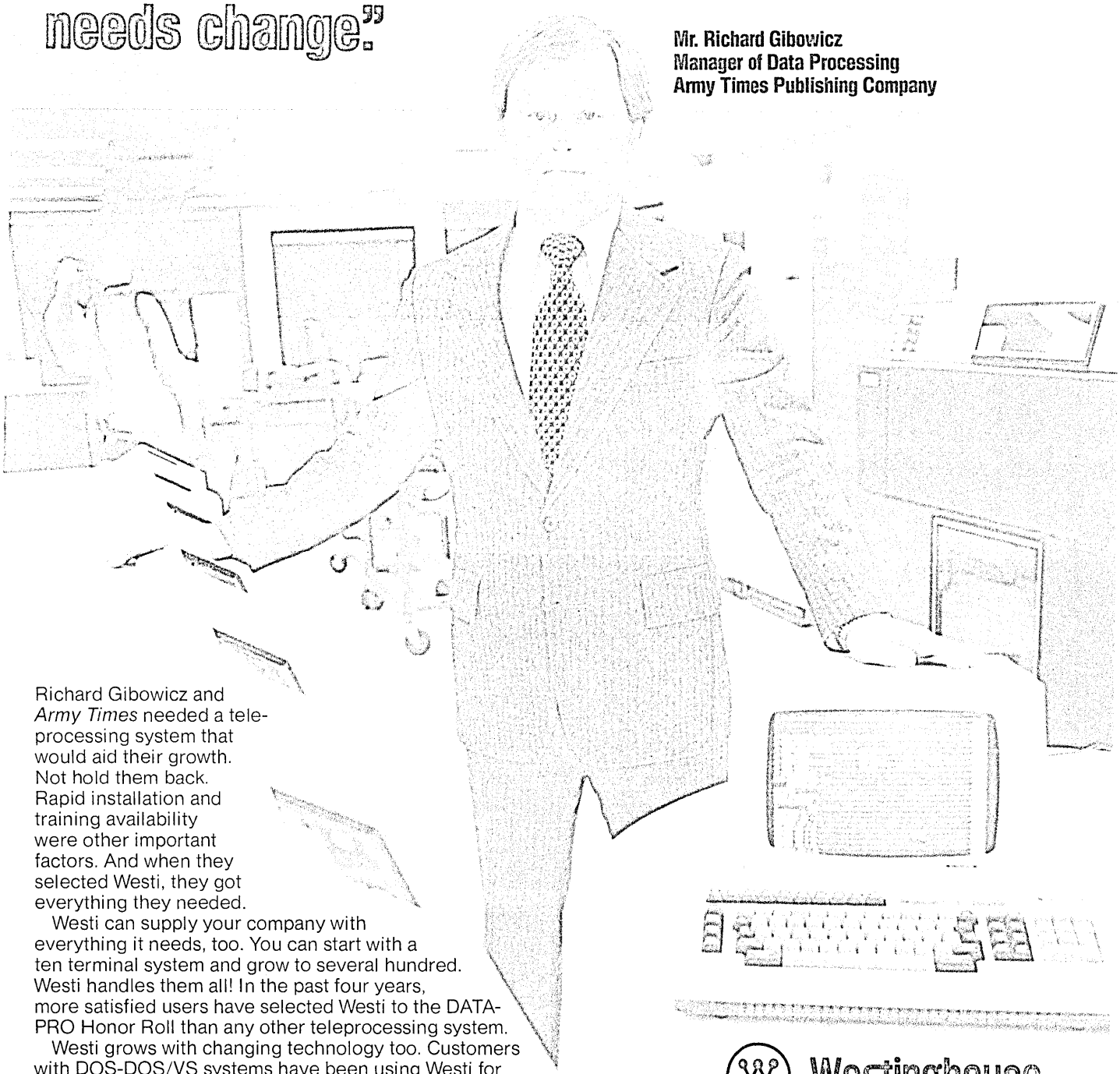

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PERFORMANCE The performance claimed for the 3033 was based on data obtained from a detailed cycle by cycle simulation model, driven by instruction traces extracted from a commercial and a scientific workload running under an MVS 3.7 operating system. Since the absolute value of Instruction Execution Rate varies widely and is, in fact, a function of an object workload running on a specific hardware/software system, we chose to project the performance relative to a 370/168-3 UP with the high speed multiply feature.

A detailed analysis comparing identical 1,000-instruction samples from the commercial workload indicated that the performance gain was normally distributed about a mean that was somewhat more than 1.8 times the performance of the 168-3 (see Fig. 8).

A similar analysis on the scientific workload shows a similar distribution about the same mean, with the significant difference that it is bimodal with a spike at 1.5 (see Fig. 9). This spike is a kernel with a FORTRAN execution step that is composed of an optimized set of instructions that runs particularly well on the 168. Although the relative weight of this kernel in the test stream was not sufficient to adversely affect the mean, we expected to find cases where the mean was heavily biased by this type of activity. Thus the low end of the performance ratio was consciously chosen to reflect a workload with such a bias. Early benchmarks have included at least one case that has demonstrated this phenomenon.

The engineering benchmarks, on which the projections were based, more closely resemble what is often described as "full function" benchmarks rather than kernels. Their performance ratios were measured as 1.93 for commercial and 1.88 for scientific. This is consistent with the projected means as shown in Figs. 8 and 9 respectively.

The performance enhancements of the 3033 processor are further extended with the announcement of the 3033 Multiprocessor. The 3033 MP performance which is stated to be "1.6 to 1.8 times the 3033 UP" was based on simulation results and experience with the 3168 MP and AP. It is pure coincidence that these ratios appear the same as those relating the 3033 UP and the 168-3 UP.

The MP/UP ratios reflect the combined effect of processor contention for the shared resources plus software overhead required to manage two processors plus a higher level of multitasking. The announced MP/UP ratios do not include the software improvements in the MVS/System Extensions program product. Experience with the System Extensions on the current MP and AP products indicates a significant improvement, especially where the supervisor component of the instruction mix is high. The 3033 MP complex spends about 20% less time in supervisor state and shows about a 14% increase in work throughput capability as compared to a 3033 MP without MVS/SE.

THE SAME, BUT DIFFERENT Thus the 3033 is a substantially altered version of the basic architecture already previewed in the 370 family, just as the 370 carries the genes of its 360 forebears. The specific alterations made were those which best suit a very large processor: wider data paths, greater memory interleaving, bigger buffers, longer registers, faster circuitry, etc. How effective the changes were is suggested by the simulations and engineering benchmarks: almost double the performance of the 3168 — which is a fast machine by any measure. It is a sign of the times that this increased performance can be installed in a smaller package, at lower cost for any given unit of computing, while maintaining compatibility with existing user-developed applications.

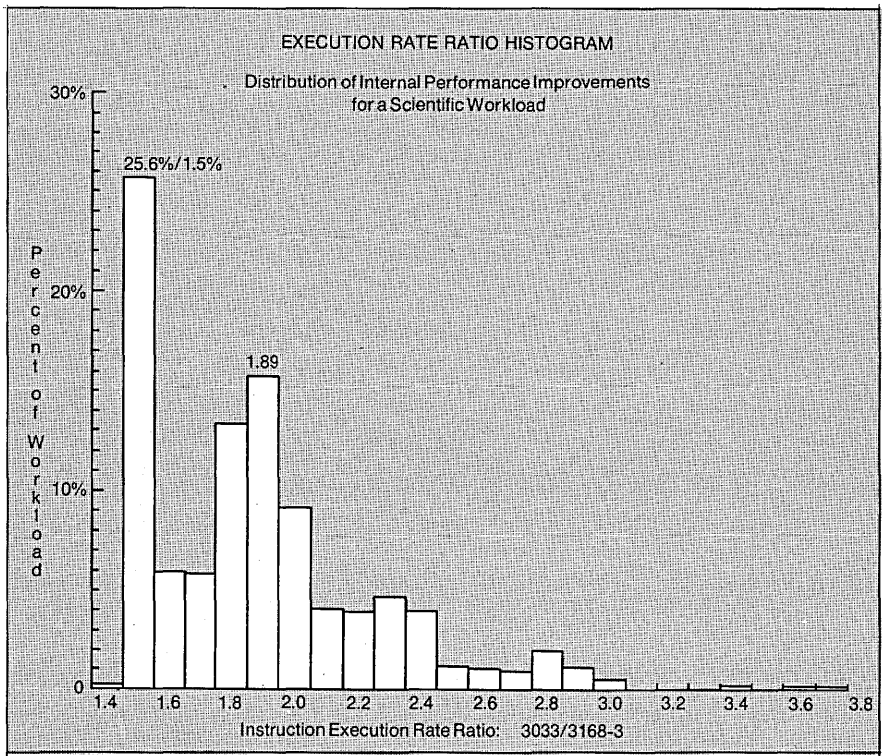

Fig. 9. On scientific workloads, the 3033 again appears to be just under 1.9 times as fast as a 168-3 with the high speed multiply feature. Some optimized FORTRAN execution steps are very well suited to the 168, however, and the 33 can manage only 1.5 times the instruction execution rate for those.

WILLIAM D. CONNORS
JOHN H. FLORKOWSKI
SAMUEL K. PATTON

Mr. Connors has been involved in the manufacturing and development of IBM processors since 1960, having worked on the 7070/7074, 360/91 and 95, the 370/165, 168, 168MP/AP, and the 3032/33. He was manager of the large processor measurement and analysis group at the Data Systems Div.'s Poughkeepsie Lab when this feature was written, but has since been assigned to the Americas/Far East Complex Systems Support Center.

Mr. Florkowski also joined IBM in 1960, as a design engineer in the Advanced Systems Development Div. Currently he is a senior engineer/manager at the Poughkeepsie Lab with responsibility for determining internal performance of large processors—from the 370/158 on up.

Mr. Patton joined IBM in 1959. He has been involved in or has managed projects in systems programming, modeling, performance measurement, systems architecture, and machine organization in several divisions. Currently he is also with the Data Systems Div. Lab.

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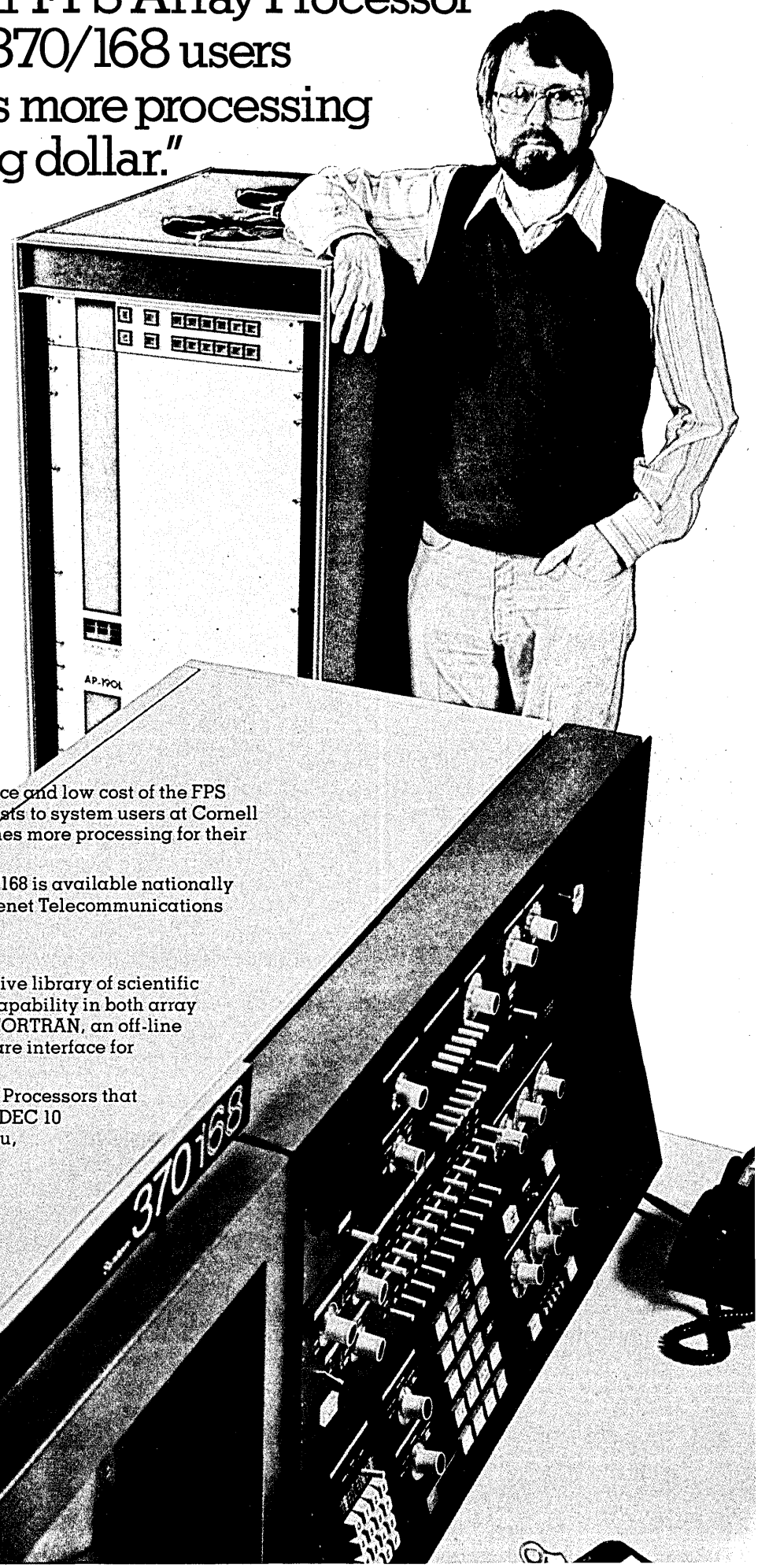

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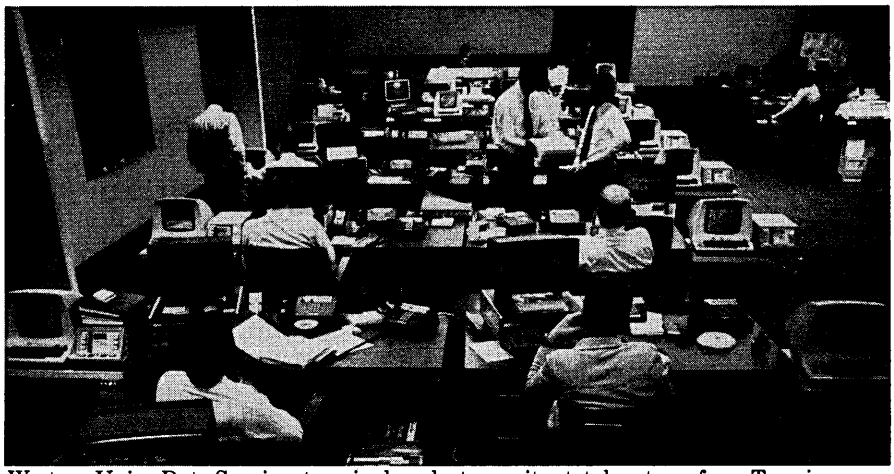

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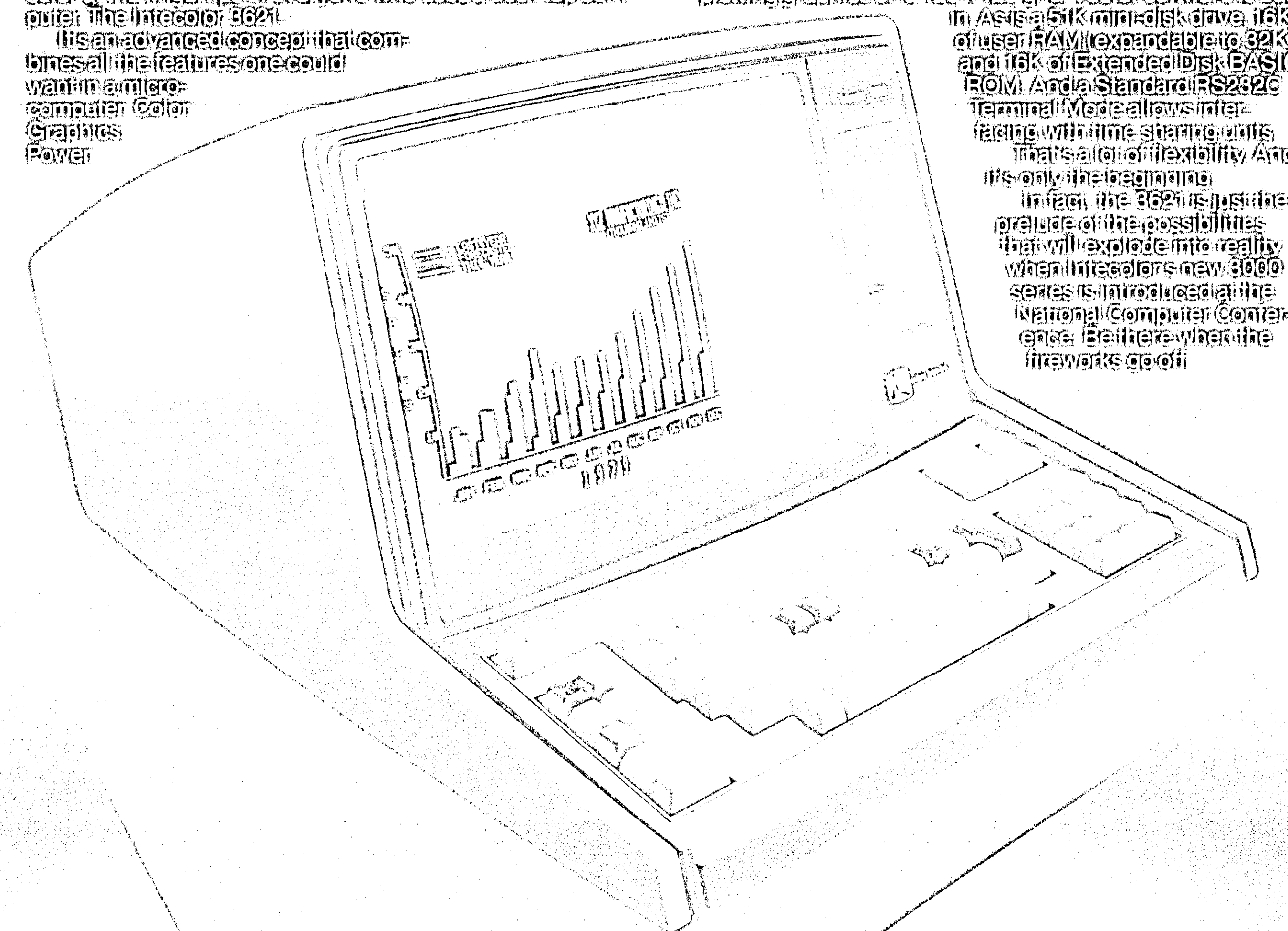

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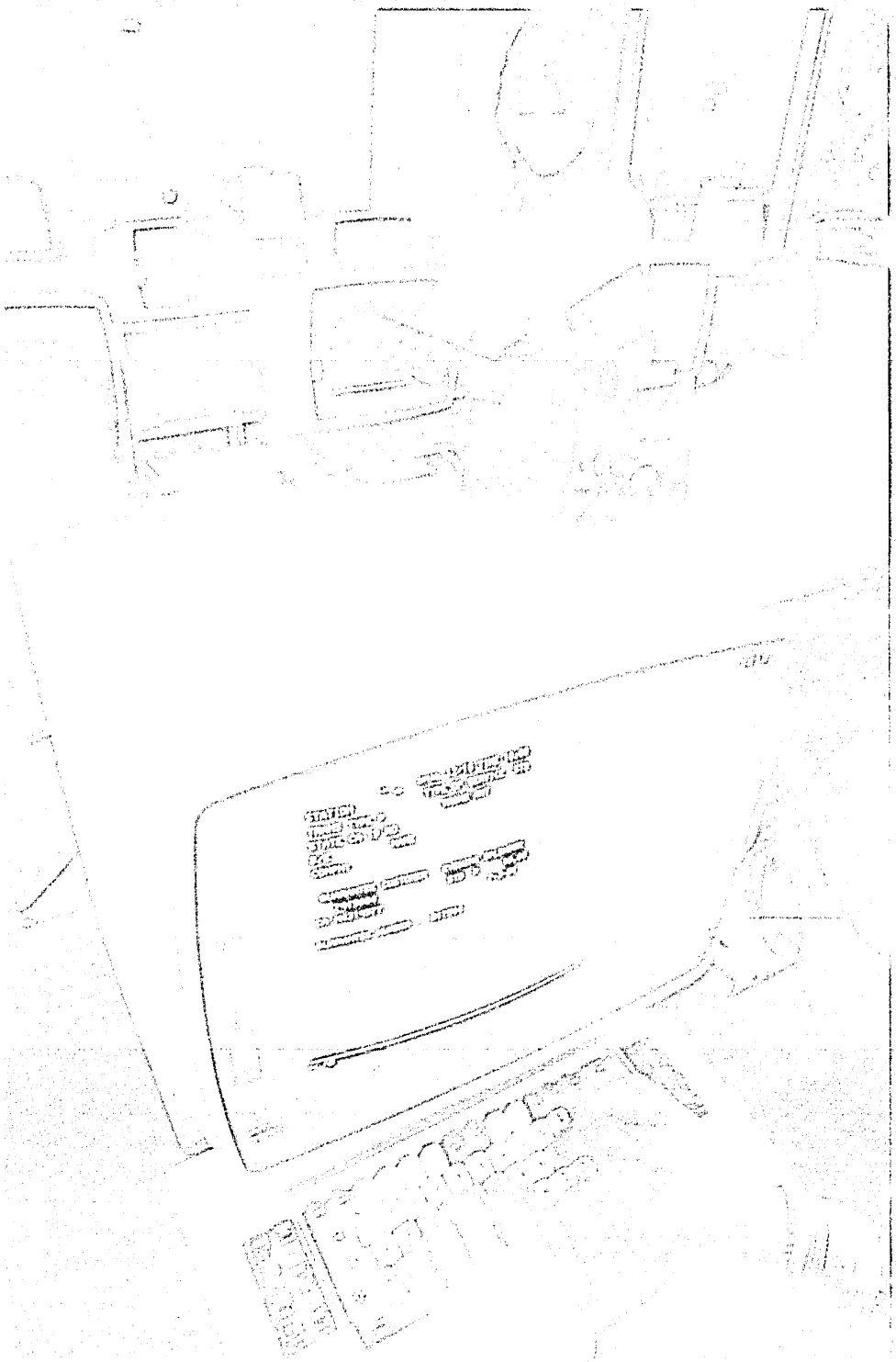

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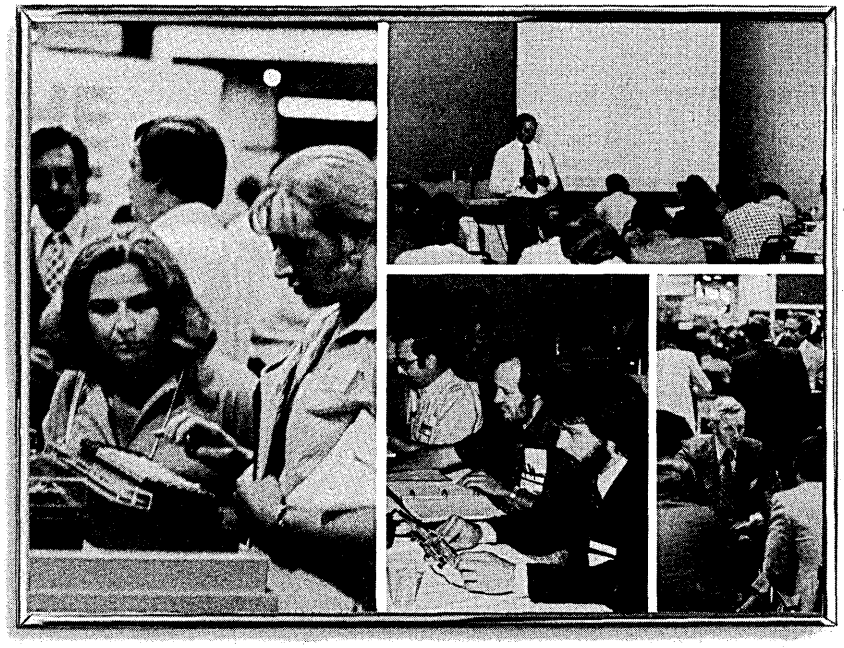

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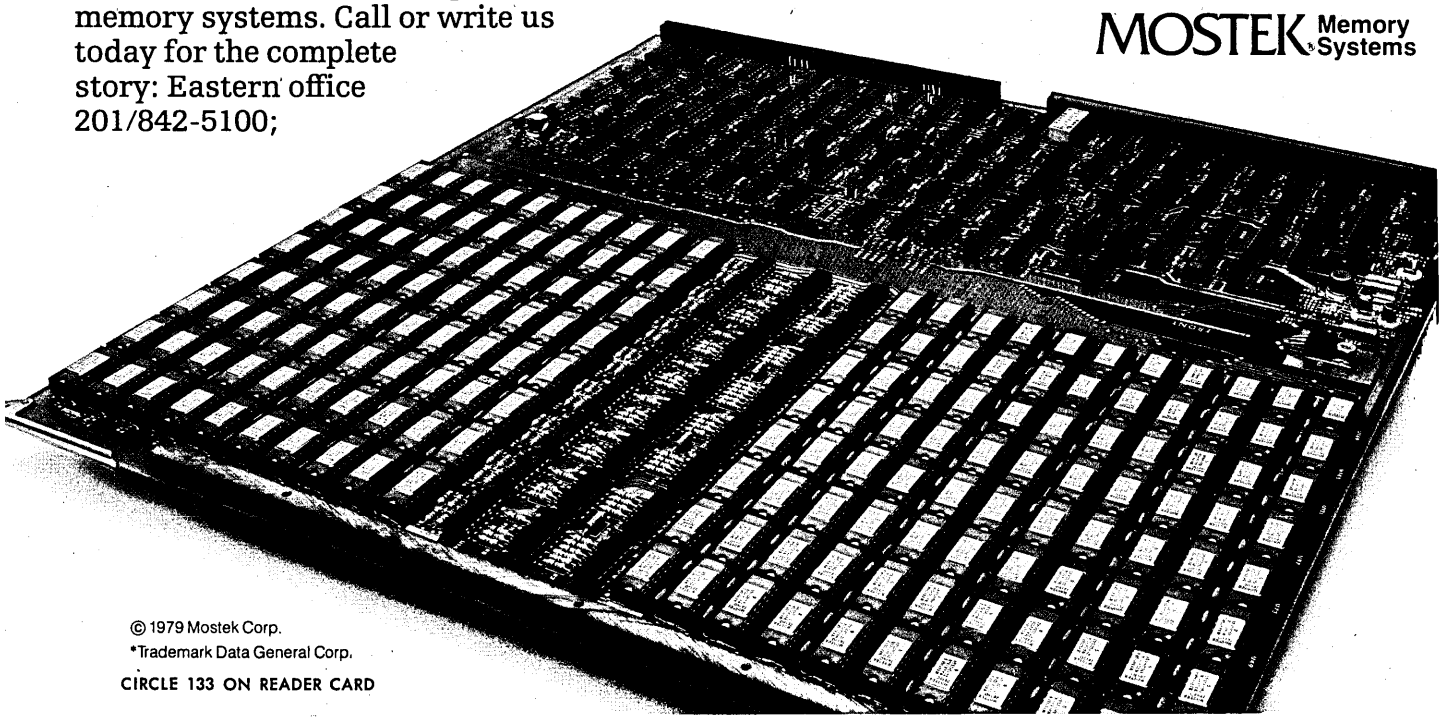

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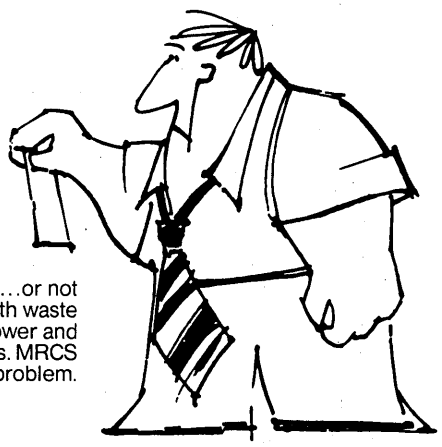

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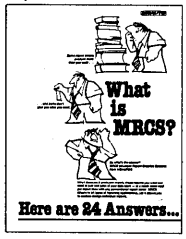

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The courts have ruled its patent invalid and it didn't have a stored-program capability—still it was the first electronic digital computer.

