DATAMATION®

JUNE/4.00 U.S.A.

DATA COMMUNICATIONS:
THE TOP 50 MANUFACTURERS

ALSO

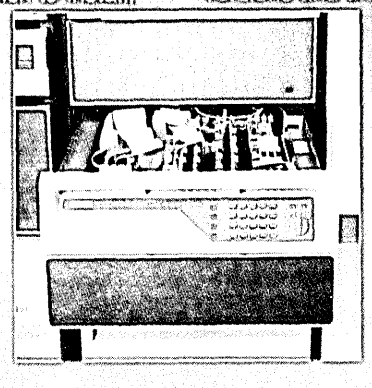
SYMMETRICAL MULTIPROCESSING

REDUNDANT SYSTEMS

FOCUS ON MAINFRAMERS

A Marriage of Convenience— for PDP and LSI users!

It's a marriage made in heaven—for DEC PDP-11 and LSI-11 owners who would like a low-cost, quick-to-install, high-density data storage system.
The union consists of Kennedys' Series 5300 fixed media, Winchester technology disk drives and Kennedy emulation controllers. The controllers, which use standard DEC PDP-11 operating systems and diagnostic software, are embedded inside the computer, allowing the Series 5300 to be easily attached to both PDP-11 and LSI-11 minis in one sweet stroke.



The ceremony: Series 5300, with its one, two or three platter versions and unformatted data capacity of 70M bytes and track density of 300 TPI can be joined with the KSC11 unibus disk controller for the PDP-11, and the KSC01, for use with the LSI-11. And no software changes or other alterations are required.
Kennedy Series 5300, controllers and your PDP-11 or LSI-11—put them together, plug them in and you have a winning system.

KENNEDY
Subsidiary Magnetics & Electronics Inc.
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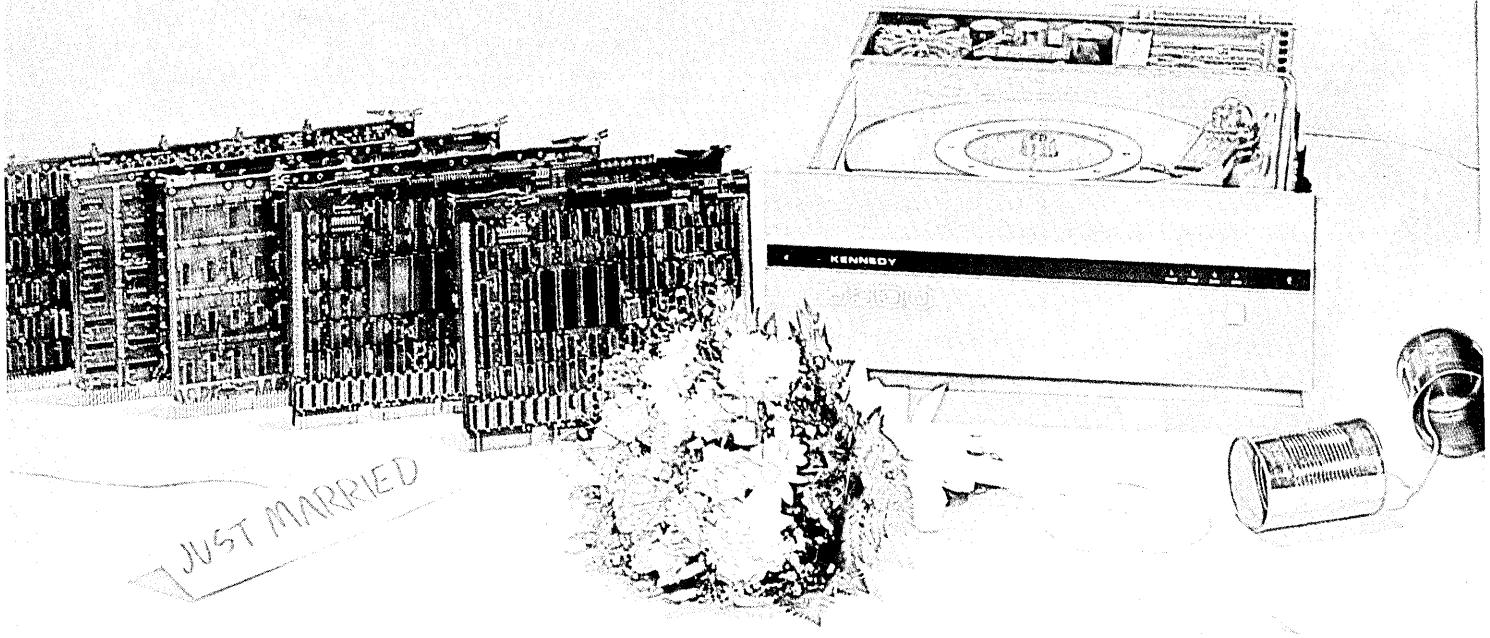

BONANZA!

For PDP-11* users, the most cost effective, "no-compromise," SMD disc controller

Maximize your system's cost performance factor with the full capability DC-233 Disc Drive Controller. Its unique master-slave bit slice microprocessor architecture provides total DEC software transparency with up to eight drives. Use it with the CDC 9762 80mb drive to emulate DEC's RM02/03 (67mb of formatted capacity per drive). Or–use it with the Memorex 677 Series 100/200mb drives to emulate DEC's RP05/06 (up to 176mb of formatted capacity per drive). Or–use it with eight 300mb drives for up to 2.1 billion bytes of formatted data in non-software compatible mode.

AND THERE'S MORE

- **Embedded design fits all PDP-11's***
- **Dual drive porting**
- **Optional dual unibus porting**
- **Automatic NPR throttling**
- **ECC fully implemented**
- **Media compatible**

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*Trade name of Digital Equipment Corporation

CIRCLE 4 ON READER CARD

Here's the state of the art in low-cost hard-disk computers

11 MEGABYTES OF FAST HARD-DISK STORAGE

Yes, the Cromemco Model Z-2H is in a class by itself in the computer field.

These Z-2H features tell you why:

- **11 megabytes of hard-disk storage**
- **64 kilobytes of fast RAM**
- **Two dual-sided floppy disk drives**
- **Z-80A type processor**
- **Fast 4 MHz operation—150 nanosecond access time**
- **Fast hard-disk transfer rate of 5.6 megabits/second**
- **Low cost**

And that's not all you get. Not nearly.

BROAD SOFTWARE SUPPORT

You also get Cromemco software support—the broadest software support in the microcomputer field. Software that Cromemco is known for. Like this:

- **Structured BASIC**
- **FORTRAN IV**
- **RATFOR (RATional FORtran)**
- **COBOL**
- **Z-80 Macro Assembler**
- **Word Processing System**
- **Data Base Management**

And more all the time.

FIELD PROVEN

The Z-2H is clearly in a class by itself. We introduced it last summer. It's field proven. It's reliable.

And it's rugged. Housed in a sturdy, all-metal cabinet.

EASILY EXPANDABLE

As always with Cromemco, you get expandability. The fast 64K RAM in this Model Z-2H can be expanded to 512 kilobytes. That amount of RAM combined with 11 megabytes of hard-disk storage gives you enormous computer power—the equal or even beyond what much larger computers sometimes offer.

What's more, this computer gives you a 12-slot card cage. That's to plug in your special circuits as well as additional RAM and interface cards.

This expandability is supported by still more Cromemco value — the Z-2H's heavy-duty power supply that gives you 30A at 8V and 15A at ±18V to support plug-ins.

LOW COST — SEE IT NOW

The Z-2H is real. It's been in the field for many months. It's proven itself.

You should see the Z-2H now. Contact a Cromemco representative and arrange for a demo. Learn that Cromemco is a survey-winner for reliability.

And learn that the Z-2H is under $10K.

In the long run it always pays to get the best.

Cromemco
incorporated

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Tomorrow's computers today

CIRCLE 5 ON READER CARD

JUNE 1980/4.00 U.S.A. VOLUME 26 NUMBER 6 This issue, 163,972 copies

DATAMATION®


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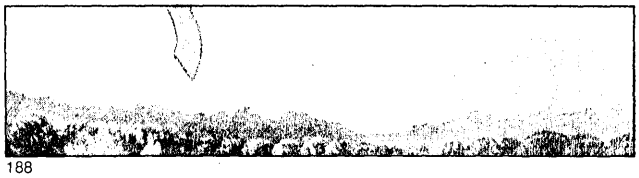
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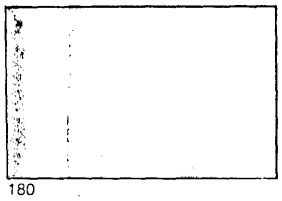
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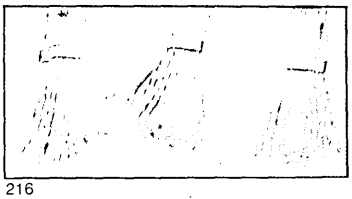
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A Lasting Relationship.

Intel and Information Resource Management, your family of solutions.

A lasting relationship is exactly what you'll find in Intel's new family of Information Resource Management products. Combining the very best of proven products with Intel's newest innovations in both hardware and software, it's a family which brings an integrated data dictionary, powerful data base management, coordinated data communications, distributed data base facilities, and incredibly efficient data base hardware.

Integrated Data Dictionary: IDD.

Heading up the family is Intel's Integrated Data Dictionary, IDD. An indispensable tool for effective data administration, IDD helps you streamline and control your environment. IDD is an applications design aid, a documentation vehicle, a way to enforce standards and procedures, a master reference for determining the impact of changes to your data.

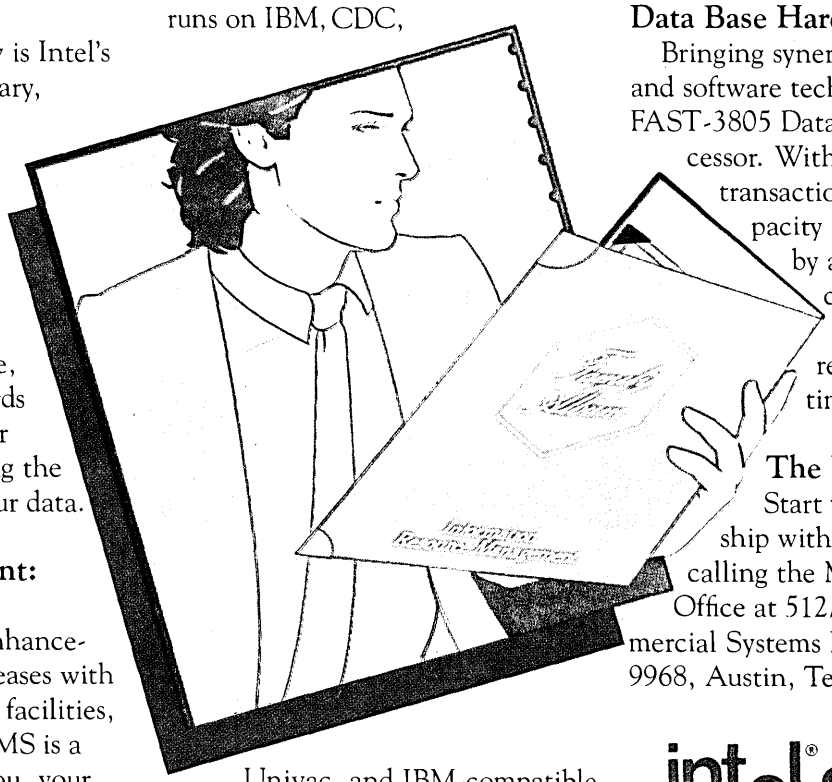
Data Base Management: SYSTEM 2000®/80.

Blending the finest enhancements from previous releases with a multitude of advanced facilities, SYSTEM 2000®/80 DBMS is a family member which you, your designers, programmers, data administrators, and end users will all appreciate. Each feature is designed to increase productivity and make your environment as flexible as possible.

Multiple languages. For designers and programmers, there's PLEX, Intel's Programming Language Extension to COBOL, PL/1, FORTRAN and Assembler. And for end users, Intel provides QUEST, an easy-to-use (but powerful) English-like language.

Multiple data structures. SYSTEM 2000/80 DBMS indexing and direct access keys provide fast access to relational, hierarchical, and network data structures.

Multiple operating systems and mainframes. SYSTEM 2000/80 DBMS runs on IBM, CDC,



Univac, and IBM-compatible mainframes. And Intel was first with a DBMS for IBM's new 4300 series.

Data Communications: DC.

Supporting your need for high volume, on-line production processing are Intel's communications extensions to the leading TP monitors, including CICS.

Distributed Data Base: DDB.

Intel's newest addition is Multiple Systems Coupling, MSC. Providing communications between two or more IBM processors, including the new 4300 series, our MSC software lets you execute applications and transactions in one CPU while accessing data managed by SYSTEM 2000/80 DBMS in another.

Data Base Hardware: DBH.

Bringing synergism to hardware and software technologies is the FAST-3805 Data Base Assist Processor. With this option, transaction throughput capacity can be improved by as much as 100 percent and with a 50 percent or better reduction in response time.

The Family and You.

Start your lasting relationship with our new family by calling the Market Information Office at 512/258-5171, Intel Commercial Systems Division, P.O. Box 9968, Austin, Texas 78766.

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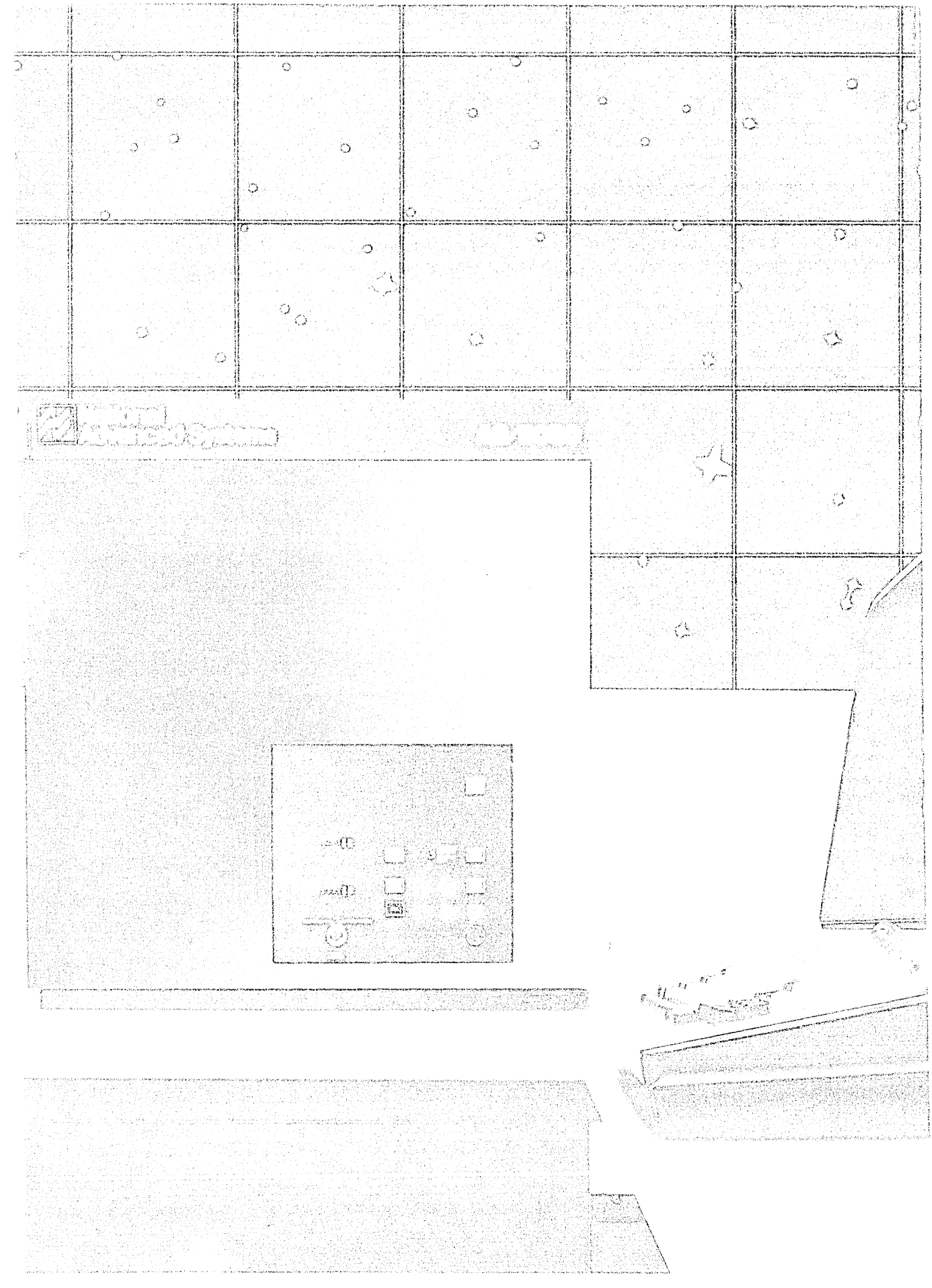
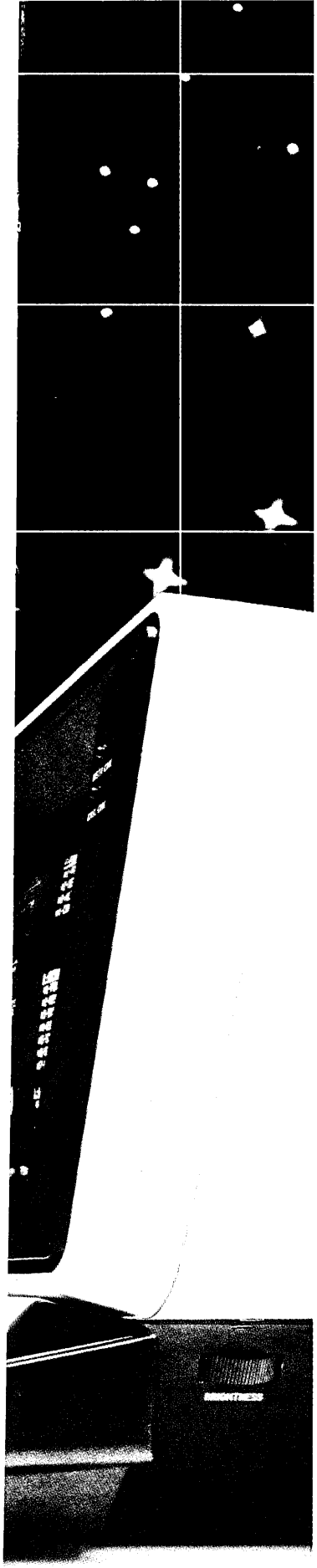
CIRCLE 7 ON READER CARD





The AS/5000. Not even IBM can offer this much for this little.

It has been a popular misconception in the computer industry that no one is able to offer the kind of price, performance, and support that IBM can.

We'd like to clarify matters.

Our AS/5000 computer is a medium-scale, IBM-compatible system that offers 15% better performance than an IBM 3031, at a substantially lower cost. It forms the middle of our Advanced Systems (AS) product line, the broadest range of IBM-compatible computers available today.

The AS/5000 is a two-megabyte, six-channel system, optionally expandable to eight megabytes. Through the use of advanced integrated circuit technology, the number of components, pins, and connections is substantially less than used by IBM – resulting in unsurpassed reliability. The AS/5000 is lighter, takes up less floor space, requires 50% less power, and generates about half as much heat as comparable IBM systems.

A truly flexible system, with tailored support.

The AS/5000 supports all IBM System/370 and 303X operating systems, including their extensions. The AS/5000 runs complete VM-ECPS, including EVMA, more than is offered on the IBM 3031.

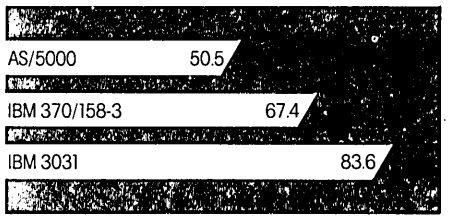
In addition, we offer new, more flexible software support services. Choose between Central Program Support Services or Local Program Support Services, and get software support tailored to your specific needs.

Another important feature of the AS/5000 is its advanced microcode architecture. Through microcoding, language functions become a part of the machine itself, rather than an element of the software. This feature allows performance enhancements such as MVS/SE and VM-ECPS to be implemented, and allows the AS/5000 to remain compatible with any additional enhancements to existing IBM systems. We provide what you really need – on-going compatibility to protect your sizeable investments in systems, software and training.

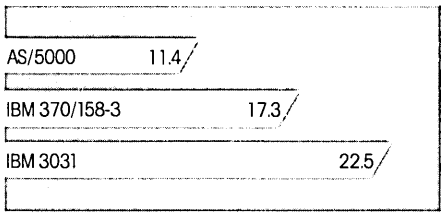
That's one reason why we're called the Compatible Computer Company.

More computer for your money. Now.

The AS/5000 is manufactured at our Southern California facility and is available now. You can receive shipment of your computer when you want it – and need it.



FLOOR SPACE IN SQUARE FEET



POWER CONSUMPTION IN KVA

Our commitment to deliver superior performance and reliability at a lower cost extends beyond the design and development of our equipment. We back the AS/5000 with the finest support in the industry, including a world-wide network of expert Field Engineers and Software System Support Representatives. We offer total support capabilities to help protect your computer investment. Now and in the future.

We also offer versatile financing alternatives, including several highly competitive long-term or short-term leasing programs.

If the AS/5000 sounds like what you've been looking for, contact your local National Advanced Systems sales office, or write to Marketing Dept. A2, 3145 Porter Drive, Palo Alto, CA 94304, 415/856-5000. We'll be happy to send you all the information you need.

The AS/5000 from National Advanced Systems.

If IBM built theirs like ours, we'd have some serious competition.

National Advanced Systems

The Compatible Computer Company

A Subsidiary of National Semiconductor.

CIRCLE 8 ON READER CARD

Twenty Years Ago/Ten Years Ago

LOOKING BACK

MAY/JUNE 1960

A major feature in this issue was a discussion of the uses and the advantages of tunnel, or Esaki, diodes. Frank J. Hierholzer Jr., Sperry Rand, stated, "Perhaps the two most important assets of the tunnel diode are the potential extremely fast switching speed and the power gain capability of the device." He also had positive comments on the tunnel diodes' low cost, reliability, and resistance to water and other impurities.

A.K. Rapp, Pacific Semiconductors, Inc.; Jan A. Rajchman, RCA Labs; R.L. Petritz, TI; J.F. Kalbach, Burroughs Corp; and F. J. Van Poppelin, Jr., Motorola, Inc., all had positive comments on the future of tunnel diodes in the digital computer industry. An example from Petritz: "The effect that diodes will have in the next five years can be discussed with relation to two broad areas. The first area concerns the general purpose digital computer that operates at clock rates slower than one millimicrosecond; the second area is the extremely high speed computer that operates at clock rates faster than one millimicrosecond. High speed transistors can serve the first area and have a number of desirable features. Tunnel diodes, on the other hand can be a serious competitor to the transistor for this market if it proves to be a more economical and more reliable device." Van Poppelin discussed Motorola's interest in diodes, and stated in his closing, "We believe there will be a large market for both tunnel diodes and transistors 10 years from today . . . "

Leo Esaki, inventor of the tunnel diodes, was in Japan when he invented the new diode in the early '60s, and later worked for IBM Research Labs in Yorktown Heights. Esaki's diode is still manufactured today by a few companies, and is used in highly specialized microwave applications.

The major reason for the diodes' diminished popularity was that transistors and integrated circuits were easier to manufacture and control. Tunnel diodes also had a comparatively short life span during high power usage, and were not feasible as high speed computer switches.

JUNE 1970

The FBI's NCIC (National Crime Information Center) network began pilot operations in January 1967, with 16 law enforcement agencies all over the country on-line to an FBI computer in Washington, D.C. NCIC programs were run on one of the FBI's two 360/50s, with another identical machine available for backup. Originally, NCIC was to act as a record index on wanted persons, stolen property, and criminal events.

With the exception of Alaska, the U.S. and Canada were both entirely on-line with the NCIC network. As of January 1970, 93 control terminals were directly connected to Washington, and 24 of these remote terminals were computers. They consisted of IBM, RCA, Univac, and Burroughs machines. During the first half of 1970, over 2,000 law enforcement agencies had direct access to the NCIC via local or state computer terminals. By the end of 1970, a minimum of 15 additional computer terminals were planned to be added to the system. NCIC also interfaced with the U.S. Secret Service, the U.S. Army, Navy, and Air Force, and the Royal Canadian Mounted Police in Ottawa, Canada. This extensive coverage supplied on-line agencies with accurate, vital information in a few seconds. Average response time to an inquiry from a remote terminal was five to 10 seconds. Over 470 "hits" a day were made by participating law enforcement agencies. A "hit" is a positive match made by the computer between the participating agency's inquiry and an identical record on file in the NCIC data bank.

The NCIC has expanded quite a bit since 1970, and now has tie-ins to Alaska, Puerto Rico, and the Virgin Islands. It operates on one 360/65, with an undedicated 65 available for backup. Plans for upgrading are in the works.

—Deborah Sojka

The NEC Disk Drive. Ahead of its time.

High-performance Winchesters. Available right now.

When you need Winchester-type disk drives in 20-, 40- or 80-megabyte capacities, take a hard look at the NEC D-1200 Series disks.

You'll find packaging, features, reliability and technology that are the results of 15 years of building high-performance disk systems.

Take the read/write head of the D-1200. It is loaded with technical enhancements. Like contact fixed read/write capability that reduces ambient errors. Like LSI preamplification in every head, which further reduces errors by improving signal-to-noise ratios. Like address mark detection for faster seek-and-search. Like high-speed data transfer rates of 1.2 megabytes per second. And with two fixed-head-per-track options to improve seek time and speed up overall performance even more.

Every NEC D-1200 disk has an industry-standard storage module (SMD) interface, so it is immediately connectable to any mainframe or mini that uses storage module disks. But with higher speeds (8.3 millisecond latency time) and greater configurability (its dual-port option lets two CPUs share a single disk) than many other SMD disk drives.

And every NEC D-1200 disk drive has reliability-plus. Its MTBF exceeds 10,000 hours. Because all of its components are NEC-designed and NEC-built—the unique rotary actuator, the circuitry, the sealed disk module, and the read/write heads.

Join the growing number of systems builders who rely on NEC D-1200 disk drives to make their total system more attractive. For more information, contact our nearest sales office.

NEC Information Systems, Inc.

Head Office: 5 Militia Drive, Lexington, MA 02173, (617) 862-3120
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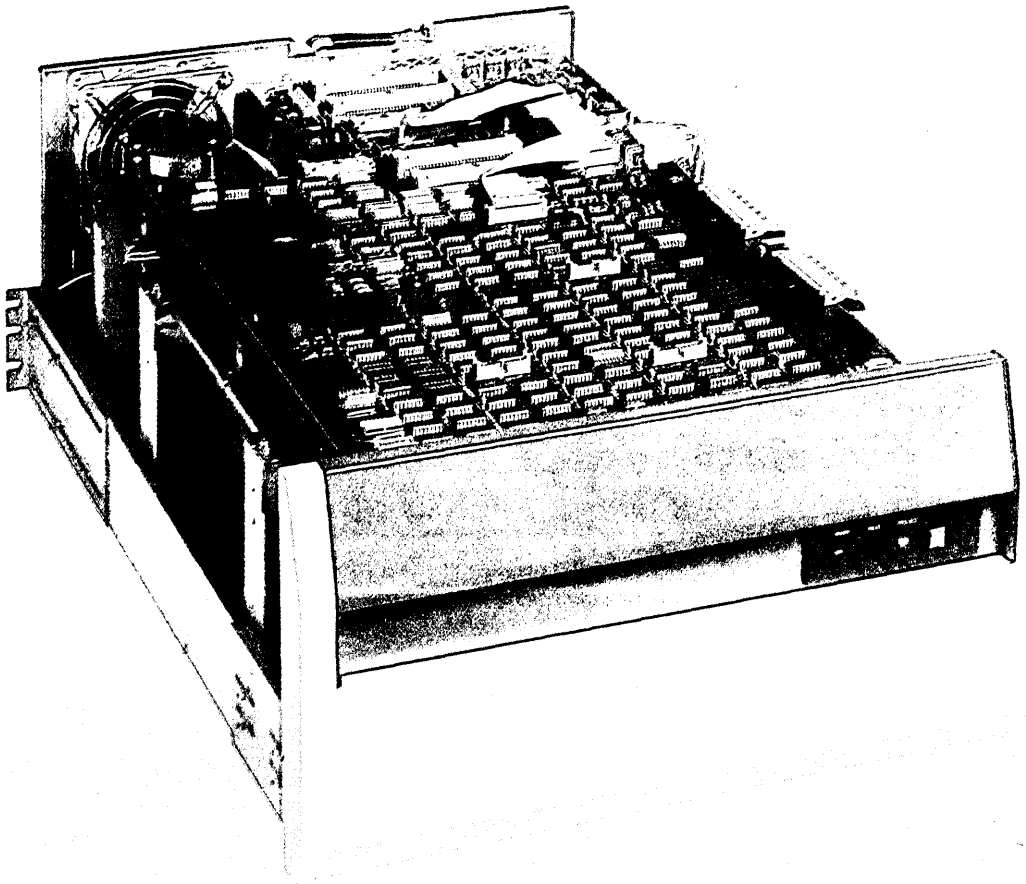
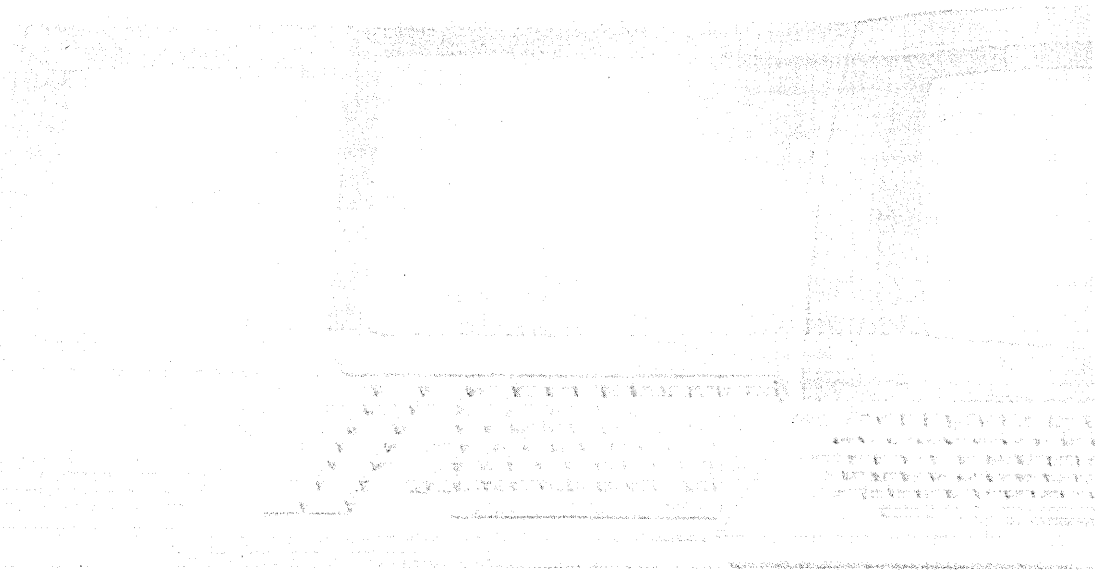


CIRCLE 10 ON READER CARD

Datapoint introduces Four systems,



Word Processing **Data Processing** **Electronic Message Service**

This is the only system which offers you full physical and functional integration of WP, DP, EMS, and Voice and Data Communications Management. Why settle for any system offering less?

If you thought multifunction systems just mixed words and data, we've got news for you. Now organizations of any size can significantly increase the efficiency with which they handle *all* the basic business media—data, words, messages and telephone communications. This is Datapoint's Integrated Electronic Office. It offers a unified approach to office automation that lets you grow step by step from where you are today to where you want to be tomorrow.

The multifunction system you can't outgrow.

Most multifunction systems work fine...up to a point. But no one can predict just when they'll run out of gas trying to support increasing terminal and application loads. Not with Datapoint. Here's why.

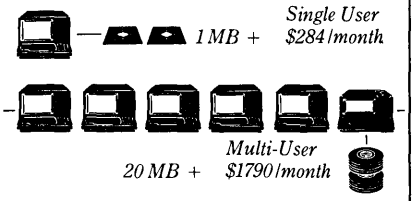
With our ARC™ system architecture, you can add on work stations, increase processing power, expand peripherals, and broaden the common database virtually without limit. And no matter how large the system, the same responsive performance is provided at every Datapoint work station without the degradation common in shared logic systems.

Put a hundred work stations at headquarters. Ten in each region. And one in every branch—each with local files and peripherals. Datapoint lets you tie it all together, uniting your organization with a two-way path for information flow.

Word processing with new search power.

Datapoint's Word Processing System speeds and simplifies the generation, revision, and distribution of general correspondence and other business documents. Complementing a full range of text-editing features is AIM (Associative Index Method), a content-oriented information retrieval system that lets you find any document quickly based on phrases, words, or even partial words. If you can't find it with AIM, it isn't there.

Pick the size you need.

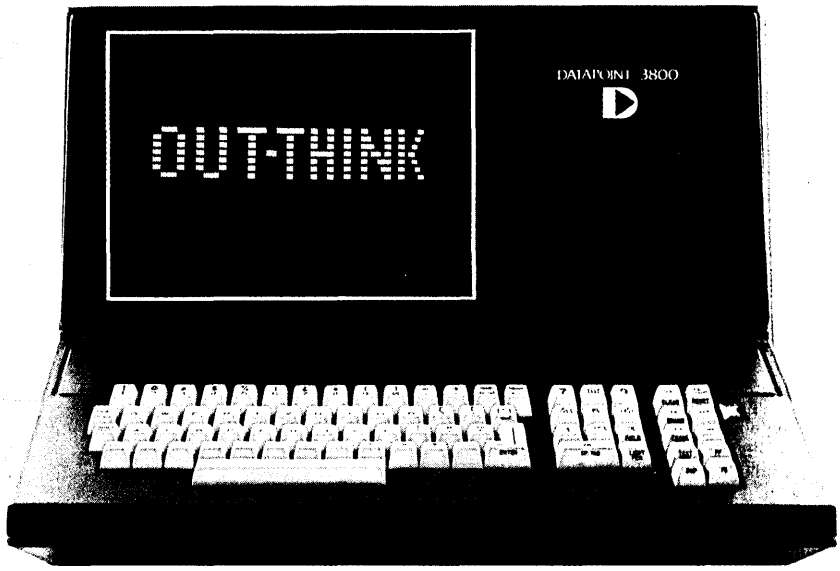


3-year lease prices shown do not include printers (many types available) or maintenance/installation charges. WP & EMS software licensed at $750 and $1500 respectively including training.

Cut long distance telephone costs up to 40 percent.

One of the largest expenses in most offices is voice communications, often rivaling data processing costs. You

true office integration: one keyboard.



Data and Voice Communications Management

Datapoint has combined all four capabilities into one integrated system using a common database. And every function is available at each 3800 work station.

can control these costs with our Long Distance Control System, a key component of the Integrated Electronic Office. Operating with existing PBX or CENTREX exchanges, the LDCS reduces long distance costs by a combination of least-cost routing, queuing, and call buffering. You can add LDCS capability to your system at any time. Or begin building your automated office here.

Send messages across the hall or across the nation—free.

Datapoint's Electronic Message System enables documents entered through the Word Processing System to be stored, retrieved, and transmitted to other Datapoint work stations automatically.

By interleaving message traffic with voice communications and utilizing excess line capacity during off-peak hours, EMS gives your interoffice correspondence a free ride. You can also use EMS for automatic encryption/decryption, priority transmission, and downline loading of system software and application programs to remote Datapoint processors.

Process transactions and batches concurrently.

What about data processing? That's where we began. And it's all still here for source data entry, local processing, and printing with COBOL, BASIC, RPG, and our easy-to-use DATASHARE®. A choice of compatible processors and a broad range of peripherals lets you match system capacity exactly to the job.

Apply the power of integrated function.

New applications come up fast with Datapoint. The key — simple programming, a common database, and ARC.

ARC communicates easily with your central mainframe, in both batch and interactive 3270 modes.

Enter data...compute and store...retrieve and incorporate in text...transmit messages interleaved with voice...receive confirmations automatically. With Datapoint, anything goes.

We're ready to help you apply the power of the Integrated Electronic Office to your organization *now*. Our team of marketing representatives, systems specialists, and customer service engineers will support you with experience gained in over 30,000 user locations worldwide.

For further information, call (512) 699-7151 for the number of your nearest Datapoint office. Or write Datapoint Corporation, Marketing Communications MS-KO5, 9725 Datapoint Drive, San Antonio, TX 78284.

DATAPOINT

CIRCLE 11 ON READER CARD

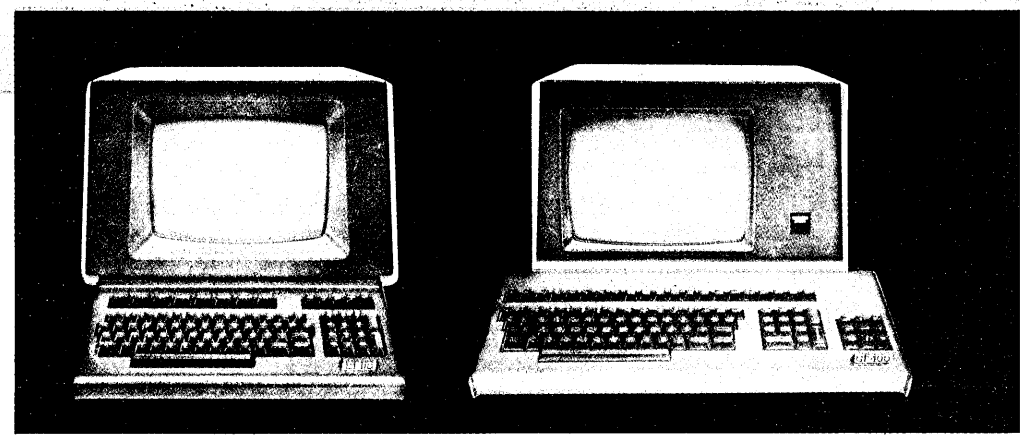
GTC. The right button to push for all your display

The key to GTC is versatility. We're the only terminal manufacturer with production and service facilities on both U.S. coasts. And GTC is one of the largest suppliers of data display terminals to Europe and the Orient. So we can deliver whatever you need, wherever you need it.

GTC offers models that are teletype-compatible as well as terminals that are interface-compatible with DEC, Burroughs and NCR computers. And GTC offers models that emulate other major terminals, too.

Both our GT-100 and GT-400 Series also offer the versatility of user-programmable function keys, multiple keyboard configurations (including foreign character sets), full video attributes, plus editing and line drawing capability.

GTC is versatile in its thinking, too. We're willing to spend a little more, to experiment and innovate a little more, to bring



terminal needs.

you a lot more, for the money.
And if that's what you want in a display terminal source, then you've got your finger on the right button.

For more information on GTC products and services, call toll-free today. In California: 800-432-7006. Anywhere else in the United States: 800-854-6781. Ask for Gloria Page. Or write Gloria Page at General Terminal Corporation, 14831 Franklin Avenue, Tustin, CA 92680. Telex: 910-595-2428. We have offices throughout the world. In Canada, contact Lanpar Ltd., 85 Torbay Road, Markham, Ontario L3R. Phone: 416-495-9123.

GTC®

The right button to push.™

General Terminal Corporation

CIRCLE 12 ON READER CARD

Our new display terminal has a great supporting cast.

The AJ 510 display terminal with AJ 460 Micro Diskette System, AJ 832/RO receive-only printer, and AJ 1234 acoustic data coupler/modem.

The AJ 510, the most versatile CRT terminal in its class, excels at interactive timesharing and a lot of other jobs. And with the addition of these supporting AJ products, you can greatly expand your application flexibility.

Start with the AJ 510

As a stand-alone device, the AJ 510 is ideal for jobs such as data entry, text editing, order entry, and graphics. It includes such features as ASCII, Graphics, and optional APL character sets; a bright 15-inch screen; 16 video enhancements; editing capability; a format mode with protected fields; and communications rates up to 9600 bps.

Now add data storage

For convenient, low-cost data storage and retrieval, the AJ 460 Micro Diskette System offers you local data manipulation and high-speed on-line communications. Combined with the AJ 510, the AJ 460 helps you reduce telephone charges and computer connect time, while further increasing application flexibility.

And top quality printing

Connect an AJ 832/RO receive-only printer and you get letter-quality hard copy output. Features include selectable data rates up to 45 cps, dual pitch selection, vertical forms control, and more—even interchangeable "daisy" wheel printing elements so you can customize the type face to the application. Now you have a system that's ideal for form letters, contracts, and camera-ready art of all kinds.

And communications

Finally, from the wide range of AJ couplers and modems, select the one that best fits your application. The AJ 1234 coupler/modem, for example, lets you take advantage of full duplex 1200 bps communications over dial-up or two-wire leased lines.

The final act

We not only build all this equipment, we also lease, sell, and service it. We'll take care of it throughout its lifetime. Which makes life easier for you.

So whether you need a stand-alone terminal or one with a strong supporting cast, AJ has the answer. Get in touch with the AJ regional office nearest you: San Jose (408) 946-2900; Chicago (312) 671-7155; Hackensack (201) 488-2525. Or write Anderson Jacobson, Inc., 521 Charcot Avenue, San Jose, California 95131.

Also available through AJ subsidiaries in Ottawa, Ontario; Paris, France; Shepperton, Middlesex, U.K.; and distributors throughout Europe.

ANDERSON JACOBSON

CIRCLE 13 ON READER CARD

PRECISION PLOTTING

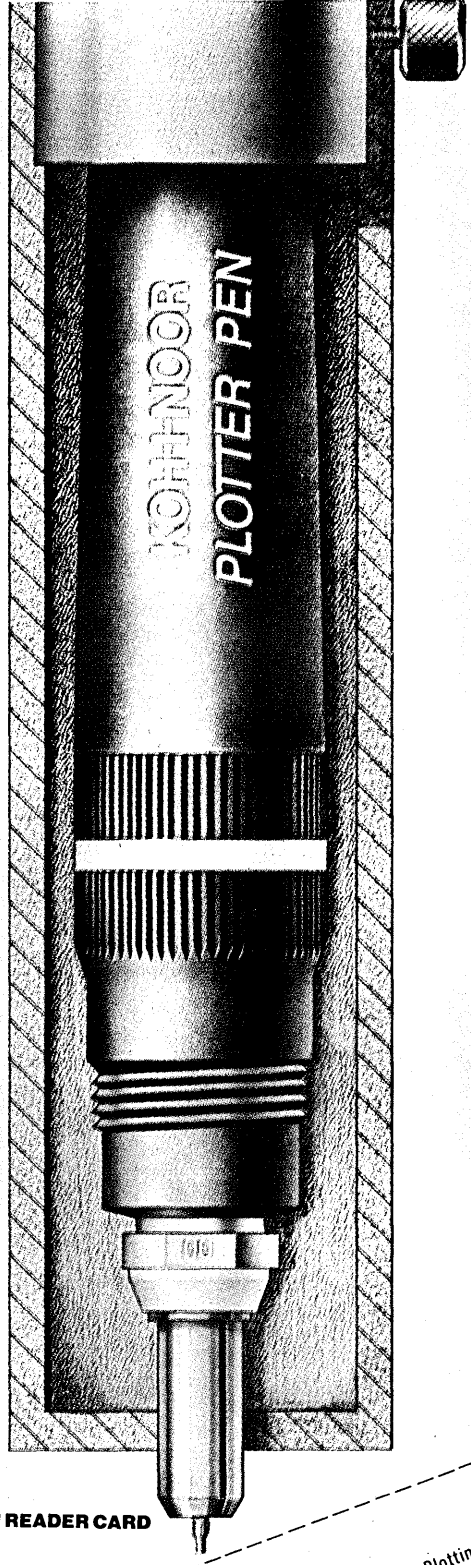
...at the speeds for which your plotter was designed.

Ask about the Koh-I-Noor "RAPIDRAW" System for Liquid-Ink Plotting, a total integration of the most effective plotting point, plotting ink and plotting surface to provide a system customized for your requirements. This total-system approach assures superior quality and faultless operation for even the most demanding plotting requirements.

At a single point of contact — where the plotting point touches the plotting surface — you see the final results of your investment and time. It is here that Koh-I-Noor should be your point of contact, because we provide plotter points in 3 different materials, pen bodies, complete plotter pens and adaptors for numerous plotters and a broad range of applications. In addition, we custom engineer pens, adaptors and bushings for specialized applications, eliminating expensive plotter modifications.

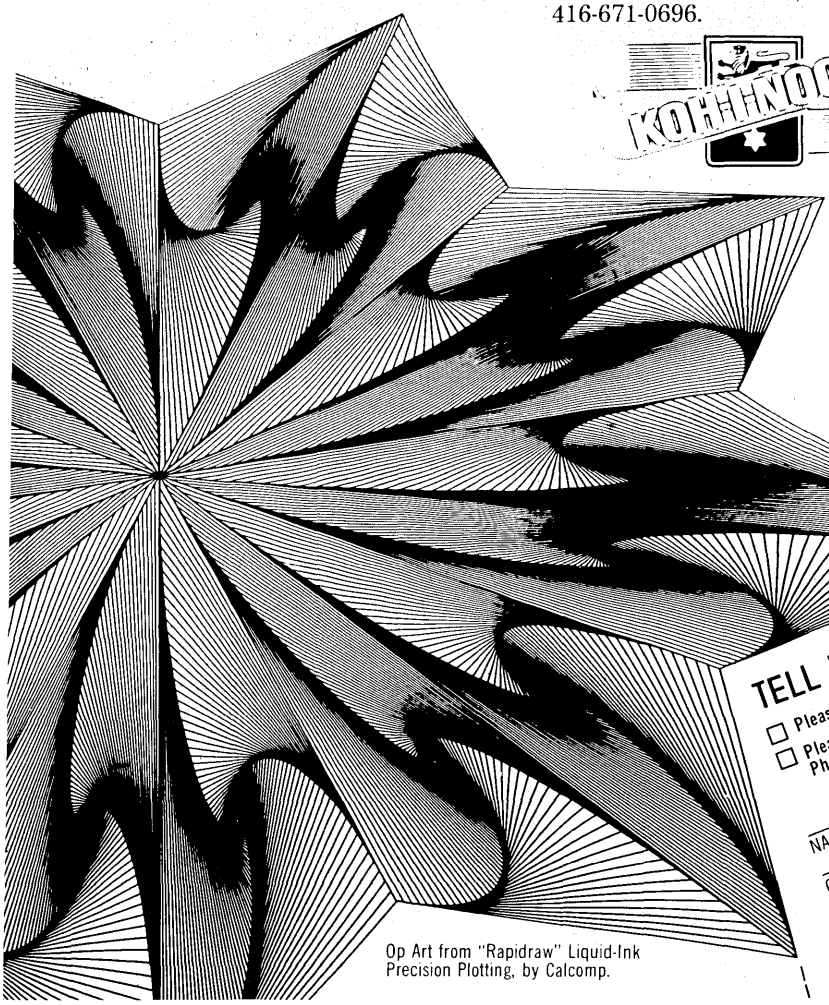
The total systems approach integrates the proper pen flow rate, point material, ink viscosity, surface tension, and drafting surface chemistry with the plotting speed, and up and down acceleration of your machine to achieve optimum efficiency with liquid ink plotting.

If you want more from your plotting point of contact, call or write Koh-I-Noor Rapidograph, Inc., 100 North St., Bloomsbury, N.J.; toll free 800-631-7646, or collect 201-479-4124. In Canada: 1815 Meyerside Dr., Mississauga, Ont. L5T 1B4; toll free 800-268-4961, or collect 416-671-0696.



KOH-I-NOOR®

CIRCLE 14 ON READER CARD



Op Art from "Rapidraw" Liquid-Ink Precision Plotting, by Calcomp.

TELL ME MORE, KOH-I-NOOR!

☐ Please send me your free brochure on the "RAPIDRAW" System for Liquid-Ink Precision Plotting.
☐ Please have a representatvie call me about a particular plotting materials question.
Phone: ( )

NAME (PLEASE PRINT OR TYPE) _____ TITLE _____
COMPANY _____
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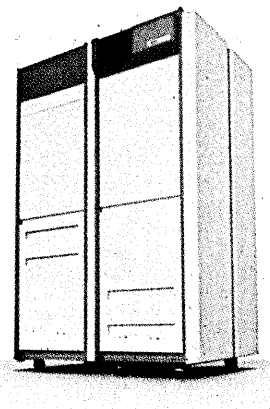
D-6-80

Introducing. The entire BTI family of 32-bit multiprocessor systems.



Finally, there's a computer system that lets you grow by plugging in resources, instead of by changing models—the BTI 8000.

Our family secret is Variable Resource Architecture (VRA): a flexible mix of hardware resources controlled by a single, self-regulating operating system. The result is mainframe level performance at substantially lower costs, plus unequalled flexibility.

You can tailor the BTI 8000 to serve over 200 on-line, interactive users. Or to handle large batch loads. Or to do some of each. And, you can vary processing capability **over a tenfold range** by merely adding or deleting hardware modules.

Additionally, built-in growth potential allows you to respond to changing requirements easily and quickly—without modifying either the operating system or your applications software.

As for reliability and support, they're established family traditions, proven by over 2,500 other BTI computers operating in the U.S., Canada and Europe. For full details about the BTI 8000, contact the BTI office nearest you.

BTI
COMPUTER SYSTEMS

Corporate Offices: 870 West Maude Avenue, Sunnyvale, CA (408) 733-1122 Regional Offices: Piscataway, NJ (201) 457-0600; Palatine, IL (312) 397-9190; Dallas, TX (214) 630-2431; Sunnyvale, CA (408) 733-1122 Sales Offices in major U.S. cities.

CIRCLE 15 ON READER CARD

LOOK AHEAD

BELL DREAMS OF LOCAL DATA NETS

When an unregulated subsidiary of the Bell System finally makes an appearance in the big, cruel, competitive world, it may well have some unexpected products to help build customers fast. In addition to modems, terminals, and probably diagnostic gear, Bell Competition Inc. might become a provider of local data networks. These nets, which interconnect a myriad of otherwise noncompatible devices, would be a natural for a telco spin-off. The phone company has endless experience wiring up office buildings, campus environments, and other localized areas where these data nets will be required in the coming years. And BCI would be allowed to provide customers with the processors required to operate the local data net. Some sources see the new Bell company becoming a turnkey business house to solve users' local networking problems. Asked to comment, a key AT&T official admitted that the local network area was being studied, adding with a smile, "You're getting a little bit ahead of us."

B-OF-A SET TO BUILD IMS NET

Having just qualified 120 different contract programming firms for future work, running help wanted ads across the country, and hiring IBM's guru, Peter Hill, as a new vp, the Bank of America has set out to develop the world's largest IMS network.

BEING SHARPER THAN SHARP

Sharp Corp. of Japan has a pocket computer that speaks BASIC. While the New Jersey headquarters of the company denies the machine's existence, we have seen a prototype. The $175 model has 1K of user memory; the $125 model has a lot less. Actual marketing is being held up until the plug-in printer is ready, we hear. The machine features full alphanumerics displayed via a 20-character LCD window into memory.

WANG SPEAKS IN MANY TONGUES

Wang will introduce an ideographic word processing system -- for Chinese and Japanese script -- this month. Wang now offers keyboards and printers for 15 different languages.

NEW INFONET SERVICE COMING

Infonet, the network services of Computer Sciences Corp., this month will introduce a distributed network service for its large customers who operate remote computing sites. DEC hardware, and software provided by INFONET, will link these remote sites to the five Infonet centers in North America as well as to others in 50 nations

LOOK AHEAD

overseas. Infonet's service will allow remote centers to perform data entry and data editing, develop local applications packages, and do data base management using a subset of CDC's dbms. DEC's PDP-11/14 or 11/23 will be bundled with the service at prices as low as $5,000 for 128K of main memory, a megabyte of disk storage, a 180 cps printer, and a video terminal. The largest of six configurations to be offered has 512K of main memory, 286 megabytes of disk storage, a 600 lpm printer, and six terminals.

EDUCATORS WON OVER BY APPLE

There may be some eye-opening price/performance comparisons when commercial users see the Apple Computer-based network now going on-line among the college dp consortium, EDUCOM, of Princeton, N.J. Using software developed by the North Carolina Educational Computing Service, EDUCOM colleges can use 48K Apple II units to access any of the 19 large systems already linked in the consortium's EDUNET -- with automatic log-on from five systems and file transfers from two. EDUCOM gets a discount, but list price for this intelligent terminal configuration -- the Apple, 48K, Apple PASCAL language card, communications interface card, floppy diskette drive, and controller -- is still a bargain at $2,810.

NEW FROM LEXITRON

Raytheon's Lexitron will introduce its eighth communications protocol this month, reportedly making its VP word processing terminal the first wp system with 327X emulation for tie-in to IBM-compatible mainframes.

NEW FROM LEXICON

Lexicon, the little Miami corporation which developed the first handheld language translator (now the LK 3000 sold by Nixdorf), has come up with a little battery-powered modem -- the LEX-11, which can turn the LK 3000 into a minuscule terminal -- pulling, say, stock quotes over a pay phone.

ICL'S WOES WITH U.S. SIBLING

It looks like British mainframer ICL is having trouble with its U.S. sibling. The first wind of that trouble came when ICL's U.S. chief Dick Bright bolted for greener pastures. Sources close to the company speculate that Bright's defection was due in large part to ICL's unwillingness to fund the U.S. plunge. During his brief stint as ICL's man in America, Bright reportedly received no marketing budget and only paltry funds for an ad campaign. To add to its U.S. woes, ICL is also rumored to be considering transferring its Utica, N.Y., manufacturing oper-

(Continued on page 63)

Our users save over $1,000,000 a month.

The SHRINK 2 file compression systems reduce the volume of data on disks and tapes by as much as 80% for users of IBM 360/370 and compatible systems.

A software solution to a hardware problem. File sizes can be enlarged without adding more spindles.

Existing spindles are freed up for new applications.

That can mean enormous savings in capital outlays for hardware.

Not to mention the savings on enlarged computer rooms, cooling requirements and other related costs.

And encrypted files are made secure through encryption at no extra cost.

We also offer another version, SHRINK/IMS, designed for IMS/VS data bases. It's totally transparent to IMS application programs; the programmer never even knows it's there. And its compression is selective for maximum performance.

Why not help yourself to more file capacity from your present hardware and to big savings. Call, send the reply form below, write on your letterhead, or just attach your business card to the coupon.

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- Send me information about SHRINK 2.
- Send me information about SHRINK/IMS.
- Send me a salesman with an order form.

Name Title

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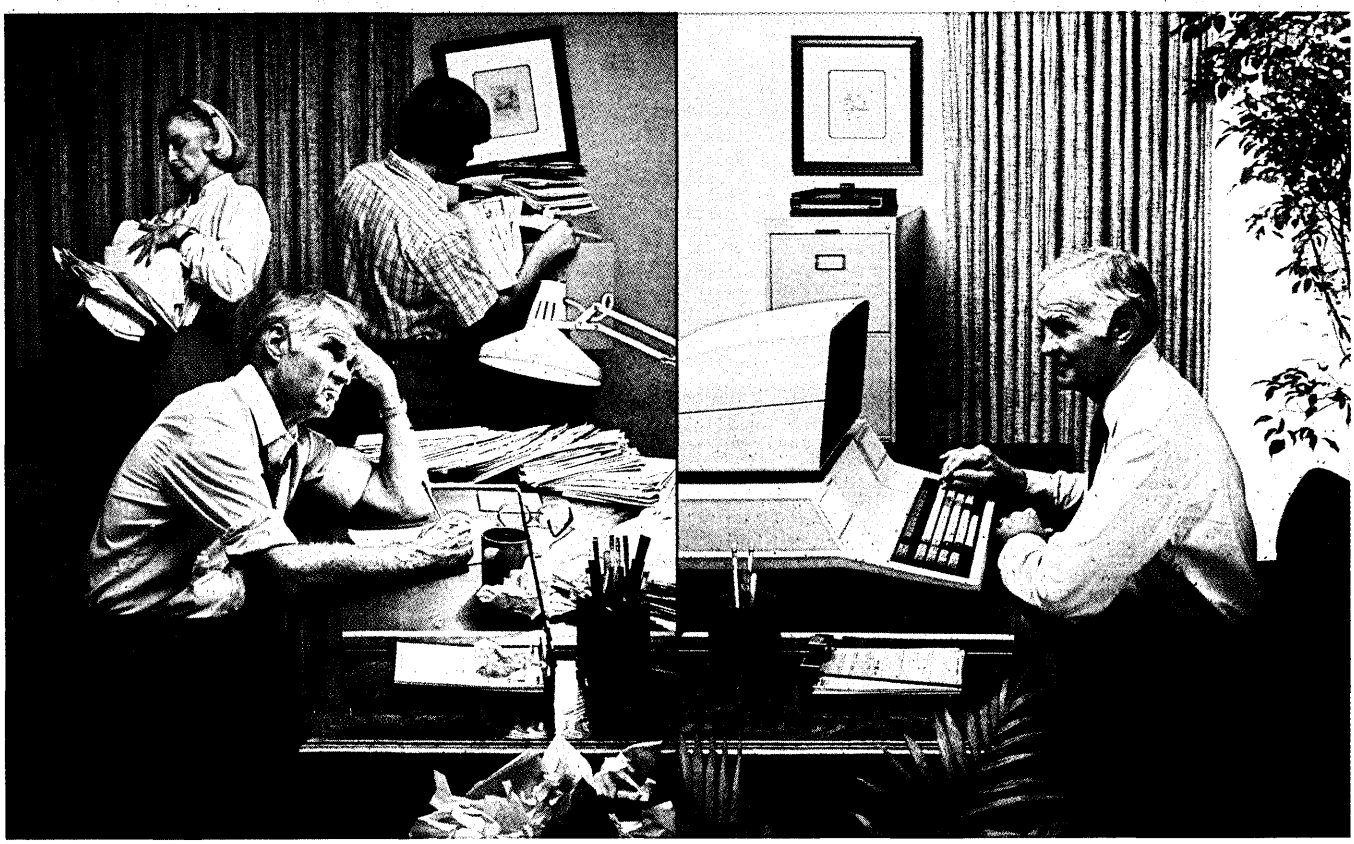
CPU Op. System Disk: Model Quan.

SHRINK® Software by Informatics.

The Information Management Company.

CIRCLE 16 ON READER CARD



Problem Solved.

TI's small business computers. Solutions for OEMs and their customers alike.

Solve problems for your customers and solve a few of your own at the same time—and at prices starting at under $10,000*!

Your applications programs combined with TI's highly-reliable small business computer systems give your customers the power they need to tackle today's demanding business problems—like payroll, accounting and inventory control.

Both the Model 771 and DS990 Model 1 are powerful, complete, desktop systems. Since they are compatible with our larger business computer systems, helping your customers upgrade as their needs grow is a snap.

Implementing your applications on both these systems is no trouble either. For maximum versatility the DS990 Model 1 operates on a variety of software and programming languages, including BASIC, FORTRAN, COBOL, Pascal and TPL, TI's unique program for simplified forms generation.

The Model 771 desktop computer, with its single-sided, single-density diskette, stores up to a total of 500,000 characters of instantly available on-line data.

The DS990 Model 1 stores up to 4,600,000 characters using double-sided, double-density diskette storage. This outstanding capacity makes it among the most powerful small business computers available anywhere.

Texas Instruments products are backed by trained specialists world-wide. Service is available wherever TI products are sold or TI will train your service personnel.

Solve your problems reliably and efficiently using small business computers from Texas Instruments, the company appointed the official computer and calculator company of the 1980 Olympic Winter Games.

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Contact the TI sales office nearest you, or write Texas Instruments Incorporated, P. O. Box 1444, M/S 7784, Houston, Texas 77001. In Europe write, Texas Instruments, European Digital Systems Division, Bôite Postale 5, 06270 Villeneuve-Loubet, France.

Fifty Years of Innovation

*Quantity one, U.S. domestic price. Quantity discounts available.

TEXAS INSTRUMENTS

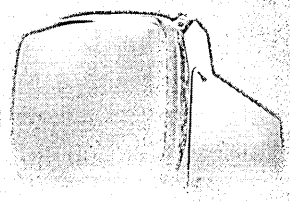
We put computing within everyone's reach.

CIRCLE 17 ON READER CARD

A video bandwidth of 30 MHz and a 1200-line resolution make this new CRT monitor the brightest and sharpest you can get.

C. Itoh's new model 1201BE in our QDM series is capable of receiving separate horizontal drive pulse, vertical drive pulse and video input at the TTL level. This separate signal mode eliminates composite sync and video signal processing. The CRT is equipped with its own power supply unit. P4 phosphor is standard, but optional P31 or P39 phosphors can be provided. Available options: Dynamic Focus, Skip Scan, a non-glare etched face and a 19.5 KHz horizontal frequency.

The high performance and low price offered with this new CRT monitor give you all you need to really outshine your system's competition. For complete information contact your nearest C. Itoh representative or C. Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, CA 90066; Tel. (213) 390-7778; Telex: (WU) 65-2451; or 666 Third Avenue, New York, NY 10017; Tel (212) 682-0420; Telex: (WU) 12-5059.



C. ITOH ELECTRONICS, INC.

Introducing the 12" CRT monitor for the systems designer with bright ideas.

CIRCLE 180 ON READER CARD

OLIVETTI ANSWERS SOME OFFICE AUTOMATION.

A famous tough guy puts Olivetti through its paces.

Q. How come you're talking about automation? I thought all you made was typewriters.
A. No sir. We make a full line of office products. We've got electric and electronic typewriters. Word processors. Electronic calculators. Copiers. Terminals. Mini-computers. Supplies. Software. The whole works. In fact, nobody else has a broader line for the office.

Q. A little company like Olivetti does all that?
A. We're not exactly little. Had $2.3 billion in sales worldwide last year. We have 28 factories. Employ 57,000 people. Do business in over 100 countries. Worldwide, we're one of the top companies in office automation.

Q. Okay. So you're a giant. But there are hundreds of suppliers out there. Why do I need Olivetti?
A. One reason is that we're pretty hard to match when it comes to return on investment. In some cases, downright impossible. Our ET221 is the only electronic typewriter for $2,000 with text display. And our TES401—also with display—has the most text editing power of any desktop unit for $6,000. Our Copia 2000 is the only copier under $16,000 that reduces, collates, and prints on two sides. Should I continue?

Q. Never mind. I get the picture. But nothing's perfect. What about service?
A. If you mean technical support people, we've got them. In 36 major cities. As a matter of fact, we have one of the biggest service organizations in the business. We're ahead of Lanier, Wang, and Qyx. And all of our technical people use state-of-the-art equipment to test and train with.

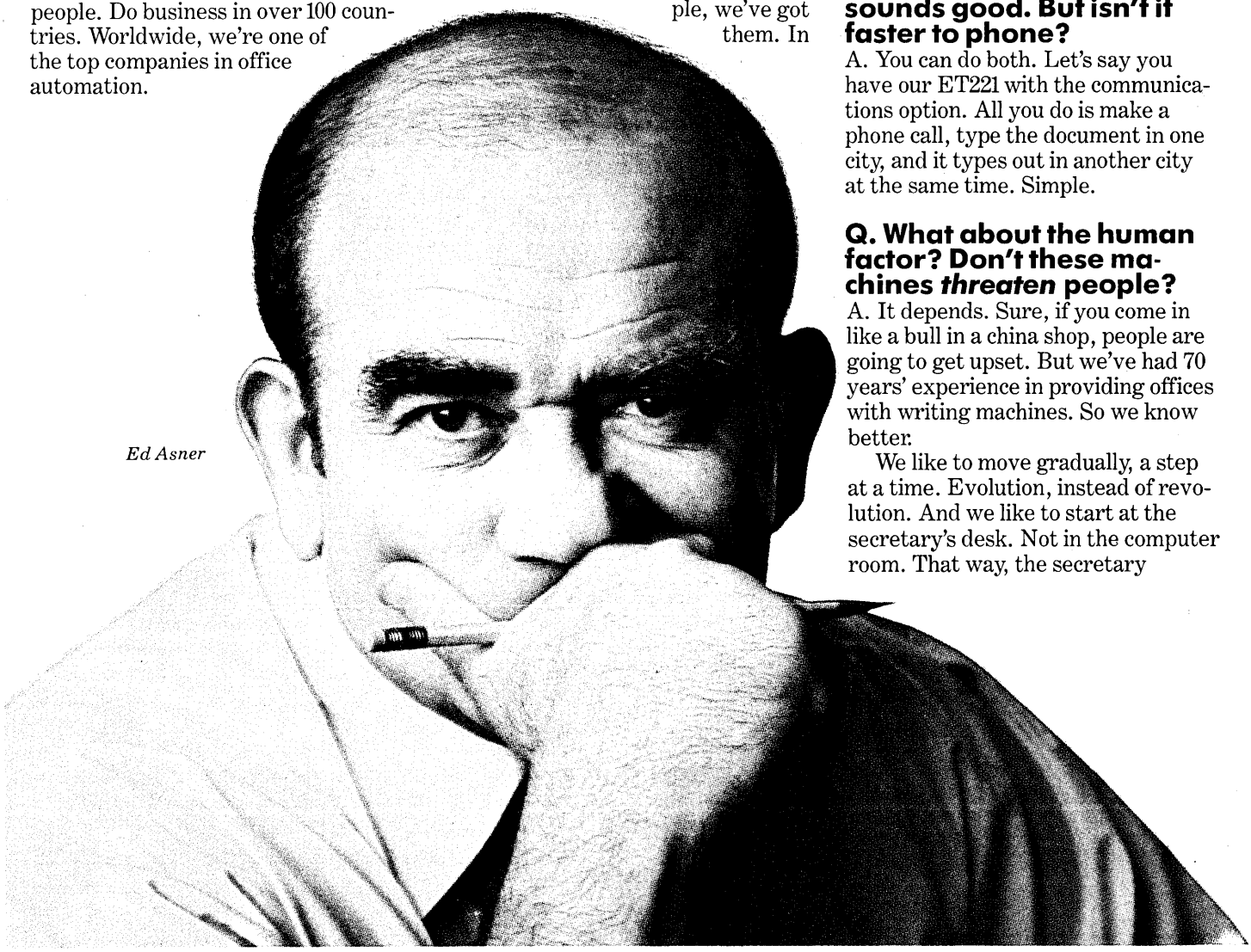
On the other hand, if you mean software and sales support, we've got that, too. In just as many places. In fact...

Q. Yeah, okay. Suppose I'm not in one of those 36 cities.
A. We can handle it. We've got 2,000 dealers, and we're in every state. If we can't service a product, we won't sell it.

Q. All this electronic typing sounds good. But isn't it faster to phone?
A. You can do both. Let's say you have our ET221 with the communications option. All you do is make a phone call, type the document in one city, and it types out in another city at the same time. Simple.

Q. What about the human factor? Don't these machines *threaten* people?
A. It depends. Sure, if you come in like a bull in a china shop, people are going to get upset. But we've had 70 years' experience in providing offices with writing machines. So we know better.

We like to move gradually, a step at a time. Evolution, instead of revolution. And we like to start at the secretary's desk. Not in the computer room. That way, the secretary

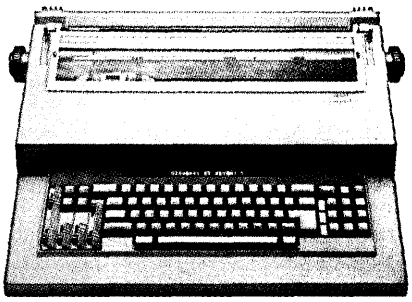


Ed Asner

TOUGH QUESTIONS ABOUT

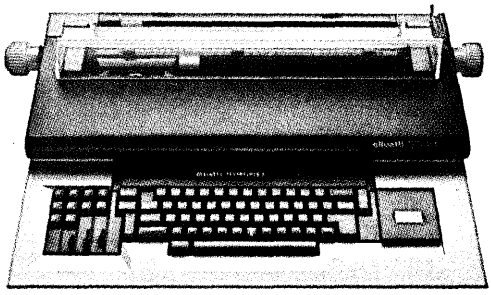
doesn't get tossed into a typing pool. And the boss doesn't lose the secretary.

ET221: the only electronic typewriter for $2,000 with text display.
"Thin window" text display. It's the coming thing. But we've got it now



because we pioneered it. Lets you correct mistakes before they go on paper. Other ET221 features: Interchangeable print wheels. Automatic decimal tab. Non-volatile memory that can't be erased by accidental unplugging.

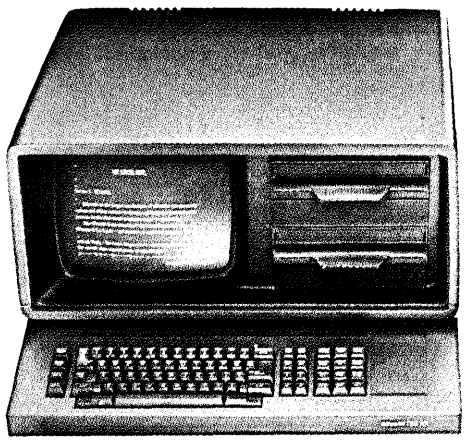
TES401: the most text editing power of any desk-top unit for $6,000.
Brings word processing to the secretary's desk. Approaches text



editing power of much more costly machines, yet easy to master. Removable, dual-source memory with automatic merge (so you can "mass produce" personalized letters). Many advantages over "mag card" machines—at same or lower cost. Thin window text display. Interchangeable print wheels.

TES501: the only word processor under $10,000 with information retrieval.
You can access the external memory (100-page discs) at the touch of a key. Thin window text display. Handles words or numbers equally well. Sort by up to 40 different qualifiers. Perfect for operations like selective mailings, calling for high-speed search and retrieval, plus automatic personalization and typing. (Not Shown)

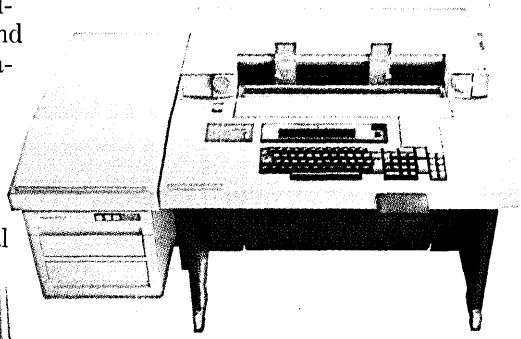
TES701: the CRT text editor to beat.
All the power of the TES501, plus page text display. Ideal for statistical



typing and documents requiring a lot of formatting and revision. Stores on single or dual diskettes. Interchangeable print wheels. High-speed printer. Easy to learn because it instructs operator.