IN THE BEGINNING, THE ENIAC

By Nancy Stern

The ENIAC (Electronic Numerical Integrator and Computer), a World War II project that resulted in this nation's first electronic digital computer, was constructed under the supervision of John William Mauchly and John Presper Eckert, Jr. at the Moore School of Electrical Engineering of the Univ. of Pennsylvania; the project was supported entirely by government funding.

The project was a result of a direct response to U.S. wartime needs. The Army's Ballistics Research Laboratory (BRL), an agency responsible for developing range and trajectory tables for new weapons, was having great difficulty supplying these tables within a reasonable time frame. Without these firing tables, the new weapons and artillery were useless to gunners.

The BRL employed more than 200 people, mostly women, who, using desktop calculators, solved the necessary ballistics equations. Preparation of the tables for a single weapon would take one person many hours, even days.

By the beginning of the war, BRL had already received assistance from the Moore School of the Univ. of Pennsylvania. The electrical engineers at the Moore School had constructed a differential analyzer, an analog device based on Vannevar Bush's 1930 design. Moreover, the Moore School was conducting courses to train additional people for BRL work. In 1942, the lab sent Lt. Herman Heine Goldstine, a mathematician trained in ballistics, to serve as a BRL liaison with the Moore School and to see if he might discover alternative methods for improving computational speed.

At the Moore School, Goldstine met John Mauchly, a physicist who had only recently arrived at the college. Formerly a professor of physics at Ursinus College, Mauchly had, during the 1930s, experimented with many different techniques for developing and using computational equipment to solve physical problems.

In the early 1940s, Mauchly's main interest was in building an electronic analog of the mechanical desk calculator which would use vacuum tubes for storing and accumulating data. He attended a war training course at the Moore School in the summer of 1941 which was intended to teach scientists the principles of electronics. Asked to stay on as an instructor, he accepted the offer, hoping the highly competent engineers at the Moore School might help him build such a device. From 1941 to 1943, he discussed his ideas with many of the engineers, most specifically John Presper Eckert, Jr., a brilliant young graduate student.

Goldstine discussed Mauchly's ideas with John Grist Brainerd who was the Moore School's liaison with BRL. Brainerd thought Mauchly's proposed device was technically feasible. Goldstine's appreciation of the pressing need facing BRL led him to promote a proposal for such a device which was presented by the Moore School to the Army Ordinance Dept. on April 2, 1943. Within three weeks, on April 26, 1943, the Army agreed to fund the project.

On June 5, 1943, the contract was signed; Brainerd became the project supervisor; Mauchly, the principal consultant; Eckert, the chief engineer; and Goldstine, the technical liaison.

A BARGAIN IN ANY ERA

The ENIAC, as it was called, was to be a special purpose computer for solving ballistics problems, although the machine, as originally envisioned, could have far wider applicability. The first year's development cost was estimated at $150,000. In total, the project cost the Army under $400,000, a decided bargain in any era.

It is interesting to note the Army's decision to support the project was not a cautiously planned policy in which the technical features were carefully considered. Rather, the ENIAC contract reflected the government's tendency to fund

projects at reliable institutions without paying too much attention to the nature of the proposal. Because the Moore School had a good relationship with BRL and because of BRL's pressing need, the Army was willing to take a chance. But despite the Army's immediate acceptance of the Moore School proposal, technical feasibility and reliability were seriously questioned by the government's scientific agencies which were established during the war.

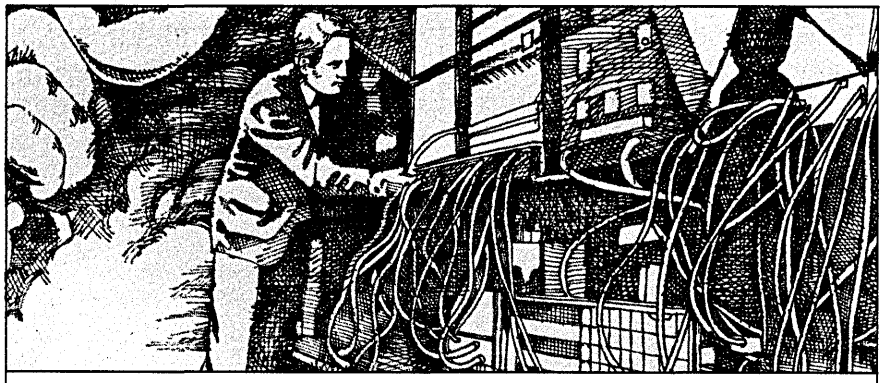
The National Defense Research Council (NDRC) was founded during the war to provide technical asistance to the government. It was composed of some of the country's most prominent engineers and scientists. NDRC was very vocal in its lack of enthusiasm for the ENIAC. Two of its members, Samuel Caldwell and Harold Hazen, along with Vannevar Bush, were pioneers in the field of analog computers. George Stibitz, also serving on the Council, was responsible for Bell Laboratories' development of its electromechanical relay computers, which, by 1943, were becoming respectable scientific instruments.

With two established computational fields, one analog and the one digital, but electromechanical, and both significantly influenced by members of the Council, it is not at all surprising the NDRC would view the ENIAC venture and its expense with some reservations. Moreover, NDRC members had reason to believe that the construction of a reliable electronic counter, the basic unit of an electronic digital computer, was not feasible. It had supported several industrial projects in this area and all had failed.

The Moore School engineers proved NDRC wrong. An electronic decode ring counter was designed by Eckert by December 1943. This counter was incorporated in two accumulators which were completed, as prototypes, by June 1944. They would perform 5,000 additions of ten-digit numbers in one second, about 1,000 times faster than mechanical calculators. The construction of these two accumulators, completed only one year after the contract was let, virtually assured the ultimate success of the project which was to include 20 such devices.

The ENIAC consisted of many different components. Several units were required to regulate and control the transmission of pulses, 100,000 of which could be entered per second. Developments in this area were based on the Moore School's previous radar work. An initiating unit was designed to control the power. A cycling unit was necessary to control the sequence of pulses.

The arithmetic units consisted of



WHAT'S IN A NAME?

The meaning of the word "computer" has changed over the last 30 years. Today it refers to a specific type of device, but in 1946 it had a looser connotation that encompassed any calculating device. Much confusion results from this shift.

I feel rather strongly on this issue because, if I am not mistaken, I was the one who instituted the semantic distinction between "computers" and "calculators." It was around 1960, and I was serving as a sub-editor of an ACM publication, when the Burroughs people put out a news release about their new *computer*, the E101.

Young computer science students of today wouldn't believe the E101 if they saw one. It was a sequenced calculating device (of large physical size and price) whose control was a *pinboard*; that is, you stuck little pins in a punched pegboard and mounted the contraption in the machine and prayed a lot. It worked after a fashion, and even ground out some useful results. The E101 *was* electronic, but no way could it be considered a computer in the same sense as the IBM 650, or 701, or the Univac I or II.

So I changed that news release to refer to the E101 as a calculator, and the Burroughs people raised hell. But ACM backed me up, and the distinction was firmly established. We drew the line this way: computers were machines in which stored instructions could operate on other instructions to modify or alter them. The distinction derives from the characteristics laid down by von Neumann, the chief one being that data words and instruction words be the same size, be stored in the same medium, and differ only in their function. As a direct corollary, the same word can be both a data word and an instruction word, at different times during the execution of a program.

Early work on calculating devices was done by Zuse, Atanasoff, Stibitz, Eckert, and Mauchly. Was the computer —that is, the machine we call *today* a computer—invented by any of these men? Stibitz, for example, being a good telephone company man, worked primarily with relays; one definition of "computer" may specify that it must be an electronic device. Atanasoff came close to describing a sequenced calculator. And so on. Those people who grew up in the Remington Rand-Univac school have talked for years about John Mauchly's memo of 1942, that gave him a clear track to the title of the "inventor of the computer." This memo is reproduced in Brian Randell's *Origins of Digital Computers*. What does this memo reveal? That Mauchly had deduced, in 1942 that operations performed electronically, as opposed to mechanical devices, would function very much faster. Is that, then, the birth of the computer? It was certainly an acute observation, and way ahead of its time, but a computer it was not.

With the arrival on the scene a few years ago of sophisticated pocket programmable machines, the distinction between computers and calculators began to get quite fuzzy. (Notice, however, that those companies that make both devices —which include Wang, Texas Instruments, and Hewlett-Packard—see fit to preserve the distinction.) It is, in fact, difficult now to cite the specific attributes that relegate the TI-58 to the class "calculator" and the PDP-11 to the class "computer." Looking at it the other way, in the years prior to about 1953 the trouble went the other way; that is, anything and everything could legitimately be called a computer, because (a) there was no confusion among those who knew; (b) the total number of people who could possibly care was perhaps 250; and (c) there was nothing to be gained by mislabeling any machine. Hence the terms "computer" and "calculator" were *at that time* synonymous, and we had the Electronic Numeric Integrator and Computer, the Selective Sequence Electronic Calculator, the Card Programmed Calculator, the Universal Automatic Computer, etc.

It is discouraging we can't, as a profession, get simple things like definitions straight. Perhaps we will never be able to fabricate a decent definition of a term like "systems analyst," but we ought to be able to pinpoint a term like "computer." If we don't, then some ill-informed judge will pinpoint them for us, and we won't like the outcome.

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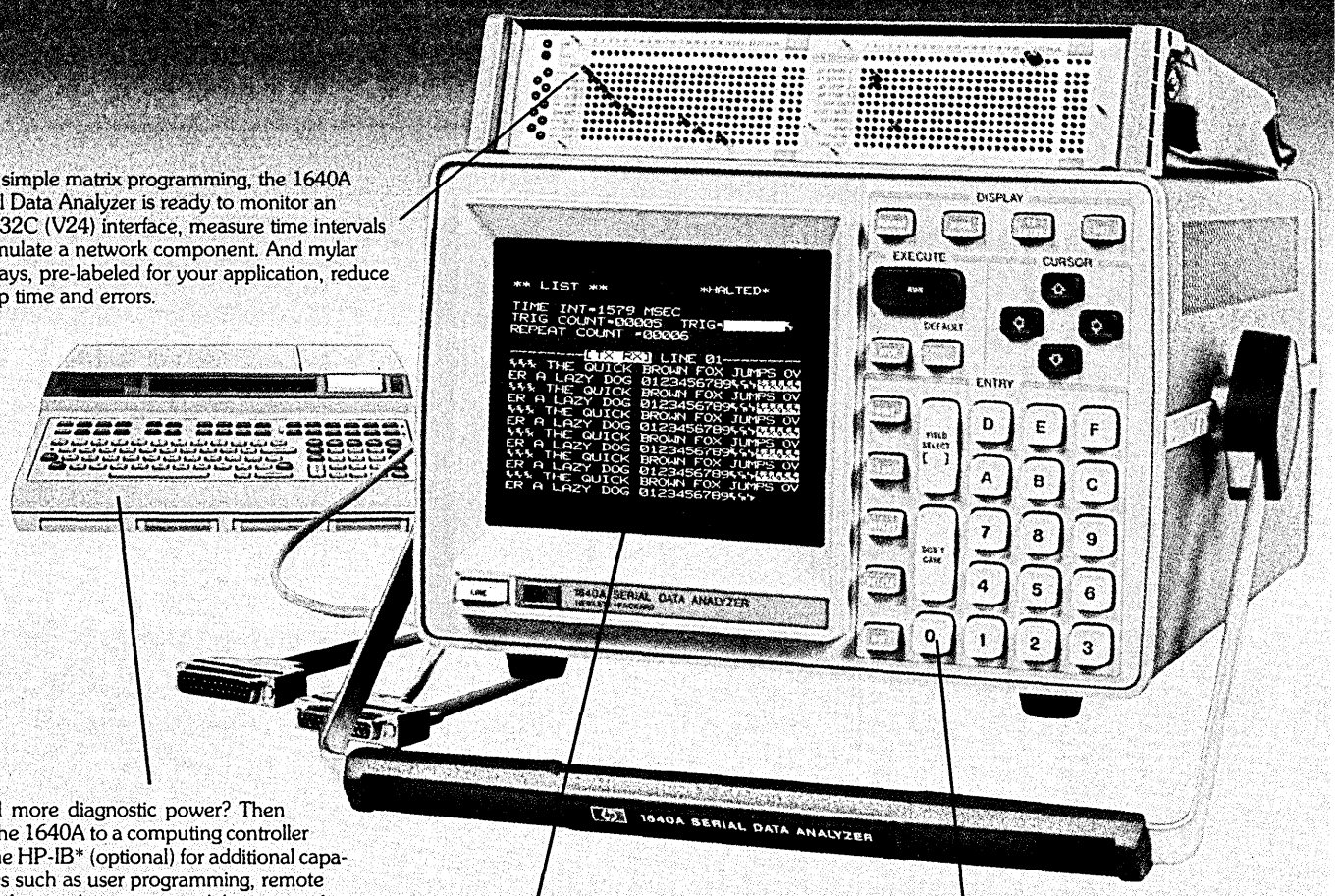

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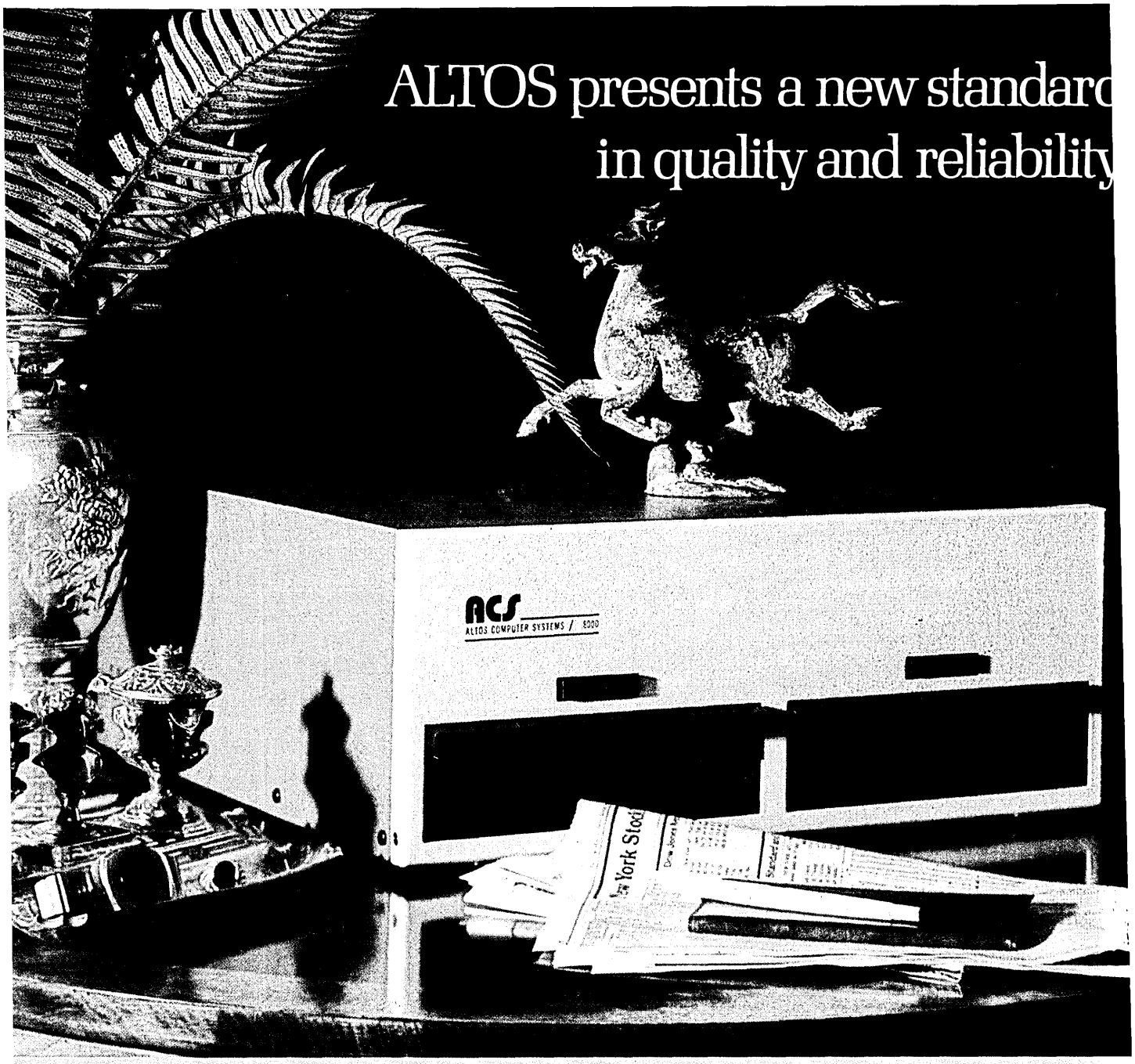

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20 accumulators which functioned as high-speed registers capable of adding and subtracting through complementation. A high-speed multiplier and a divider-square rooter were also constructed.

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Instructions were entered into the ENIAC through its master programmer, a unit consisting of plugs and switches similar to those used in an IBM plugboard. Because the ENIAC was designed to prepare range tables, one setup requiring the slow, manual setting of switches would be sufficient for several hours or even a day's work. Hence, manual setup was not considered a great disadvantage.

Thus, stored programming was not a feature in the ENIAC. Although there has been a good deal of controversy over priority claims for the invention of the stored-program concept, there is evidence to suggest that the Moore School staff had explored the possibility of incorporating automatic controls but, because of the exigencies of war, chose to develop a less revolutionary but more timely device. The December 1943 Progress Report and a disclosure written by Eckert a month later both include discussion of the stored-program concept. Because the need for stored programming for general purpose computers became increasingly evident, the Moore School undertook a second computer project in the fall of 1944 for the design of a stored-program device called EDVAC (Electronic Discrete Variable Automatic Computer).

An IBM card reader with a speed of 120 cards per minute served as the input unit of the ENIAC and an IBM summary punch with a speed of 100 cards per minute was used as the output unit. In this case, the needs of war resulted in the adaptation of existing equipment rather than the invention of faster, electronic I/O units. The constant transmitter and the printer were units developed to interface the IBM electromechanical equipment with the electronic components of the ENIAC.

In total, the computer consisted of 40 panels grouped to form 30 units, 18,000 vacuum tubes, 70,000 resistors, 6,000 switches, and 10,000 capacitors, When operating, it consumed 140 kilowatts of power.

INITIAL TEST RUN IN 1945

The initial test run on the ENIAC in November 1945 was, ironically, unrelated to ballistics problems. The urgent need for firing tables had ended a few months before when the war was over. But the need for computational equipment for war-related purposes persisted in many scientific laboratories. At Los Alamos Scientific Laboratories, many people previously engaged in the development of the atomic bomb were developing, with similar intensity, a new, thermonuclear weapon called the "Super," later known as the hydrogen bomb.

John von Neumann, an eminent mathematician, was intimately involved with the Los Alamos group and had also been working closely with Eckert and Mauchly on the design of the EDVAC, the new stored-program computer. He was largely responsible for bringing together the Moore School's ENIAC with the computational needs of the nation's top-secret research facility. For its initial test run, the ENIAC performed a series of complex calculations which were used to help determine the feasibility of the H-bomb.

On February 16, 1946, the ENIAC was formally unveiled at a special dedication ceremony. This occasion (and, later, a series of courses at the Moore School) demonstrated to the scientific and technological communities the foresight of the government in funding such a project, the preeminence of the Moore School in the computational field, the potential applications of such devices and the need for mathematicians to develop improved numerical methods which would enable future electronic digital computers to have even wider applicability. In effect, 1946 ushered in the new era of the electronic computer.

Despite the significance of this first electronic digital computer, there has been a great deal of controversy related to the ENIAC's inventive features. A 1971-1973 court case held that the ENIAC patent was invalid. Among many reasons for this decision, primary was the fact that Mauchly had derived his ideas from John Vincent Atanasoff, a physicist at Iowa State College who had constructed a prototype of an electronic digital computer which could solve up to 29 simultaneous equations.

Atanasoff, who had already developed his prototype, became acquainted with Mauchly in 1940-1941. Mauchly had visited Atanasoff and had seen his device firsthand. But it is there that the close relationship between the two men ended. Atanasoff had developed the concept of a vacuum tube machine which could solve a specific problem. He was never able to get it to work nor was he able to obtain funding for his project. Mauchly and Eckert, however were able to convince the government of the importance of such a device and were able to successfully build one. Therefore, despite the court's decision, they are clearly entitled to be considered the inventors of the first fully operational electronic digital computer.

A second major controversial issue relates to whether or not Eckert and Mauchly were key figures in the development of the stored-program concept. As noted, the ENIAC was not a stored-program computer, but Eckert and Mauchly recognized such a device could be built. Mauchly later developed a technique for using the ENIAC as if it had stored-program capability. A similar technique was implemented in the late 1940s by Richard Clippinger and John von Neumann.

Because of von Neumann's association with the Moore School and because of his eminence in the field of mathematics, his name has been generally associated with the stored-program concept. Althought he was influential in providing the logic structure for stored-program computers, the concept ought really be credited to Eckert and Mauchly as well.

The ENIAC was a major technological accomplishment of the early 1940s. It was shipped to BRL in November 1946, and was operated there until it was disassembled on October 2, 1955. ✲

NANCY STERN

Dr. Stern is Assistant Professor of Administrative Computer Systems at Hofstra Univ. She is also Assistant Editor-in-Chief of the *Annals of the History of Computing*, a journal AFIPS Press will begin publishing in July. The dissertation for her Ph.D. in the History of Science and Technology is entitled "From ENIAC to UNIVAC: A Case Study in the History of Technology."

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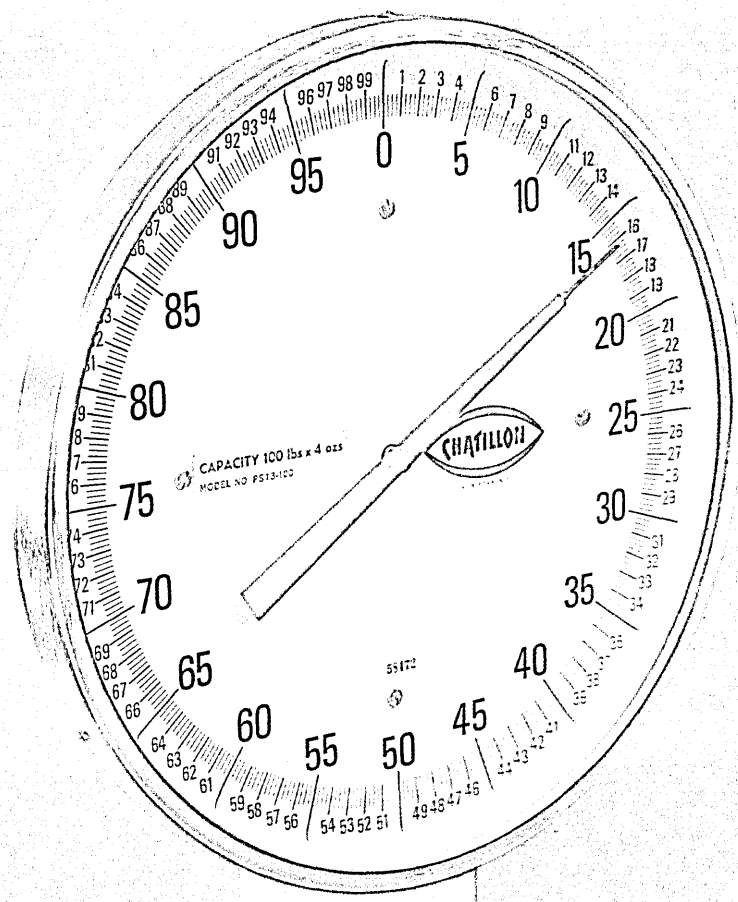

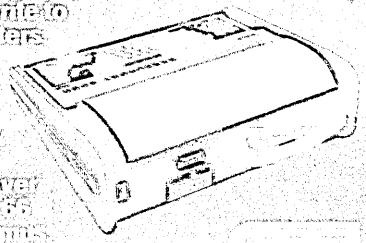

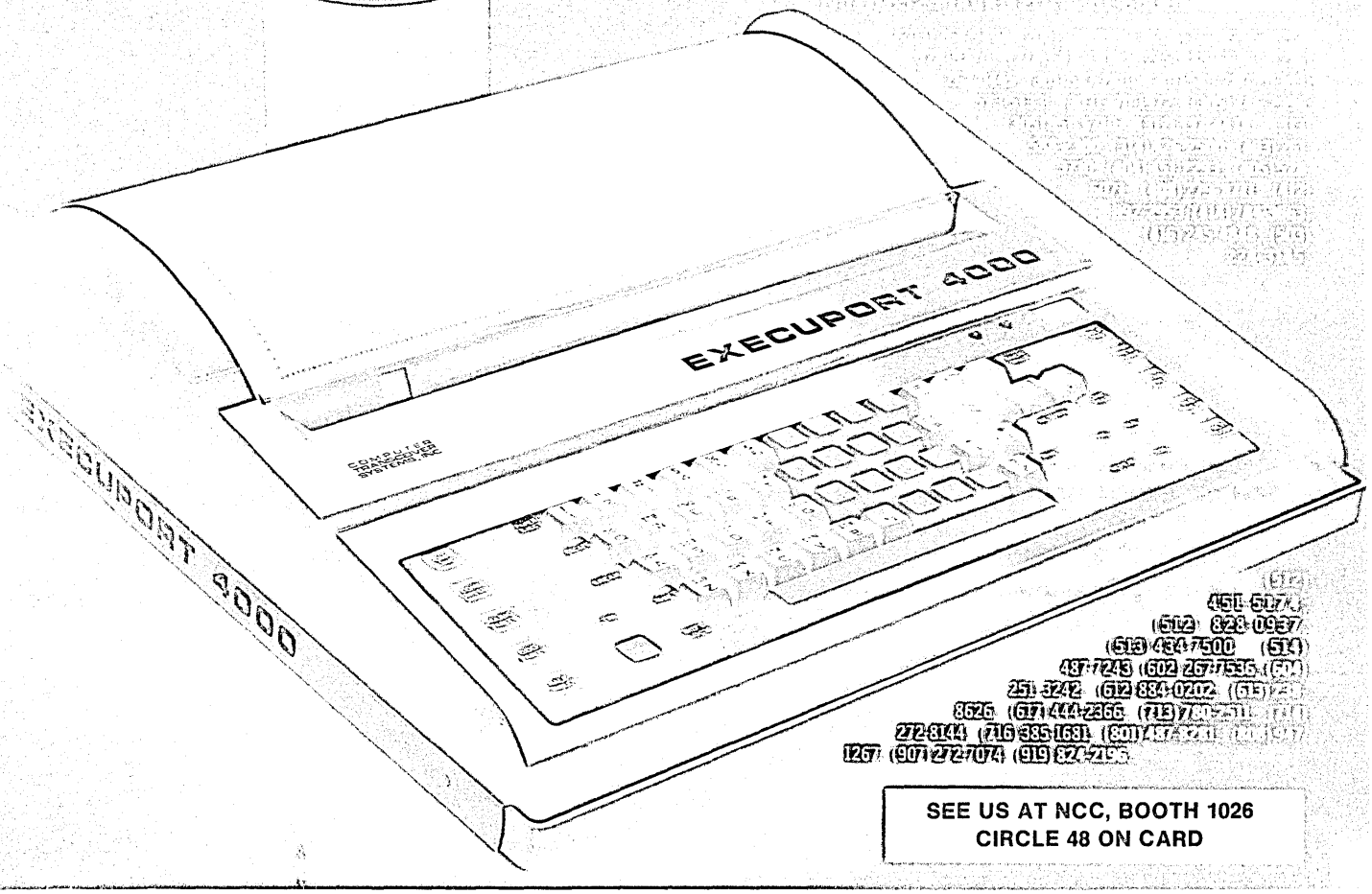

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NCR'S DUBOSE:
That's NCR's Migration Path Engineering. Your software always runs on the next larger system.

BROWN:
VRX (Virtual Resource Executive) really makes our NCR V-8550 go. Our lab program is very large and is used heavily in the morning, but only occasionally in the afternoon. Because we have virtual memory, this program resides in main memory only when it is advantageous. Otherwise, that program would choke our operation.

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VRX allows you to run up to 35 jobs simultaneously. It dynamically allocates memory and other resources. It controls virtual memory swapping. It constantly monitors for memory thrashing and program loops. And adjusts the job mix to eliminate them automatically.

BROWN:
VRX also provides Online Program Development. Our EDP manager tells me OLPD has doubled our programmer productivity.

NCR'S DUBOSE:
System dependability has been important, too.

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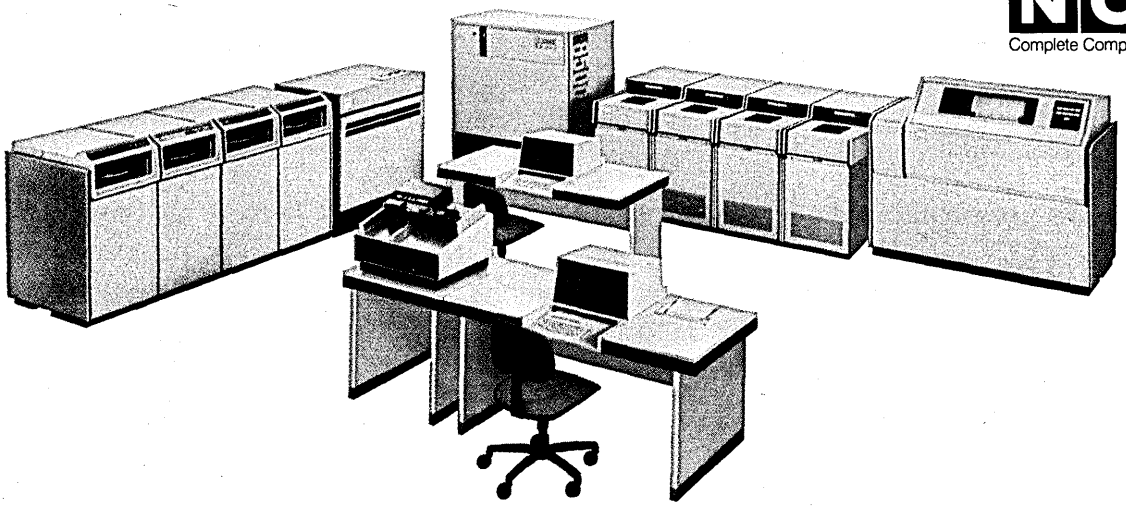

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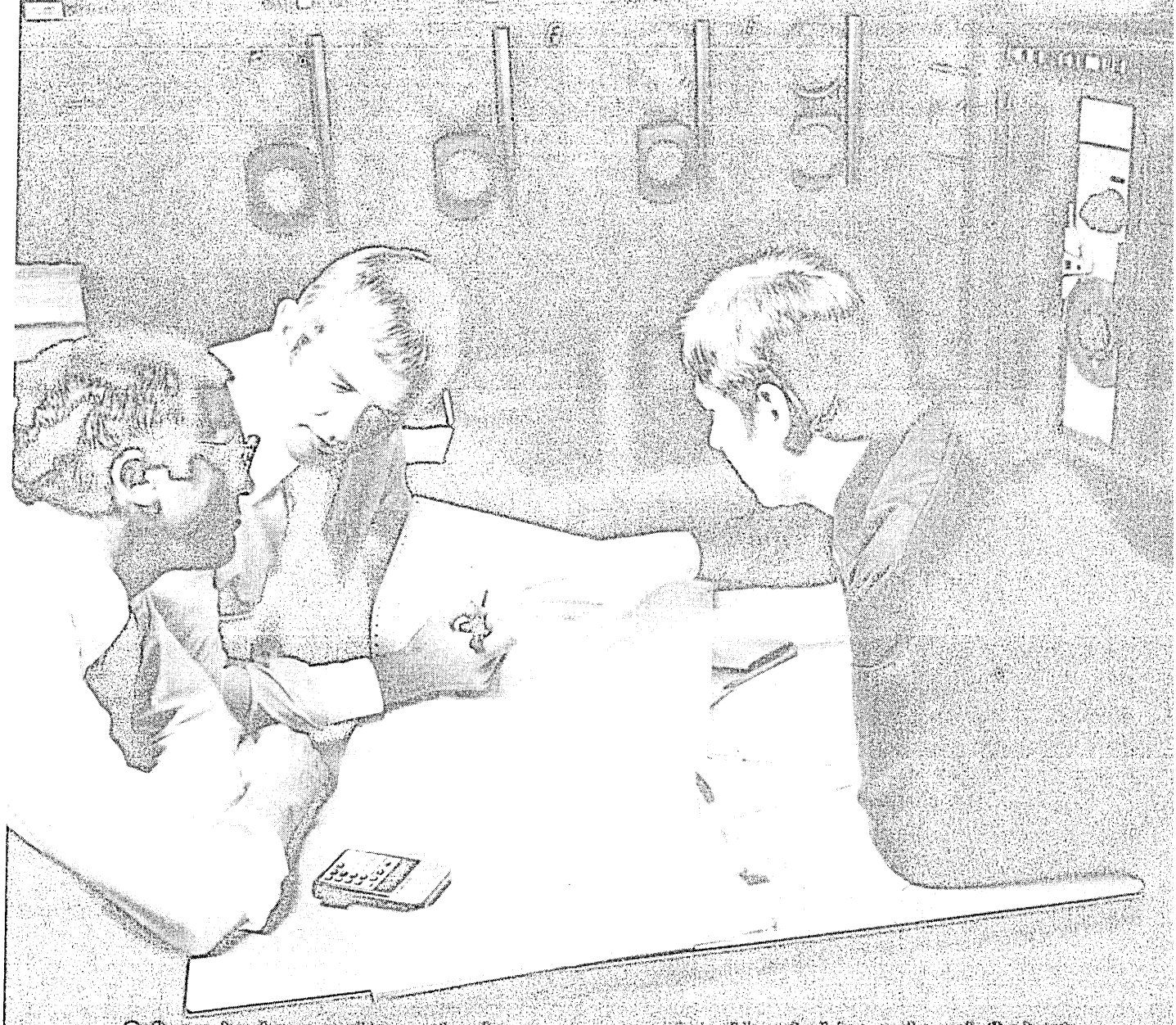

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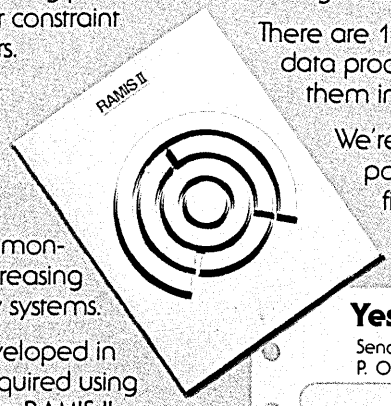

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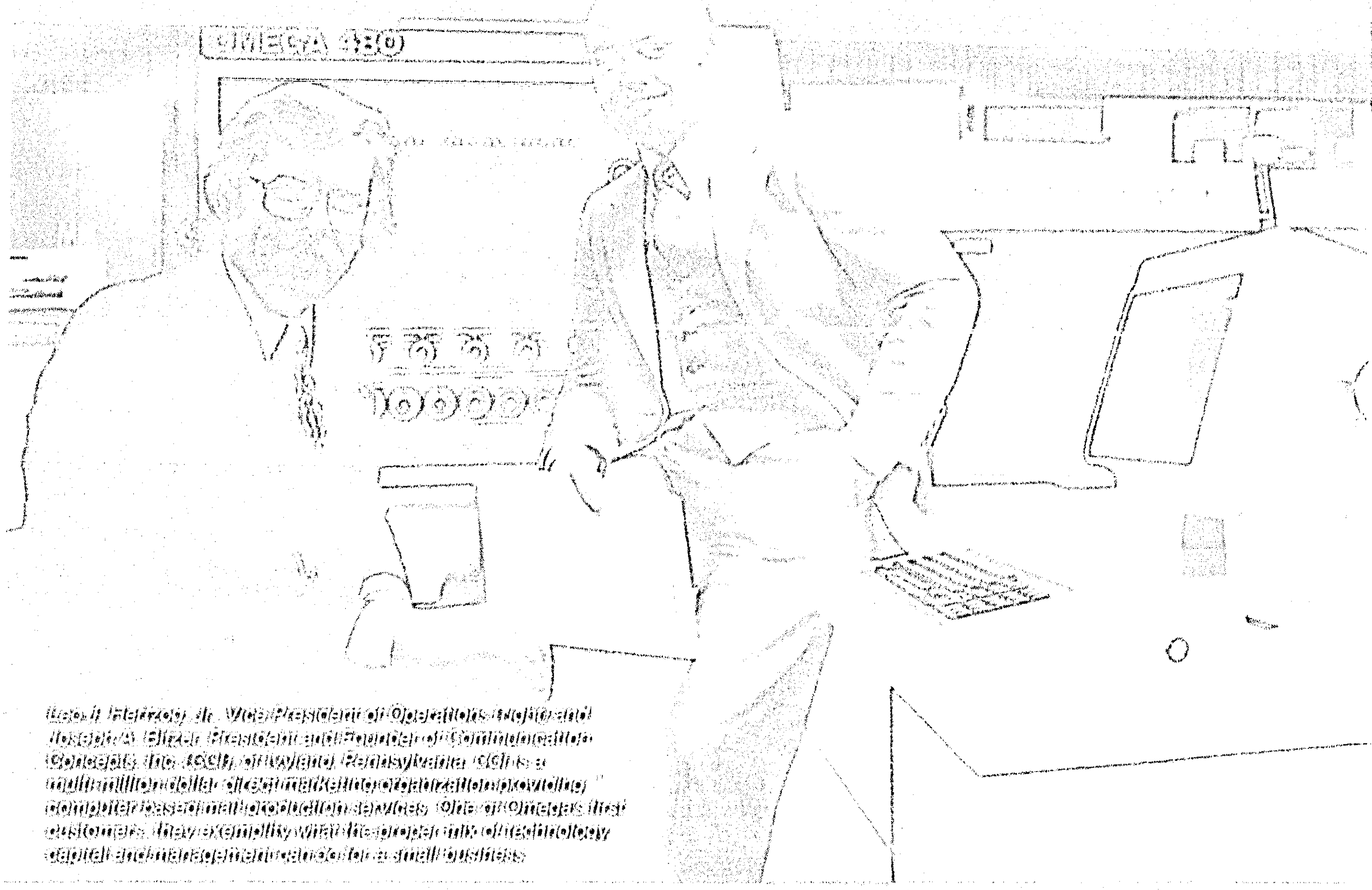

Leo J. Herzog, Jr., Vice President of Operations (right) and Joseph A. Sitzer, President and Founder of Communication Concepts, Inc. (CCI), of [illegible], Pennsylvania. CCI is a multimillion dollar direct marketing organization providing computer-based mail production services. One of Omega's first customers, they exemplify what the proper mix of technology, capital and management can do for a small business.

...it was the better business decision."

Sitzer: "First and foremost, [illegible] our decision [illegible]. You have to [illegible]."

Herzog: "Most companies of our size have problems with financing and expansion. Having a partner like Control Data to help with these problems was a big factor in our growth."

Sitzer: "That's correct. Control Data was willing to install this equipment, help us finance it and absorb the investment by credits along to us during the term of the contract. We were able to upgrade to the latest [illegible] computer resources."

Herzog: "Upward hardware and software compatibility were key. Omega 480-I gave us more throughput than a 370/158. With a field upgrade, our 480-II gives us more power than a 370/168. We're driving two laser printers, two more are on order, and 5 impact printers, using the latest releases of IBM operating software without modification."

Sitzer: "The computer is a revenue producer for us, so price/performance is important. Omega just gave us more value for our dollar than the comparable IBM equipment. But it was more economical in other ways too. We figure it needs about half the floor space, a quarter of the power and a fifth of the air conditioning."

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Perhaps Omega 480 is the better business decision for you. Call [illegible] or contact your local Control Data representative.

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PORTIA ISAACSON, CONTRIBUTING EDITOR

PERSONAL COMPUTING

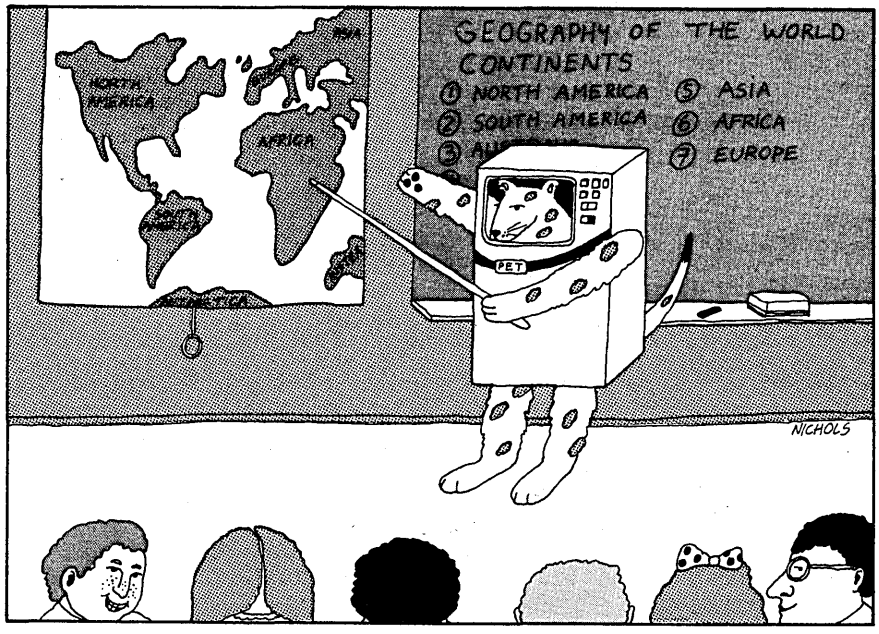
A BEVY OF BOOK BRIEFS

Our bookshelves bulge. For an industry founded in microminiaturization personal computing reciprocates by generating publications in inverse to size of the processors under discussion.

To help us check out the tomes in our ever-expanding library we called upon L. P. Davanzo, a senior statistician for the Univ. of California at Berkeley. Holder of a triple-major bachelor's degree in computer science, mathematics, and statistics, Davanzo's computer experience dates back to one of the earliest personal computers, the Bendix G15D. Herewith, his opinions on half a dozen or so books that may (or may not) find their way onto your bookshelf. ✲

32 BASIC PROGRAMS FOR THE PET COMPUTER
by Tom Rugg & Phil Feldman

Intended largely to introduce the neophyte to personal computing, Russ and Feldman present a well chosen mix of ready-to-run programs for the PET computer. Six classifications of programs are offered: "applications," educational, games, graphics, mathematical/ statistical, and miscellaneous. Each program is accompanied by a discussion of its purpose, specifics as to its use, a sample run (complete with photographs of screen displays), suggested easy changes, descriptions of the main routines and variables used, and suggestions for related projects entailing major program modification. The authors make available separately a collection of six cassette tapes together containing all of the programs described. Conceptually, the programs range in scope from the straightforward to the moderately intricate. They should attract the interest of those who are becoming acquainted with computing by means of a personal computer, as well as the initiated who seek to broaden their technical skills by means of experimentation with the potentials of personal computing. In this connection, it is worthy of note that many of the discussions accompanying the programs are intended to induce the reader to explore the subject more thoroughly. (By way of example, the sample output from the program PI—which employs Monte Carlo techniques to compute (pi)—moves one to question the quality of PET's random number generator.) The volume seems a worthwhile contribution to the field of personal computing. dilithium Press (1979, 267 pp., $15.95, paper).



PEANUT BUTTER AND JELLY GUIDE TO COMPUTERS
by Jerry Willis (with Deborrah Smithy and Bryan Hyndman)

Written in a smooth, clear style, this compendium proves an informative and diverting introduction to the fundamentals of personal computers. It addresses the essentials of hardware (e.g., cpu, memories, chips, I/O interfaces, peripherals) in considerable detail, and touches on some software considerations, while skipping overly technical discussions to the extent possible. It easily fulfills the claim on its back cover that it "is a welcome relief from the jungle of jargon and technical terms that seem to thrive like crab grass in the garden of personal computing ... contains a wealth of information that will be of interest to the experienced computer user as well (as to the beginner) ..."

Discussions of hardware basics are punctuated with descriptions of extant products, and are accompanied by a generous selection of illustrations. The volume is replete with advice respecting the practical aspects of home computing. The last three chapters, moreover, are devoted exclusively to the process of purchasing a home computer. dilithium Press (1978, 207 pp., $7.95, paper).

THE HOME COMPUTER BOOK
by Len Buckwalter

This nontechnical work seeks to introduce the novice to home computing. Beginning with a brief overview of the most significant technological developments in the industry, the book goes on to explain the very basics of computer design, and to describe some microcomputers presently available and how to assemble those that come in kit form. Software is discussed largely in terms of "canned programs" and, indeed, some 70 pages are filled with listings of BASIC programs (mostly the game-playing variety) which were written by Scientific Research, and which "can

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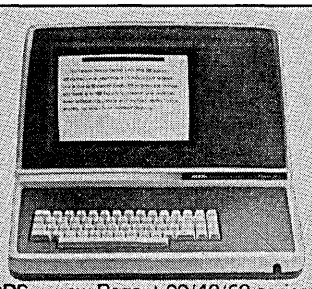

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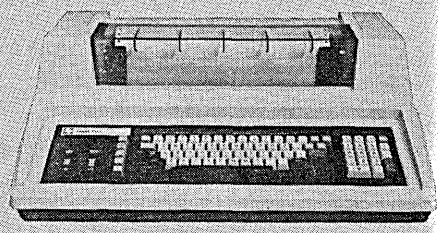

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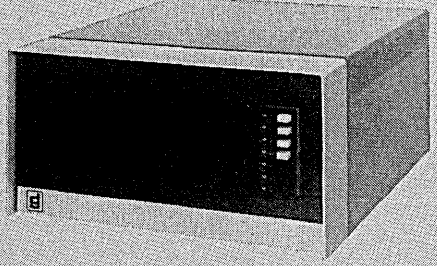

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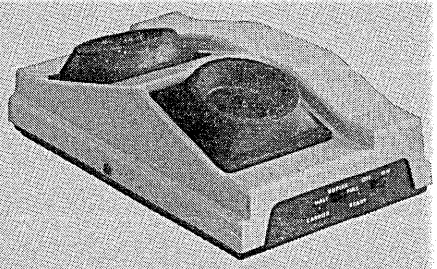

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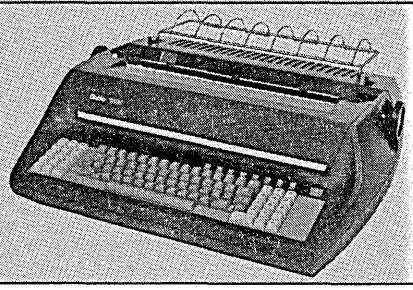

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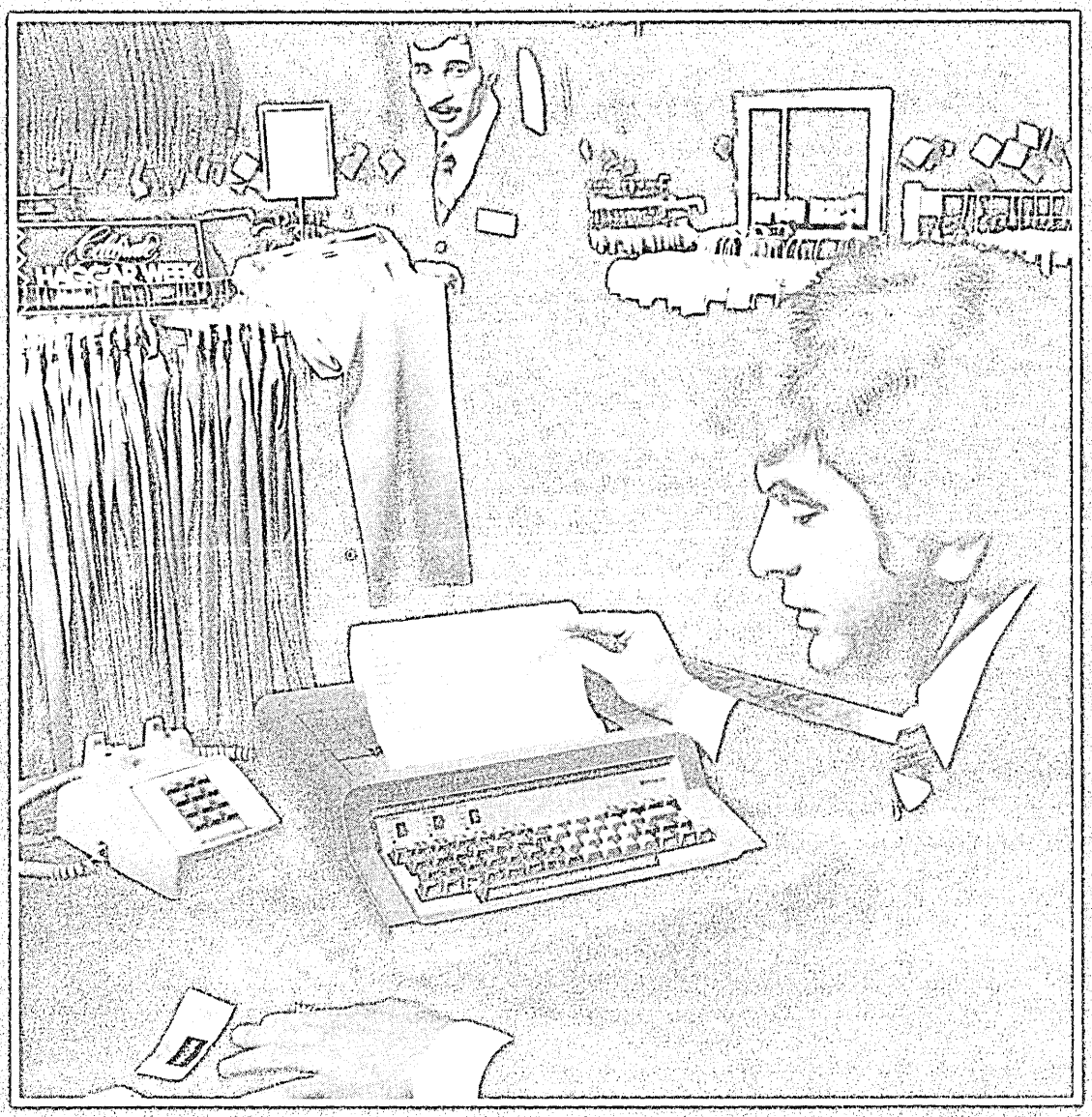

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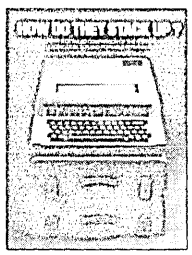

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be universally applied." (Presumably to the unspeakable benefit of the ignorant?) A 23-page glossary is followed by a "Buyer's Guide" to various products which contains such indispensable information as: "The video display screen measures 9 inches, the keyboard has 73 keys, and the memory storage will be a standard audio cassette."

It need hardly be added that the book contains more than 100 photos.

Even as an introduction to the field, this book seems overly naive and simplistic. Much of the narritive is anecdotal and not particularly informative. The most interesting chapter is probably the "Buyer's Guide," of which enough has been said. It seems unlikely that this book could attract a serious beginner. Wallaby Pocket Books (1978, 254 pp., $4.95, paper).

MICROCOMPUTER DESIGN by Carol Anne Ogdin

Intended "to show the designer who is already comfortable with the design of conventional digital logic systems how to use micros for better design results," this book provides general discusions of systems design. Althrough few purely theoretical considerations are explored, a certain computing maturity is expected from the reader. While some attention is directed toward hardware, and the hardware/software interface in particular, the focus is on software aspects. An appreciable portion of the text is devoted to the practicalities of design inplementation—project management, engineer-programmer interaction, and the like. In essence, the volume seeks to provide those who are interested in "rolling their own" with the requisite "papers"; the substantive ingredients are, of course, within the individual's purview.

Its purported audience notwithstanding, this book is highly accessible not only to systems designers but also to anyone with reasonable programming experience. It seems, indeed, to have been written more from the vantage of the programmer than the engineer. It should prove a valuable addition to any analyst's library. Prentice-Hall (1978, 190 pp., $12.95, hardcover).

THE HOME COMPUTER HANDBOOK by Edwin Schlossberg and Lyn Horton

A masterwork of prose, this volume is described by its publisher as "a complete, definitive consumer guide to the burgeoning world of home computers ... (which) covers everything you need to know to get involved in this exciting, revolutionary field ... (an) impartial book ... of tremendous value ...."

This sterling work is divided into nine chapters, spanning some 100 pages, accompanied by 150 pages of appendices.

Nine pages are devoted to the first chapter, "Possibilities—Present to Future," which provides incomparably lucid descriptions of potential uses of home computers. Among the more imaginative of these are: (a) Information Searches ("Ask the computer any question based on fact and receive an immediate answer"), (b) Personal Mapping Service ("Anticipatory Design of Personal Experience. You will find out in advance if the parks are crowded, if there are fish in the stream, the ratio of males to females at a social event, etc."), and (c) Personal Security System ("By storing heights, weights, and diameters of all your acquaintances, the home computer will tell you who is at your doorstep—friend (who will be indentified), or stranger (whose dimensions will be revealed)"). It is our sincere hope that, should you own such a security system, you will not be visited by dimensionless strangers.

In comparison, the second chapter, "Key Words for Home Computers," is decidedly anticlimatic. It does, however, provide crisp definitions of those words most frequently used in "computerese." One example will suffice: "Bit: the term used to indicate a piece of information denoting whether a place is on or off. Each bit requires a place in which a circuit is on or off."