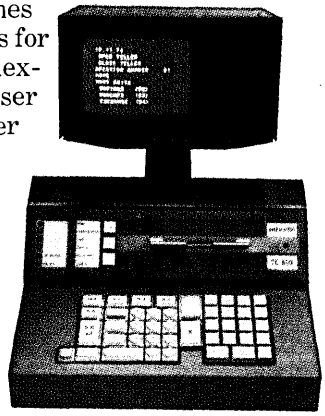
Copia 2000: the only copier under $16,000 that reduces, collates and prints on 2 sides automatically.
Prints 30 copies per minute, any size. A unique "batching" system easily separates varied sets of copies. Self-diagnostic reliability: checks your supply levels and minimizes downtime. Blessedly simple to operate. The first *complete* system at anywhere near the price. (Not Shown)

BCS2030: the only minicomputer in its price range that produces a full-size hard copy.
Fits easily into any working environment. Reflects what we've learned from installing over 300,000 account-



ing, administrative, and data management systems worldwide. Simple to operate: no need for computer specialists. Flexible: uses mag cards or floppy discs as storage media.

TC800: ultimate reliability for thrift institutions and insurance companies.
On-line financial terminal. Works on distributed intelligence. Operations continue even if central processor or communications line fails. Modular design. Comes in 3 versions for maximum flexibility and user growth. Over 40,000 sold. Available in selected markets.



olivetti **Ask us your own tough questions: 800-431-1866.**

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CIRCLE 19 ON READER CARD

CALENDAR

JUNE

DATA COMM, June 17-19, Geneva, Switzerland.

DATA COMM is an international forum where developments in microprocessors, mini/microcomputers and associated services can be seen, together with new equipment for data communications and distributed processing. Contact Industrial and Scientific Conference Management, Inc., 222 West Adams St., Chicago, IL 60606, (312) 263-4866.

Computerfest '80, June 20-22, Columbus, Ohio.

Fifth annual gathering of the Midwest Affiliation of Computer Clubs (MACC), focusing on small business and personal requirements and uses. Contact James Crowley, 4008 Rickenbacker Ave., Columbus, OH 43213.

World Computing Services Industry Congress II, June 23-25, San Francisco.

Geared toward the serious discussion of responsibilities as custodians of the international information resources. Contact ADAPSO, 1925 Lynn St., Arlington, VA 22209, (703) 522-5055.

Syntopican VIII, June 23-26, Minneapolis.

The International Word Processing Association conference will feature four days of conference and three days of exhibits. Contact IWP, Maryland Rd., Willow Grove, PA 19090. (215) 657-3220.

JULY

Harvard Computer Graphics Week 1980, July 28-August 1, Cambridge, Mass.

Five-day conference features business graphics and computer mapping in commercial, educational, and governmental areas. Contact Kathy Devaney, Center for Management Research, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020.

SEPTEMBER

Workshop for International Marketing Decision-Makers, September 8-9, Washington, D.C.

Exporting products in the '80s is the theme. Cosponsored by DATAMATION and the U.S. Department of Commerce. Contact Graydon Associates, P.O. Box 566, Red Bank, NJ 07701 (201) 741-2690.

MIMI '80, September 9-10, Montreal, Quebec, Canada

13th International symposium and exhibition on mini and microcomputer applications. Contact Prof. M.H. Hamza, Department of Electrical Engineering, the University of Calgary, Calgary, Alberta, Canada T2N 1N4.

Integrated Systems Expo '80, September 9-11, Washington, D.C.

The National Micrographics Association will feature the development and promotion of the effective uses of micrographics, including interfaces with other information-processing technologies. Contact John Bidwell, NMA, 8719 Colesville Rd., Silver Spring, MD 20910, (301) 587-8202.

Internepcon/Semiconductor International Expo, September 11-13, Singapore.

Keyed to the specific needs of engineering, manufacturing, and support personnel of Southeast Asia. Contact Industrial and Scientific Conference Management, Inc., 222 W. Adams St., Chicago, IL 60606, (312) 263-4866.

DPMA Symposium on Office Automation, September 15-17, Chicago.

The Education Foundation of the DPMA announces a one-day series of workshops, followed by two days of general conference. Contact DPMA, 12611 Davan Dr., Silver Spring, MD 20904.

Wescon '80, September 16-18, Anaheim, Calif.

This convention is the largest high technology assembly in the U.S. Contact Robert Myers, Communications Counsel, Wescon, 999 N. Sepulveda Blvd., El Segundo, CA 90245, (213) 772-2965.

SICOB '80, September 17-26, and Convention Informatique, September 15-19, Paris, France.

These back-to-back exhibitions and conferences cover personal computing to office equipment, and constitute the largest French international show. Contact Pierre Wagner, International Trade Shows in France, 1350 Sixth Ave., New York, NY 10019, (212) 582-4960.

IPAD National Symposium, September 17-19, Denver.

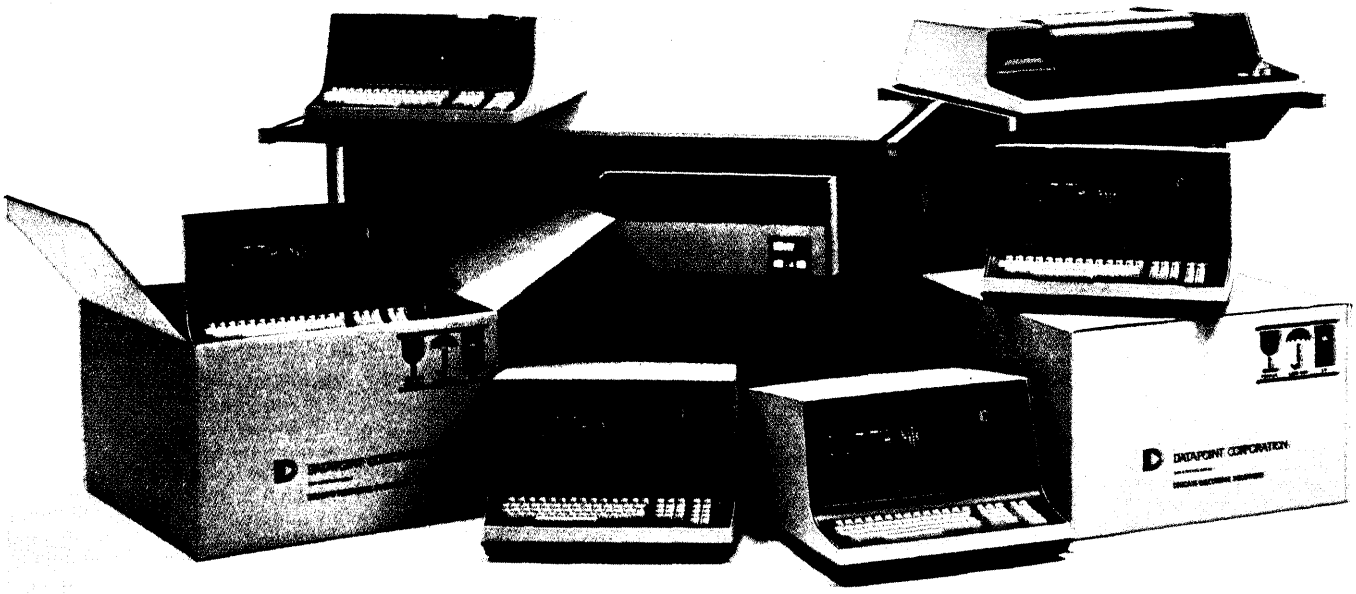
NASA and an Industry Technical Advisory Board (ITAB) to report on progress of the joint industry/government computer-aided design project called IPAD (Integrated Programs for Aerospace-Vehicle Design). Contact IPAD Project Office, Mail Stop 246, NASA Langley Research Center, Hampton, VA 23665, (804) 827-2888.

Federal Computer Conference, September 22-24, Washington.

Cosponsored by DATAMATION. Will address the management of change in the 1980s for federal dp users. Contact Ms. Lynn Green, P.O. Box 368, Wayland, MA 01778, (617) 358-5181.

12th Annual Conference of the Society for Management Information Systems, September 22-25, Philadelphia.

The conference theme will be "MIS Management in the Emerging Information Age" and will examine the challenges facing the MIS Executive. Emphasis will be on the impact of converging technologies on the role of the MIS executive in the 1980s. Contact M. Rippey, the Society for Management Systems Information, 111 East Wacker Dr., Chicago, IL 60601, (312) 644-6610. ✱



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DATAPOINT

CIRCLE 20 ON READER CARD

Stained glass and needlework are among the craft projects available from Arteraft Concepts. The C. H. Stuart division uses distributed data processing to cut both the time and the cost of customer order processing.

Quicker Shipment: Distributed Processing Shortens Customer Order Cycle

Through the use of distributed processing, Arteraft Concepts, a division of C. H. Stuart Inc., has shortened the customer order cycle from three days to two, resulting in a corresponding reduction in receivables outstanding.

Arteraft designs, manufactures and markets craft projects including crewel, in-the-home needlepoint, weaving, stained glass, and rug hooking. According to Robert G. Boss, vice president of management services, Arteraft has been the Stuart pilot division for distributed data processing. Today, the processing of customer orders for Arteraft is performed on an IBM 8100 Information System at the division's headquarters in Ballston Spa, New York. Formerly, all order entry for Stuart, a world leader in direct-to-consumer marketing, was handled in a computer center in the Stuart corporate headquarters in Newark, New York.

Customer orders for Arteraft are written by field representatives called counselors and mailed to Ballston Spa. There, operators key the data into terminals online to the 8100.

"The people who process the orders are intimately familiar with the product line, so they can answer most questions immediately," Boss points out.

Previously, he explains, couriers brought the order forms 200 miles to Newark for processing, and brought the shipping documents back to Arteraft. This remains the standard procedure for other Stuart subsidiaries which make and market jewelry.

"The division now has complete control over its own data entry, its own priorities," Boss notes. "But control of data processing implementation is retained at corporate – there are no programmers at the division location. By keeping the expertise here, we can bring the techniques developed for one division to the others, and act as a catalyst for DP development throughout the company."

Today, the corporate computer queries Arteraft's 8100 to pick up the order data, which it needs for inventory control and sales analysis. And it batch transmits shipping and payment data back to the 8100, which prints the shipping documents and commission checks for the counselors.

"We avoid the delays, the costs of the courier, the extra handling, and the vulnerability to snow," he says. "And we protect the integrity of our operations: the original written order never leaves Ballston Spa.

"We installed the 8100 ourselves," Boss adds. "We had it running – operating system and application programs – in two eight-hour days."

With Data Encryption, Scents are Safe at IFF

Ingredients are mixed for a perfume fragrance at International Flavors & Fragrances. To protect valuable formulas during transmission, IFF uses IBM 3845 and 3846 Data Encryption Devices.

Some of the world's most fragrant data traffic flows between New York City and Hazlet, New Jersey. As International Flavors & Fragrances Inc. (IFF) transmits valuable formulas for synthetic scents between its Hazlet headquarters and its New York office through the public telephone system, an IBM data encryption device protects them from unauthorized access.

Referring to the IBM 3845/6 Data Encryption Devices, Lewis G. Augustine, director of systems and data processing, says: "We plugged them in and they worked; that was the entire installation procedure. And data encryption has never been the cause of any operating problem."

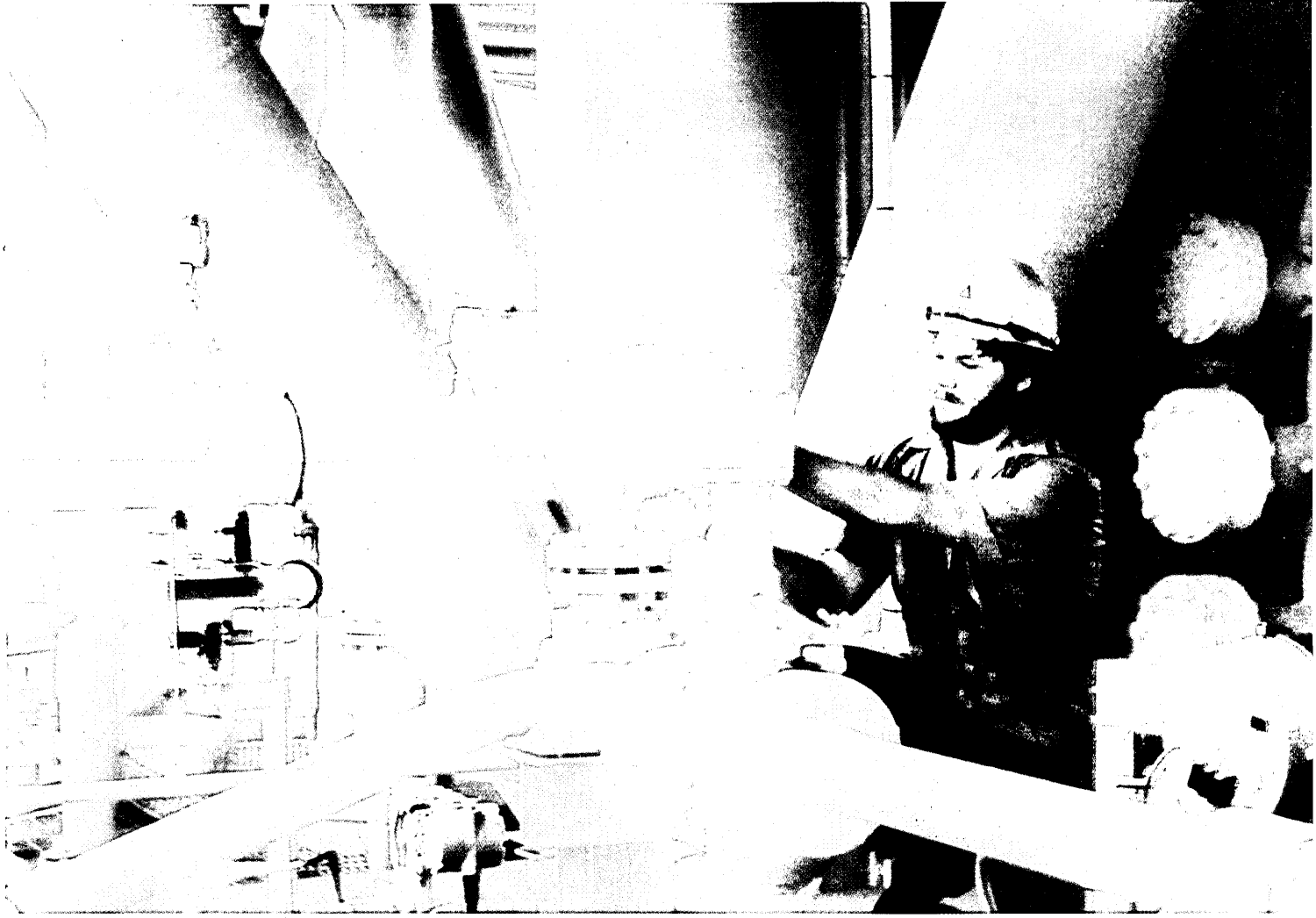
Few compounds are more complex than the fragrances used in toiletries, detergents, cosmetics and many other consumer items. The bill of materials for one scent typically includes thousands of line items, and its summarized "explosion" can require 50 pages of printout from the firm's IBM System/370 Model 138 at Hazlet. Augustine points out that fragrances are formulated by combining "subcompounds" – recognized varieties such as lilac and geranium – which are themselves mixtures of subcompounds and primary ingredients. A completed formula may include subcompounds at 33 levels.

"Our creative group in New York develops a thousand new fragrances a month to submit to our customers," Augustine continues, "so there is a continuous heavy flow of formulas between that office and our technical people here. This traffic is multiplied because a single fragrance often must be formulated many times: a scent for, say, a line of related toiletries works differently in the cologne, soap, deodorant, and so forth.

"The ability of our creative group to develop a fragrance that meets a customer's need – and to synthesize that fragrance suitably for his product – is our major business asset. The security of that data traffic is vital to us. With the IBM data encryption devices, we have the absolute security of communication we need."

The 3845 and 3846 use the U.S. National Bureau of Standards Data Encryption Standard, a process for encrypting data under control of a key-variable supplied by the user.

"Without these devices, our alternatives would not have been attractive: to develop our own software encryption method and install a decrypting computer in New York. Or to hire couriers to hand-carry formulas. Obviously, the IBM devices have been far more simple, economical, and effective."



Interior of a Cities Service production platform in the Gulf of Mexico. Cities Service uses the IBM DB/DC Data Dictionary to help assure the integrity and validity of data in its corporate information system.

Dictionary Insures Data Integrity at Cities Service

"We concentrate on making data meaningful," Larry Myerley of Cities Service Company says. "Vital strategic data must be current, accurate and secure. The dictionary plays a vital role in achieving that."

Myerley, manager, data base development, is discussing the role of the IBM DB/DC Data Dictionary. Cities Service, he explains, has made data management for its corporate information system a separate professional function, to define and standardize data elements used in common by many applications.

Myerley's staff has identified 28 attributes of a data element, he continues, such as the coding structure, the input source, persons authorized to access or change it, and other data with which it is interdependent. The dictionary stores these attributes of each element, the identity of all programs that use or affect it, and a record of the frequency with which it is used. Naming standards created at Cities Service are used to assign both computer-oriented and business (i.e., end-user oriented) designations, with the dictionary providing the cross-references between them.

The Cities Service corporate computer center in Tulsa, which includes an IBM System/370 Models 168AP and 158AP, uses the Information Management System/Virtual Storage (IMS/VS). "When we began putting data in IMS instead of imbedding it in individual programs," Myerley notes, "we immediately found that we needed a tool to keep track of it, even on a small-scale pilot project. We couldn't keep the information in our heads."

It is important, he points out, to respond to changing needs. As an example, he cites the introduction of a new employees stock ownership plan that required 11 or 12 new programs.

"With the aid of the dictionary," he adds, "we had no difficulty adding the required elements to the IMS data base without impacting existing programs.

"Or consider a set of 12 master files for financial processing. They support about 300 programs serving different interests, but the dictionary enables us to identify every application program using any data element, and to measure and plan the work of preparing these applications to migrate to IMS.

"Eventually, the data system, though independent, will be available to the information systems, and will be dedicated to producing valid, current data. It will be stable, changing slowly. But the information systems – processing data to produce useful information – will be dynamic, changing as needs change. The stability of the data environment, achieved with the help of the data dictionary, will let us respond fast to these demands."

DP Dialogue is designed to provide you with useful information about data processing applications, concepts and techniques. For more information about IBM products or services, contact your local IBM branch office, or write Editor, DP Dialogue, IBM Data Processing Division, White Plains, N.Y. 10604.

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CIRCLE 22 ON READER CARD

LETTERS

ONIONS

Re: "Hanging In" (Nov. 25, 1979, p. 104), I am writing to let you know how much I disliked your inclusion of the ridiculous, uninformed, uncalled-for article by Marvin Grosswirth. I was talking with a fellow DATAMATION reader the other day, and he and I ended up agreeing that the overall quality of your magazine has noticeably declined in the past couple of years. Pointless contributions such as Grosswirth's do nothing to reverse this perceived trend.

SID HUFF
Professor, School of Business Admin.
The University of Western Ontario
London, Canada

Marvin Grosswirth replies: What can one say beyond, "*Chacun a son goût?*" I feel obliged to add, however, that satire is never "pointless," and if Prof. Huff and—presumably—his fellow reader failed to perceive the point(s) in "Hanging In," then clearly there exists a communications problem. Whether the malfunction is in the transmission or in the reception I will leave for others to decide.

STANDARDS DEVELOPMENT

Re: "Networks At Last?" (March, p. 122), mention is made of "open systems architectures" without further specific identification. Since the same nomenclature has been employed from time to time in the U.S. and internationally in the course of development of the "Reference Model of Open Systems Interconnection" (OSI), some clarification would be helpful to the readers. (In the U.S. the primary public standards development body is the American National Standards Committee (ANSC) X3 for Computers and Information Processing, organized under the American National Standards Institute. Internationally, similar work is carried out by ISO, the International Organization for Standardization; the U.S. is a member of ISO.)

The scope of the Reference Model (which has a total of seven layers) is to provide "a common basis for the coordination of standards developments for the purpose of systems interconnection," and clearly is a generative step removed from the standards themselves and several steps removed from any implemented devices.

Standards themselves are adopted voluntarily in the U.S. as each implementing organization deems appropriate. The concept of forcing is totally absent from the voluntary standards process. The Reference Model has been adopted for use in ANSC X3 as one planning and management tool for systematizing the standards development work of over 65 technical committees and working groups in ANSC X3. In itself it is not intended for and not suitable for implementation as the standards are.

J.S. FOLEY
Manager, Systems Standards Engineering
Burroughs Corp.
Detroit, Michigan

IN MEMORIAM

Re: "In the Beginning there was Mauchly" (March, p. 55), Dr. Mauchly claimed to have proved that the moon influences the earth's weather. While I have not seen his proof, I suspect it is similar to one I investigated and disproved some years ago.

Back in the middle '60s I worked as a computer programmer at the Bureau of Meteorology in Melbourne, Australia, and the director of adp mentioned to me one day that someone in the U.S. weather service had claimed to have proved that the moon influenced the earth's weather. In particular, the claim was made that rainfall varies with the phase of the moon. Out of curiosity I did some research into the matter, and discovered that there was a fundamental flaw in the methodology of the proof which accounted for the apparent variation in rainfall.

To show that rainfall varied according to the phase of the moon, a given day's rainfall was allocated to the particular phase of the moon on that day. The problem is that the phases of the moon do not correspond to equal intervals of time, owing to perturbations in the moon's orbit. In particular there is one perturbation, discovered by Ptolemy, whose period is exactly one-half the fundamental period of 28 days, so that averaging over a number of periods, the various phases of the moon will not be of equal duration.

We did not publish our result, as it did not seem all that important at the time, especially as the view that the moon affects the earth's weather has never received any significant support from the scientific community.

ALAN J. ROBINSON
Flossmoor, Illinois

MISINFORMATION

Re: "1980 Salary Survey" (April, pp. 110-118), the survey has again misinformed the data processing community of what the real world is like. DATAMATION has taken a survey of only 400 to predict what thousands of data processors are making. The survey has left many gaps, and many more disillusions which are being used by personnel departments to set salary requirements. Conclusions are being drawn on a relatively small amount of information.

Marketing research personnel could argue that a survey of 400 would be adequate if distribution of the inquiries were made in a scientific and orderly manner. DATAMATION has failed to illustrate on p. 116 the number of respondents by industry. From p. 118 of the survey, I conclude that data base administrators are nonexistent in Atlanta, and systems analysis and programming is not being used in San Francisco. From p. 114 of the survey, I suggest that position number 521-7 staff consultant make a career change since the $2,397 that the person is earning does not fall in the range of $18,000 to $21,128.

In conclusion, and furthermore, DATAMATION will continue making salary surveys in the same manner, personnel departments will continue to look at these surveys, data processors will continue to be misinformed and misunderstood, and I will continue to be amazed at the lack of concern.

RENDER SWYGERT
Systems Manager
Lakeland, Florida

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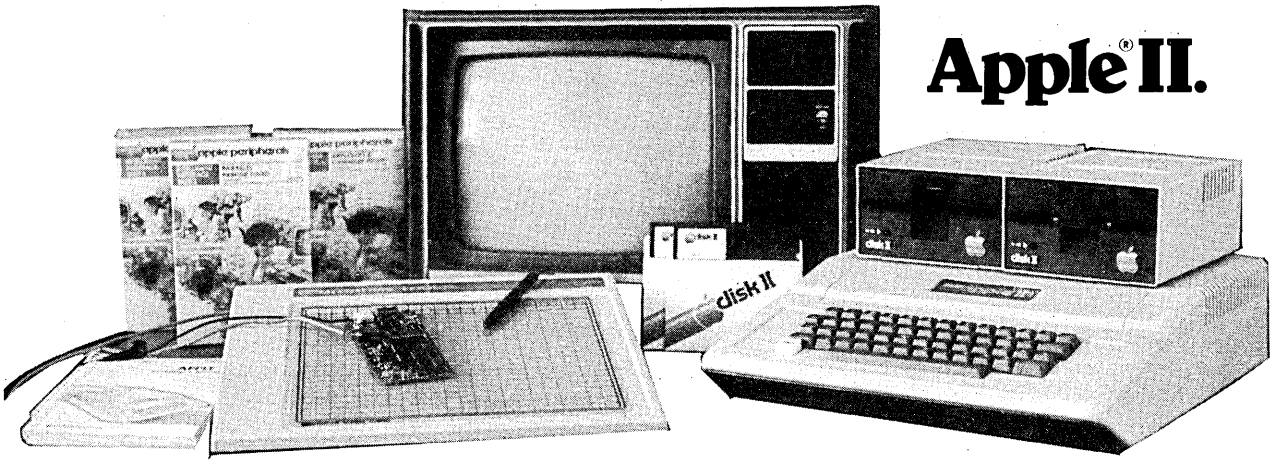

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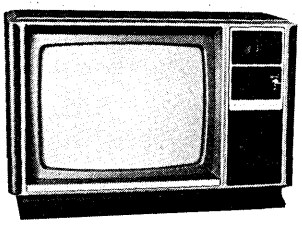

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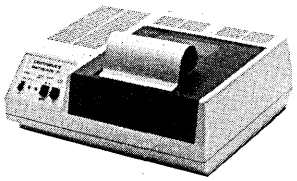

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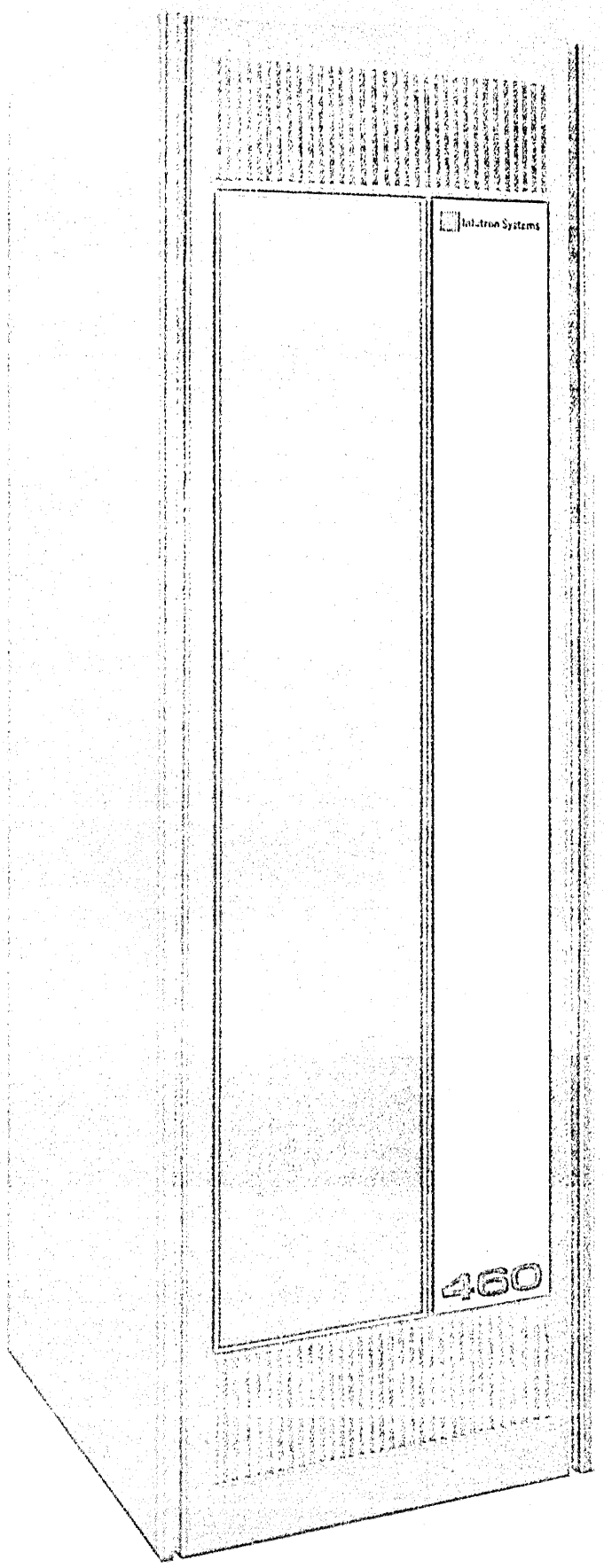

Intelitron's New Data PBX


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Executive 80™ is a beautiful new concept in smart terminals, designed to meet the needs of the new decade.

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Don't be dumb.
Get smart!

Hazeltine Executive 80

Answers for the Eighties

CIRCLE 25 ON READER CARD

SCIENCE/SCOPE

New three-dimensional polymer fiber networks show promise for a variety of industrial and commercial applications. The unique materials, comprised of high-strength fibers, are produced by vibrating an object in a supercooled polymer solution. The fibers can be grown directly on electronic devices prior to encapsulation with plastic, thereby providing internal fiber reinforcement. Hughes, with U.S. Air Force sponsorship, will apply its proprietary in situ fiber technology to a number of high-voltage electronic devices to validate a production process. Other potential uses include filters, high-strength composites, and medical implants.

Novel digital logic circuits employing charge-coupled devices (CCDs) may soon be used in a wide range of military systems, including communications, radar, voice processing, sonar, and guidance. Experimental chips developed by Hughes are five times more compact than similar circuits made with I^2L (integrated injection logic) or CMOS (complementary metal oxide semiconductor) processes. They also can provide up to 10 times the throughput per unit power when structured to perform many different logic operations at the same time.

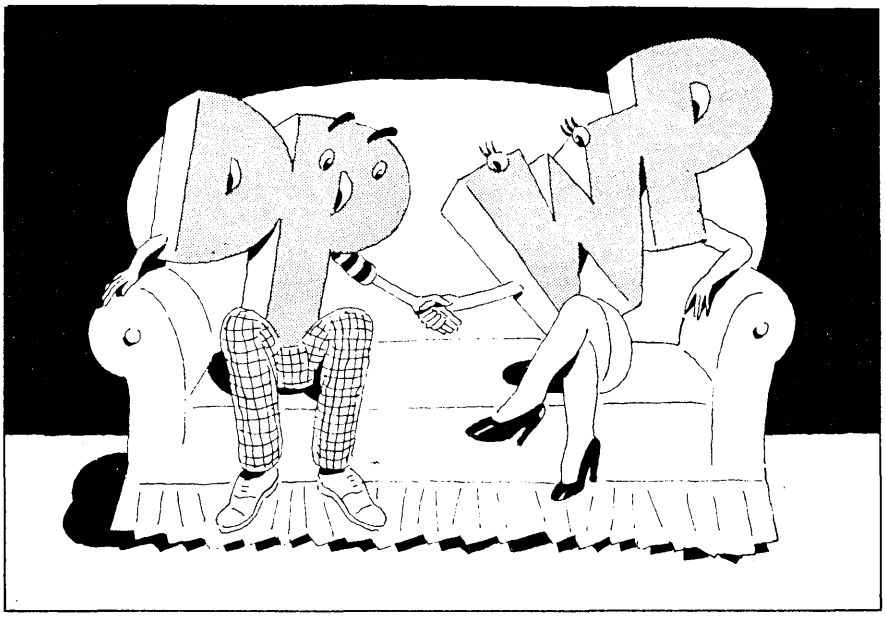
An infrared sensor that would detect and track ballistic missiles -- and perhaps even distinguish "live" missiles from decoys -- has proven extremely successful in initial tests. The device, a part of the Designating Optical Tracker (DOT) program, is designed to be carried by a rocket to an altitude of 100 nautical miles. There, at the outer edge of the atmosphere, it scans a wide area of space and then relays the data it gathers to the ground. The infrared sensor is much more sensitive than conventional infrared devices because it's supercooled. The device was developed by Hughes for the U.S. Army Ballistic Missile Defense Advanced Technology Center under subcontract to Boeing Aerospace Company.

Hughes Missile Systems Group, located in Canoga Park, California, is seeking engineers and scientists to work on a growing list of development and production programs. The list includes AMRAAM, Wasp, multimode guidance, TOW, Phoenix, Maverick, and U.S. Roland. Typical openings are in areas of LSI, radars, IR systems, signal processing, pattern recognition, computer software, electronic components, guidance and controls, gyro-stabilized platforms, and digital systems. Please send resume to Hughes Engineering Employment, Dept. SE, Fallbrook at Roscoe, Canoga Park, CA 91304. Equal opportunity M/F/HC.

A traveling-wave tube newly introduced for use in satellite earth terminal transmitters is capable of more than 250 watts of CW power in the 14.0 to 14.5 GHz frequency range. The device is a metal-ceramic tube with PPM focusing and forced-air cooling. A modulating anode allows beam current to be turned on and off quickly during normal operating sequencing and under fault conditions. Internal programming assures a proper TWT/power supply interface and simplifies field maintenance. The TWT is designated Hughes Model 881H.

EDITOR'S READOUT

WHO HAS THE LAST WORD?



Second verse, same as the first

About five years ago we were speculating that word processing and data processing were more than just casual friends and actually might enjoy connubial bliss sometime in the future.

We were also concerned about who was going to implement and manage this new partnership—the data processing manager or the administrative manager. Showing a not unexpected bias toward our readers, we opted for the data processing professional, arguing that he knew more about the emerging technology and that he had to integrate word processing into the overall corporate information structure. We felt this was particularly true if his company's needs called for word processing gear which used the capabilities of the central computer site.

We must admit that these thoughts didn't come in a blinding flash of insight over coffee one morning. At the time we were receiving much advice and counsel from Amy Wohl and Phil Dorn. Dorn was, and still is, an advisor for DATAMATION and a highly respected industry consultant; Wohl was working for Datapro at the time and beginning to carve out a reputation as the most knowledgeable person around in this new field of word processing. She is now also a highly respected consultant and a DATAMATION advisor.

Time has proved the accuracy of their contention that wp and dp would merge. But they were not the only ones examining this phenomenon.

Five years ago, in Technical Publishing Co.'s East Coast headquarters, Debbie Dwelley and the members of the DATAMATION marketing research group wrote their questionnaires, addressed their envelopes, licked their 10¢ first class stamps and launched their first study of the interaction of these two technologies.

Being tenacious types, they reasoned that their data would be all the better if they came back and asked the same questions at some point in the future. They did so this year. And happily for our two advisors and for us, their research confirms the speculations we made so long ago.

Both surveys confirm the dp department's frequent involvement in recommending and selecting wp gear for use in its own or other end-user departments. Five years ago, of the dp managers who were planning to acquire wp equipment for their own department, 16% were first time users, 11% were adding to existing wp equipment. Today the picture has changed. The 1980 survey shows a reduction of first time users to 8% and a jump to 24% in those who plan to expand their use of wp.

The research group also discovered that the highest acceptance of wp today is among computer and data processing service bureaus. Other big users are in manufacturing, government, and the finance sectors. Education, usually an also-ran when it comes to adopting new technology, is surprisingly one of the sectors where wp is finding strong acceptance.

Until recently, one of the articles of faith in the wp/dp world was that one system could not be used efficiently to do the other's work. But the 1980 survey shows that fully 36% of the respondents are doing word and data processing on the same system. And, with the rash of new announcements of office automation equipment having both capabilities, the figure is sure to rise rapidly.

With the introduction of the new digital PABXs and a flood of multifunction devices such as the IBM 6670 "Information Distributor," with the lowering of communications costs and the implications of AT&T's entry as an unregulated competitor into information processing, the outlines of the office of the future are beginning to emerge.

But despite the accelerated pace, our message to the dp professional hasn't changed much in five years. You are the individual who should be putting together the pieces of this complex information system for your corporation. You must learn all you can about wp, electronic mail, and all the rest. And you must understand data communications, the glue that ties all these systems together. And further, once it is all in place, you must provide the leadership to manage and constantly improve this information resource.

It's a big challenge, but one that we know today's data processing professional will meet and overcome. ✲

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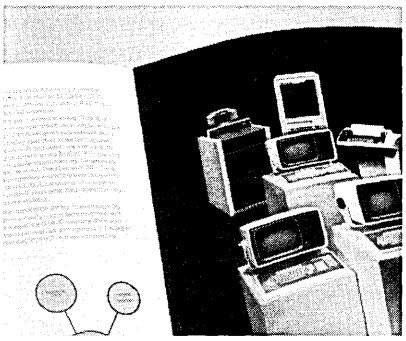

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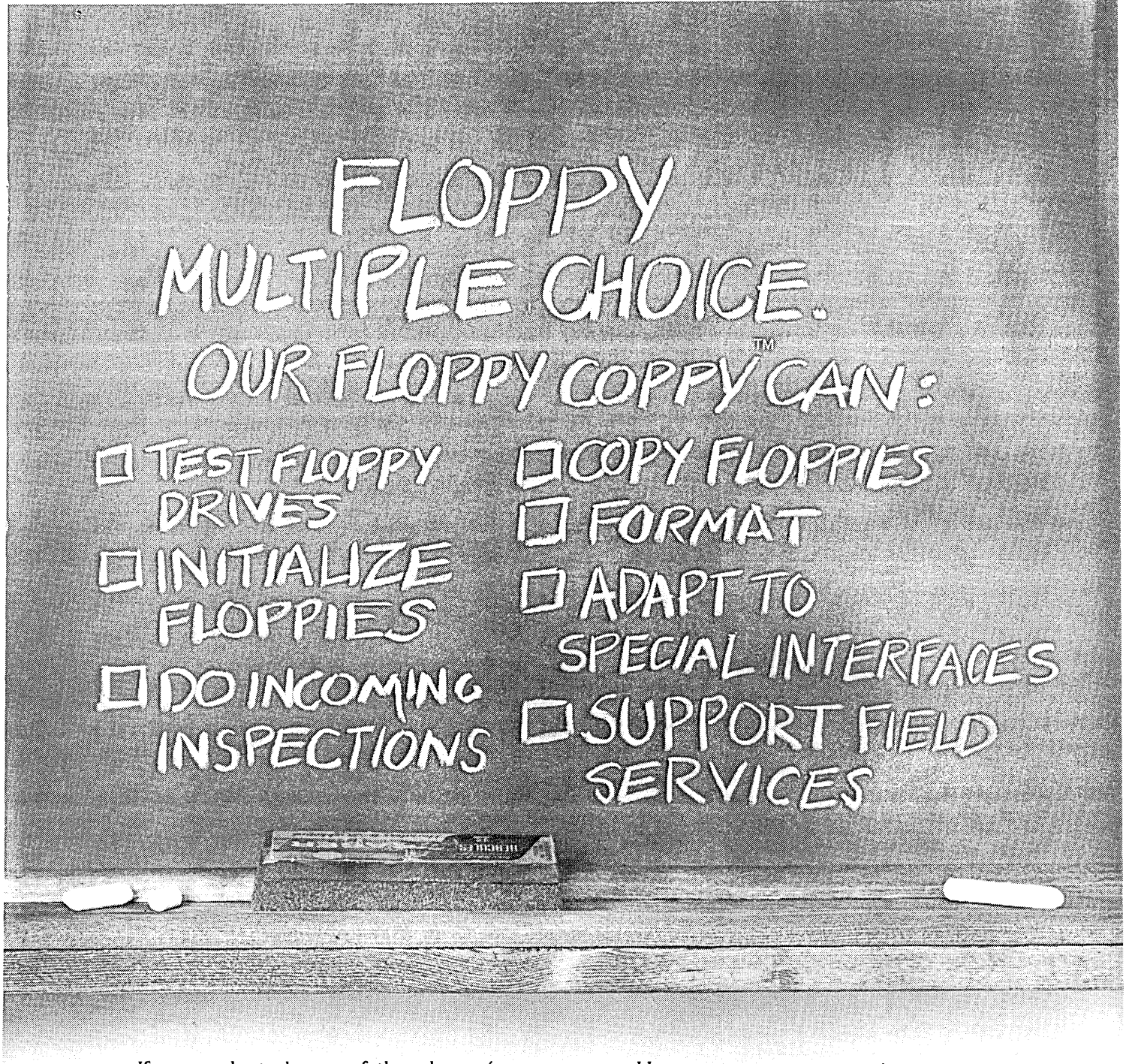

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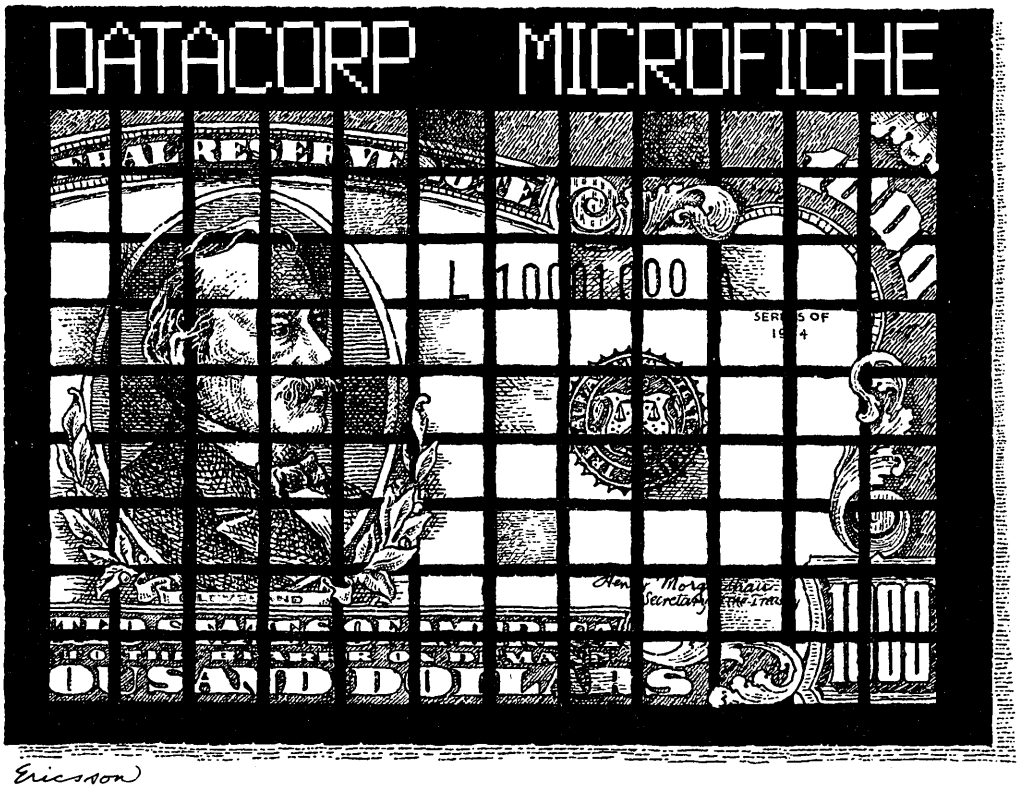

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MAINFRAME INDUSTRY SURVEY

Despite economic and product cycle uncertainty, the outlook for the mainframe industry appears basically positive, although less so than a year ago.

Neither price increases nor energy crises nor inflation nor recession apparently can stay the yearning for increased systems capacity.

Despite economic and product cycle uncertainties, the outlook for the mainframe industry appears positive, according to the 1980 Mainframe Industry Survey conducted by DATAMATION and G. S. Grumman/ Cowen & Co., the Boston-based investment research firm.

Based on responses from 5,773 mainframe users in the U.S., the recently completed survey indicates that software and a melding of dp and office systems functions will be where it's happening in the next few years.

The past year proved to be one of industry cross-currents. This was most apparent in the year-end spate of price increases, which reversed the steady down trend that had been in progress since the last bout with hyperinflation in 1974/75. On balance, last year's pricing actions will result in a net increase in 1980 for the mainframers, and dp budgets will be stepped higher accordingly for hardware, and even more so for software.

Sharply rising deliveries of systems announced in '79, coupled with a strong peripherals add-on business for already installed cpus, should buttress 1980 shipment and net yield prospects. Moreover, the absence of visible excess installed capacity—and, indeed, the perceived future need for additional capacity, especially at the high end—as well as a substantial new applications backlog should help mitigate the potential impact of a recession.

The key question once again will be the sales/lease mix and, for IBM at least, the cost/availability of third party financing could be crucial. The outlook appears favorable for rental and services revenues, on the other hand, helped in part by the price increases. And, a sizable pool is being built for possible future lease-to-purchase conversions.

For the longer term, the market still appears to be price elastic. If inflation persists, however, the trend in prices could well be up rather than down for the foreseeable future. Nevertheless, a favorable progression in system price/performance is expected to continue and could be even more compelling in an inflationary environment.

The shift continues in systems pricing mix from hardware to unbundled software and services, with a discernably higher rate of growth shaping up on the non-hardware side of computing. Still, the principal reliance for development of new user applications is expected to stay with short-supply in-house resources, a factor which could constrain industry growth.

Looking at the competitive picture, the survey found that the PCM market incursion has seemingly stabilized in the cpu area, much as it did a few years earlier where peripherals were concerned. This situation allows IBM greater leeway in raising prices and it eases the pressures on the non-PCM suppliers in the process.

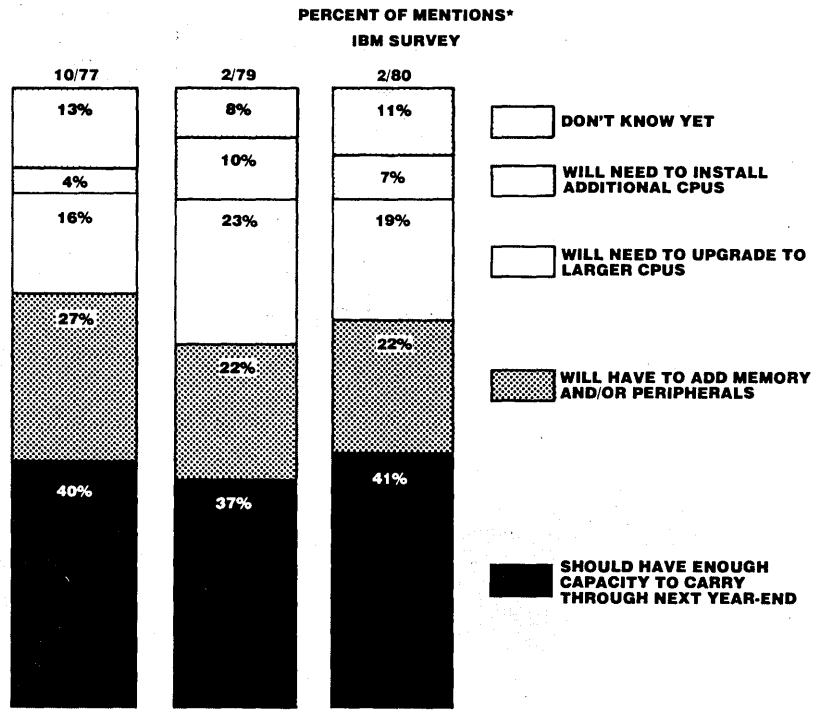
Looking at the survey of IBM users, respondents indicated plans to install IBM systems worth roughly $1.7 billion on an if-sold basis during the next 24 months. This represents a sharp drop-off in planned installation activity, in dollar terms, largely due to a substantial reduction in 303X systems that respondents project will be installed, versus a year ago.

In terms of units, however, planned installation activity is up somewhat over last year's projections, perhaps due to the lower priced 4300. With the 303X apparently heading for a shipment decline and the 4300 on a steep up-ramp, the survey suggests relatively flat gross system shipments for IBM in 1980. Nonetheless, IBM is expected to experience a good aggregate net installation increase, with a lift coming largely from peripherals.

Respondents indicated plans to add significantly to already installed IBM systems during 1980/81. Users anticipate needing 11,300 disk drives, a 28% increase on an average-per-site basis over 1979, with IBM enjoying a modestly improved share; 2,500 tape drives, down somewhat from the previous year; more than 67,000 terminals, a 29% jump over last year's expected needs, with IBM receiving an expanded share in that market activity; and nearly 650 MB of memory, a 23% jump over last year's

FIG. 1

YEAR-AHEAD DEMAND OUTLOOK



* EXCLUDES S/3-34 SITES

projections, of which IBM will recoup its majority share position due to its aggressive 1979 pricing actions and shorter delivery lead times.

Considering that IBM has both raised and lowered hardware and software prices during the past year, users were asked what the aggregate pricing effect would be in 1980. Of those surveyed, 43% expect to experience a price increase, 11% expect a decrease, and 46% expect no aggregate effect at all. Of those expecting a price increase, 12% anticipate adding to their installed systems sooner than previously planned; of those expecting a decrease, 23% plan to add now rather than later, as will 6% of those expecting no change in their overall budget. Compared to respondents' previous 1980 budget expectations, 39% expect to spend more, 12% expect to spend less, and 49% expect to stay at the same level.

Asked how they expected to be set for systems capacity at year-end 1980, 11% of IBM users replied they did not yet know,

Respondents indicated plans to add significantly to already installed IBM systems during 1980/81.

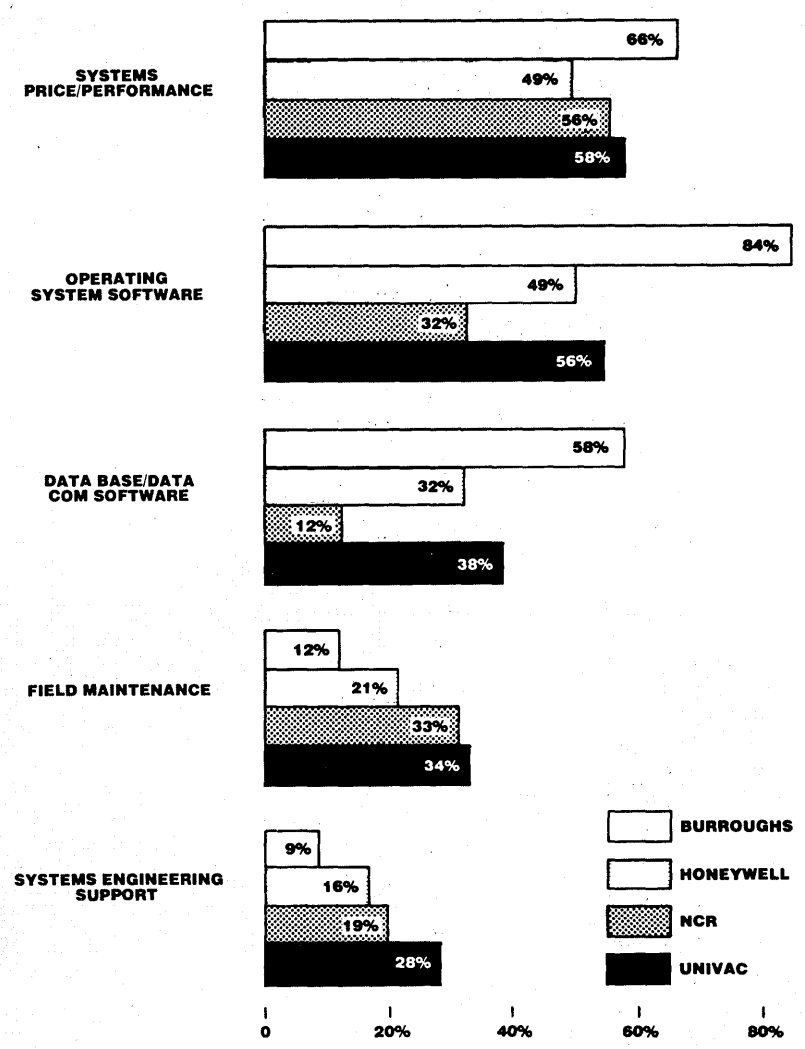
7% said they would need to install additional cpus, 19% will upgrade to larger cpus, 22% will add memory and/or peripherals, and 41% said they can hang on with what they've got until next year. Looking at the General Systems Div. users only, 15% said they were unsure, 3% expect to need additional cpus, 16% expect to upgrade, 24% will need to add memory and/or peripherals, and 42% expect no change.

Consistent with last year's survey was the relatively small downward migration evidenced in plan-to-install responses, with few 4341s scheduled to replace installed 3031s. Also in line with 1979's survey, 4341s account for nearly 60% of the expected 4300 unit shipments and more than 70% of the dollar value. The migration patterns additionally indicate generally favorable net yield trends for IBM.

With the 303X apparently headed for a shipment decline, even the expected rise in 4300 installation activity will not be enough to prevent the industry leader from an overall activity drop compared to 1979. Strong net yields from peripherals will be one revenue boost. Since 4300s as well as 8100s and System/38s will be much more heavily leased than purchased, and with 4300 shipments exceeding 303X shipments in dollar terms, this should lead to a strong improvement in rental revenue growth.

The overall sales/lease mix, however, seems likely to move lower unless high-end system introductions, such as the H Series, are soon forthcoming. With a majority of indicated 303X purchases actually third-party leases from a user stand-

FIG. 2
PERCENTAGE RATING VENDOR'S PRODUCTS/SERVICES SUPERIOR TO IBM's



point, the willingness and ability of third-party lessors to continue business in the dire straits of an adverse money market is among IBM's key questions for 1980.

The same dilemma may affect Burroughs. Its users showed a modest downshift in total purchase business from a year ago. At the same time, Burroughs experienced a 5% increase in leases from the manufacturer itself and a corresponding 5% decline in leases from third parties. Burroughs' large lease pool remains a stabilizing force for its business, but as users upgrade from a leased cpu to a new leased cpu, the rising incidence of sideways of adverse netting provides a source of long-term concern. The recent upturn in pricing may offset these pressures. In addition, some of the slack in rental growth is being alleviated by expanding revenues from separately priced software.

The survey showed continued strong demand for Burroughs products, with planned installation activity ahead of a robust 1979. In part, this reflects the attraction of aggressively priced machines, particularly at the high end.

Respondents' planned installation activity over the next 24 months will be up both in unit and in dollar terms. The B68-6900s to be installed in that time period will equal half of the B67-6800s currently in place at respondent sites. And B7800s to be installed will equal 78% of B77-7800s in place. Such plans indicate a spurt in large systems shipments, augmented by a migration of the remaining 700 series base. Users indicated plans to upgrade 26% of their B6700s and 24% of their B6800s and replace 26% of their B7700s with B7800s.

Burroughs' major problem appears to be its poor image on maintenance and system engineering. So far, however, this potential Achilles' heel is not being evi-

DOUBLE
OR
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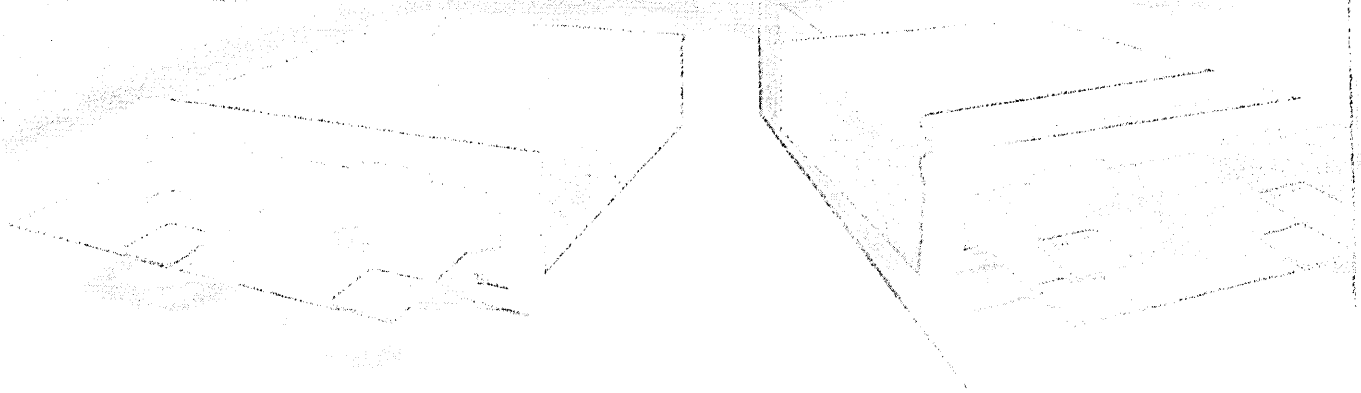

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denced by customer defection. When asked about the primary course for future system expansion, most existing Burroughs users indicated plans to grow within the current family of systems. While there was relatively little evidence of customers planning to switch vendors within any Burroughs product family, the highest committed customer defection was seen at B1700 (9% of surveyed sites), B25-4700 (10%), and B4800 (7%) user sites. Not one B67-7800 user expressed plans to switch vendors, nor was there a single instance of vendor switching among those planning to install 900 series gear. While respondents' plans to install the 900 series is reminiscent of the cautious initial reaction to the 800 series, 13% of respondents said they intend to have 900 series gear on site by the end of 1981.

The survey showed that users do seem satisfied that Burroughs is keeping pace on the key parameters of systems price/performance, operating system software, ad data base/data communications software. And the survey left no doubt that Burroughs customers consider themselves in the forefront with respect to the use of advanced functionality.

The survey showed continued strong demand for Burroughs products, with planned installation activity ahead of a robust 1979.

As for NCR, the V-8500M, introduced in response to IBM's 4300, appears to be progressing well and could be a major factor for the improved, healthier outlook for the company than was recorded last year. However, the absence of any user plans to install 8600-class systems raises some question about the prospective success of NCR's high-end thrust, at least in the U.S. (It is important to note that NCR's computer systems business is much larger outside the U.S. than domestically.)

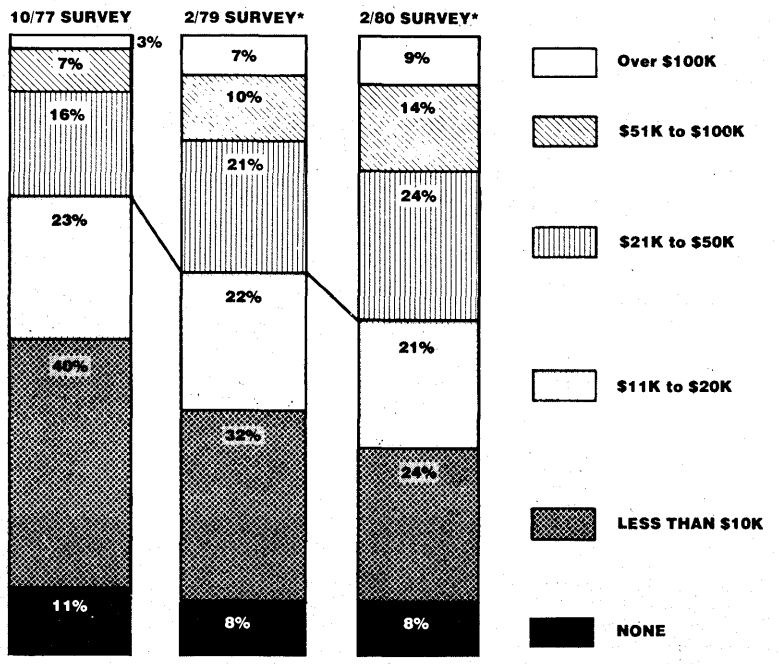
NCR's outlook would be considerably brighter were it not for the problems with systems engineering support, which 42% of the respondents rated inferior to IBM, and sales personnel, which 36% rated inferior. Those low marks held NCR to a 2% jump in overall product/service rating over last year, which was interpreted as a positive indicator.

Another positive indicator was the average price of systems to be installed, which at $8,300 was more than 20% higher than the $6,800 average of 1979 and 15% greater than the average for systems already installed. Respondents' planned installation activity was up three percentage points in dollars and down one percentage point in units, reflecting a shift in the mix of to-be-installed systems to the higher average priced 8500M series machines.

There was also a sharp shift in the

FIG. 3
GROWTH OF UNBUNDLED SOFTWARE REVENUES

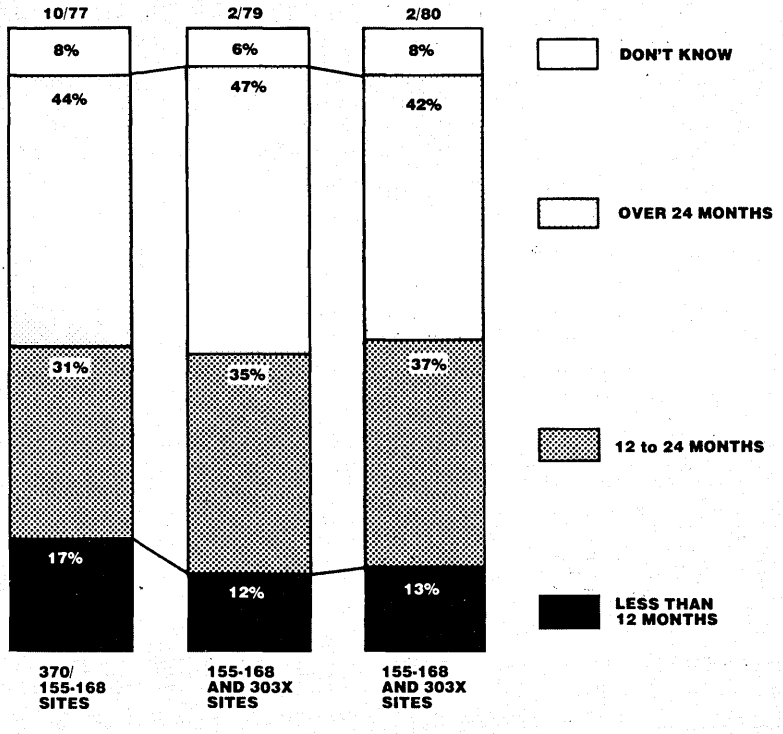
PERCENTAGE OF ANNUAL DP BUDGET CURRENTLY SPENT ON UNBUNDLED SOFTWARE FROM IBM AND OTHER OUTSIDE SOFTWARE PACKAGES



*EXCLUDES SYSTEM/3, 32 AND 34, WHICH HAD NOT BEEN INCLUDED IN 77/78 SURVEY SAMPLE

FIG. 4
NEW APPLICATIONS BACKLOG
IBM USER SURVEY

MONTHS REQUIRED TO IMPLEMENT ALL CURRENTLY PLANNED APPLICATIONS



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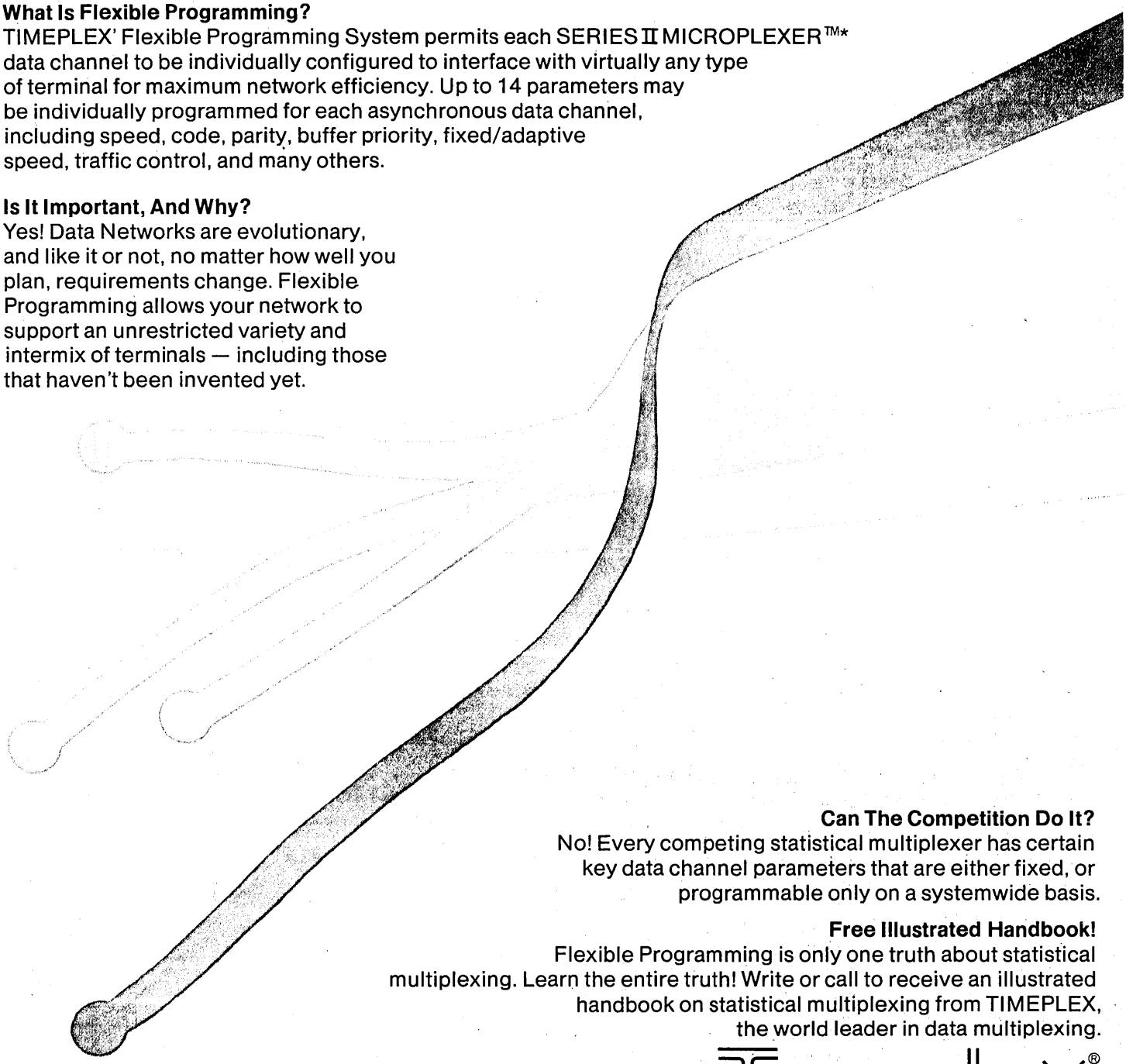

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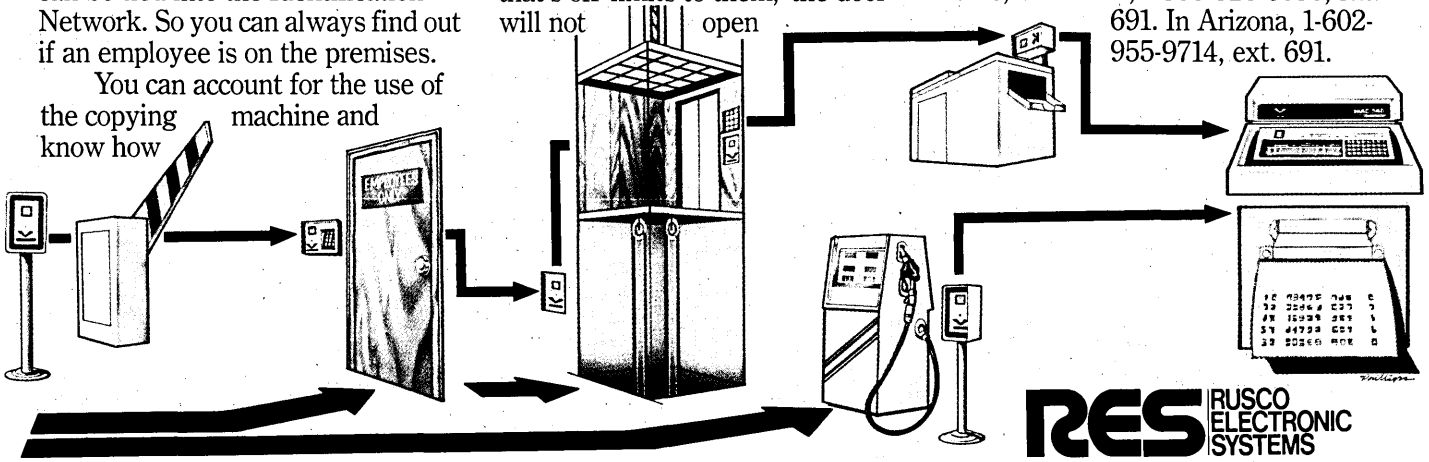

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FIG. 5
PERCENTAGE OF SOFTWARE STAFF RESOURCES ALLOCATED TO NEW APPLICATIONS DEVELOPMENT

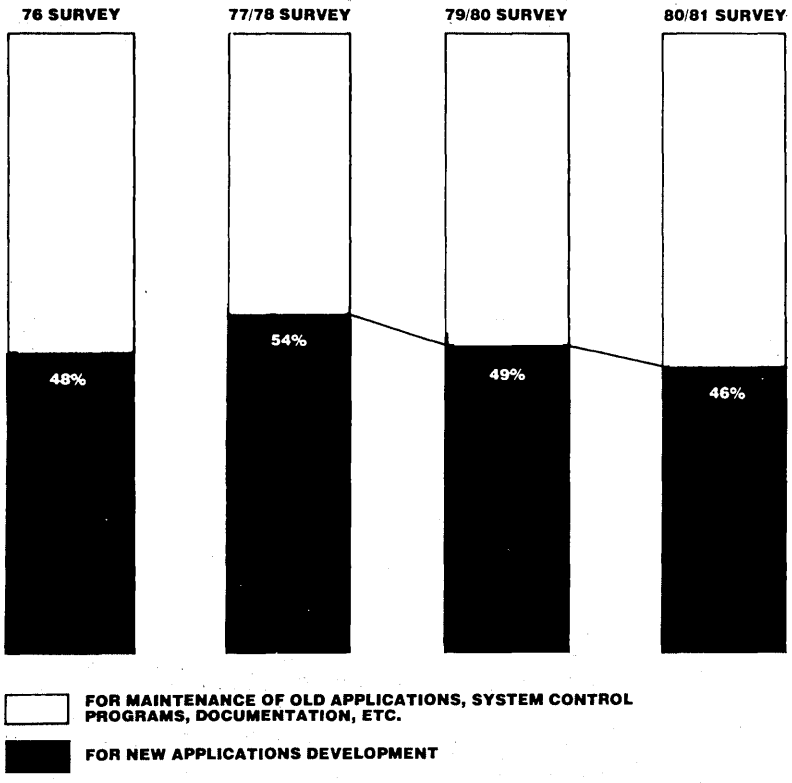
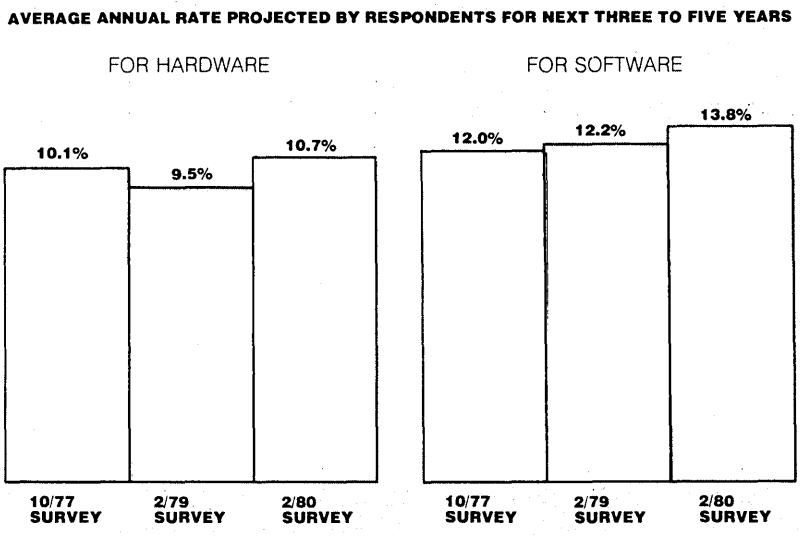


FIG. 6
LONGER-TERM GROWTH IN USER SPENDING



to-be-installed mix toward long-term lease, based primarily on respondents; fears that product technology was changing so fast that they wanted to maintain the flexibility to change with it. Despite NCR's aggressive pricing actions, which are expected to result in an overall increase in budget spending for 52% of surveyed users, the net yield looks strong on replacement of those systems already on lease. Those users who have already purchased a Century 101-201 machine, however, are less inclined to follow the general migration trend toward the Criterion/8000 series than those who are leasing or renting. Of those not planning to install Criterion, 26% cited dissatisfaction with NCR as their supplier, a four percentage point increase in that category over 1979.