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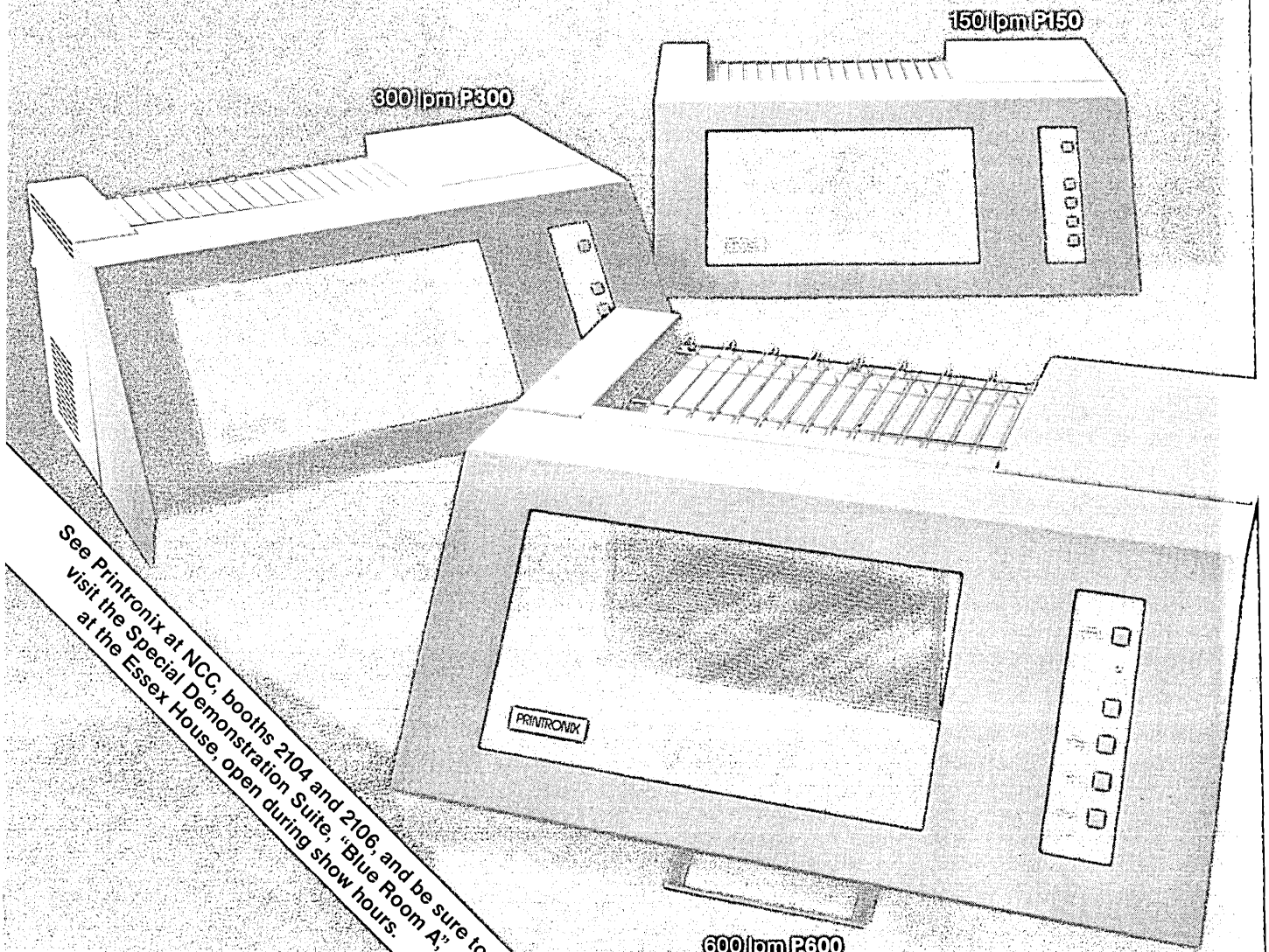

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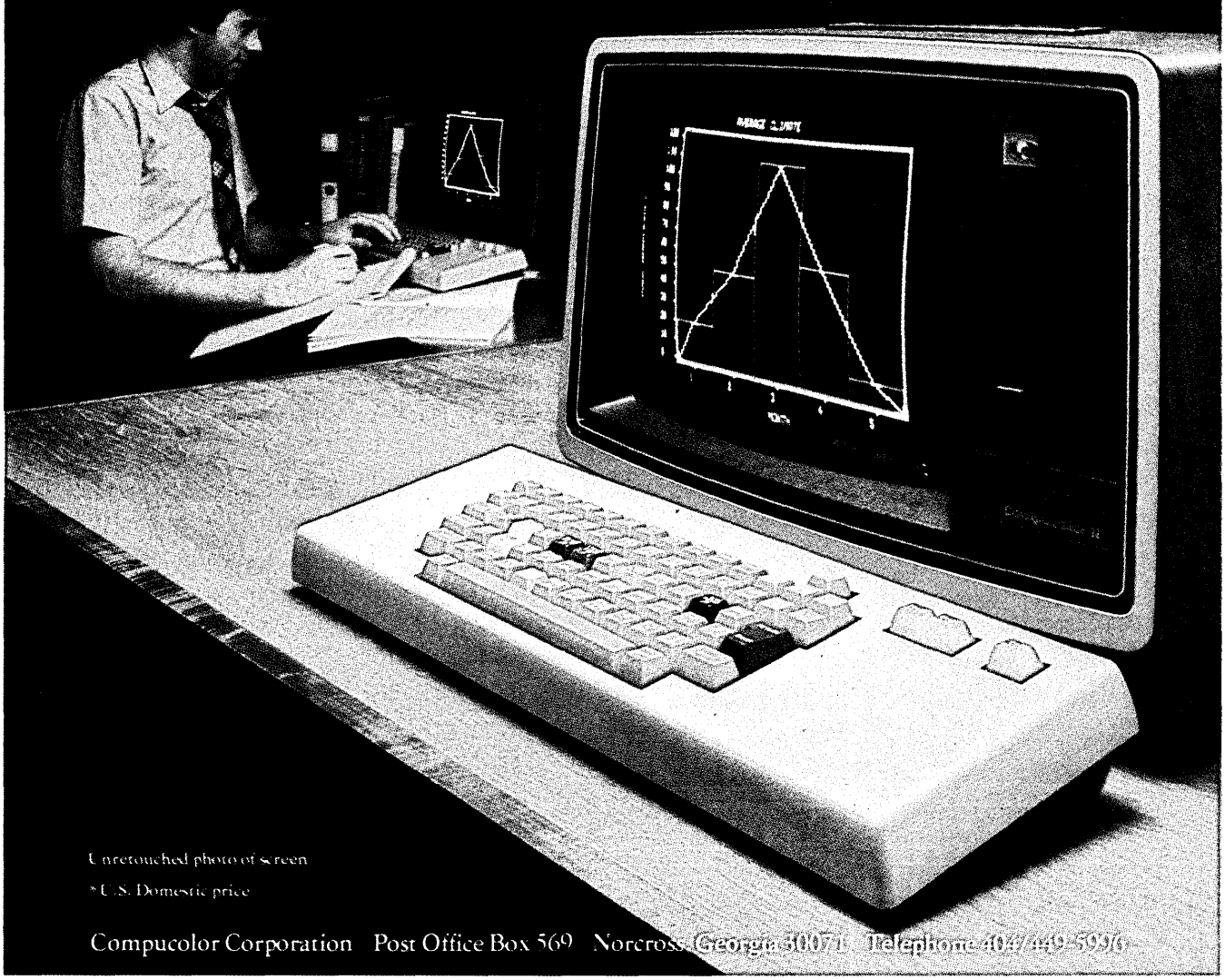

Unretouched photo of screen

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CIRCLE 30 ON READER CARD

The third chapter, "The Home Computer: What It Is and How It Works," occupies 17 pages of text, and "presents the most frequently asked questions about home computers along with their answers." It merits attentive reading. To the question "What is a computer language?" the authors provide the definitive response:

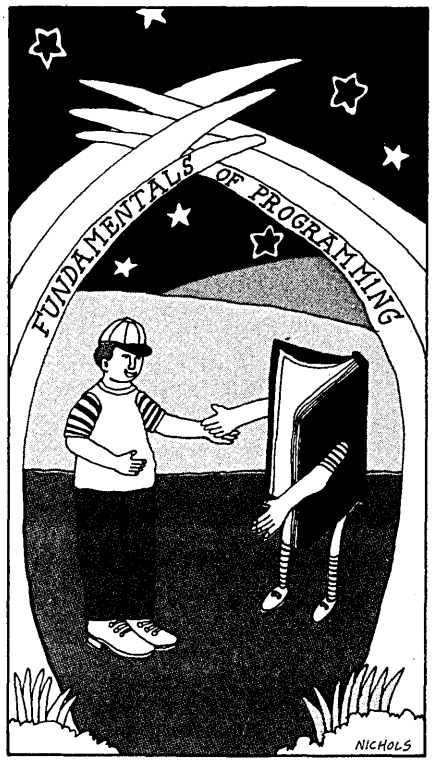
"Computer languages were developed to make it easier to use computers. They are continually being refined and improved to make the functioning of computers easier and consequently swifter. Computer languages allow you to communicate with a computer, or allow computers to communicate with each other. A programming or computer language must have a 'vocabulary' that follows a specific set of rules."

Unhappily, space does not permit the review of each individual chapter in so thorough a fashion. However, the reader will doubtless be recompensed by the immense joy afforded by exploration of the remainder of the book.

Suffice it to add that the most helpful portion of the volume appears to be Appendix D, consisting of a 17-page bibliography of books relevant to home computers. It alone should be worth the cost of the book. Sterling Publishing Co., Inc. (1978, 250 pp., $10.95, hardcover).

BASIC FOR HOME COMPUTERS (A SELF-TEACHING GUIDE) by Bob Albrecht, LeRoy Finkel and Jerald R. Brown

In keeping with Wiley's standards, this Guide is an excellent self-teaching tool which is geared effectively to the reader totally uninitiated in programming. As-



suming only the barest mathematical essentials, this workbook gently leads the reader through the fundamentals of programming using BASIC. Although it focuses on the MICROSOFT BASIC developed for the MITS ALTAIR, it does so with little loss of generality. In terms of audience, it seems particularly useful at the junior high or high school levels.

The text flows smoothly and is well intregrated. In introducing increasingly sophisticated concepts, it is careful to reinforce the relevant preliminaries. While probably too structured for someone acquainted with programming, it should be of considerable value to the neophyte—particularly the apprehensive neophyte. John Wiley & Sons (1978, 336 pp., $5.95, paper). ✲

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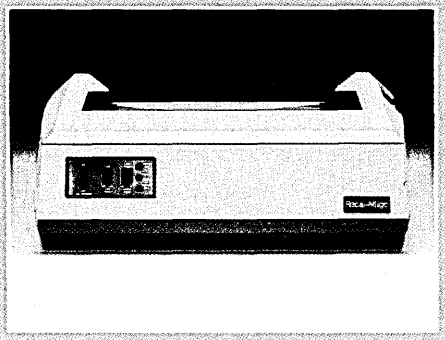

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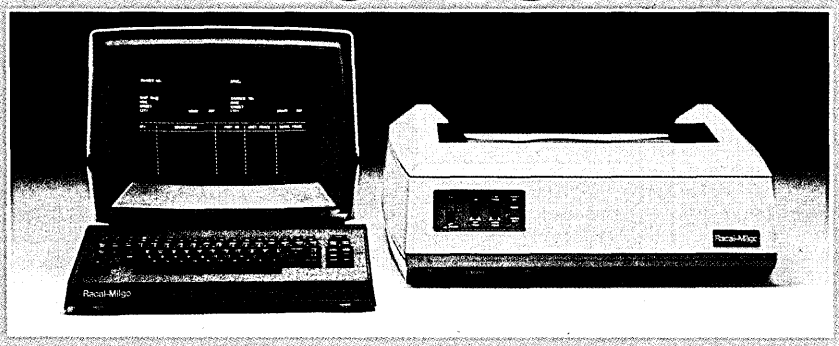

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SCIENCE/SCOPE

The first production model of a radar that can track an artillery shell in flight and determine its origin before it hits has been delivered to the U.S. Army for tests. The Hughes-built system, called the AN/TPQ-37 artillery-locating radar, is designed to let crews return hostile fire more quickly and accurately than ever before. The system erects a sensitive electronic barrier over a broad area and can detect any projectile piercing the screen. After tracking a shell and plotting its path, the system's computer backtracks the trajectory to the firing location. The TPQ-37 is similar to the smaller, highly mobile TPQ-36 that Hughes developed for locating hostile weapons.

Communications via satellite continue to cost less every year despite inflation. The International Telecommunications Satellite Organization, crediting improved technology and efficiency of its Intelsat network of satellites, has cut its monthly charge for a full-time, two-way telephone circuit by 16 percent to $960. The same service in 1965 initially cost $5334. If that charge had risen with inflation, the cost today would be about $11,000. Intelsat, a consortium of more than 100 nations, has lowered its rates for nine consecutive years. The satellites presently providing the service were designed and built by Hughes.

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A newly developed closed-cycle cooler that chills the Sidewinder missile's infrared sensor to -320 degrees F will simplify logistics support and reduce life cycle costs. The air-to-air missile's infrared eye must be super-cooled to increase its sensitivity to a target aircraft's engine heat. In the past, the Sidewinder has used an open-cycle nitrogen or argon gas cooling system that needed complex logistics support and could be turned on only for limited intervals before needing recharging. With the new closed-cycle cooler, a combat pilot may leave the missile sensor on throughout a mission with no concern for mission duration.

Under contract to the U.S. Air Force, Hughes built 10 advanced development models of the closed-cycle cooler, which are now undergoing tests. An additional 42 coolers are being built for evaluation and flights tests under an AIM-9L product improvement contract (AIM-9M) with the Navy.

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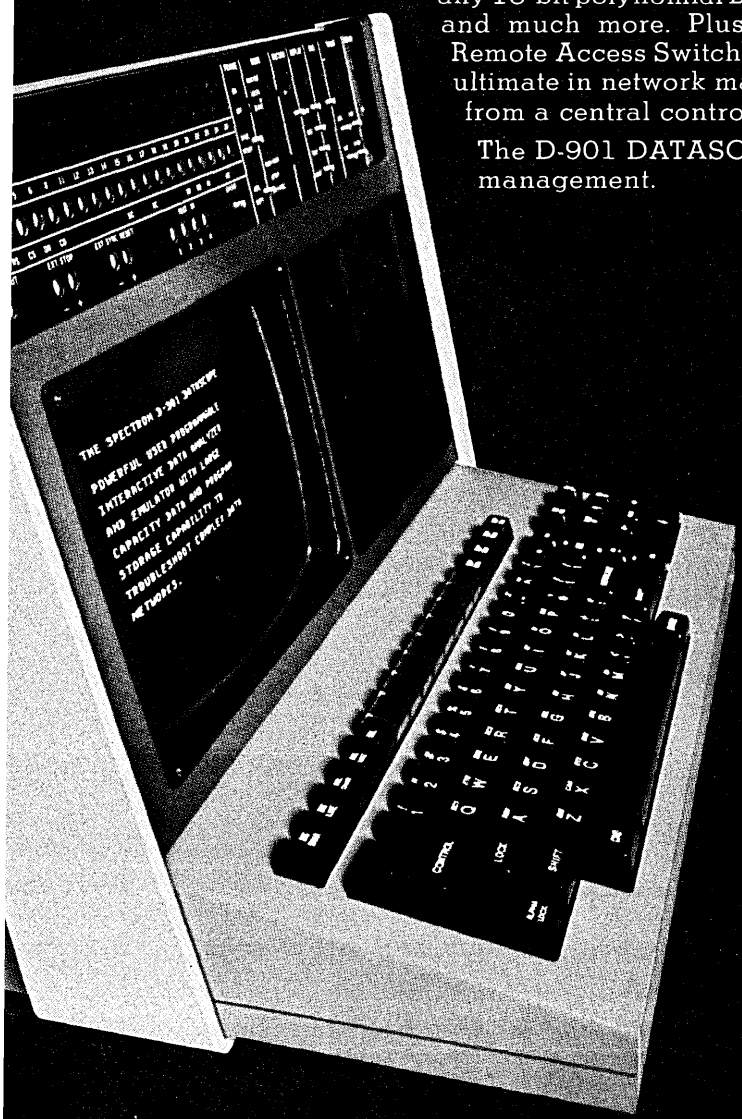

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PEOPLE

HISTORY AND THE FUTURE

Erwin Tomash is a history buff.

"I'm fascinated with things very old, things from the Middle Ages and even before," said the 57-year-old chairman of Dataproducts Corp. Among prized possessions in his office is an 1870 typewriter he found in a village in Alsace which has a removable cartridge a la a Selectric.

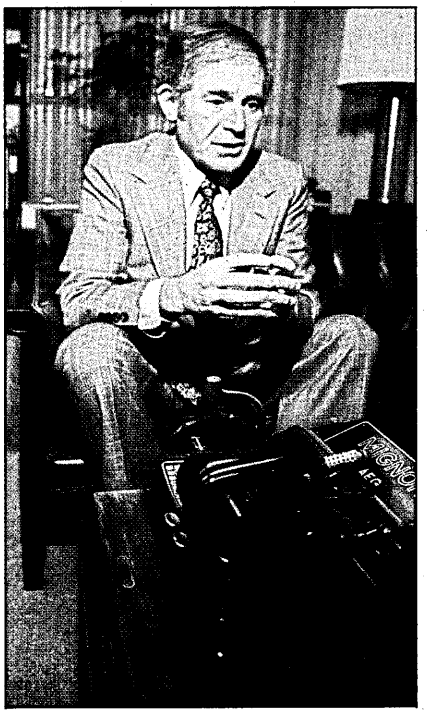
But history is more than a hobby with Tomash. He has been in the computer industry almost since its beginning, is involved in its history and would like to see it preserved. "The computer industry is unique. We have moved from an industrial society to an information society. It's happened in a lifetime and the people involved are still alive."

At first he thought he'd write a book. He enrolled in graduate courses at UCLA in 1974 in the history of science and technology and in historiography, what history is all about and what its value is. "When I took pen in hand," he said, "I realized my thoughts were jumbled, that anything I would write would be more in the nature of reminiscences."

So instead, in November 1977, he founded the Charles Babbage Institute (CBI) as a nonprofit foundation dedicated to the history of information processing. He contributed $150,000 to get it started. He had help. "People were very helpful. It's been my experience over the years that people will help."

In the spring of 1978, an advisory committee made up of historians and people in the industry, met all day and developed a set of four principles for the foundation: 1.) It is worth doing. 2.) It should be broadly based, covering the business, social and economic aspects of the industry as well as the science and technology. 3.) It should be done well and professionally and not be just a bunch of reminiscenses. 4.) It should be fun.

"We have a broad charter and we want to keep it broad," said Tomash. He said the objective of CBI is to establish, sponsor, support or conduct a fiscally sound, multifaceted, scholarly, interdisciplinary, on-going program in the history of computation, data communications, and computing and data processing machinery. He sees a day coming when Ph.D. degrees will be granted in the history of computing.



ERWIN TOMASH —"I'm fascinated by anything old."

The institute has set up an interim office in Palo Alto, with Paul Armer as executive secretary and one clerical person. A committee is seeking a permanent home on a university campus, one which possibly could share its (CBI's) director as a faculty member. Tomash said a director and an associate director are being sought. "We want an outstanding person, either a historian or an archivist—actually one of each; one would be director, the other associate director."

"We're building a big data base," said Tomash. "We want to collect stuff while it's still available and encourage its use." Will they use computers? "It would be ridiculous if we didn't use the latest techniques. We probably will have documents on microfilm and indexing on a computer ... I suspect we will use whatever network is available."

CBI is expecting support from the American Federation of Information Processing Societies (AFIPS) and has individual support from a group of Founders, 12 now and 50 hoped for, who have committed a minimum of $10,000 over a five-year period, and from industry.

Tomash has carried his enthusiasm for history into his own company. "We have a history program." Dataproducts took on as an intern a graduate student from the Univ. of California, Santa Barbara's graduate program in public history. "We liked his work so much (his masters' thesis was on the history of the first 10 years of Dataproducts) we hired him permanently." One of his projects is writing a report on how to conduct a company history project which Dataproducts will make available generally.

All of Tomash's fascination is not with the past. When he talks about the company he formed in 1962, he prefers to talk about the future. "We're dedicating all of our resources to become *the* printer company." The firm, founded by Tomash and others from Ampex Computer Products, an entity formed when Ampex acquired Telemeter Magnetics, of which Tomash was president, was first a "peripherals company; the only peripherals we weren't going to make were those made by Ampex." They first got into printers with acquisition of a Telex (then primarily a hearing-aid firm) division. Later core memories became a part of Dataproducts operations but they're phasing that out.

A FUN PLACE TO WORK

At the age of 42, Jack M. Mitchell had it made in 1966.

He'd amassed a fortune heading the manufacture of computers at Scientific Data Systems, Inc., the fabulously successful Santa Monica, Calif., company that eventually was sold to Xerox for $900 million in 1969. So in 1966, he quit. He learned to play tennis. And to fly—he bought a Cessna 206 single engine plane. And to ski—he acquired a 100-acre farm in Hartland, Vt., across the Connecticut River from Dartmouth Univ.

But Mitchell never quite abandoned the computer business. He installed a Xerox Sigma II in the den in his home in Pacific Palisades, Calif., and built a controller for a single cartridge disk. He'd have lunch every Wednesday with a group of the "old boys" from SDS in a Mexican restaurant in West Los Angeles and he did

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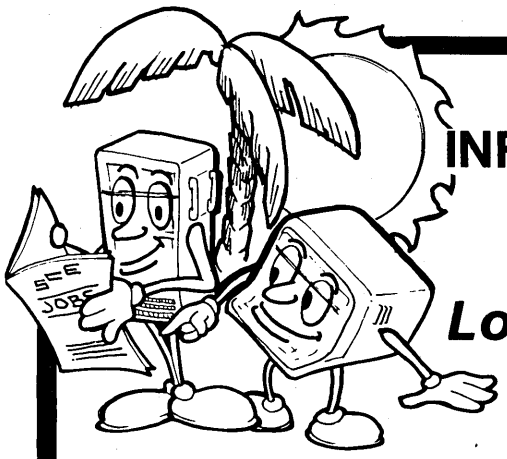

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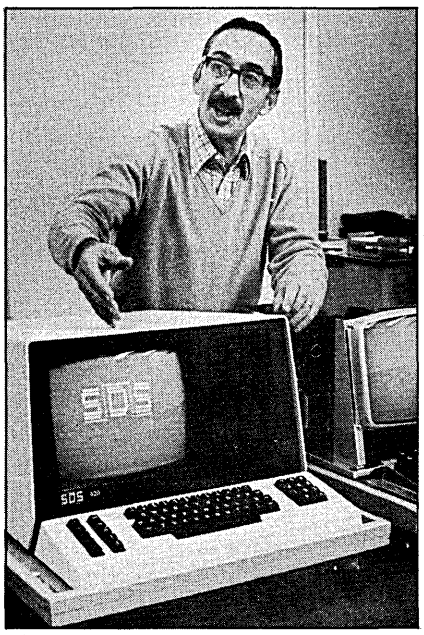

JACK M. MITCHELL — With microprocessor-based model 420.

a little consulting from some of the former SDSers who were launching startups. He also built a few controllers for the Sigma's single cartridge disk drives and two years ago he had to learn about microprocessors to help another former SDSer who was getting into that business.

Today, he's back in business full time—as the president of Scientific Data Systems, Inc., a name he acquired after Xerox let it lapse. The product is a 65-pound microprocessor-based computer for small business users, called the model 420, priced at $7,800 with 32K of memory, expandable to 56K and with a dual floppy disk drive that provides as much as 2.5 megabytes of storage, a 12-inch crt and a separable keyboard. The feature that excites Mitchell is its size. "People get excited when you walk in carrying the entire computer system," beams Mitchell, a continually smiling, easy going person whose chief memory of the old SDS was "a fun company to work for, where we were growing fast and did innovative things."

When Mitchell decided to go into business more than a year ago (February 1978, p. 206) he called his old boss, Max Palevsky, to tell him laughingly he had another great idea he hoped he'd eventually sell to Xerox. "Max took this to be a solicitation for seed money and told me, 'Jack, I don't know if I want to get into that kind of business.' I said I wasn't looking for money, I just wanted him to know of my plans to come out of retirement," said Mitchell.

"A few months later, Palevsky called and said, 'When are you going to send me the stuff (the business plan)?'"

Palevsky became an SDS backer, along with Arthur Rock, the former SDS chairman, and Dan McGurk, the original SDS marketing whiz. Last month Palevsky was named chairman of the new SDS, "a post he cherishes, because now when he's interviewed for magazine articles there's a title to go after his name." Previously Palevsky had been called, "Max Palevsky, Intel" (in reference to his holdings as an investor in that semiconductor organization).

Mitchell feels, though, that the most important investors are those working with him at the company, many of them from the old SDS, including Bill Scheding, secretary and vice president, and Henry Herrold who will head engineering. The company has received a lot of publicity because of its name and a recent article in *Fortune* drew a lot of inquiries from former SDS field engineers who would like to do maintenance on his systems. "As I said, the old SDS was a fun place to work and they want to get in on the fun in the new company. And I intend to make it a fun place to work."

The 420 uses a model 6502 chip set made by Rockwell International with a very fast instruction time of from 1 to 3.5 microseconds. Mitchell's company has applications software in place, which it will offer customers at no charge. ("Software is so easy to copy, you offer it for free so there's no percentage in copying it.") The business plan was to name 35 dealers in the first year (which began Jan. 1) and to sell 250 machines. In March it had lined up only two dealers, but had orders for 150 machines. Later the company will offer a multistation version as an upgrade path for customers. Several 420s on the same bus driver would share a common hard disk system in file management applications.

After his many years of "retirement," Mitchell admits the pace of running a startup is taxing. He comes in at 8 a.m. and leaves well after 6:30 p.m. He used to carry piles of paperwork home in large envelopes. But for his 55th birthday earlier this year, his sister-in-law presented him with a briefcase, his first. "I feel I've arrived," he says.

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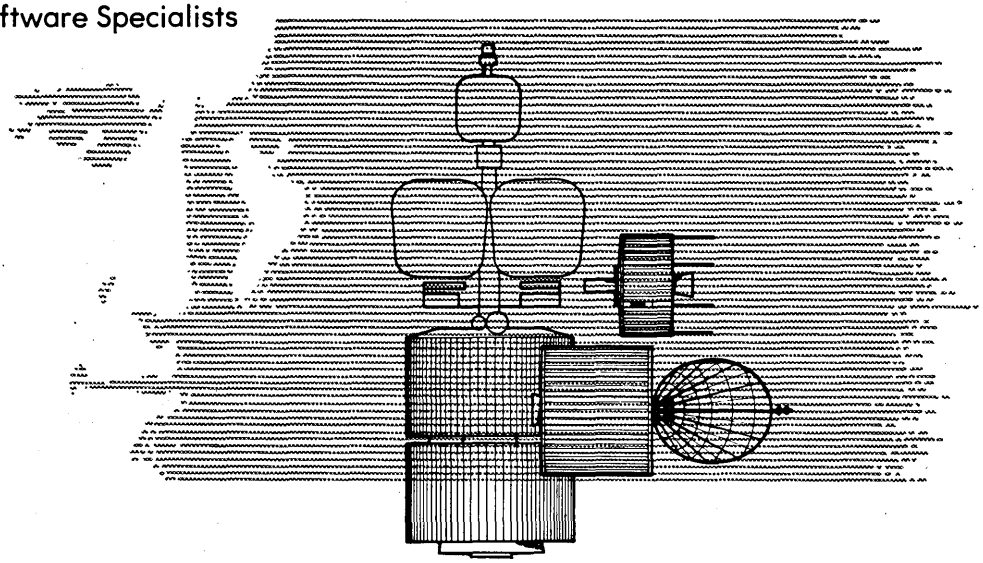

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CIRCLE 250 ON READER CARD

But he's hedging his bet. He also believes a recession is due. "Possibly in the fall of 1980."

He feels his insurance against recession damage will be customer loyalty. "In a recession, who buys computers?" His firm, Compusource, sells computers —Data General Computers. "We're the largest Data General oem in Southern California." The company also sells software packages nationally.

But he sees the trend of the future, a recession-ridden future, as belonging to companies providing turnkey—"and I don't like that term but I can't think of another"—systems.

Compusource's customers are oem systems houses and small business end users. "To these end users, support is the thing," said Tilbury. "I've seen too many firms lose customers because they went to outside software houses for help. The loyalty ends up going to the software house whose people are around when the customer needs help."

He's counting on customer loyalty to carry Compusource through any kind of recession which might come. "We've never lost an account." He said Compusource has some 100 small business turnkey systems installed and has sold approximately 300 discrete packages, mostly in the east and in Canada.

HAL TILBURY — A computer for every company.

The former IBM salesman who sold System/3 before going into his own business, feels his former employer is "making big mistakes" in going after the small systems user and "I hope they keep on making them."

He pointed to lack of programs for the Series/1 and a "significant insignificance" in the oem prices announced for the Series/1, as a reason why they won't make it in the small-side market. "Most oem's will give them only a passing glance, he said of the oem price lists from the gray giant.

Tilbury is counting not only on the proliferation of computers among small companies for his firm's continued success but on a perceived coming together of data processing and word processing.

"Where you have both a computer and a typewriter," he said, "it's natural to hook them up. It's economical to add word processing to an existing computer operation, far more economical than buying a standalone word processing unit."

His company sells a software product called Wordpro, a package he said will run on any Data General computer and will permit data processing and word processing to be run simultaneously against a common data base.

"We don't sell word processing," he said. "We are dealing with first-time users and to them the impact of data processing is more dramatic and word processing takes a back seat. But we mention it and we're sure it's something they consider in making a final decision." ✱

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Functional Designer / Programmers

—to participate in and possibly also lead a design/development team in the functional definition, detail design and eventual development of software applications for a large Management Information System. Will prefer COBOL programming (experience with data base related systems).