Honeywell's hopes for the future are largely pinned on prospects for the DPS 8. Bolstered by a good initial takeoff for DPS 8 high-end products, respondents installation plans are tangibly ahead of those indicated one year ago. As a percentage of the installed base, mainframe installation activity over the next 24 months (excluding Level 6)

Honeywell's hopes for the future are largely pinned on prospects for the DPS 8, and HIS is under the gun to deliver as promised.

should be up four percentage points in dollars, while installation activity in units should be down one percentage point from a year ago.

But HIS is under the gun to deliver as promised. Users indicated a willingness to shuffle expansion plans to get an early crack at DPS hardware. Thus Honeywell's ability to ramp up production of these new systems is the major key to 1980 shipment trends. Assuming DPS 8 deliveries materialize as expected, HIS shipment and revenue picture, on balance, should be in pretty good shape for 1980, despite the distinct shift from third-party leasing.

Among those users who have set their long-range expansion plans, Honeywell must confront customer defection ranging from 11% of those replacing the L64 to 31% of those replacing the small H200/2000. This potential loss may be softened, however, by very extensive minicomputer add-on activity, particularly among high end systems users. Honeywell had a far higher percentage in this area than any other vendor.

Long-range prospective demand is equally encouraging in the add-on market for memory and peripherals, as 30% of Honeywell users surveyed said they would have to boost those requirements by year-end. Users' expressed cpu capacity requirements for the post 1981 period bode well for DPS 8 demand in 1981 as well.

Longer term returns in the computer

business remain sub-par, although the picture is much better than a couple years ago. Until returns improve, HIS has limited tools with which to cushion adverse developments and/or truly stimulate growth.

The forecast for Univac is that the add-on business will boom and the cpu business will just hang on. Univac's add-on business is second only to IBM's, with substantial installation increases indicated in disks, terminals, and add-on memory.

As for cpus, however, the survey indicated that there was not much user enthusiasm among Series 90 users for converting to Univac's mainstay 1100 series. Only 11% of 90/30 users and 6% of 90/60 users indicated a desire to switch to the 1100 for their future systems growth. More significantly, not one 90/80 user indicated definite plans to convert. However, with 39% of

The forecast for Univac is that add-on business will boom and cpu business will just hang on.

90/30 users and 28% of 90/60 users still undecided about expansion plans, those now uncommitted customers could prove to be a source of new 1100 series users. The survey suggested that most 90/80 users apparently feel trapped, and 18% of those responding indicated a long-term plan to install non-Univac equipment.

Thus, planned installation activity was down markedly over the 1979 survey—20 percentage points in dollars and one percentage point in units. The decline was partially due to shorter lead times, with 78% of 1100s to be installed scheduled for delivery in 1980, whereas in the 1979 survey 44% of expected installations spilled over beyond the ensuing 12 months. But Univac's very large foreign business is probably in a position to take up much of the slack in shipments if it occurs in the next 12 to 18 months.

With cpu shipments down from a year ago, the respondents' sharply increased add-on peripherals plans should provide a good buffer. Finance leases and cash sales continue to account for almost all of Univac's mainframe-related revenues. Ultimately, however, the accelerating industry product cycle, particularly at the high end, precludes major benefits from finance lease residuals and casts doubt on the profitability of the company's finance lease strategy. Another long-term problem is the melding of product lines, made extremely difficult by Series 90 users' lack of enthusiasm for the 1100.

The greatest detriment appears to be Univac's sub-par profitability ratios. With purchase content already very high, it is difficult to visualize the avenues for much improvement in margins and return on assets.

Some additional survey findings are shown in the accompanying graphs.

—Willie Schatz

FIG. 7

IBM LEAD AMONG RESPONDENTS AS WORD PROCESSING SYSTEMS SUPPLIER

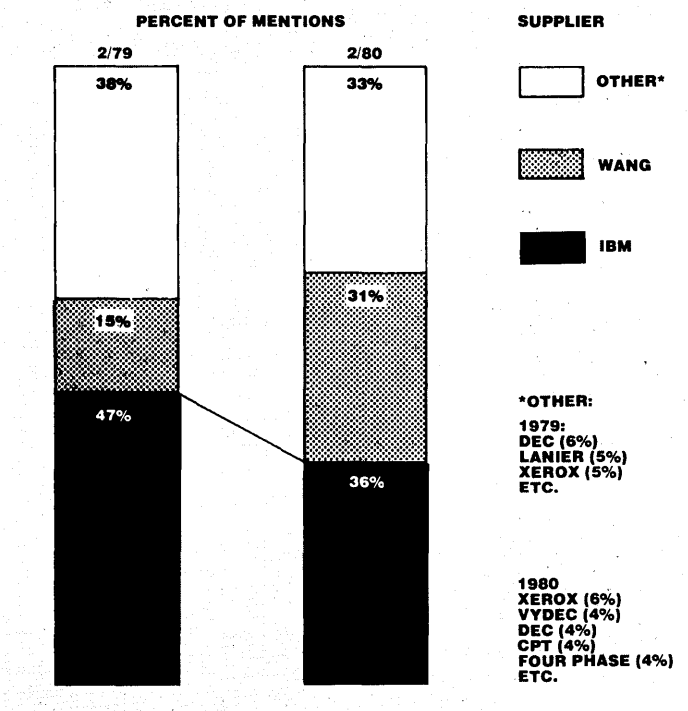
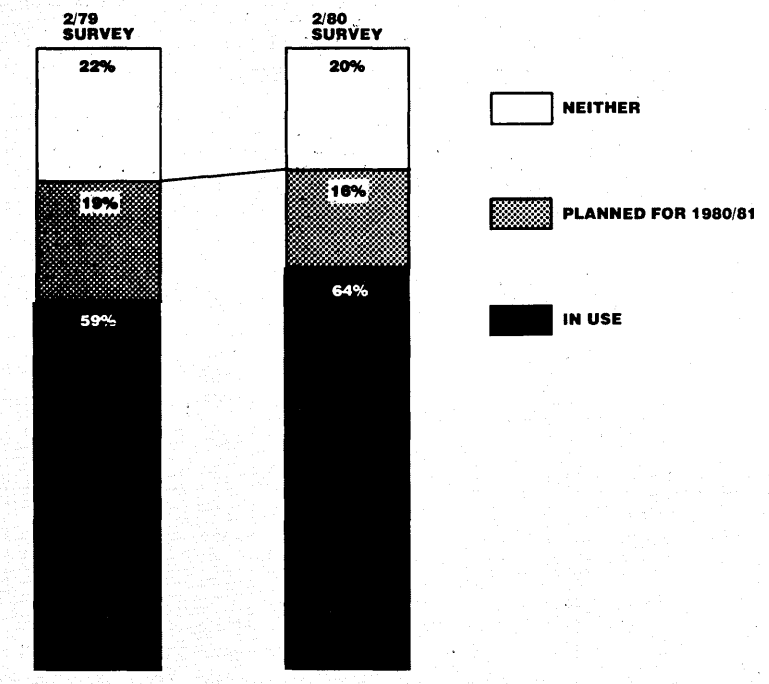
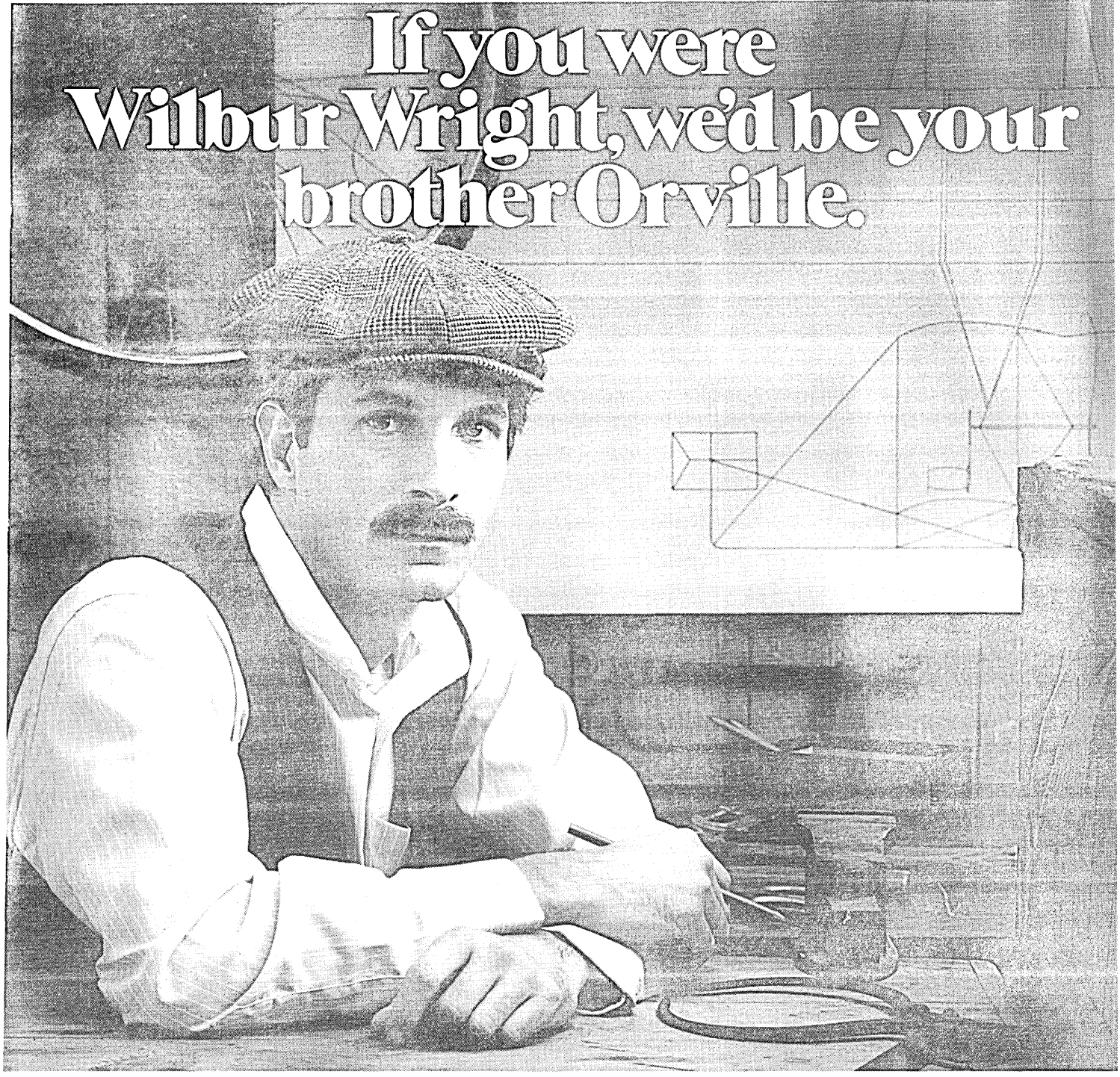


FIG. 8

GROWTH IN DATA COMMUNICATIONS USAGE



If you were Wilbur Wright, we'd be your brother Orville.



They were more than just brothers. They were a team.

On the ground or in the air, Wilbur knew Orville would always be there when he needed him.

Which is just how a lot of people feel about us.

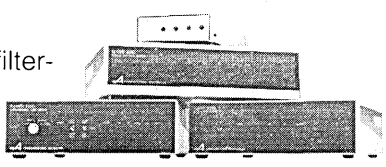
They count on Avanti to always come up with newer and better solutions to their local data distribution problems. To keep expanding our family of telephone line modems to meet their changing needs.

Avanti's new 9600 is a prime example. It's the kind of high speed medium distance modem you need today. With room for a lot of the options you'll want tomorrow. And a list of features no modem's ever had before. Like:

- Microprocessor-based and all digital filtering for flawless operation in any environment
- Compatibility with CCITT/V.29 long haul modems
- An Intelligent Equalizer™ that entirely eliminates manual line adjustments
- Hinged front panel for easy access to option switches, board replacement and maintenance
- Optional voice or data communication

Surprisingly, you can own any of Avanti's phone line modems for about half the cost of a conventional modem. For complete details on the Avanti 9600, or the equally remarkable 4800 model, write or call Avanti Communications Corp.

AVANTI



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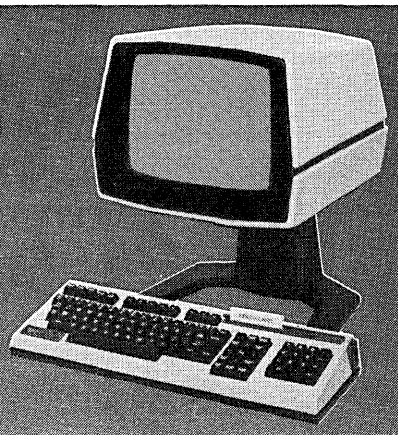

Model 70C Microprocessor Based CRT

Card Reader CRT Terminal

- Magnetic stripe card reader keyboard.
- Reads cards encoded to the international air transport association (IATA) standard.
- Up to 76 alpha/numeric characters may be recorded on one card.
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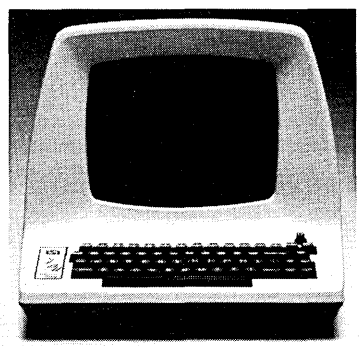
If you're going to copy it, at least do it right.

You see them every day.

Copycat terminals, with flashy features, all claiming to be as good as the renowned Dumb Terminal® video display terminal. Some even claim the same reliability that made the Dumb Terminal a household word.

But none can claim the ADM-3A's field-proven average of 15 months between service calls. Which means you spend less time and money on repairs. That's why the Dumb Terminal has become the industry standard—and why we've sold over 100,000 of them. It makes us feel that our extensive burn-ins and grueling quality control have been worth it.

We didn't load the Dumb Terminal with fancy frills—just dependable features that get the job done. Like a 12" diagonal screen, full or half duplex at 11 selectable data rates (75-19.2K baud), 1920 characters in 24 rows of 80 letters, RS232C extension port, and direct cursor addressing. Plus a host of sensible options. All for just $895.



DUMB TERMINAL. SMART BUY.

So don't be fooled by Dumb Terminal imitations. Because there's simply no substitute for Dumbness.

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CIRCLE 38 ON READER CARD

LEAR SIEGLER, INC.
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Dumb Terminal® is a registered trademark of Lear Siegler, Inc.

=A new compatibility breakthrough

CPT, Lanier, DEC, Lexitron and 24 other computers or word processors can now "talk" to each other with the TNI 303 Protocol Translator.

Your own word processor or computer, regardless of make, can talk over telecommunications to practically every other major system...regardless of protocol and embedded code differences. Finally, electronic mail has a new dimension and an unlimited capability. Each TNI 303 is customized to your own specific requirements...each vendor system is on its own PROM...and additional systems up to 10 may be included in the same box.

The large digital readout (LED) counts characters during connect time in the transmission and also counts any telephone line transmission errors that may occur. Now you have exact cost control because the TNI 303 counts the number of characters transmitted during connect time.

There are 3 different ways you can use the TNI 303 Protocol Translator:

1. In electronic mail, whereby distant systems can communicate with your host system, using telephone modems.

2. In hard-wiring between 2 systems, computer or word processor, whereby you convert directly without telephone modems.

3. In the creation of your own message transfer system with one TNI 303 and 2 modems, one on each RS232c port of the box.

As new systems are developed by the vendors, you benefit because we furnish you with the required transfer capability. When you lease or purchase the TNI 303, you select the first 3 vendors you wish and the communications protocols they have created. These PROMs are initially programmed in your TNI 303.

Size: 5" x 18" x 14"; weight, 12 lbs.; transmission speed range: 75, 134.5, 300, 600, 1200, 2400, 4800, 9600 baud. Cost, $8,385. Rental and lease plans available. Delivery, 30 days.

Telesystems Network, INC.

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CIRCLE 56 ON READER CARD

Another Able card trick which can make your PDP-11 run three times faster.

SCAT/45™
(ADD-IN FASTBUS MEMORY)

Applicable Computers – PDP-11/45, PDP-11/50, and PDP-11/55.

Run and Response Time – Run time reductions up to 67% make possible the same amount of computing functions in 33% of the time required without SCAT/45.

Switch Selectable – Can be used across the 124K word range. Beginning address on any 4096 word boundary gives user up to 124K words of 330 nsec cycle time memory instead of the 32K word limitation of MOS or bipolar memory option if purchased from computer manufacturer.

Expandability – Expands in 32K word increments with each increment requiring one circuit board. Only half the available FASTBUS space required to accommodate a FULL 124K word memory complement.

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Teach your computer our latest card trick. You'll get performance you never thought possible at a price which makes SCAT/45 the biggest bargain in the industry, using 1/4 the power and 1/4 the space at 1/4 the cost of the DEC "equivalent" bipolar. That's a pretty good trick! Write for details, and find out why our customers call us the leader among manufacturers of DEC enhancements. Able Computer, 1751 Langley Avenue, Irvine, California 92714. (714) 979-7030. TWX 910-595-1729.

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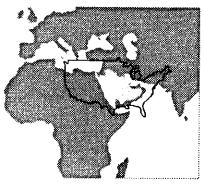
CIRCLE 40 ON READER CARD

Abqaiq, Saudi Arabia

No baseball, no morning paper, no pizza, no autumn leaves.

But here's the great life that makes Aramco people stay on and on.



If you never considered working in Saudi Arabia because you think it's all sand and hardships, consider this.

3,900 Americans like you work for Aramco in Saudi Arabia now. Ask them why they stay and they'll tell you that, besides money, it's the casual lifestyle, American-style hometowns, top-notch schools, and vacation travel they used to only daydream about.

Where on earth is Abqaiq?
Located close to the world's largest oilfield (Ghawar), Abqaiq is the center of a giant oil-gathering and processing system that handles 60% of all the oil produced by Aramco, the world's largest producer.

Does Aramco's paycheck justify living in a desert kingdom?
Yes! You get a base salary competitive with top U.S. oil firms. We compensate you for overseas cost-of-living differences.

On top of that, Aramco pays an **incentive of up to 40%** for overseas employment, and you are reimbursed for any foreign or U.S. Federal income tax on the premium. So your premium is tax-protected.

Another benefit: employees overseas participate in Aramco's Retirement Income Plan on an **accelerated** basis.

With this financial package, no wonder 3,900 Americans like you work for Aramco in Saudi Arabia today.

What can you do with all that money stuck out in the desert?
Aramco people use 40-day paid vacations (every 12½ months) and 12 paid holidays (average) to visit fabulous places like the Pyramids, Greek Islands, Mt. Everest, the Serengeti Plain, Hong Kong.

Aramcons vacation in Asia, Africa, the Middle East and Europe

Doesn't a child's education suffer so far away?
No! Aramco has a modern American school system. Teachers are primarily American and more than 75% of them have master's degrees. The teacher-student ratio is 1 to 15 in grades 1 to 6; 1 to 20 in grades 7 to 9.

Where do you go if you get seriously ill, or need dental surgery?
Aramco's Dhahran Health Center is one of three hospital systems outside the U.S. accredited by the Joint Commission on Accreditation of Hospitals. The Dental Clinic is as fine as any in the States. Better than most.

Aramco recruiting ads mention "comfortable housing." Is that on the level?
At first, you'll live approximately 18 months in adequate but not terribly attractive off-camp temporary housing. Next, it's on to comfortable on-camp temporary housing. Then, based on a housing priority-point system using job level and length of service, you'll get your permanent residence. Many of these are like homes you'd want to live in, in the States.

What jobs are open today? Can a person advance?
Aramco's operations are so big that our job opportunities are probably unduplicated anywhere. Challenging jobs are open in administration, refineries, gas plants, support facilities, everywhere.

We need accountants, medical personnel, technicians, teachers, vocational trainers, communications specialists and materials forecasting specialists. And scores of engineers: in construction, project management, operations and maintenance—for operations in oil, gas, petrochemicals, EDP, computers, transportation, utilities, name it.

You'll have challenges, responsibilities, and management advancement opportunities.

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WHEN YOUR COMPUTER'S DOWN, ARE YOU OUT OF BUSINESS?

You need the Tandem NonStop™ System. It will keep on running right through a failure which would shut down any other system on the market today.

And never lose or duplicate any transaction in process at the time of a failure.

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Transaction oriented, with an extremely low cost-per-transaction. Cost efficient. High throughput. Wherever computer downtime equals irreversable or non-supportable loss. Dollar for dollar, it's the soundest investment you can make for high volume transaction processing.

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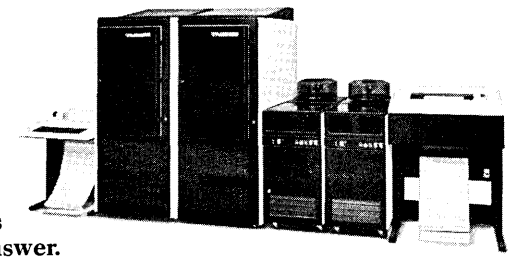
Branch Offices throughout the U.S.A., Canada, U.K. and Europe. Service throughout the world.



Here's the answer.

A Tandem NonStop System. From $150 thousand to $3 million. Expandable without cost or performance penalties to sixteen processors per system and up to 255 systems per network. Local or global, no system of comparable cost can even approach the performance.

CIRCLE 42 ON READER CARD

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Attn: Marketing Communications, Department D-6

☐ Please send me your introductory brochure on the benefits and applications of NonStop computing.
☐ Please arrange a demonstration of your unique NonStop capabilities.

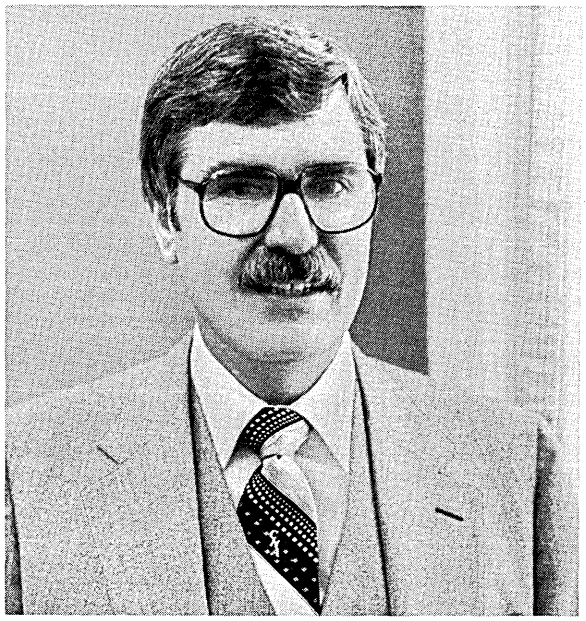
My potential application is in _____

Name _____ Title _____

Company _____ Street _____

City/State/Zip _____ Phone _____

"Cost savings of 70%."



Chuck Anastasi, Manager, Timesharing Services, 3M, St. Paul, Minnesota.

Price/Performance.

"3M is a worldwide company with 47 U.S. operating divisions and subsidiaries.

"We were buying computer time from 15 different service bureaus and spending between $1.5 million and $2 million a year. Because of this cost we decided to develop an in-house system and establish our own timesharing service.

"Within 18 months we had installed two DECSYSTEM-2060s and were providing 75% of our U.S. timesharing requirements. Eventually, we'll have over 90% of our work done on the in-house computers.

"Our price/performance ratio is outstanding. The in-house service on the DECSYSTEM-2060s costs 30% of what it would cost to do outside. That's a cost savings of 70%, which is even more than we expected."

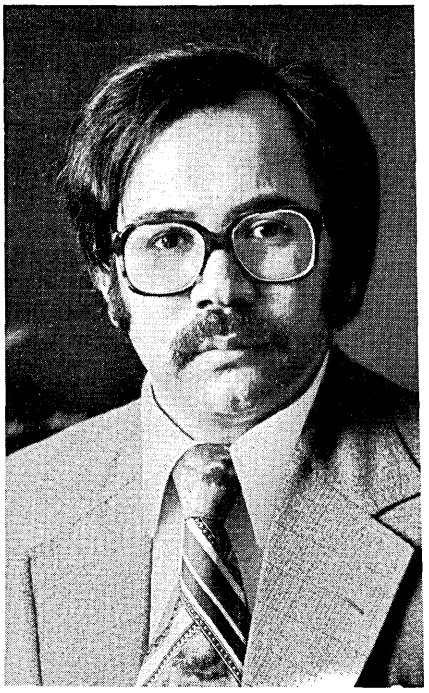
Versatility.

"The University of D.C. was created in 1976 as a consolidation of three colleges in the area.

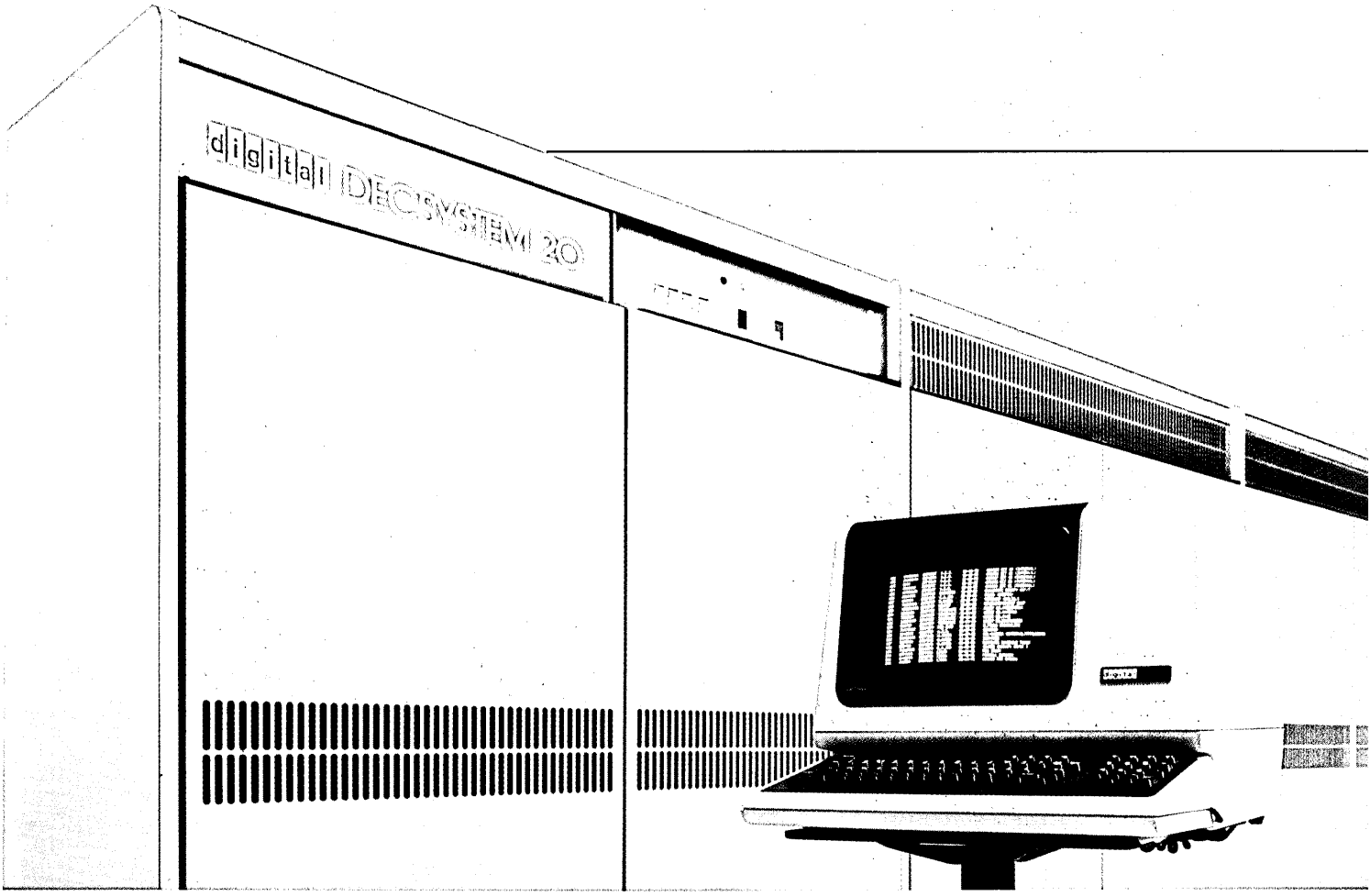
"Initially U.D.C. had a batch system, but since it was already overloaded with administrative work, neither the faculty nor the students could get any computer time. We decided to get another system to share the workload and to improve services to the students and the faculty.

"We wanted a distributed system that could be used on all three campuses, and that meant an interactive DECSYSTEM-2060.

"Now we can use our DECSYSTEM-2060 any time day or night because our uptime is over 98%. Our applications range from word processing for producing proposals to sophisticated graphics, which we use extensively in our Physics, Chemistry, and Engineering departments. And response time is six times faster than with our batch system."



Dr. Daryao S. Khatri, Associate Professor, Physics Dept., University of the District of Columbia, Washington, D.C.



Ease of Use.

"At the Paulsboro Lab of Mobil Research, we do research and development for petroleum refining processes and products.

"Our laboratory was computerized with a network of PDP-8s and PDP-11 s. But to handle the enormous amount of data generated, we decided to add a computer as a database and for data analysis. APL was the language we needed, and we also wanted a system that was easy enough for everybody to use—scientists, engineers, technicians, and management people.

Dr. Dwight Prater, Sr. Scientist and Research Advisor, Mobil Research and Development Corporation, Paulsboro, New Jersey.

"Since most APL-systems on the market had been tested extensively, we knew the best system was APLSF on the DECSYSTEM-2060.

"Now we have up to 45 interactive users at any one time and virtually everybody here can run this system. Even some of the secretaries are trained in APL.

"With the DECSYSTEM-2060 and APLSF, data can be analyzed and processes are devel oped three to five times faster than before."

DECSYSTEM-2060
The interactive computers for the big system jobs.

☐ Please send your Interactive User Reports Brochure.
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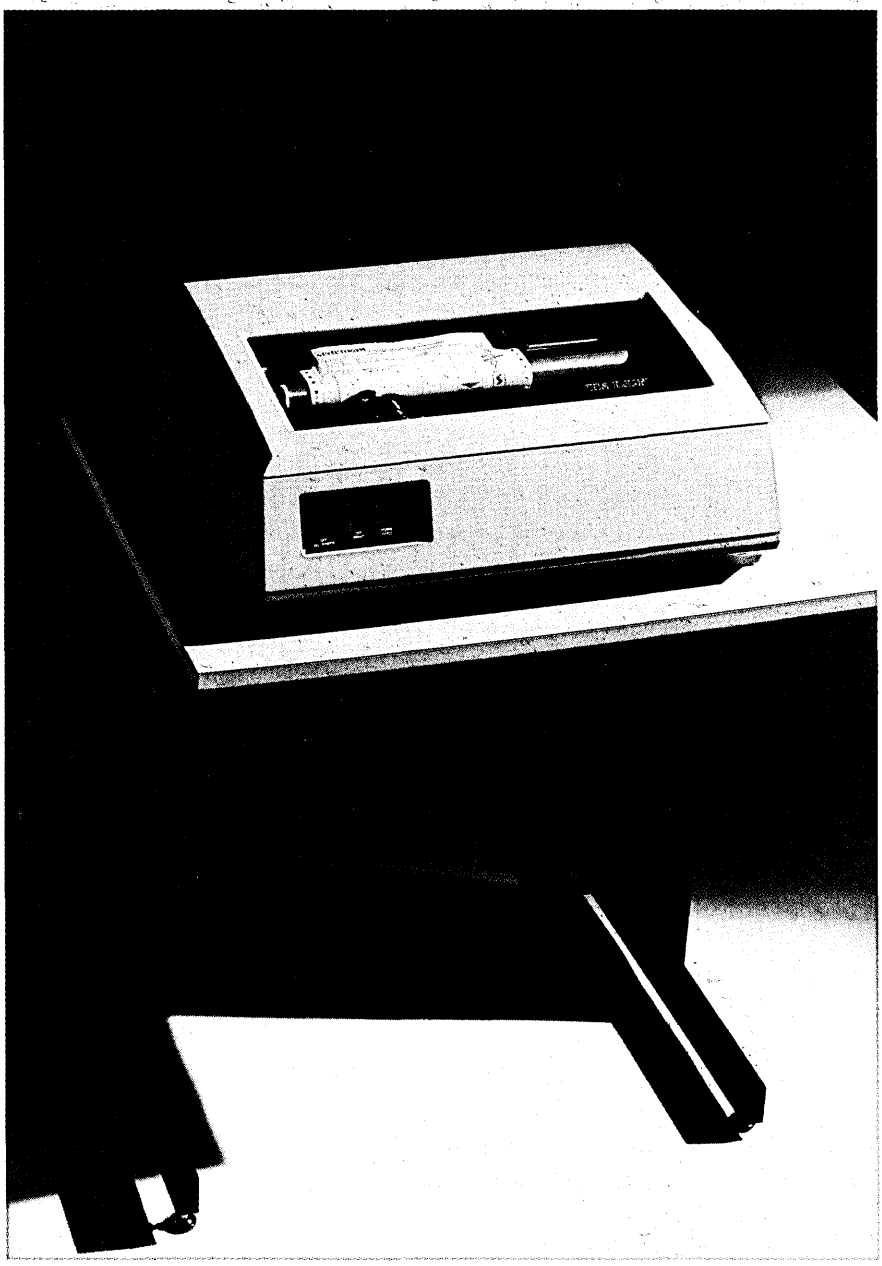
A-6-0

digital

A NEW SERIAL PRINTER FROM THE LEADER IN MATRIX TECHNOLOGY



Mannesmann Tally sets the pace in price with the T1705.

From the Tally tradition of quality and reliability comes another dramatic advancement in lowered cost of ownership. A combination of low purchase price, low maintenance costs and low parts usage. A "no options" fully loaded printer that combines the latest in LSI electronics with precision mechanics. You get standard features that are extra cost options on other printers.

OEM's will select it because users will prefer it!

The T1705 is the quietest impact printer on the market. It has 160 cps optimized bi-directional printing with high speed 48 ips head slew for throughput speeds up to 200 lines per minute. Rugged reliability. No preventive maintenance requirements.

Standard features include a new operator changeable precision print head for long life and superb print quality. Dual tractors for positive paper positioning and control. Operator selectable 6 or 8 lpi spacing. Self test. Forms control. A convenient snap-in ribbon cartridge for clean, fast and easy ribbon changing. Double wide character printing. And a buffered serial interface.

A new serial printer. Competitively priced. 30 day delivery. Call your nearest Tally sales representative today.

See us at NCC Anaheim, Booth #1527

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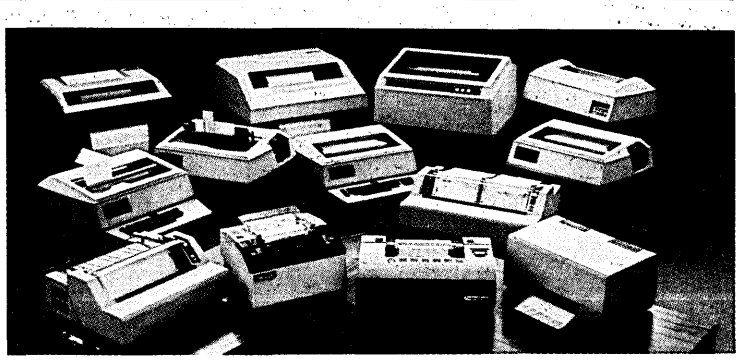

CIRCLE 44 ON READER CARD

LOOK AHEAD

(continued from page 18)

ation back to British shores. The move, which would severely undermine ICL's U.S. image, would appease U.K. unions and gain the company more preferential funding from the British government.

AFIPS HIRES HEADHUNTERS

AFIPS is dead serious about finding a new executive director. The group has hired honcho headhunters Russel Reynolds Associates Inc., the prestigious and high-priced firm that earns its fee (rumored to be at least 30% of salary) for producing what it feels is a qualified body, whether or not its recommended recruit is accepted for the post. RRA men were combing the crowds at NCC last month in search of a likely candidate.

EURONET'S DAYS NUMBERED?

How long will Euronet survive? Not very long, claims one senior British Post Office official who sees the European PTT's packet switching fading away. Its demise stems from the fact that the data base traffic on the once highly touted net has remained national rather than international. To make matters worse, one of the overriding rationales for Euronet now no longer exists -- the PTTs hoped to use the net to interconnect separate national packet nets as they went into operation.

RACE IS ON IN ECON MODELING

Merrill Lynch Econometrics has apparently dumped NCSS service to its huge econometrics model -- one highly regarded on Capitol Hill -- and has brought the gargantuan processing job in-house. Merrill Lynch salesmen are already canvassing the econometric crystal ball market, and the Wall Street firm is set to challenge DRI and Chase Econometrics in the thriving soothsayer business.

IBM HAS MIDEAST VENTURE

The oil-rich Middle East is the site of one of IBM's newest international ventures. This time IBM is setting up an applications research center in Kuwait. Due to start operating by year-end, the center will be run by IBM in conjunction with the Kuwait Institute for Scientific Research.

RUMORS AND RAW RANDOM DATA

Brazil is wooing U.S. semiconductor firms in hopes they'll set up a manufacturing facility on Brazilian soil. But one company, National Semiconductor, has initially nixed these overtures, feeling the market there is still too small... Following recent leaks of confidential information, ICL has created a new and "elite" core of execs. Known internally as the General Salary Survey, the GSS club includes 500 of ICL's key worldwide employees who will be plugged into an "insiders" information grapevine.

NEWS IN PERSPECTIVE

STRATEGIES

FORGING A NEW ALLIANCE

Interesting alliances are shaping up in the world dp market.

A complex series of institutional investments in France, Italy, and here in the U.S. have recently created a new European consortium of advanced data processing firms. Loosely linked are Italy's Olivetti Corp.; Cii-HB, the French computer firm in which Honeywell has a strong minority position; and St Gobain Point-à-Mousson, France's largest private company.

St Gobain, a cash-rich multinational construction conglomerate, recently purchased a 22% share in the holding company which has the 53% controlling share in Cii-HB. And St Gobain is rumored to be seeking the French government's 20% share in the holding company.

In April, St Gobain also moved into Italy, purchasing one-third of Olivetti—forging a promising link between Olivetti, Europe's leading automated office equipment supplier, and Cii-HB, whose prime interests are in large mainframe computers.

Olivetti meanwhile purchased one-third of IPL Systems Inc., an American company recently chosen by Olivetti to offer the bottom line of PCM systems Olivetti planned to market in Europe. Based in Waltham, Mass., IPL is the plug-compatible mainframe vendor that supplies CDC's Omega.

The announcements of the various agreements, purchases, and investments seemed to come quickly, one upon the other, over the last few months. But there is at the moment little sense of exactly how these firms will interrelate or cooperate, although Olivetti issued an ebullient statement celebrating its new relationship with St Gobain and Cii-HB.

Bruno Bisentini, Olivetti chairman, said the French investment "will enable Olivetti to form an industrial and financial alliance" with St Gobain, which, through its Cii-HB holdings, is "already active in sectors very similar to those in which we operate."

"The operation opens the way for cooperation between Olivetti, Europe's leading company in office equipment and distributed data processing, and Honeywell Bull, Europe's leading company for mainframe data processing," declared Prof. Bisentini. "The object of this cooperation, which would be based on a common strategic viewpoint, will be the specification of joint initiatives in the fields of research, production, and marketing."

As is often the case in European corporate alliances, a shared institutional investor can redefine company relationships and forge the first links of a working partnership. Such, obviously, is Olivetti's understanding of St Gobain's role and plans. (St Gobain executives had previously said that they had an agreement with Cii-HB not to make any outside equity purchases without Cii-HB's approval.)

It is not yet clear what, if any, impact Olivetti's new liaison with Cii-HB would have upon the Italian firm's announced plans to market Hitachi and IPL IBM-compatible mainframe systems in Europe, but Olivetti finalized its purchase of one-third of IPL Systems only days after the St Gobain/Olivetti announcement.

IPL Systems Inc. is the smallest pawn on this corporate chessboard, with 1979 sales of a little over $12 million. IPL has introduced three models of its 480 processor, in successive upgrades, all competing in the IBM 4341 market. IPL was only recently able to buy back the 40% of its stock previously held by Cambridge Memories Inc. The plug-compatible peripherals firm had taken $4.125 million and a license to manufacture the IPL 480, models 1 and 2, for its holding. Olivetti stepped in and financed the Cambridge deal with its own purchase of one-third of IPL's stock. (Olivetti put Vittorio Levi, the Olivetti marketing director, and Mario Gabrielli, the company's chief financial officer, on the IPL board.)

A shared institutional investor can redefine company relationships and forge the first link of a working partnership.

IPL has a nonexclusive agreement with Control Data Corp. to market Omega, but IPL president Stephen Ippolito said he expected no difficulties in continuing the agreement. It was his understanding, said Ippolito, that Olivetti had "no near-term plans to market the 480 in the U.S. or Canada," but that the Italian firm might move into South America. (Cii-HB has a sizable South American operation, which may or may not be involved in Olivetti's expanded marketing.)

In both Europe and America, the St Gobain buy into Compagnie des Machines Bull, the French holding company for 53% of Cii-HB, sparked rumors of unhappiness at Honeywell Corp., which holds the other 47% of Cii-HB. Informed Honeywell sources report, however, that the U.S. firm seems considerably more sanguine about the St Gobain moves than indicated by its restrained public comment on recent devel-

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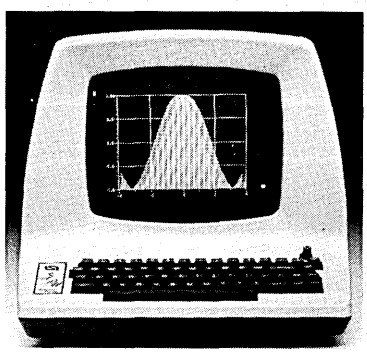

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opments, St Gobain and Honeywell executives are familiar with each other and the French firm is held in high regard in Minneapolis. St Gobain, for its part, is even now installing HIS process control systems in its cement and fiberglass factories. There is, say these sources, virtually no overlap between Olivetti and Honeywell Italia, the U.S. firm's wholly owned Italian subsidiary: "The only duplication is in small impact printers."

"In fact," said a Wall Street source, "Olivetti and HIS Italia are really very compatible, but that doesn't mean Honeywell wants to take on that company with all its problems." Olivetti, which is expected to earn only $40 million on international sales of over $2 billion this year, will undoubtedly gain from St Gobain's solid financial management, note Honeywell sources.

Honeywell, according to several reports from HIS' Minneapolis headquarters, feels no sense of threat from St Gobain and has been kept fully informed of the European developments.

The tie with St Gobain would permit Olivetti to bid on French government contracts that are restricted to French firms.

HIS president Stephen Jerritts is perhaps one of the best informed American ceos when it comes to the French style of blended business and politics. After 18 years with IBM, Jerritts went to France in 1967 as a consultant for Bull-GE, a Cii-HB predecessor. He stayed with the company first as a consultant and then as a top executive, for 5½ years, during and after the merger of Honeywell and General Electric. Jerritts, in fact, came to Honeywell via Cii-HB. His recommendations for the reorganization of Bull-GE resulted in the formation of the French company's peripherals division, which Jerritts was asked to manage. In that position, he was a member of the Cii-HB management committee. Jerritts became president of Honeywell Information Systems last January.

Honeywell, according to financial analysts, understands that St Gobain has a strong nationalistic and European interest in developing high technology on the Continent. "It's that crazy French way of mixing business and politics," explained a Midwest analyst, "but Honeywell has learned to live with that." In France, it is commonly reported that the French government would be pleased to see St Gobain—a $10 billion multinational conglomerate with U.S. revenues of close to $1 billion—take over the government's paternalistic role in French dp. Honeywell seems adaptable.

It's evident that both the French and Italian governments heartily approve the St Gobain moves. If the Olivetti public statement is any measure of the Italian attitude, the French money was certainly welcome. Olivetti executives have blamed capital shortages for their company's poor financial performance. And there is, apparently, a natural synergy between Cii-HB and Olivetti. Even Honeywell, noticably weak in automated office systems, could benefit from some of the products that might develop from joint ventures.

St Gobain, according to Olivetti, had agreed before the sale to reconfirm Olivetti's top executives—Bisentini as chairman, Carlo de Benedetti as ceo and vice chairman, and Franco de Benedetti as managing director—when they stand again for election in 1982. Olivetti executives seemed particularly excited that St Gobain's participation would permit Olivetti to bid on French government contracts restricted to French firms.

The script, style, and pace of the St Gobain reorganization of European dp reflects the very different structure of European capitalism, where weak public money markets throw the task of capital formation to institutions. It often seems mysterious and vaguely conspiratorial to businessmen accustomed to American business—and perhaps, by American terms, it is. St Gobain is not the first to attempt to weld together such a European consortium, but if St Gobain lives up to its reputation, it may offer its U.S. allies and competitors an interesting blend of style and savvy: French commerce that's frankly commercial.

St Gobain, by the way, was founded by Louis XIV and his chief economic consultant, Colbert. And that, in France or elsewhere, indicates some measure of corporate adaptability. St Gobain has stepped into new markets before.

—Vin McLellan

EDUCATION

PROBLEMS WITH DP SCHOOLS

By all indications, computer trade schools are still missing the mark in training tomorrow's computer professionals.

Members of the Massachusetts Chamber of Commerce could have gagged when the state's High Technology Council recently reported that at least 53,000 new jobs in high technology fields would be created in the Bay State in the next three years. You see, the council also warned that many of the jobs might not be filled for lack of trained personnel. "The education system," it reported, "will not be able to supply a sufficient number of personnel . . . to meet the demand."

The situation in Massachusetts, one of the nation's leading technology centers, is indicative of the education crisis plaguing the computer industry. While demand for trained workers is high, the supply is very low; qualified personnel can practically name their price.

Logically, computer trade schools should fill the gap, providing a stream of trainees, computer operators, programmers, and systems analysts. Numerically, they do. But when employers look for skills, these schools and their graduates often get poor marks. Computer professionals say graduates lack proper training; even educators say the training doesn't emphasize needed skills.

When asked what is the most pressing need in computer education, educators and industry leaders point to the absence of any set, national standards for training qualified personnel. Computer techniques and systems go by several different names, as do courses of study. Although educational associations have recommended degree standards, these are nonbinding, allowing schools to offer programs that vary widely in quality.

One industry source summed up computer vocational education thus: "They offer what's hot this year."

The computer education field has grown so quickly—some sectors by over 100% a year—that there is no reliable national survey of the quantity, much less the quality, of the courses offered. "This has gotten so big, you can't put your arms around it," said one computer education vendor. "This is an easy business to get into and it encourages people to get in. It's the biggest single market for continuing education. What other field obsoletes itself every three or four years?"

The more things change, the more they remain the same. In the computer industry, where equipment seems to become outdated even as it is being installed, the appeals made by computer schools have remained remarkably constant. By direct statement and innuendo, they promise would-be students wealth, happiness, glamour, and excitement in the computer field. Yet, while making such blatant appeals, many computer schools fail to provide students with basic skills to get the high-paying jobs in the field.

Who are these students? A recent survey showed that students taking courses at computer trade schools are young (80% under 30), a majority (58%) are women, and a high proportion are nonwhite (28.5%). They often come from lower income groups, viewing computer education as a key to a better standard of living.

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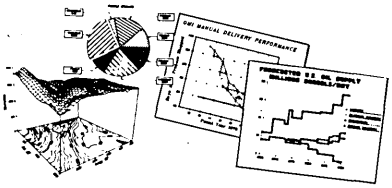

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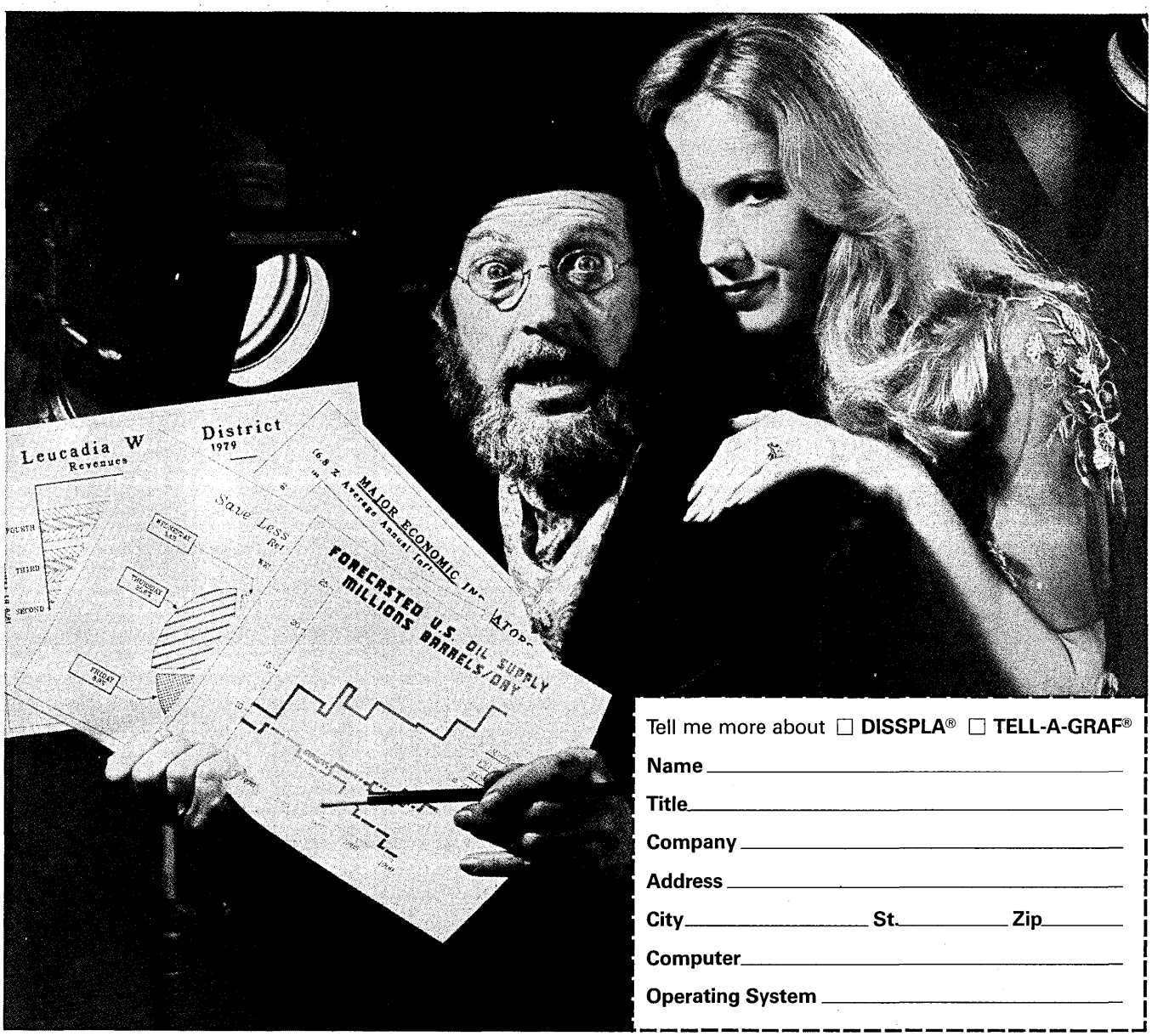

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CIRCLE 46 ON READER CARD

The quality and cost of the computer education they receive can vary widely.

According to figures compiled by the U.S Department of Education, the average private computer education program provides 536 hours of instruction and costs $1,755; the average public computer education program provides 612 hours of instruction and costs $205. There is a course to meet any student's ability to attend and to pay. But student evaluation of these courses prior to attendance is extremely difficult. An education official in California said that just keeping track of the number of schools was a formidable task: "Private schools come and go every month."

In most states, prospective computer school students have a hard time getting any evaluation of vocational education programs. Roy McDermott, manager of the Illinois State Board of Education's division of Non-Public School Approval, points out that "all the data is present, but we're not required to report it." Interviews with education officials in other states show that the necessary data often isn't even collected, provided minimal criteria are met by school operators. A California Department of Education official reported that at present "we only get information from degree-granting institutions."

McDermott said that Illinois set "stringent requirements" for proprietary

EMPLOYMENT, 1978 and 1990 (projected)

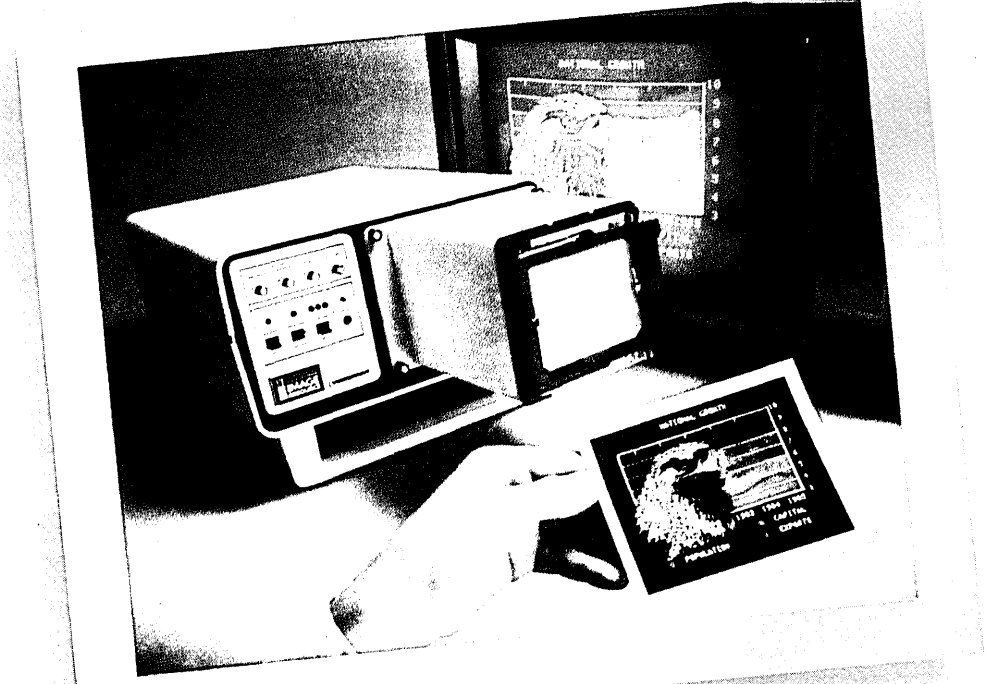
Occupation	Employment 1978 (est.)	1990 (est.)	Percent change	Annual openings
Office Machine Operators	160,000	202,000	26.2	9,700
Computer Operators	666,000	665,000	(.2)	12,500
Programmers	247,000	320,000	29.6	9,200
Systems Analysts	182,000	250,000	37.4	7,900
TOTAL:	1,255,000	1,437,000	23.2 (avg.)	39,300

Source: U.S. Department of Labor

STUDENTS

Program	Total No.	Public	Private
Computer Operator	1,534	97	1,437
Keypunch Operator	18,106	2,710	15,396
Computer Programmer	17,084	2,540	14,544
Systems Analyst	100	—	100
Bus. Data Programmer	10,025	3,689	6,336
TOTAL:	46,849	9,036	37,813

Source: U.S. Department of Education



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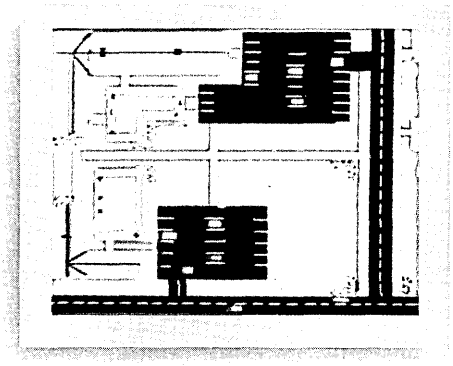

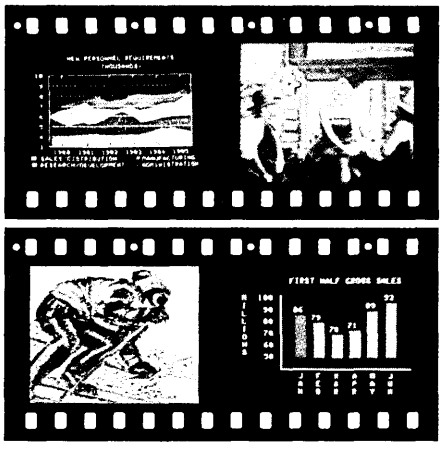

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schools, to foster "a quality education." However, in an interview he added that such requirements generally regulate the "process of education," not the content: "Regulations governing the content are the weakest," he said. The private computer schools are left alone, providing they don't "mislead" the public. Also, there is no "stringent requirement" covering the equipment used in computer training courses.

"Equipment standards are difficult to set," McDermott said. "Some fields lend themselves to common, set standards, but this is not one of them. The state does not have the staff resources to establish specific skill standards in all fields."

There is one big exception. In December 1979, the New York State Consumer Protection Board issued a report entitled "Check It Out: A Comparative Guide to New York State's Computer Schools," providing the first in-depth examination of computer training schools (often only after suing other state agencies for data, under Freedom of Information statutes).

The report, designed for use by students, concluded that only 25 of the 230 programs offered by computer schools in New York State were providing "modern instruction" for entry level students or those seeking instruction in computer programming. It found that many schools

COSTS

Program	Mean Charges Public	Mean Charges Private	Mean Length(Hours) Public	Mean Length(Hours) Private
Computer Operator	$255	$1,409	547	364
Keypunch Operator	127	666	377	266
Computer Programmer	356	2,242	1,132	593
Systems Analyst	—	2,298	—	586
Bus. Data Programmer	290	2,164	1,006	872
AVERAGE:	$205	$1,755	612	536

Source: U.S. Department of Education

SALARIES (average weekly)

City	Systems Analyst	Programmer	Operator	Key Entry
New York	$424.50	$318.50	$235.50	$181.00
Los Angeles	407.50	292.50	239.00	197.50
Philadelphia	401.50	319.00	229.00	171.50
Chicago	387.50	305.50	236.50	187.50
Boston	366.00	279.00	213.50	174.00
AVERAGE:	$397.40	$302.90	$230.70	$182.30

Source: Bureau of Labor Statistics

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CIRCLE 50 ON READER CARD

exaggerated or distorted course offerings, used obsolete equipment and/or techniques, and distorted placement records; 10 schools refused to provide any information despite the urgings of state officials.

"It is a startling indictment of the [computer school] industry," said Rosemary S. Pooler, executive director of the Consumer Protection Board. "Few programs were recommendable."

"Check It Out" found that many of the state's schools use "very small" IBM 360 mainframes, limited-capacity minicomputers, and a variety of "obsolete" electronic accounting machines (EAM) to teach dp techniques. For example, while many of the schools teach modern data entry methods in the classroom, their hands-on training often requires keypunch cards for input.

The report also found that many schools taught obsolete techniques (such as EAM instruction) and "entirely outdated" languages (RPG I, FORTRAN II, COBOL D, COBOL F). Donald E. Price, president of the Data Processing Management Association (DPMA) Education Foundation, notes that a recent survey of 1,200 companies showed that 47% use COBOL; only 17% use RPG and 10% use FORTRAN. "If a community college or technical school is training programmers or programmer analysts, it's got to teach the business languages," he said.

COURSES

Program	Total No.	Public	Private
Computer Operator	60	5	55
Keypunch Operator	247	45	202
Computer Programmer	184	28	156
Systems Analyst	7	—	7
Bus. Data Programmer	185	78	107
TOTAL:	683	156	527

Source: U.S. Department of Education

"Check It Out" revealed that many of the schools, regardless of their job placement record, had extremely high dropout rates. On average, in a breakdown of 93 programs, 33% of the students dropped out, 14% got no jobs, 34% got jobs, and 19% were listed as "other" (generally indicating students who went on to further study or who got jobs in other fields). Looking at the entire list of 93 programs, a 0.0% showing could be found in each of the categories. The highest showings in each category were 86% dropout, 78% no jobs, 90% got jobs, and 78% "other."

The cost of the courses ranged from nothing up to $7,000. While many of the less expensive courses were found useless, some had job placement percentages among the very highest; conversely, some of the most expensive schools (including a few two-year degree programs) were so inadequate that most graduates had to find work in other fields.

"The figures we came up with showed 24,000 students and ony 3,000 jobs," said Lawrence Kramer, a consultant with the Consumer Protection Board. "Even in a high growth field, that's a problem. A lot of people are going to be losers."

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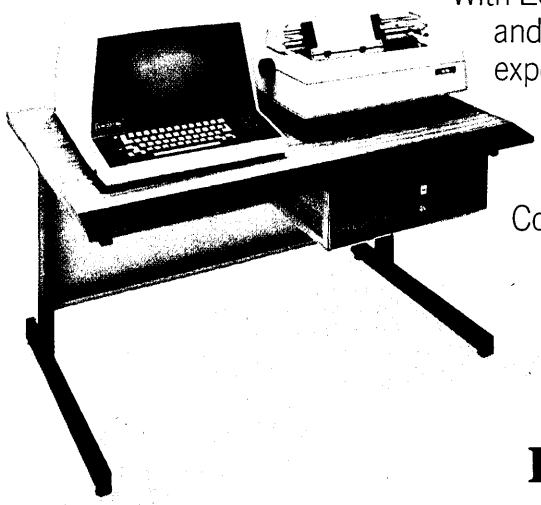

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on its release, prompting several state and local governments to launch similar projects. In Washington, D.C., the Vocational Education Information Project issued a guide in January 1980, called "Where to Get Job Training in the D.C. Area," which included a special section on Data Entry Training. A second guide, to be released in the fall, will add a guide to computer programming courses.

As was the case in New York State, Washington, D.C. computer school operators were reluctant to provide course information. The authors of "Where to Get Job Training" refused to rate 70% of their programs due to the poor quality of information provided.

However, as the number of students in vocation schools grows, consumer groups will put greater pressure on computer schools to provide prospective students with full information. Officials in California, Illinois, and other states have indicated a strong interest in putting together reports evaluating computer schools, and New York's Consumer Protection Board has prepared a booklet, "Checking Them Out," showing them "how to prepare a shoppers' guide to vocational training programs."

Criticism of computer schools dates back to the early '60s, and in 1965 the industry created its own accrediting group, the National Association of Trade and Technical Schools, NATTS. It requires computer schools seeking accreditation to provide:

- Qualified and sufficient instructors
- Up-to-date courses
- Proper facilities ("If the school doesn't have its own computer, it must lease time")
- Standards for admission ("It must admit only those students who are at a level to benefit from training")
- Success in placing graduates in the industry

"Some fields lend themselves to common, set standards, but this is not one of them."

However, a NATTS spokesperson pointed out that the association does not collect information on vocational education as a sector: "We stay away from ratings."

The New York State Consumer Protection Board takes a dim view of NATTS and other private accreditation groups. "The agencies involved rarely take strong action against any school," it reported, "and they devote much of their efforts to protecting the schools from public scrutiny and criticism."

Public scrutiny, along with effective quality control and ratings, is precisely what many industry observors say is needed. Computer education programs "are not meeting the needs of industry," says DPMA's Price. "People hired out of [them] aren't prepared to be programmers, application programmers, or programmer analysts."

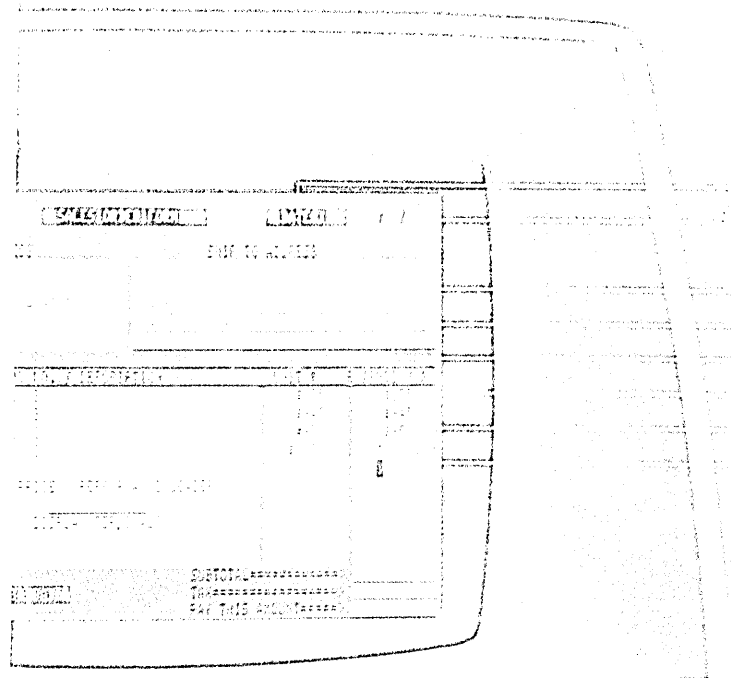
J. Daniel Couger, professor of computer and management science at the University of Colorado, says failure to set education standards is creating a "national deficiency" of trained computer personnel.

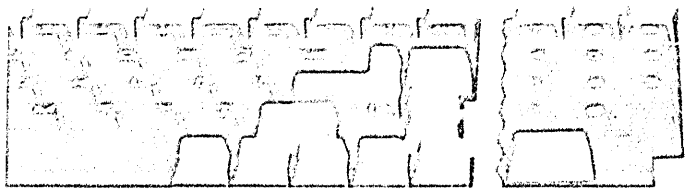
A recent survey of information systems programs in American colleges, conducted by the Association of Computing Machinery (ACM), of which Couger is a leading member, revealed that 25% of the undergraduate and 33% of the master's degree programs do not meet ACM "minimum requirements" for information systems programs (which include five semester courses in technical areas and four in organization and administrative functions).

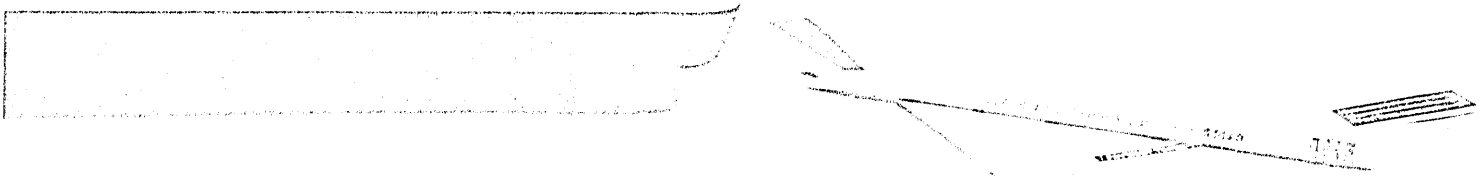
Price said there were several areas where computer education could be improved, but the most important was development of an "applied program" which would be "much less theory-oriented" than most present programs.

The DPMA is working on a new approach to computer education. "We are proposing a core of 10 courses, with probably four at the community college level," says Price. The objective is to improve

COMPARE SMARTS.







NEWS IN PERSPECTIVE

education standards by treating programming and other computer skills "as professions rather than applied vocations."

Price believes that professional status could alter education standards, by mandating some degree of individual certification. "Rating [schools] would be an excellent thing, but very difficult," he said. "Until we can certify individuals, it will be impossible to rate trade schools." Illustrating his point, Price adds that the CDP (Certificate of Data Processing) exam, offered by the Institute for Certification of Computer Professionals, has a current success rate of only 35%.

National figures, though not as complete as those gathered in New York State, indicate a similar oversupply of computer school graduates. But, if reports like that of the Massachusetts High Technology Council are correct, the shortage of graduates with the necessary qualifications is acute.

The U.S. Department of Education reports there are now 683 noncollegiate computer education programs with over 46,000 enrolled students. These students are competing for the 39,300 annual job openings for computer operators, programmers, and system analysts.

A research report by the Conference Board showed only 14,400 annual openings for computer and peripheral equipment operators, and 12,300 openings for programmers, with none projected for keypunch operators save through attrition. However, the number of jobs overall is expected to increase by 25% in the next decade—one of the highest growth rates in any job category.

Regardless of whose figures are used, the shortage of trained, qualified personnel is evident from a glance at any newspaper employment listing. The key word is "qualified."