Data Base Management

Immediate openings include at least one group leader and several moderate level individuals with a capability for defining data base schema for the MANAGE DBMS system, preparing data base design documents indicating the interrelationships of various record types, files and elements of a data base of national proportions. Experience with the MANAGE data base operating system preferred, as would be experience with large data base systems.

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CIRCLE 243 ON READER CARD

HARDWARE

OFF-LINE

New developments in magnetic bubble memory research were presented by AT&T and IBM researchers at the International Conference on Magnetic Bubbles (sponsored by the Magnetics Society of the IEEE). Andrew Bobeck, a Bell Labs pioneer in the field, described a method for eliminating the coil windings used in existing devices to rotate the magnetic field that moves the bubbles around their predetermined paths. Bobeck and his team cut the size of their package by a third by replacing coil windings with one or more wafer-thin conducting layers punctuated with oval-shaped holes. A current applied to the conducting layer causes the bubbles to move -- at up to 10 times the previous speed.

IBM researchers reported on two projects leading to denser bubble memory chips. One project developed a working test chip storing bubbles one micrometer in diameter (2- or 3-micrometer diameters are used conventionally). The small diameter is made possible by using "contiguous disk" circuit patterns to guide the bubbles; the bubbles trace a path along the outside edge of the guides, instead of under the guide as in conventional devices, removing constraints placed on bubble size by current technology that limits bubble size to the width of the guide it passes under.

Another IBM research project lead to a fourfold density increase through the two recognizably distinct types of bubbles. The group built operational 15,000-bit devices using chevron guides half as tall and half as wide as usual, resulting in a density of 3.3-million bits per square centimeter.

8-INCH RIGID DISK

Packaged in a unit said to by physically interchangeable with popular 8-inch floppy drives (down to the screw holes), this vendor's initial entry into the hard disk market comprises drives with 9MB, 27MB, and 45MB capacities. The oem drives are intended for use with small mainframes, minicomputers, and microcomputers. As many as three nonremovable platters are used in each drive; each recording surface has an unformatted capacity of 8.7MB. The drives use Winchester technology, with the disks, heads and positioner environmentally sealed in the lower half of the unit. The rigid disks have average access times of 45msec and rotational speeds of 3,600rpm. In 1,000-lot quantities, the 27MB drive sells for $1,350. An optional intelligent controller board goes for $500 in the same quantities. The controller is said to allow a choice of a number of hard-sector formats, and it can support up to four drives, direct or buffered data transfers, and error correction. Evaluation units are slated for availability next month, with production shipments expected by year's end. MICROPOLIS CORP., Canoga Park, Calif.

FOR DATA CIRCLE 351 ON READER CARD

MAINFRAMES

IBM's E-Series announcement may be a tough act to follow, but this PCM, playing by the established rules, has countered with three new machines offering more for less. The smallest of the new offerings, the M80/32, is said to provide three times the performance of the IBM 4331 at roughly two-and-a-half times the price. Next, there's the M80/42, priced $10,000 over an IBM 4341, and offering 10% more performance. At the top, there's the M80/43, with 30% more kick than a 4341, and a price tag $50,000 greater. All of the M80s run processors with 100nsec processors and use 600nsec memory. Memory prices for the new processors have been brought into line with the IBM-established standard of $15,000 per megabyte. The /32 can have from three to six channels, the /42 from three to 16, and the /43 from six to 16. The two larger machines have cache, 16KB for the /42 and 32KB for the /43. Maximum memory sizes are larger than IBM's offerings: 8MB for the /32, and 16MB for the /42 and /43. The vendor plans to lag IBM's initial shipment dates by three months to make sure its microcode is totally compatible with IBM's. Existing M/80s can be upgraded. The M80/32, with 1MB and three channels, sells for $185,000. The M80/42 goes for $275,000 with 2MB and three channels. A 2MB M80/43 with six channels sells for $315,000. Additional channels are priced at $5,300 each. Availability is slated for the second quarter of next year. MAGNUSON COMPUTER SYSTEMS, Santa Clara, Calif.

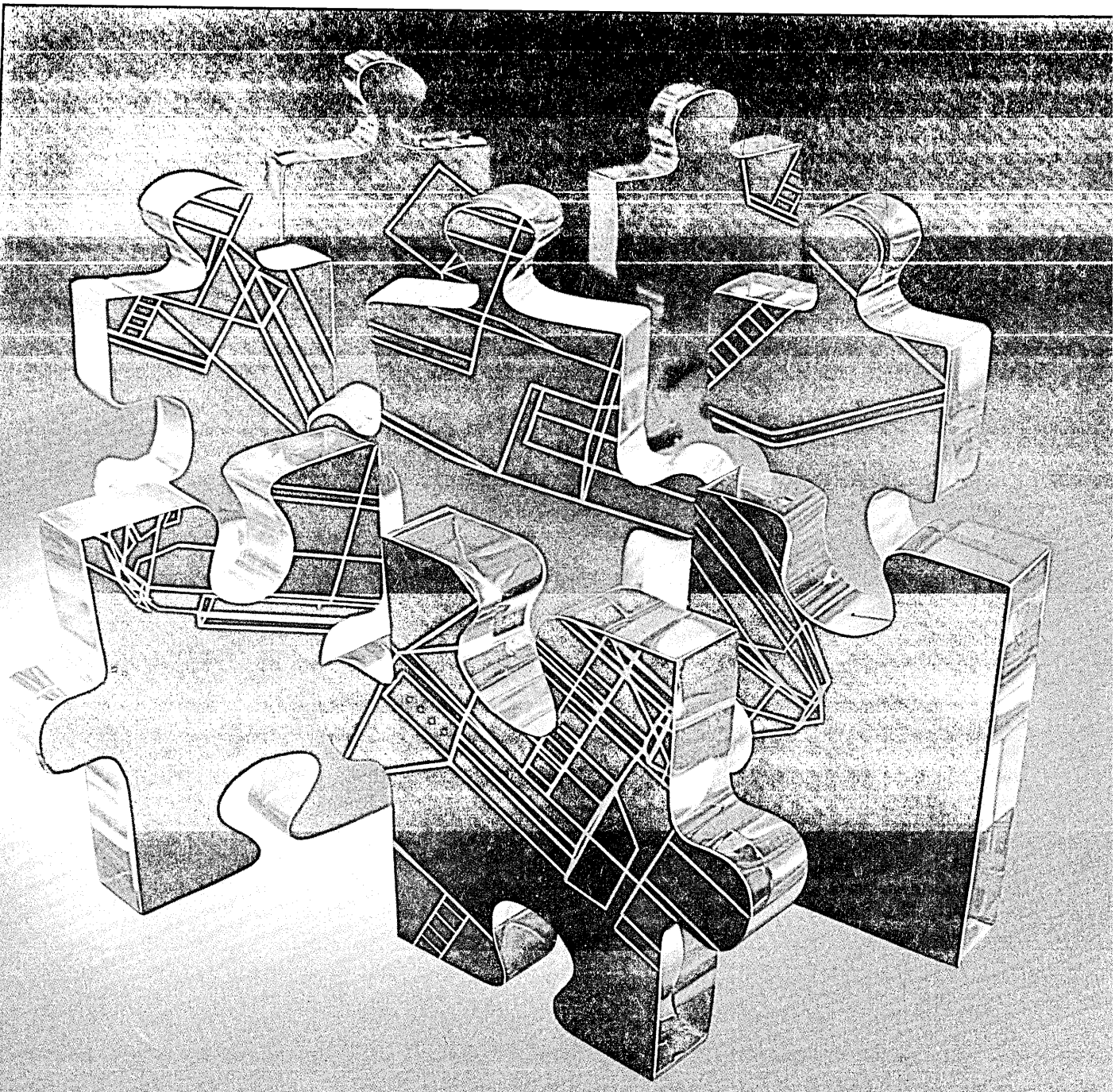
FOR DATA CIRCLE 352 ON READER CARD

TRANSACTION TERMINAL

The Computer Communications Group of TransCanada Telephone System has come up with a short inquiry/response transaction terminal with a target tariff rate of $29.50 per month. Known as Vu-

tran, the terminal communicates in ASCII at 300bps via an internal originate only modem. The microprocessor-based terminal, not much larger than a telephone, has a 16-character LED display, 20-button keypad (10 numeric and 10 function keys), and a magnetic stripe reader (ABA Track II) for financial applications. An integral memory of 452 characters is partitioned into 254 characters of transaction data, 89 characters of protected data, and 109 characters for telephone numbers used by the modem's autodialer. Vutran can work on the Datapac packet switched network, the regular telephone switched network, and on two point private lines. Outside Canada, Vutran will be marketed by Northern Telecom Ltd. THE COMPUTER COMMUNICATIONS GROUP, TransCanada Telephone System, Ottawa, Ontario, Canada.

FOR DATA CIRCLE 353 ON READER CARD



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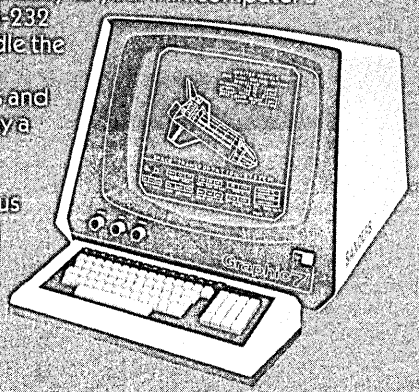


CIRCLE 53 ON READER CARD

MICROCOMPUTERS

Designed as upward compatible complements to the existing LSI-11/2 and PDP-11/03 microcomputers, the new LSI-11/23 and PDP-11/23 use the same bus structure and card size as the half-width LSI-11/2 while providing the full PDP-11 midrange (11/34) instruction set. An optional floating

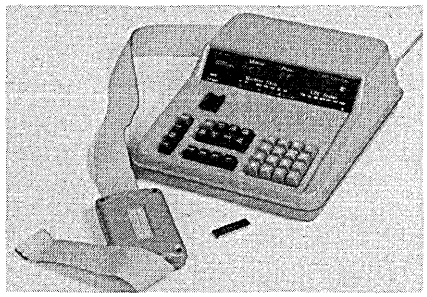
point processor chip for the LSI-11/23; depending on configuration, the new microcomputers are anywhere from two to five times faster than existing LSI-11 products. The PDP-11/23 is a packaged version of the two-board LSI-11/23.

The new processors sport main memories ranging in size from 64KB to 256KB. The processor cycles at 290nsec, while the memory runs at 500nsec (210nsec for access). At the board-level, the new machines are compatible with the LSI-11/2, and they are plug-level compatible with PDP-11 minicomputer I/O devices. The processors can run the RSX-11M and RSX-11S operating systems—previously available for mid-range (or larger) PDP-11's—or they can run the LSI-11 's RT-11 operating system. Programming languages include assembler, FORTRAN, and BASIC. The Octal Debugging Technique (ODT) is included in firmware. In lots of 100, the LSI-11/23 sells for $1,758 and the PDP-11/23 goes for $4,500. A single PDP-11/23 is $6,800. DIGITAL EQUIPMENT CORP., Maynard, Mass.

FOR DATA CIRCLE 354 ON READER CARD

MICRO DIAGNOSTIC AID

The EZ-80 plugs into a 40-pin DIP socket (in place of a Z80 microprocessor) and provides a tool for diagnosing both hardware and software errors. The Z80 emulator allows access to I/O or memory, and it offers single step execution and dual breakpoints. A trace memory captures



program activity for subsequent review. The unit also provides access to the 19 Z80 registers (which can be changed by the user). A hexadecimal display lets the user inspect addresses, data, and register contents. A keyboard provides user control of all functions. If a user's needs go beyond the capabilities preprogrammed into the EZ-80, additional functions can be programmed in 2716 or 2732 PROM's and inserted into a socket on the EZ-80. The portable unit sells for $2,295. APPLIED MICROSYSTEMS, Kirkland, Wash.

FOR DATA CIRCLE 355 ON READER CARD

TIME/ATTENDANCE TERMINAL

The 3647 Time and Attendance Terminal for use with the 8100 Information System seems to fit well with both of the 8100's intended uses: as a node in a distributed network, and as a standalone system for small users. It's a means for capturing data at its source, with subsequent processing locally or further up the hierarchy of a network. The 3647 also is intended for use with the 8100-based 3630 Plant Communication System. The terminal includes a dual entry magnetic slot reader, a four-position display for time-of-day, internal clock, and a buffer (which allows high-volume use or use when the 8100 or communications link fail). The 3647 attaches to the communications loop of an 8100 or 3630. Options include a six-position rotary function switch, and a control option that can provide signals to allow door openings, sound alarms, or whatever. The $2,725 terminal is designed for user installation, and will become available next March. INTERNATIONAL BUSINESS MACHINES CORP., Data Processing Div., White Plains, N.Y.

FOR DATA CIRCLE 356 ON READER CARD

LSI-11 CONSOLE

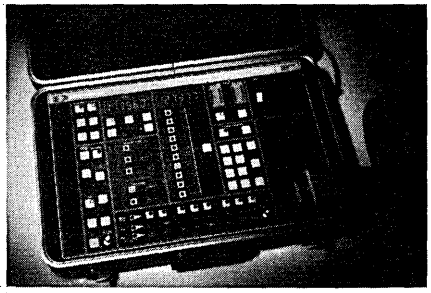
A portable, self-contained system console for LSI-11 microcomputers, the microCAS-

HARDWARE SPOTLIGHT

WORD PROCESSING PROTOCOL TRANSLATOR

The 303 Protocol Translator addresses the sticky problem of letting word processors from different vendors talk to one another. While most communicating word processors have RS232 interfaces and use ASCII-coded characters, a nasty bit of incompatibility arises from the different internal formatting codes used in different systems. The 303 allows bidirectional translations between as many as 10 different systems. Initially, six product lines are supported: IBM (Office System 6), Vydec, Lanier, Wang, DEC, and Lexitron. In use, an operator would switch-select the originating and target machines, as well as the data transmission rate (from 300bps to 9600bps). From that point on the translation is under control of the 303. The word processing systems may be hard wired or connected over telephone links. The vendor does note that basic differences between systems may require occasional touch-ups after that 303 finishes its translation. A 303 Protocol Translator, with three bidirectional conversion routines, will sell for $7,950; additional conversion programs, beyond the first three, will go for $350. Deliveries are scheduled to begin in mid-July. TELESYSTEMS NETWORK, INC., Chicago, Ill.

FOR DATA CIRCLE 350 ON READER CARD



11 can replace a DLV-11 serial interface and console device. The unit lets users single step through programs, examine or alter data in memory or registers, trace programs, and use breakpoints. Monitoring memory contents can be performed dynamically as the program executes, or when a breakpoint is encountered. Preprogrammed maintenance and troubleshooting routines can make use of an extended ROM and RAM feature. The microCAS-11 sells for $3,895. ELDYNE, INC., San Diego, Calif.

FOR DATA CIRCLE 357 ON READER CARD

SMALL BUSINESS COMPUTERS

The four-system Astra family of small business systems can provide canned applications, as well as user-developed BASIC and COBOL programs, to as many as 32 concurrent users. The smaller systems use a proprietary 16-bit microprocessor with an 800nsec cycle time; the largest processor uses a bipolar implementation of this micro. A DMA channel controller handles communications between cpu and workstations (at 1Mbps, it takes about a tenth of a second to transfer a full 2,000 character screen). The workstations are microprocessor based and include 32KB of memory. Data communications also are supported, at speeds of up to 9600bps, using 2780, 3780, HASP, and 3270 protocols. Applications packages for sales order processing, sales analysis, inventory control, accounts receivable, accounts payable, general ledger, and pay-

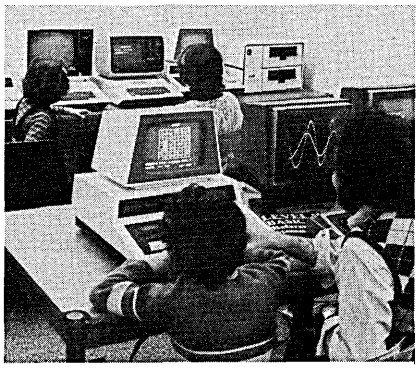
roll, will be available with first customer shipments.

The smallest Astra system, the model 210, is a single workstation system with 128KB memory, and from one to four IBM diskette units. Its pricing starts at $13,200 with one diskette unit and a printer. The model 230 supports up to four operator stations, and main memory to 256KB. It can use diskette drives, or the vendor's Winchester drives (20MB, 40MB, or 80MB capacity). For $17,080, customers can get a 230 with one workstation, two diskettes, and a printer. Prices begin at $38,980 for the model 250 with one workstation, 20MB of disk, one diskette, and printer. The 250 can grow to 16 terminals, and 256KB of main memory. The largest system, the 270, can handle 32 terminals and 0.5MB of main memory. Prices begin at $53,780. NEC INFORMATION SYSTEMS INC., Lexington, Mass.

FOR DATA CIRCLE 358 ON READER CARD

CLUSTERED PERSONAL COMPUTERS

The Cluster/One looks like your run-of-the-mill floppy disk system, but it's unique in that it will support as many as 30 personal computers (of mixed types) connected over a high speed ClusterBus. In its initial form, the intelligent unit is intended to provide a central repository for BASIC programs; planned enhancements include data file storage, support of a printer for spooled output, and a cross-loading capability to allow the transfer of



programs between personal computers. A rigid disk system, using 8-inch drives, is also in the works.

Cluster/One currently supports PET's TRS-80's, and Apple II's. Only Microsoft BASIC, supported by all three, is handled by the unit. With its two IBM-compatible diskettes, the unit can store 630KB worth of programs (or 1.2MB with double-sided drives); the Cluster/One understands a set of commands, similar to those used with a personal computer's local cassette tape unit. The ClusterBus is a ribbon cable (limited to 250 feet in length) along which as many as 15 personal computers can be daisy chained; adding a second ClusterBus allows the maximum 30 attachments. An interface, specific to each type of personal computer, is needed for each unit along the bus. A PET is used as a console device with the Cluster/One. A basic Cluster/One sells for $4,500 (don't forget, you'll need another $795 for the requisite PET console), and personal computer interfaces are in the $100 to $150 range. NESTAR SYSTEMS, INC., Palo Alto, Calif.

FOR DATA CIRCLE 359 ON READER CARD

ACCESS CONTROL

Designed for oem use, this security access/data collection card reader uses the vendor's proprietary magnetic cards (and an optional numeric keypad) to limit access to restricted area and equipment. The unit communicates over a 20mA current loop interface at 1200bps (factory set —150bps, 300bps, and 600bps can optionally be specified). The readers use full duplex communications and can operate in either instant response (the magnetic card's contents are sent upon insertion) or polled modes; as many as eight units can share a single communications loop of up to four miles. A control relay within the unit can be actuated for a specific time ranging from one to 15 seconds, or it can remain set until cleared by an external signal. Options include weatherization, a tamper sensor, and a variety of packaging. A single unit with flush-mount packaging sells for $895. RUSCO ELECTRONIC SYSTEMS, Glendale, Calif.

FOR DATA CIRCLE 360 ON READER CARD

32-BIT MINICOMPUTER

This established 32-bit mini maker has launched the first in its new 3200 series of 32-bit processors. The 3220 supports from 256KB to 1MB of 500nsec MOS memory with error-correcting memory; later this year the vendor will begin marketing processors with as much as 4MB (existing 3220s will be field upgradable). The vendor's existing 7/32 and 8/32 products will continue to be marketed to users preferring the nonvolatility of core memory; as standard equipment the 3220 has battery backup that can retain the contents of a 256KB memory for about 20 minutes. The 3220 and core-based systems can participate in shared memory multiprocessor systems.

The 3220 has four external priority interrupt levels (supporting up to 1,023 I/O devices), and eight sets of 16 32-bit general purpose registers (four sets are dedicated to interrupt priority levels). Options include a floating point box, 2KB of writable control store, and 1KB of cache. A 256KB 3220 sells for $33,500; a full megabyte processor is $59,000. Field upgrades to memory go for $10,000 per 256KB. PERKIN-ELMER CORP., Computer Systems Div., Oceanport, N.J.

FOR DATA CIRCLE 361 ON READER CARD

CASSETTE TAPE SYSTEM

The model 374 cassette tape system should appeal to creative systems integrators. The 8085 microprocessor-based unit can be configured with as many as three Philips cassette drives and, optionally, I/O ports for low-speed peripherals. An RS232 interface, with switch-selectable data rates ranging from 110bps to 19.2Kbps, is standard. The vendor cites several interesting applications where the 374 can take over some of the host's overhead: printing a spooled output file on a printer attached to the tape subsystem, or acting as a buffer between the mini and a communications line. Currently, the 374 is not user programmable, although that capability is said to be on the way. To provide support on the host mini, the vendor provides its own operating system—CMTOS— for HP, DEC, and Data General minicomputers. A single cassette transport model 374 sells for $3,720; a three-drive unit is $5,770. Deliveries are said to take 120 days. DICOM INDUSTRIES, INC., Sunnyvale, Calif.

FOR DATA CIRCLE 363 ON READER CARD

COMMUNICATIONS TESTER

Intended for use in the computer room or in the field, the portable Comtest data test set measures bit errors, bias distortion, and turnaround time. The unit operates at asynchronous speeds ranging from 300bps to 19.2Kbps, and at synchrous rates to 100Kbps. The Comtest can use a number of test patterns, including CCITT 511 and ICC 2047. A three-digit LED display indicates errors counted or, by flipping a toggle switch, RTS/CTS delay measured in milliseconds. LED's also are provided to monitor signal lines, and test points provide access to the signals. A single Comtest sells for $700; quantity discounts are offered. KAPUSI LABORATORIES, San Mateo, Calif.

FOR DATA CIRCLE 364 ON READER CARD

LINE PRINTER CONTROLLER

Compatible with DEC's LSI-11 microcomputers, the DLP-1100 line printer controller supports Dataproducts, Centronics, and Digital Equipment LA180 printers. The software-transparent controller has switches for addressing command status, data register, and vector register. A self-test mode eases installation and trouble shooting. A single DLP-1100 sells for $475. DATASYSTEMS, San Diego, Calif.

FOR DATA CIRCLE 365 ON READER CARD

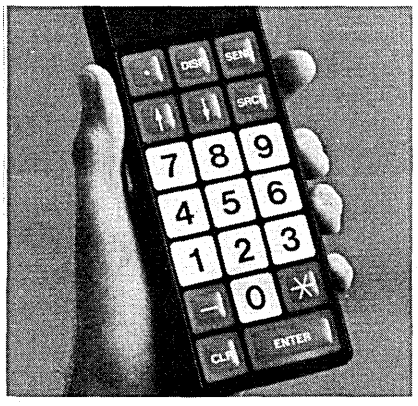
OCR DATA ENTRY

The OCR500, for applications such as remittance processing, order entry, and charge card processing, scans one (or, optionally, two) lines of data from documents ranging in size from 1 X 2½-inches to 6 X 8½-inches. It operates in either of two modes: scanning only, with continuous automatic feed, and scanning with subsequent keyed data entry (each document stops, face up, after being scanned, so the operator can key in other data). Nine fonts, including limited hand print, are supported. An extended BASIC allows users to develop programs specific to their application. The OCR500 can operate on-line, in a communications environment, or with output directed to floppy disk or magnetic tape. Pricing starts at $25,200. AMER-O-MATIC CORP., Birmingham, Ala.

FOR DATA CIRCLE 366 ON READER CARD

HAND-HELD TERMINAL

The pocket-size Sprint 100 order entry terminal includes 4KB of memory, acoustic coupler, operating manual and one-year factory warranty. Battery-powered, the microprocessor-based terminal has a



20-key keyboard and a 12-position alphanumeric display. The transmit-only acoustic coupler can send data at 1200bps or 1050bps (Bell 202S compatible). The unit also features programmable parameters for data input, programmable header ID, free-format data entry, and, for verification of entries, search-by-item and serial search. A single Sprint 100 sells for $495, with prices dropping to $395 in quantities. An additional 4KB of memory is optional. NORAND COMPUTER SYSTEMS, Cedar Rapids, Iowa.

FOR DATA CIRCLE 368 ON READER CARD

APL CRT

The model 11 APL/ASCII crt terminal operates in character or block mode with transmission rates ranging from 50bps to 9600bps. The unit can display all APL characters and overstrike combinations (when in APL-mode) as well as alphanumerics. In ASCII-mode, it can display 96 ASCII characters, and 32 control codes in a monitor mode. Programmed functions —up to 32—can include forms, answer backs, and control sequences totaling more than 500 characters. Normal and wide character formats, independent I/O and peripheral speeds, and cursor positioning functions (read and write) are standard on the model 11. Various field attributes, including blink, inverse video, and underscore, are available. The RS232-interfaced terminal sells for $1,590. TELERAY DIV., Research, Inc., Minneapolis, Minn.

FOR DATA CIRCLE 367 ON READER CARD

COMPUTER SYSTEMS

Intended for marketing to first-time users through a network of dealers, this vendor's Information Systems combine existing hardware with Information software. The software provides the user interface, a new business language, an English-like inquiry language, and an information management system. Inform, an English-like language, gives casual users access to business records. The Inform vocabulary, stored in files, can be tailored to suit user requirements. Reports are automatically formatted, and the user can add Inform statements to customize the reporting format. More complex tasks can be written in Info/BASIC, a general-purpose language for developing business applications. Programs are developed on-line in a multiuser (up to 63) virtual memory environment. The system's information management system, Info/DMS, lets users maintain their data bases with "no practical limit to the number or size of files." The Information Systems share the same operating system and networking capabilities of the vendor's existing product line. A typical Information 1000 System, configured with 0.5MB of main memory, 96MB of disk, a 300 lpm printer, and four crt's, sells for $93,000. An Information 5000 System, including 2MB of main memory, 160MB of disk, an 800bpi tape drive, 300 lpm printer, and four crt's, sells for $260,000. Typical 1000 Systems carry prices ranging from $75,000 to $200,000; they are available now. Pricing for 5000 Systems ranges from $160,000 to $500,000; deliveries begin this summer. PRIME COMPUTER, INC., Wellesley Hills, Mass.

FOR DATA CIRCLE 369 ON READER CARD

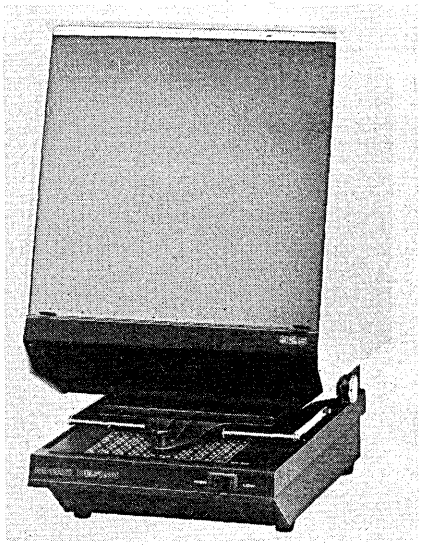
MODULAR MODEM

For designers building products requiring integral communications capabilities, the three module R24 2400bps modem may fill the bill. The modules, each roughly three-inches square and half-an-inch deep, are encased in plastic and can be plugged into standard connectors or wave soldered onto pc boards. The transmitter consists of one module, and the receiver consists of two modules. The Bell 201 B/C compatible modem has a TTL/CMOS compatible digital interface, and includes a scrambler/descrambler meeting CCITT V.27 specifications. In sample quantities (less than 10), the three-module set sells for $550. ROCKWELL INTERNATIONAL, Electronic Systems Group, Anaheim, Calif.

FOR DATA CIRCLE 370 ON READER CARD

MICROFICHE READER

The model 925 microfiche reader has an 11-inch square screen, lens magnifications ranging from 18X to 66X and a



front-access power-drawer module containing all electrical components. The convection-cooled reader can be had with any of three screen colors. The 925 sells for $210. MICRO DESIGN, Div. of Bell & Howell Co., Hartford, Wisc.

FOR DATA CIRCLE 374 ON READER CARD

CRT TERMINALS

This Canadian crt manufacturer has broadened its VC400 product line with the introduction of an APL terminal and DEC VT52-compatible unit. The VC415APL features APL overstrike, character rubout in APL interactive mode, and remote selection of either APL or ASCII modes. The VC4152, a VT52-compatible unit, has several added bells and whistles, including a 25th status line, character highlighting, and 10 special function keys. Both terminals display data in a 24-line by 80-character format on a 12-inch crt. Both provide an RS232 interface (20mA current loop optional), and communicate asynchronously at speeds ranging from 110bps to 9600bps. Both terminals are priced at $1,850 for singles, with a discount schedule ranging to 45%. VOLKER-CRAIG LTD., Waterloo, Ontario, Canada.

FOR DATA CIRCLE 372 ON READER CARD

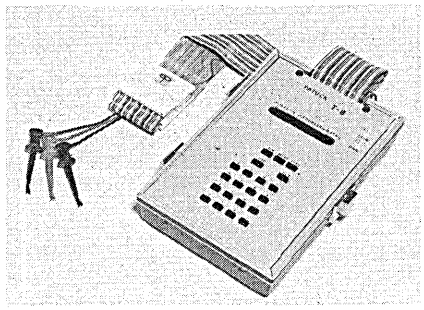
S-100 STATIC MEMORY

Sold fully assembled and tested, this vendor's 32KB static memory board is S-100 compatible and runs at 300nsec. It includes bank-switching, for extended addressing. The board sells for $625; the same board is offered with 16KB worth of chips installed for $390. TARBELL ELECTRONICS, Carson, Calif.

FOR DATA CIRCLE 373 ON READER CARD

MICROCOMPUTER ANALYZER

The T-8 microcomputer analyzer can single-step a microcomputer or let it run until it hits a breakpoint. The unit's 8½-digit display can be used to review the 63



machine cycle prior to a breakpoint halt. The portable T-8 connects to the microcomputer via a 40 pin chip clip; interfaces allow connection to 8080, Z80, 2650, 6501, 6502, 8060, and 8085 based processors. The T-8 sells for $695, quantity one; each interface is $50. PAUTUCK INC., Pennsauken, N.J.

FOR DATA CIRCLE 371 ON READER CARD

SOFTWARE AND SERVICES

UPDATES

While PCMs and other mainframers face a potentially austere future in light of IBM's aggressively priced E-Series, software vendors should find their potential market growing rapidly. One such software supplier, Cincom Systems, developers of the TOTAL data base management system, says IBM's announcement and pricing structure pleases the firm. Two years ago the firm began reworking its products in light of a perceived shift on IBM's part toward VSAM-only processors and peripherals. Cincom says its products will run in native E environment, as opposed to 370 emulation mode.

Computer signal processing techniques have been applied to Loran-C navigation by researchers at the Johns Hopkins University Applied Physics Laboratory. The computer-aided removal of interference from Loran radio navigation signals is said to yield a fivefold increase in accuracy. The new Loran Navigation Receiving System -- LONARS -- reportedly has been used to give fixes accurate to 30 meters. These experiments were carried out on research vessels off the coast of Florida. The LONARS development program is sponsored by the Strategic Systems Project Office of the U.S. Navy.

Technical Analysis Corp., vendors of a minicomputer word processing system described in last month's Software & Services section (see p.210), informs us that system's name has been changed to avoid confusion with a product offered by another software vendor. TAC's product will be known by the generic name of "Word Processing System."

X.25 COMMUNICATIONS

This vendor has developed X.25 packet-switched communications software for its full line of computers—all the way from the Eclipse down to the microNOVA. The software runs under RDOS, RTOS, or DOS on processors having at least 64KB of memory. The X.25 protocol also can be used in interprocessor communications; the vendor's multiprocessor communications adaptor (MCA) and the software can work together. And, with the ability to handle multiple outstanding frames, the X.25 software should be able to handle the latency problems involved in using satellite communications links.

RDOS X.25, as it is known, has been certified by Telenet and Transpac (the French X.25 network). RS232 interfaces are used at the interface between a user's data terminal equipment and the network's data circuit-terminating equipment. The software supports the vendor's DG/CS communications subsystems (synchronous line multiplexors, DCU/200 data communications controller, etc.). The interface between user equipment and the packet-switched network is via synchronous lines running at speeds of up to 56Kbps. RDOS X.25 has a one-time license fee of $1,000 for the first cpu, and $600 for each subsequent cpu. DATA GENERAL CORP., Westboro, Mass.

FOR DATA CIRCLE 376 ON READER CARD

VS1 ASSIST

IBM 370/145 systems can get a 10% to 15% performance boost when running VS1 and the MicroFast/VS1 Assist. Said to be functionally equivalent to the VS1 Assist part of the 148's Extended Control Program Support, the MicroFast/VS1 Assist shows the greatest performance increases on heavily used 145s. Residing in main memory beyond IBM-supplied microcode, the Assist is completely self-contained and creates no interference with the 145's normal microcode. The MicroFast microcode speeds storage management, page management, IOS, SVS, FLIH, and CCW translation. The microcode has a monthly rental cost varying with the term of the contract. For three years, the monthly rate is $500, two years is $600 per month, and for one year the price is $700 per month. MicroFast is distributed as an IPL tape, customized for each cpu. It's loaded during Initial MicroProgram Load (IMPL). ITEL CORP., Data Products Div., San Francisco, Calif.

FOR DATA CIRCLE 377 ON READER CARD

CALCULATOR PROGRAMMING

Want to run BASIC on your Texas Instruments 58 or 59 pocket calculator? Well, you can't do it directly, but this vendor has the next closest thing: a BASIC cross-compiler that generates a keystroke equivalent of a BASIC source language program. The cross-compiler itself is written in BASIC, so it should be adaptable to a wide variety of hosts. The cross-compiler optimizes keystrokes by eliminating redundant operations and unneeded parenthesis. It recognizes standard BASIC verbs and functions and some new commands specific to the calculator (DISPLAY, RAD, DEG, PGM, etc.). The cross-compiler outputs a keystroke listing and cross-reference between BASIC variables and calculator registers. Aimed at industrial, educational, and hobbyist users having a 16KB BASIC machine in addition to the calculator, the cross-compiler sells for $65. For the price you get the cross-compiler source listing, users guide, and documentation. SINGULAR SYSTEMS, Sidney, Ohio.

FOR DATA CIRCLE 378 ON READER CARD

TRS-80 COMMUNICATIONS

ST/80 (Smart Terminal program) lets a Radio Shack TRS-80 personal computer function as a computer terminal. The program supports selectable printer output and program-selected transmission speeds. ST/80 comes in three versions. Version 1 ($39) runs on a 16KB machine with expansion interface, RS232 interface, and (optional) printer. Disk support is added to version 1 to come up with version 2, priced at $79 on diskette. Version 3 uses the version 2 configuration and adds an editor, and transmission to or from the disk. Version 3 sells for $150. SMALL BUSINESS SYSTEMS GROUP, Dunstable, Mass.

FOR DATA CIRCLE 379 ON READER CARD

COMMUNICATIONS

The General Protocol Driver, for Data General minis running under AOS, RDOS,

asi/inquiry

The IMS DB/DC QUERY LANGUAGE

USED BY MORE IMS INSTALLATIONS THAN ANY COMPETING PRODUCT

ASI/INQUIRY is an IMS DB/DC query language that operates completely as an interactive Message Processing Program. The design of ASI/INQUIRY is such that the *structure of the data base is transparent to the user*. Moreover, one need not have familiarity with DL/1 segment logic or the complexities of multi-pathing. Extremely rapid response time is assured.

MAJOR HIGHLIGHTS

- ☐ End-user oriented
  - —Easy-to-use language
  - —Requires no knowledge of IMS
  - —Comprehensive diagnostic messages
- ☐ Rapid response time for even the most complex queries
- ☐ Dynamic priority scheduling to maximize system performance
- ☐ Availability of default as well as user-defined screen formatting

Additional features and functions include:

- Supported under both IMS DB/DC and TSO
- Full support of IMS/VS secondary indexing
- Open-ended computation facilities
- Ability to SORT display output
- Complete security through password protection
- Comprehensive log of all session and run statistics
- Unlimited data base concatenation and referencing
- Optional usage of qualified SSA's

In summary, ASI/INQUIRY represents the state-of-the-art product in an IMS/DC or TSO-supported environment. Contact us and learn why organizations such as *Hughes Aircraft, Standard Oil of Indiana, Hydro-Quebec* and *EXXON* are processing queries like "What if . . . . " and obtaining a return on their investment many times over.

asi

The Software Manufacturer

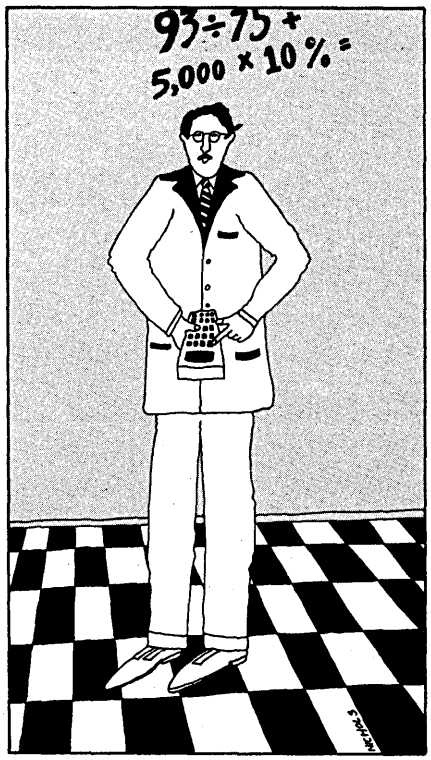
Applications Software, Inc.
Corporate Offices
21515 Hawthorne Boulevard
Torrance, California 90503
(213) 542-4381

CIRCLE 77 ON READER CARD

SOFTWARE SPOTLIGHT

SOFTWARE COST ESTIMATING

Managers faced with the thorny problem of estimating the cost and schedule of a software development effort may find Slim a valuable tool. The management tool provides estimates of manpower, cost, and schedule from information on the development environment (batch, on-line, etc.), personnel skill level, type of software under development, estimated number of source statements involved, etc. The package finds the limiting constraints on manpower and schedule, identifies trade-offs between cost and development time, projects cash flow of the life cycle, and projects the risks associated with cost and schedule. Users also can specify constraints—personnel, time, cost, etc.—and Slim will generate an optimal management plan. The package is based on a life-cycle model developed by L.H. Putnam, who gained experience in managing large software projects while working at the Pentagon. Slim is accessable through the American Management Systems time-sharing network. Slim carries an annual lease fee of $15,000; the user is responsible for computer usage charges. QUANTITATIVE SOFTWARE MANAGEMENT, INC., McLean, Va.



FOR DATA CIRCLE 375 ON READER CARD

and RTOS, allows users to develop support software for various communications protocols. The software runs in the mini or in the programmable front-end Data Communications Unit (DCU). Using a macro language, the systems programmer can define protocol descriptions. As an example, the vendor cites IBM 2780 bisync transparent protocol, which, it is said, can be coded in 200 instructions. The software can reduce cpu overhead when used with a DCU. Both synchronous and asynchronous protocols can be mixed, and each processor or DCU can support an aggregate throughput rate of 7,000 characters per second. As many as four DCU's can be handled, providing 28,000 characters per second throughput. Any control character set (ASCII, EBCDIC, etc.) can be supported, as well as transparent and non-transparent operations. The package licenses for $4,000 for the first system, and includes object code, source code of user modifiable tables, source code protocols, and documentation. Licenses for subsystems two through four go for $1,000, with subsequent licenses going for $500. SYSTEMS STRATEGIES, INC., New York, N.Y.

FOR DATA CIRCLE 381 ON READER CARD

DOUBLE PRECISION

Personal computer owners running Microsoft BASIC (including TRS-80 Level II BASIC) can use DPFUN, a 16-digit precision scientific subroutine package. The package contains 13 double precision exponential, trigonometric, exponential, and inverse trig functions. Intended for serious engineering and scientific applications, DPFUN uses truncated continued fraction algorithms, said to provide fast execution, and full exploitation of 64-bit floating point notation. The total set of subroutines takes about 2.5KB of the personal computer's memory. DPFUN, supplied as source code, sells for $10. MIKEN OPTICAL CO., Morristown, N.J.

FOR DATA CIRCLE 382 ON READER CARD

TRANSACTION PROCESSING

For medium-scale (and larger) transaction processing applications, TPS 6 allows this vendor's Level 6 minicomputers to control a combination of three types of terminals: the synchronous VIP 7700R, asynchronous VIP 7200, and the microprocessor-based VIP 7801. The package executes as a self-contained GCOS 6 Mod 400 facility on Level 6 models 43, 47, 53, and 57; 128K words of memory are required. A high-level language, Screenwrite, can be used to write transaction processing applications. Screenwrite is said to be compact, while still allowing flexible control of display terminals. Data management capabilities are extended with the introduction of indexed key files and detail files accessed through chaining methods. For large applications, a file can extend over several disk volumes. Data files can be processed by applications written in either Screenwrite or COBOL. Batch programs can be activated from an on-line transaction or from the system console, and they can run in parallel with the on-line system. TPS 6 also performs continuous collection of performance statistics. TPS 6 has a basic perpetual license fee of $7,000. Adding more bells and whistles can bring the price up as much as another $3,200. HONEYWELL INC., U.S. Information Systems Group, Waltham, Mass.

FOR DATA CIRCLE 383 ON READER CARD

IMAGE ANALYSIS

Written at Texas A&M Univ., the Mathpac Image Analysis Library conists of general purpose mathematical and statistical routines, as well as routines basic to image analysis. The library comprises six packages. The Linear Algebra package includes matrix manipulation routines for inversion, decomposition, calculating eigen values, and more. The Optimization package can calculate zeroes, minimums, and maximums. It can handle linear and quadratic programming problems. Moments, means, deviations, coefficients and other information can be calculated by the Statistical Summary package. The Densities and Distribution package gives the user a tool to calculate probabilities related to various distributions, including binomial, Poisson, and hypergeometric distributions. The Regression package can solve multiple linear regression analysis problems and perform nonlinear least squares parameter estimation. Finally, the Statistical Test packages handles goodness of fit tests, analysis of variance, and other functions. The library is written in FORTRAN IV PLUS for DEC PDP-11's running RSX 11D. The package runs in batch mode, and occupies about 99K words of disk space. With modifications, the package should compile under other FORTRAN IV compilers. Documentation sells for $36; the programs, on nine-track 800bpi tape, go for $970. COMPUTER SOFTWARE MANAGEMENT AND INFORMATION CENTER, Univ. of Georgia, Athens, Georgia.

FOR DATA CIRCLE 384 ON READER CARD

OS FILE COPIER

Copymacs, a file copy utility for OS shops, is said to provide a reduction in cpu and elapsed time of up to 60% when compared with IBM's IEBGENER. While compatible with IEBGENER, Copymacs has additional functions, including the ability to start multicopy functions in a single step, copy to multiple output files, and to detect conditions that would cause IEBGENER to ABEND (in which case Copymacs issues an error message instead of an ABEND dump). Copymacs is said to require no JCL changes. The package carries a

$1,500 price tag. MANAGEMENT AND COMPUTER SERVICES, INC., Valley Forge, Penn.

FOR DATA CIRCLE 385 ON READER CARD

PROGRAM EXCEPTION MONITOR

SOCKO is a tool for the applications programmer faced with debugging a program. It catches SOC*x*-type program exceptions, collects data for debugging, then resumes execution of the program. SOCKO is activated and controlled through JCL; it runs under OS or OS/VS. The programmer has control over the number of exceptions allowed and various core dump options. SOCKO carries a $1,100 perpetual license fee, and is supplied with an assembler code listing. ILLINI SOFTWARE CO., Pawnee, Ill.

FOR DATA CIRCLE 386 ON READER CARD

SORT/MERGE

Said to optimize both memory usage and execution time, this vendor's sort/merge package runs on PDP-11's under RSX-11M, RSX-11D, or IAS. Any files supported by DEC's FCS (including FORTRAN unformatted files) can be processed. The package goes for $100 per month (three months minimum) or $1,020 per year. Pricing includes maintenance. CAMBRIDGE COMPUTER ASSOCIATES, INC., Cambridge, Mass.

FOR DATA CIRCLE 388 ON READER CARD

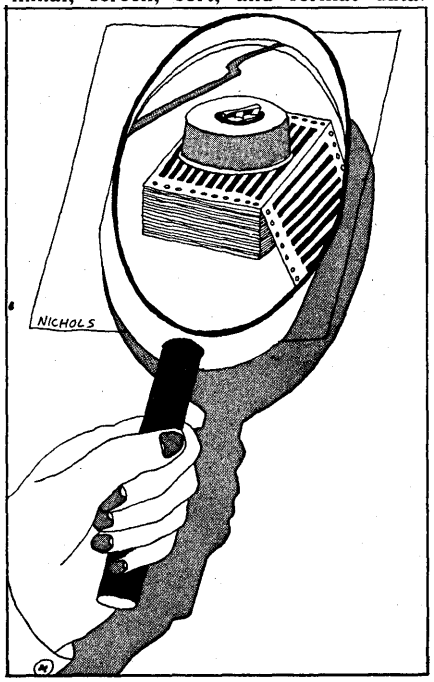
HASP COMMUNICATIONS

The HASP/16 Workstation Emulator allows this vendor's 16-bit minicomputers to submit jobs to, and receive output from, remote IBM mainframes. Support of both host and alternate remote modes of operation allow the vendor's 16-bit machines to communicate among themselves, and with the vendor's 32-bit product line. HASP/16 is said to be a compatible subset of the HASP software for the 32-bit processor line. HASP/16 can handle up to seven card readers and eight printers, a control console, and communications (over dial-up or leased lines) at speeds of up to 19.2Kbps. Up to seven job streams (in each direction) can be multileaved over one communications line. On nine-track tape (800bpi or 1600bpi) or diskette, the HASP/16 software is priced at $1,000; on a 10MB disk pack, it goes for $1,300. PERKIN-ELMER CORP., Computer Systems Div., Oceanport, N.J.

FOR DATA CIRCLE 387 ON READER CARD

DATA BASE REPORTING

An interface between Cullinane's IDMS and this vendor's Focus information control system provides a nonprocedural reporting language to users of IDMS. The English-based report language lets users specify desired reports without going into details of how the reports are prepared. IDMS users can, from a time-sharing terminal, screen, sort, and format data.



Users also can take advantage of Focus' graphics, financial modeling, and formal statistical analysis subsystems. The package gets data for the report writer through read-only IDMS calls, and runs on 370s under TSO (OS/VS/MVS) or CMS (VM/370). The interface between IDMS and Focus sells for $8,000 (Focus starts at $39,000). Monthly licenses available. INFORMATION BUILDERS INC., New York, N.Y. ✲

FOR DATA CIRCLE 380 ON READER CARD

The Rapifax 100 Electronic Mail System

The mail is great if you've got time. A minimum of 24 hours and more likely 48 hours. If your communication has time value and if you can't wait that long, the Rapifax 100 can send a letter size document almost anywhere in the world in 35 seconds. Smaller sized documents in as little as 20 seconds. That's the kind of high speed throughput that makes electronic mail a reality...today.

Costs less than TELEX, TWX and telephone

Telephone line costs increase with distance and length of time used. The Rapifax 100 makes your communications more effective because it can move a 200 word letter or hard copy information over voice grade lines at ¼ to ½ the time and cost of phone calls, TELEX, or TWX.

In addition, Rapifax has graphic capability. You can't send a written memo, signature, a copy original, or drawing by TELEX or TWX.

Cost justifiable at 10-15 copies per day

If you're sending a few facsimile copies a month, we're probably not for you. But if you're sending 10-15 copies a day, the Rapifax 100 can transmit these copies at less cost than most conventional facsimile systems.

It pays to do business with the leader

Rapifax is the leader in high speed facsimile systems. That's why, when we introduced the world's fastest facsimile transmission system three years ago we didn't just decide to rest on our laurels. Today, the Rapifax 100 is a reflection of our leadership and proven reliability in thousands of installations worldwide. Sure, one of these days, someone may match our speed and low cost. But, we're not going to sit around and wait. Neither should you. Just return the coupon today, call toll-free, 800-631-1155*, or write Rapicom, Inc., Seven Kingsbridge Road, Fairfield, New Jersey 07006.

*Except from Hawaii and Alaska.

RAPICOM

☐ Yes, I'd like to see a demonstration of the R100 and a free systems survey to improve our business communications.
☐ Send me more data on the Rapifax 100.

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CIRCLE 18 ON READER CARD

SOURCE DATA

BOOKS

COUNTDOWN: SKYDIVER, ROCKET AND SATELLITE MOTION ON PROGRAMMABLE CALCULATORS by Robert Eisberg & Wendell Hyde

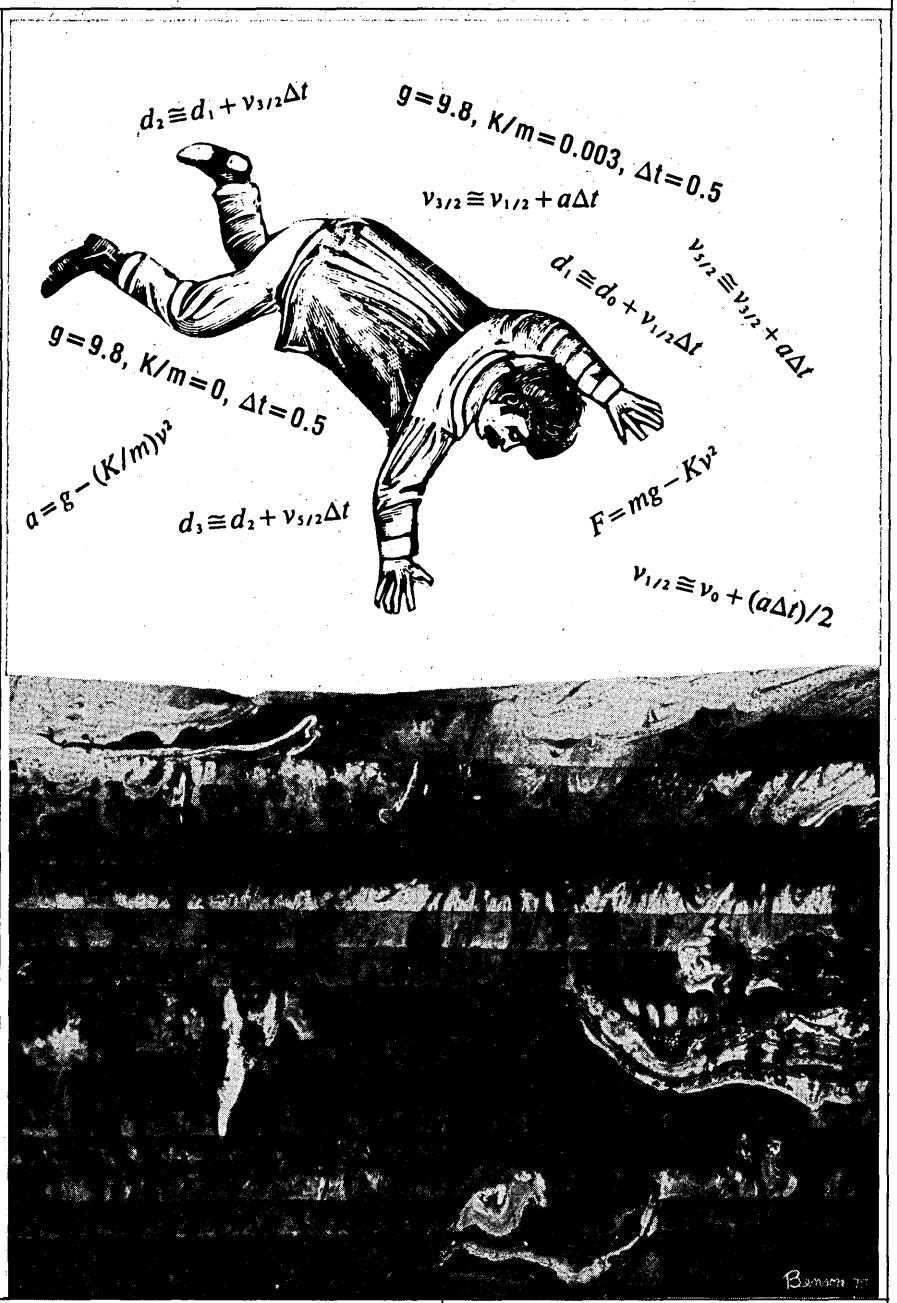
The authors have done a splendid job of combining brief explanations of the basic physics of motion with step-by-step instructions for predicting or following the motion of a variety of moving things. The calculations begin with a countdown program designed to familiarize the reader with his programmable calculator, and proceed through increasingly complex programs.

The chapter on satellites also addresses some interesting phenomena such as a demonstration of Kepler's laws, the effect of solar wind on an earth satellite, and scattering of alpha particles.

The book is complete enough that is might serve as a how-to manual for the TI-57 or HP-33E (or any programmable calculators employing algebraic logic or RPN that is capable of conditional branching and storage register arithmetic, with at least eight addressable storage registers, at least 65 different key functions, and a capacity for at least 49 multiple-keystroke steps of program memory). While the book is basic enough for those with no experience with the programmable calculator whatsoever, it is also engaging enough that it might also amuse those who *are* familiar with the machine.

The book is clearly and pleasantly written, and is sprinkled with explanatory figures (such as those shown here). dilithium Press (1979, 106 pp., $6.95, softcover).

—S.R.



INPUT/OUTPUT DATABASES: USES IN BUSINESS AND GOVERNMENT by Jay M. Gould

Decision support systems, MIS, "action aids": these are all labels applied to the new generation of systems oriented to data bases and transaction processing networks. So far, few of them have lived up to these labels. This book describes a major way in which some systems are doing so, through the use of economic models associated with files of corporate data.

Dr. Gould is president of Economic Information Systems, a company that provides tailored data bases to government and industry. He is therefore (admittedly) partisan about their use. However, his discussion of weaknesses in input-output models is candid and appears complete. Also, his approach to the issue is a completely practical one. Throughout the book are examples of the application of input-output models to specific problems of industry and government, and very little mention is made of economic theory. To an applications-oriented reader, Dr. Gould's approach probably conveys more information about the utility of this approach than any more formal text. (A bibliography of such texts is

appended.)

Basically, the idea is to relate publicly available coefficients describing overall purchases and sales of many types of goods and commodities with files describing individual companies and their activities. These files may themselves be public, may be proprietary to partners of EIS (e.g., the TRW business credit report files), or may be special corporate files developed by EIS. Combining these, specific subindustry data bases can be developed that can be manipulated by EIS clients to study markets, develop sales prospects and the like.

The process is tricky. As the examples show, effective exploitation of the files requires deep understanding of their strengths and weaknesses and a creative flair for identifying relationships between files that bear on an issue about which no direct data are available. Unless perfect and universal data become available, it seems that a professional elite will be required to manipulate these data bases—a source of sociological and political concern.

As in any general-purpose data base, the structure of the data limits the outputs obtainable. The user can manipulate data using the Lockheed DIALOG software using the following variables: states, counties, cities, zip code areas, metropolitan markets, owning companies, 4-digit Standard Industrial Classification (SIC) industry codes, and size classes. These data structures have weaknesses. In particular, a pet peeve of this reviewer is the unevenness of the SIC codes. For example, the two-digit level equally ranks "Museums, botanical and zoological gardens" ($9 million sales in 1976) with "electric and electronic equipment," which includes our own industry and had total sales of $73 billion in 1976. The five-digit level equates "metal nameplates" with "solid state logic units and microprocessors." Unfortunately, the SIC codes are weakest for the newest and fastest-growing industries such as our own.

Dr. Gould raises some major concerns that have been expressed about the use of these tools: that they will lead to baneful interference by government in free market mechanisms, and that control of the information will unfairly enhance the power of a limited Establishment. To these, I would add a third: overreliance by the uninitiated on imperfect information (which has clearly occurred sometimes in government and in the press). Unfortunately, Dr. Gould does not address these concerns at any length; he only expresses a generalized optimism (while admitting partisanship).