Earnings of qualified computer school graduates vary from region to region, state to state. Donald Price estimates an average programmer trainee/graduate should be earning around $12,000 a year in nonurban areas, and $14,000 to $16,000 in urban areas along the West Coast. According to "Check It Out," New York State figures are somewhat lower, ranging from $8,000 to $14,000. Washington, D.C., salary ranges fall between $7,500 and $9,500 for trainees, with exceptions as high as $14,000. Additional experience and/or academic training yields substantial pay increases (a computer science major can command $20,000 and up at the entry level).

But for many computer school graduates, their only substantial pay has gone out instead of come in—for a high-priced diploma and skills of questionable value. Computer trade schools, to judge from placement figures, have never been well accepted by the industry they ostensibly serve.

—Josh Martin

LEASING

FEAR AND LOATHING IN LEASING

The third-party leasing business is a "market gone wild."

The sound track from *Jaws*—manic, incessant, a rhythm of mannered hysteria—is almost a theme song for the independent computer leasing industry. And, with the bizarre economics of April and May, *Jaws* is perhaps a suitable script for an early summer audience as well.

Over the last several years, users have been luring the third-party lessors into ever-deeper waters, demanding shorter and shorter lease terms. Finally, even Lloyds of London recognized the fey chill and refused to guarantee the sand beneath their feet. When the "creature" struck last year and drew Itel beneath the waves, there was the predictable panic on shore and a lot of thrashing out to sea, but the critics had warned us about a sequel.

Sanity does not come cheaply to anyone who has had recent contact with Wall Street, bankers, the computer industry, or any nexus of the three like the computer leasing business. Blessed be the Federal Reserve, but pity the corporate budget people.

Watching the long-term interest rates—purportedly the banking establishment's estimate of the *average* interest rate over the next five years—skyrocket five to seven points in a month, then plunge as far in a week is almost enough to send grown men grasping for the kids' Monopoly money. The bankers seem honestly embarrassed, the businessmen are permanently pale, the IBM comptroller is probably under sedation, and even a quiet fellow like Hesh Wiener, publisher of *Computer and Communications Buyer*, the pricing newsletter, shrieks of "madness" and a "market gone wild" as he tries to describe the yoyo prices of the secondary markets for lease and sale of used equipment. The product markets are already wrenched topsy-turvy by the palpable force of user anticipation of IBM's new products; for the credit market to go bonkers in a sympathetic implosion is perhaps only fitting.

By the beginning of May the leasing industry had a lot in common with the Dead Sea. It was there—but there was nary a sign of life. Interest rates had peaked above 20% in April and, as Paul Raynault, vice president of Computer Financial Inc., a Hackensack, N.J., computer leasing firm, put it to institutional investors who sought his advice: "Anyone who goes to a third-party lessor for IBM computer equipment with these interest rates is just crazy!"

Raynault has earned a reputation for his dismal oracle on residual computer values and the leasing industry; he's widely respected among his peers and the financial community for unpopular but accurate forecasts. A veteran of six years with IBM as a long-range planner, he helped launch Computer Financial (CFI) in the early 1970s. For CFI, Raynault developed a computer model of IBM technology and residual product values—and the interplay of lease and purchase prices—using statistics he brought from Armonk.

"Anyone who goes to a third-party lessor for IBM computer equipment with these interest rates is just crazy."

The accuracy of his pricing forecasts over the past decade—compared to IDC, ADL, Input, and American Computer Appraisal—has been, he explained, a major factor in giving CFI a place among the cash-rich behemoths who dominated the leasing industry. CFI was hired to assist some of the largest U.S. banks place over $250 million in computer leases, and the company today is one of the few third-party computer lessors that can convincingly claim to have made money in its ventures.

CFI made money, said Raynault, because it was small enough to slow down, controllable enough to turn cautious, and wise enough to simply stop buying equipment before almost anyone else. For all that, CFI specialized in the risk or operating lease—where the lessor accepts the risk of product obsolescence, betting on residual product value after the term of the lease.

"We made money in the operating lease business because we were very selective," said Raynault. "But we've been unsuccessfully lecturing people for 10 years about not making the same mistake the 360 leasing companies made.

"The 360 was announced in 1964. But 1968 was the biggest purchase year for the 360 leasing companies. Then the 370 was announced in 1970. You don't wait four years before you buy heavily on short-term operating leases. Yet that is exactly what the 360 leasing companies did, and that's exactly what the dumb 370 leasing companies did—including some of the biggest. . . ."

"Anyone who bought IBM equipment in 1976 or later—lessors buying for risk leasing—is in deep trouble," declared Raynault, condemning virtually the entire

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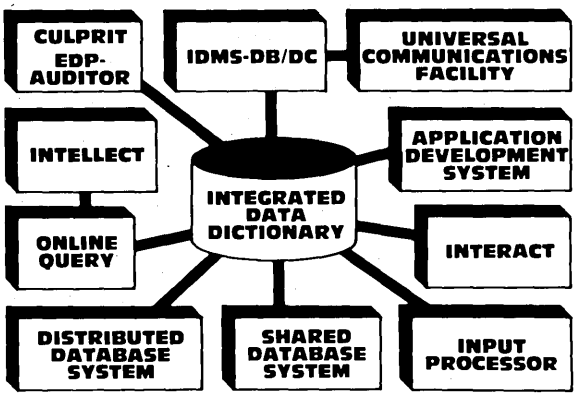

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CIRCLE 57 ON READER CARD

PAUL RAYNAULT: "The only purchaser today is the customer with the exceptional situation."

industry. "And the few who bought in 1975 may also be in trouble. Anyone who bought in 1976—IBM's biggest year for third-party lease purchasers—is up the creek." He checks off some of the biggest names in the business: Atlantus, DPF, Ford, Decimus, GE Credit, Finalco, Greyhound. "Most of these guys got damaged; many got damaged very badly," he said, "and some haven't even realized it yet." Among the large leasing firms, "I can't think of any who didn't buy late. They all got caught up in the enthusiasm of buying."

But in this industry, he said, bad management can keep people in jobs. "If you're the employee of some firm and you only get paid a commission on the business you sell, it's very hard to say, 'We should stop doing business for the next two years until a new generation comes out'—exactly what these companies should have done. But a certain momentum built up.

"What happened was, the salesmen all managed to buy such a large volume of equipment, on which they have such large exposure and on which they have to do so much remarketing, they've guaranteed themselves that while their companies are going to lose their shirts, the companies are going to need their services!" The salesmen, the managers, the managers of managers, little companies, and divisions of giant corporations—they all walked the same path, he claimed.

By April 1979, the high interest rates had dealt the coup de grace to third-party risk leasing, which had already become a borderline proposition as user anticipation of new IBM cpus forced shorter-term leases, he explained. What opportunities then existed for third-party leases—opportunities which will again emerge with lower interest rates—came out of IBM's juggling of lease and purchase prices as the Grey Mother attempts to push users toward purchase to sustain current income. In April of this year, stratospheric interest rates effectively, if temporarily, wiped out third-party leasing altogether.

Computer users see five options for obtaining a computer, Raynault said, while IBM sees only three. Users choose between IBM's monthly rentals, IBM's two- to four-year lease plans, third-party two- to four-year leases, third-party five- to eight-year leases, and end-user purchase. For IBM, the first two are lease income options, but the latter three all register on its books as purchases.

From 95% to 99% of users don't even consider the IBM monthly rental anymore, said Raynault. "It's just too high." In the mid-1970s users did a lot of direct purchases, and a "fair amount" of five- to eight-year third-party leases. As the rumors spread last year about the possibility of IBM obsoleting the 370 line—particularly after the introduction of the 4300—users cut back drastically on the length of time they were willing to commit themselves to 370 and 303X cpus. They walked away from direct purchases, he said, and on third-party leases, they wanted three- or four-year terms—at most five-year terms—rejecting the previously common seven-year lease.

For IBM the situation became awkward too. Before 1973, until the announcement of the 158/168 machines, IBM actually sold less than 20% of its machines (except for a slight spurt in 1968, when the 360 lessors bought heavily).

In 1974 through 1976, IBM's purchase income grew to 60% of revenues. In 1978, when the new 303X was shipped, CFI tracked most of the new units and identified only 7% IBM leases. A purchase income from perhaps over 90% of revenues was a "dramatic change for IBM," a peak which only highlighted the drop the following year, 1979, when purchase suddenly plunged to about 50% of revenues as users backed off long-term commitments. In the latter half of 1979, said Raynault, IBM barely managed to dampen the rush towards lease—with its immediate impact of lessening cash flow—only with three successive price changes: two hikes in IBM's rental prices, and one purchase price cut.

"Our feeling right now is that IBM is lucky to get 20% purchase income. It's shifted over completely," said Raynault. "The only purchaser today is the customer with the exceptional situation, as in the late '60s and early '70s"—insurance companies and utilities, users with a low cost of funds or guaranteed profit over costs.

Yet with IBM's finagling to control the lease/purchase balance of its income, with IBM's late fall cut of purchase prices and the hike in IBM rental, the company again opened a window for third-party lessors. Independents like CFI could use a combination of tax benefits to structure a four-

year full payout finance lease that just undercut the newly hiked IBM four-year lease plan. January and February saw a modest but brisk market for finance leases, said Raynault.

Then the unprecedented credit crunch hit. The business was already very tightly figured, and the relatively minor cost additions of the new interest rates tipped the scale. (With the users' monthly payment so principal-weighted, explained Raynault, a 50% hike in interest could add maybe 5% to the monthly payment.)

Long-term interest rates vary considerably from bank to bank to various private capital sources, and particularly so with the confusion in capital markets. (A moderate-sized bank in the Northeast chartered its five-year interest rate from 15¾% on Feb. 20, 16½% on the 25th, 18½% by March 15, 20% by April 1, and then the drop: 18½% by May 1.) CFI's capital source offered lower rates to begin with, but they climbed steeper and plunged quicker. One can imagine how IBM strategists, struggling to tilt the user trend toward purchase, saw the soaring interest rate.

Raynault said he had just finished financing a large lease with money from the Midwest at 13½% in March, when he connected on another deal to finance $1.2 million worth of peripherals for a large bank in the Northeast. "I priced this new deal at 13½% and went out to finance it, and people said, 'Hah! you're lucky if you get 17%.' And I said, 'You're kidding!' I called some more people, and they said, 'Hah! you're lucky if you get 18%!'

"In three weeks the interest rates went from 13% to 20%," he recalled. "Nobody was quoting, they just said, 'I don't know what it's going to be but . . . ' and then they'd guess higher.

"I had this lease committed at 18% and I had gotten the customer to sign it. People had been willing to lend money and commit themselves at 13% for five years,

"In three weeks, interest rates went from 13% to 20%."

and I couldn't believe that the world had changed so much that 18% wasn't a go deal. Well, I finally got the financing committed at 18¼% with almost everybody telling me 'twenty, twenty, twenty.' For two weeks, I'm living with the fact that I had a lease signed at 18% and the best I could get on the money was a commitment at 18¼%. So I was going to lose money on it. And everybody is telling me I was lucky to get 18¼%.

"Then, a week and a half ago, when Chase brought its prime down a quarter of a point, all the banks say, 'Hah! look at that! The direction is down!'

"And day after day, I was calling. One bank, on Thursday, said 20%; on Friday,no problem at 19%. Called them on Monday and the guy said he could commit at 18½%. On Tuesday, another bank calls me and says, 'Hey, we're back at 17½%. And on Wednesday, two people called with 17%. And now I'm negotiating with someone at 16½%. I see where it's going, but I'm going to close it at 16½%. I don't trust any of it.

"But I'll tell you, this has never happened before. In my years in this business, when long-range interest moved a half-point, it was a big deal; it really hit people. The prime can jump around, but this is the bank's estimate of average interest over five years! For a bank to say, money on an average of 13% over the next five years and two weeks later say, no, on the average of 19%! The guy was a fool at either one or the other rate.

"That's almost a 50% difference in a one-month period. It's just shocking. It totally destroys my confidence in the banking community. And you know, I give this same spiel to all these bankers, and they say, 'You're absolutely right. We don't know what we're doing.' "

Maybe in the banks, at the Treasury, or in the Fed, they're whistling the soundtrack from *The Fog*.

—Vin McLellan

READY TO COMPETE WITH BELL

Modem makers assess their positions as competition with an unregulated AT&T subsidiary draws nearer.

The specter of an unleashed Bell System entering the competitive arena free from the umbrella of regulation has haunted the data communications industry for some time. But is the specter real? Opinion seems to be divided.

One of the directly affected industry segments would be the modem makers. Having competed head-on with the telephone company for many years, these vendors have flourished in the existing environment against a regulated Bell monopoly. And now that AT&T competition appears to be coming closer, the modem vendors are carefully assessing their positions.

One industry spokesman who believes Bell has been benefiting from regulation is Matt Kenny, vice president for sales and marketing at Racal-Milgo Inc. "If AT&T is spun out there in the cold cruel world along with the rest of us, they'll have to be a lot more accurate about what they are doing," he says.

"It costs an incredible amount of money to develop a new product in today's technically sophisticated environment, and those firms in the unregulated sector have to make each product stand on its own. If it's not a profitable product, we can't continue with it. A regulated monopoly is not under that particular constraint." Thus, Kenny adds, the net result of an unregulated Bell subsidiary would be higher prices to the customer since actual costs would have to be recovered in the price of the product. He believes that AT&T prices are often unrealistically low under the present regulatory framework because Bell is able to subsidize equipment costs with revenues from other areas.

So, can an adequate structure be developed by the Federal Communications Commission to safeguard against one service subsidizing another? "It depends on whether the spin-off requires that the regulated subsidiaries operate as a profit and loss center on their own," Kenny explains. "If set up correctly, a competitive subsidiary would have to subcontract its research and development work to Bell Laboratories and they would have to pay for the results at reasonable engineering rates that are standard in the industry. And manufacturing costs for the subsidiary would have to be accurately stated as compared to the rest of the industry. Then the volume of their sales would give an indication of what the manufacturing costs of the subsidiary were. And these types of data, taken together, would provide a reasonably good picture of whether accurate costs were being reported."

A less positive evaluation was given by Sidney C. Haw, vice president of marketing and sales at Penril Corp. "If we get a competitive subsidiary from AT&T in the marketplace, it is going to be a very prominent factor." The biggest selling point of the independent suppliers, Haw says, has always been that Bell was restricted to monthly rentals of its equipment while users had both longer term lease and purchase options from the independents. If the phone company is able to sell its equipment in the same way as other competitors, "it will do nothing but expand on its present customer base," he predicts.

Haw also expressed doubts that a structure could be devised that would eliminate the cross-subsidy problem, and if allowed to go through, the results would "be like an octopus—an extension of the present Bell System with more options."

At Intertel, Ralph Lowry, vice president of product and international marketing, commented that even with a fully competitive subsidiary, AT&T would face many of the same limitations that it copes with today. Among them, he questions how quickly Bell can introduce new products, how well it determines its pricing strategies, and how quickly it can adapt to the needs of the marketplace.

"Presumably they would take some business away from us, but our firm and the other competitors would not be in business unless we could do some things better with products than they can, and we will still be strongly competitive," Lowry says. "While I am not anxious for them to come in on a nonregulated basis, it certainly would not cast a big dark shadow over the entire industry. The independent vendors will not just shrivel up and die; the Bell subsidiary will have to prove itself just like any new company would."

The new AT&T subsidiary would "be like an octopus—an extension of the present Bell System with more options."

Assuming that outright financial subsidy from the parent telephone company could be avoided by strict rules, Lowry sees some benefits coming to a competitive entity from such things as manufacturing tech-

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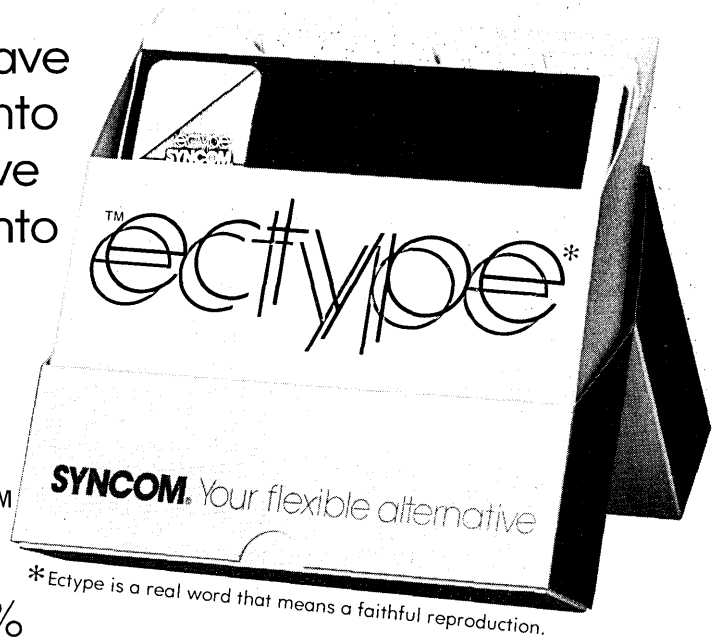

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niques at Western Electric, "but that is a very limited type of subsidization compared to skimming money from every phone call." And the independents could compete against such technical benefits as long as no financial subsidy entered into the picture, he adds.

If a telephone company competitive arm is "done right" with the proper safeguards, the larger independents that have adequate financial resources will be able to handle the added competition, says John W. Pugh, vice president of marketing at Codex, which is now a subsidiary of Motorola. But some of the smaller suppliers would be adversely affected. For these companies with more limited finances, the entry of a competitive telephone subsidiary would mean that they have to become "niche players," Pugh claims. While not predicting that a new Bell entry would force a shakeout among the smaller independents, Pugh made it clear that these vendors would have a much harder time and thus would have to carefully select how and where they were able to compete.

Data communications is becoming a big business and only the largest companies can afford to be total systems suppliers, Pugh points out. As the market expands, the smaller independents will find pressure from other areas regardless of what AT&T does.

Actually, IBM is already in data communications, and probably the real threat will come from "Japan Inc.," Pugh contends, "But I don't see our strategy changing one bit as a result of an AT&T subsidiary entering the market."

A much harder line was taken by Walter Manning, president of ComData Corp. A regulated monopoly should stay out of competitive markets, he believes, pointing out that the industry has developed as a result of the free enterprise efforts of the independents. The independents "have completely swamped Bell with technology," he says, and while the competitors can certainly hold their own against the phone company, they should not be allowed to compete.

Comparing the situation with the early days of electric and gas utilities, Manning notes that these utilities initially provided appliances as well as electricity and gas. Now the appliances are supplied by competitive vendors and the utilities provide only the basic service. That is the way it should be done with the Bell System too, he suggests.

But conceding that AT&T might well enter the competitive arena, Manning expressed confidence that the independents would be able handle the situation as they have managed to live with the phone company in the past.

Unless the accounting systems are clear, there will always be that gray area about where the money is coming from to finance any competitive subsidiary, according to David L. Peters, product marketing manager at Racal-Vadic Inc.

But past history shows that even with its vast resources, Bell has not been terribly innovative, Peters says. So even if a subsidiary appears on the scene and some dependence on the parent company is evident, he thinks the independents will handle it. He points out that in 1980, Vadic expects for the first time to ship more modems than the Bell System. All in all, the company is thriving and it will be able to react to any competitive threat launched by Bell in the future, he says.

In three to four years, a large percentage of the modems will be built into terminal devices. And in this area a Bell subsidiary will be at a disadvantage compared to the independents, Peters predicts.

Most of those surveyed felt it would take several years before an AT&T subsidiary could actually begin operations. Many full regulatory and legal challenges will have to be cleared away before the FCC mandate to compete is allowed to stand. And Bell will need to gear up to a new role as an entrant in the competitive market, while the challenges are being adjudicated.

Thus, nobody in the modem industry expects any instant changes as a result of the FCC's decision in Computer Inquiry II.

—Ronald A. Frank

FINDING THE IDEAL PRODUCT

TeleProcessing Products started with a staff, and then went in search of an ideal product to produce.

It's a rare company that staffs up first and decides on a product second, but TeleProcessing Products Inc., Simi Valley, Calif., did just that.

In 1978 the then four-year-old company was little more than a garage shop operation, "merely a refined version of junior achievement," said president David Kirby. "I decided it was time to either get out of the garage or quietly die."

So, "I hired a bunch of people, a manufacturing guy, an engineering guy, and a resident wizard (executive vice president John B. Scott), and we spent the next six to eight months deciding on a product."

In a sense, TeleProcessing Products dates back to the early '70s, when Kirby, then a manufacturers' representative in the

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DIGITAL RESEARCH

data communications field, and a friend got an idea for a battery operated, transportable line tester that would tell a data communications user first if he had a line and second if it would support data communications.

Nothing was done for a couple of years until Kirby got together with another friend, this one in the field service business, and built a model. This they shipped with a check to another company and got two prototypes. "To refine to something shippable took another three or four months," Kirby recalled. "We were shipping by early 1975 and had also cooked up several other equally simpleminded products." In the next two and a half to three years we added other little products."

In early 1977, Kirby's partner learned of an opportunity to distribute a printer interface for the Teletype 40, produced by an East Coast company. "He liked the idea and I didn't," Kirby recalled. "We agreed to get a divorce." At that time the company was a partnersip with three employees.

It was then that Kirby made his get-out-of-the-garage or die decision.

"We filled two pages with criteria for our ideal product," he remembered. "We wanted to be in data communications because we had a track record there and a customer base. Also, I felt that was the fastest growing segment of American industry."

"We also wanted a product that wouldn't require field maintenance. We wanted something in the price range of $2,000 to $3,000, and we looked at the other half—what people needed."

Kirby came out of the metalworking industry in New England. "There, people know exactly what they're buying, what they can expect, when it will wear out. There are no surprises."

In the computer industry, he said, "the average user doesn't know what he's spending his money on. It's gotten a lot better in the last 10 years but there's still a long way to go."

TeleProcessing Products decided on a product "that would give the data communications user a device to find out whether or not he's getting what he's paying for, one that would help him contemplate major expenditures and know where to throw his money."

"What we wanted," said Kirby, "was something to evaluate data communications, to provide fault isolation. There was a need to analyze performance."

What they came up with was their TP-270 network analyzer, "and we're still pleased almost two years later." The product has been in production a little more than a year.

The first version was for users of 3270 remote bisynchronous protocol. A more recent one is for users of SDLC SNA. "But," said Scott, "the units can be made sensitive to any protocol. The two units are the beginning of a family of devices."

"We underwrote software development for the IBM environment because the market is there. If we see other markets developing . . . it's just a matter of changing the firmware to the microprocessors," Kirby said. The bisync version uses one Intel 8085 microprocessor and the SDLC SNA version, two.

The TP-270 was designed to permit a user to determine the effects of both hardware and software changes to an on-line system.

What they came up with was their TP-270 network analyzer.

"There's a lot of equipment around for troubleshooting, diagnostics," Kirby said. "We chose a different approach, performance measurement. Comparing our unit to diagnostic equipment, stuff which can cause you to go bananas when you're setting it up, we're straightforward."

He described the unit as easy to use and "friendly to the user." Ease of use, he said, was one of the design criteria.

One user, Charles R. Autry, teleprocessing analyst with the First National Bank of Denver, found this trait a good selling tool for his management.

Autry's bank has a network supporting 56 affiliate banks, most in Colorado and two in Wyoming. When the bank's Sales and Service Dept. began getting response time complaints, "they came down on the head of data processing," Autry said. "Correspondents [banks] were threatening to shop elsewhere."

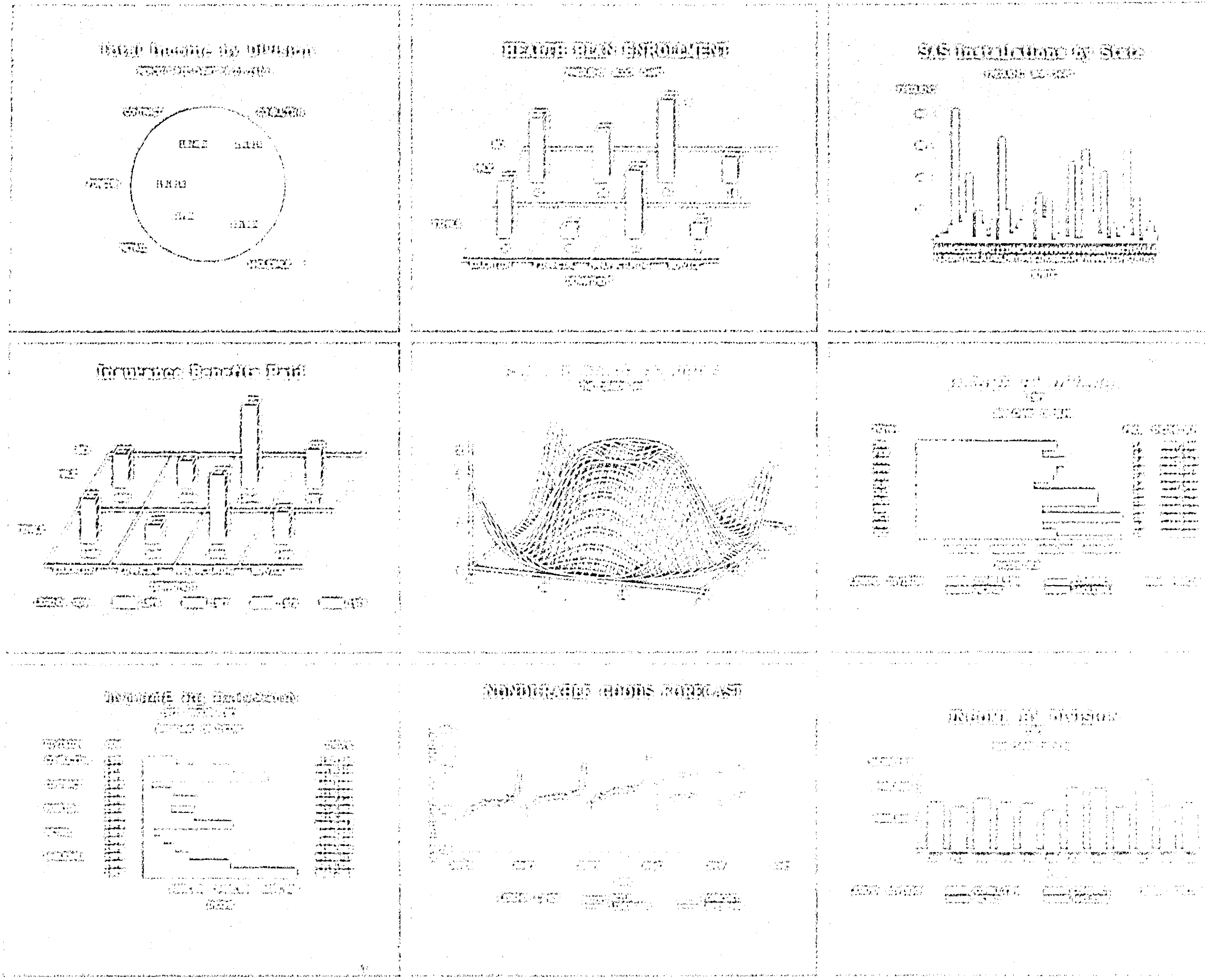
Autry was assigned the responsibility for finding out what was wrong. "I looked up everything I could about response time. I had a Spectron Data Scope. We did have I/O counts, done with a stopwatch by sales and service. I had no software tools to tell me what was going on out there. I felt it would take me six months to find out what was happening."

The Data Scope gave only symptomatic data. Autry contacted local suppliers to see what network analysis equipment was available. Late in the second quarter of 1979, he acquired a TP-270.

"It impressed management," he said, "because even they could understand it."

For the three months following acquisition of the TP-270, each line on First of Denver's teleprocessing system was monitored. Autry said he discovered, based on the records generated, that the average response time rarely exceeded three seconds.

"This was excellent system respon-



[illegible] tion. And we've packed our years of experience into a new product: SAS/GRAPH.

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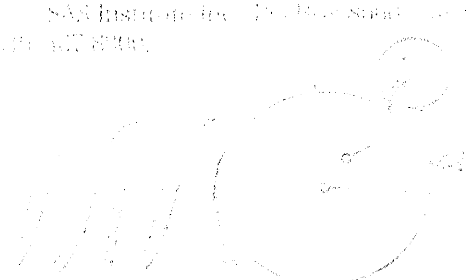


siveness but it was the maximum response times that were causing complaints."

The maximum response times were observed and broken down to the factors involved. This, Autry said, showed poll to poll times which were consistently responsible for the greater percentage of overall response time. It showed the most severe problem was line loading. "As the number of active messages increased, the amount of time given to polling decreased, resulting in the maximum response times." In addition, he said, ailing terminals and cpu tie-ups also were pinpointed as contributors to the problem.

Based on data obtained from his monitoring, Autry determined that reconfiguration of teleprocessing line loading would alleviate the maximum response time problems during peak periods.

And, in anticipation of network expansion, Autry said he now requires his technicians to monitor each of the teleprocessing lines daily. These data are compiled and are used on an ongoing basis for network modifications.

Routine problems, he said, are now discovered before they become complaints. "We can go to the users before they come to us."

At present all sales are to end users but the company foresees an oem business with development of systems using its units.

Kirby said 60% of all sales of the TP-270 have been to banks and other financial institutions. At present all sales are to end-users but the company foresees an oem business.

"We see development of systems using our units which would incorporate a mini to poll them and to develop and message the data. We did add a remote control option but we stopped there."

If the TP-270 does become a systems component, TeleProcessing Products will be content to be a supplier. "We're talking possible systems now with three major modem manufacturers," said Scott.

TeleProcessing Products continues to sell its earlier "more simpleminded" products including the one that got the company started, now sold as the TP-260 line tester.

And the company is getting help from IBM. In one of a number of regional tests linking IBM's Office Products Div.'s Office System 6 with the firm's 3800 laser printer, a mix of TPI's products was used to link the two.

"Now their salesmen are quietly recommending us," said Scott. "We even were asked to display the equipment at the most recent meeting of their 100% club."

—Edith Myers

PERSONAL COMPUTERS

KIDS LOVE THE DP SCENE

Children flock to Menlo Park's public library to do more than read books.

In a public library in Menlo Park, Calif., are four personal computers that can be used at no charge. They are part of a program to acquaint people with computers in this affluent city of about 30,000 adjacent to Palo Alto and Stanford Univ. Fifteen minutes of instructions suffice to teach people how to turn the machines on and off, insert a cassette tape, load a program, and respond when the processor asks whether the user is ready. That instruction, too, is free and is a prerequisite to hands-on use, in addition to a card from any recognized library.

"Last week I taught someone from Australia," says teaching assistant Jim McClenahan matter-of-factly, "and I also taught six people from Argentina." The TA, one of two hired by the library, is 12 years old. He was an early convert to the cult when the first personal computer was brought to the library early last year, received the same instructions, and showed sufficient interest and proficiency to subsequently be offered the newly funded job. This summer he and the other TA are scheduled to begin writing their own programs under supervision, most likely more games to be added to the extensive inventory of games on cassettes at the library.

The computers, three Pets from Commodore Business Machines and a TRS-80 from Radio Shack, are located in the children's library, although they are available also to adults. The goal has been to introduce them to students from grades 3 through 8. Because the local high schools have a number of personal computers, those students tend to use the machines at their schools.

During school days, computers are in constant use from 2 p.m. to about 6 p.m., according to Suzanne Rocca-Butler, head of the children's library. There's sporadic use during the day and after 6 p.m. But during the summer months and on weekends, the computers are in constant use during library hours. And on weekends, kids are lined up before the librarian opens the doors at 10 a.m., which produces a mad rush to the sign-up book. Users are guaranteed a half-hour without interruption, but then must surrender the machine to anyone signed up for the following 30 minutes. There have been as many as 15 people waiting for a turn on one of the computers.

"It's caught on like wildfire," says Rocca-Butler. "It brings out the most amazing reactions in the kids." There nor-

FAMILY COMPUTING: A father and son, enrolled in Bob Albrecht's junior college evening course called "Computers for Kids and Parents," spend Tuesday nights at the Menlo Park Library playing one of more than 30 computer games available to the public. The course requires that a parent and a child aged 7 to 13 enroll together to learn how to use and program personal computers. The Pet is said to have a good cassette operating system, making it ideal for this Computertown USA program. But elsewhere in this room, another father and son were writing their own program on the lone TRS-80 at the library.

mally is no discipline problem in the library with kids, she explains, but they do experience some problems over the use of computers. "It brings out a competitiveness, a lot of emotion. It's just amazing to watch."

The community project, promoted as "Computertown USA," is the work of the Peoples Computer Co., the folks who opened the world's first storefront computer center in this town for use by neighborhood kids and adults alike. PCC now publishes *Recreational Computing* magazine, and two of its editors, Bob Albrecht and Ramon Zamora, have donated to the library the proceeds from introductory courses they've taught so that TAs might be hired to monitor the equipment use. They also wrote introductory and instructional books for the vendors in return for the computers.

Albrecht, in trying to promote this project, was rebuffed early on by the local supervisor of schools and by the chamber of commerce. From the latter he wanted a donation of a color tv set so they would be able to use Atari and Apple computers. The request was turned down. Undaunted, Albrecht has completed more writing assignments and is awaiting five or six more Pets for use in the library, in addition to an Atari.

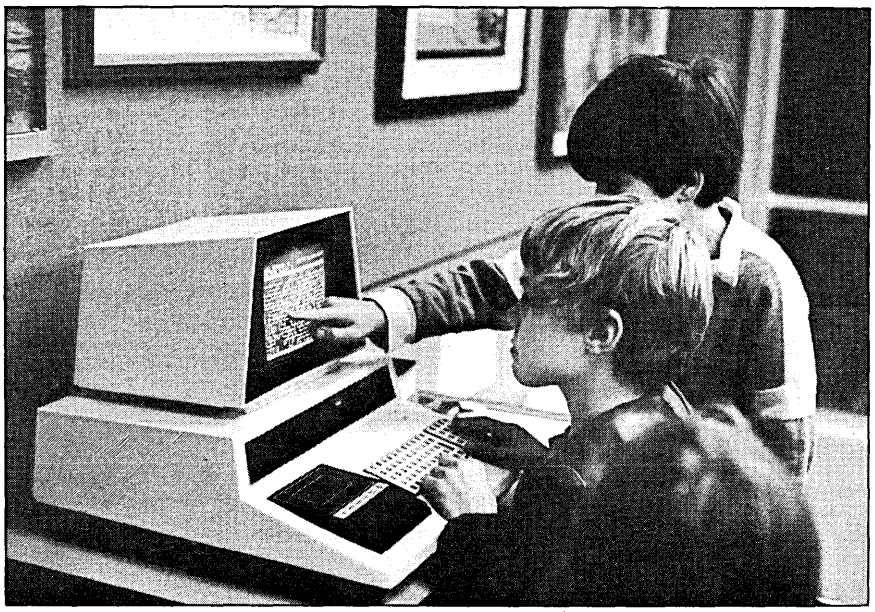
He looks forward now to permitting the youngsters to take a computer home. No fee has been set as yet, but Albrecht thinks an 8K Pet might rent for $5 a day.

But it is not at all clear that a library is the ideal site for a collection of personal computers. Some will have you believe that youngsters who go to a library to use a computer will, while awaiting their turn, read books. Not necessarily true, says Rocca-Butler.

The computer games improve a child's skills in quick response, quick thinking, mathematical abilities, and strategies.

"If anybody can figure out a transition from using a computer to reading, I would be very interested," she says. When the machines are all taken, she observes, the kids lean over the shoulders of others playing games and kibitz, rather than curl up in a corner with a good book. "It does not work," she sighs. "They do not read."

The computer games played, of which the library has more than 30 cassettes, have such names as Swordquest, a fantasy of exploration and problem solving. It is said to develop in a child such things as intuitive probability (in some circles, it's called oddsmaking), resource conservation (whether to expend one type of firepower, of which there is a plentiful supply, or a more powerful missile, a resource quickly exhausted), and contingency planning (he who fights and runs away lives to fight another day). And there's also Taipan, a simulation of seagoing trade in China in the 1800s. For the younger set, there's a game that teaches the names of the states.



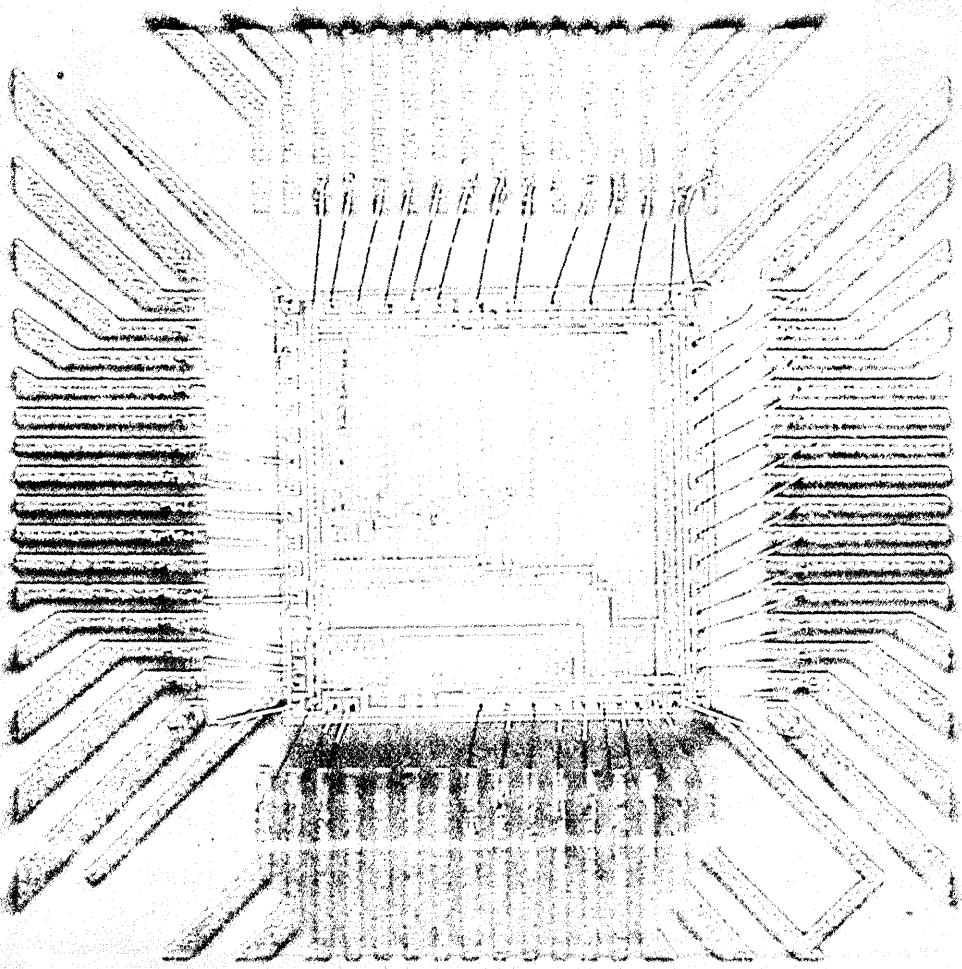
GAMES PEOPLE PLAY: These kids are playing Swordquest, which visually looks like a maze on the screen. In it, the player must work his way from the left of the grid to the far right while being pursued by a devilish enemy armed with an assortment of weapons. The player is given time to evaluate his position on the grid, look over the encroaching enemy, and make his move, all the while being called upon to fire from a limited supply of ammunition. The object: make it to the opposite end before exhausting his supply. In the photo below, Bob Albrecht can be seen among a gaggle of kids. Albrecht is explaining the several alternatives open to the player if he is to escape from the approaching bad guys. Here, too, it's a boy's world; there's only one girl.

"What this does, I'm sure, is improve the skills in quick response, quick thinking, mathematical abilities, strategy," Rocca-Butler says. "I'm sure the computer games have this impact." And while more youngsters come to the library because of the computers, their coming is not at all related to the presence there of books. "But it's related to learning, very definitely."

Accordingly, the librarian thinks the ideal setup would be to have a separate audiovisual wing of a library equipped with such things as computers, phonographs with headsets, and slide projectors.

—Edward K. Yasaki

Hewlett-Packard
COMPUTER
ACTIVITIES
Vol 5 No 3 Jun 1 30



Two SOS processors
in one low-cost computer

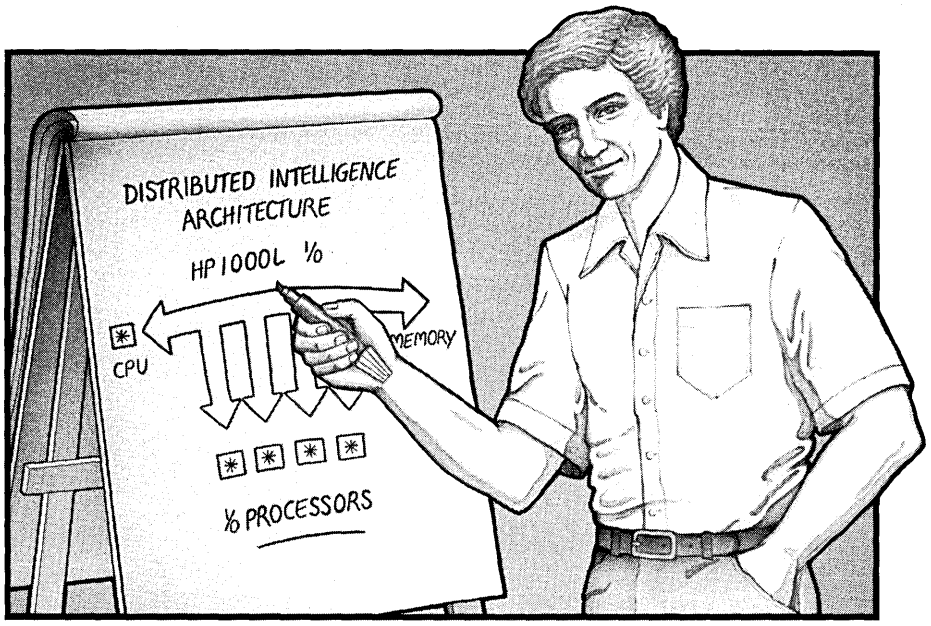
SOS lowers cost, speeds I/O in new HP 1000 L-Series

Many low-cost computer applications are so I/O-intensive that the sheer volume of input/output transactions can degrade overall computer performance despite a high CPU instruction rate.

We designed the HP 1000 L-Series computer, newest and least expensive of the HP 1000 family, so that CPU and I/O instructions are processed separately. This "distributed intelligence" architecture provides high performance in both dimensions. And because this performance is achieved with silicon-on-sapphire LSI technology, it comes at a low cost. The L-Series CPU and 64K byte memory "board set" can be bought for $2,250*

Two SOS microprocessors are the brains of the L-Series. One is the central processing unit for the computer; the other is an input/output processor (IOP).

The CPU chip implements the base instruction set common to all HP 1000 computers, making the L-Series compatible with the more powerful M-, E- and F-Series HP 1000s. Also implemented on the CPU chip are a real time clock and the memory protection facilities necessary to support real-time multi-programming applications. The IOP, one of which runs each interface board in the L-Series,



Multiple I/O processors, each with direct access to memory, speed I/O and free the CPU to perform computation.

accesses memory directly, and performs other "housekeeping" functions so that the CPU is free to compute.

This architecture was made possible with the SOS technology that only HP, among major chip and computer makers, has delivered in commercial products. The crystalline structure of SOS allows devices to be packed very densely on the chip and to be operated at high speeds. SOS has shrunk the parts count in the HP 1000 from 337 in previous family members to 67 in the L-Series. The result is higher reliability as well as lower costs.

I/O power on a card

The HP-IB interface card makes the fullest use of the L-Series exceptional I/O power. The board has two SOS chips—an IOP and a special processor to control the interface protocols of both the 1975 (low speed) and 1978 (high speed) IEEE 488 standards. The benefit is that a single HP-IB card can interface with up to 14 instruments, or the same card can be used for connecting a wide variety of peripherals, including fixed and removable media hard discs, flexible discs, and printers. This interface saves I/O slots and power.

For users who wish to implement special I/O cards, a breadboard card supplies the IOP and space for custom logic or microprocessors. Other cards interface with asynchronous serial (RS-232C and 449) devices, and make high-speed parallel transfers. A storage module provides up to 64K bytes of UV-erasable PROM storage of user

◀ *Cover*
The HP 1000 L-Series central processor provides many system level functions integrated into a single silicon-on-sapphire (SOS) chip.

programs and data; this card can eliminate the need for peripheral memory devices, allowing the L-Series to be operated in harsh environments.

Real-time operating software

The L-Series operating system, RTE-L, is a comprehensive subset of the RTE-IVB real time multiprogramming system introduced for the HP 1000 family last year. RTE-L will support program development in FORTRAN, BASIC, and assembly language, and will execute programs written in PASCAL. It can manage on-line and background batch processing simultaneously. Systems can also be developed on an RTE-IVB machine and loaded into the L-Series.

Configurations

The simplest L-Series system, the 2103LK, consists of a set containing the CPU board and a 64KB memory board. It sells for $2,250.* The OEM user can add a power supply, a 5- or 10-slot card cage, and interface boards.

The L-Series also comes as a rack-mounted computer, the 2103L, with processor, memory board, and 8 I/O slots, for $4,450.* A complete system, the HP 1000 model 10, includes the L-Series computer with 64KB of memory, RTE-L, a 1.2 Mbyte flexible disc, 12 Mbyte fixed disc console and cabinet. It costs $22,500.*

Please check A on reply card for L-Series literature.

*USA domestic price only

DMA saves CPU cycles

Since each interrupt by an I/O device can cost the CPU up to a millisecond of computing time, the key to I/O performance is to minimize the number of interrupts. Direct memory access (DMA) requires only one interrupt for an entire block of characters and thus offers significant advantages over the normal method in which the CPU is interrupted for every character transferred. The I/O processor on every L-Series interface card provides DMA at a very low cost.

Setting up an I/O transfer under DMA is fast and simple. Only three pieces of information are usually needed: a buffer address that tells where the data will be transferred to or from in memory; a word count that tells how much data is to be transferred, and a configuration word that specifies how the information is to be transmitted to the interface card.

Three instructions will enter control words into three registers on the IOP chip, and a fourth instruction starts the transfer. The IOP takes care of all handshaking protocols with the peripheral device. Information is transferred to memory on a cycle-stealing basis, and the IOP interrupts the CPU only when the transfer is complete.

Chained DMA transfers

Another way to set up the interface card for a data transfer is to use the IOP's "self-configuring mode" for multiple transfers. In this process, the program tells the IOP where in memory the three control words are located, and the IOP can configure itself for the transfer by loading the words into its own internal registers.

With this approach, the IOP can check at the end of each transfer to see if another transfer is required, and then configure itself to perform the next operation.

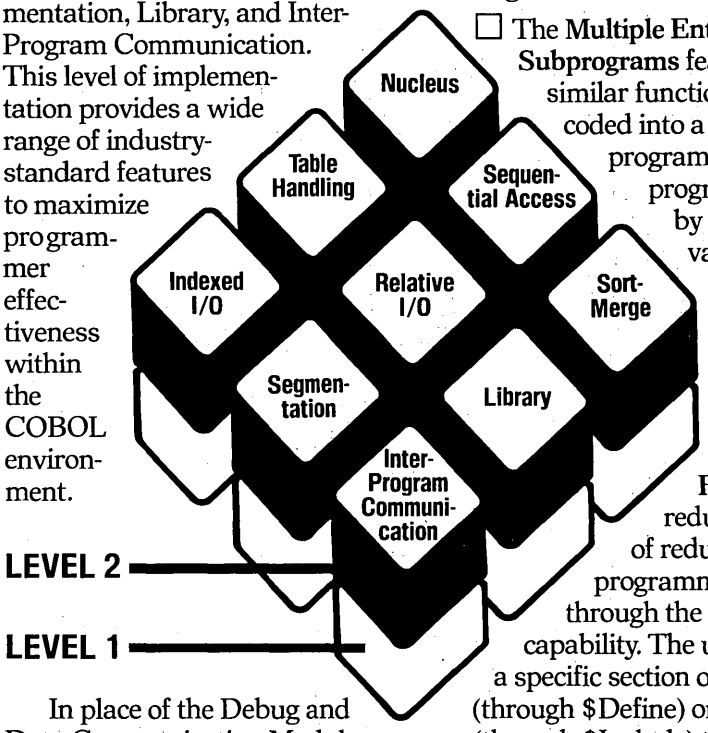
DMA itself eliminates about 95 percent of CPU interrupts; chained DMA saves two-thirds of the remaining interrupts.

Since it has an IOP on every interface board, the L-Series computer has DMA capability on every I/O channel. Because of this feature, the I/O programs in RTE-L use DMA for all low-speed as well as high-speed transfers, resulting in a significant increase in overall processing efficiency. Total DMA bandwidth is 2.7 Mbytes/second.

High-level implementation of 1974 ANSI COBOL

COBOL II/3000 is one of the most complete implementations of the 1974 ANSI COBOL Standard for any system in the price range of the HP 3000. It executes under the MPE operating system on the HP 3000 Series III, 30, and 33, offering a wide range of standard and extended features to improve both programmer efficiency and run-time performance.

HP's COBOL II implements 9 out of 12 modules at level 2 of the ANSI Standard—that is, with all the instructions and options defined for them. The 9 modules are: Nucleus, Table Handling, Sequential Access, Relative I/O, Indexed I/O, Sort-Merge, Segmentation, Library, and Inter-Program Communication. This level of implementation provides a wide range of industry-standard features to maximize programmer effectiveness within the COBOL environment.



In place of the Debug and Data Communication Modules defined by the ANSI Standard, COBOL II offers interactive debugging through MPE Debug and data communications through DS 3000. These facilities are simpler to use in an HP 3000 environment than those defined within the ANSI Standard.

Extended features improve productivity

HP's COBOL II/3000 offers extended features which reduce the coding effort by eliminating redundant code. Programmers using typical structured programming techniques will find COBOL II extremely efficient since code may be written once and accessed thereafter by a single identifier.

☐ The **Multiple Entry Points to Subprograms** feature allows similar functions to be coded into a single subprogram. This subprogram is accessed by entering at various sections of the code and executing only the portion appropriate to the function.

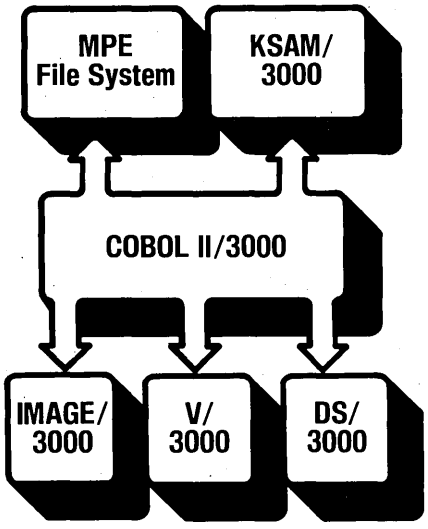
☐ **Preprocessor Functions** help reduce the amount of redundant code a programmer must write, through the use of a macro capability. The user can equate a specific section of code (through $Define) or a file (through $Include) to a single identifier. When this identifier is referenced in a program, the compiler will automatically replace it with the referenced code.

Easy access to system capabilities

COBOL II/3000 is designed to allow users to access powerful MPE operating system features through CALL procedures without having to write system-level interface routines. The result is simplified access to a broad range of HP 3000 operating system features, with a reduction in coding effort and system overhead.

Tools for simplified programming

COBOL II/3000 provides full access to standard data management and data communication software of the HP 3000. Standard tools which can be directly accessed include the MPE Sequential File System and KSAM/3000 (HP's Indexed File System). These are accessed directly as defined



within the ANSI Standard to simplify the programming effort.

In addition, COBOL II interfaces to the other HP 3000 data management and data communication tools through library procedures, thus increasing the overall capabilities of the programmer. These tools include IMAGE/3000, HP's data base management package, V/3000, which is used to generate and access complex screens for data entry, and DS 3000, which is used for data transfer between systems.

Data management extensions to ANSI Standard

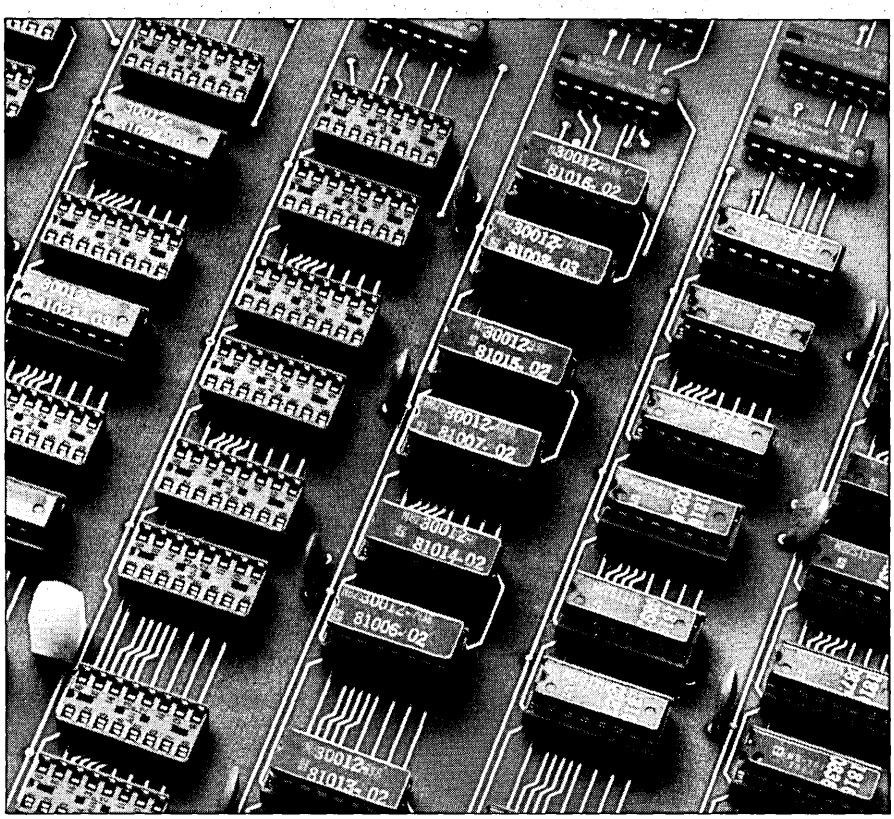
In addition to providing access to the data management tools of the HP 3000, COBOL II implements special extended features which simplify the complex programming effort normally required for elementary data manipulation. An example is the ACCEPT-FREE statement, which allows users to invoke terminal input of single fields. The user merely inputs the data, and COBOL II does the editing and formatting.

Ease of conversion

COBOL II—with its high-level implementation of the ANSI Standard and widely used, packed decimal data format—provides most of the programming features available in the industry, thus simplifying conversion to the HP 3000.

In addition, HP has provided a simplified conversion path for existing customers by means of an upward compatibility of features. All features available under COBOL/3000 are supported by COBOL II/3000 through the 74 ANSI Standard implementation or through language extensions. The only changes a user must make are when new reserved words, defined for the 1974 Standard but not for the 1968 Standard, have been used as identifiers in a COBOL/3000 program.

To simplify making these changes, a conversion guide and program are provided. The guide lists all the new reserved words as well as all the new features of COBOL II/3000 which were not available under COBOL/3000. The conversion program, described in the guide, automatically flags any of the new reserved words being used as identifiers in the COBOL/3000 program. The programmer can then simply change the flagged statements and recompile under COBOL II.



Microcoded instruction set improves run-time efficiency.

Increased performance through firmware

COBOL II offers improved run-time performance through the implementation of a microcoded instruction set. This instruction set optimizes run-time performance of frequently utilized code for subroutine access, data manipulation, and editing.

In tests run in a batch environment, improvements in the range of 10 to 20 percent for execution time were observed. Tests run in an on-line environment yielded execution times equal to or slightly better than those written in COBOL/3000. Performance comparisons with COBOL/3000 may vary depending on the exact application.

The microcoded instruction set, along with the high-level implementation of the ANSI Standard and COBOL II's many extended features, reaffirms HP's commitment to high-technology software products designed to increase programmer productivity and improve run-time performance.

For more information check B on reply card.

Data base management— on a desk top

The first data base management system (DBMS) implemented on a desktop computer—the HP System 45—will reduce programming costs and improve data integrity, access and security for a wide range of scientific, technical and industrial users.

At the heart of System 45 DBMS is IMAGE/45, a subset of HP's user tested and approved IMAGE/3000, one of the most widely installed DBMS packages in the world. IMAGE/45 provides 26 new BASIC statements and routines in ROM for managing the data base. It enables you to build, maintain, access, re-structure and back-up a data base without writing special application programs.

IMAGE/45 provides great flexibility in data base size: up to 32 data sets per base and 32,767 records per set. Within each 1,022 byte (max.) record, you can have up to 127 fields.

System 45 DBMS uses a chained approach to data retrieval in which pointers logically connect records having common attributes. This allows cross-referenced access to collections of data and ensures fast access to related data by key values.

Included in System 45 DBMS is QUERY/45, a highly interactive and powerful data access and manipulation software package—written using IMAGE/45 tools—that enables you to access your data base without writing BASIC programs. QUERY/45 facilitates "ad hoc" or unanticipated data base inquiries through the use of user soft keys, "help" files and a system information file. QUERY/45 is divided into six software modules that contain the primary data access routines:

☐ DEFINE, allows you to create or modify a data base while being prompted from the CRT screen.

☐ SHOW, provides a graphic "picture" of the data base structure.

☐ SEARCH, allows multi-criteria data selection (including computed or partial value searches). Searches are done using "threads" that link sets with common key values.

☐ UPDATE, allows you to add, delete or modify data with or without a pre-defined form.

☐ FORMS, allows you to create new forms to be used with UPDATE, or modify old ones.

☐ FRAMEWORK, allows QUERY/45 to function as a front-end to user written programs. Your program can use QUERY/45 to select and sort data from the data base.

Reduced costs

System 45 DBMS lets users modify a data base with a minimum of programming effort because the data is defined independently of the application programs. Moreover, QUERY/45 can serve as a direct replacement for many applications programs.

Improved data integrity and security

System 45 DBMS allows independent files to be consolidated into a centrally located set of files. This ensures that the most current information is maintained. It eliminates the problems associated with multiple users updating multiple versions of the same file.

Powerful error detection and recovery routines are also provided. If a data transfer is interrupted for any reason, the data base is flagged "corrupt," since the pointer updates may not have been completed.

A system of passwords, maintenance words and named values provides excellent data security for System 45 data bases.

Link to HP software

To simplify statistical processing, QUERY/45 provides a program that lets you reformat data from the data base and then automatically pass that data to programs from the HP Statistical Software Library.

System 45 DBMS is powerful and easy to use. It doesn't just put your data on file... it puts it to work.

The System 45 DBMS includes firmware, software, manuals, a practice data base and a data base design kit and costs $5,000.

For further information, check C on the reply card.

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INTERNATIONAL

DP: AN EASY TARGET

While terrorist attacks usually endanger people, Europeans fear computers are being threatened as well.

Firms with dp operations in Europe are faced with a new threat to computer security —terrorist attack. In the last 18 months, more than a dozen installations have been victims of sabotage in a number of countries, including Italy, the German Federal Republic, France, and the United Kingdom.

Despite this disturbing new phenomenon, observers say most users remain careless over security gaps in their own installations. Vendors, however, have become distinctly jumpy because full-scale security systems might give computers a "1984" image. They are also concerned that publicity for the terrorist actions might attract even more anticomputer attacks, a view shared by the national police.

The most recent wave of attacks came in France, where extremists damaged installations at Air France, Philips Data Systems, and Cii-Honeywell Bull—all in the space of a few days. A further unsuccessful bazooka attack was made on a French Transport Ministry computer center. There, terrorist rockets missed the sixth floor computer suite, hitting instead the fifth floor library.

While Italian and German dp sites have also suffered, the United Kingdom has so far been exempt, apart from incidents in the already embattled province of Northern Ireland. Here, a dp center was incidentally damaged in an attack on the Belfast Cooperative Society, and a more specific attack was made on the Queen's University computer, also in Belfast, which was suspected of holding police information.

"I don't think people are very aware of this sort of threat. We're doing our best to make them aware," says Michael Wood, privacy and security manager at the United Kingdom's National Computing Center (NCC) in Manchester. "Most installations continue to be very, very vulnerable, just like normal offices," he declares. Concern at the NCC mirrors anxiety in other European countries, but this is often at official or governmental levels rather than at the user level. Wood circulates security information to about 120 firms, and some of these companies are beginning to take action.

According to Wood, the European scene is different from that in the U.S. where, he says, "they seem more concerned about monetary fraud than terrorist attacks." In Europe, banks have already begun to take some initiatives towards increased physical security. They are moving their dp centers away from big cities, and adopting a perimeter fence approach instead of having entrances straight off the street. Another dp banking expert comments: "They are moving away from one central computer to several regional centers" to guard against all aspects of vulnerability.

But the European security campaign is only gathering momentum slowly, boosted a bit by the events in France, where the incidents at Philips and Cii-HB made front page news in the national dailies. According to unconfirmed information from an industry source, one U.S. chemical company is considering pulling most of its dp operations out of France. The reason is that it feels the dangers of terrorist attack in France are too great. What the firm plans in order to reduce reliance on its French dp center is to move it to a site close to the Swiss border and set up back-to-back system with another mainframe just over the border on the Swiss side. Also nervous about France's Arab oil connections, the firm believes the Swiss may have the terrorist problem under better control, says the source. In the event of any problems in France, the firm can switch to the Swiss center, it reasons.

One new French computer security outfit, Sogesi, launched with impeccable timing just a couple of days before the Philips and Cii-HB attacks, reports that as a result of the incidents, company heads are now asking their dp managers if they have taken measures to guard against terrorist action. Says Sogesi president Pierre Leroy: "Most firms are very badly protected in terms of general computer security. There are now very few risks at the level of hardware alone. But there is a real risk in how and why dp is used." Leroy says it is increasingly important for dp users to be very conscious of the risks—for the people as well as to the hardware and software.

Nonetheless, no site can be totally secure. At Air France, the first of the French attack victims, the attackers blew up telecommunications lines outside the airline's already heavily fortified center on the French Riviera. Though a spokesman said the airline had stepped up its security measures, it is almost impossible to protect telecommunications lines outside its premises. The incident, which went unclaimed by any terrorist organization, managed to put the airline's reservation system out of action for five hours.

The Philips and Cii-HB incidents both took place in Toulouse, and both were in customer demonstration centers. While this minimized the damage done to the ven-

dors' major operations, in the Philips case the attack came while customers were waiting for application programs being developed by the vendor. Both companies admit they had only normal office security precautions in force. The intruders broke into the offices, setting fire to data storage media (tape cassettes, floppy disks and punched cards) at Philips, and destroying a Level 61 DPS system at Cii-HB with a fire bomb plus incendiary chemicals.

The companies will give no official estimate of the damage done, although unofficial reports say it is unlikely to have exceeded $700,000. This is a small amount compared with what could have happened if either of the two companies' internal dp systems had been destroyed. Besides considerable costs to replace mainframe hardware and software, consequential losses of stored data and ongoing operations could cripple a company if it had no adequate backup systems available.

It is not clear whether there is any common political thread connecting the sabotage attempts in different European countries. Commentators have for some time suggested links between Italian, German, and French terrorists. But the computer incidents seem to have been provoked by different bodies. In the recent French attacks, the Air France incident, not far from the Italian border, was not claimed by any organization. But two organizations claimed to have sabotaged the Philips installation.

The first, Action Directe, a little-known leftist body, also claimed responsibility for the attack on the Cii-HB center and the Transport Ministry (where the attackers also damaged two other ministry buildings in different parts of Paris). But police have discounted the Action Directe claim for the Philips job. Another organization, CLODO, seems to have come up with convincing proof that it entered the Philips premises. It reported afterwards that there was a Rolls Royce brochure in the Philips manager's desk—a claim substantiated by the company. ("It was there because we advertised in it," said a Philips spokesman, anxious to dispel any impression that its branch managers were in the Rolls Royce league.)

CLODO, translated as the Computer Liquidation and Hijack Committee, boasts of its attack on Philips Data Systems.

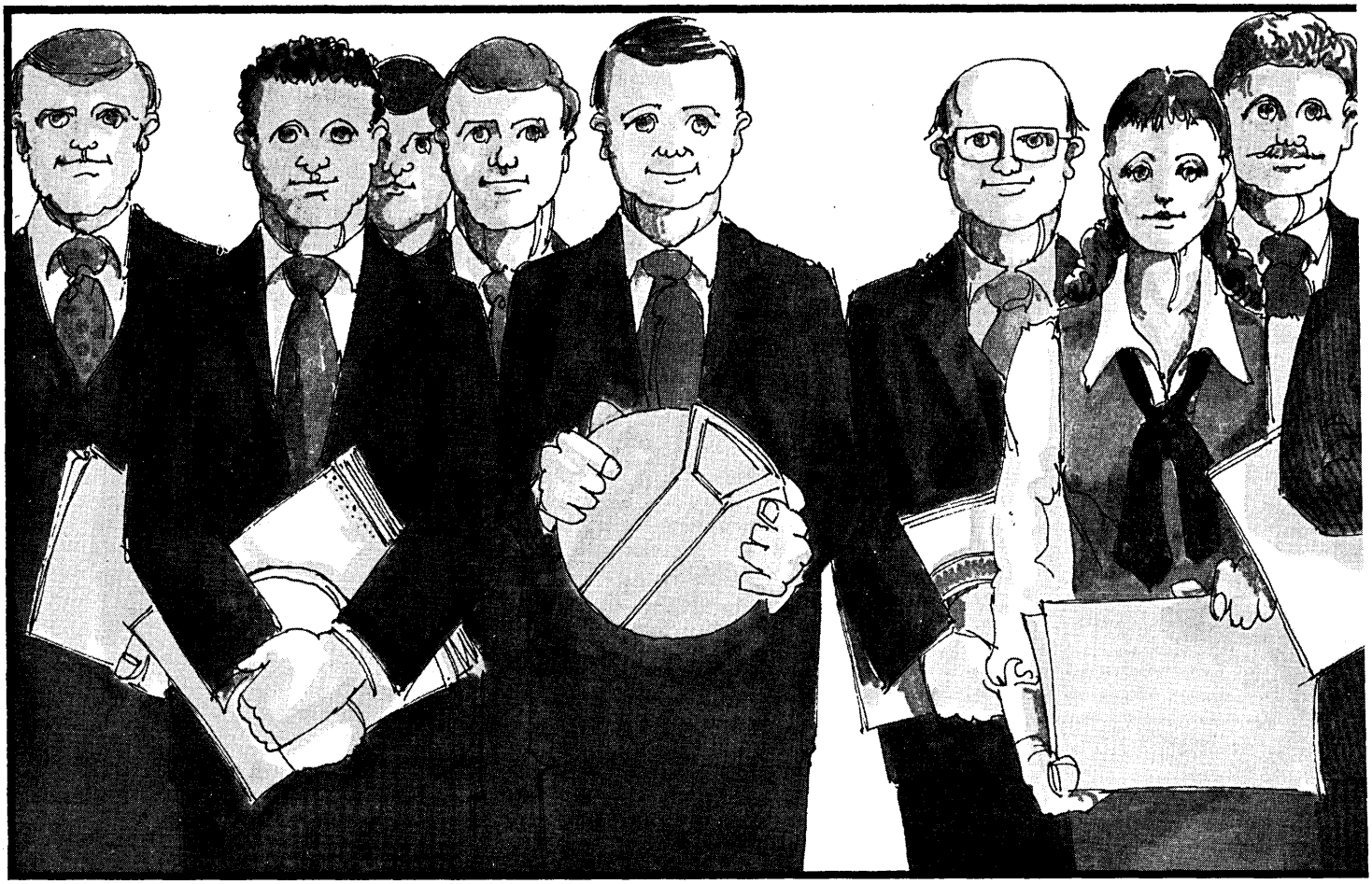
CLODO stands for Comité Liquidant ou Détournant les Ordinateurs, which translates to Computer Liquidation and Hijack Committee. Police in Toulouse believe that this group has been responsible for other anticomputer actions in the last few months. In one instance, CLODO publicly exposed a local department store that was maintaining a file on petty thieves caught in the store, including data on their psychology and morals —a file which is illegal under French data protection laws.

CLODO made its views on dp quite clear in a statement to the French press: "We are workers in the field of dp, and consequently well placed to know the current and future dangers of dp and telematics. The computer is the favorite tool of the dominant. It is used to exploit, to put on file, to control, and to repress."

But the message that the French press seems to have picked up is that terrorists are well aware of the vital role played by computer systems in the day-to-day management of powerful organizations. As the leading pro-government French daily, *Le Figaro*, observed in its page-one leading article: " . . . a modern nation is infinitely vulnerable. It is much more effective for those who aim to harm or even paralyze it to put computers out of action than to shoot up ministries or murder policemen."

In France at least, security forces have increased their surveillance activities at all Toulouse offices of computer suppliers, and an Interior Ministry spokesman said police were also intensifying security efforts in Paris.

—Andrew Lloyd



SOFTWARE

COMPILER COMPANY GROWS

Many companies are built on breakthroughs.

Donald R. Ryan and David E. McFarland have been building a company at a 50% compounded growth rate since 1970 on a lack of breakthroughs.

"Software development isn't any better now than it was in 1963," said Ryan, president of Ryan-McFarland Corp., Palos Verdes, Calif.-headquartered developers of custom and proprietary compilers. McFarland is vice president.

"The hardware is beautiful," said Ryan. "Hardware problems are a thing of the past. We don't even account for time lost because of computer down time."

But he doesn't look for any breakthroughs in software development in the foreseeable future. "I've been hearing about automatic software generators ever since I've been in the business."

And that has been since 1961 when, with James Dunlap, he founded Digitek Corp. Digitek was formed to build a computer, but turned to designing compilers and compiler kits as its initial operation. It never did build a computer, but continued with compiler development and got into time-sharing. McFarland was a vice president of Digitek.

STRICTLY COMPILERS: Donald R. Ryan (left) and David E. McFarland formed the company to develop custom and proprietary compilers.

Digitek came into bad times in 1970 and on July 5 of that year, Ryan and McFarland left and formed their present company. At the end of July it acquired the Systems Programming Div. of Digitek for "a percentage of participation" over a two-year period. With the acquisition of the Systems Programming Div., Ryan-McFarland got all contracts, warranties, and maintenance rights for existing customers, many of whom they still have today.

As a fledgling firm, Ryan-McFarland wanted to develop commercial software packages in addition to developing compilers. It developed and began selling a billing package for orthodontists. This activity didn't last long. "Orthodontists are too hard to deal with," said Ryan. "They needed too much hand-holding and we weren't equipped for that." So they decided to stick to compilers.

The company, with 50 employees worldwide, has developed more than 100 compilers, encompassing most generally accepted programming languages.

Early this year it established a Software Products Group in Aptos, Calif., to specialize in packaged compilers for

microcomputer-based systems. That division supplies RM/COBOL to Onyx Systems for its Z-80 based C 8000 microcomputer.

Michael Saccomano, general manager of the group, believes there "is a tremendous growth potential in adapting large-machine languages on microcomputers." He explained that RM/COBOL is a high-level ANSI/COBOL, providing many extended features including full Level-2 I/O. "The combination of multikeyed ISAM and Texas Instruments' 990/10 language compatibility provides immediate availability of large-machine application packages to the microcomputer."

Ryan-McFarland Corp. has a spin-off company, Ryan-McFarland Inc., in Austin, Texas, dedicated to providing custom software for Texas Instruments and proprietary packages for TI oems.

The parent company's products include the first FORTRAN for a 4K minicomputer, the first time-sharing COBOL for 16-bit minicomputers, the first COBOL system for microcomputers, and Micro BASIC I and D systems for 8080/Z80 and 6800-based microcomputers.

Ryan said microcomputers are "a different industry. The computer business it isn't. They're now running into the same problems everybody else did in 1963." He'll go with the microcomputer business "as required" but he doesn't want to "compete in the toy business. They're like the orthodontists."

He prefers to "deal professional to professional."

Ryan considers in-house development to be his firm's biggest competition, and says, "We can do it in one-third or one-fourth the time. The way we build these things, 40% is old code, well tested. We don't have to do everything from scratch."

Ryan-McFarland's customers have included Texas Instruments, ITT in Europe, Data 100, Pertec Computer Corp., NCR, Univac, Data Saab in Sweden, RCA, Redcor, IBM, System Development Corp., Airborne Intruments Lab., Control Data Corp., Electronics Associates Inc., General Electric, Computer Automation, Ford Motor Co., Hughes Aircraft, Sun Oil, and Leeds and Northrup.

Computers for which they have developed compilers include Motorola 6800, Intel 8080, TI 990, IBM 360 and 370, Data 100 Model 85, Z80, NCR 8200, Century 200 and 315, ITT 3200, General Automation SPC 16, Univac 90/30 and 90/70, Data Saab 5/30, RCA 1600, SDS Sigma 5, CDC 3200, EAI 8400, Computer Automation LSI 3, LSI 4, and Alpha/LSI, DEC PDP-6, Honeywell 20, and General Electric 635.

Currently they are working with Tandy Corp. on language preparation on Radio Shack computers and with Sycor Inc., among others. Many of their customers, they say, shy away from precompletion announcements, even though work is being done.

At present they have 14 computers on-site at their Palos Verdes headquarters, although they own only one of these, a TI 990. "Customers ship us a computer to use in development and when the development is done, we ship it back." They had the TI 990 "so long it seemed like a fixture. We got it at a good rate," said Ryan.

McFarland said they often keep computers on-site long after their development work has been completed. "They [the customers] sometimes forget where they are."

In addition to the TI 990 at headquarters, the company owns two more 990s at Austin and a Zilog MCZ and an Onyx at Aptos.

And they're even having computers shipped to them from Europe. In the old days, they recalled, we'd have to send a man over for a number of weeks to develop software for a European customer. "Now it's cheaper to ship the computer."

—Edith Myers

MEETINGS

ONE DAY AT A TIME

Thousands flocked to Washington's Federal DP Expo to hear that creating a successful information system doesn't happen overnight.

Due to "technical, logistic, and business planning considerations," the anxiously awaited IBM series won't debut until sometime in 1981. Such was the latest pronouncement on IBM's next generation of computers from Charles P. Lecht, president of Advanced Computer Techniques Corp., who until recently was one of the last holdouts for a late June announcement of the H series.

In the keynote speech at the recent Federal DP Expo in Washington, Lecht offered his listeners a number of predictions on the computer giant's future offerings. Foremost among them was his statement that a "stretched" 303X series will be introduced by IBM this summer as "end-of-life kickers" to boost its mainframe dominance until the H series can be introduced.

"Although H series design and preproduction models have successfully passed their reviews," Lecht said, "the

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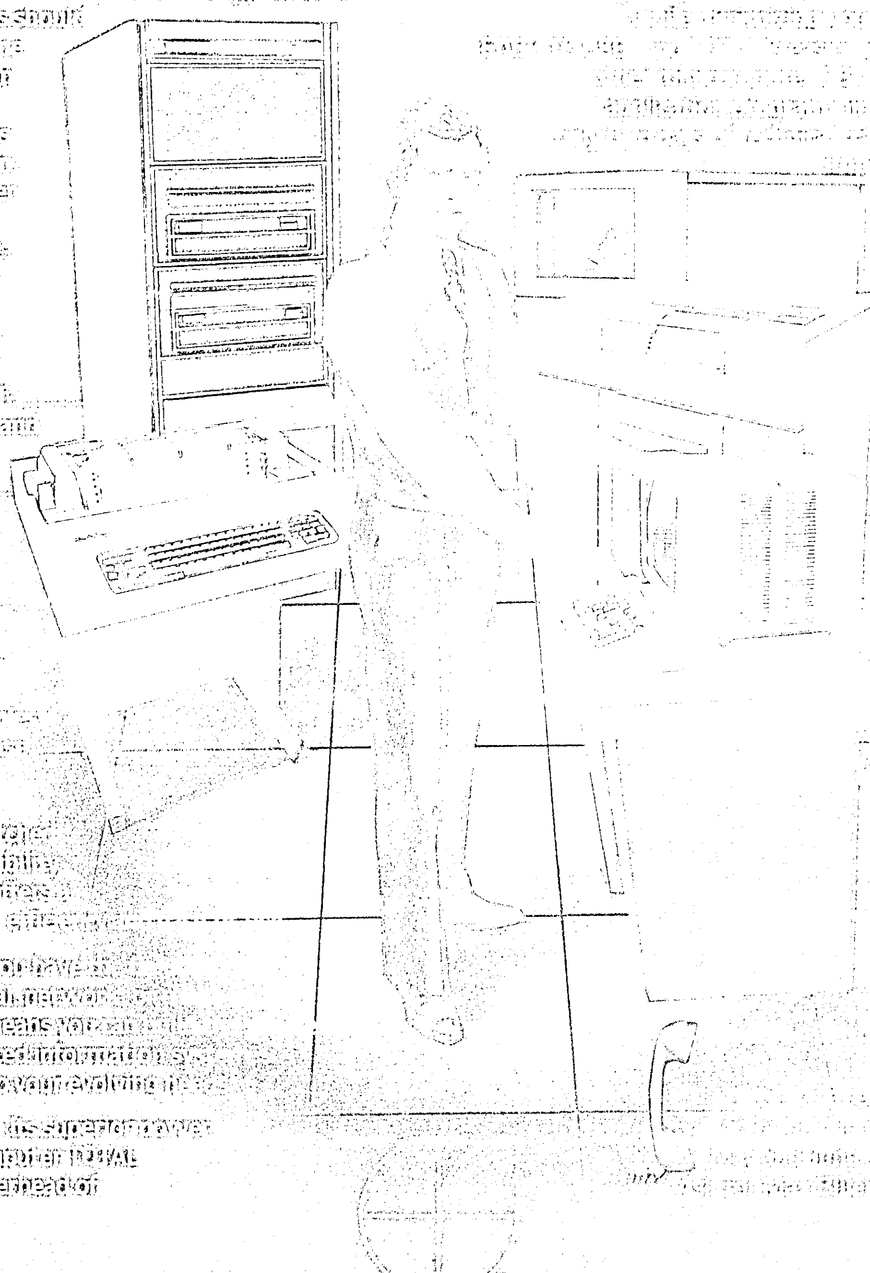

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product line could not be certified for manufacturing mass production in time for the original 1980 introduction.

"To recoup from these slippages," he continued, "we believe IBM has implemented a 303X 'stretch' tactical plan. Stretch is a fallback plan which, if successful, would enable IBM to maintain its competitive position and earnings growth during the difficult 1980/81 period, and at the same time buy time to ensure the successful launching of the H, G and Sierra series models."

Delaying the H series introduction should improve 1980 earnings at the expense of 1981's, Lecht postulated, as the expected stretch processors—3031E, 3033N, and 3034—will carry higher price tags than their predecessor models. But Lecht added that he and his associates at ACT weren't in agreement with IBM about the validity of that strategy.

"In our view," Lecht said, "it would be far better for IBM management to introduce the new technology and new function product line now, and take its earnings lump in 1980, rather than again extending an aging technology." While he conceded that there are mitigating factors such as the weakness of the U.S. economy and competition from Amdahl/Storage Technology and the Japanese forcing preemptive action, he still contended that the right time for H is now.

Most of the three-day conference focused on the here-and-now of federal data processing.

So much for the future. Most of the three-day conference focused on the here-and-now of federal data processing, as in the session on microcomputers' impact on dp. A panel comprised of two software company presidents and a government naval engineer agreed that micros and desktop computers are developing capabilities previously expected only from mainframes or large minicomputers.

"I see the same historical cycle as in the early days of mainframes," said Larry Putnam of Quantitative Software Management in McLean, Va. "Efficiencies started to come into software programs as the language became more sophisticated. When we learn that these computers have a terrible time sensitivity, we'll be able to build software for microprocessors."

"People want to buy machines that can deliver to the user right away," explained Paul Willis of Polytechnic Associates in Arlington, Va. "There's no difference in buying a microcomputer or a larger computer if you have people who can program the software. Bringing the problem to the computer has been replaced by bringing the computer to the problem. It

132 columns	underline	8 function keys	row & col cntr	half & full dplx
132 COLUMNS		8 FUNCTION KEYS		HALF & FULL DPLX
132 columns	blink	8 function keys	current loop	half & full dplx
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24 lines				auto repeat
24 LINES				AUTO REPEAT
24 lines	dual intensity	numeric pad	menu set-up	auto repeat
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	dual intensity		menu set-up	
STATUS LINE	DUAL INTENSITY	CURSOR CTRL	MENU SET-UP	VT-100 OPTION
Status line	dual intensity	cursor ctrl	menu set-up	vt-100 option
STATUS LINE		CURSOR CTRL		VT-100 OPTION
Status line	underline	cursor ctrl	row & col cntr	vt-100 option
STATUS LINE	UNDERLINE	CURSOR CTRL	ROW & COL CNTR	VT-100 OPTION
	underline		row & col cntr	
132 COLUMNS	UNDERLINE	8 FUNCTION KEYS	ROW & COL CNTR	HALF & FULL DPLX
132 columns	underline	8 function keys	row & col cntr	half & full dplx
132 COLUMNS		8 FUNCTION KEYS		HALF & FULL DPLX
132 columns	blink	8 function keys	current loop	half & full dplx
132 COLUMNS	BLINK	8 FUNCTION KEYS	CURRENT LOOP	HALF & FULL DPLX
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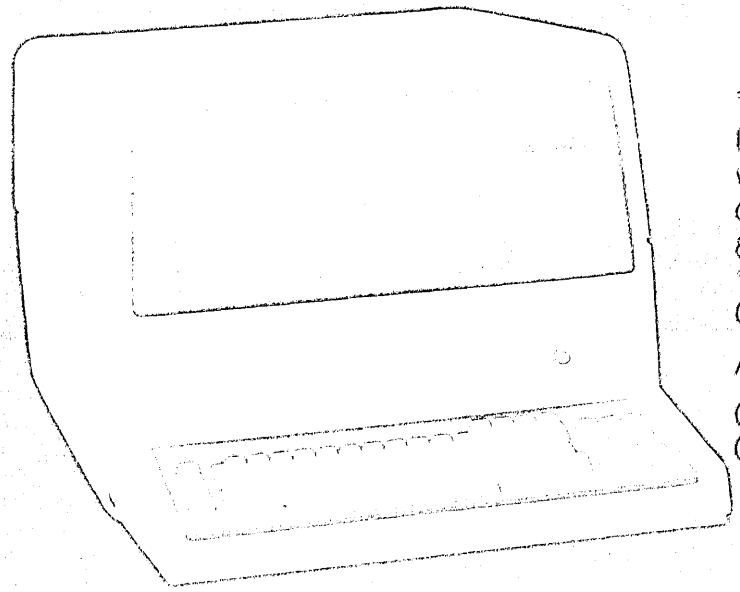
24 LINES	BLINK	NUMERIC PAD	CURRENT LOOP	AUTO REPEAT



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may not be the best solution in terms of cost/benefit analyses, but it's here."

The productivity predicament was another topic probed in a conference session. The fault for lack of productivity improvements, according to a panel of experts, lies not with the machines but with their masters. The panelists—Zalman Shavell, director of an EFT study in the congressional Office of Technology Assessment; Ann Work, senior education consultant with Deltak in Washington; and David Skeen, director, MIS Division of the Naval Civilian Personnel Command—agreed that lack of planning, understanding, and communication among managers, workers, and users has resulted in a disturbing shortage of professionalism and productivity in dp.

"In terms of professionalism, dp managers are better than they're given credit for," Work said. "But their weakness is spending too much time communicating with their subordinates. They need to use both data processing and new educational techniques to improve performance. The tremendous shortage of dp professionals can be solved if you change the emphasis and analysis of the situation. Let people know where they stand and what's expected of them, but keep the organization in mind at all times."

But keeping an eye on the big picture is not always easy, said Walter Haase, a consultant to the Office of Management and Budget. In a session he chaired, Haase said the recommendations of the President's task force on federal adp are being implemented slowly but not necessarily surely.

"We have to recognize that a successful information system must be developed in an evolutionary manner," Haase said. "You have to state the unknowns as often as the needs, and stress a system that can adapt and grow incrementally. Build on the existing system, strengthen its operation, and think about software development."

Now in its fourth straight year in the nation's capital, Federal DP Expo '80 attracted a crowd of about 10,000, hosted 37 technical and management sessions, and packed 175 exhibitors into the Sheraton Washington Hotel. The breadth of exhibitors stretched from the likes of the Bell System and Burroughs, both of which described business at the show as "fantastic," to the Brookings Institution, more renowned for its lofty intellectual analyses of the world's ills than for the time-sharing program it was promoting.

"You go to this for the exposure," commented Carl Rushling of Computer Sciences Corp., one of the 175 companies displaying their dp wares. "I wouldn't expect to sell anything here. I never bring any order blanks with me. But we've had a lot of interested people come by. It's much better than last year. Nothing happened then."

—Willie Schatz

BENCHMARKS

AT&T PLANS SATELLITES: AT&T has a $230 million plan to launch and operate three of its own satellites. The company has been leasing three Comstar satellites from a unit of Communications Satellite Corp., and wants to end its dependency on leasing. An application for clearance has been filed with the FCC, and AT&T hopes to launch the first of its satellites in 1983. Another is planned for launching in 1984, and the third in 1985. The AT&T/Comstar lease for two satellites continues through 1983, but the third satellite lease runs until 1985. AT&T plans to use a fourth Comstar satellite until its own system establishes full operation, to "ensure continued capacity." Comstar had stated earlier that it did not expect AT&T to renew the leases, which cost almost $47 million per year. AT&T said its satellites will have a longer life span (approximately 10 years compared to Comstar's seven years), and each satellite could handle as many as 21,600 simultaneous conversations (Comstar's allow approximately 18,000). AT&T has not yet selected suppliers for the satellites or launch vehicles.

SIMULATING MAGNETIC BUBBLES: IBM engineers have developed a computer controlled simulator for designing magnetic bubble chips. This is a process that allows research scientists to test new designs before building the actual hardware. Magnetic bubbles, small regions of magnetism that exist in certain types of magnetic materials, are used for information storage and can be relocated within the material by applying magnetic fields. This technology permits greater storage capacity potential than conventional magnetic recording methods. The design system consists of three parts: a large host processor, a display terminal, and a designer. These parts are then linked together by several computer programs. Dr. R. Wade Cole and Dr. Thomas W. Collins, both of IBM, developed this simulation process. Use of these magnetic bubble chips helps produce a theoretical base for design, predicts specifications, aids in selecting design directions, and thus reduces the number of hardware iterations.

WEST COMING EAST?: Maryland business, government, and education representatives recently traveled to Santa Clara, Calif., to woo Silicon Valley companies over to the East Coast. The semiconductor industry has long been based in Silicon Valley, and Maryland state officials are trying to alter the geographics. Gov. Harry Hughes and James Roberson, secretary for economic and community development, related the marvels of Maryland to some 70 valley-based company representatives. "We're deadly serious about being the most pro-business state in the nation," said Roberson. Maryland offers "an ample supply of talent that lessens competition, respected schools of engineering, and reasonably priced land." Expansion plans in the semiconductor industry continue, while land costs rise, and competent workers become scarce. Maryland's promises were tempting and well directed. State officials are planning a follow-up visit to talk over the details with interested companies. This opening of the Maryland campaign cost an estimated $70,000 to $80,000, paid for half by the state and half by the Economic Development Council of the Greater Baltimore Committee. The program, according to attendents, was well done and well received—the highlight being the Maryland crab luncheon, of course.

IBM 4331 MODEL GROUP 2: IBM's expected 4300 announcement came last month—the 4331 Group 2 processors, developed at IBM labs in Boeblingen, Germany. They will be manufactured at IBM's Endicott, N.Y., facilities. The new 4331 Group 2 processor offers almost twice the internal performance and up to four times the storage capacity of the 4331 Group 1 machines. The Group 2 also offers midsized system users significant growth potential, and the Group 1 processors can be upgraded on location to Group 2 level.

In addition to increased speed and storage capacity, the Group 2 processor increases versatility in configuring systems. An optional high-speed channel is available which allows data to be transferred from IBM 3330, 3340, 3344, 3350, and 3370 disk storage devices at speeds of up to 1.86 million characters per second. Customer shipments of the new processor are scheduled to begin in the fourth quarter of this year, and upgrades from Group 1 to Group 2 are scheduled for the third quarter. Purchase price for a Group 2 with 1 million characters of main storage is $150,000. The processor can be rented monthly for $5,035, and can be leased for two years at a monthly rate of $4,285. The Group 2 equipped with 4 million characters of main storage can be purchased for $197,100, rented for $6,445 a month, or leased for $5,485 a month.

INFORMATICS INTO MINI SOFTWARE: Informatics has entered the small computer packaged software market, with products for use on IBM System/34s and Hewlett- Packard HP 3000s. A new division has been set up, called the Minicomputer Applications Products Div., which is headed by Donald K. Lane, vice president and general manager. The first new product offered, a general ledger system, will have capabilities for forecasting, cost allocation, profit planning, budgeting, and variance reporting. Planned in the near future is an accounts payable system. *

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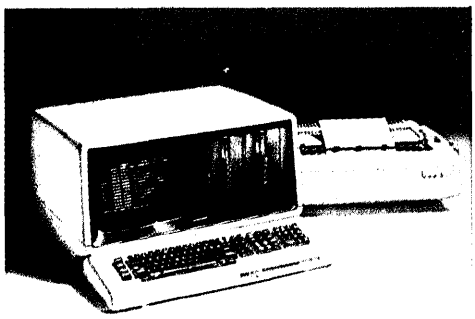

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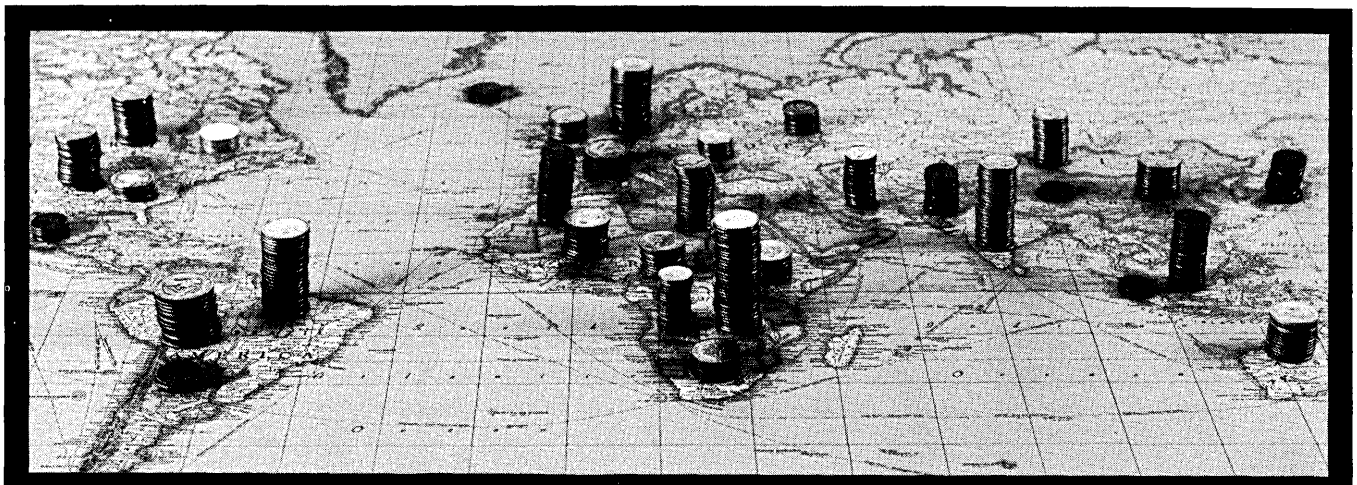

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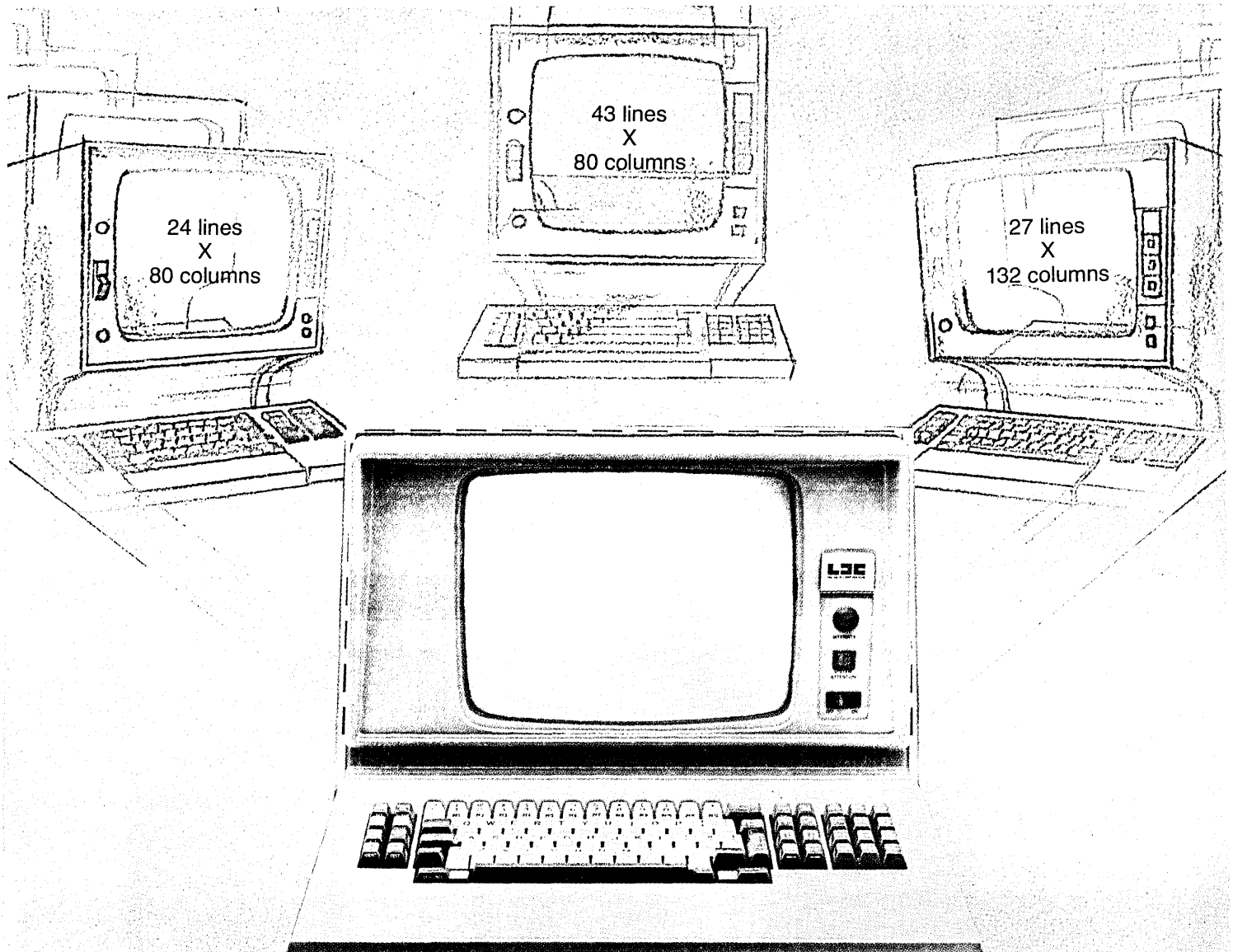

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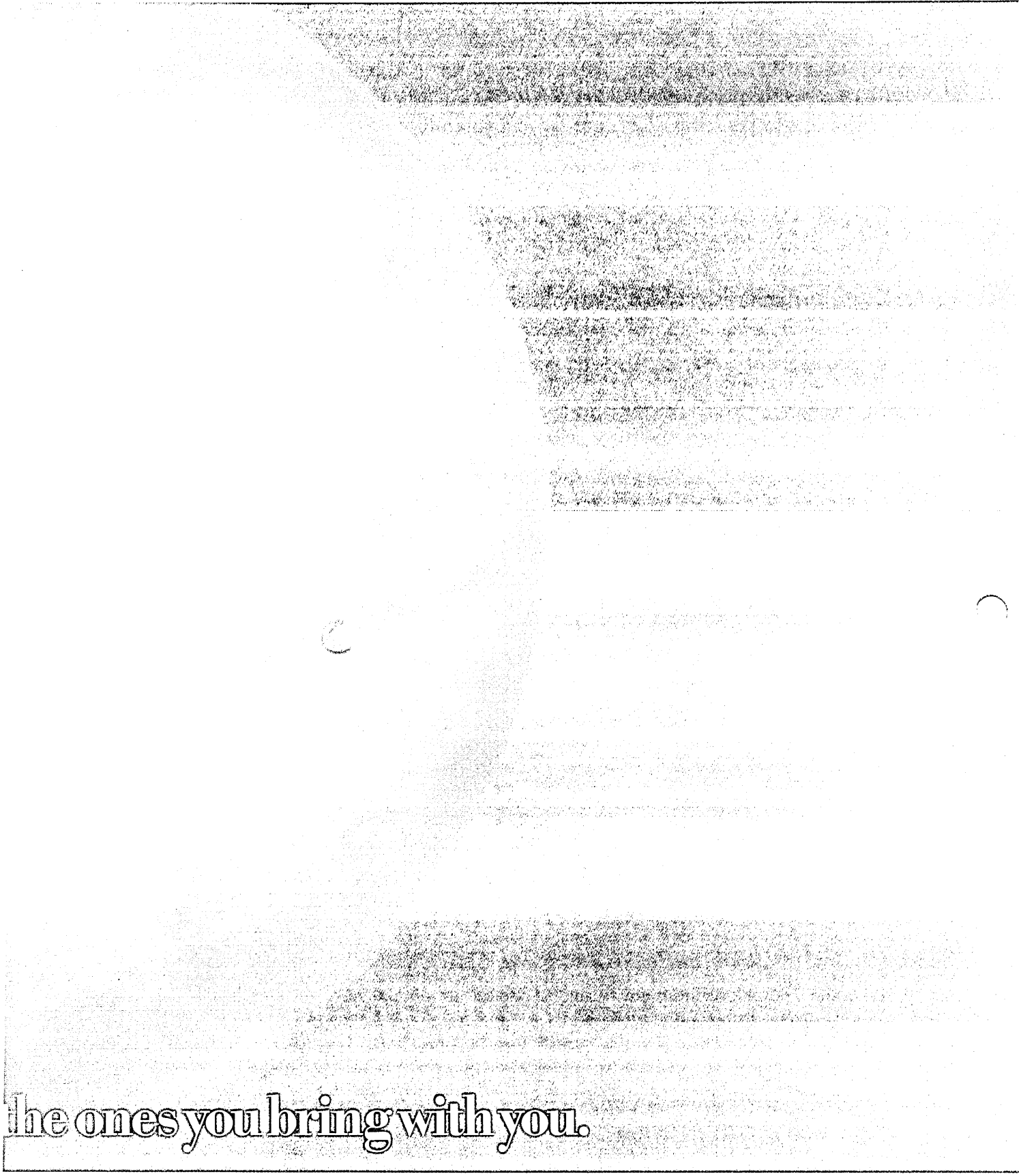

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Healthy sales gains and respectable profits mark data com companies, according to the second annual survey of the industry.

ALIVE AND WELL

by Ronald A. Frank

The data communications industry continues to move along at a healthy clip—this, the second annual industry survey, shows most of the 50 suppliers etched out sales gains and achieved respectable profit levels, even though there was gloom in other sectors of the economy.

While the major upheaval of a shift from analog to digital facilities remains a favorite speculation at industry conferences, data communications *networks* continue to rely on analog technology. The real changes are taking place in the data communications *equipment* area.

As users have become more familiar with the powers and pitfalls of their networks, suppliers have increased the sophistication of product lines. This trend is evident in management and control as users want more detailed operational data about systems.

Not so long ago the modem was considered necessary—it was the black box that *had* to be installed wherever a business machine was to operate compatibly with a data communications line. Now, however, modems have taken on a new identity as the catalyst and the focal point of more complex systems. The first indication of this change came several years ago, when modem suppliers began to incorporate test features in individual data sets.

More recently, modems have become key elements in the so-called technical control centers installed in large private line networks. These control centers were pioneered and developed by independent modem vendors, providing a level of user control previously reserved for the telephone companies.

Many of the control centers have now grown beyond the original network tasks and have taken on such diverse functions as accounting, statistical management, encryption, and protocol conversion. Users have been able to progress into advanced capabilities as their network needs become more complex. The advanced control centers now available are a far cry from the simple modulation and demodulation functions originally found in modems.

It should be added that the independent (noncarrier) vendors such as Racal-Milgo, Intertel, Paradyne, and a host of pioneers have become so successful they have spurred both IBM and AT&T into responding with similar capabilities. It is generally recognized within the industry that IBM's introduction of its 386X series of diagnostic modems was a move to start users of Systems Network Architecture (SNA) down the road to network management. Despite the IBM modem announcements, many private line networks at sites that have IBM mainframes rely on data communications modems and other specialized devices from independent suppliers, if for no other reason than deliveries of the IBM modems weren't scheduled to begin until this March.

So there is little doubt that modems are the center of the action in data communications. A recent study by Creative Strategies International estimates that the independent modem business will be worth about $550 million in 1980, which is a jump of $100 million over 1979 shipments.

Modems are generally classified into three groups based on speed. The low speed area covers up to 1,200 bps, with medium speed ranging up to 2,400 bps, and high speed units reaching into the Kbps area. Although dividing lines between the groups may overlap, as speed goes up so does price.

As more devices within companies are connected to communications facilities, another type of modem is taking on increased importance. With word processing, electronic mail, and similar operations expanding, short haul modems must be used for local data networks. These local nets usually operate within the same building or several buildings located near each other, and they provide a method of interfacing terminals that operate in local mode, meaning they transmit data over short distances without going over conventional telephone company lines. Gandalf, Prentice, and other suppliers provide short haul modems. Generally speaking, when local links exceed several thousand feet in length, short haul modems must be used. Extensive research is being done in the area of local networks, and the technology is changing rapidly so that the need for short haul modems often depends on the specific characteristics of a network.

SMALL COMPUTER IS KEY

Data communications is one field where small computers have taken on a high degree of specialization. From the early days of the IBM 270X series (which was designated as a communications line controller) to today's more sophisticated front-ends and intelligent network processors, these cpus have become key elements in communications networks.

Since a mainframe computer is designed for data processing and not data communications functions, the communications processor acts as a buffer or interface between the mainframe on the one side and the network on the other.

Among the functions typically performed by these specialized processors are line control, character and message handling, conversion of data and protocols, error control, message editing, flow control, message queuing, and a variety of similar network-related tasks. The IBM 3705 is the most common front-end and it shares network software with the host and also handles increasingly complex network control functions as IBM continues to expand its SNA capabilities. The 370X series has been a major IBM product for many years and industry observers expect major upgrades during 1980.

Most mainframe vendors have their own front-ends and in many cases this is the major communications revenue source for computer suppliers. The number of independent front-end vendors has always been small; it includes Memorex and Computer Communications Inc. Comten was on the list until it was recently acquired by NCR; its future role as a front-end supplier is being watched by the industry.

There is another class of communications processor which operates in distributed dp networks. These processors perform functions similar to front-ends but their communications operations are not dependent on associated mainframes. There appears to be trend developing in the network area to have

PHOTOGRAPH BY JAMES JOERN


Bourgogne

Small computers have taken on a high degree of specialization in data communications.

freestanding computers dedicated to management network and control, as exemplified by the GTE Telenet TP 4000 and the Tymnet Engine. IBM has hinted that its 8100 and 4300s may assume this role in the future, but detailed software has yet to be announced.

As dp functions become decentralized, it seems logical to move communications out into the network also. One advantage of a centralized front-end/mainframe approach, however, is that network traffic can be funneled through one site. It is not clear how this could be accomplished in distributed nets, and it is likely that each processor will need to have some communications capability with perhaps the dedicated communications machine handling network management functions.

Many users prefer independent communications processors for the same reason that they use independent modems. They theorize that vendors specializing in communications will provide more expertise than a mainframer that supplies data communications machines as an adjunct to its main business. Despite this theory there are many more communications networks where the same vendor supplies the host cpu and front-end.

Because of the variety of functions provided by communications processors, accurate estimates of the market are relatively scarce. It is probable that shipments of these machines total about $600 million dollars, which puts them close to revenues derived from modems. But modems are low-cost items ranging in the hundreds of dollars, while processors are priced in the hundreds of thousands with far fewer shipments.

It is estimated that 70% of communications processors are used as front-ends, about 20% as terminal controllers, with a small percentage used as message switching devices and remote concentrators.

Multiplexors are natural extensions of modems and many suppliers handle both types of devices. Multiplexors become important as networks grow in size because they allow data streams to be combined over common carrier facilities, thus lowering communication line costs. The early muxes used frequency division multiplexing (FDM) and were primarily analogs operating at lower data speeds. More recently all-digital time division multiplexors (TDM) have gained in popularity as networks handle data at higher speeds.

As users have demanded more sophisticated network features, the statistical TDM has evolved. These are intelligent muxes that can monitor lines for transmission errors, buffer data, and retransmit information—all under microprocessor control. By providing network management diagnostics and control, the statistical multiplexors are taking on many of the functions previously handled by front-ends and network control centers.

The multiplexor vendors include Infotron Systems, Timeplex, Codex and General DataComm.

TEST EQUIPMENT

As networks become more complex and user sophistication increases, communications testers are gaining in popularity. Most of these units provide users with a crt display of vital data and line characteristics. Where down time cannot be tolerated, as in on-line bank teller nets, test equipment at network control centers provides continual hardcopy readouts of important parameters. In many cases line or equipment outages can be prevented if malfunctions are preceded by warning signs monitored and recorded by test devices. It is not unusual for a corporate network control center to call a local phone company data communications group to warn that rapidly degraded line quality may require a switch to backup facilities. Most users who install this level of test capability report that carriers and vendors readily accept trouble reports once they understand the capabilities the customer has in-house.

While some of the testers are portable so they can be moved from site to site, others are built into network centers and operate under computer control. Among the vendors supplying test equipment are Racal-Milgo, Universal Data Systems, Spectron, Tran Telecommunications, and a host of others. Most vendors will provide training in the proper use of this equipment as well as accurate interpretation of the test indications.

Some categories of data communications capabilities did not fit in the major groups. These included voice response systems that provide computer-controlled synthesized "voice" answers to terminal inquiries. Although these systems usually are installed in front-end processors, they differ from the usual communications features. Switching also stands apart in that these units allow network operators to shift from primary to alternate facilities when network problems occur or during test periods. Most switches must be activated manually, but a few systems are available that will automatically switch to backup equipment or lines when malfunctions occur.

NOTES ON THE SURVEY

The only manufacturer from last year's list not back this year is Plessey (number 36 in 1979). Not that it doesn't deserve to be, but when the final deadline had come and gone with no word from Plessey, there was no choice but to leave it out.

The top 50 chart is heavy in financial information. The survey directory of the individual companies is slanted toward product categories. The profile of a particular company is placed under the category heading where most of its data com revenues are made. If there is a 60%-20%-20% breakdown of products, the company's name only will appear in the 20% categories. This year's questionnaire asked for percent of data com revenues attributable to six main product categories: network/node controllers, computer front-ends, modems/multiplexors, test equipment, switching, and finally "other." Each category is followed by a definition.

Looking over the list, a few numbers stand out. Of 50 companies, the majority, 24, fall into the modem/multiplexor category as the major product producing data communications revenues. There are 11 front-end manufacturers, with the heavyweights—IBM and Control Data—appearing here. Down in the "other" column, the most frequently

"All right—who stole my gavel?"

CARTOON BY SIDNEY HARRIS

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The Electronics Group

Photo courtesy of International Harvester.

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mentioned product was audio response; in future surveys it may warrant a heading of its own.

Had we gone down to 51 companies, that spot would have gone to ADC Products in Minneapolis, whose sale of test equipment totaled $1.5 million for fiscal year '79.

As for the financial figures, every reasonable precaution has been applied to collection and assemblage. Those coming from publicly held companies carry a greater weight of accuracy, especially when they are doing business in one nicely defined category. Private companies, always reluctant to part with figures, were asked to give guidelines and direction. Of greatest concern was that as much help as possible be directed our way in order to ensure an accurate and fair survey.

It must be emphasized that many companies don't separate figures by industry segment or product category. Northern Telecom is one example. For many companies, public or private, the name of the game was estimating. Some even undertook to break out the figures for us for the first time. The final result is that the numbers are correct in proportion if not absolute dimension; they represent the bulk of what is out there between the terminal controller at one site and the cpu at another.

Our first questions were what are the boundaries? What will be included? What will be left out? Are terminals to be counted? How many new product categories have appeared? What do we do with companies with data com products that aren't sold as separate entities but as parts of larger products?

The final decision? Last year's definition remains the guide—"All the hardware and all the services that operate on our coded message as it travels between a terminal or terminal controller and the computer to which it is addressed." We still excluded "Anything that smacks of telephony, anything that wouldn't have a role to play if all data died tomorrow morning." PABXs were again excluded but maybe for the last time, as they are blending more and more with network/node controllers and multiplexors.

And finally a note about acquisitions and mergers. At first glance it seemed they played havoc with last year's list. The number 17 company last year, NCR, bought the number four company, Comten. The end result was NCR Corp. residing in third place. 3M bought Interactive Systems, Inc., which last year was number 42. This year 3M is the number six data com company, with its Interactive/3M division producing data com revenues of almost $49 million—not quite 1% of its parent company's total earnings. The largest corporation in the U.S., Exxon, purchased last year's 21st largest data communications company by revenues, Periphonics. This year Periphonics, as a wholly owned Exxon subsidiary, is ranked as the 26th largest data com revenue producer. ✻

The data com survey was prepared by Louise C. Shaw with the assistance of Marva Levine and Roseanna Gulisano.

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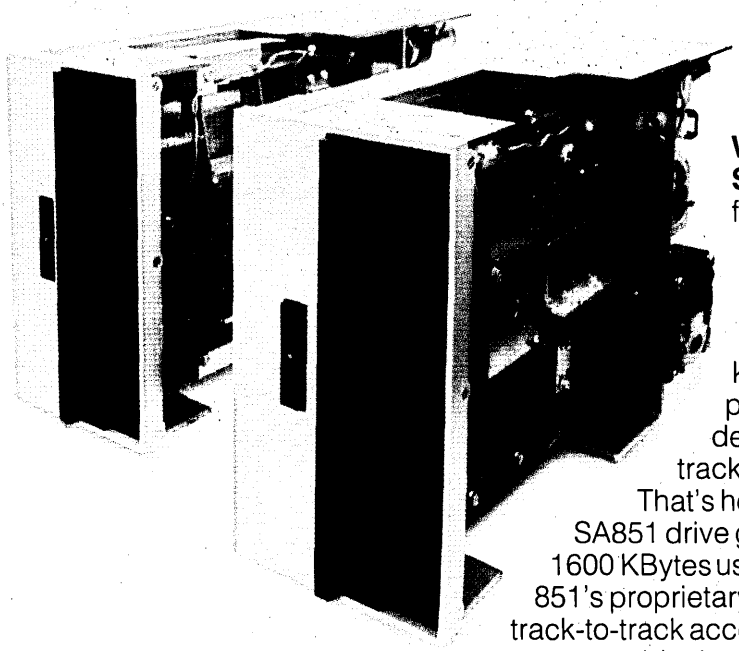

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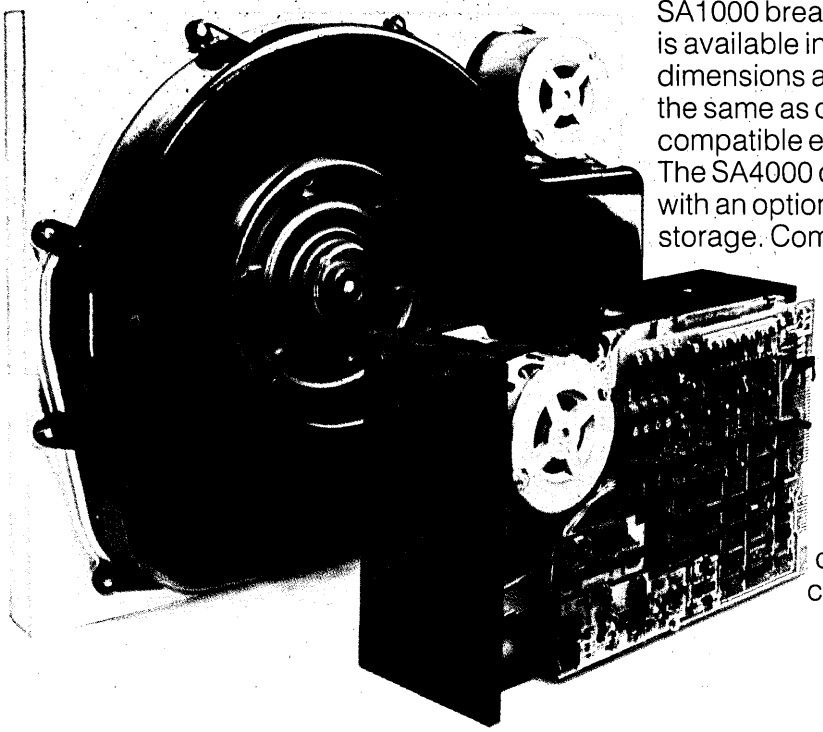

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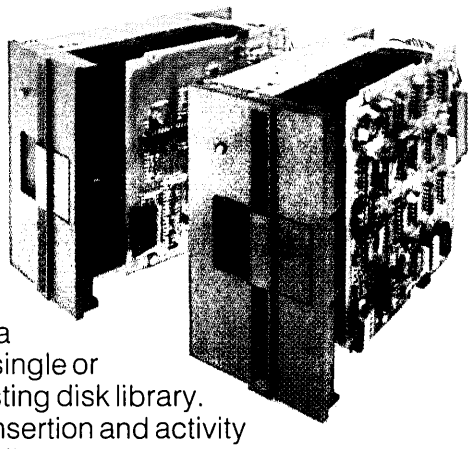

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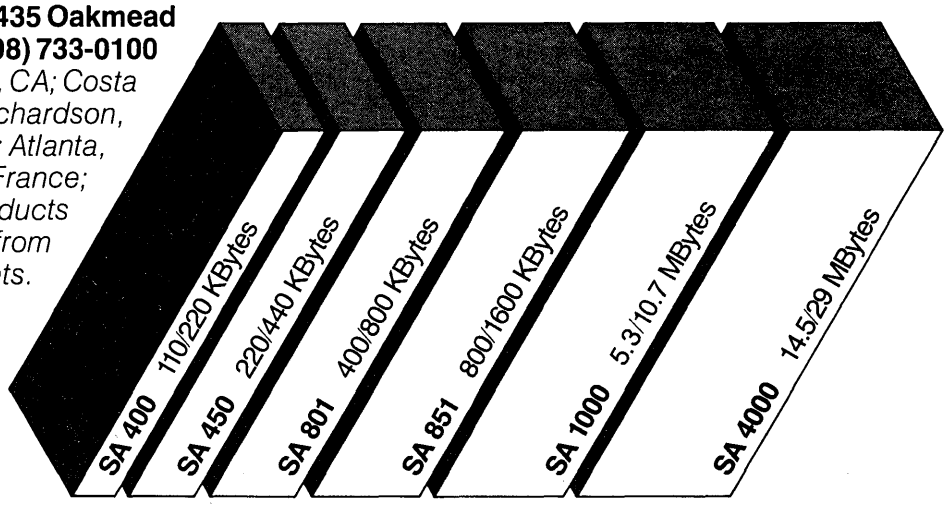

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THE TOP 50 DATA COMMUNICATION INDUSTRY MANUFACTURERS

Rank	Company	Total Data Com Revenues $K	Data Com Product Revenues % of Total	Controllers	Computer Front-Ends	Modems Multiplexors
1	IBM*	157,753	<1	0	100	0
2	Racal-Milgo, Inc. (A)	121,000	100	0	0	80
3	NCR Corp.*	81,588	2.7	20	80	0
4	Motorola*	81,319	3	0	0	90
5	Memorex	53,944	7.3	0	100	0
6	3M*	48,960	<1	0	20	80
7	General Data Comm	41,724	100	0	0	85
8	Paradyne Corp.	41,411	100	0	0	70
9	Control Data	40,000	>1.2	40	60	0
10	Rixon, Inc.	36,156	100	0	0	100
11	Northern Telecom/Spectron	30,000	<2	0	0	0
12	Hewlett-Packard*	29,500	<1	0	67	0
13	Burroughs*	28,309	1	12	88	0
14	Racal-Vadic, Inc.	24,500	100	0	0	100
15	Data Access Systems, Inc.	24,000	90	0	0	5
16	Sperry-Univac	23,700	<1	0	100	0
17	Tran Telecommunications Corp.	19,700	100	40	0	50
18	Infotron	18,785	100	0	0	100
19	Computer Communications	18,200	100	18	60	2
20	Micom Systems	15,400	100	10	0	90
21	Intertel, Inc.	15,000	100	0	0	70
22	Honeywell*	14,530	1	0	100	0
23	Timeplex Inc. (A)	13,659	100	0	0	100
24	Bolt, Beranek & Newman	12,441	33	70	30	0
25	Digital Communications Corp.	11,900	>35	40	20	30
26	Periphonics	11,000	100	0	80	0
27	Atlantic Research Corp.	9,778	18	0	0	0
28	Anderson Jacobson	9,715	28	0	0	100
29	Dynatech Corp.	9,275	33.7	0	0	5
30	T-Bar Inc.	9,250	50	0	0	0
31	Tektronix Inc.*	7,869	1	0	0	0
32	Gandalf Data	5,577	100	0	0	60
33	Prentice Corp.	5,200	100	0	0	100
34	International Data Sciences, Inc.	5,024	100	0	0	0
35	Rockwell International Corp.*	5,000	>>1	80	20	0
36	Digitech Data Industries, Inc.	4,600	100	0	0	0
37	Penril	4,415	19.5	0	0	100
38	Halcyon*	4,000	33.3	0	0	0
39	Novation Inc.	3,500	100	0	0	100
40	Livermore Data Systems, Inc.	3,400	100	0	0	90
41	Cognitronics	3,000	35	0	0	0
42	Comdata	3,000	100	0	0	80
43	Digital Communications Assoc.	2,700	100	35	20	45
44	Harvey Hubbell*	2,537	>1	0	0	100
45	Tek-Com, Inc.	2,500	100	0	0	100
46	Votrax*	2,407	4	0	0	0
47	Wavetek*	2,360	8	0	0	0
48	Astrocom	2,300	60	0	0	70
49	Datastream Communication*	2,200	100	30	45	20
50	Nytronics, Inc.	1,679	100	0	0	100

Source: * DATAMATION Estimate A: Fiscal figures adjusted for calendar '79 R: Restated figures

Test Equipment	Switching	Other	1978 Data Com Revenues $K	1979 Total Revenues $K	1979 Net Income (loss) $K	Fiscal Year Ends
0	0	0	144,000	22,862,776	3,011,259	Dec. 31
0	0	20	—	121,000	—	(March 31)
0	0	0	—	3,002,640	234,602	Dec. 31
0	0	10	66,200	2,713,795	154,296	Dec. 31
0	0	0	8,750	737,761	31,544	Dec. 31
0	0	0	—	5,440,000	655,000	Dec. 31
0	0	15	31,169	41,724	3,236	Sep. 30
0	0	30	25,899	41,411	4,117	Dec. 31
0	0	0	15,800	3,250,000	124,200	Dec. 31
0	0	0	22,000	36,156	3,152	Dec. 31
100	0	0	—	1,900,522	113,500	
33	0	0	14,800	2,361,000	203,000	Oct. 31
0	0	0	18,800	2,830,976	305,536	Dec. 31
0	0	>85	2,415	28,153	3,415	Aug. 31
0	0	0	12,000	24,500	—	March 31
0	0	0	15,600	2,050,000	199,000	March 31
10	0	0	11,293	19,700	218	June 30
0	0	0	14,387	18,785	3,157	Dec. 31
0	12	8	17,129	18,200	900	June 30
0	10	0	5,400	15,400	1,850	March 31
0	0	30	12,500	15,000	2,400	Oct. 31
0	0	0	16,500	1,453,000	152,000	Dec. 31
0	0	0	11,517	13,659	1,086	(June 30)
0	0	0	10,550	37,708	2,700	June 30
0	25	10	7,160	30,291	—	Sep. 30
0	0	20	11,000	11,000	—	Dec. 31
70	10	20	4,970	54,556	1,632	Dec. 31
0	0	0	7,615	34,697	1,760	Dec. 31
25	70	0	6,600	27,527	2,328	March 31
0	100	0	6,350	18,500	1,553	Dec. 31
60	0	40	8,607	786,936	77,151	May 31
0	40	0	3,300	5,577	—	July 31
0	0	0	3,500	5,200	—	April 30
75	20	5	3,700	5,024	387	July 31
0	0	0	4,500	6,180,000	261,100	Sep. 30
100	0	0	—	4,600	—	Dec. 31
0	0	0	R4,471	22,692	1,453	(July 31)
100	0	0	—	12,000	—	March 31
0	0	0	2,000	3,500	360	June 31
0	0	10	—	3,400	—	Dec. 31
0	0	100	—	8,000	526	Dec. 31
0	0	20	3,014	3,000	—	June 30
0	0	0	1,427	2,700	—	June 30
0	0	0	1,967	362,438	26,757	Dec. 31
0	0	0	—	2,500	—	May 31
0	0	100	1,970	60,180	3,828	July 1
0	0	100	2,567	29,500	1,958	Sep. 30
30	0	0	—	3,400	<90	Dec. 31
0	0	5	1,800	2,200	—	June 30
0	0	0	1,600	114,871	3,264	July 31

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For example, IDC reported Series 80 TOTAL saves man hours two ways. First, it only requires an average of one person spending half his time to support the system. That's one fourth the people required by another leading package which needed four people on average and sometimes as many as 12. Unlike another leading package, Series 80 TOTAL was reported up and running right on schedule, not behind it. And unlike two other major packages, Series 80 TOTAL users were completely satisfied with its fast response time in actual operation.

EASILY ADAPTS TO CHANGE

It stands to reason that the more useful a DBMS is to management, the more they'll use it. According to the IDC survey, users integrated Series 80 TOTAL into an average of 41% of all applications. That's more than any other DBMS and almost twice as much as the next leading system.

That's because with Series 80 TOTAL's powerful data structuring capabilities almost any data relationship can be rapidly and easily defined.

And, as your business needs change, Series 80 TOTAL's modular step-by-step development capabilities are flexible enough to be adapted to change, quickly and economically.

You can add new data, new functions, even new applications without having to scrap, update, maintain or rewrite a dozen existing programs for every new one.

KEEPS ALL ITS PROMISES

Many DBMS packages promise to do everything we have just told you Series 80 TOTAL does. But when IDC asked DBMS users how they'd change their present package, Series 80 TOTAL was the only one of the three leading systems to emerge with a clean bill of health.

None of this is the least bit surprising. Because many of the new features and facilities that have made Series 80 TOTAL so successful come from more than 3,000 users who have used Series 80 TOTAL in almost half their operations over the last decade.

The end result is a DBMS that easily accommodates distributed processing, data base machines, even migration to the new IBM 4300 (because it supports VSAM) and TIS, Cincom's revolutionary new Total Information System. So, if you don't want to take our word, take the word of the users IDC surveyed.

Fill in the coupon below, or call Dennis Yablonsky, our National Sales Manager at (513) 662-2300 and we will review all the pertinent details of the IDC study. You will learn how Series 80 TOTAL has been designed and engineered for the 80's.

Contact us now, because the best time to find out how well a DBMS will do after it's installed, is before you buy it.

Please bring me proof of why Series 80 TOTAL outperforms the competition.

Name _____ Title _____

Company _____

Address _____

City State _____ Zip _____

Mail to: **U.S.A.**: Department D.C.
Cincom Systems, Inc., 2300 Montana Ave., Cincinnati, Ohio 45211, (513) 662-2300
International: Cincom Systems International, 17-19 Rue Montoyer, 1040 Brussels, Belgium, (02) 511-6548

Cincom Systems
Systems Software Division

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*Quantity prices start at $5,883 each for five units, the minimum factory order, with 16KB of main memory (32 and 48KB available) and two microfloppy disc drives. Each drive has its own controller and DMA channel.

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Speeds screen generation.

The Model 3500's Screen Generator software makes developing transaction processing applications especially easy, from screen formatting right through to establishing, maintaining, and accessing the associated disc files and interfacing with the application tasks.

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MANUFACTURERS AND PRODUCTS

In DATAMATION's 1980 survey to determine the top data communications manufacturers, companies were asked to indicate how their products were divided among six major categories: network/node controllers, computer front-ends, modems/multiplexors, test equipment, switching, and other.

A definition of each of the six categories precedes the list of companies that offer those products. The companies are listed under each category in which they manufacture products, and a company profile is provided under the category from which the majority of its data com revenue is derived. Thus Digital Communications Associates, Inc.'s name will be found under the controller, front-end, and modem/multiplexor headings and its profile under modems/multiplexors. Except for 100% product companies such as IBM and Memorex (front-ends) and Rixon (modems/multiplexors), most manufacturers appear in several categories.

What name should appear on the list has always been something of a debate. This year the following rule of thumb that was followed as closely as possible (sometimes without success): subsidiaries of companies appear under their own name (such as Periphonics, a subsidiary of Exxon), while divisions appear as the parent company on the list (e.g., 3M), but the division's name is given prominence in the list of manufacturers (e.g., Interactive 3M).

Finally, the reporting was done on a fiscal year basis, where a company's reporting cycle is different than the calendar year. In an up market like this one, such reporting can work to the disadvantage of some firms' rankings, since they are reporting revenues from an earlier, less productive period. Business done in a fiscal year which ends on March 31, for example, is for sales through March 31, 1979—a year ago.

There is at least one company which reported a negative income; we urge caution about classing anyone as a loser in any way. Spending money on development and staking out new market territories is a common characteristic of these companies, which comes across in the profiles.

NETWORK/NODE CONTROLLERS: Specialized processors which perform communications control functions within data communications netwoks. Typically used in distributed processing network configurations, these processors act as controllers to maintain communications.

BOLT BERANEK AND NEWMAN, INC.
33 Moulton St.
Cambridge, MA 02238
(617) 491-1850

Bolt Beranek and Newman, Inc. is the data communications subsidiary of BBN Computer Corp. BBN, Inc. developed ARPANET, one of the pioneers of packet-switching networks, which it now operates for The Department of Defense. It is also the founder of Telenet, a network of 91 switching centers in 182 U.S. cities. In June 1979, Telenet merged with GTE, the culmination of a major effort on BBN's part to transform its developed packet-switching technology into a nationwide public data communications network. While its business is split into acoustics and computer technology, BBN has now transferred expertise in packet switching to its new manufacturing company—BBN Computer Corp. This year BBN unveiled its new C/30 packet-switch processor—a very fast, powerful, microprogrammed cpu. We estimate BBN's data communication revenues to be at $12.4 million, or about 33% of its total revenues. This number reflects a gain of about $2 million over the previous year.

(Rockwell International Corp.) COLLINS COMMUNICATION SWITCHING SYSTEMS DIV.
P.O. Box 10462
Dallas, TX 75207
(214) 996-2336

Collins Communication Switching Systems Div. is the data communications arm of Rockwell. It is here the design, development, and manufacture of data communication and digital voice switching systems takes place. Its products fall into the categories of controllers, computer front-ends, and switching. The C-System for computer front-ending is its baby and is used by commercial banks to interface specialized financial wire services and to automate internal processing for such transactions. The Rockwell financial network controller is a standalone front-end switching system designed to integrate dissimilar networks such as SNA and Telex. Collins specializes in supplying large scale, multicenter, high reliability communication networks on a turnkey basis. Although Collins' financial reporting is hidden beneath the layers of Rockwell's, we estimate it contributed much less than 1%, or $5 million, to Rockwell's $6.8 billion total revenues last year.

COMPUTER COMMUNICATIONS, INC.

CONTROL DATA

DATASTREAM COMMUNICATIONS, INC.

DIGITAL COMMUNICATIONS ASSOCIATES, INC.

DIGITAL COMMUNICATIONS CORP.
117 Exploration Lane
Germantown, MD 20767
(301) 428-5500

Digital Communications Corp., a subsidiary of M/A Com, did $11.9 million worth of data communications business last year under its Data Communication Div. DCD manufacturers a wide variety of equipment, including controllers, front-ends, modems and multiplexors, and switching devices. This year it introduced the CM9100, a low-cost concentrator multiplexor fashioned after its CM9000, a multiple microprocessor. DCC also offers the Bus Interface Unit (BIU), which is a wall mounted device that allows economical interconnectivity among hundreds of terminals and computers in a local data distribution system using a single high-speed cable bus, such as used by CATV systems. Last year DCC's total revenue was $30 million of which slightly more than one-third was brought in by the data communications end of the business. Two new major network customers last year resulted in a spectacular jump in revenues—to $11.9 million, from $1.4 million the year before.

MICOM SYSTEMS, INC.

NCR CORP.

TRAN TELECOMMUNICATIONS

COMPUTER FRONT-ENDS: specialized processors attached to mainframe cpus which handle communications control between computer and network. The front-end performs network control and access method functions so that data transmitted over the network can be assimilated by the computer.

BOLT BERANEK & NEWMAN, INC.

BURROUGHS CORP.
Burroughs Place
Detroit, MI 48232
(313) 972-7267

Burroughs is second to IBM in the dp equipment business and is a principal supplier of node controllers to the SWIFT network. The company remains well poised, through its Redactron word processing systems, its office equipment, and its Dexnet facsimile network, to capture its share of the developing office communications market. It labels its new B6900, in the medium- to large-scale family, as a step toward the "coming era of worldwide computer networks."

(Rockwell International)
COLLINS COMMUNICATION SWITCHING SYSTEMS DIV.

COMPUTER COMMUNICATIONS, INC.
2610 Columbia St.
Torrance, CA 90503
(213) 320-9101

Computer Communications Inc. is an independent supplier of data communications systems. It manufacturers a bit of everything in this field: network controllers, computer front-ends, multiplexors, switching equipment, and software products. CCI produced the IBM 270X/370X emulation/front-end processor, sophisticated networking including remote concentration, and airlines reservations systems. CCI was formed in 1966. This year it introduced the CC-85 Advanced Communications Processor and the C-8R Remote Concentrator. CCI recently made an agreement to supply communications processors to Codex. Having reported healthy growth in both sales revenue and net income, CCI's 1979 revenue is at the $18.2 million mark.

CONTROL DATA CORP.
Box O
Minneapolis, MN 55440
(612) 853-4656

Control Data Corp. had an excellent year, with data communications revenue up to the $40 million mark, according to CDC estimates. An upward trend started last year, when CDC clocked $15 million, as contrasted with 1977, when the revenue in the data communications field was about $12 million. Its business is three-quarters in the controller field with the remaining income coming from computer front-ends. CDC's Cyber 1000 product line is marketed as either a protected message exchange or distribution network. CDC's 252X series network system provides communication capabilities for CDC Cyber 170, 70, 6,000, and 3,000 product lines. CDC recently moved its Communications Div. from Santa Ana to Anaheim.

DATASTREAM COMMUNICATIONS, INC.
555B Ellis St.
Mountain View, CA 94043
(415) 965-9911

Datastream is the producer of small front-end processors which can attach to minis or to large computers to handle protocol conversion, message routing, message translation between dissimilar terminals, or cpus—many of the functions which Bell's ACS intended to provide. In addition, Datastream manufactures controllers and modems and multiplexors. Started in 1973, this is a closely held private company. We estimate its 1979 revenues to be at the $2.2 million level, a half-million increase over the previous year. The company recently moved from Brisbane to Mountain View, Calif.

DIGITAL COMMUNICATIONS ASSOCIATES, INC.

DIGITAL COMMUNICATIONS CORP.

HEWLETT-PACKARD CO.
1501 Page Mill Rd.
Palo Alto, CA 94304
(415) 857-1501

Hewlett-Packard makes two general categories of data communications equipment: specialized test equipment and data facilities to link data acquisition equipment to computers and other peripherals. Examples of HP specialized data communications test equipment include pattern-generator/error-detectors and automatic data network surveillance systems. The data specific test and measurement products are thought to be about 5% of the total test and measurement business done by HP. Data links to interconnect HP computers and their peripherals constitute a small fraction of equipment sales. HP estimates sales for fiscal year 1979 of test equipment was $10 million, and sales in front-ends was $19.5 million. While some unknown number of HP small computers are in use as communication controllers, none have been included in the $29.5 million total estimate.

HONEYWELL, INC.
Honeywell Plaza
Minneapolis, MN 55408
(612) 870-5200

Honeywell's communications front-ends claim ancestry going back at least to the joint project between General Electric and Dartmouth which led to BASIC language and time-sharing. Although Honeywell's smaller computers have integrated communications, its large-scale machines have had separate communication boxes at least through the beginning of the third generation, when those large scale machines wore GE labels (and beat IBM into the third-generation marketplace). Honeywell takes a slightly different tack on its front-end processors too, allowing the direct attachment of disks, for instance, to log communications traffic independently. The main part of Honeywell's current front-end business is in attaching such devices to Level 66 DPS, DPS 8 and Level 68. The firm also owns Spectronics (which is developing fiber-optic data communications gear but is not yet a significant data com revenue generator), and a Florida branch that builds suchs things as modems, primarily for the military. Although Honeywell does not break out its data com revenues, we estimate this to be about 1% of its annual revenues for FY 79 of $1.4 billion, or $14.5 million.

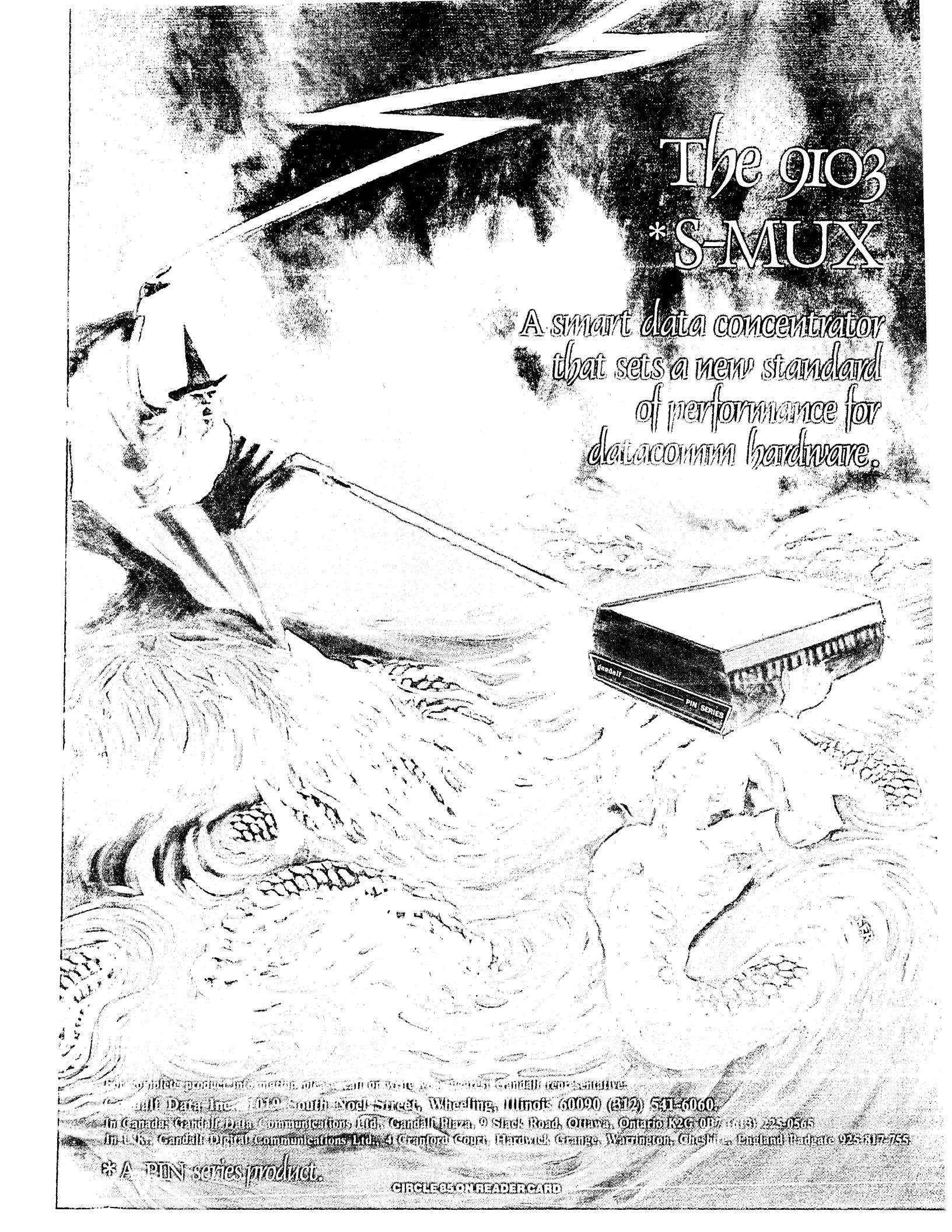
IBM
Armonk, NY 10504
(914) 765-1900

IBM's 370X series front-end processors still qualify it as the unequivocal leader in the data communications industry. It has also recently gotten into the modem production end of the industry, but as yet has not marketed any test equipment. Although IBM does not break out its data communications figures specifically, we estimate its annual revenue to be 1% of IBM's total business, or about $158 million for fiscal 1979.

(3M)
INTERACTIVE/3M

MEMOREX CORP.
San Tomas at Central Expressway
Santa Clara, CA 95052
(408) 987-1000

Memorex is one of the few companies manufacturing data communications products for both ends of the transmission line. Memorex's 1270 hard-wired communications controller supports a wide variety of synchronous and asynchronous terminals, line types, modems operating systems, and software. Intelligence has now been added to the 1270 with ILA (Intelligent Line Adapter), a microprocessor-based component that provides system flexibility. The Memorex 1380 communications processor is a programmable communications controller that uses intelligence in emulation mode, performing control and monitoring functions without demanding host cpu time and storage. We estimate Memorex's data communications revenue to be 7.3% of total revenue, or about $53.9 million. Last year Memorex's data com revenues were listed at just over $8 mil-



For complete product information, please call or write your nearest Gandalf representative.
Gandalf Data, Inc., 1019 South Wood Street, Wheeling, Illinois 60090 (312) 541-6060.
In Canada: Gandalf Data Communications Ltd., Gandalf Plaza, 9 Shaw Road, Ottawa, Ontario K2G 0B7 (613) 225-0565
In U.K.: Gandalf Digital Communications Ltd., 4 Cranford Court, Hardwick Grange, Warrington, Cheshire, England Padgate 925-817-755

*A PIN series product.

CIRCLE 85 ON READER CARD

lion, or a little over 1% of its total revenues. Those figures were too low, a result of first year information gathering.

NCR CORP.
1700 S. Patterson Blvd.
Dayton, OH 45479
(513) 449-2000

NCR has always been one of the leading data com manufacturers, appearing on last year's list as the 17th biggest company. Last June NCR acquired Comtem, last year's fourth largest company. The financial figures presented represent the combined NCR-Comten operations in the data communication field. NCR Corp. now has the luxury of offering potential users products from two areas. Computer front-ends remain the dominant product offering, with Comten the largest independent manufacturer of such devices and NCR bringing two of its own models into the merger.

PERIPHONICS CORP.
75 Orville Dr.
Bohemia, NY 11716
(516) 567-1000

Periphonics is now a wholly owned subsidiary of Exxon. Its main business is the manufacture of communication front-ends used by the banking industry, among other concerns. Periphonics also produces audio response systems. This company is best known for its T-Com 7, a commercial front-end processor, and the audio response system Voice Pac 2000. Revenue for fiscal 1979 reached the $11 million mark.

SPERRY UNIVAC
P.O. Box 500
Blue Bell, PA 19424
(215) 542-4736

Sperry Univac computer operations had a strong year. Revenue and income increased substantially, and at year-end the installed base exceeded $10 billion, an increase of 13% over the previous year. In the data communications field, it manufactures computer front-ends. The big product here is the Distributed Communications Processor (DCP) which connects to anything in Univac's line from 9060 up. Univac has introduced the Distributor Communications Processor/40, and it will be worth watching closely as to its effects on the industry. The data communications revenue, which is slightly more than 1% of Univac's $2 billion business, brought in about $23.7 million to the coffers last year. This is a substantial increase from the $15.6 million of the year before.

MODEM: since a business machine generates a digital signal and conventional phone lines accept only an analog signal, it is necesary to MODulate the signal on the transmit end and DEModulate the signal on the receive end. A modem is the device that performs these modulation/demodulation functions.