In addition to presenting the nature and method of use of the data bases, Dr. Gould includes some overall results of manipulating them: statistics on industry concentration, energy use, and foreign sales of multinational companies are presented. These have appeared in the press from time to time, but Dr. Gould's candid discussion of errors produced by the initial assumptions and subsequent efforts to make corrections add an interesting dimension.

The book is short, prepared in a highly legible large format, and easy to read. It is also quite free of typos and the like, though one unfortunate error appears in the headings of a key table listing sales of the top 2,500 companies by 2-digit SIC sectors. The "Total Sector Sales" column head says "$ billion" instead of "$ million." Anyone who works with numbers must commiserate: these minor disasters have befallen us all. Overall, the book would be a good choice for readers interested in the applicability of input-output data bases to their particular problems. Garland STPM Press, New York (1979, 127pp., $19.95).

—Frederic G. Withington

COMMUNICATIONS ARCHITECTURE FOR DISTRIBUTED SYSTEMS by R. Cypser

This book is the best published material I have seen on the concepts of IBM's System Network Architecture (SNA). It is a good

and very readable lead-in to the SNA manuals for those who must work with SNA products, particularly software. It is unfortunate, however, that the book gives little comparison of SNA with other architectures. It emphasizes SNA almost to the exclusion of other architectures—less than 5% of the text deals with other communication architectures. SNA is not the only logical approach for a teleprocessing system, or even for a distributed teleprocessing system.

No negative aspects of SNA are mentioned, which tends to make the book essentially a marketing tool. As such, it would be reasonable to expect some discussion of the cost of converting to SNA versus the achievable cost savings for lines and processing power and the SNA features. Also conspicuously missing is discussion of some of the confusing issues associated with major SNA products, such as the questions surrounding TCAM and VTAM under SNA—their specific roles, the functional and performance differences between them, etc.

The book does contain an overview of communications-based data processing systems in part one, providing background for the rest of the book. Chapter 1 contains an examination of early transmission systems and of today's teleprocessing systems. In chapter 2, trends in computer technology, including the consequences of distributed processing, are considered. Chapter 3 covers the evolution of network hardware components, and programming structures, and groups communication functions into hardware categories—host computers, communication controllers, and cluster controllers. The principal techniques for improving communication line use are reviewed in chapter 4, and the objectives of communication architectures for distributed system—at least SNA's objectives—are summarized in chapter 5. These five chapters give the reader a proper perspective to appreciate SNA; for those with a data communication background, they provide a good review.

Part two begins with an introduction to the functions and services under SNA, which are organized into six major layers. The first layer, called the Network Address Unit (NAU), is the service layer, providing an interface with end users (an end user in this case might be an application program or a terminal operator). The second layer is the Presentation Service. Its main function is to map the formats between the end user and the transmission network. The third layer is the Data Flow Control, which regulates traffic flow between sender and receiver. The fourth layer, Transmission Control, primarily coordinates the transmission between a pair of end users. The conversation established between two end users is called a Session. The fifth layer is Path Control for routing input messages to appropriate output. At the lowest layer is the Data Link Control that controls the flow of data on the links.

The basic concepts are first presented in chapter 6. Chapters 7 through 11 examine each of the layers described above.

In chapter 12, a number of important multilayer sequences are traced step-by-step, the boundaries between layers are summarized, and the operational aspects of a "single domain" network are illustrated. (Single domain means that the computer system has a single host computer.) An overview of the operations of recovery, integrity, and security is provided in chapter 14. Multihost networks are covered in chapter 15. Chapter 13 is a theoretic treatment on how the SNA communication protocol can be more precisely defined in terms of finite state machines. This will probably not be of interest to most readers.

The routing and interface of public data networks are covered in the last section of the book. Techniques for routing messages in a distributed network are discussed, as are X.21 (the international interface standard between the user and the digital transmission networks) and X.25 (the standard between the user and the packet switched networks).

Chapters 6 through 15 (excluding chapter 13) are the main body of the book. Anyone working in the teleprocessing field is likely to find the layer concepts discussed in chapter 6 to be useful. Anyone who works closely with communication software will find all the main chapters to be essential reading. The book should become part of the reference library of every teleprocessing professional. However, since this book is dedicated to SNA, a reader with interest in other protocols may want to read *Computer Networks and Their Protocols*, by Don Davies, et al. (published by John Wiley). Addison-Wesley (1978, 711pp., $20.95).

—W. Chou

REPORTS AND REFERENCES

COMMUNICATIONS

Available and emerging communications technologies are detailed in a 334-page report sponsored by the National Library of Medicine entitled *Communications Technology Forecast*. The scope is broad enough that the report can serve as an overview, yet the discussion is sufficiently in-depth that the report will also be a welcome reference.

The material is well organized. Each section first introduces the technology and gives background of how it has been used, then a forecast is given in which advantages and disadvantages are pointed out, market considerations are brought up, and trends are explained. This format makes these predictions easy to understand and refreshing in contrast with the more usual method of organization wherein the forecast is a speculative final chapter. Another unusual and helpful characteristic of the report is that each section is followed by a bibliography, providing easy-to-find references for each technology discussed.

The report is in three chapters. The first is a 9-page overview, in which major trends are mentioned; among them, the relaxation of regulatory restrictions. The second chapter, on data communications, covers network architectures, transmission media (satellites, fiber optics, common carriers, specialized and value-added carriers, private microwave and CATV), protocols, internetworking, security, software, and a section on microprocessors, minicomputers and terminals. The final chapter is on other communications-based technologies: digital transmission of analog signals, facsimile and ocr, audiovisual techniques, teleconferencing, and distributed data base systems.

Not only does this seem to be an exceptionally good report, it is available at an exceptionally low price: $50. Contact Ms. Marianne Steiner, Computer Systems Div., Bolt Beranek and Newman Inc., 50 Moulton St., Cambridge, MA 02138 (617) 491-1850.

RISK

A series of papers together entitled *The Future of Risk* is available from the Risk Studies Foundation, a not-for-profit adjunct of the Risk and Insurance Management Society.

The first paper, "Risk and the Future," by Orville Freeman of Business International (and former Secretary of Agriculture) provides a frank discussion of a wide variety of political elements, such as Russian expansionism, the arms race, poverty, the situation of developing nations, and the realities of multinational corporations. Referring to an ill-fated discussion between the United Nations and some corporate executives from his company, the author relates, "The U.N. officials simply did not understand that international companies in the private sector make investments based on an assessed balance of risk and return, and the considerations of the political needs and moral demands of the developing countries can play only a marginal role in this assessment . . . private companies are not charitable institutions, and must be responsive to the challenges and standards set in the competitve, worldwide business environment that is reflected in the performance demands of board of directors and employees, of shareholders and security markets."

SOURCE DATA

In the same essay, talking about change, the author quotes James Thurber: "Man is moving too fast for a world that is round. Soon he will catch up with himself in a great rear-end collision, and will never know that what hit him from behind was man."

In a paper entitled "Computer Crime in the Future: Evolutionary and Revolutionary Risks," Cynthia E. Huston, an analyst in the Futures Research Div. of the Library of Congress' Congressional Research Service, discusses crime in the context of our evolving post-industrial society. For example, she says, " . . . radical changes in the form and handling of money which we will experience over the coming years will inevitably be accompanied by significant changes in the nature of crime in our society." In another part of the paper it is pointed out that the five principal phases of computer system operation, input, programming, processing, output, and communication, are each vulnerable to certain kinds of crimes.

Five theories as to why computer crime seems particularly tempting are given. These theories are that: computer crime provides an intellectual challenge, it is generally more profitable relative to the risk taken than other criminal activities, the computer is viewed by many as an impersonal object and symbolizes a system of uncaring power, "there is virtually no security at most computer installations," and computer crime is extremely difficult to detect.

An interesting scenario about the possibility of home computers bringing about a new variety of computer crime is presented.

Finally, recommendations are given as to how computer crime can be prevented and/or dealt with.

The softcover book sells for $15. Contact Dept. FOR, Risk Studies Foundation, 205 East 42nd St., New York, NY 10017 (212) 557-3210.

REMOTE BATCH TERMINALS

Datapro has just released All About Batch/RJE Terminals. Among the findings of the survey, which drew 205 respondents, are that the EBCDIC transmission code is used by 73% of users surveyed, while 16% of them use ASCII. Only 6% of those surveyed use SDLC as apposed to the 80% using binary synchronous line protocol. Seventy-one percent of the users surveyed use their terminals mostly for remote batch input/output. Key-to-disk data entry is the major application for the terminals for 22% of the respondents, with 18% using them for data processing, and 8% in the other applications category. The 40-page report includes specifications of 138 current batch terminals from 51 vendors. $12. Datapro Research Corp., 1805 Underwood Blvd., Delran, NJ 08075 (609) 764-0100.

VENDOR LITERATURE

IMS/VS REFERENCE CARD

This vendor's IMS/VS reference card has been revised in light of IBM's release of version 1.1.5. The four-panel foldout pocket reference includes such information as status and function codes, commonly seen ABEND codes (and pointers on avoiding them in the future), and other coding and debugging aids. A sample card is available free. BABB COMPUTER ASSOCIATES, INC., Rockville Centre, N.Y.

FOR DATA CIRCLE 389 ON READER CARD

SOFTWARE

Separate brochures describe this vendor's three software packages: Datamanager, Projectmanager, and Testmanager. Each of the six-page brochures describes a problem environment and a potential solution. The Datamanager flier notes "Decisions are the life blood of corporate growth," and their quality is a property of the decisionmaker's experience and the information available. From the observation that "Data is the prime component of accurate decision making," the brochure goes on to describe the systems's ability to

maintain data relationships, handle inquiries, and enforce privacy and security.

FOR DATA CIRCLE 390 ON READER CARD

The Projectmanager brochure opens with a block diagram of 'the vital steps in project management." A two-page diagram shows where data enter the system (from the shop floor, dp department, project planner, and others) and other departments (personnel, accounting, etc.) that can use Projectmanager's reports.

FOR DATA CIRCLE 391 ON READER CARD

Testmanager ("a program tonic") is described against the background scenario of "Programming sickness . . . the deadly virus of edp." The symptoms of the malaise, treatment with suitable doses of Testmanager, and the prognosis are covered. MSP INC., Lexington, Mass.

FOR DATA CIRCLE 392 ON READER CARD

COURSES

COMMUNICATIONS

"The bread always falls jelly-side down," is the first quote of Charley Murphy (a distant kin of the Murphy's Law clan) in this vendor's case study of how it helped Charley solve his data communications problems. "The more important and visible the system, the more noise it makes going down," the vendor notes, while Charley concurs, "If you mess with a thing long enough, it'll break." Charley started his communications efforts with a few lines and a black box, but as his system's communications needs grew, he saw increasing overhead degrading system performance. While the booklet doesn't go into nuts-and-bolts details, it does explain how the company offered Charley a choice of communications processors. For readers seeking more detailed information, the vendor includes a postage-paid postcard offering specific information on front-ends, networks, remote concentrators, and message switching. COMPUTER COMMUNICATIONS, INC., Torrance, Calif.

FOR DATA CIRCLE 397 ON READER CARD

BUBBLE MEMORY

If you need to know about magnetic bubble memories, this booklet may be a good starting point. For those seeking to hold their own in cocktail party conversations in Silicon Valley, the booklet's introduction should provide enough background and vocabulary to keep you in the discussion. The introductory section covers a little history, a description of the functional operation of a bubble memory, interfacing information, and a short section on the advantages of bubble memories. Readers seeking more detailed information are provided with spec sheets for the vendor's TIB0203 bubble memory chip and related support circuits. TEXAS INSTRUMENTS, INC., Dallas, Texas.

FOR DATA CIRCLE 398 ON READER CARD

CCD COURSE

Charge-Coupled Devices: Operation and Application will be presented June 18-22 in Wakefield, Massachusetts. The instructors will be Mr. William C. Bradley of Itek Corp., Dr. Barry T. French of Rockwell International, Mr. Doug MacFall and Dr. Jay Sage of Raytheon Co., Dr. Charles R. Hughes of Texas Instruments, Dr. Lewis M. Terman of IBM Corp., and Dr. Thomas A. Zimmerman of TRW Defense & Space Systems Group. Tuition is $495. June 21 Dr. Barry T. French will present a workshop on high speed CCD's, for which the tuition is $125. Contact the Institute for Advanced Professional Studies, One Gateway Center, Newton, MA 02158 (617) 964-1412.

THE CORPORATION AND THE ECONOMY AS SYSTEMS

A seminer entitled Corporate and Economic Policy: The System Dynamic Approach will be offered at MIT June 11-22. The program is said to present a new way of thinking about the corporation and the economy, "such that the manager is better able to anticipate the impact of policies, understand long-term consequences,

SOURCE DATA

and identify important policy leverage points." The program includes afternoon workshops in creating and using computer models in the DYNAMO simulation language. Contact Director of the Summer Session, Room E19-356, MIT, Cambridge, MA 02139 (617) 253-2101.

MANUFACTURING

A course entitled Computers in Manufacturing is being offered June 27-29 in Chicago. Fee: $330 (a team rate is offered). Contact AIIE Seminars, Dept. DTM, P.O. Box 3727, Santa Monica, CA 90403 (213) 450-0500.

SOFTWARE

Information Technology, Inc. is offering a series of seminars on software subjects. June 18-20 in Chicago and July 16-18 in Washington, D.C., Software Engineering will be taught by Lazlo A. Belady, C.V. Ramamoorthy, and Raymond T. Yeh. Validation Techniques and Tools, taught by Leon G. Stucki, and Performance Modeling, taught by Mani K. Chandy, are both being offered June 21-22 in Chicago. Data Base Management will be offered in Washington, D.C., July 16-18. And July 19-20 in Washington, D.C., both Project Management, taught by Donald E. Reifer, and Structured Programming, taught by Victor R. Basili, will be offered. Fees: $595 for 3-day seminars, $425 for 2-day seminars. Contact Information Technology, Inc., P.O. Box 10129, Austin TX 78766 (512) 345-5434.

CRYPTOGRAPHY

An intensive course on computer cryptography will be presented June 4-5 at the Massachusetts Institute of Technology. The course will focus on the Data Encryption Standard and the MIT public-key algorithm. Cryptographic techniques for securing communications will be emphasized. Other aspects of cryptography to be covered include message authentication, digitial signatures, hardware standards, and communications protocols. Contact Seminar Office, MIT, Center for Advanced Engineering Study, Cambridge, MA 02139 (617) 253-7406.

DP SECURITY

Data Processing, Security, Inc., is sponsoring a seminar June 18-20 in Dallas. Among the topics to be addressed are contingency planning, risk analysis, and dp auditing. Fee: $425. Contact Director of Seminars, Data Processing Security, Inc., 235 N.E. Loop 820, Hurst, TX 76053 (817) 589-2244.

PERIODICALS

TECHNOLOGY NEWSLETTER

A new monthly newsletter, *Computer and Data Processor Technology* is being offered by Hobbs Associates, Inc. The subject of the newsletter is "the really significant developments in the computer field, incuding related semiconductor technologies." Charles Hobbs, president of Hobbs Associates, says, "The publication brings experienced judgment to bear in evaluating information gathered from hundreds of personal interviews with technologists and users each year, dozens of publications per month, and many conferences and meetings each year." Recent subjects addressed include an evaluation of bubble and CCD memories, including applications and trends; fiber opitics; displays and terminals, posing the question: will crt's continue to fend off flat panels? is COM finally being integrated into the computer mainstream? and mass storage —is 10^{15} bits a realistic goal?

Annual subscriptions to the newsletter are $85 in North America; add $15 per year for overseas subscriptions. Single copies are $10 (back issues are available). Contact Hobbs Associates, Inc., Box 686, Corona Del Mar, CA 92625 (714) 546-0961. ✱

The Marketplace...

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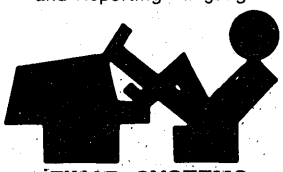

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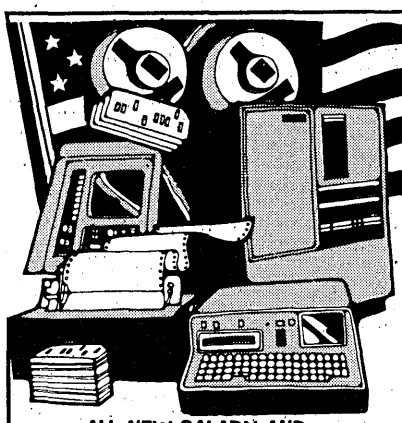

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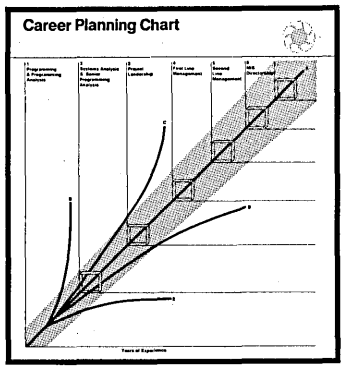

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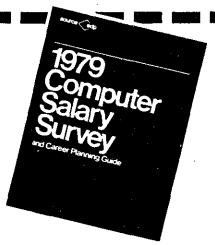

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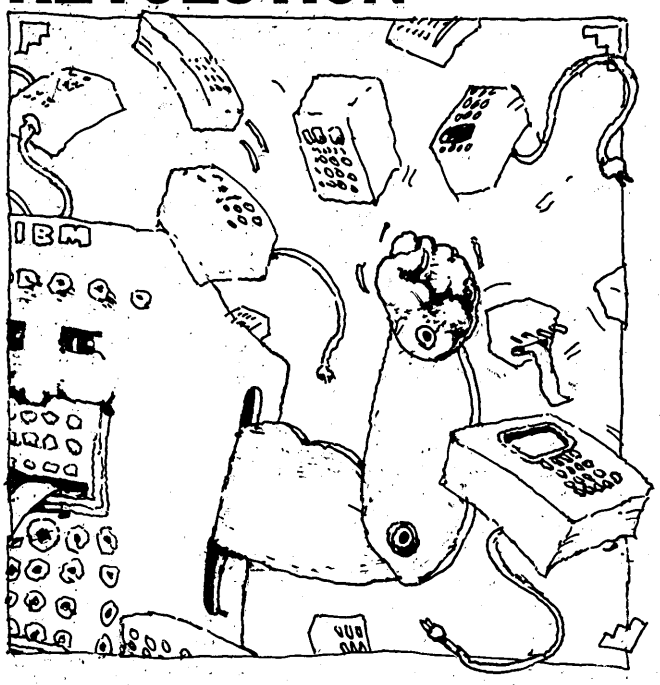
READERS' FORUM

THE 4300 REVOLUTION



What can you say when a 900-pound gorilla trots out his new computer?

Go, baby!

The 4300 series is truly revoluntionary. It is IBM's counteroffensive to the plug-compatible 370 gear, and a barrier to the Japanese. It is the long awaited replacement for IBM's low-end (370/115, 125 and 138) and a move to break the mini-market with System/3 and Series/1 replacements. However, the real import of the 4300 announcement is the fact that in making the announcement IBM has redefined its markets and clearly charted its future course for all to see. After redefining its markets, it emphatically stated that it now has announced the bulk of the hardware (4300s, 8100s, 303Xs, etc.) and communications (SNA) technology it needs to support those markets for the next few years. Further, by locking in virtual operating systems, edging them out of the public domain and nearly eliminating conversion problems, IBM has guaranteed its customers' future and asserted its dominance of the data processing industry. And, finally, by overwhelming competition with price/performance, it has declared its intentions to not only continue as a dominant force in the industry, but increase its market share.

IBM has clearly redefined its markets.

Calling its markets "supported environments," IBM has calls them: 1) standalone applications, 2) distributed applications, 3) distributed data applications, and 4) distributed network applications. These supported environments officially separate standalone and distributed computing. Further, IBM has recognized, within the distributed environment, two distinct types of applications environments: distributed applications (which talk to each other from time to time) and distributed data applications (which share data bases). IBM calls the fourth market segment "distributed networks," and defines it by host plus peer coupling, i.e., "star" networks.

The 4300 systems give IBM the high ground on all four of these new dp battlefields. The 4331 has been proclaimed as a *distributed processing system* for the ddp markets and *an entry system into a new era in full function dp* for the standalone market. It can be pictured as fitting upstream of the newly announced 8100 box or as a full-blooded minicomputer. On the other hand, the 4341 was announced as an *intermediate computer*. It fits between the 303X and the 4331. Internally, the 4331 and 4341 are not the same. The 4331 is decidedly smaller and less powerful. But raw speed is not really the key anymore, as these devices clearly demonstrate; these machines are more *data processors* than they are *computers*. They can store tons of data on-line (9 billion characters for the 4331 and up to 18 billion characters for the 4341), and they can get at it quickly and economically. There is no other machine on the market which can do either.

Calling them data processors is not enough. We must add the word *communicating* to the phrase. Remember that of the four supported environments proposed by IBM, *three of them are distributed*. And these three market segments create the need for *communicating data processors*. Communications is, thus, a critical key to this announcement. The 4331 has an internal (optional) communications adaptor that will handle up to 8 communication lines and *simultaneously* support bisynchronous, SDLC, or start/stop transmission modes, two at a time, with transmission rates on the first two modes up to 56,000bps. On the other hand, the 4341 uses the conventional 370X attached to byte or block multiplexors for its communications, but for good measure IBM has thrown in a channel-to-channel adaptor so the 4341 can be channel-hooked to a 370, 360, 303X, 4331 or another 4341 processor.

Clearly, the hardware and communications capabilities for these communicating data processors are awesome. But even that hardware strategy would not support the market without good systems software. That's been the main problem with the minicomputer market all along. IBM has addressed those issues in spades. It is now obvious that IBM intends to standardize its operating systems (one of its greatest strengths) around virtual concepts. The 4300s, 360s, 370s and 303Xs have all been blessed with virtual operating systems: DOS-VSE, VS-1, VM and MVS. Apparently, IBM intends the DOS-VSE operating system to dominate the lower end of its lines and MVS to dominate the high end, i.e., the 303X machines. VM is the key to linking 360, 370, 4300 and 303X software without requiring conversions.

This move toward standardization is supported by a simultaneous move toward performance improvement using what IBM calls Extended Control Program Support (ECPS). These ECPS features, portrayed as efficiency boosters, actually remove the operating systems from the public domain, while the IPO/E (Installation Productivity Option/Extended) working in conjunction with IBM's Remote Support Facility (RSF) almost eliminates the need for an on-board technical staff and an IBM operating system maintenance staff. IPO is the method IBM uses to configure or "generate" an operating system and install it without the need for extensive on-site testing. RSF allows IBM to maintain operating systems, diagnosing breakdowns and shooting bugs over the telephone.

The 4300s attack the hardware problem, the communications problem and the operating system problem. So what's left? Not much. Only price/performance. Apparently, all we need say in this area is that a million characters of 4300 memory costs about $15,000, or that the 4341 is equal to 3.2 370/138s and costs about the same ($250,000). That's a pretty dramatic hardware price/peformance improvement. But, if we were to just leave the price/performance improvements at the hardware level, we would be missing the *main* price/performance thrust of this revolution: *people/software.*

To understand IBM's intentions here, we need to look at the software support structure Mr. Grabe (IBM division director of systems management) used in his product announcements to depict the 4300 software support (Fig. 1). IBM has clearly staked out the three lower tiers for itself. Systems control is the operating system level, and we have already seen that IBM intends to cut both its costs and its users' costs at that level through standardization, efficiency boosters, IPO and RSF.

Level two, Support/Data Management, addresses the second highest people cost in data processing: managing master files and data bases. Here we find much new IBM-supplied file management, access and control software.

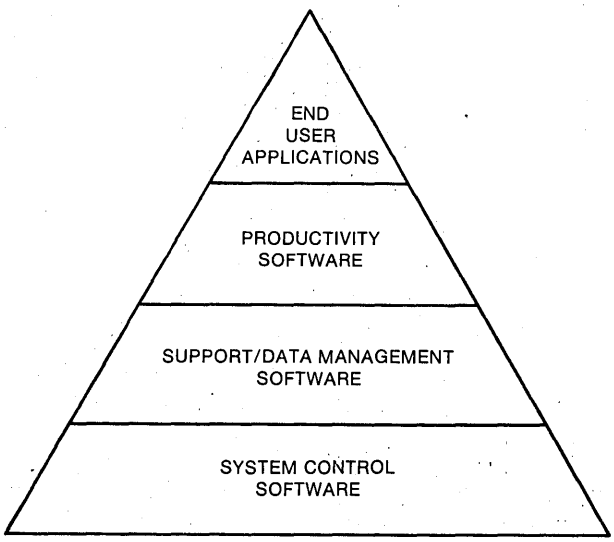


Fig. 1. Software support strategy.

The level two thrust at improving price/performance in data management is in turn buttressed by level three's attack at "Productivity" software. This IBM supplied software is clearly intended to improve the productivity of *in-house dp resources*, specifically in the areas of input and output coding, documentation and project management and control. At this level, we also find the new CADAM (Computer Augmented Design And Manufacturing) system.

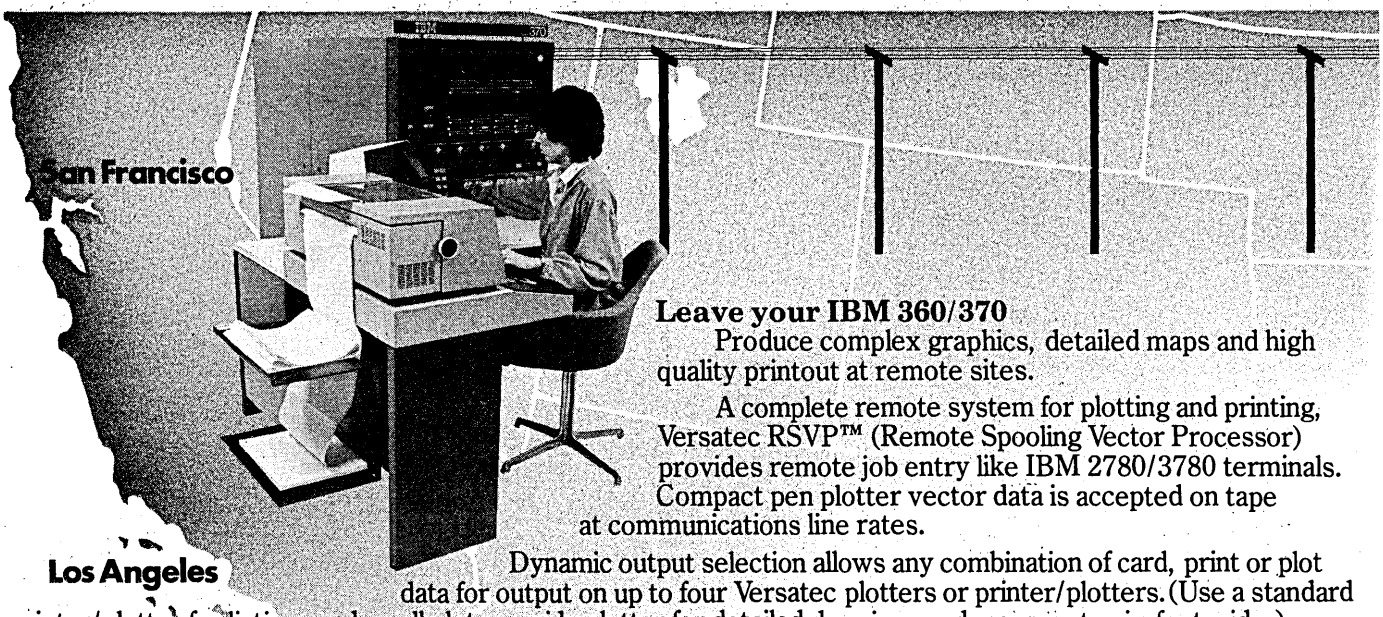
"End User Applications," level four, are squashed up at the top of the triangle. These include, in IBM's terminology, Program Products, Field Developed Programs and Installed User Programs. This canned applications software is geared to making the user more productive.