MULTIPLEXOR: a device that makes it possible to transmit two or more messages simultaneously over a single channel or other transmission facility.

ANDERSON JACOBSON, INC.
521 Charcot Ave.
San Jose, CA 95131
(408) 263-8520

Anderson Jacobson has just completed its 12th year as a manufacturer of proprietary computer terminals and data communications equipment. In its data communications line are found acoustic couplers and modems. We estimate that the coupler and modems are now bringing in about 25% of the firm's revenue, or about $29.7 million for fiscal 1979. New product development expenditures of $1.6 million for fiscal year 1979 represented an 11% increase over the previous year. The continued emphasis on new product research and development resulted in the introduction during the past year of the AJ1234, a 1200 baud acoustic coupler, and its modem equivalent, the AJ1255.

ASTROCOM
120 West Plato Blvd.
St. Paul, MN 55107
(612) 227-8651

Astrocom, appearing for the first time in this survey, is the maker of synchronous and asynchronous short haul modems (to 300bps), acoustic couplers, and asynchronous long haul modems, as well as a modem emulator. In the test equipment area two devices hold sway: the Mini-Check, a bit error test set, and the Maxi-Check. The company's net income loss was due to the starting up of a small business computer division. Astrocom's other major line of production is printed circuit cards. The company, formed in 1968, reports data communication revenue of $2.3 million, or 60% of its total revenue.

COMDATA CORP.
8115 Monticello
Skokie, IL 60076
(312) 677-3900

ComData is a manufacturer of multiplexors, acoustic couplers, and modems of all speeds. Modems and multiplexors contribute 80% of the total revenue, with 20% going to the couplers. A privately held corporation, it was established late in 1968 after the Carterfone decision. Since that time it has developed its operations to the $3 million point.

COMPUTER COMMUNICATIONS

DATA ACCESS

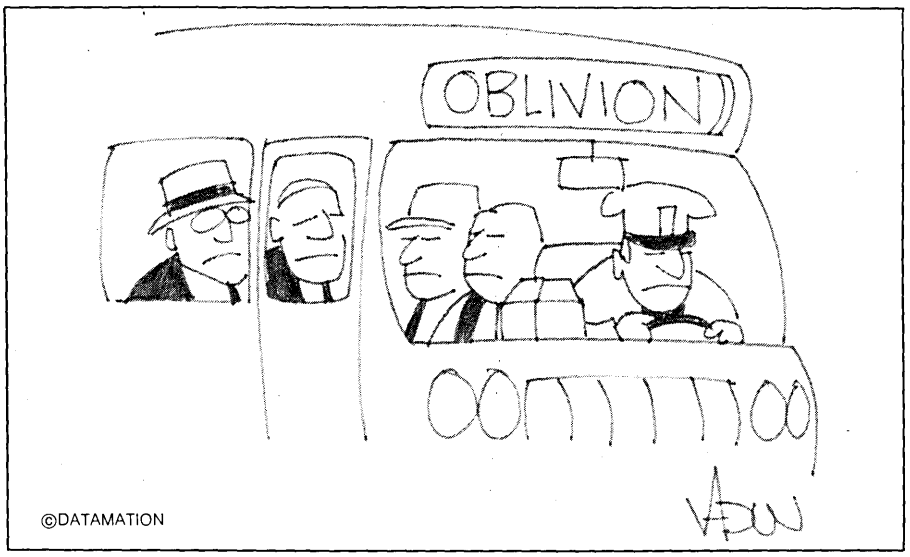
DATASTREAM COMMUNICATIONS

DIGITAL COMMUNICATIONS ASSOCIATES, INC.
135 Technology Park/Atlanta
Norcross, GA 30092
(404) 448-1400

DCA made its appearance on the data communications scene in 1972 and since then has done well. Last year its name appeared in the number 50 slot on the list of top manufacturers; this year it's climbed up quite a bit. Fiscal year earnings totaled $2.7 million ($3.8 million on a calendar basis) as it continued to make strides in the production of statistical multiplexors and nextwork processors. Currently DCA has three series of statistical multiplexors: the 100 transparent line of stat mux; the Series 200, which consists of data com front-ends for DEC computers; and the Series 300, which is the newest line of transparent high performance network processors. DCA prides itself that all networking systems are compatible and are easily expandable.

DIGITAL COMMUNICATIONS CORP.

DYNATECH CORP.



CARTOON BY CHUCK VADUN

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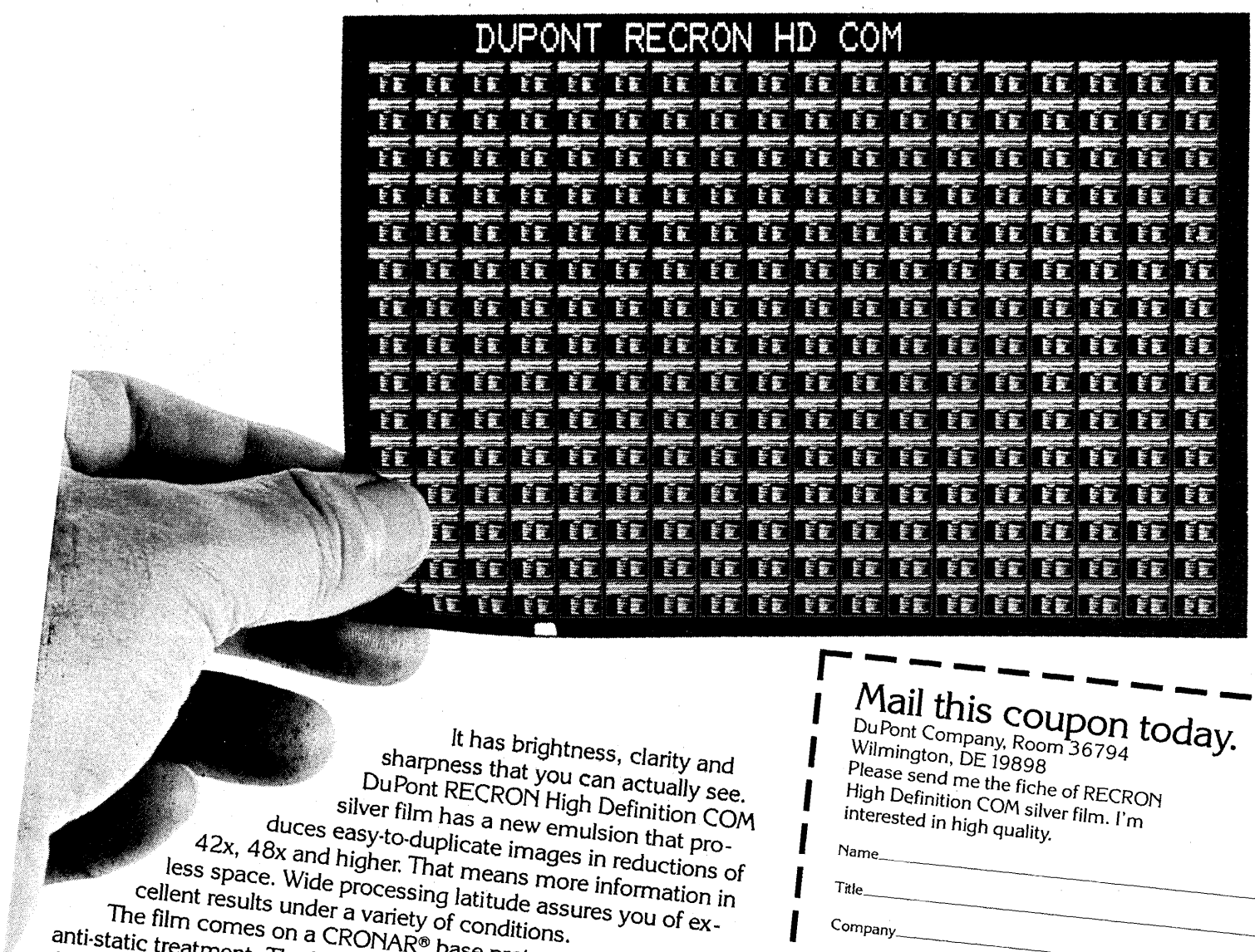

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DuPont Company, Room 36794
Wilmington, DE 19898

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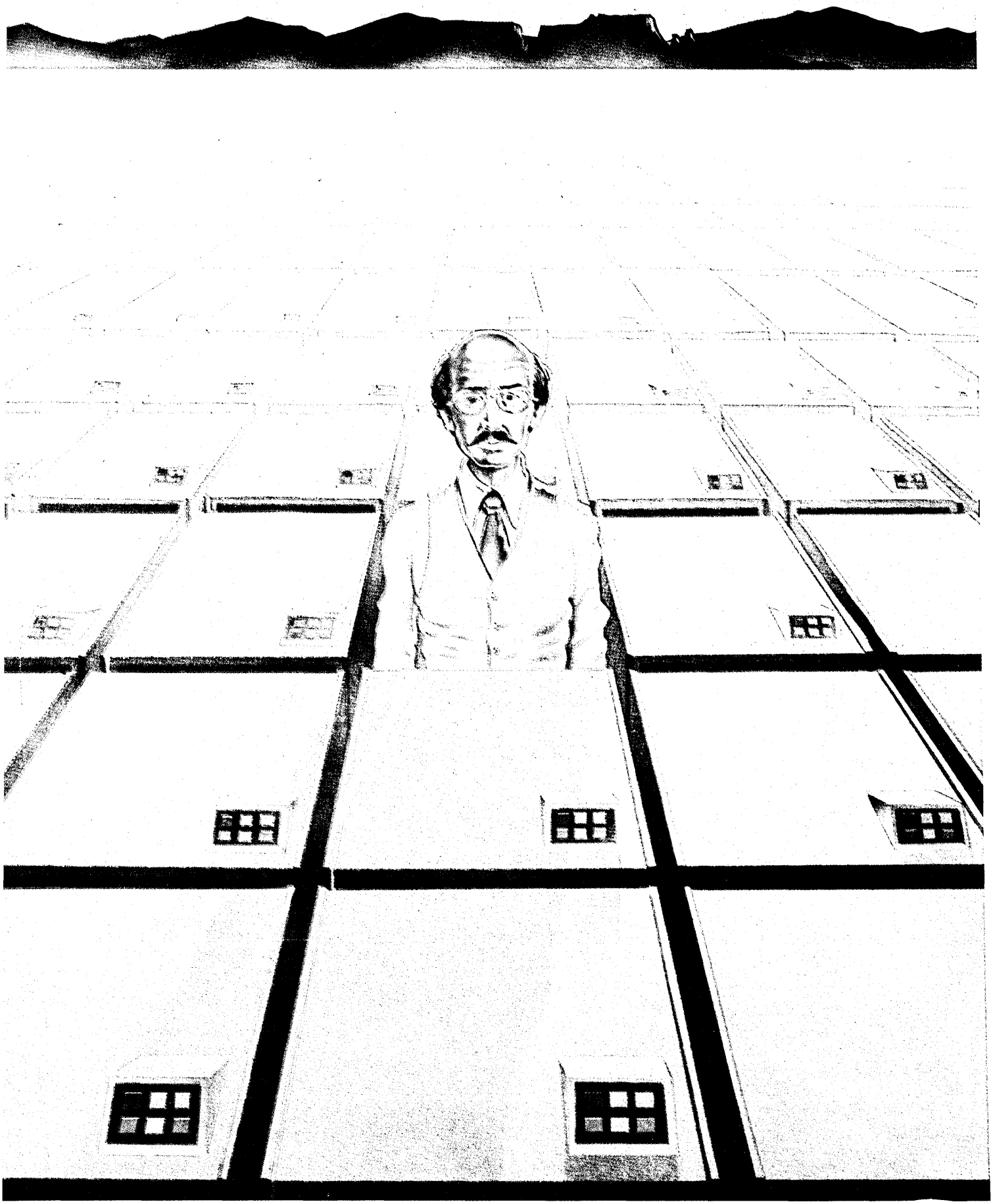

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GANDALF DATA INC.
1019 S. Noel Ave.
Wheeling, IL 60090
(312) 541-6060

Gandalf, founded in 1974, manufacturers a broad base of modems, multiplexors and data switches. The U.S. branch does the manufacturing and selling for the U.S. market while the designs come out of the Canadian parent company. The parent also manufactures for the international market. Its products include modem eliminators and short-haul modems which can have multichannel interfaces. Among Gandalf's new products are the SM9600, which is a long-haul 9600bps modem, a statistical mux, and a new line of asynchronous short-haul modems. Gandalf has now begun to shift emphasis to forming a broadened data communication base of products. Last year its efforts pulled in $5.5 million, a healthy 40% increase over the year before. Combined sales of Gandalf and its Canadian parent were over $12 million for 1979.

GENERAL DATACOMM INDUSTRIES, INC.
One Kennedy Avenue
Danbury, CT 06810
(203) 797-0711

General DataComm believes it is now the largest independent supplier of equipment to the data communications market, claiming it represents 10% of the total market and has captured 25% of the low speed data transmission business. The equipment made by GDC includes time division and frequency division multiplexors, a wide range of data sets, and network diagnostic equipment to monitor and maintain data communications systems. In 1979, GDC introduced its 1240 and 1241 statistical multiplexors, which can achieve multiplexing efficiencies far exceeding those offered by hard-wire logic multiplexors through the application of advanced microprocessing techniques. It also launched the GDC 4801 Fast Poll Modem, which incorporates state-of-the-art techniques featuring microprocessor elements for internal signal procesing. Sales grew 34% over last year with the most significant gains coming in the international market. The overall company revenue is marked at $41.7 million.

(Harvey Hubbell Inc.)
PULSECOM
5714 Columbia Pike
Falls Church, VA 22041
(703) 998-4300

Hubbell's Pulse Communications Div. represents its participation in the data communications market. Pulsecom supplies advanced equipment to more than 2,000 customers worldwide for voice and data transmission over telephone lines. Although Pulsecom represents a small part of Hubbell's total sales, we estimate its contribution to be around the $2.5 million mark.

INFOTRON SYSTEMS CORP.
Cherry Hill Industrial Center
Cherry Hill, NJ 08003
(609) 424-9400

Infotron, a privately held company formed in 1968, features a line of statistical multiplexors, modems, and data switches as its primary products. The multiplexors operate in intelligent time division and conventional time modes. Also offered are computer port selectors and processor interfaces. Last year three new products, including two modems and a data switch, were introduced. On the financial side, revenues increased by $4 million to $18.7 million for FY'79. Infotron had also opened direct sales offices in nine cities and relocated its engineering department to its own 15,000 square foot building.

(3M)
INTERACTIVE SYSTEMS/3M
3980 Varsity Dr.
Ann Arbor, MI 48104
(313) 973-1500

3M's listing represents its purchase of last year's 42nd largest company Interactive Systems located in Ann Arbor, Mich. IS/3M is now a part of 3M's Telecom Division. IS/3M is in the business of manufacturing coax cable networks for carrying voice, data, and video in-plant. The pieces of the networks include modems, multiplexors and intelligent multiplexors which front-end the cpu. In an attempt to expand its product line into the broadband total communications systems components for oems and end-users, it introduced the model 920 Universal Broadband Communication modem and the model 460 multichannel frequency switch.

INTERTEL, INC.
6 Vine Brook Park
Burlington, MA 01803
(617) 273-0950

Intertel closed out its first decade with company revenues reaching the $15 million mark. Its revenues come from the sale of high-speed modems and a related network of monitoring and diagnostic equipment. The latter is its microprocessor based EMS 1 series, which provides for automatic or manual monitoring of data communications lines. Among the new product offerings last year was the M1200, the RAP1000 and the ACH410. Intertel plans to relocate to a new 83,000 square foot facility in Andover, Mass., this July.

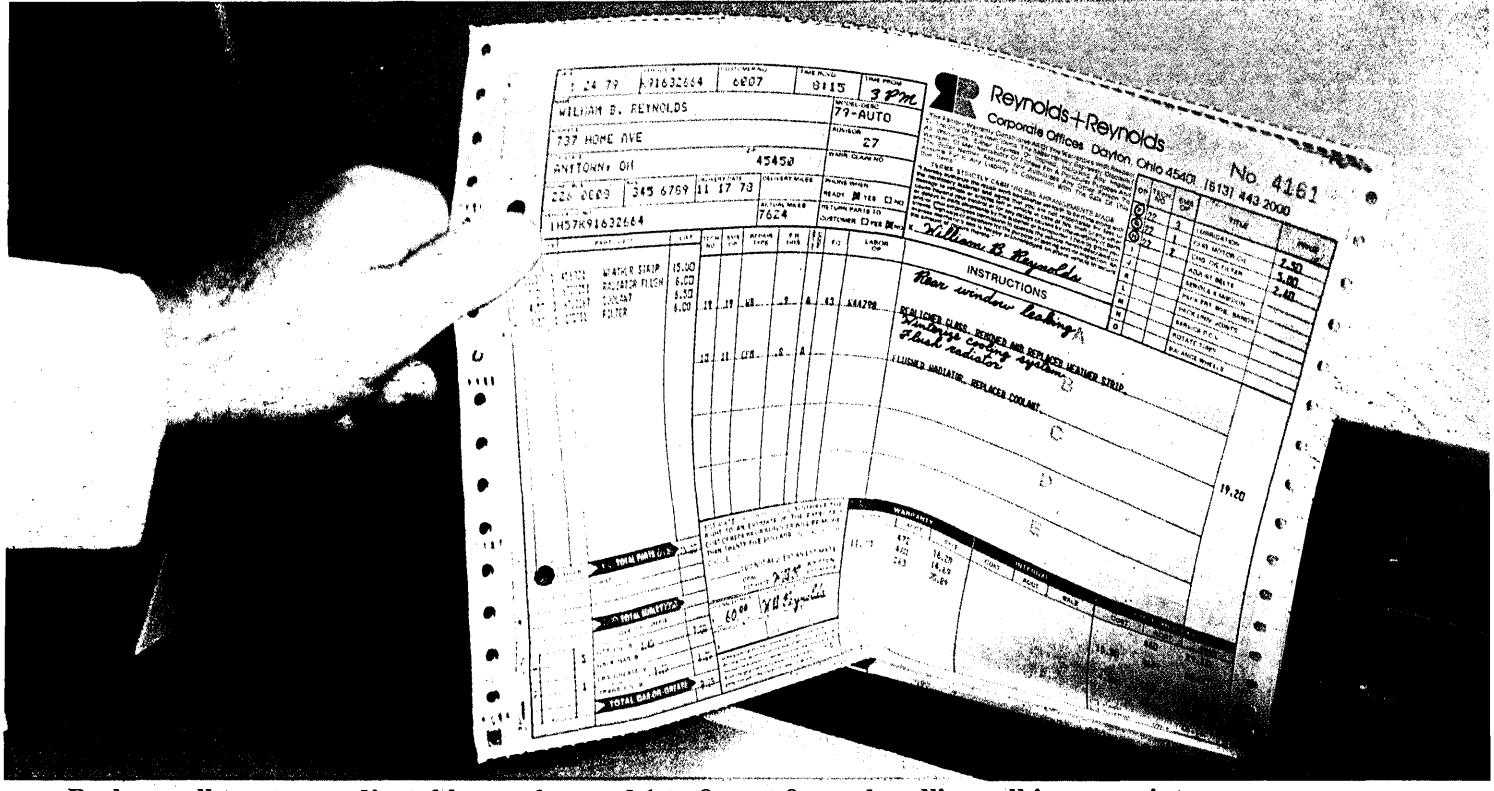
LIVERMORE DATA SYSTEMS, INC.
2050 Research Dr.
Livermore, CA 94550
(415) 447-2252

Livermore Data Systems is in the business of manufacturing modems. The company manufactures a 300 baud acoustic coupler called the Star, which was introduced last year. The Star is an answer and originate, half and full duplex system with full diagnostic capabilities. This 11-year-old company reports 1979 revenues at the $3.4 million mark.

MICOM SYSTEMS, INC.
9551 Irondale Ave.
Chatsworth, CA 91311
(213) 882-6890

Micom, a privately held corporation founded in 1973, recorded a revenue and net income increase last year of 300%. The company's products address the three fundamental prob-

CARTOON BY HARLEY L. SCHWADRON



Push-n-pull tractors, adjustable tear bar and 1-to-9 part forms handling: all in one printer.

Great rip-offs: Just one way TermiNet® 200 printers give you no-waste forms access

Finally, real-time forms access plus continuous forms output in one printer. Perfect for such applications as airline ticketing, invoicing, order preparation and more. And another example of the expanding TermiNet 200 printer family's application versatility.

No-waste, flexible forms control

One reason: an adjustable tear bar that lets you use standard forms with different header lengths. For precise alignment, no paper waste and clean paper tear. Every time.

More reasons: servo-driven tractors that allow infinite manual adjustment in both forward and reverse. A non-volatile electronic VFU that makes forms set-up easy and permits storage of up to 8 vertical formats. A down-line loading option enabling you to load formats directly from your data source. Plus straight-through paper path and push-n-pull tractors that give you perfect first-to-last-copy registration. As well as smoother paper handling for all types of forms, including single-part paper.

More features add up to more application versatility

With TermiNet 200 printers, you can also get a 9 x 9 printhead for exceptionally legible underlining and lowercase descenders. Two complete 96-character switchable print fonts for ASCII/APL use or your own special needs. A choice of Magnetic Tape or Edit Buffer Accessory. Plus a 100% duty cycle capability, excellent print quality at speeds up to 200 cps and low cost of ownership. All of which help make TermiNet 200 teleprinters and line printers the industry workhorses.

Immediate delivery instead of piecemeal allocation

Why wait months for other printers when TermiNet 200 printers are available now? When you need them. Mail the coupon today and find out how the expanding TermiNet 200 printer family can meet your range of application needs and generate real cost savings.

Mail today to:
J. Walsh,
General Electric Company,
TermiNet 794-49
Waynesboro, VA 22980.
Telephone: (703) 949-1474.

☐ Send me more information about the expanding TermiNet 200 printer family.

☐ Have a sales representative contact me.

☐ I'm also interested in a TermiNet 200 printer demonstration.

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Title _____

Company _____

City _____ State _____ Zip _____

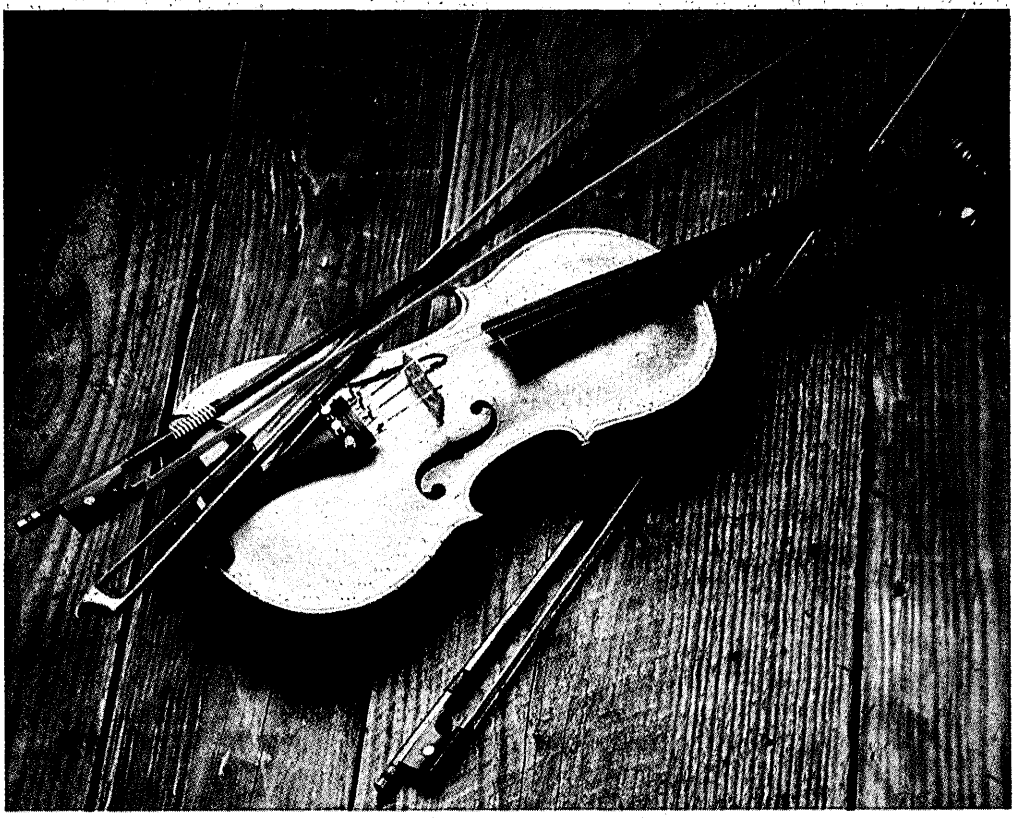
Telephone _____

Quality that will make a lasting impression

GENERAL ELECTRIC

CIRCLE 100 ON READER CARD

TO EVERYONE WHO'S SAID, "DATA TRANSMISSION ERRORS ARE INEVITABLE,"



FIDDLESTICKS.

DCA statistical multiplexors/network processors have been providing error-free data transmission in terminal-to-computer networks since 1974. And DCA equipment is completely protocol compatible — our newest stat muxes communicate error-free with our six-year old models. So if you can't afford mistakes, contact DCA — the company that made errors obsolete. Digital Communications Associates, Inc., 135 Technology Park/Atlanta, Norcross, GA 30092 404/448-1400.

dca

ENGINEERED TO EXPAND

CIRCLE 101 ON READER CARD

DCA announces new high-performance network processors that lower data communications costs

A new concept in datacomm networks was introduced at Interface '80. The DCA Series 300 statistical multiplexor/network processor line is the foundation for a range of products that can be upgraded with future technology. A unique "building block" approach based on DCA's proven Integrated Network Architecture (INA) allows networks to grow either in size or performance — or both. Thus, small networks can be configured without paying for performance that would never be used. And by the same token, any network — large or small — can have "big network" features.

Modular Network Expansion. For networks that are bound to grow, Series 300 continues a DCA tradition: highly cost-effective modular expansion. The series supports from 1 to 62 trunk links so networks that begin small can grow into the future. The new series is also completely compatible with all existing INA network processors — the current Series 100 line can even be upgraded in the field to the Series 300 level!

Modular Performance. Common hardware is used extensively, and Series 300 actually achieves greater results (10 to 20 times the throughput of presently-available technology) with less hardware than ever before. This unique growth-oriented architecture allows system performance to be improved at very low cost and without obsoleting investments made in DCA components.

DCA's microprocessor-based processing modules (PMs), for example, can be interchanged to achieve just the level of performance that's needed for a particular network. Because system programs are software loaded, the same PMs can be used throughout the entire series. They can be programmed and updated to perform any networking function, yet since they are identical until programmed, a single PM acts as a spare for the entire series.

Advanced Features. Series 300 supports any asynchronous and certain synchronous terminals, plus a multitude of network protocols — including X.25. Series 300 offers a private network as a superior performing, low-cost alternative to packet-switched networks. DCA's exclusive protocol conversion modules will give terminal users access to virtually any host computer. Extensive self-diagnostic capabilities surpass anything currently on the market.

Like other INA systems, Series 300 offers multipoint multiplexing, error-free data transmission, port contention, host selection, and a multitude of other features that reduce data communications costs.

Before you buy a network to meet today's needs, check out the network that's designed to meet tomorrow's needs as well. For complete details on the Series 300 network processors, write or call DCA today. Digital Communications Associates, Inc., 135 Technology Park/Atlanta, Norcross, GA 30092. 404/448-1400.

dca

ENGINEERED TO EXPAND

CIRCLE 102 ON READER CARD

lem areas of line costs, transmission errors, and computer port utilization, especially where microcomputers are involved. It is best known for its Micro800 Data Concentrator, a low cost statistical multiplexor. Since its introduction in January 1978, more than 10,000 of these units have been installed. The Micro800 is now complemented by the Micro900 Multidrop Concentrator, which allows dumb terminals, for the first time, to be multidropped without special software. Also at bat for the first time is the Micro500 Error Controller, which guarantees error-free data communication for dumb terminals, and the Micro600 Port Selector, which allows dumb terminals to select host computers in a multiple computer environment. These additions to its line helped bring in $15.4 million worth of revenues last year.

(Motorola)
CODEX
20 Cabot Blvd.
Mansfield, MA 02048
(617) 364-2000

UDS
4900 Bradford Dr.
Huntsville, AL 35805
(205) 837-8100

Motorola's data com operations are provided by two major U.S. subsidiaries: Codex in Mansfield, Mass., and Universal Data Systems (UDS) in Alabama. The parent company does not break out the revenue and data com figures for either subsidiary. Among new data com product announcements last year were the 6520 communications front-end processor, the CDX-68 family of intelligent terminals, and the LSI 48 v/.27 data modem.

NOVATION, INC.
18664 Oxnard St.
Tarzana, CA 91356
(213) 996-5060

Novation's business is acoustic couplers, low and medium speed direct modems, and automatic dialers. The couplers range up to 300baud and the modems to 1200baud. A privately held company, it made its appearance on the data communications scene in 1967. Novation reported an annual revenue of $3.5 million for last year.

(Nytronics, Inc.)
OMNITEC
2405 S. 20th St.
Phoenix, AZ 85034
(602) 258-8244

Nytronics' niche in the data communications chart is provided by its Omnitec Data Products Div., which manufactures components for computer time-sharing and message communications equipment. In fiscal 1979, this division accounted for 2% of the company's sales and 1% of its operating profit. Omnitec's product line consists of two major items —acoustic telephone couplers and modems. When the division was organized in 1965, the acoustic coupler was its principal product, and in 1979 the coupler continued to account for over half of its sales. Recently Omnitec began to increase its production of modems and at present is developing nine modems, five of which will be in production during fiscal year '80. Last year it also obtained a license from Western Electric to manufacture and market a variable speed modem. Omnitec's products are sold to the oem market through distributors, manufacturers' reps, and directly to certain factory users.

PARADYNE CORP.
8550 Ulmerton Rd.
Largo, FL 33542
(813) 536-4771

Paradyne celebrated its 10th anniversary in the data communications industry last year. Among its presents was an increase in company revenues of about 65%, bringing the figure to just over $41 million. The company develops, manufactures, markets, and services high speed data communications equipment. Its products are offered in system configurations to handle the transmission of data among computers and peripheral devices via public and private communications media, principally telephone lines. Primary products are medium and high speed modems and the PIX/PIXNET systems. PIX/PIXNET is designed to provide more efficient communications between remote peripheral devices and IBM computers. In 1979 Paradyne announced a new product called RESPONSE, which provides users with a distributed data processing capability placing application hardware and software in remote locations utilizing PIXNET for its communications function.

PENRIL CORP.
5520 Randolph Rd.
Rockville, MD 20852
(301) 881-8151

Penril's Data Communications Div. manufactures a broad range of low, medium, and high speed modems which have put Penril on the map of data com equipment makers. It also offers styles that are compatible with European common carrier specifications and short-haul modems. All of the modems in Penril's line contain basic built-in diagnostic capabilities, but several models go significantly further, offering extensive centralized diagnostic testing, monitoring, and control of the complete data com network. A large year-end sale in '78 pushed revenues up to $4.9 million, compared to $4.1 million last year. The company is already projecting record revenues for FY '80, saying the first half of this fiscal year saw sales totaling $4.4 million. As a result of two product line acquisitions the division now offers Bell compatibility, including a 300/1200 modem introduced in February of last year. The second product acquisition in the summer of '79 brought to the company a line of Bell-compatible modems from the Tele-Dynamics Div. of AMBAC Industries Inc.

PRENTICE CORP.
266 Caspian Dr.
Sunnyvale, CA 94086
(408) 734-9810

Prentice is a full-line supplier of low-speed Bell compatible modems, short-haul modems, and statistical multiplexors. The product emphasis is on diagnostics, packaging, and other user conveniences. The 10-year-old company saw revenues of $5.2 million last year. Several new products were added to its offerings, including a statistical multiplexor and full duplex line of modems, which includes a Bell-type 212A. Two other major changes during the past year were the official change of the company's name from Prentice Electronic Corp. and location change to Sunnyvale from its old home in Palo Alto.

RACAL-MILGO, INC.
8600 N.W. 41st. St.
Miami, FL 33166
(305) 591-5225

Racal-Milgo is a subsidiary of Racal Electronics Ltd. of Bracknell, England, and is among the leading manufacturers of data communications products, including modems and a network of management and control systems as well as terminals. The modems are of the medium-speed, high-speed, wide-band and short-haul variety. These account for 80% of the data communications revenue. Last year new loop modems, clustered terminals, and data security products were launched. This Miami-based firm also conducts business in California, England, Japan, Germany, and Argentina. The data com revenue figure of $121 million is adjusted to the 12-month 1979 calendar year. For its FY 78/79 which ended Mar. 31, 1979, the revenue figure was $83 million. Revenues for this company and its sister company, Racal-Vadic, are listed separately.

RACAL-VADIC, INC.
222 Caspian Dr.
Sunnyvale, CA 94086
(408) 744-0810

Racal-Vadic, sister company of Racal-Milgo, manufactures low- and medium-speed modems with speeds of 300, 1200 and 2400 bps, acoustic couplers and automatic dialers. Its dial-up modems are FCC registered and directly connect to telephone lines, and are available in rack-mounted and standalone form. Racal-Vadic has introduced several new products, including a triple modem and a modem compliant with CCITT recommendation V.22 alternative C for use outside the

U.S. and Canada. Its products are marketed in the U.S. via stocking reps and distributors. In export market areas the products are sold and serviced through the same distribution network as Racal-Milgo of Miami, Fla.

RIXON, INC.
2120 Industrial Parkway
Silver Spring, MD 20904
(301) 622-2121

Rixon saw its 1979 revenues increase by 63%, bringing its annual revenue to $36.1 million. This company is a subsidiary of Sangmo, which is held by Weston, itself a subsidiary of Schlumberger. Products marketed include a complete range of modems from 300 to 9600 bps, line drivers and statistical multiplexors from 4 to 240 channels, and private line diagnostic and termination equipment round out the choices. Product distribution is mainly to commercial concerns, with about 5% of its sales going to the United States government. This year Rixon started to put a greater emphasis on expansion from a telephone company supplier to the end-user supply line. New product introductions included a Bell-type 209 modem with 9600 bps, a statistical mux, and LDM.

TEK-COM INC.
2142 Paragon Dr.
San Jose, CA 95131
(408) 263-7400

Founded in January 1977, Tek-Com has in a short time become an important supplier of acoustic couplers and modems. The basic product is the low-medium speed modem (0-2400 bps). Tek-Com offers the series 3000 data modems, which are designed for acoustic and hard-wire operations via the switched telephone network or private line installation. Of this line, Tek-Com produces the TC 3006 acoustic coupler, and the TC 3001 and TC 3002, which are acoustic coupler/modem devices. The company is 100% data communications-oriented and 100% in the modem field. Tek-Com estimates an annual revenue of $2.5 million for 1979.

TIMEPLEX, INC.
One Communications Plaza
Rochelle Park, NJ 07662
(201) 368-1113

Timeplex moved from Hackensack this year, transferring 65% of its staff to new corporate headquarters and engineering center. The 10-year-old public company's product offerings consist principally of data multiplexors. The newly released Series II Microplexer series of statistical multiplexors/data concentrators augments Timeplex's leading share in TDMs. Its newly formed modem division provides total data communication systems capabilities. Future plans call for expanding end-user and distribution sales, and keeping a close watch over direct sales and service subsidiaries in the United Kingdom. Last year Timeplex posted $13.6 million company revenue, all from sales in the data communications area.

TRAN TELECOMMUNICATIONS CORP.
2500 Walnut Ave.
Marina del Rey, CA 90291
(213) 822-3202

Tran Telecommunications develops public and private digital telecommunications networks, and manufactures computer-based network switching and management systems. Its products include test sets, modems—both high and low-speed—multiplexors, network access concentrators, and data switches. Tran lists among its "firsts" since beginning operation in 1969 the first optical transceiver (infrared) for short-haul high-speed wireless data communications, the first wide-band time division multiplexor for use within the Bell System, and the first nationwide digital data network (Canada's Dataroute). Among its new product introductions during the past fiscal year was XPRT, an X.25 protocol tester. Tran's revenues increased by 50% last year.

TEST EQUIPMENT: devices used to monitor the characteristics of communications lines. These devices usually provide detailed analyses of physical line parameters as well as monitoring the contents and formats of data being transmitted over these facilities.

ASTROCOM

ATLANTIC RESEARCH CORP.
5390 Cherokee Ave.
Alexandria, VA 22314
(703) 642-4416

In 1979 Atlantic Research strengthened its position in the data communications field by further establishing itself as a prime developer and supplier of test equipment. The Intershake Test System continued to be accepted in the marketplace as a powerful and versatile diagnostic test instrument, with sales remaining at a level of about $2 million. Also, a new product, the Interview 3000 series, was introduced at the end of 1979. The unit is primarily a data analyzer and is designed specifically with a less technical operation in mind. Another high point in FY '79 was a doubling of network control systems sales.

DIGITECH DATA INDUSTRIES, INC.
66 Grove St.
Ridgefield, CT 06877
(203) 438-3731

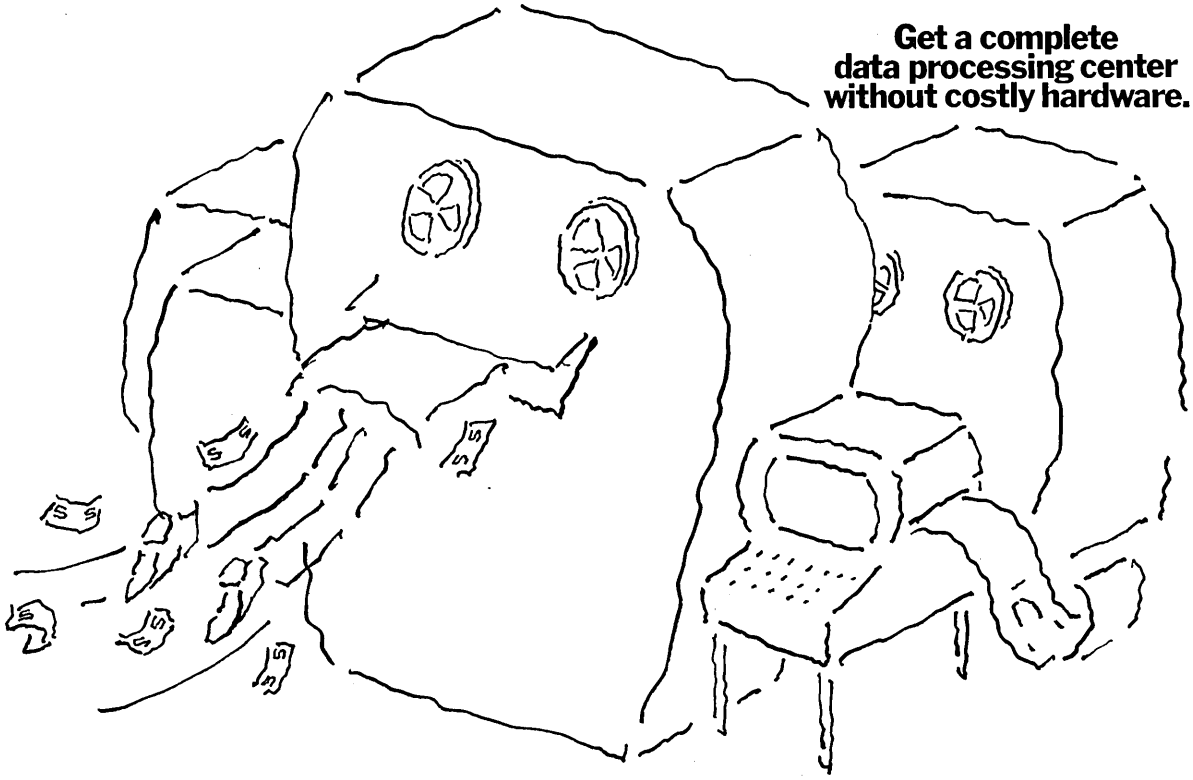
Digitech has the major distinction of being affiliated with one of the major data com carrier companies. A subsidiary of Central Telephone and Utilities, Digitech is a first timer on this list. It manufactures and markets digital diagnostic equipment for data communications products. Digitech, which was acquired in 1979, introduced its Encore data communications test unit, which has shown extremely strong sales results. During 1980 the company plans to introduce several new products, including a data line monitor called Data Monitor 200, which is a field diagnostic test system expected to perform more functions and cost less than competitive models. Digitech reports a $4.6 million 1979 fiscal year.

DYNATECH CORP.

"By heavens, Higgins, you're right. It *is* magic marker." ©DATAMATION

CARTOON BY JOSEPH A. DAWES

Get a complete data processing center without costly hardware.



Now there's a software package that can turn a minicomputer into a small-scale data processing center with from 5 to 40 terminals. The UNIX™ System.

UNIX Systems are time-sharing operating systems that are easy to program and maintain. So easy, in fact, that more than 800 systems are already in use outside the Bell System.

UNIX Systems give fast and efficient data processing. They feature more than 100 user utilities.

UNIX System, Seventh Edition, and UNIX/32V System. The new UNIX System, Seventh Edition, offers greatly enhanced capabilities, including a larger file system and inter-machine communications. The Seventh Edition is designed for PDP-11 minicomputers. For those needing its capabilities on a larger machine, the UNIX/32V System is available for the VAX-11/780. The Seventh Edition's improved portability features allow users to adapt it more easily to other computers.

Both the UNIX System, Seventh Edition, and the UNIX/32V System can support up to 40 users with FORTRAN 77 and high-level "C" languages.

Programmer's Workbench. For large software design projects, the PWB/UNIX System (Programmer's Workbench) allows up to 48 programmers to simultaneously create and maintain software for many computer applications. The PWB/UNIX System features a unique, flexible set of tools, including a Source Code Control System and a remote job entry capability for the System/370.

Developed for our own use, UNIX Systems are available under license from Western Electric and come "as is". With no maintenance agreements, no technical support.

For more information about UNIX Systems or other Bell System software, complete the coupon and mail to Bell System Software, P.O. Box 25000, Greensboro, N.C. 27420. Or call 919-697-6530. Telex 5109251176.

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DAT-11

To: Bell System Software,
P.O. Box 25000, Greensboro, N.C. 27420

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Telephone_____ Hardware_____

CIRCLE 103 ON READER CARD

HALCYON
1 Halcyon Plaza
2121 Zanker Rd.
San Jose, CA 95131
(408) 293-9970

A subsidiary of Tortel Inc., Halcyon posted $12 million in revenues for fiscal 1979. Of that figure, data communications revenue totaled about $4 million. Test equipment is the main product category, which features analog and digital equipment. Halcyon is moving into the multiplexor business with its new 4200 series statistical multiplexor. The new 802 Data Monitor is described by the company as the world's first automatic monitor.

HEWLETT-PACKARD

INTERNATIONAL DATA SCIENCES, INC.
7 Wellington Rd.
Lincoln, RI 02865
(401) 333-6200

International Data Sciences makes patching and monitoring systems, switching devices, and modems. The company's most successful product remains the Rangerider line diagnostic series. Two years ago it added the Mini Tech control and protocol monitoring device. Combined, these products brought in $5.02 million for fiscal 1979, a healthy increase over the $3.7 million for the previous year. Calling itself a growth-oriented company, IDS has listed extensive plans for the next five years, including an ambitious product development program. Product development under this program will enable IDS to explore new markets. The program officially got underway with the introduction of limited distance modems.

(Northern Telecom Inc.)
SPECTRON
344 New Albany Rd.
P.O. Box 620
Moorestown, NJ 08057
(609) 234-5700

Northern Telecom Inc.'s Spectron Div. is its best-known data communications manufacturing area. NTI is owned by Northern Telecom Ltd. of Canada. Spectron is a manufacturer of data transmission test equipment and line drivers. It also produces switching devices and transmission equipment. Northern Telecom Ltd.'s total revenues for 1979 were $1.9 billion, $30 million of which were from sales by Spectron.

TRAN TELECOMMUNICATIONS

TEKTRONIX, INC.
P.O. Box 500
Beaverton, OR 97077
(503) 644-0161

Tektronix's business falls into two categories: display products and test/measurement products. The latter constitutes 79% of its sales but only a tiny portion of that is in data-specific test and measurement equipment. Of new equipment, the 833 Data Tester heads the list. It is a high performance, first-line service tool that provides the means to locate problems in a data com network. Also available is the 851 Digital Tester, an easy-to-operate first-line tool used to troubleshoot and maintain a wide range of digital equipment. We estimate the data communications revenue figure to be about 15% of its entire revenue, giving Tektronix data communications revenues of $7.9 million for fiscal 1979.

SWITCHING: equipment which allows users to select specific communication circuits on demand. Such switching equipment may operate either manually or in automatic mode and is designed to provide alternate facilities in case of line malfunctions, circuit overloads, or other operational conditions.

What do you do when your large-scale IBM is all batched up?

Call the second center facility you probably didn't know you had. The Sungard Center.

There are a number of different ways your large-scale IBM can be nonplussed by overload.

Which could result in the delay or deferment of a number of pressing projects. From new program development to critical application back-up. And cause costly overtime in batch or interactive processing, software conversions or systems development.

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We're glad to report that the response to this service has been overwhelming. We're also glad to report that no one has yet had a disaster.

So now we find our 3033 has a lot of spare time on its hands. As will our shortly-to-be-installed 3031.

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Able to take a big load off your mind. Or act as an interim facility until IBM introduces its new package.

We offer this spare time at extremely attractive rates. Because it's pre-emptible. In case the center is ever needed for disaster recovery.

Whatever the need, remember, you now have another large-scale computer to count on.

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Sungard Headquarters
656 E. Swedesford Road
Wayne, PA 19087 (215) 972-4776.

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ATLANTIC RESEARCH CORP.
COMPUTER COMMUNICATIONS

DYNATECH DATA SYSTEMS
7644 Dynatech Ct.
Springfield, VA 22153
(703) 569-9000

Dynatech Data Systems, a subsidiary of Dynatech Corp. in Burlington, Mass., manufactures test equipment for high-speed data communications systems. Its test instruments interact with the network, simulating a terminal, modem, or computer to locate sources of system errors. Using backup and patching, the flow of traffic can be redirected to isolate faulty equipment for further analysis. The microprocessor-based Dyna-Test 2000 features a preprogrammed menu of analysis routines plus the ability to construct custom programs for complex monitoring functions. This year the parent corporation acquired Telecommunications Techniques Corp., which deals in satellite test systems, and U-Z Manufacturing Inc., producers of high frequency switches. Last year Dynatech Data Systems reported a 40% sales growth, bringing data com revenues to $9.2 million, about one-third the company's total revenues.

DIGITAL COMMUNICATIONS CORP.
GANDALF DATA, INC.

INTERNATIONAL DATA SCIENCES
T-BAR INC.
141 Danbury Rd.
Wilton, CT 06897
(203) 762-8351

T-Bar manufactures switches used in switching peripherals from one processor to another and in switching communications lines. T-Bar has also developed equipment that would allow an operator to reconfigure data flow so one computer or its peripherals (such a printers, displays, or banks) could move from task to task as desired. This eliminates the necessity of having duplicate equipment assigned to each specific task, increases utilization, and reduces capital output. The company also pioneered three distinct applications of supervisory control, one for data communications and data processing systems; another for restoring service through reliable switching; and the third for facilitating monitoring, testing, and reconfiguring systems upon command. In 1979, T-Bar realized a sales increase of 46% and an increase in earnings of 41%. Last year T-Bar introduced two new products to its data communications line, the MASS+ and the Explorer instrument line.

OTHER: Equipment not included in other categories, such as voice response equipment.

ATLANTIC RESEARCH CORP.

(Motorala)
CODEX, UDS

COGNITRONICS CORP.
25 Crescent St.
Stamford, CT 06906
(203) 327-5307

Cognitronics is in the audio response league. Its 680 series Speechmaker is a microprocessor controlled voice response unit used in a wide range of applications from account status and credit checking to instrumentation readout, as well as a variety of telephone industry uses. Data communications revenue, which accounts for about 35% of the total company revenue, is pegged at $3 million for fiscal 1979. Cognitronics, another Top 50 debutante, was formed in 1960.

COMDATA CORP.
COMPUTER COMMUNICATIONS

Amnon Ben-Yehuda
General Manager
Micrographic Systems Division

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NCR
Complete Computer Systems

CIRCLE 107 ON READER CARD

DATA ACCESS SYSTEMS, INC.
Route 42 & Coles Rd.
P.O. Box 1230
Blackwood, NJ 08012
(201) 335-3322

Data Access Systems, Inc.'s 1979 data communications revenue of $25.3 million is 10 times the 1978 figure of $2.4 million. This represents roughly 90% of total business. Modems and portable data terminals are the proprietary products manufactured by DASI. The company provides service for all equipment which it markets, including products from the leading U.S. manufacturers of computer peripherals. DASI's "One Source Responsibility" provides servicing for its data communication equipment through its 21 nationwide marketing centers, which is double the number the year before. The company credits its large jump in revenues to an expanded sales force.

DATASTREAM COMMUNICATIONS, INC.

GENERAL DATA COMM INDUSTRIES, INC.

INTERNATIONAL DATA SCIENCES, INC.

INTERTEL, INC.

LIVERMORE DATA SYSTEMS, INC.

PARADYNE CORP.

PERIPHONICS CORP.

RACAL-MILGO, INC.

TEKTRONIX, INC.

(Federal Screw Works)
VOTRAX
500 Stephenson Highway
Troy, MI 48084
(313) 588-2050

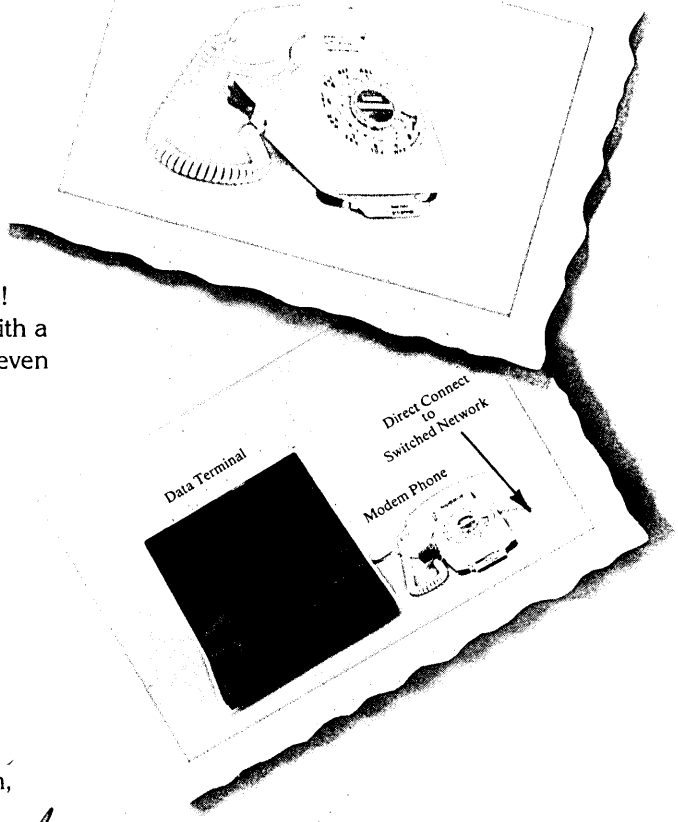
Federal Screw Works data communications division is Votrax (Vocal Interface Div.). It is engaged in the manufacturing and selling of electronic voice products, including phonetic voice synthesizers and digital voice systems, both of which are solid-state devices for simulating human speech. This end of the business accounts for about 4% of its total revenue, or about $2.4 million. The rest of business is, as the name implies, in nuts, bolts, and screws, with a large portion of that being used in the automotive industry. This year FSW introduced the LVM-80 Business Communicator and VSB Voice Synthesizer, both expected to contribute to next year's data communications' picture.

WAVETEK DATA COMMUNICATIONS
9045 Balboa
San Diego, CA 92123
(800) 854-2846

Wavetek manufactures and markets products in two principal industry segments: general-purpose electronic test and measurement instruments and special-purpose data com systems. Data communications products account for 8% of overall Wavetek sales. The audio response line includes terminals, network controllers, voice and ARU units, from direct channel devices to complete standalone systems. A communication network processor was introduced last year. *

Dear Ma:

Stop looking for Racal-Vadic's new modem. It's inside the telephone!



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PS: Racal-Vadic has shipped over 250,000 modems to date. *Alexander Graham Jr.*

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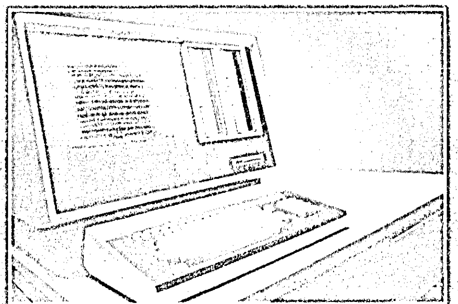

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A country beset by social and political problems embarks on the rocky road to renaissance, counting on computers to pave the way.

COMPUTING IN THE NEW INDIA

by Hesh Wiener

Mr. Wiener recently returned from a trip to India organized by the U.S. Department of Commerce. His article is based on extensive discussions with users and vendors in that country.

You hear about it in the gleaming capital of New Delhi. You hear about it in the business center of Bombay, and even in Communist Calcutta. Everywhere you go, you hear about the New India. And when you hear about the New India, you hear about computers.

Computers will help India bridge the gap between its older ways of doing business and the more modern methods used by nations it has targeted for exports. The country also needs computers to be competitive with the increasingly automated producers in Asia and the rest of the Third World. This need for enhanced management capability through automation is recognized by India's business community. But until recently the government has set equivocal policies on the importation and local manufacture of dp equipment. In the New India, the government will have to work closely with business to insure easier access to computer resources.

Computers are currently scarce in India, and the demand for data processing is high. This is despite government policies and social problems that make it easier for many organizations to avoid computing entirely. In recent months, for a variety of reasons, the restrictions on computer imports have been relaxed. Prospective buyers have become more optimistic, and Indian agencies, overseeing machine acquisitions, have been deluged with import license requests.

It will take time for this new wave of systems to come onstream, but the country's automation intentions are clear. A New India is in the making, and computers will have to play an important role in that renaissance.

India's culture has been shaped in part by persons and ideas from other lands. In the centuries before Christ, Hinduism gave way to Buddhism which was again replaced by Hindu philosophy. Along the way, the country's science, architecture, medicine, and social organization grew richer and more diverse. During the past two millennia, the Muslim influence was strongly felt. In recent centuries, this influence has been diluted by the European incursion.

In this century, India has been strongly affected by the United States and the Soviet Union. Both these nations have reshaped the Indian way of life. One area where the influence of the 20th century superpowers is quite visible is in technology.

The first computer in India was of British origin, but the most populous range of machines, 1401s, came from IBM. These computers are considered obsolete in the U.S. but are still of current value in India. Today, one out of four computers in India is a 1401.

Such vintage wares as the 1401s are all that's left of IBM's equipment base in India. That's because the company, responding to the government's Foreign Exchange Regulatory Act, decided in November 1977 to close or sell off its local facilities. (The act requires foreign companies to sell 60% of their equity to Indian investors.) Preliminary discussions between IBM and the Indian government were held in the hopes of striking a compromise, but no accord was reached. Presently, IBM would like to set up what it calls a "liaison office" to assist customers in buying IBM machines imported from other countries. If and when such an office is opened, IBM will try to provide new and larger systems to Indian users.

Computers from the Eastern Bloc are also very important in India, but they will soon be joined by more advanced mainframes of various capacities supplied by Burroughs, Univac, Cii-Honeywell Bull, and ICL. There is also interest in large, fast machines from Control Data Corp., at least among scientific researchers, but this interest may be frustrated by U.S. export restrictions.

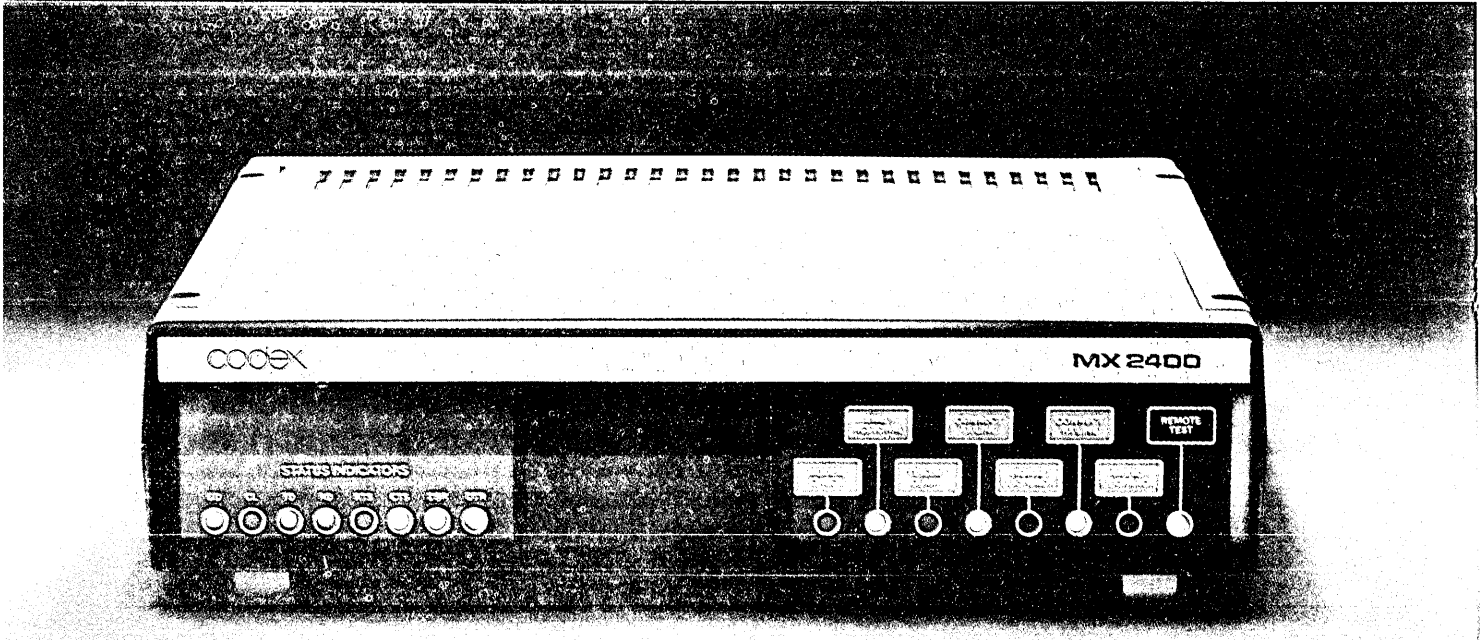
The lively part of the market is not at the top, however. Indian users are more interested in small mainframes and large minicomputers. Increasingly, the versatile small business machines made from microcomputer chips are attracting the attention of users, and a domestic small computer manufacturing industry is developing. Imports of micro-based systems are being blocked by the Indian government to enable local production to get off to a safe start, but peripherals for local as well as imported machines must, in general, be purchased abroad. This situation could well change in the coming years.

Foreign companies seeking a piece of the Indian market must join forces with Indian companies. They can do that either by using the Indian companies as sales agents or by forming partnerships where the majority ownership is vested in Indian hands.

When an Indian buyer wants a computer, things can get very complicated. To get an imported machine, such as any medium- or large-scale system, a license must be obtained. Basically, this is a declaration of need, a procedure to give the Indian authorities control over the export of wealth. Once an import license is granted, the buyer must also meet other demands aimed at fostering the export of an Indian intellectual product (as well as the physical products of data processing).

Indian organizations that bring in computers are expected to export goods or

ILLUSTRATION BY CHRIS SPOLLEN



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CIRCLE 112 ON READER CARD

The Indian organizations most eager for new computers are service bureaus, many of which have IBM 1401s.

Table I

SUPPLIERS OF INDIAN COMPUTERS

(Data complete through May 1978.)

Vendor	Number
Burroughs	6
CII	4
Comp. Auto	19
DEC	59
ECIL (India)	99
Honeywell	12
HP	17
IBM	154
ICL	42
Interdata	4
Ryad	8
Varian	6
Others*	18
Total	448

*Others include: Elliot (U.K.), Metrimpox (Hungary), Minsk, CDC, BESM, Data General, Fujitsu, Ju (India), TIFR (India), Ural, HIL (U.K.) Telescience.

services equal in value to the systems they import. Alternatively, duties exceeding the cost of the system must be paid to the government. In the end, a person who does not reexport and buys a computer with funds earned within India may pay twice the value of the computer in taxes. Thus a computer in India can be two or three times as expensive as the same machine in the exporting country.

Other means are available to Indian nationals who wish to import a computer, however. These approaches to import problems are helping users acquire systems on a more affordable basis.

SERVICE BUREAUS EAGER

The Indian organizations most eager for new computers are service bureaus. Many of them now depend on IBM 1401s, which are run three shifts a day and usually boast a large complement of peripherals. Nearly all the 1401 users are in the process of adding to and diversifying their facilities. The favored method of expansion is via U.S. minicomputers.

The service bureaus' mainstay machines include: DEC 11/34s and larger 16-bit systems; the full range of Prime computers; all of Wang's dp gear; and various Burroughs computers.

These computers will be configured for bread-and-butter data processing, mainly in batch mode. They control printers, disks, tapes, and unit record equipment. Increasingly, Indian service bureaus are adding terminals, but data base applications lag behind other on-line uses of the machines.

Because computers are so scarce in India, service bureaus can charge high prices and still get heavy loadings on their systems. This can offset the high prices and difficult terms under which Indians acquire their systems. In addition, Indian computing operations must run at high levels of efficiency to turn a decent profit. Many of their customers are only interested in results, so the service bureaus provide in-depth support including software, analysis, and planning services.

Quite a few of the service bureaus will mature into facilities management companies. This change is already under way, with some of the service companies being asked by their customers to replicate bureau facilities as in-house computing installations. They will also manage these operations once they are up and running.

As the service bureaus move into facilities management, they seem to be taking on the style and philosophy of IBM. Several former IBM executives, in fact, run full-service companies in India. These companies import only carefully selected machinery and tested software packages such as language processors. They do everything else.

As these service bureaus/facilities management companies grow, and as their customers' needs become more complex, a market for IBM plug-compatible systems may emerge. There have been talks between software-compatible machine makers and Indian organizations, but none of these discussions has resulted in any installations so far. This leaves the Soviet Union as the only supplier of systems compatible with IBM mainframes.

Some computers are sold directly to users by representatives or affiliates of the major manufacturers from other nations. This direct selling is the basis of all installations of large systems, and will increasingly result in installations of small systems. In the academic world, users are very well prepared to run their own operations, but in many businesses, the problems associated with getting a computer for the first time can lead to short-term disillusionment.

USERS CRY FOR HELP

It can also lead to sales agents getting caught between the buyer and the foreign vendor, with users asking both vendor and agent for help. This help may have been promised to the user or

Table II

WHERE COMPUTERS ARE USED IN INDIA

Year Installed	R&D Education	Public Sector	Private Sector	Total
1960	1			1
1961		1		1
1962		1		1
1963	3			3
1964	6	4		10
1965	4	3	5	12
1966	2	5	7	14
1967	6	8	9	23
1968	2	13	8	23
1969	4	7	8	19
1970	2	7	5	14
1971	8	10	16	34
1972	1	12	18	31
1973	5	7	5	17
1974	5	15	7	27
1975	14	33	4	51
1976	12	17	2	31
1977	11	25	6	42
1978*	7	15	8	30
Unknown°	16	34	14	64
	109	217	122	448

* 1978 data through May only
° Records unclear or prior to 1960

Only two mainframers seem to have outstanding reputations in India, Burroughs and Fujitsu.

otherwise represented as part of a sale. The Indian buyer may also be expecting more free support than is realistic, and if the agent does not clarify things, acrimony can follow an installation. With time this kind of friction will decrease, but for now it is affecting potential sales to India's largest and most important business organizations. Only two mainframe suppliers seem to have outstanding reputations in India, and they have good images for different reasons.

Burroughs sells its systems in India through the Tata Group, one of the two most powerful private conglomerates in the country. Tata is a tightly run organization and prides itself on good customer relations. Because of its highly diversified nature, many Tata clients deal with the giant company on several fronts. Thus the partnership appears to be giving Burroughs a significant advantage with customers.

Fujitsu also is enjoying good relations in India, even though the company has not really sold much machinery yet. Fujitsu seems to be trying to enter the IBM-compatible market (or at least promote systems similar to those made by IBM). Fujitsu owes its good image to its realistic approach—the company tells prospective buyers the bad news as well as the good news about computers. This realistic attitude and a certain inflexibility in negotiations is followed, various sources say, by a determination to make everything work once a sale is completed. In the long run, this will prove to be an advantage.

Because there are so many highly educated people in the Indian academic world, computers in university or research settings are diverse in size, origin, and configuration. In addition to direct uses, such as handling school recordkeeping, computation centers operated in conjunction with academic institutions also provide data processing to outside organizations. Often these outside clients are government agencies. Private firms, however, also take advantage of this computer power. Regional computing centers controlled by the public sector are also springing up to serve the full spectrum of Indian computing needs.

Research laboratories, with their need for large scientific systems, do not have an easy time in India. While the Indian government seems to be interested in boosting its scientific computing capability, political considerations in the U.S. and other vendor nations have made it difficult if not impossible for India to get the kinds of computers it wants. The rationale for American export restrictions is complex, and stems from the U.S. desire to discourage, or at least not encourage, research into the military uses of atomic energy. India has already demonstrated its ability to detonate nuclear charges, but little is known outside government circles about the practicality or sophistication of Indian nuclear devices.

There is also fear in Washington that technology entering India could find its way to the U.S.S.R. The Soviets enjoy good relations with India. Ironically, the systems American vendors might suply to India have long since been sold to the Russians.

INDIA'S PIVOTAL POSITION

One result of Indian's pivotal position in Asian (and world) politics has been the installation of several large Eastern Bloc computers. These machines are sold through the Indian company Computronics. The company has supplied Russian Ryad systems as well as products from Warsaw pact nations to various Indian users. The Ryads run IBM software. Depending on their vintage, they are compatible with IBM 360 or 370 systems.

European vendors are interested in the Indian market, too, but have not really gotten much penetration. Cii-HB is relatively active these days, and ICL had installed a number of systems but has not made much headway recently. ICL however, is expected to make another push in the subcontinent, and may be waiting for the right political climate.

The Indian government that served in the latter years of the last decade was reluctant to deal with the issues raised by automation. The Indian economy was in a state of stagnation while population increased, leaving a troubled legacy for the present Gandhi government.

India is beset by social and political conflicts. The nation may be viewed as two distinct countries, one essentially agrarian and based on a populous peasantry, the other an advanced industrial state. The two nations coexist in a democratic federation of states more loosely bound than those of the U.S. and more tightly connected than the nations of the European Economic Community.

Hindi is the official language of India, but it is not spoken by the majority of the people. There are something like 14 major languages and hundreds of dialects. Not only are the words in India different in different regions, but the alphabets are also completely independent of each other. English, where it is spoken, is the one language that connects India's different regions. It's also the language of the industrial state; the agrarian nation is largely ignorant of English and illiterate in any language.

In addition, India's caste system resists change, notwithstanding the election of a pariah, or untouchable, as the last prime minister. The combination of caste distinctions with poverty—the gross domestic product in India is less than $200 per capita per year—makes any threat to workers severe.

Sometimes it seems that it is impossible to govern India, let alone to bring in technology with the risk of social disruption. But India cannot sacrifice its businesses to stability; it must compete in world markets. So India is trying to use computers in ways that provide maximum benefits at minimum social cost.

Word processing, for example, is pretty much out of the question, while process control is a fertile field. Accounting, a traditionally difficult area, may be accepted in some settings but not in others. Banks in India desparately need to use computers, but clerical unions have been adamant in their opposition to automation.

India is aware that the electronics business can be a source of income. Other Asian and Pacific sites, such as Singapore and Taiwan, have worked well for both host and source nations in the electronics industry. India has abundant inexpensive labor and a social tradition that will readily accept the new skills of high technology manufacturing.

The first concrete result of New Indian attitudes may be found outside Bombay at the Santa Cruz Electronics Export Processing Zone (SEEPZ). This free trade area has no barriers to imports and exports, although sales from SEEPZ into India are treated much the way sales from other areas of the world are handled.

The computer industry's showcase at SEEPZ is a matrix printer plant built by the Burroughs-Tata partnership. There, 20,000 printers a year will roll off the assembly lines, more matrix printers than are made at any other single factory in the world. Today, everything but print heads is made at SEEPZ, and the print head fabrication facility will come onstream soon. Intersil, which also makes products in Singapore, has come to SEEPZ, too. A number of other companies have also set up plants in the free trade zone, and it is generally expected that many of the SEEPZ residents during the 1980s will be American and European.

SEEPZ not only provides India with wealth, it provides the country with a base of trained technicians. SEEPZ will also benefit India without incurring social costs, because the products of the zone will be reexported.

In the long run, the success of SEEPZ will make the Indian people aware of the benefits of electronics and computing. This will alter the population's receptivity to the changes that must come through the import and application of computers in India—the New India, just on the verge of developing its own computer industry that is now very small. ✻

Hesh Wiener, publisher of the monthly "Computer and Communications Buyer" and "Technology News of America," has been an industry analyst for eight years.

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CIRCLE 114 ON READER CARD

R.W. Bare, Assistant Corporate Controller, J I Case, A Tenneco Company, Racine, Wisconsin

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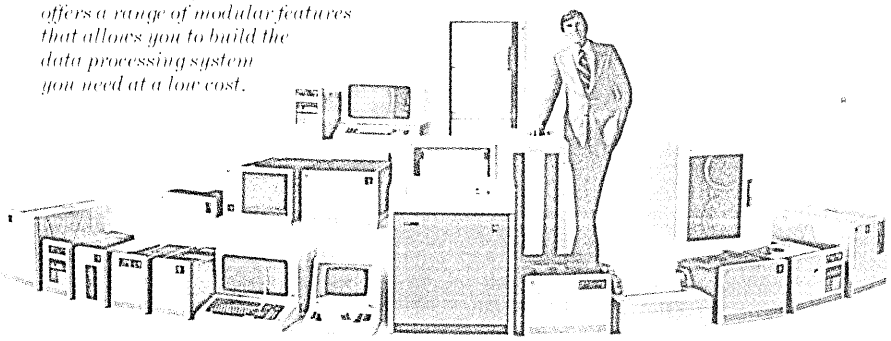

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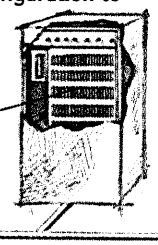

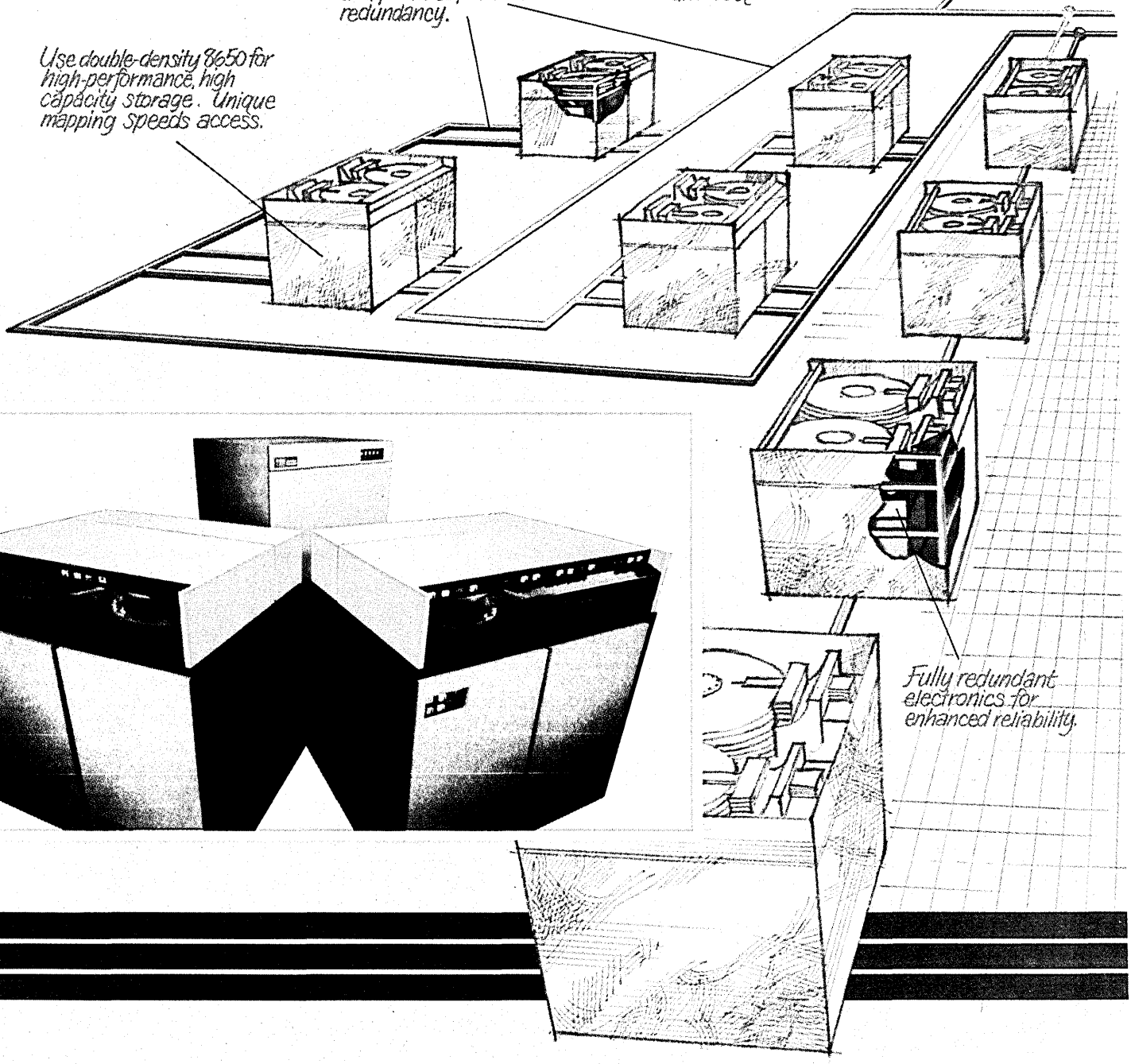

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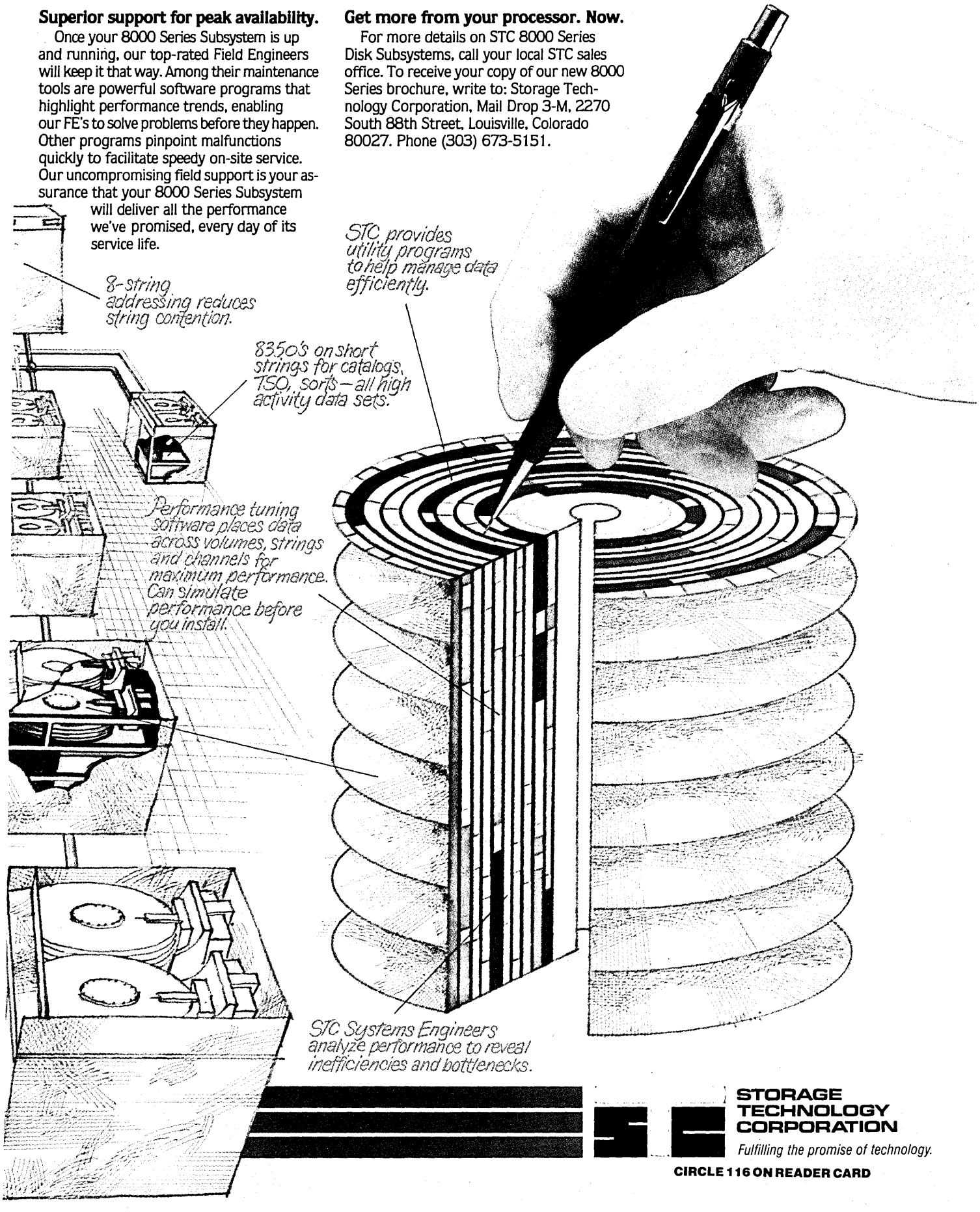

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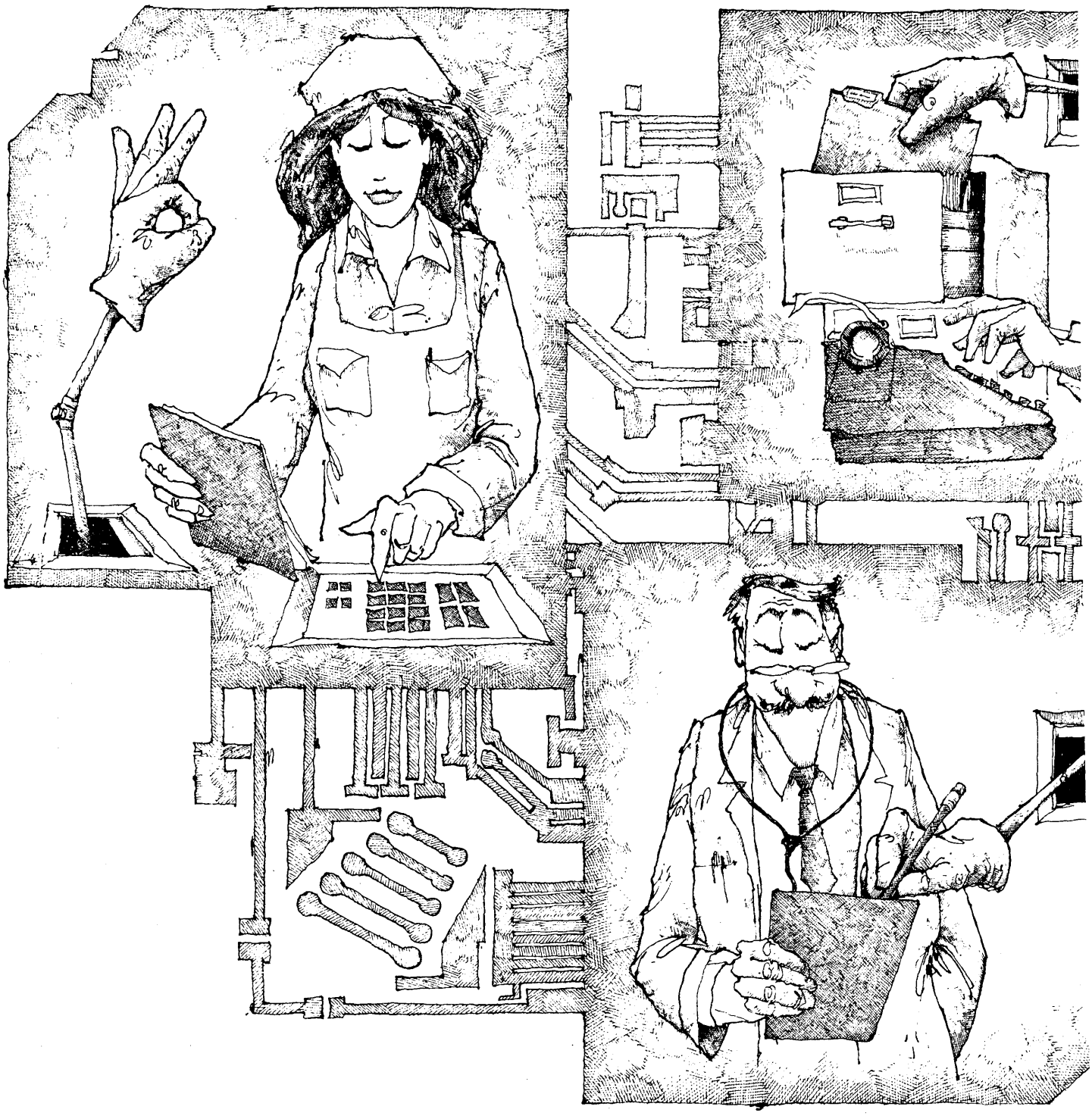
CIRCLE 116 ON READER CARD

Huntington Memorial was bogged down by increasing data management problems until a dedicated in-house system was installed.

A HOSPITAL'S CARES

by Robert Spaziano

Huntington Memorial Hospital was founded in 1892 as the 16-bed Pasadena Hospital Association. It took its current name in 1936 after receiving substantial bequests from the estate of Henry E. Huntington. Today, HMH operates 565 general acute beds and 32 newborn bassinets and has an occupancy rate of 76%. As the major regional health care provided for Pasadena and the greater San Gabriel Valley east of Los Angeles, it is a teaching hospital for interns, residents, nurses, and technicians. The staff includes more than 2,000 full- and part-time employees, over half of whom are in nursing. In 1979, there were 147,000 patient days, 85,000 outpatient



visits, and 37,000 emergency cases.

In the late '60s, HMH was facing increasingly sizable data management problems, and an effort was made in 1969 to install a time-sharing computer system to provide current hospital bed census and to process accounts payable and outpatient billing.

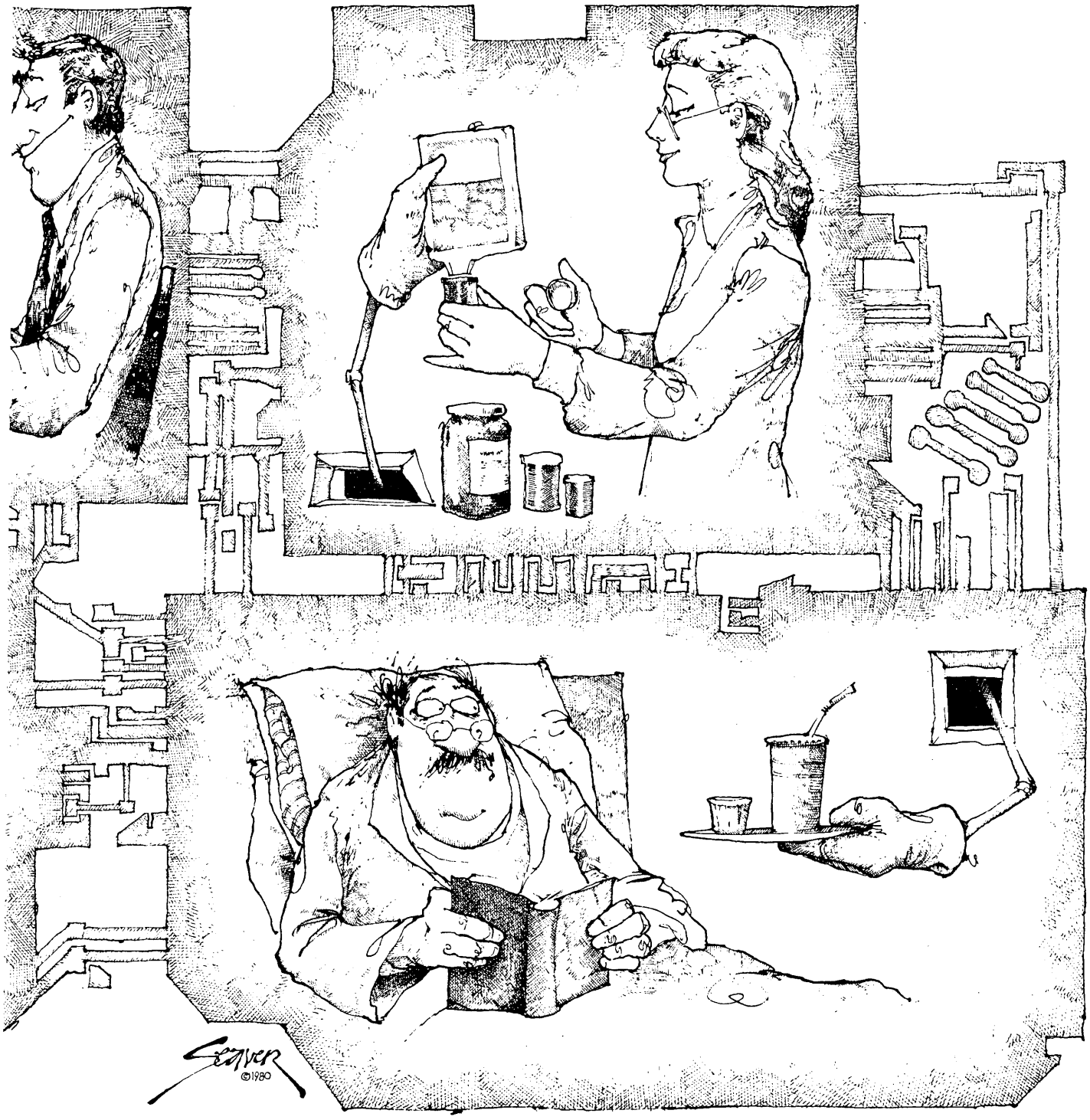
Conversion from the manual system to the time-shared service bureau was slow. Census took six months to come on-line, and progress stopped at outpatient billing. From 1970 through 1973, there were continuing difficulties from debugging software. Costs and system down-time were excessive. Data entry and report delivery were slow. There were many problems communicating with the remote mainframe computer. Finally it was determined that the shared services system simply could not handle the volume and growth factors of a 565-bed hospital.

In September 1972, the board approved a study recommending the investigation of the time-shared system with a dedicated in-house system, and an RFP (request for proposal) was prepared.

An ad hoc management committee heavily involved in specifying system criteria for the RFP met many times to help the dp staff review vendors and proposed systems. Membership included the chief of staff; the directors of nursing, ancillary services, materials management, and plant maintenance; plus the vice presidents and administrators in charge of finance, administration, health care, and general services. The committee still meets at least quarterly to review progress, discuss new applications, and analyze costs.

In establishing its objectives, the committee's overriding goal was to attack sources of data throughout the hospital, rather than follow the then traditional technique of working backwards through historical data coming into the business office. In essence, if HMH were going to be automated, it would be done in patient care areas where everything originates, and have business data fall through as a direct by-product of patient care.

That approach was based on belief that a hospital-wide system would be justified if its only accomplishment was to centralize and expedite interdepartmental communica-



DRAWING BY JEFFREY SEAVER

The goal was to establish credibility and success, not just to make waves.

tions, particularly in support of nursing. As in many hospitals, HMH's communications were hampered by nonstandard messages, memos, and requisitions; the variety of professional and foreign languages and technical jargon being used; and an unsatisfactory pneumatic tube system.

The financial department and auditors were also aware that in any large hospital, with the tremendous number of ancillary services being provided to patients, all paperwork doesn't always find its way to the business office. There are problems transcribing data where they are generated: in writing down correct dollar amounts, in rewriting data, in lost pieces of paper.

The "known" solution was a computerized system to pick up standardized data once and lock it into the system. Then, there would be no worries about language interpretations, pricing errors, nonrecording of services, or the loss or misrouting of data. What was unknown was the tremendous magnitude of the problem.

ABOUT THE RFP

The RFP encompassed five major objectives, all to be attained within the initial five-year period 1974-79.

- Capture all patient data (whether medical or business) at their source, and store them in a single record for each patient.
- Accept and record all orders and other patient data from the professional and administrative staffs, and communicate them as needed to other authorized personnel and to medical records.
- Facilitate record-keeping and communication of data to enable scheduling of patients, hospital personnel, and medical care services.
- Improve the quality and decrease the cost of medical services.
- Have sufficient capacity and growth potential to serve increasing numbers of patients, doctors, and health services, such as automated clinical lab tests and results reporting.

To do all this, the system would have to capture all data at the source and put it into a single, variable-format, variable-length record for each patient. The patient's record would have to include all doctors' orders; diagnoses and diagnostic interpretations from ancillary departments; drugs administered or dispensed; clinical laboratory results; services, operations, deliveries, etc.; and admissions/discharges/transfers information, including patients' selective histories, insurance pro-rationing, and other financial data.

Additionally, the system would have to provide physicians and nurses, other staff personnel, and the business office with all or any part of that data, automatically or on-call, in the form of visual displays or printed reports, as required by each department.

Above all, the system would have to be usable by regular hospital personnel. HMH did not want to hire typing pools or specialized data transcribers who would add complexity to system usage, as well as add personnel costs.

The RFP also stated clearly that vendor selection would depend on demonstration of a fully operational, field-tested installation of any system that was proposed. HMH did not intend to design and develop its own. Neither was it going to pioneer anything new for a vendor that wanted a test-bed to enter the field. The committee was interested only in something whose efficacy could be proved, something that would be seen, studied, and evaluated in light of its specifications.

Formal criteria for ultimate vendor selection also called for an evaluation of the vendor's financial stability, management competence, personnel turnover, and its user satisfaction. Conversion, training support, and costs were considered, along with documentation capabilities, hardware/software growth potential, data security, and disaster recovery.

The RFP was issued in October 1972, and it was sent primarily to vendors of small business systems. Of the 26 vendors who submitted proposals, most told us that we would not find what we wanted—particularly when it came to nursing station automation—but that we would do well to help the vendor develop its system, which *might* do the job someday.

The 26 proposals were reviewed with the help of the ad hoc management committee, our auditors, Price Waterhouse & Co., and a consultant. Eighteen were eliminated quickly as being totally unresponsive to the RFP. The remaining eight were invited in for personal discussions of their proposals, which narrowed the field to four: McDonnell Douglas Automation Co., National Data Communications, Inc. (Nadacom), System Development Corp., and Technicon Corp.

Each of the four prospective vendors made detailed presentations. Then committee and consultants scheduled visits to user installations to evaluate actual field operations. In two cases, it was found that working user installations did not really exist; the proposed systems were still under internal vendor development. With the two other vendors—after many discussions with nurses, ancillary deparments, and business offices at the hospitals that were using the systems—the committee and consultants finally determined that Nadacom came closest to doing the kind of job called for by the RFP.

NADACOM DESIGNS CARES

CARES (Communications, Analysis, and Reports for Effective Services)was designed by National Data Communications, Inc. (Nadacom). Throughout HMH 145 Nadacom remote keyboard/display terminals are distributed in departments for data entry and retrieval by authorized staff and administrative personnel; 90 remote terminal printers provide hardcopy where required, and the system's software runs on a triplexed minicomputer installation in the main computer room.

The Phase I plan was to have CARES process the on-line real-time inpatient admitting applications 10 hours a day to cover the peak period. Then the system would be cycled down overnight to do 12 hours of key entry and batch processing of ancillary department charges, accounts payable, patient billing, and other business office tasks. The two hours remaining were for overruns and preventive maintenance.

With equipment scheduled for installation in May 1974, HMH had six months to build a computer room and department, begin training programs, develop the visual display screen formats needed to admit patients, design the paper forms for the remote printers, and assemble the "catalogs" of services and their individual costs.

Hands-on user training to enter patient charges into the system was conducted in the department for dp and pharmacy personnel. Admitting personnel trained in their own areas. (Business office personnel were not trained initially because dp was providing data entry for them.)

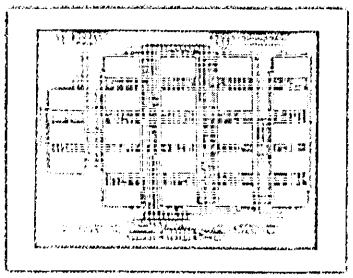
Throughout the training program and installation of keyboard/display terminals outside of dp, care was exercised to keep a low profile and allow the system to "seep" into the organization. The goal was to establish credibility and success, not just to make waves and appear to be precipitating major changes for the sake of change.

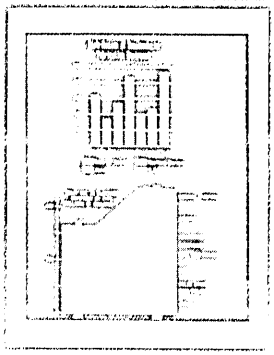
The result was an extremely smooth conversion. After the hardware was in and the software was tested, the dp staff came in on a Saturday night, changed out the old forms and imprinters, and had everything in place, working and ready for the first shift Monday morning. After a one-month test period, CARES went live on June 1, 1974.

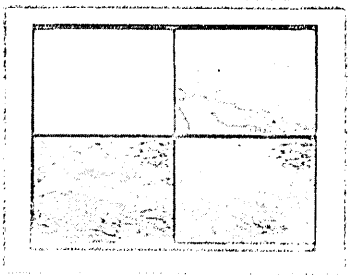
Despite all the advance planning and smooth conversion, the system was severely overloaded within a week. Batch processing for the business office, required 14 to 16 hours, rather than the usual 12. When eight to 10 on-line, real-time (OL/RT) hours were added, which were committed firmly to admissions, there was no margin left for problems, especially a problem as basic as the one that appeared.

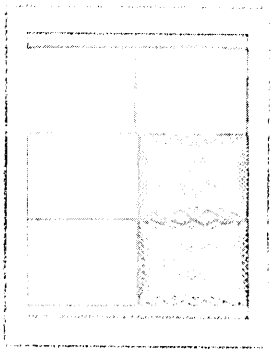
No one—not HMH nor Nadacom—had expected CARES would have to process as much data as turned up; the historical records and preliminary surveys had been wrong.

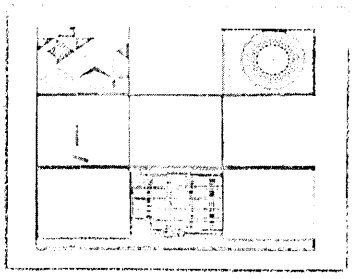
First, twice as many patient accounts

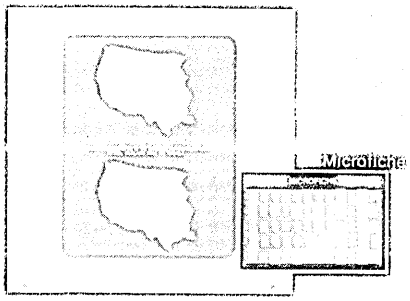












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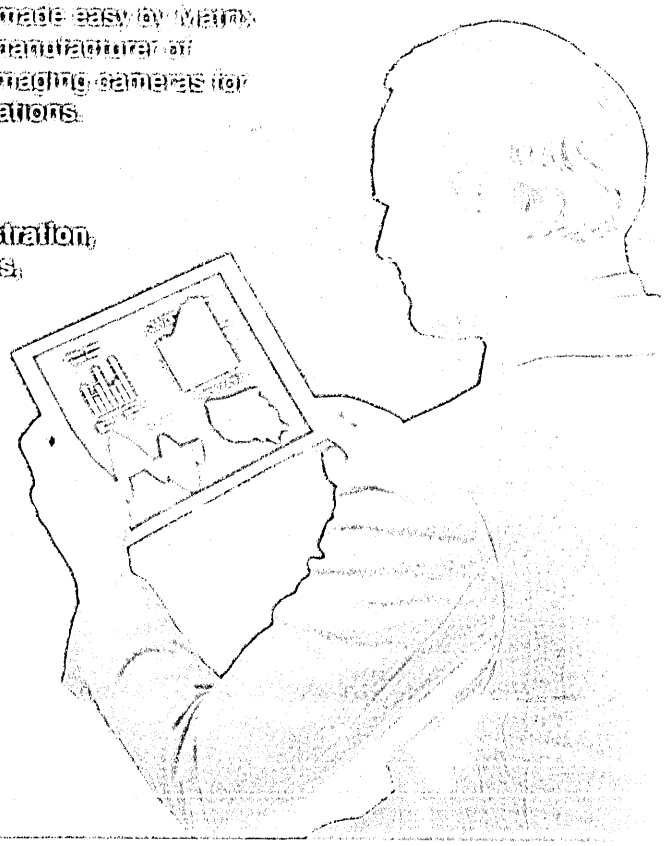

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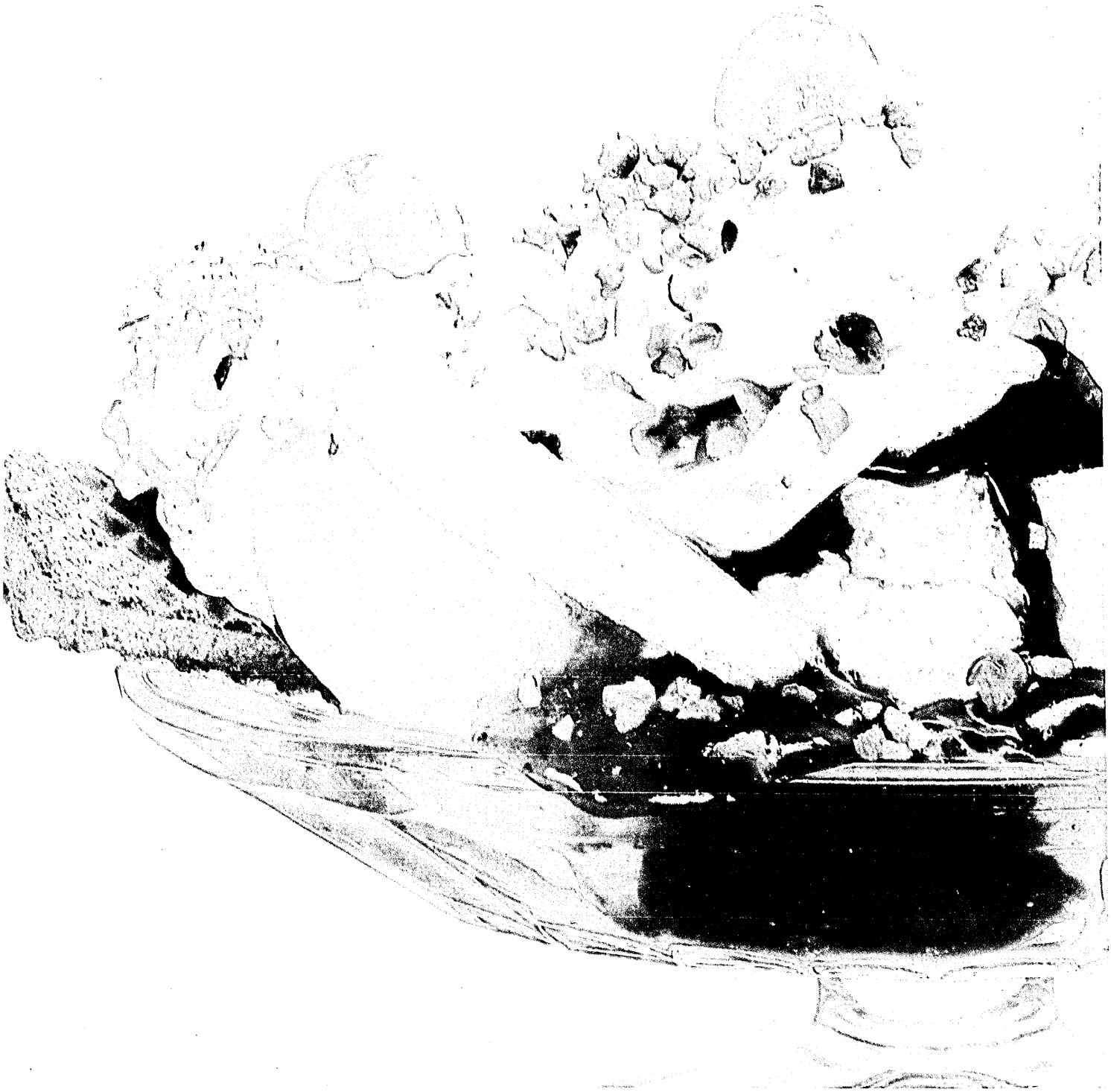

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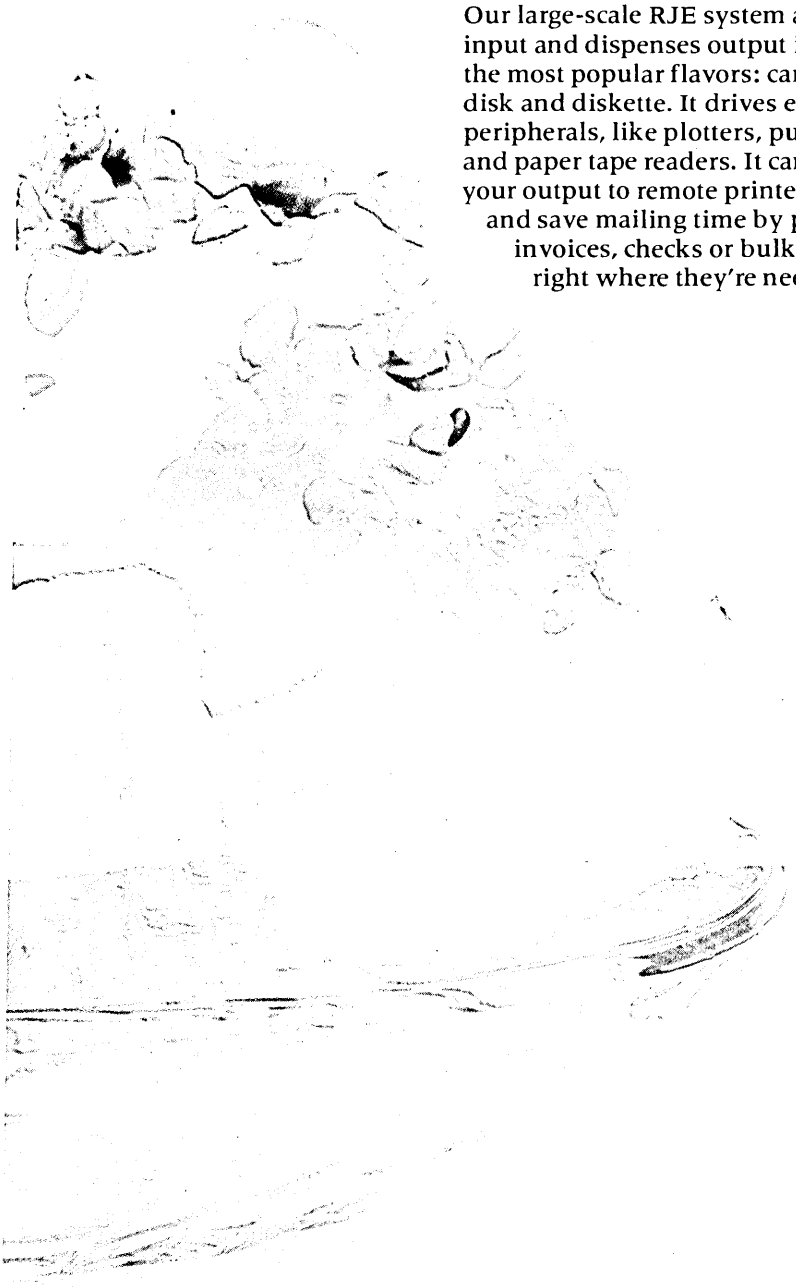

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CIRCLE 118 ON READER CARD

Essential to the expansion was top management support and the complete participation of the user departments.

as anticipated had to be converted, doubling processing time for that one major element. Secondly, far more data than anyone knew existed was being generated by the ancillary departments. Patient tests and services already in catalogs were being performed in unprecedented high numbers; tests and services no one knew about were coming out of the woodwork.

Much of the unexpected data overload simply came from CARES' greater efficiency and complete accuracy. The system was getting all the information that was being generated, and it was correct information.

We also learned that under the previous system tests and services requiring prices that had not been listed in the catalogs often had not been priced and charged to the patients, and some data had been discarded when people had not completed their day's work.

The net result of all the additional data turned up by CARES was that HMH's catalogs got bigger and bigger, and the amount of information that had to be processed grew and grew. This situation continued for almost a year until all patient tests and services were identified properly and entered into the catalogs.

In the meantime, within its first month of operation, CARES was behind on everything. The harder and more successfully it worked, and the better it kept track of the data being generated throughout the hospital, the further it fell behind.

The solution to the data overload was the installation of a second central processor in August 1974. With another 516, CARES came out of the woods rapidly. The 10-hour window for OL/RT admitting applications could be expanded to 24 hours on one system, while the second system was available another 24 hours for all business office processing.

The two central processors eliminated the backlog within a few weeks; then keyboard/display terminals were installed in the business office for direct OL/RT input of cash accounts. This made it unnecessary for the business office to send its paperwork to dp for key entry. As the cash applications came online, others followed, and soon the entire business office had OL/RT access to the system.

By late 1974, CARES was running smoothly enough to consider Phase I of its implementation a success. Attention then turned to expanding the system throughout the hospital, with the nursing stations and ancillary departments being first in line for installation of keyboard/display and printer terminals.

Essential to the expansion was top management support, the complete participation of the user departments, thorough preparation for the orderly conversion of each department, and adequate orientation and training of all users and data processing, personnel sufficiently experienced in planning and control.

FINDING A HALF-MILLION

Progress during Phase I was being watched very closely by the board of directors, which asked for a full report on whether the original objectives were being met. Rather than conduct an in-house study that later might be interpreted as self-serving, the dp department asked the finance committee to conduct the study with its independent auditors.

Price Waterhouse's consulting team investigated everything: system implementation in admitting and the business office, the overload during the first six months, the situation after catching up. Included were initial and incremental costs for equipment, maintenance, software, facilities management, data processing personnel, and forms.

Results of the study were presented to the board in February 1975, nine months after the system began working. They were very favorable. Price Waterhouse found the system was not only cost-justified and doing the job it was designed to do, but it was far exceeding original cost-containment expectations. Pricing and charging for services were far more complete and accurate with the system, all data was being captured, and no data was being lost or misplaced—which had been responsible, for example, for ancillary services losing from 2% to 5% of the revenues that should have been received. It all added up to an estimated additional $600,000 annual cash revenue for HMH.

With those early results, the board unanimously approved condensing the original five-year, multiphase plan to two years. Rather than wait until late 1979, the decision was made to bring up the nursing stations and ancillary departments by the end of 1976 (about 18 months after approval).

It wasn't that CARES needed that much time; technically, the nursing and ancillary departments could have been brought on-line almost immediately. The time delay was intended mainly as a period to train nurses, laboratory technicians, and others in using the system. It also afforded them an opportunity to suggest any changes they thought would help them do their jobs better. This helped dp and Nadacom further define the system according to the individual needs of each user department, rather than tailor user procedures to the initial system.

The training and evaluation period lasted about nine months. During that period, all systems changes were accomplished, and complete documentation was produced, including user manuals for 21 departments.

During Phase III, many orientation meetings were held for hospital personnel, including physicians, to increase their awareness of computers and computer usage in a hospital environment. Overcoming fear of the unknown and the kind of skepticism normally associated with major change was a critical mission for dp.

Formal training programs for more than 1,000 employees provided eight hours of hands-on experience during an eight-week period before the system was brought on-line in nursing and ancillary departments.

Each trainee received an initial three hours of training on operating the keyboard/display and printer terminals. This was followed by another three hours of studying departmental procedures, and classes concluded with two hours on terminal operations and procedures.

By the time training classes were over, not only were all new users throughout HMH thoroughly familiar with the system, but their comments and suggestions had led to useful changes and additions to display and printed formats, input techniques, and more. As a result, before the system went live in nursing and ancillary services, it had the full support of its users. They knew the system was designed to make their jobs easier, and they wanted to begin using it. Now, if the system goes down, nurses would rather wait for it to come back up to enter an order (unless it's "stat") because it's much easier and there is no chance of an order getting lost.

A particularly strong effort was made to train nurses to use the system. As the central link in patient care (half of all hospital personnel were nurses), their proper usage and complete acceptance of CARES was essential to its success.

All head nurses went through the program first. This ensured at an early date that each nursing floor would have at least one person on duty during each shift who would be expert enough to help others learn to use the system and had the authority to get things done, with the flexibility to adjust their schedules for training others. In some cases, head nurses who were particularly effective in running the system and training others were relieved of their regular duties temporarily to concentrate on the conversion.

When nursing went on the system during Phase III, everyone in the department, including RNs and secretaries, knew what to do and how to do it.

CARES' nursing and ancillary services applications were turned on in March 1976—three years ahead of the first schedule and a half-year ahead of the second. After two to three weeks of the type of system debugging that is always needed, CARES again had settled into a dependable routine and was performing as planned.

By keeping track of all orders and charges, plus automatic communications

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CIRCLE 119 ON READER CARD

The system would have to capture all data at the source and put it into a single, variable-format, variable-length record for each patient.

among departments and a single record for every patient, it completely solved the major problems inherent in traditional paperwork communications. Now, all data had to be entered into the system before anything could get done; all data were edited for accuracy by the user as they were entered; all data in the system were communicated correctly; and no data were lost, misrouted, or otherwise delayed.

Price Waterhouse & Co. was brought in again (as it has been every year since) to audit the system planning, training, and so forth. Once more, the system received high marks for meeting or exceeding every operating and cost goal.

The outcome was the further telescoping of the original five-year plan. By the end of 1976, everything planned for accomplishment by the end of 1979 was in and operating according to objectives. Payroll, budget, general accounting, time-clock entry, and other new applications were added; new objectives were being set.

A major accomplishment in 1978 was interfacing CARES with automated test equipment in the clinical laboratories, which perform some 300,000 tests annually for HMH and private laboratories.

Before CARES, a pneumatic tube system connected the laboratories and nursing stations; carriers were constantly being sent to the wrong places, or they were not being put into the tubes at all. When doctors couldn't find their results, they would reissue "stat" orders and start the process all over again. This led to slower turnaround on test results and much duplication in work by nursing and laboratory personnel, and it frayed tempers seriously.

Many of these problems disappeared (after data overload problems were solved) when CARES began communicating orders and reports between nursing stations and laboratories. Yet it continued to be a slower process than it might have been, because laboratory results still had to be typed into the keyboard/display terminals manually, even though much of it was produced by automated test equipment.

Solving the latter problem is a two-way automated laboratory interface developed jointly by Nadacom and Berkeley Scientific Laboratories, Inc. (BSL). Installed in April 1978, it connects CARES directly with the standalone BSL minicomputer used for clinical laboratory applications.

RESULTS WITH CARES

When a patient enters the hospital, all admitting information is transferred immediately and automatically from CARES to the BSL system via the interface. This ensures that as soon as the patient is admitted, the laboratory has correct information on the patient's name, medical record number, hospital location, date of birth, and anything else pertinent.

Orders for laboratory tests flow automatically through CARES into the BSL system; results—whether from automated or nonautomated test equipment—automatically flow back into the CARES system. During this process, the combined system automatically prepares worksheets and load lists, prepares reminders, prints labels and specimen collection lists, and so forth.

All clinical laboratory data, results, and reports that have been completed are viewable immediately on CARES' keyboard/display terminals throughout the hospital. Printouts can be directed selectively to all intensive care units.

Again, with the system handling all transactions for the automated laboratory interface and other new applications, no data related to those applications were overlooked or lost; and, by finding that more data existed than anyone had ever recognized, CARES again began moving into an overload situation. One 516 was devoted solely to 24-hour-a-day OL/RT work, while the other was being used 20 hours a day for batch processing.

The obvious growth path was into Honeywell 716s, but they were no longer being manufactured. After a late 1977 study of available minicomputer hardware and software, HMH and Nadacom decided to get a Prime 400 as the third computer in the CARES system.

The Prime 400 was brought on-line over the weekend of June 10-11, 1978, creating a triplex computer system in which all three computers work together, sharing resources as required. Its installation was no more difficult than that of the second 516, because the Prime 400 hardware is compatible with the Honeywell mainframes and Nadacom's software is hardware independent.

The Prime 400 now supports all OL/RT applications 24 hours a day without any capacity problems, and the current configuration can be expanded considerably whenever required. The two 516s make available 48 hours a day of batch processing time.

Addition of the new hardware—including 10 much larger disk drives in two five-disk mirror-image strings—not only solved previous capacity problems, but also enabled additional key applications to be brought on-line in 1979, including processing pharmacy orders and inventory, patient billing, and so forth.

(By this time, the original 90 keyboard/display terminals have grown to 145, and the two remote printers have become 90. In the span of five years, CARES is running at 145% of original capacity, and there are more new services to bring on-line.)

Many benefits can be attributed to CARES' steady growth and success: services and charges are more clearly identified, operations are much more businesslike; and myriad internal and external reports are produced quickly and easily.

Previously, when a body such as the Joint Commission on Accreditation of Hospitals (JCAH) asked to see the hospital's catalogs, about all that was readily available on laboratory, for example, might be a two-page list of frequent tests. Now, with a completely detailed, completely priced catalog of every test and procedure , JCAH has everything it needs.

HMH is much more efficient in many other ways. All personnel now have clearly defined data recordings and communications processes to follow in their jobs. The general ledger has considerably more detail than before. Budget reports are available with a depth of detail and at a speed that were unknown before.

Eliminating the sometimes interminable delays in receiving all patient charges from the departments enables patient bills to be produced in a much more timely manner. With the exception of data such as additional charges that may be incurred for on-going laboratory tests, for instance, all charges are in the system by the time a patient has been discharged. To provide some leeway, the cut-off for completion or cancellation of all orders in the system is 40 hours after discharge.

This makes it possible to mail bills to patients four or five days after they leave the hospital. Previously, 15 working days was normal, and the delay would often be as long as 20 to 30 days.

A valuable by-product of more timely patient billing has been more timely patient payments. Generally, this has reduced the level of receivables and improved cash flow considerably.

CARES has also made it possible to reduce the rate of increase in personnel costs throughout the hospital—a rate that had seen the number of employees per patient double from less than two to slightly over four in the past 10 years. The business office, for example, has been able to handle a tremendously increased work load with about the same staff; dp requires only 20 people for all jobs on all shifts, compared with previous staffing, where 22 people were needed around the clock just to keypunch data for the business office and admissions.

The system's rapid, fail-safe communications also has eliminated the need for nurses, orderlies, and others to spend considerable time preparing written orders and reports and, many times, having to personally hand-carry those pieces of paper to their destination to be certain of their delivery and

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CIRCLE 120 ON READER CARD

Overcoming fear of the unknown and the kind of skepticism normally associated with major change was a critical mission for the dp department.

follow-up action. This growing freedom from paperwork enables hospital personnel to spend far more of their time providing patient care and performing administrative services.

Although new positions have to be added continuously to keep pace with HMH's growth, personnel costs as a percentage of total costs have been dropped to about 50%, versus 60% in 1976 (some of which may stem from sharply higher costs in expenses such as insurance, equipment, and depreciation). The unknown factor is how many more employees of all types HMH would have needed if CARES did not exist. It is certain, however, that the effect on the bottom line has been significant compared with what costs would have grown to without the system.

PATIENT DAY COSTS

Net cost for the total CARES system in 1979—based on equivalent patient days (comprising inpatient days plus one-third of outpatient visits)—was approximately $4.50 per patient day. The finance committee considers this level more than acceptable.

Assumptions underlying the calculation of that amount include a split of expenses (based on file structure) that allocates 39% to the business office and 61% to interdepartmental communications. Subtracted from gross system costs in both areas are confirmed dollar savings the auditors established from installation and operation of the system.

By the middle of 1980, HMH anticipates having a completely OL/RT patient data base. This will store and have available for immediate recall all hospital/medical records and complete demographic data on each of the more than 125,000 outpatients and inpatients who will be in the system initially, with a growth capacity to store 600,000 names.

A major benefit from a complete patient data base is the ability it gives many departments to provide each patient with faster, more personal services. And it saves much time. Admitting clerks, nurses, and technicians, for example, do not have to ask repeatedly for the same information. Data for each returning patient are available immediately, whenever he or she enters the hospital. All patients know the hospital remembers them as individuals.

In development for implementation in 1980 is a total nursing program that will support all of the nurse's data needs. Added to CARES' current capabilities will be nurse care planning, charting according to plan, staffing according to acuity factors, and automatic auditing of the quality of nursing care.

Generally, after a nurse enters a patient's diagnosis into the system, the system will respond with information on potential problems associated with that diagnosis and a checklist of what might need to be done. The nurse then will select the areas that need to be followed through routinely. As long as the patient is in the hospital, CARES will update the plan regularly from more recent orders and reports, and it will produce a complete care plan for each shift or as needed.

Additionally, with a complete nursing care plan and all orders in the system for each patient, the system will not accept charting unless a report is made for each item in the plan. This will mean that the nurse, automatically and provably, will meet all standards of JCAH Title 22, which requires charting according to care plan.

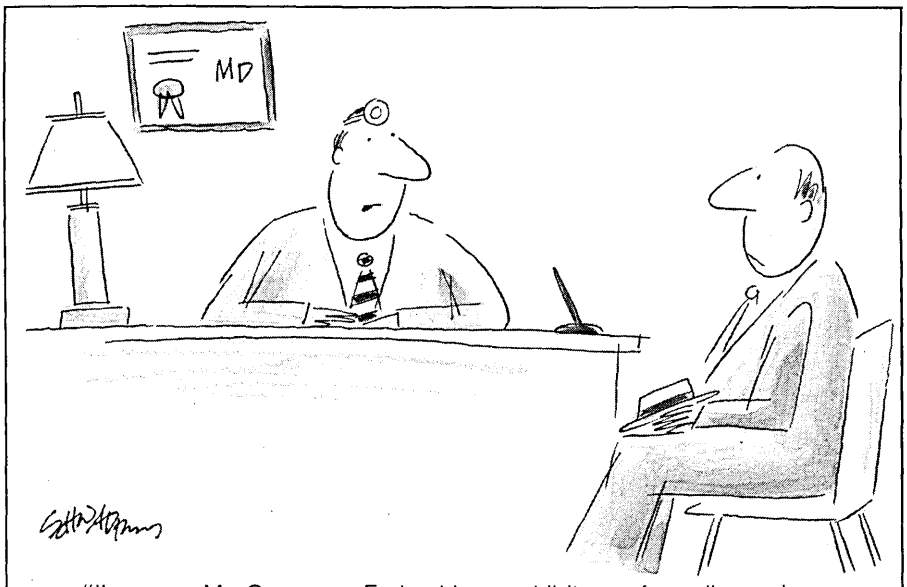
In acuity planning, a requirement of various regulatory bodies, each procedure will be assigned a relative unit of value. The value might encompass, for instance, how many minutes of RN and/or LVN time the procedure requires. Aggregating the values for similar procedures and personnel required in all the nursing care plans for each unit will provide a reasonably good estimate of the types and numbers of staff personnel needed for each shift.

In auditing, actual nursing care will be evaluated after a patient is discharged to determine if everything was done that was called for in the plan. Exception reporting will indicate what should have been done that wasn't, and vice versa. JCAH Title 22 requirements also will be met with auditing. It will obviate the need for nurses to spend hours poring through their records to prepare the paperwork required.

The future is also expected to bring more work from the medical staff. Some doctors, particularly obstetricians, are already using CARES to issue standing orders automatically when their patients are admitted and to check on their patients' progress during their stays.

Being considered, too, is installation of keyboard/display terminals in off-site doctors' offices. Data communications technology will enable these doctors to use their remote terminals to enter admitting information and orders directly into CARES and to access laboratory, X-ray, and other reports without actually having to visit the hospital.

The ultimate goal, attainable within the next five years, is to interface CARES with any function in HMH that generates, receives, or otherwise uses data—which means virtually everything in the hospital. ✲



"I'm sorry, Mr. Cosgrove, Federal law prohibits me from dispensing advice or prescription without a drug."

ROBERT SPAZIANO

Mr. Spaziano is the director of systems and communications at Huntington Memorial Hospital, Pasadena, Calif. His responsibilities include the ongoing development and implementation of the hospital-wide information processing system. Mr. Spaziano also teaches systems implementation at Cal State—L.A., and is affiliated with the Hospital Management Systems Society, Hospital Information Systems Sharing Group, DPMA, and Association of Systems Management.

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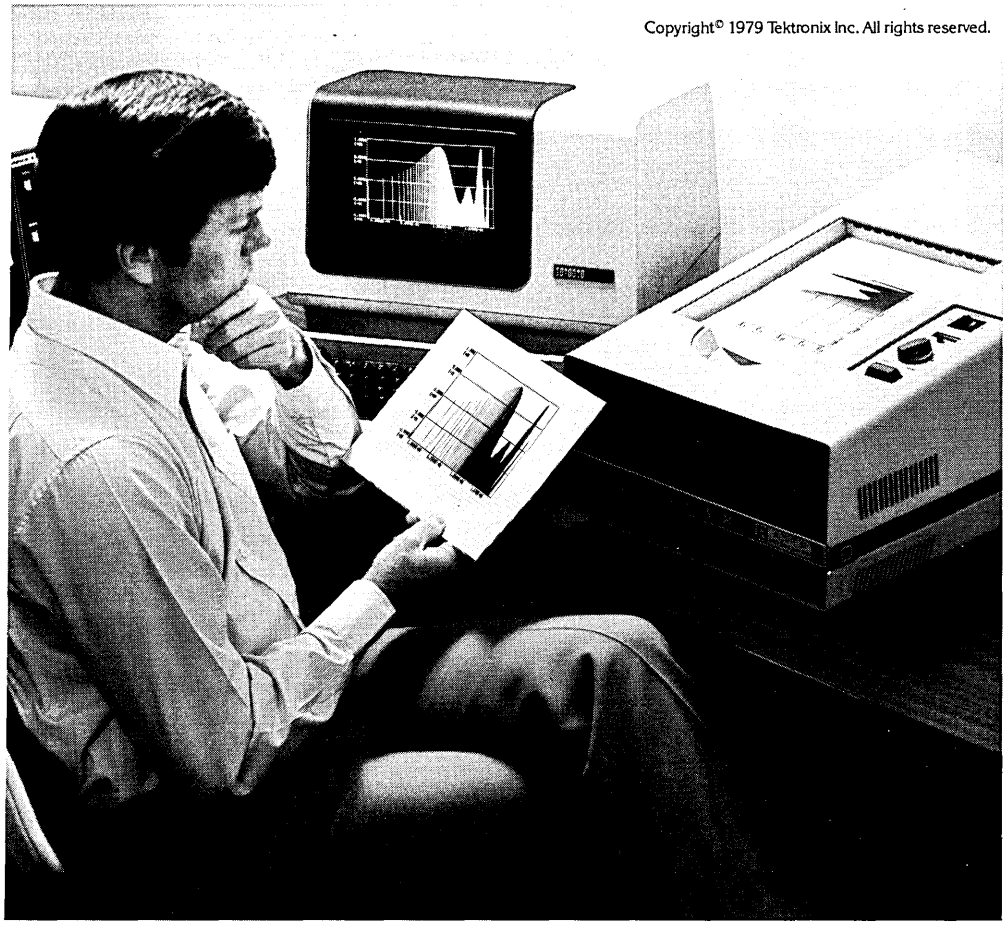

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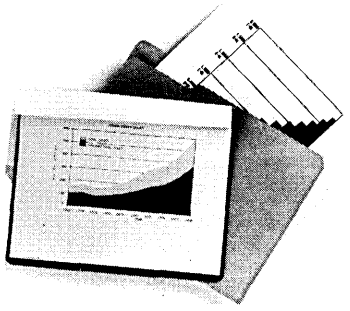

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Computer-based work stations would do away with the antiquated tools professionals and managers have been using for a hundred years.

REPLACING THE PAD AND PENCIL

by Amy D. Wohl

For about 15 years, most office automation activity has focused on the mechanization of a single task—typing—through the creation, refinement, and spread of word processing technology. While many worthwhile gains in secretarial productivity have come about by this technique, it is clear that plowed ground will be less fertile as time goes on and that it is now time to seek new fields. Secretaries are only a fraction of the total office work force. And typing is perhaps 20% of the total function of the "average" secretary.

Most office workers spend a major portion of their time collecting, analyzing, and assembling information and then communicating that information to their employees, peers, or superiors. Word processing assists all levels of workers in this process by offering better quality documents more quickly, but large portions of the data collection and distribution process remain virtually untouched by computer-based products.

The management work station (currently the subject of much discussion in the office automation field—and the main item in two major studies by the consulting firms of Quantum Sciences and Booz Allen, Hamilton) offers fertile new ground for improvement of productivity. Most managerial and professional workers face each day with tools that have been available for nearly a hundred years—pencils, yellow pads, and a telephone. In a few cases (perhaps 10 percent), they have become converted to the use of dictation equipment to speed document input, but many resist this technology or feel that it is too difficult to dictate anything but routine correspondence. A very few professionals and managers work with computer-connected display terminals. These professionals are generally concentrated in the data processing area itself—some programmers now write programs or program documentation directly on computer systems—or in financially focused areas such as banking, the stock market, and insurance.

The focus on the definition and development of a computer-based work station for managers is intended to offer new tools to enhance and support traditional management skills. Some of the tasks that these workers perform which lend themselves to computer assistance include:

Data Access. Most managers and professionals spend a large part of their day collecting data and rearranging this data into meaningful presentations. The assembly and arrangement of data is a prerequisite to the decision-making process that is a main function of management. Today, much of the office's data is still retained on paper, in metal filing cabinets, or it exists on computer printouts, inaccessible to the office worker except as it appears on the printed page.

A terminal in the manager's office or at the professional's desk could provide access to data stored in the firm's computer facilities, provided that proper access arrangements are available. Please note that this function is equivalent to the MIS type of function long touted as the wave of the future, but slow in coming due to the cost of providing large numbers of terminals, the cost of making mainframe access available (in both hardware and programming resources), and the difficulty in providing an appropriate level of interface for noncomputer users. Management work station designers and theorists hope to avoid the problems faced by the MIS group in several ways:

- Bring down the cost or amortize it more successfully by offering a variety of meaningful functions. If the terminal is used intensively enough, it will be easier to cost justify.
- Lessen the strain on the data processing department by offering some processing at the management work station and most of the programming (if not all) on a packaged basis.
- Provide a human engineered interface which essentially allows the manager or professional to use the computer-based work station with minimal training and no need to learn a new language. An English language interface is considered a requirement here.

Self-Authored Text. Today, managers get text typed in one of several ways. They write material in longhand and have it typed on the word processor or (frequently) by typewriter. They dictate material for keyboarding (usually employing machine dictation equipment, although a few traditionalists continue to use a stenographer). A very few professionals, generally ex-journalists who work in areas like advertising and public relations, or technical writers, work with a typewriter.

Obviously, there is not much incentive for the high level manager whose text is dictated to a shorthand-taking executive secretary (or written for him by professional staff) to learn to do word processing for himself. However, many professional workers find it difficult to get text typed on a timely basis. If we could offer a very-easy-to-use word processing function on a multifunction work station it is likely that some professional and managerial workers would choose to keyboard at least some of their own text. Even if this facility is not used by all workers, or only on occasion (such as evenings and weekends), it would still be a useful enhancement to the manager who does not mind typing and wants to see immediate results. Again, the problem is providing an English language interface that requires the minimum of memorization and provides reasonable function.

AN ADDED USEFUL FUNCTION

For those who will be quick to point out that managerial typists would prove unreasonably expensive, it should be mentioned that it is *not* intended that every manager become a typist. It *is* intended that this useful facility be offered as an additional function those managers who find it useful. There is nothing that says the professional could not choose to use part of the function. For instance, a professional with a multifunction work station could choose to:

- Self-author drafts, but leave cleanup and formatting to his secretary.
- Continue to get text into the system via his

With the proper access arrangements, a terminal in the manager's office could provide access to data stored in the firm's computer facilities.

normal route (longhand, shorthand, machine dictation, staff writer), but use the word processing functions of the work station to permit review and revision.

- Use the system only to review documents, giving revision instructions to the secretary through notes or machine dictation.

Electronic Mail. Many of the pioneering firms that have already started to offer some office automation to nonsecretarial workers begin with electronic mail. In the jargon of the office automation expert, this is a high leverage application. That is, small sums of money can potentially have large results in terms of cost savings or positive feedback on the viability of office automation projects in general.

First, it might be well to define what we mean by electronic mail. Some word processing users think of electronic mail as document distribution, the electronic transmission and receipt of formatted documents with a "letterlike" appearance. Most of the electronic mail pilot projects are not like that at all. In fact, they are electronic message systems that permit managers or professionals (and, in some cases, their secretaries) to send informal notes at high speed. They tend to fulfill several needs:

- They permit managers to exchange information in a timely way. It is no more trouble or effort to inform all of your peers of an idea or activity than to inform one, thanks to the "carbon copy" function on these systems.
- They permit workers to send memos at convenient times, without regard to normal working hours. This permits the writer to create his electronic message at any time (regardless of whether secretarial help is available at that time) and permits the document to be sent immediately or at least-cost time in the future. The recipient need not be in the office and can "read his mail" when he next returns or from a compatible terminal nearly anywhere in the world. Sophisticated systems permit messages to be automatically rerouted to the correct location to allow for transferred managers or managers in transit.

AVOID TIME ZONES

An interesting aspect of electronic message systems is that they get around the problem of workers who function in widely separated time zones. For instance, a firm with offices in New York and California may actually have only two hours per day when both offices are fully staffed. A firm with offices in the U.S. and Far East may have no overlapping hours at all. An electronic mail system permits questions to be asked and answered without the constant game of telephone tag that is normally played in such situations.

Users of electronic message systems generally check their electronic mailboxes three or four times a day (for regular users), typically first thing in the morning, around lunch time, early afternoon, and just before leaving for the day. A few hardy users take a terminal home with them (or have installed a home terminal on a permanent basis) and can continue to send and receive electronic mail at all hours.

Also, messages on an electronic mail system tend to be brief and to the point, frequently achieving real savings in managerial time (on both the authoring and the reading ends), plus savings in telephone charges spent exchanging meaningless pleasantries.

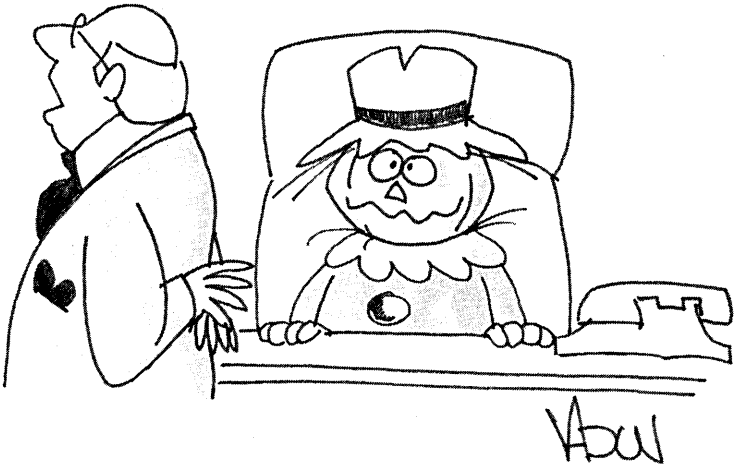
While it is sometimes difficult to justify the use of a terminal only for electronic mail, depending upon the frequency of usage, the cost of the terminal selected, and the value of the electronic mail itself (a single timely message in the change of a commodity price could, for instance, pay for the annual costs of an entire system all by itself), in multifunction environments the incremental value of electronic mail is usually easy to sell. Also, electronic mail is a good beginner's application. It doesn't require much training (even on current commercial systems, which offer precious little human engineering) and the user can remember how to get onto the system and send and receive mail even if he or she an infrequent user. It frequently causes satisfied users to ask for additional functions in areas like storage and text editing, leading the user into natural extensions of office automation functions.

Administrative Functions. This tag is used to include a market basket of activities including an electronic calendar, scheduling functions (cross-checking with other's calendars to plan meetings), and tickler files (reminding the user of deadlines to be met and activities to be performed). Essentially, any data processing system which can offer selecting and sorting functions can provide, via software, these types of facilities. The catch is that they must be provided, once again, in a form the user is willing to work with. This probably means very easy, English language access, with a minimum of procedure for entering and retrieving information.

Also, scheduling systems turn out to have a moral overtone in that many employees do not want their peers (much less management) to have full details on their individual schedules. What would happen to long lunches, afternoon golf games, leaving early? Therefore, several creative solutions have been offered. The system could inspect each individual calendar when, for instance, it tries to schedule a meeting between four managers, but would not be told *what* they are doing—only *if* they are available.

Again, employees do not want to give up control over their schedules, so the system would be likely to request that they schedule a meeting for a time known to be suitable, rather than simply adding the meeting to their schedule, without permission. Given the number of phone calls secretaries must normally make to set up a meeting between several managers, any kind of assistance in scheduling meetings should be helpful.

It is also possible to schedule the meeting space as well. Simply by making the meeting rooms participants in the scheduling system, the secretary can find out if a particular room (of the correct size, location, equipment, etc.) is available when the participants are free. The room can, of course, be scheduled without its permission (although the system may make room scheduling the function of a particular administrative employee and



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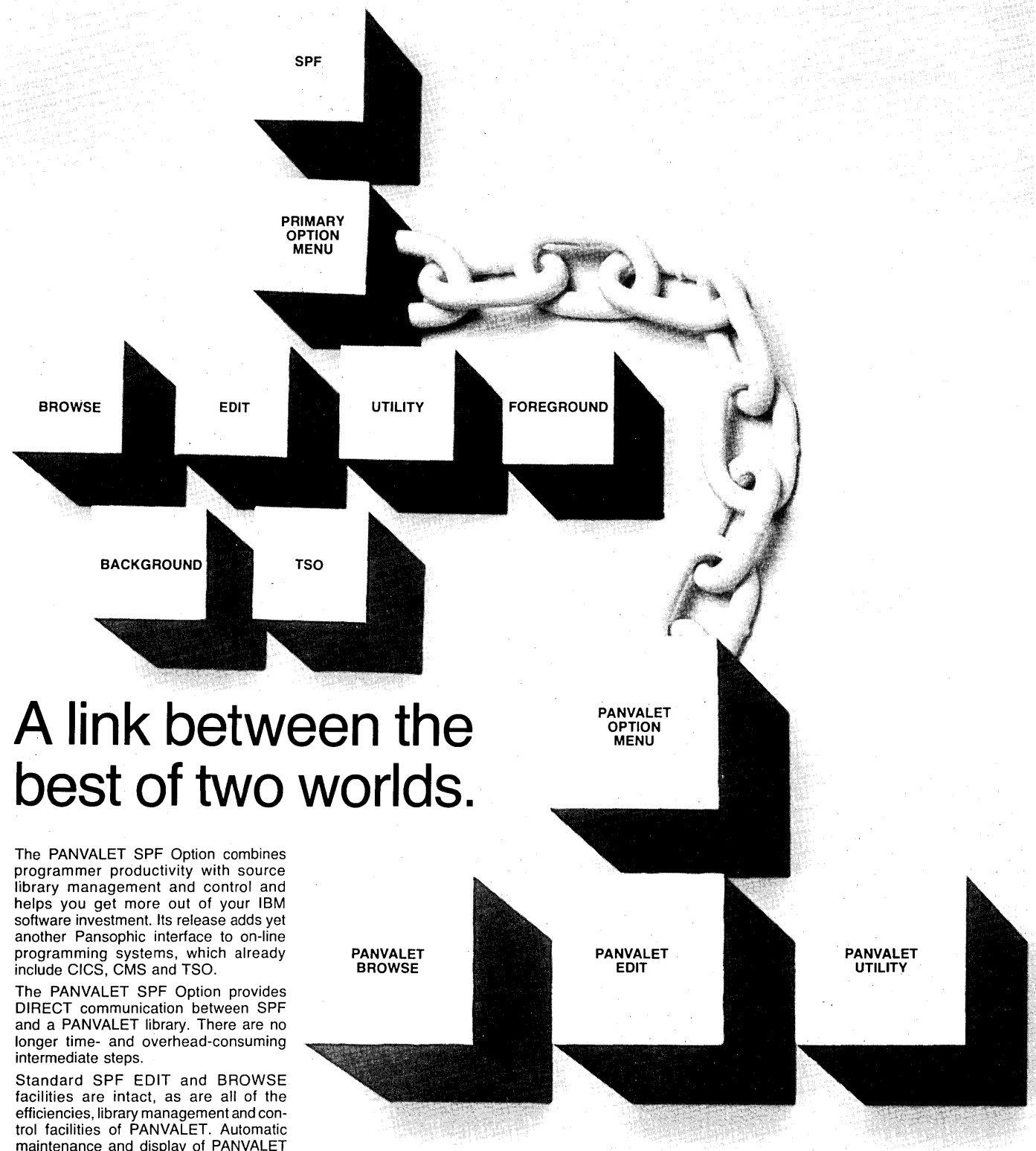

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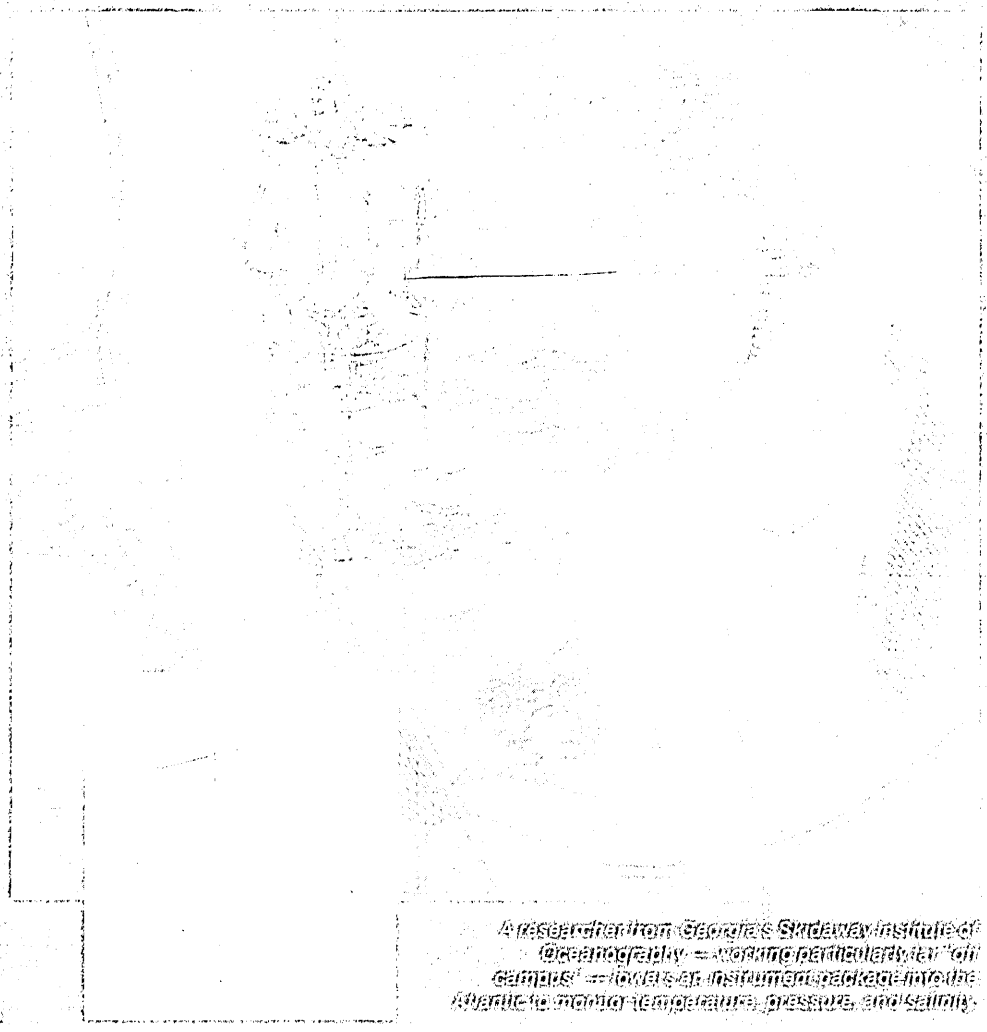

A researcher from Georgia's Skidaway Institute of Oceanography — among partners in "on campus" — loves an instrument package into the Atlantic to monitor temperature, pressure, and salinity.