IBM's price/performance concept provides a much needed revoluntionary movement in both hardware and software (people) costs. Cost reductions in hardware are geared to beating the competition; cost reductions in software are geared to selling more hardware. Or it is that easy? Maybe IBM is going into the software business: the old razor and blades approach, with software as the blades. That makes sense, and it also explains why IBM officially introduced in its 4331 sales brochure, "a new concept called Application Machines, which offers you a hardware and software configuration that is simple to install and provides a cost-justified, single application as a base from which to grow." After all, IBM does have 2,000 software packages (PP's, FDP's, and IUP's) it can sell, and it has just completed programming its ninth COPICS module.

SO WHAT? Competitors and customers alike are all agog about this IBM 4300 announcement. But what difference does it make if you can't get one. If you didn't order your next two to three year supply of 4300s by March 2, 1979, you may be out of luck. (If first-day orders reached 20,000 units—and that's not too farfetched considering that after five months IBM's backlog of 8100s was 40,000 units, and the 8100s weren't scheduled for volume delivery until 1980—IBM will have to produce 10,000 units per year to guarantee two-year delivery.) The Endicott plant may be able to manufacture 10,000 cpu's a year, but what about all the new peripherals? It's a good thing the old peripheral gear will operate with the new cpu's.

So in the near term, IBM's policy and direction are probably more important than its 4300s. Users may begin readjusting their plans and schedules to coincide with still indeterminate 4300 deliveries, and this will impact other vendors, as it always does. There even may be some initial realignment of vendor rankings, the more flexible vendors being able to adopt to IBM's fancy footwork early, and the less flexible vendors being faced with loss of market share to the more flexible vendors and/or to IBM itself. Suppliers of 370-compatible proprietary software will be ecstatic, as will those manufacturers already heavily committed in the direction of SNA ddp. Most of these vendors were

Get away from your cc



Leave your IBM 360/370

Produce complex graphics, detailed maps and high quality printout at remote sites.

A complete remote system for plotting and printing, Versatec RSVP™ (Remote Spooling Vector Processor) provides remote job entry like IBM 2780/3780 terminals. Compact pen plotter vector data is accepted on tape at communications line rates.

Dynamic output selection allows any combination of card, print or plot data for output on up to four Versatec plotters or printer/plotters. (Use a standard printer/plotter for listings and small plots; a wide plotter for detailed drawings and maps up to six-foot wide.) Off-line tape systems available, too.

Escape with Harris

Use the new Versatec Remote Plotting Controller and any of eighteen Versatec models to plot and print from Harris 1600 remote batch/remote job entry terminals. Data is compressed and transmitted in encoded raster format to the Harris. Then the Versatec RPC decompresses encoded raster data and directs plotting and printing.

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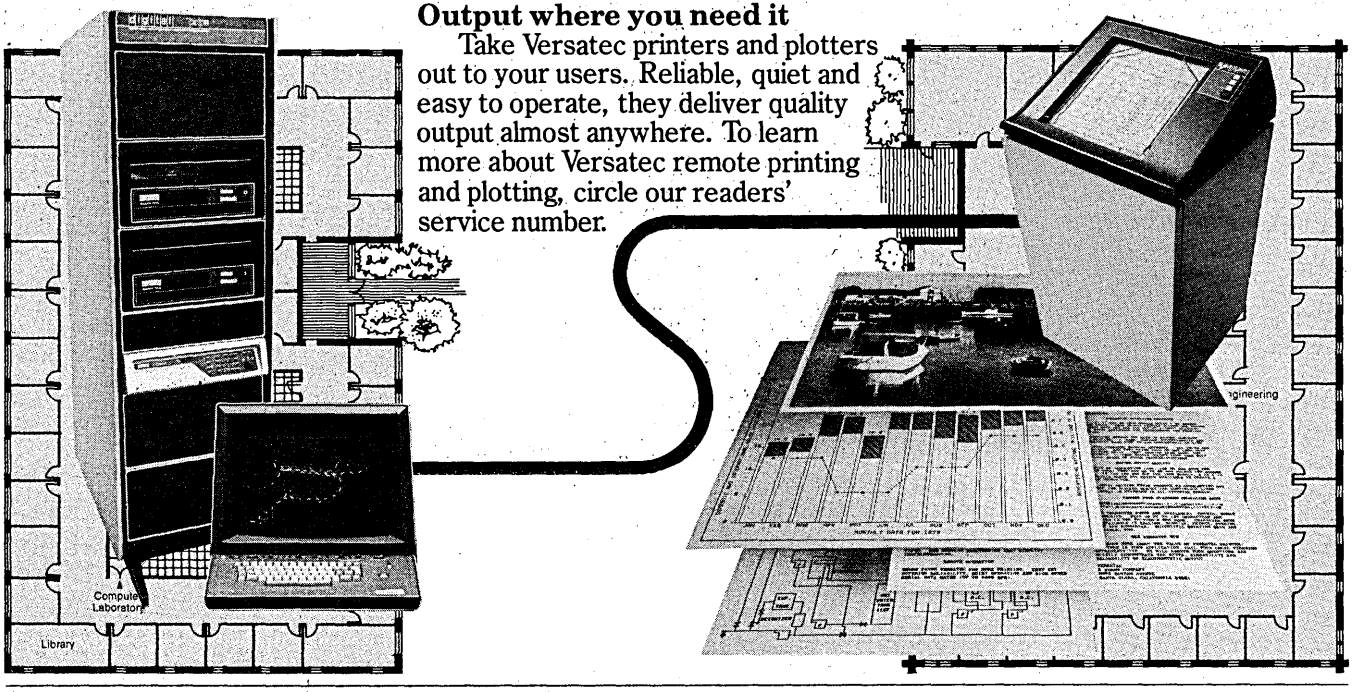
A Versatec multiplexer can drive any two Versatec output units from a single computer or parallel data source. And it can extend long lines another 1000 feet. With chaining, you can add more data sources or print/plot stations.

Share hard copy from display

Versatec printer/plotters produce hard copy, on command, up to 1000 feet away from Tektronix or digital video terminals and displays. Share hard copy without leaving your chair.

Output where you need it

Take Versatec printers and plotters out to your users. Reliable, quiet and easy to operate, they deliver quality output almost anywhere. To learn more about Versatec remote printing and plotting, circle our readers' service number.



CIRCLE 36 ON READER CARD

READERS' FORUM

riding IBM's coattails anyway and should be elated that IBM has finally declared its long-range strategy.

Turnkey software vendors may be in real trouble. IBM has declared its intentions to compete with them, using its own equipment and operating systems. IBM is moving the bases while the pitch is still on its way to the plate. If turnkey vendors fall down, they will injure their hardware suppliers; those suppliers may have to abandon their "hands-off" approach to applications software and pour money into beating IBM into the Application Machine marketplace. But even that may not be enough to keep them alive. The problems with Application Machines are identical to those of application: how will they be integrated? History has taught us that regardless of how desperate users are to satisfy their appetite for applications, inevitably they will get indigestion. Integration is the only cure. And integration can only be achieved at the data management level, using standardized file management strategies and software. Undoubtedly, it will be more difficult for IBM's competitors to convince their potential customers they can support the level of commitment necessary to sustain an integrated application machine environment.

As to how, specifically, Application Machines will be integrated, one possible answer lies in what was *not* announced: a relational data base replacement for IMS. Maybe IBM's is looking at the 4341 as the long anticipated (and longed for) 256-pound IMS chip—that, however, is doubtful. Out there somewhere may be a relational data base engine that will offer no conversion problems to IBM's captive IMS users. Certainly, IBM has laid the foundation for such a strategy with its concept of "distributed *data* applications," and certainly it is heavily committed to data base technology. After all, data bases are the *a priori* requirement of flexible, responsive data processing. This is further acknowledged by IBM's level two software support strategy. Maybe Application Machines will eventually be hooked to Data Base Machines. Then we could call them End User Work Stations, and watch the world that opens up.

—George Conrad

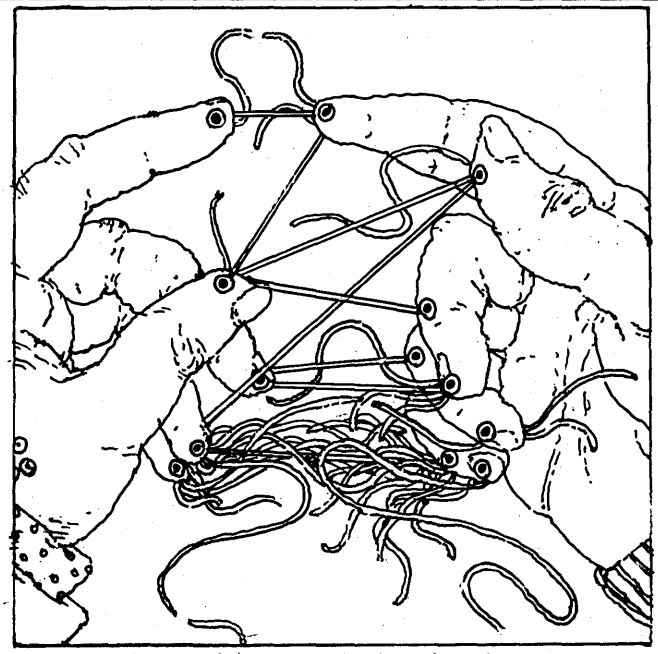
Mr. Conrad lives and works in Manhattan Beach, Calif.

IT'S TIME TO MAKE THE NETS WORK

There's quite a difference between the capabilities of present-day communication networks and the current capabilities of computers and terminals. We read a lot about the impact of computers, and it's easy to become enamored with them. In fact, that's what usually happens. We talk about the future, about computerized homes and computerized offices, as if it were coming tomorrow. But that's not the case. Those advances will surely arrive one day. But these things always seem to take longer than we thought, and we usually don't realize all that must be done first. The United Computing Systems network is a case in point.

This network covers the entire United States, crosses over to London, then down to Zurich where it interfaces with the FIDES network. FIDES, a subsidiary of Credit Swiss, has a joint networking agreement with United Computing. Most of United Computing's network is comprised of lines leased from telephone companies. Today it has 60,000 miles of leased lines, operating at baud rates of 2.4KB to 56KB.

This is a fairly efficient system—but much better communications are going to be needed in the future because of our



customers' demand for more sophisticated services.

Today, the company's network looks similar in many respects to AT&T's Advanced Communications Service and to the value-added carriers. But United Computing is not in the business of selling a communications system. Our network is designed to give customers quick access to computer power through shared computing hardware, software and specialized communication links to customers. Efficient use of the system is very important in keeping down our costs so that the company can compete with other firms offering similar services.

United Computing currently has data concentrators at 98 points in the network, and customers access the network from more than 190 points. The concentrators receive customer input —at baud rates ranging from 110 to 19.2KB—and the data is recorded for transmission at rates up to 56KB to one of four data centers.

UCS' entire network ties to these data centers in Kansas City, Boston and London, and the FIDES computer center in Zurich. The data centers are equipped with large-scale computers including Control Data, IBM, and the first commercial installation of the Cray-1.

The data centers are operating a total of 19 central processors, 13 of them in one center in Kansas City. That's a large amount of computing power—consequently, United Computing has a large amount of data flowing over its network.

The Cray computer is the fastest machine in use today. It runs at speeds up to 80 million operations per second. The company's total capacity is in the order of hundreds of millions of computations per second—with a corresponding flow of data potentially required over the network. In fact, this entails millions of characters of information routinely moving throughout the system.

Ten years ago, before minicomputers were widely available, UCS was serving a few hundred, not several thousand, customers. Our customers were dialing in on 10cps terminals, and the amount of data we could move was restricted. The primary services offered involved very small scientific and engineering jobs, primarily problem-solving applications. Gradually, the capability of the hardware improved to handle much larger problems.

Customers started to use faster and more efficient equipment, and UCS leased a few high-speed lines for remote batch

entries. By the beginning of the 1970s, we were able to go, routinely, to 4800 and 9600 baud, with a few 56KB lines. And though the original services continued to be offered, the company quite rapidly specialized in large-scale scientific and engineering applications and data base management systems.

Now, at the end of the 1970s, not much has changed. The terminal equipment at the end of the lines is considerably different. Electronic switching and other improvements have been made by the telephone industry. The network is much larger, and better equipment, such as data concentrators, is used to make the transmission system more efficient.

But functionally, operations are pretty much the same as they were 10 years ago. Transmission rate is about the same and very little economy of scale has been experienced in transmission costs compared to what has been experienced in computer hardware.

In terms of hardware, computing power has gone up geometrically with very little increase in price. The Cray computer, running at 80 million computations per second, needs another large-scale computer to feed it data. And UCS can price it at a rate that saves customers money on running large, complicated jobs. However, these new applications are related to the expanded capability of the computer, not the network.

Today, the output capacity of the computer far outpaces the capabilities of the network to carry data. The computer output capacity is measured in millions of characters per second while the throughput of the network is measured in thousands of characters per second. Many of the business applications that would require large amounts of data cannot be provided because it is not feasible given today's network costs and capabilities. And certainly, applications where data is passed directly from one computer to another are limited by the capacity of today's network to the most trivial applications.

DRIVING ON TWO-LANE ROADS

If the communications network had evolved as fast as computers in the last 10 years, economically feasible megabaud lines would be available. That vital economy of scale in our communications network that we've already achieved in our computing power is missing. In effect, United Computing has a garage full of modern automobiles and it is being forced to drive them over old, two-lane roads built years ago.

That points up one of my major concerns. At present, 65% of UCS business comes from remote computing services. And communications affects that product more drastically than any other factor.

When a customer wants time—wants to run a job and get results—that means right now! It doesn't matter that the customer may be in Los Angeles or London. There's an instant need to communicate.

Here's the concern: We hear about a big revolution in communications. The telephone industry is changing—becoming more marketing oriented. The industry is talking about high-speed computers here and terminals there. But *nobody* seems to be talking about the requirements and capability of the network. Everyone talks about who should own it and control it, but not what it should do.

It seems to me that things are getting out of phase. There is hardware today, at the ends of communications lines, that is improving much faster than the capacity of the line that is provided by the telephone companies. Remote computing services are hampered in their quest to keep up with customers' demand for fast, high-volume service. The ability to offer a wide variety of new applications is limited by the communications system used to deliver them. Without some economy of scale on communications costs, the remote computing industry will ultimately not be able to compete with standalone computer systems. The

communication system on which remote computing companies rely to deliver their products is not keeping up with technology.

That's a bad situation—for remote computing companies, for our customers, and eventually for the telephone industry. The technology that allows such applications is here today, but the implementation of technology to communicate is lagging.

Yet, we continue to read about a revolution. But there need be no revolution if the communications industry reacts to the needs of the market. Computers are going through a process of evolution, and networking capabilities are almost standing still. Computers have gotten better and better—and faster and faster—but the technology has been refined, not revolutionized.

And what are computers doing differently today than they did 10 years ago? Frankly, not much. Most computers are still doing payroll, inventory control, and general ledger. To be sure, they're doing it cheaper and faster. And there are many more computers hooked up to communications lines. But basically, they're doing the same jobs they did a decade ago.

So computer hardware has evolved, but the applications haven't, except in the elementary use of low-speed communications. Part of the reason applications are lagging is that remote computing firms can't communicate fast enough and economically enough over our network to offer more. One of the reasons distributed processing is not more widely accepted is that even though minicomputer prices are going down, communications costs are not.

Some applications today actually require putting a person on an airplane with an armload of disk packs, simply because *it's cheaper than transmitting data over leased lines.* Now *that's* inefficient. But there are times when it's the only economic alternative.

That has been the industry's experience over and over again. At UCS, for example, there are a lot of smaller customers who need, say, four or five hours a day just to transmit data, because a 9600-baud line is the fastest communication link that can be used and still make a profit. Faster communications could be made available to the customer, but in many cases that would push the costs up to a burdensome level. Such a step would be disadvantageous, both to the customer and to the remote computing industry.

In the simplest terms, the cost of volume intercity communications is a major factor inhibiting the distribution of computer power. There is great need to make high-speed digital data transmission more cost effective.

Of course, telephone companies have their own problems. They have to satisfy many regulatory boards and commissions. They have accounting rules and depreciation schedules that can force them to live with outmoded equipment when they should be upgrading to new technologies. They have massive investments in hardware and they visualize hauling it away to a scrap heap.

Those are some of the key reasons a communications revolution may never happen. Each of those factors must fit into the equation; each will affect the time frame of change.

The primary need, however, is for communications industry to put the same effort into improving the networks that the computer manufacturers have put into improving the hardware that is connected to the networks.

—G. J. Lorenz

DDP'S FORGOTTEN REQUIREMENT

A critical requirement that is lacking in most current distributed processing systems, and is generally unrecognized by the user community, is ease of transfer of programs between the central host and the local processor. To meet this requirement, the architecture of the host and the satellite must be uniform; use of any distributed processor with an architecture different from that of its host is inherently limiting. With the marketing of the 4331 as a distributed processor, IBM has (quietly) shown its recognition and acceptance of this principle.

There is no question that such uniformity must ultimately be the rule. It is up to us, the users, who must risk fortunes in development costs, to see to it that our vendors meet this requirement sooner rather than later.

Distributed data processing is, at heart, a movement of technological liberation. It draws on a new flexibility in our technology that makes information processing services accessible wherever the organization needs them; where remote access to a large central system is not economical because of communication costs, access to a small local system has become an attractive alternative or supplement. This means some functions that were done on the central system will have to be moved to the local system. We will want to be able to do this gradually. And we may want to move some processing back as usage patterns or economics change or are found to have been misunderstood. If distributed processing systems are to deliver the liberation they promise, programs or transactions running on the central system must run on the local system (and vice versa) without any major conversion problems.

The technology that has made small processors cheap has made them able to mimic our large processors. We no longer have to use a mini with strange architectures, strange languages, and strange operating systems. We can use a mini with 370 architecture that executes 370 programs under 370 operating systems. These systems have recently appeared; they are still not as cheap or as oriented to end-users as the simpler minis, but this will change. In the IBM 4331 we see a $65,000 processor with 512K of memory that can execute CICS transactions from our large mainframes without change. This is just the beginning.

A distributed processor that looks like a 370 (or whatever host is used) is rapidly being recognized—particularly by vendors of small 370 copies—as practical and profitable, and has been referred to as the "second generation of distributed processing." This idea is too vital to the effectiveness of our distributed processing systems to be allowed to develop at its own pace. The established vendors of distributed systems are not eager for this development, and IBM may hedge on the costs and risks of a bold move. The independent vendors of mini-370s do not yet have much influence or strength. We users must recognize this is something we need as soon as possible—and we must impress this fact upon our vendors.

The largest cost of distributed systems is not equipment but application development. Maximizing this massive investment requires that applications be developed for an architecture with a long life. This is why the 370 (actually 360) architecture arose in the first place. Reworking an application inventory every time we convert to a newer or larger machine is unacceptable. So an entire line of machines with uniform architectures was developed, and prevailed; the idea had irresistible merit. Similarly, before we invest heavily in distributed applications we must settle on an architecture that will preserve the value of that investment.

There are a number of reasons the architecture of the host will prevail (whether it be the 370 as it exists or evolves, or the look-alike of the other vendors' families):

- One man's satellite is another man's host. We cannot maintain one architecture for hosts and another for satellites because there is no clear distinction. Large sites may use large

processors for the same tasks that small sites use small ones for. Large processors may be satellites to still larger processors. And most companies will continue to have substantial central systems that must coexist with local systems spanning a broad range of sizes.

• What is here today may be elsewhere tomorrow. We often don't know enough to decide in advance where each function is best placed; to find out we often need to give it a try. Serious mistakes are hard enough to avoid without ease of migration back and forth, these mistakes will be cast in stone. And even if we have the economics of distribution right today, the rapid changes in processor and communication costs—along with evolving usage patterns—may make them wrong tomorrow.

• Headstarts are nice. We already have expensive inventories of applications on our host. With compatible satellites, we can put those applications to work for distributed use *now*, not after a long expensive conversion process.

• "Do I talk to the mini people or the maxi people?" Not only do current systems have different languages and operating systems, they have different development support tools. As we move toward programmer's workbenches and extensive automatic aids, do we want to develop two parallel, but alien, communities when we could have a single, organic pool of talent and expertise?

ARE THERE PROBLEMS WITH UNIFORMITY?

It is clear there are powerful reasons for demanding uniformity—are there any good reasons we cannot or should not have it? There are some reasons at the moment but they are quickly disappearing.

The major limiting factor has been cost, but that is changing rapidly. It is not hard to put 370 logic in a mini, but 370 I/O architecture has been a challenge. We see evidence of progress in the I/O adaptors of the 4300, and can expect this progress to continue.

Those parts of the large host that are hard to scale down are not the ones that are important to the user. We are concerned with the architecture seen by our application programs. This means the same compilers, and the same *interfaces* to the operating system and data base/data communication system. The system software does not have to be identical to that in the large hosts, as long as it looks the same to our applications. The internal structure of this software can hide differences of scale and such details as minor differences in I/O architecture. We can supplement the miracle of hardware technology with the magic of software (and firmware) to get conforming systems at lower and lower entry levels. The several operating systems used on the present 370 line have shown we can benefit from uniform architecture even if we are forced to make some compromise to scale. Our application inventory can still be transported with relatively modest effort.

I should emphasize that I am not speaking here of distributed data base systems, where data may be transferred from node to node independently of progams. That is still an unsolved problem (but one that is obviously easiest to solve within a uniform architecture). My point assumes programs and data will be moved together as necessary. The problem of breaking out pieces of data bases to go with migrating functions is not trivial but, given a uniform environment with uniform file system facilities, it is readily practical. With an alien environment and alien file sytem it is difficult and expensive.

The principal objections to the call for uniformity will undoubtedly come from those who criticize the 370 environment (and that of large hosts in general) as unwieldy, and take the dissimilarity of small systems as an advantage. This position is not without merits, but those mertis are transitory. The central mainframe is not about to disappear—it *has* to be made manageable, and much progress is occurring. Software structures are becoming more rational and usable. The mini systems are sim-

pler because they offer more narrow facilities. By subsetting and selecting facilities from host systems we can approach that simplicity and not sacrifice the flexibility of selecting from a rich menu. The need for broad function is turning minis into megaminis that suffer from the same complexity as mainframes. Wouldn't we be much better off if we turned 370s into megaminis and minis instead?

Ease of operation by nontechnical personnel at the remote site is also a concern. Presently, 370 operating systems require more operator sophistication and provide less remote control and diagnostic capability than a conventional distributed processor. This is a disadvantage that must be taken into account now, but there is no good reason software can't be added to provide all the same capabilities on a 370.

Development for nonconforming architectures should be done only to the extent that it has a clear payoff that cannot be achieved with a conforming system. We must also make it clear to our vendors that we consider architectural uniformity to be an essential and urgent requirement.

Every equipment acquisition and every development project should be reviewed. We must ask if our excursions are necessary.

Could we get the same function and benefits from terminal access to the central system? Are the operating penalties modest enough compared to development costs to defer physical distribution until a suitable processor is available? This would let us develop now in the architecture we want, and then later migrate them to a conforming satellite without serious expense.

Could we use a mini 370 now? Even if the premium over alternative equipment is substantial, it is not likely to stay that way for long. The savings in familiarity, fast migration of existing applications, and longevity of new development can dwarf the short term difference in equipment cost.

Are we using noncomforming architecture only where the payoffs and risks justify it? We should avoid developments with long payback periods, and those where development is relatively complex and difficult to convert. Distributed data entry with batch updates to the host will involve a much smaller and simpler conversion than direct on-line update of local files. Distributed access to data can be provided by teminal pass-through to programs and data at the host, thus avoiding any need for development of noncomforming programs and files. Such a strategy exploits the 80-20 rule to let us use existing products to bring most of the function we want to our end users without requiring large investments in application programs.

Such policies by users will speak to vendors in the language they hear best. To be sure the message is read clearly and early, we must be explicit in demanding products that fit our accepted architectures and criticizing those that do not. There are a lot of very nice systems that have been designed well and with good intentions, but we cannot afford to use them without a great deal of caution. (Currently, the IBM 8100, is a great disappointment in not having 370-architecture uniformity; IBM should be encouraged to do something about it.) At the same time, systems that do have the key quality of conforming to our architectures are in their formative stages. Now is the time to influence and hasten their refinement into a truly powerful and flexible vehicle for the liberation we seek in distributed processing.

—Richard R. Reisman

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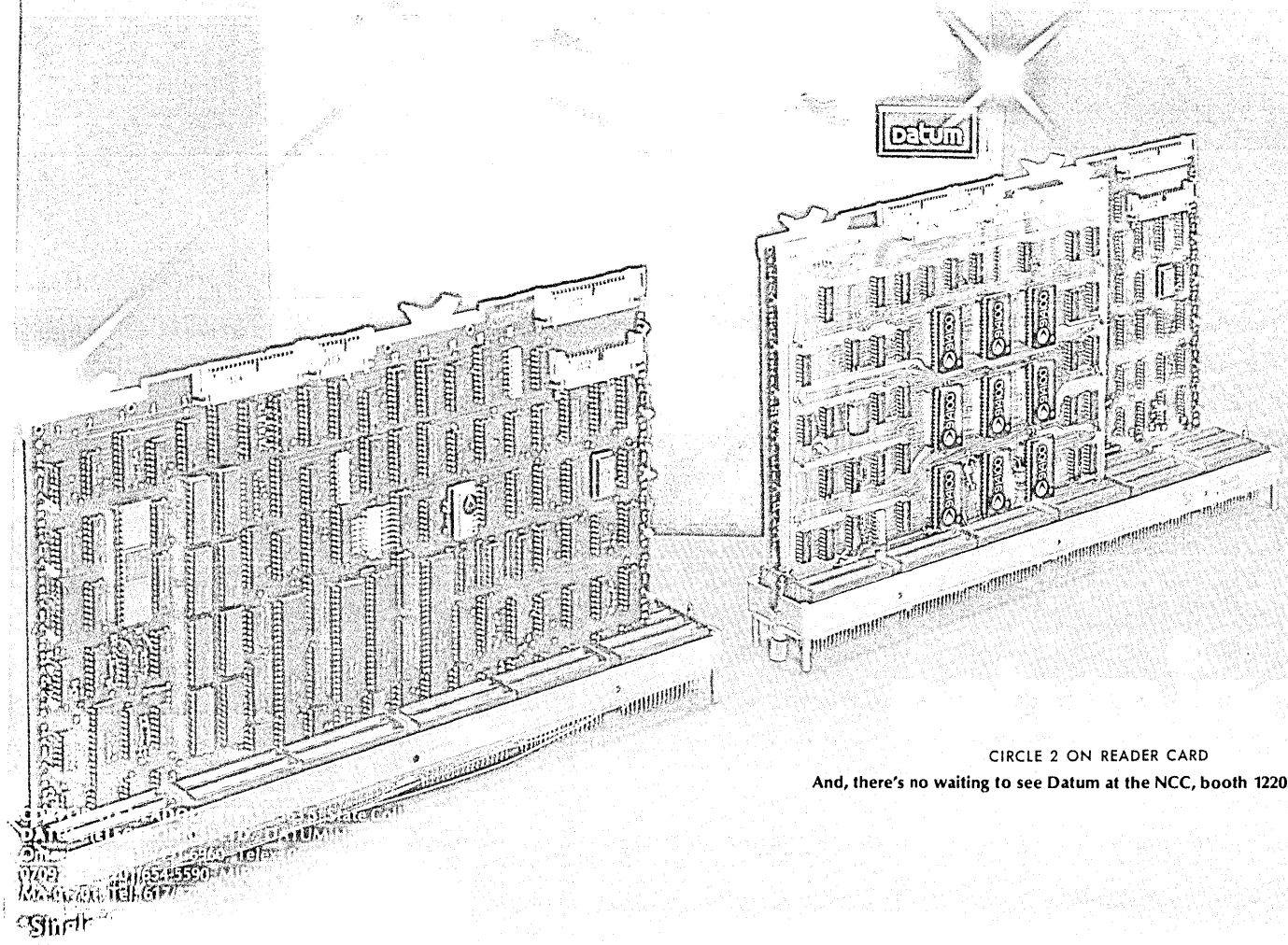

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