... is also a Titan Network.

Georgia's University System Computer Network was officially established in May, 1979 to provide access to major computer resources for all units of the university system. The problem then, as now, was in providing a cost effective communications path from any terminal to any computer.

Today USCN encompasses hundreds of pieces of communications equipment and over 2,500 miles of private and foreign exchange telephone lines. It links the central office, 35 campuses, experiment stations, the Skidaway Institute of Oceanography, and several other user sites throughout the state. And dial-up facilities further extend its reach.

The all-digital complex concurrently supports switched synchronous and asynchronous traffic at up to 4800 bits per second statewide, plus simultaneous packet and time division switched traffic at 56000 bits per second between its main nodes in Atlanta and Athens.

Over forty computers are tied to the network at present, the largest of which are Control Data Cyber 70/74s, IBM 370/168s, and Univac 1100s, which serve as network hosts. Remote job entry stations plus many hundreds of remote and local terminals keep the processors busy.

No census of the rapidly growing and changing mix of computers front end communications processors and terminals stays current long. Anticipating this, USCN designers produced a network which is easily reconfigured and which can quickly grow to accommodate new users and applications. In these respects too, USCN continues to be a happy success, confirming the original design philosophy.

Titan has installed several such networks for university systems and many more for sophisticated users in private industry, financial institutions, government agencies, telephone operating companies, and others both in the United States and in other nations. As a result, Titan has more international experience in the connection of digital data networks than any other communications company in the world.

Titan Information Systems Corporation

Professionals would probably choose to keyboard at least some of their own text with a very-easy-to-use wp function on a multifunction work station.

request that this employee schedule the room —again, the issue of control).

Storage and Retrieval of Files. Eventually, all data and text are likely to be stored electronically (although additional paper or other files may be maintained for convenience or for legal reasons). When that day comes, it is likely that office workers will want to access and review stored data and text electronically, on a display work station, rather than having it transferred to paper. Already there are systems on the market (and many waiting in the wings) that permit some limited retrieval of electronically stored data with a minimum of user knowledge of data base or file structures. While it is clear that we will want to have electronic access to files (and some of us want it right now), a few things will have to happen first:

- Storing files electronically, particularly text files, will have to become cheaper. This requires cheaper, very high capacity storage.
- Access to the files will have to be available using English-type commands. No one is going to ask for File #123654.987. We will want to say, "I want the letter I sent to Mr. Jones last year about the lost tractor shipment." Or, "May I have any correspondence from Mr. Client to Mr. Hostile or Mr. Unfriendly."
- We will have to get into the filing system all the documents that were created and stored on paper before the creation of electronic files. While most of us will probably choose to go with a mixed paper-electronic system for some time, omnifont optical character recognition scanners show some promise for converting previously typed material to digital codes, storable in an electronic filing system. The Kurzweil scanner, acquired by Xerox recently, already offers most of the capabilities that would be required for such functions.
- Entering into the system all the paper that comes into our office after the electronic filing system is implemented. Again, the omnifont OCR scanner seems to have interesting possibilities. Also, this need would presumably go down as more and more businesses converted to electronic document distribution systems during the mid-'80s to early '90s.
- We will have to figure out a legal way of filing things on magnetic media (not subject to invisible, undetectable change). Or we will have to discover a low-cost alternative to magnetic media. Optical media, such as the materials being discussed in video and optical disk, seem to have applicability here.

FILLING WORKERS' NEEDS

In addition to the functions mentioned here, management work stations could include other functions, with the capabilities offered tied to the needs of the individual worker. For instance, some workers would want graphics capabilities. Others would want personal (or local) computing, with programmability via a flexible, higher level language. Others will want special software that will permit specialized functions such as money market analysis or sales reporting, and so forth. It is likely that hardware and/or software vendors will offer special multifunction packages designed for specific vertical markets with well-defined special needs. These packages are likely to include both general-purpose functions (like electronic mail and electronic filing) plus special functions. For instance, a system for law firms might offer tax law information (customized by state), client billing, interface to the electronic legal data bases, and special tickler files for filings. Other systems might include general ledger packages, personnel subsystems, and the ability to build custom data bases.

Before we get managers to use multifunction work stations designed and marketed for their special requirements, there are some issues to be addressed:

- Should such systems be centralized in nature (dumb terminals connected to the mainframe computer), or should they consist of their own microprocessor, multistation system nodes, with each node connected to the mainframe for such functions as access to high capacity storage?
- Will data bases have to be redesigned to permit the efficient storage of text? And can we build more human engineered interfaces in front of data base management systems, so that office users will be able to use them meaningfully?
- Does the firm require a large critical mass to start an office automation project such as electronic mail? Or can small projects (with minimum investments), properly chosen, give useful information and positive feedback?
- What does a management work station look like? Answers here vary from a traditional display work station to specialized display work stations where all functions are accessed via labeled keys to such special arrangements as a large display on the wall plus a keyboard that can be moved around the room (e.g., from desktop to sofa table). It is clear that the electronic office environment will have to replicate a number of managerial processes if it is to gain wide acceptance. This will probably require large displays (so that they can be broken up into multiple simultaneous functions, much as today's managers work with multiple piles of paper).

It may also require exotic interfaces, designed for nonkeyboarding managers. Areas that seem fruitful include voice, touch screens, and light pens—with voice likely to be the most important. Already, it is possible to use relatively primitive single-word voice recognition systems to provide an interface to office automation systems, permitting the user to get things out, but not to put things in (unless he cares to spell!) More sophisticated multiword, large vocabulary voice recognition systems are likely to become available (at commercial prices) in the mid- to late '80s.

There are already some management-directed office automation products in the commercial market. They include Datapoint's offering, which provides such functions as electronic mail, data processing, data entry, word processing, and information retrieval (but most of these functions at lower levels than will be required for meaningful, widespread use of such systems), and the new Axxa offering, born of the Citibank management work station project.

Most users of managerial office automation today are pioneers. Convinced that even small productivity gains among classes of employees that are valuable, scarce, and highly paid will translate into large dollar savings on the bottom line, a number of firms—particularly those in the paper-heavy industries like insurance and banking—have begun to explore office automation for managers and professionals. Most firms are starting small, with pilot projects designed for specific, high-leverage groups. A few firms are planning to study their entire corporation looking at all the possibilities before making long range, big dollar commitments, and picking individual projects.

This is an area that has the potential to be even more important than word processing in changing the way that people work in offices—and allowing them to perform their business functions more effectively. Also, by doing the repetitive and mechanical parts of employees' jobs, the employee is left with the most meaningful, most interesting part of the job.

Of course, not every employee wants to be challenged, and there is sure to be resistance to any kind of change, much less changes with such broad implications. Because when the automated office really comes (and it is sure to do just that) it has the potential to change our entire way of doing business.

People will be able to choose to work at home or in remote locations with all the support normally afforded to them only in their offices. And professionals and managers, freed of semimenial tasks, will be free to set their minds roving in search of ever more creative (and profitable) ways to further the business goals of their firms. ❋

Amy D. Wohl, a contributing editor of DATAMATION, is president of Advanced Office Concepts Corp., Bala Cynwyd, Pa., and the publisher of a monthly newsletter on word processing.

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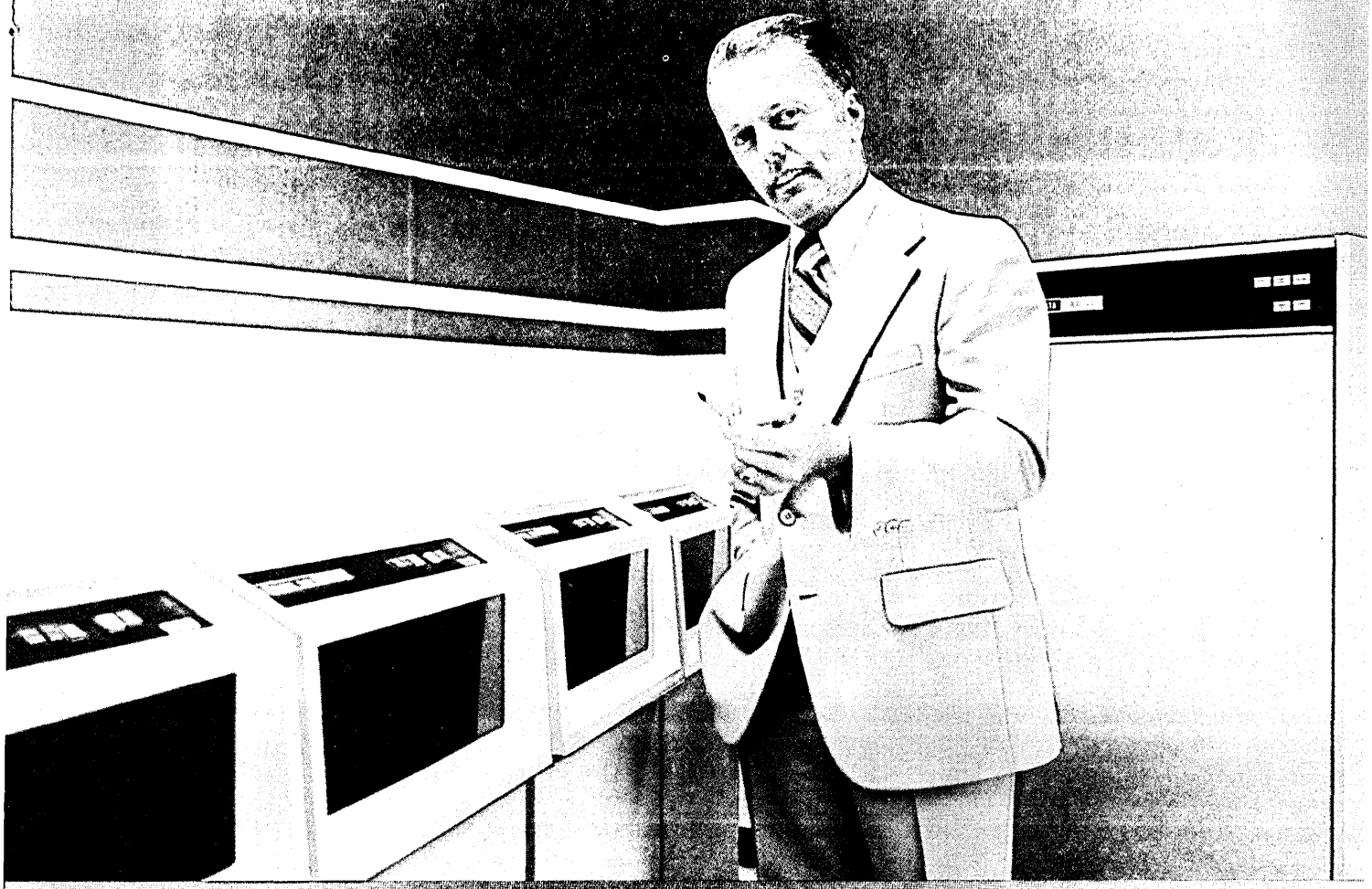

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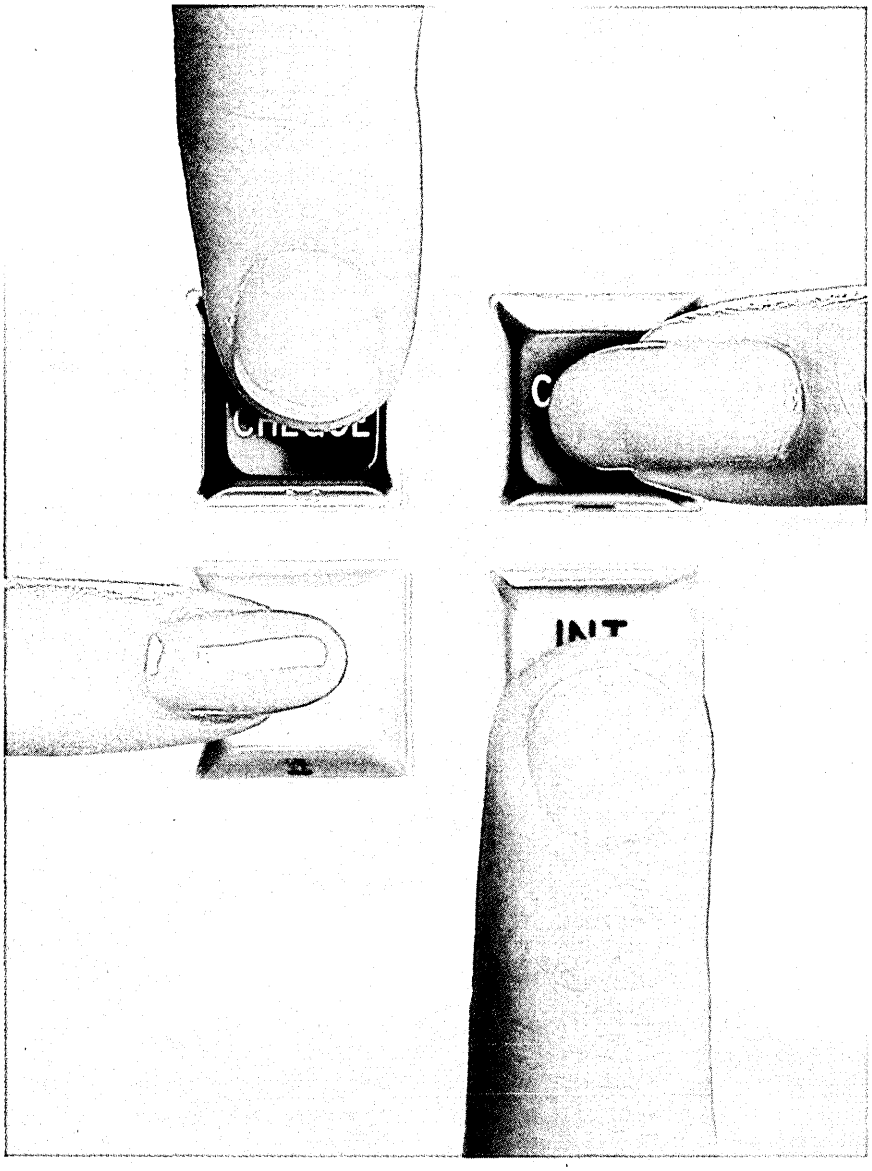

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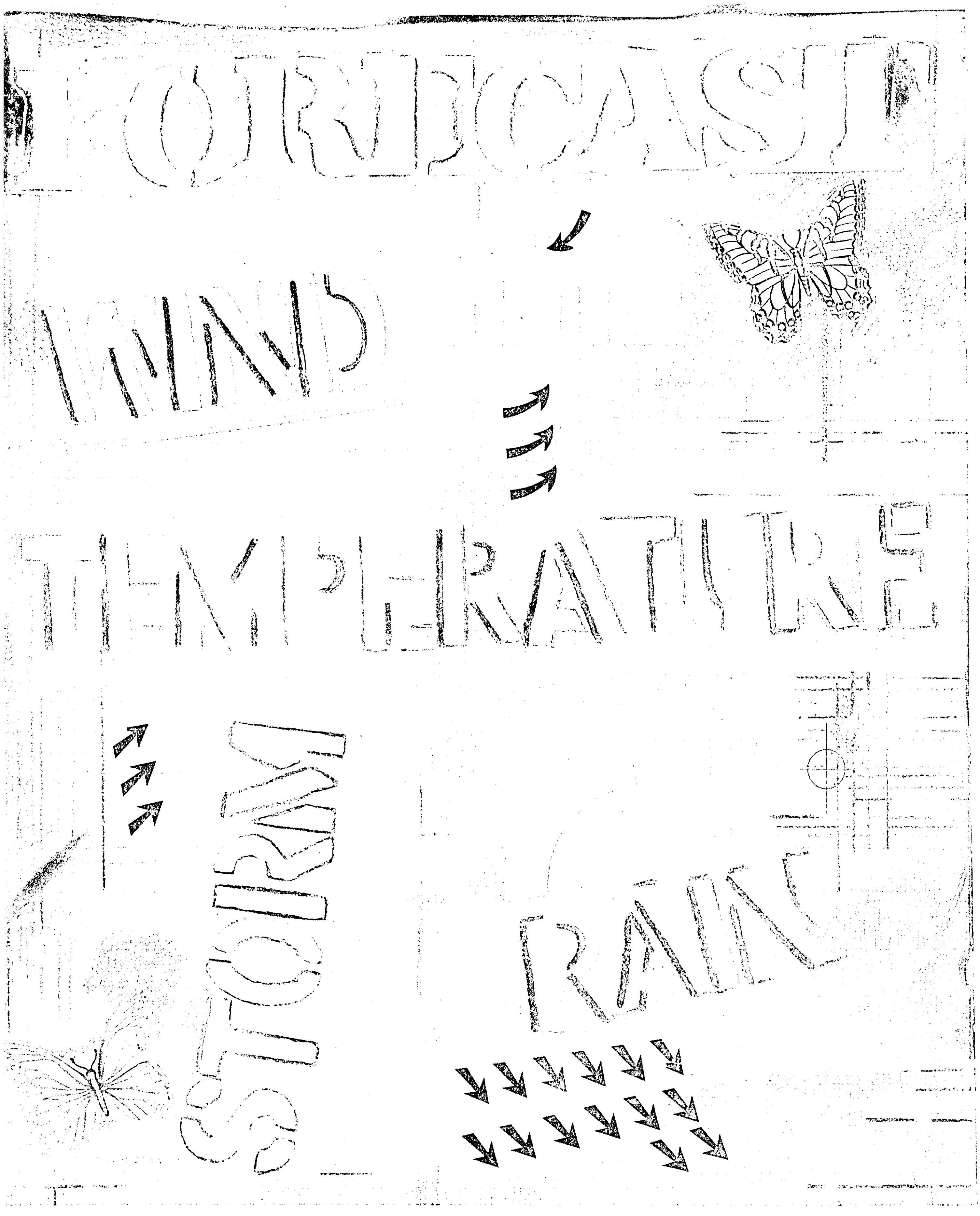
FORECAST
WIND
TEMPERATURE
STORM
RAIN

Lewis Fry Richardson dreamed of saving man from the destruction caused by tornadoes and hurricanes.

THE FIRST MAN TO COMPUTE THE WEATHER

by Molly Gleiser

Once a man had a dream: perhaps it would be possible to make a numerical prediction of the weather from atmospheric models. Such a prediction would save man from the destruction wreaked by tornadoes and hurricanes, and might even avert famine through forecasts of droughts and wet spells. When his numerical weather model failed to work, he turned to a greater dream: a mathematical theory of war. That man was Lewis Fry Richardson.

Richardson was born in 1881, the youngest of seven children of a Quaker family in Newcastle-on-Tyne, England, well known for owning a profitable leather works for about 300 years. At age 13 Lewis was sent to a Quaker boarding school, Bootham, in York. This school did not allow use of the cane, and functioned rather like an extended family. To encourage autonomy and breadth, it awarded all prizes for work done outside the classroom, and placed great emphasis on extracurricular activities such as archeology, debate, drama, music, and natural history. Here, Richardson first discovered meteorology, and became convinced through one of the masters, A. Neave Brayshaw, that "science ought to be subordinate to morals."

As a family, the Richardsons were talented both scientifically and artistically. Lewis later drew comical little sketches of colleagues, and one of his nephews became the world-renowned actor, Sir Ralph Richardson. A brother, Lawrence, discovered a new star, and another brother, Gilbert, who could read Sanskrit and Greek fluently, started a new international language, Edo. The family, though, considered it a sacred duty for all the children to enter the leather works. Luckily for Richardson, with four older brothers already in the tannery there was no place for him, and he was left free to pursue his scientific interests.

He studied under the famous physicist J. J. Thomson at Cambridge, where he took the natural science tripos, a smorgasbord of several sciences. For nearly a decade he held a couple of minor teaching posts and short-term scientific jobs: one at the National Physical Laboratory's meteorology department, three years at a tungsten lamp factory (the Sunbeam Lamp Company in Gateshead), and another at the National Peat Industries. There he became interested in the flow of water through peat, a problem that involved the solution of differential equations not formally soluble. The work terminated abruptly when the managing director absconded with a large sum of money. Richardson, however, without formal mathematical training, had already discovered how to solve the differential equations by an approximate method of finite differences. When in 1913 he landed the job of director of Eskdalemuir Observatory high up in a remote part of Dumfrieshire, Scotland, he decided to apply these methods to a numerical calculation of the weather. At that time, weather could only be roughly forecast from an extrapolation of human observation.

Richardson's idea was not new. In 1904, a Norwegian physicist, Vilhelm Bjerknes, had already suggested that accurate forecasting was a problem in mechanics and physics that could be solved by mathematical analysis. Essentially, the problem was to predict temperatures, rainfall, and so on from the change in atmospheric flow, but the differential equations involved presented difficulties. Richardson had the answer to these equations, and by the time he reached Eskdalemuir he had conceived a detailed plan.

His idea was to divide the atmosphere into layers and the layers into squares, and to tabulate values of the pressures, temperatures, and humidity of various upper air data at given longitudes, latitudes, and heights on "computing forms," the equivalent of today's computer program, to describe the state of the atmosphere. Then, by using classical laws of physics such as the conservation of energy, and by solving the resultant equations, he could obtain subsequent states of the weather after a series of short time intervals. He had even visualized the offices in which these calculations were to take place.

WEATHER COMPUTER THEATER

"Imagine a large hall like a theater . . . The walls of this chamber are painted to form a map of the globe. The ceiling represents the north polar regions, England is in the gallery, the tropics in

ILLUSTRATION BY JANE STERRETT

"The man in charge is like the conductor of an orchestra in which the instruments are slide rules and calculating machines."

the upper circle . . . A myriad of computers are at work upon the weather of the part of the map where each sits . . . Numerous 'night signs' display the instantaneous values so that neighboring computers can read them. Each number is thus displayed in three adjacent zones so as to maintain communication to the North and South on the map. From the floor of the pit a tall pillar rises . . . In it sits a man in charge of the whole theater . . . One of his duties is to maintain a uniform speed of progress in all parts of the globe. In this respect he is like the conductor of an orchestra in which the instruments are slide rules and calculating machines. But instead of waving a baton he turns a beam of rosy light upon those who are behind hand."

He concluded rather whimsically: "Outside are playing fields, houses, mountains, and lakes, for it was thought that those who compute the weather should breathe it freely!"

A happy fantasy. But in 1914, war broke out, and as a Quaker and conscientious objector his mind was not at rest.

"I was torn," he wrote, "between intense curiosity to see war at close quarters, and intense objection to killing people, both mixed with ideas of public duty, and doubt as to whether I could endure danger."

Finally in August 1916, with British casualties mounting—in the battle of the Somme alone they were to reach half a million men—he extricated himself from Eskdalemuir, where the authorities were reluctant to release him, and volunteered for the Friends' Ambulance Unit.

By September, Richardson found himself in France, confronting a battlefield strewn with helmets, badges, ripped uniforms, and human rubble. Men were scraped from tanks, bones protruded through skin, and limbless soldiers screamed with pain as they were eased ever so gently onto stretchers into the motorized ambulance convoy and conveyed to makeshift hospitals in the rear.

To keep his sanity, Richardson carried his weather manuscript with him, continuing to revise it between intervals of transporting the wounded.

"My office," he wrote, "was a heap of hay in a cold rest billet."

The calculations involved complex thermodynamic and hydrologic considerations and were massively detailed descriptions of the atmosphere in terms of the role of radiation, eddy diffusion, and other factors. He faced enormous difficulties. High altitude winds were explored; observatories were not arranged in the chessboard fashion required in his model; and worst of all, fast computers had not yet been invented. He was not discouraged.

"Perhaps someday in the dim future," he wrote, "it will be possible to advance the computations faster than the weather advances and at a cost less than the saving to mankind due to the information gained. But that is a dream."

In fact, the drawbacks had the paradoxical effect of encouraging him. In Chapter 9 of his manuscript, he forecast a change of pressure at the ground of 145 millibar in six hours at a point in central Europe. The actual change was more than 100 times smaller. But Richardson was confident the error arose not from a flaw in his model but from the inadequacies of upper wind data.

Twice the manuscript got lost, once during the battle of Champagne in April 1917, only to be recovered months later under a pile of coal. But still Richardson pressed on, escaping at least for a time the realities of war.

Richardson had married Dorothy Garnet in 1909; she was a sister of a fellow science student at Cambridge. They were Rh-incompatible and, after several miscarriages and deaths, they decided to adopt children, first Olaf, age two, then Stephen, one, and finally Elaine. After the war, sharp noises from the children startled him, and at night he sleepwalked screaming through the hall while his wife explained that father had been shell-shocked during the war.

Instead of returning to Eskdalemuir, he took a job at Benson Observatory in Oxfordshire. His work there provided much needed relief from war trauma. He was developing an accurate method to measure upper wind data by shooting steel balls ranging in size from a pea to a cherry hundreds of feet above ground and noting the return of these missiles to earth to measure wind shift.

Then, like a bombshell, the Meteorological Office was transferred to the Air Ministry. Its work conflicted with Richardson's Quaker values: private and public duty and the condemnation of war. His work was in no way warlike, but his wife described the inevitable outcome:

"There came a time of heartbreak when those most interested in his 'upper air' researches proved to be the 'poison gas' experts. Lewis stopped his meteorological researches, destroying such as had not been published. What this cost him, none will ever know."

FIRST WEATHER TEXTBOOK

Richardson left Benson Observatory in 1920 and took a job as head of the physics department at Westminster Training College in London and in 1922 his book on *Weather Prediction* appeared. With slide rule and mechanical calculator, the only tools then available, it would have taken 64,000 computers to "race the weather round the globe," but this was the first textbook of dynamic meteorology to appear. London University honored him with a DSc, and he was made a Fellow of the Royal Society.

But Richardson had a secret passion: to apply science to human situations. He had, as early as 1906, sold his physics books in order to raise money to visit Professor Karl Pearson in London and learn about statistical proof. And he had already, while with the ambulance convoy in World War I, written a paper entitled *The Mathematical Psychology of War*. So far ahead of its day was it that no suitable outlet for publication existed, so he had 300 copies printed himself and gave most of them away.

"It was little noticed," he commented. "Some of my friends thought it funny."

After publication of his weather book, he began an intensive study of psychology, and finally, at 47, he took a BSc in that field at London University. That same year he became principal of Paisley Technical College and School of Arts in Scotland, and began to devote all his spare time to developing a theory of the causes of war.

One of the first problems was to choose an index of the magnitude of war. He chose as that index the number of war dead, and combed through some 70 history books to categorize the numbers of wars according to their magnitude. He continued to update his figures through World War II including the millions of murders taken from the statistics of 17 countries.

As another part of the work, he focused his attention on the etiology of war and examined the effect of eight "pacifiers" such as sports, collective security, intermarriage, and armed strength. Then, just as he had made a mathematical model of the weather, he formulated the dynamics of war in equations like one connecting the rate of arms buildup with the perceived menace minus the restraining pacifiers.

This work must have been given great impetus by the rise of the Nazis to power. His children, with whom he played tennis and cricket and joined on camping trips, were now growing up. Olaf later became a motor engineer. Stephen, who attended Harvard, became a professor in the department of Pediatrics and Community Medicine at Albert Einstein College of Medicine in New York. Elaine studied drama before marrying M. F. Traylen, a meteorological officer. Richardson's house filled with an ominous stream of refugees who became part of the family until they could be independent.

Richardson focused more and more on the problems of the arms race. But though some of his work was published in reputable journals like *Nature*, Fellows of the Royal Society would still smile when his name was mentioned: oh, yes, a sweet man and not impractical, but a bit visionary, you know. His

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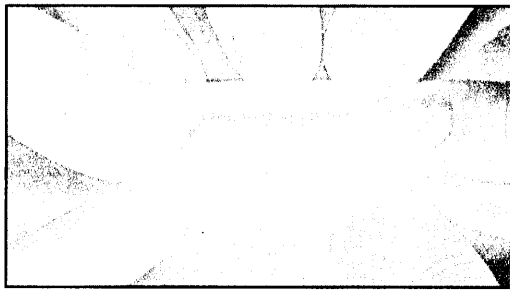

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"There came a time of heartbreak when those most interested in his 'upper air' researches proved to be the 'poison gas' experts."

Generalized Foreign Politics, published in 1939, still only groped for results. But the extent to which his work combined the philosophical, technical, and psychological-ethical aspects of such large scale events made it extraordinary.

Richardson's stand as a conscientious objector in World War I had barred him in the eyes of the establishment from university teaching. But by 1940, when a university finally did offer him the professorship for which he had longed, he turned it down to devote himself to his war studies, retiring to Kilmun, a tiny fishing village on Holy Loch, a three-mile long inlet of the Firth of Clyde. It overlooked a submarine base, a dreadful reminder of the importance of his war studies.

There the ruddy white-haired English gentleman was known to walk to the end of the pier and drop parsnips off the end to measure wind turbulence. But only rarely, for relaxation, did he indulge his passion for meteorology. Mainly he focused on his study of what, erasing the difference between riots, rebellions and wars, he called "deadly quarrels." Early retirement coupled with wartime inflation had left him quite impoverished. But that didn't matter. For him "the value of life consisted in the amount of self-denial you paid for it."

The end of hostilities in 1945 coupled with the dropping of the atom bombs and the 1948 arms race can only have served to intensify his efforts. He could now include data from 1936-39 as well as from that present period in his work on arms buildup. It looked as if international trade might be a factor in preventing war, and arms buildup one of the leading causes. But even as he worked the position changed. In 1952 the hydrogen bomb appeared. It was cheaper than its equivalent of conventional explosives, and it altered the factor of intimidation that entered into his calculations. Richardson did not even dare predict what might happen.

In 1946 John von Neumann, the famous mathematician at Princeton, formed a group for the purpose of using the modern computer for forecasting the weather. Jule G. Charney, who joined him in 1948, devised some simplified models of the atmosphere, closer actually to Bjerknes' model than to Richardson's, and in 1950 the group used a modern electronic computer, the ENIAC at Aberdeen Proving Ground, to obtain the first computerized weather forecast. A few years later the U.S. National Meteorological Center for increased accuracy adopted a mathematical model fundamentally no different from Richardson's.

In 1953, three years after the Charney breakthrough, Richardson, age 72, died in his sleep of a heart attack. He has labored alone for 30 years on his mathematical model of war. None of his publications on the topic, even his last book, *Arms and Insecurity*, reach firm conclusions. But he had seen one of his dreams come true. ✻

MOLLY GLEISER

Dr. Gleiser was born in England and came to the U.S. as part of the fabled brain drain in 1952, to work at places such as Ohio State Univ. and MIT. Later she worked on solar energy at the National Physical Laboratory of Israel. After doing more on thermodynamics at the Lawrence Berkeley Laboratory until 1970, she turned to freelance writing and editing.

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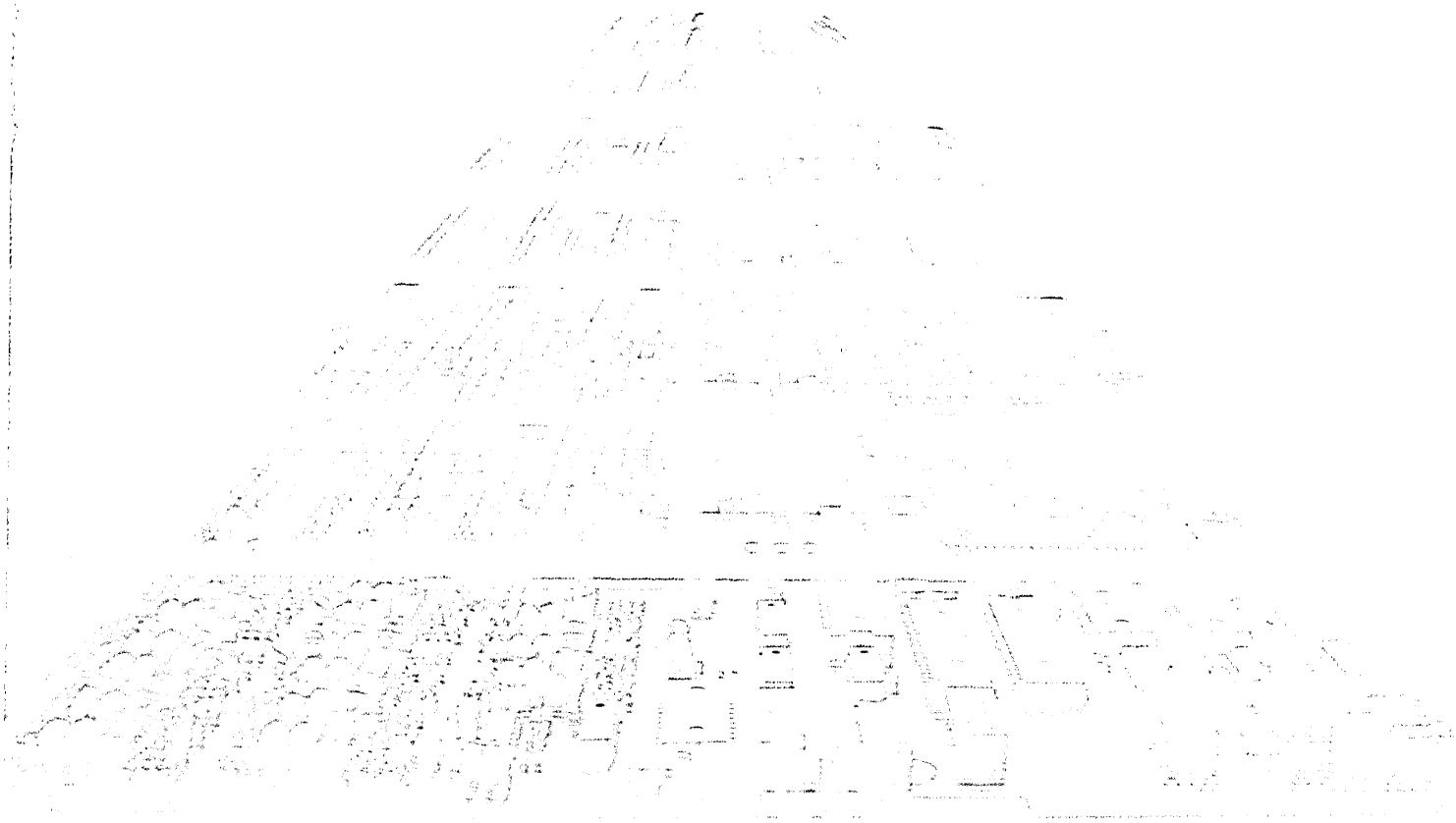

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The 50% to 100% error traditionally associated with software development cost estimates is unacceptable in today's contract environment.

REAL-TIME ESTIMATING

by Edward L. Griffin

A real-time software development cost estimate is one that is generated with minimal information in quick response to a rough order of magnitude pricing request or to a quick turnaround proposal. The quality of the estimate is impacted by the response time duration; the level of detail in the backup varies widely. These durations may be categorized into one to two hours, one to two days, or one to two weeks, any of which is possible in today's competitive aerospace or commercial world.

Despite the temptation to label this estimate a scientific wildly assumed guesstimate (SWAG), it must contain sufficient information to withstand the scrutiny of upper management and customers.

The more familiar and rigorous estimating techniques (Wolverton,[1] Metzger,[2] RADC 74-300 Vol XI,[3] Myers,[4] and Putnam[5]) are only partially applicable because of the real-time constraint. The basic steps of performance requirement definition, requirement allocation to functions, size and time estimation, difficulty factor evaluation, and conversion of these steps to manpower, materiel, and other direct charge cost numbers must still be accomplished. The error traditionally associated with these estimates, 50%-100% or more, is unacceptable in today's fixed-price or cost-plus-fixed-fee contract environment.

The cost factors that impact the development estimate include (1) level of detail of system requirement definition, (2) level of required documentation, (3) systems engineering support availability, (4) training requirements, (5) developmental facility accessibility, (6) rigor of software test, and (7) interoperability of software and systems tests. Factors not directly involved in development but in ongoing and subsequent support are complexity of hardware/software integration, level of systems test support, and level of software postdelivery support. These cost factors impact all developmental phases. Detailed knowledge of the expected impact of an item in a phase will lead to more realistic and competitive estimates.

The major developmental impact factors are tabulated with respect to the program phase they influence. The level of system definition influences the design phase first. The span of detail inherent in this definition and the availability and experience of systems engineering requirements and integration, systems design, and system tests personnel makes this the major impact to development planning and estimation. Small items that are overlooked in estimation of system performance inevitably grow to large costs during implementation. If the system requirements are not fully defined, a major risk compensation factor must be applied to both developmental planning and cost estimation.

The level of required documentation influences all phases of developmental and cost estimation planning. This documentation includes the software performance requirements, as-built software description (product specification or unit folders), developmental (unit and integration) test scripts, and qualification test plans and procedures. Levels of documentation range from handwritten data in programmer notebooks with commented listings to full military standard specifications containing detailed equations and implementations at the performance level. The detail in performance specifications influences the test program directly, since that documentation must satisfy verification and qualification of all performance requirements.

Besides being a factor in system definition, the requirements and integration, systems design, and systems test support functions can supply help in interface definition, algorithm development, and test definition that would otherwise be required of software development personnel.

Programming staff training requirements primarily affect the coding and integration test portions of the program development effort. This training may range from assembly language, through macro or operating system programming, to higher-order language programming. The impact is felt in the cost of the classes (generally lasting one week), travel, and per diem while in attendance, and in schedule, as work power is lost during the training period.

The results of this training are more efficient programs and more efficient programming, followed by actual schedule compression and cost decrease owing to the increased productivity.

The developmental facility affects the code and integration test portions of the programming effort also. The ideal facility offers unlimited access with instant turnaround to every programmer. The more realistic approach offers each programmer access of at least three hours a day, and each test team four hours a day. The facility must also support library and configuration control functions. The least desirable is a batch facility which typically offers two runs a day on a 12- to 24-hour turnaround.

Software testing may be categorized into three levels: integration/operation tests, qualification tests, and certification tests. The first level is an extension of multimodule integration testing to total program tests, accomplished by supervisor approved test scripts. The second level is accomplished by or under leadership of an independent test group to verify that all performance requirements are met. This verification includes detailed examination of the as-built code to find acceptable responses to simulation and documentation of the test set that will show the performance requirement has been met. The certification test involves exercise of the program under dynamic conditions, actual or simulated, to verify that performance is acceptable to both software and system requirements. The latter two test categories require increasingly sophisticated levels of documentation to support the tests.

The final major program impact is evaluation of the system test plan and coordination of the software test effort with that plan. This can affect the formal software test phase by allowing software operability tests to be performed at the software test level, then qualification and certification testing to be performed at the system test level in a comprehensive and cooperative software systems effort with the other systems tests (i.e., acceptance) on system hardware. The software-

ILLUSTRATION BY TERESA FASOLINO

1. Ray W. Wolverton, "The Cost of Developing Large-Scale Software," TRW-SS-7201, March 1972.
2. Philip W. Metzer, "Managing a Programming Project," Prentice-Hall, Inc., Englewood Cliffs, N.J., 1973.
3. Ronald L. Smith, "Estimating Software Project Resource Requirements," Structural Programming Series (Volume XI), U.S. Department of Commerce, National Technical Information Service AD-AO16 416, 1975.
4. Ware Myers, "A Statistical Approach to Scheduling Software Development," *Computer*, December 1978, pp. 23-25.
5. Lawrence Putnam and Ann Fitzsimmons, "Estimating Software Costs," DATAMATION, September 1979, pp. 189-198; October 1979, pp. 171-178; November 1979, pp. 137-140.

oriented documentation would still be necessary, but the task of procedure/code debug and trouble determination could be spread among a base of both software and test personnel that overall could reduce schedule time and test complexity.

DEVELOP THE ESTIMATE

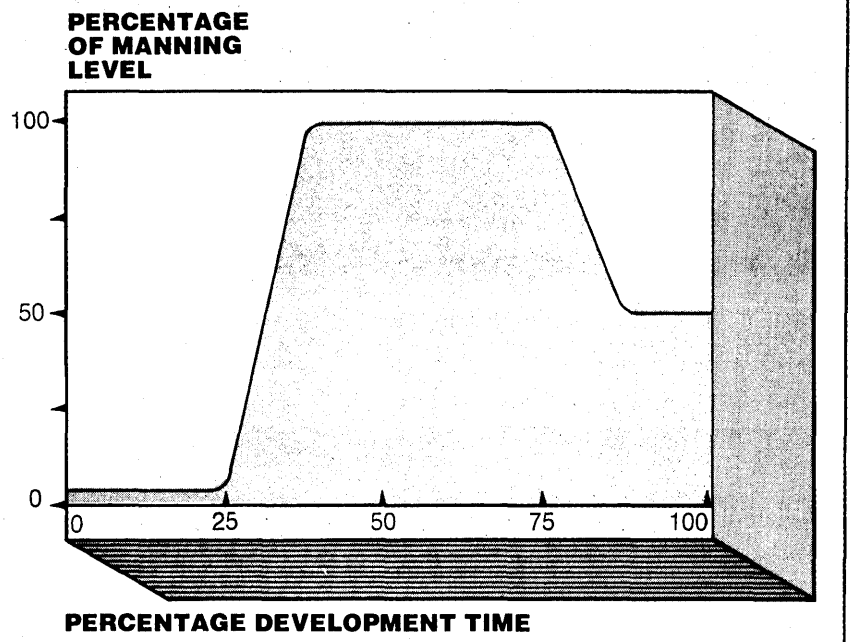
The three major jobs involved in developing the software cost estimate are defining the size of the software development task, defining the developmental program, and generating the costs on a negotiable, line item basis.

The definition of the size of the software development starts with allocation of software performance requirements from the system performance requirements. The system performance source can vary—a concept definition conversation, a feasibility study report, a technical requirement document, or a detailed system performance specification. This diversity of sources makes allocation of the applicable portions of the system requirement to the computer program hazardous. Ideally, a set of trade studies that evaluate alternative configurations of hardware, software, and manually oriented procedural functions will result in an efficient allocation of requirements to these three major subsystems. Trial approaches at implementation with tentative cost estimates will then be cross-examined to produce a cost-effective system. This process can be repeated several times. In the worst case, an engineering estimate based on an equivalent program may be all that can be accomplished. Regardless of the allowed estimation time response, the performance allocation must be defined and documented, even if only through reference to another program. The level of systems engineering support available is extremely critical in this phase.

The performance requirements allocated to the software must next be suballocated to computer program functions. This is generally documented in a design requirement sheet or a software performance requirement. This document defines the processing performed by each program function and the hardware and software interfaces (input and output) for that function. Sizing and timing estimates are generated from rough code or analytic equation operation counts, and the software test program is outlined to complete the definition. Under time-constrained criteria, an equivalent program may be all that is available to fulfill definition of software performance, sizing, and timing estimation. Experience has shown that a well-defined estimate will usually grow only by a factor of 1.5:1, while a poorly defined program can grow by a factor of 2.0 to 4.0:1. The validity of the sizing estimate and the potential growth factor must be documented for

FIG. 1

THE SOFTWARE DEVELOPMENT CYCLE



PROGRAM PHASE	PROGRAM PHASE TIME LENGTH	PERCENTAGE TOTAL EFFORT
DESIGN		3.49
DETAILED DESIGN		11.05
CODE AND UNIT TEST		23.17
INTEGRATION TEST		27.82
QUALIFICATION TEST		34.47

PROGRAMMING LIFE CYCLE

The developmental programming cycle is illustrated in Fig. 1. It is not the Raleigh distributed total life cycle curve usually quoted, but more representative of actual program generation. Its phases include design, detailed design, code and unit test, unit and integration test, and qualification test. The design phase includes interpretation of the system performance requirements and allocation into software performance functions and subfunctions.

These functions are defined as processes, with input, output, size, and time descriptors, and the results documented in a performance specification. Detailed design is first completed in skeletal form for presentation in a preliminary design review. The final draft of the detailed requirements, including data base design, signal and control flow, and processing definition in flowcharts and text are documented in a product specification for presentation in a critical design review.

The implementation portion of the task begins with coding and unit testing. Coding forms are completed, desk checks are made, documentation is updated and walkthroughs are accomplished. Compilation runs are completed, test drivers and scripts are written, and module or unit tests are completed. After successful passage, documentation is updated and configuration control invoked. The unit and integration test phase completes retest of the modules and begins integration and test of groups of modules. Test scripts and drivers are written for these groups to ensure proper flow of data and control between the modules.

The qualification test portion of the developmental cycle is accomplished to more formal test plans and procedures. A performance/conformance matrix is generated that must be satisfied by the as-built code. Detailed procedural steps based on the code are generated and debugged, and tests are run to these procedures to prove program performance. Tests may always go beyond a performance specification, but must, at a minimum, satisfy all of the performance requirements. Hardware/software integration with the target computer is accomplished, if possible, during integration and qualification testing.

Integration of the work-power curve over time gives the following nominal percentages of developmental effort per program phase:

Design	3.49%
Detailed Design	11.05%
Code and Unit Test	23.17%
Unit and Integration Test	27.82%
Qualification Test	34.47%

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The level of required documentation influences all phases of developmental and cost estimation planning.

TABLE I

SOFTWARE ESTIMATION IMPACT FACTORS

	X Instruc. Y Data Base		1.5:1 Good 2.0:1 Eq. Program 4.0:1 Weak Defin.		0.2:1 Data Base 1.0:1 Average Code 1.5:1 Complex Code
	Defined Software Functions and Size Estimate		Validity of Estimate Multiplier		Difficulty Factor Multiplier
	X Eq. Inst.		÷ 168 LOC/MM Listings ÷ 100 LOC/MM Spec, Folders ÷ 75 LOC/MM Mil Eq. Doc. ÷ 50-25 LOC/MM Mil App. Doc.		Schedule and Manloading per Function
	Equivalent LOC		Work-month Documentation Divisor		Equivalent Work-months
×	1.0:1 Ded. Facil. 1.23:1 2 hr. Cent. Fac. 1.46:1 4 hr. Cent. Fac.	+	3 weeks/task leader 2 weeks/lead programmer 1 week/programmer	+	.0 Oper. Test .32 Qual. Test .64 Cert. Test
	Developmental System Impact Multiplier		Training Impact Addition		Test Impact Multiplier
+	.25 Simple Hardware .37 Complex Hardware .5 Hardware and Software	=	Equivalent Work-months		One man level of effort per 12K LOC
	Hardware/Software Integration Multiplier		Estimate Result		Support After Delivery

subsequent risk evaluation.

The second step, developmental plan generation, combines the computer program definition, company developmental standards, and developmental resources and transforms them into a schedule, developmental facility definition, and organization. Each computer program function that was defined previously must have a difficulty factor assigned. This assignment will generate equivalent program instructions. A tested set of difficulty factor assignments are (1) data base equates to instructions by dividing the data words by 5, (2) average code (equation transformation or simple logic) is acceptable as given in the program definition, and (3) complex code (executive or heavily time-constrained routines) is multiplied by a factor of 1.5. These equivalent instruction counts may now be used to determine schedule time spans for each function.

Four categories of developmental coding time spans have been defined through experience related to levels of required documentation. Where design flowcharts and commented listings are the only documentation, program generation over the development phase can be estimated at 168 lines of code (LOC) per work-month. Where development plans, performance design requirements, product specification equivalent unit folders, and integration/test procedures are generated, 100 LOC per work-month is reasonable. Where these specifications, plans, and procedures must be placed in military equivalent format, but are not subject to customer approval, 75 LOC per work-month is used. Where a fully interactive customer/developer program with all reviews and approvals of documentation is considered, 50 to 25 LOC per work-month is not unreasonable. Using these dividers, the equivalent size estimates may be transformed into nominal developmental time spans for each function. These incremental time spans are analyzed to detect the interdependency and adaptability to the total program schedule. The final product is the nominal developmental schedule and personnel requirements, with an audit trail to the program functions.

The schedule and work-loading are now ready to be impacted by developmental system constraints, if nominal, three-hour-per-day programmer access to the developmental system is available, and work-loading is unchanged. If a central facility with two-hour turnaround is used, the programmer will have less than half the access of the interactive system, so the coding portion of software development (23%) will generate a multiplier of 1.23 to the total program work-loading for planning and alteration of work habits to accommodate the decreased accessibility. If less accessibility is foreseen, the multiplier could go to 1.46 to give revised equivalent work-loading.

TRAINING AND TEST

A further impact to work-power is training. At this point in work-power estimation, the number of people on the project and the organization of task leaders and managers can be defined. At least three weeks of study or training courses should be scheduled for task leaders, two weeks for lead programmers, and one week for programmers. This time impact can increase the overall work-power requirement if the schedule time length must remain fixed.

The final impact to development is test. Test has been categorized as operational, qualification, and certification. Operational testing assures that the program modules work together and do not impact work-loading estimates. Qualification testing, with its planning, scripting, and procedural debug, doubles the 34% of qualification test phase effort over operational testing, generating a .34 multiplier for developmental work-power. Certification testing involves program checkout in a dynamic environment, with twice the complexity of qualification testing, leading to a .68 multiplier on the developmental work-power. These factors are then added.

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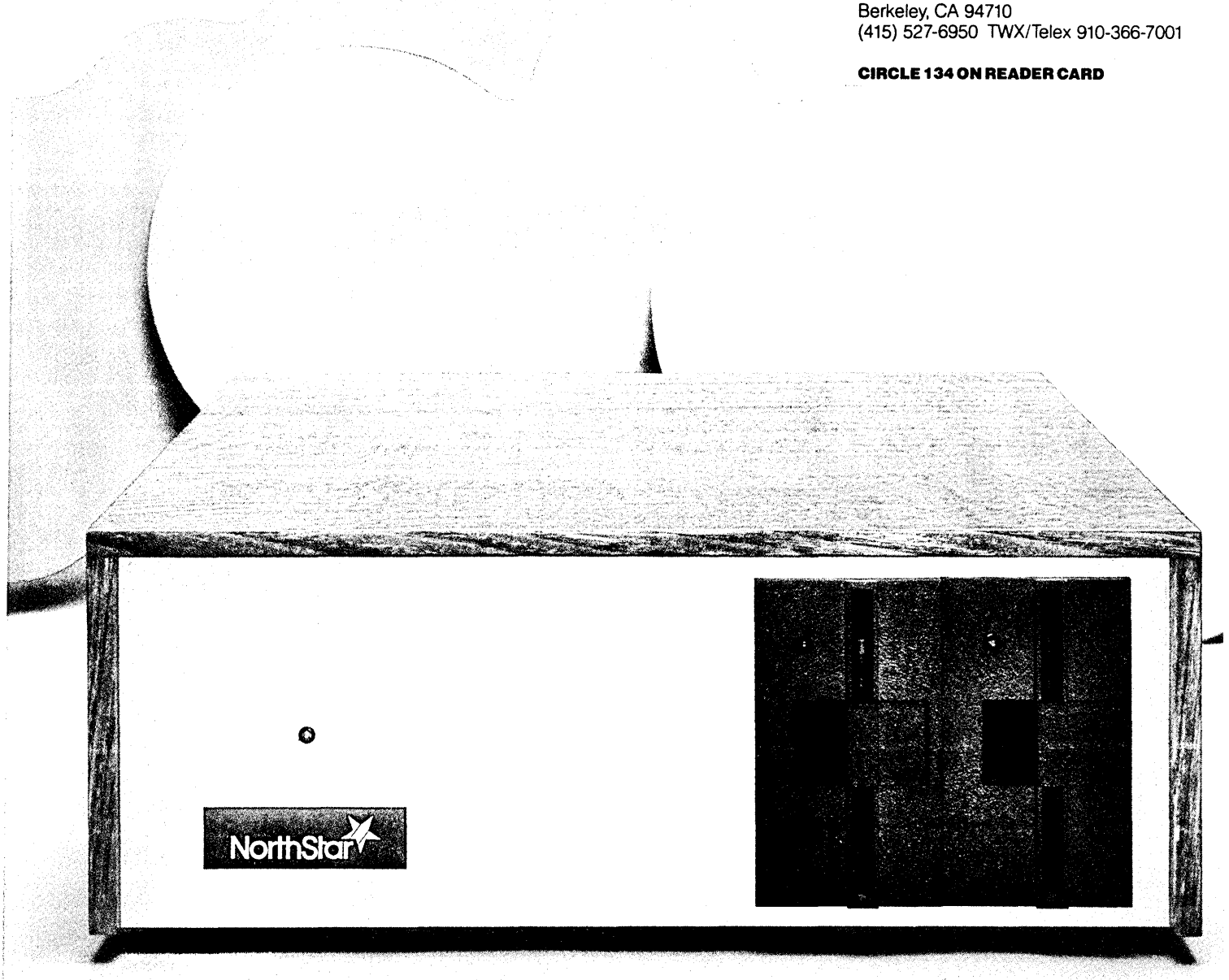

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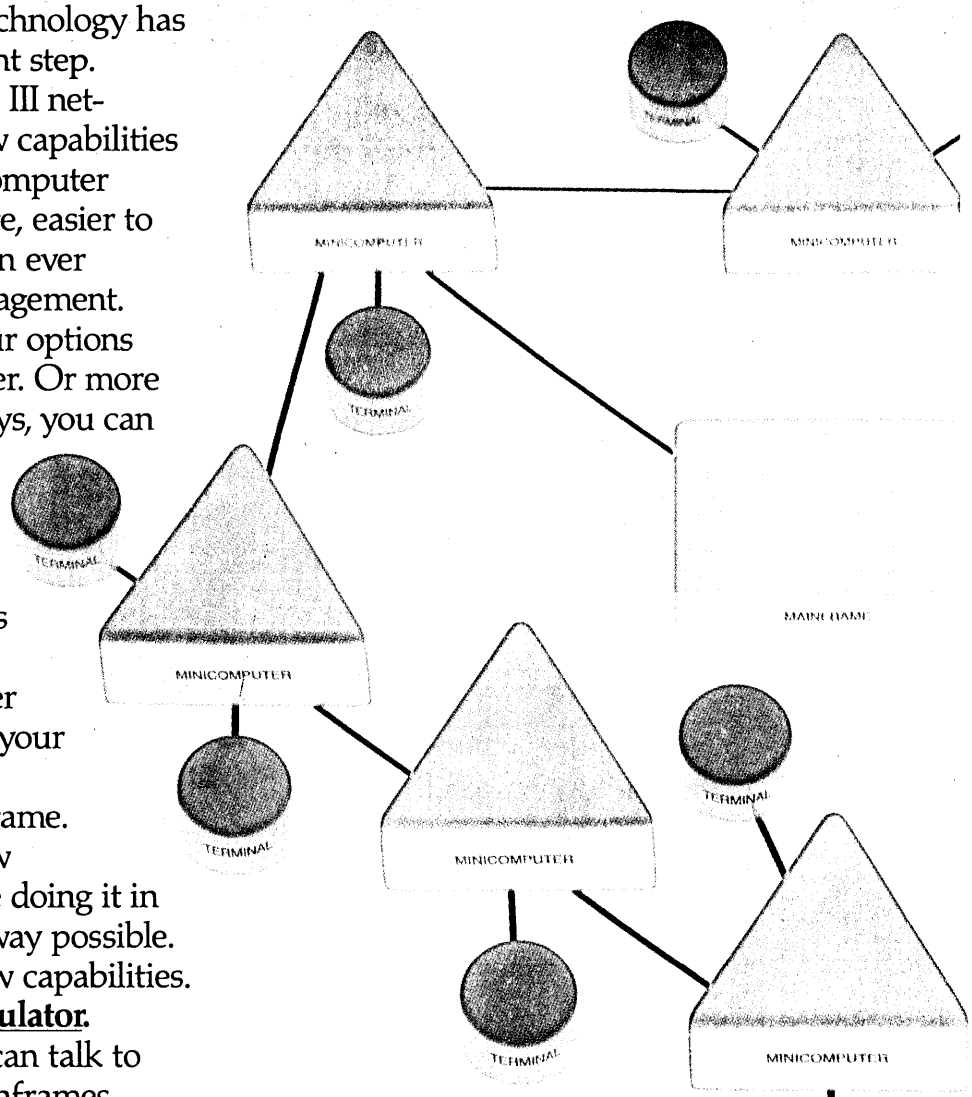

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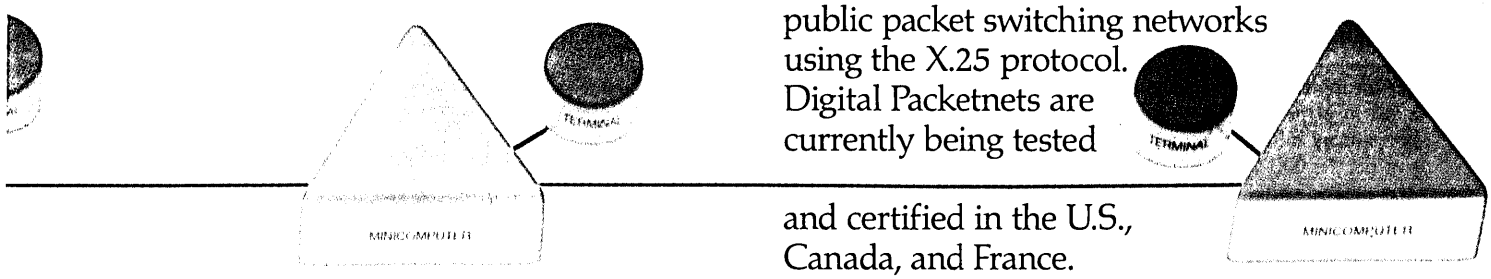

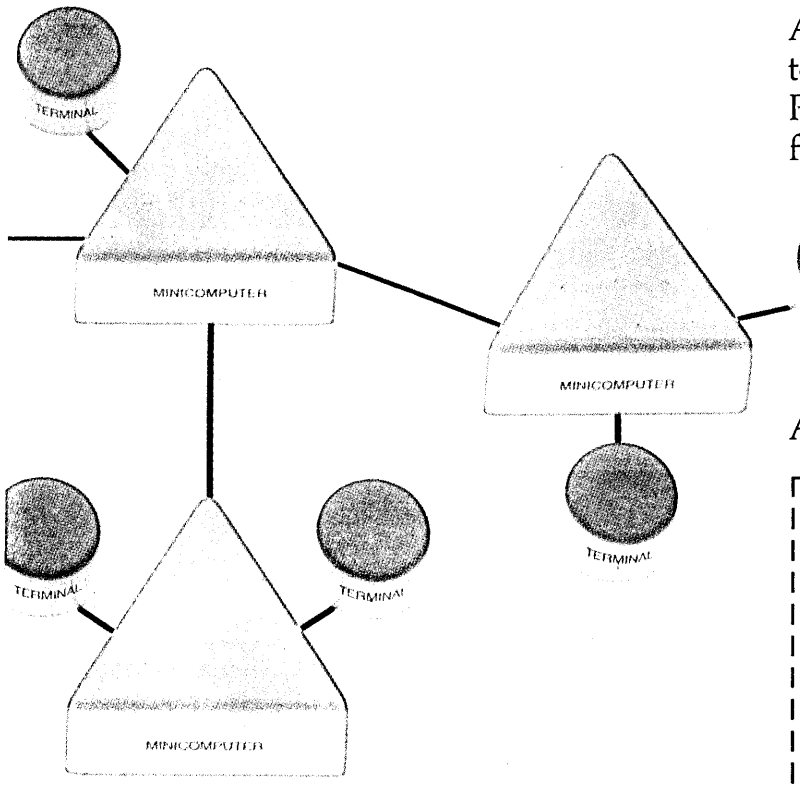

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There are three major jobs in cost estimating: defining the size of the task, defining the development program, and generating the costs.

ment but still a cost factor is hardware/software integration. If the software crew must accomplish this, the multiplier is .25 for simple (digital) interfacing, .37 for complex (analog and digital), and .5 for interface with another computer in which hardware and software must interact. All of these estimating multipliers are illustrated in Table I in order of application. Included in the table is a level of effort for subsequent program support during initial fielding or test of one person per 12,000 LOC.

The software development estimator is always faced with internal and customer audits of his cost figures. The estimator must be prepared to deal with percentage cuts and suggest scope changes if management of the customer must take out reserves or is unable to afford the estimated cost. A further level of detailed justification, show in Table II, coupled with the major impacts documented through the estimation process, should give sufficient insight into the "how" of selected scope cuts. The table shows the subtasks required for each function and the approximate percentage of effort associated with each. Where percentages vary because of impacts such as the increased documentation, or rigor of test, etc., these are noted. The availability of this level of data allows the estimator to vary the scope of the program judiciously, rather than penalizing the whole effort with insufficient application of resources in the wrong phase.

A path trace through Table I shows that 432 alternative program costs can be derived. As an example, costly, moderately expensive, and inexpensive development efforts are illustrated in Table III, in which the task is to develop an autopilot for a missile. The program schedule allocated to this development is 12 months from initiation until delivery to systems test for testing.

The first step in the example impacts the defined program with the validity of estimate factors. These are shown on the example as good, equivalent, and weak, which, except in explicit cases, will correlate to the defined time spans of one to two weeks, one to two days, and one to two hours, respectively. The same difficulty factor is applied to the validity estimates giving 1,905, 2,390, and

TABLE II

SOFTWARE DEVELOPMENT SUBTASKS

Performance Definition and Specification	
Functional Definition 1%	Interface Definition .5%
Functional Allocation .5%	Sizing and Timing 1.49%
Detailed Design	
Detailed Requirements 8.0%	Flowcharts and Writeups 3.05%
Code and Unit Test	
Code Form 8%	Test Script 3%
Desk Check 2%	Test Driver 2%
Documentation Update 1%	Test Conduct 3.17%
Recode 2%	Update and Redocument 1%
Recheck and Redocument 1%	
Integration Test	
Plan 3%	Test Drivers 5%
Procedure 5%	Integration and Debug 14.82%
Qualification Test Plan and Procedure	
Test Plan 3%	Procedural Steps 10%
Performance/Conformance Matrix 2%	Documentation 2%
Qualification Test Debug/Conduct	
Test Driver 5%	Conduct .47%
Code/Procedure Debug 10%	Report 1%
Dry Run 1%	

TABLE III

SOFTWARE ESTIMATE EXAMPLE

Required Program	Validity of Estimate	Difficulty Factor	Level of Document.	Developmnt. System	Training	Rigor of Test	Complexity of Integration
	Good						
Autopilot	1050	1050	Mil. App.	4 hr. Cent.	5 people	Cert.	HW and SW
Application	450	90	38.1MM	55.62 MM	57.37 MM	81.75 MM	100.8 MM
700 LOC	450	675	Listing	Dedicated	1 person	Operatnl.	Simple HW
300 Data B.	450	90	11.33 MM	11.33 MM	11.58 MM	11.58 MM	14.41 MM
Exec.		1905					
300 LOC							
300 Data B.	Equiv.						
	1400	1400					
	600	120	Spec., Fld.	2 hr. Cent.	3 people	Qual.	Complex HW
	600	750	23.9 MM	29.39 MM	30.64 MM	38.28 MM	47.12 MM
	600	120					
		2390					
	Weak						
	2800	2800	Listing	Dedicated	3 people	Operatnl.	Simple HW
	1200	240	30.23 MM	30.23 MM	31.48 MM	31.48 MM	39.04 MM
	1200	1800	Mil. App.	4 hr. Cent.	12 people	Cert.	HW and SW
	1200	240	101.6 MM	146.34 MM	152.34 MM	217.36 MM	268.16 MM
		5080					

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CIRCLE 139 ON READER CARD

The software development estimator is always faced with internal and customer audits of his cost figures.

5,080 LOC equivalents as the estimates to be priced. The variation between the smallest and the largest number is 2.6:1.

Two sets of documentation criteria were applied to the good and weak estimates, while a medium set was applied to the equivalent estimate. As expected, the 2.6:1 ratio holds for equal documentation criteria among the good to weak estimates, but if documentation standards are ignored, the ratio diverges to 9:1. Progressing through the development system, training, and rigor of test columns on the figure, the ratio of 2.6:1 remains constant for equal impact criteria. If impact criteria are ignored, the ratio diverges further to a ratio of 18.7:1. The integration factor causes even more divergence if the complexity factor is ignored.

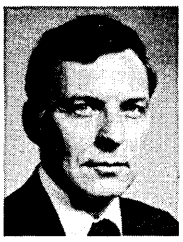
The normal yardstick used by most managers, cost per line of code, is worth investigation. Assuming an average burdened programmer cost of $6,000 per workmonth, the following results are apparent from the figure:

Good Definition, Best Case Multipliers	$45/LOC
Good Definition, Worse Case Multipliers	$317/LOC
Equivalent Definition, Normal Multipliers	118/LOC
Poor Definition, Best Case Multipliers	$46/LOC
Poor Definition, Worse Case Multipliers	$316/LOC

The results are as expected for application of equal criteria, but the differences of $45, $118, and $316 per line of code show that the managerial estimating technique of "6,000 lines of code at $25 per line" leaves much to be desired. If the variation in estimates were to become actual numbers through a program development, the best to worst case cost in $86,460 to $1,608,960. If the difference had only nominal impact on a company because of its diversity, it should have a major impact on the estimator that allowed the contract to be signed at the lower, erroneous figure.

It is evident that there is no substitute for a good program definition to begin the software estimation cycle. The major time portion of any allocated time period for estimation should be spent in defining the tasks to be accomplished or bounding the work to be accomplished. This effort will minimize the effects of the 2.6:1 error that is possible in this phase. It is also evident that ignorance of customer delivery requirements, development impacts, and integration complexity can add a further 8:1 error in the development estimate. The use of this or an equivalent methodology for a "real-time" estimate can supplement engineering judgment and provide the facts and measure the risks inherent in a software estimate. ✱

EDWARD L. GRIFFIN



Mr. Griffin is a senior group engineer with Martin Marietta Corp., Orlando, Fla. He has worked in and managed software development and test for the past five years, with previous experience in systems engineering and computer hardware applications. He serves as an Air Force Reservist, working computer hardware and software development with Wright-Patterson AFB.

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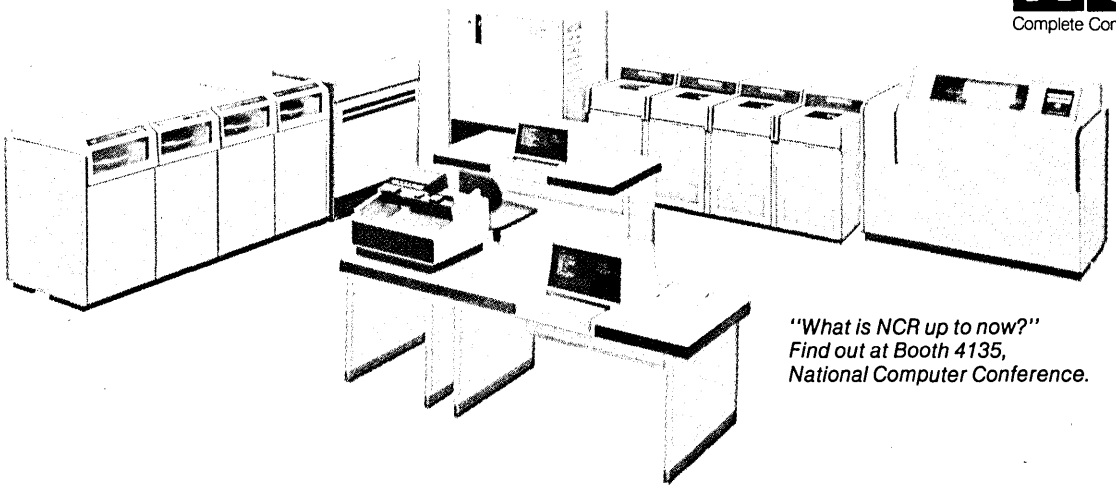

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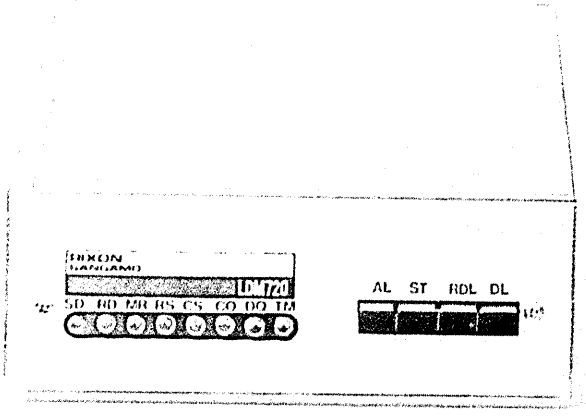

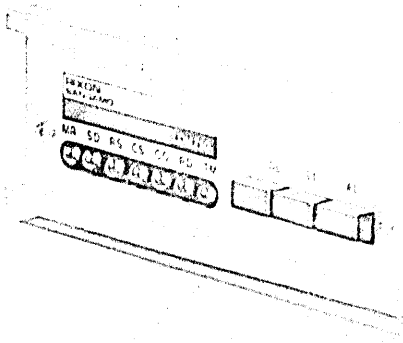

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CIRCLE 140 ON READER CARD

Duplicating processors does not guarantee reliability, but one can often achieve increased reliability by duplicating critical components.

HEDGING YOUR BETS

by Samuel Feldman

It is 9 a.m. in the control room of a large oil refinery, and already there is serious trouble. Pressure is rising rapidly on isomerization unit number two. An emergency shut down may be required. The decisive information is the unit trend data collected by the on-line computer during the night. This same computer is now undergoing preventive maintenance. The refinery operators are not concerned. All the necessary trend data was automatically copied to a redundant standby machine. As a result, a costly and possibly unnecessary reactor shutdown may be averted.

Later that afternoon, a line of thunderstorms sweeps across the rush hour congested expressway, causing numerous accidents. The highway traffic control center receives a direct lightening strike knocking out main surveillance computer A. The highway supervisor is dismayed. But his frown becomes a smile when the green computer B on-line indicator flashes on as the automatic switchover logic completes its operation.

Duplicating processors does not guarantee reliability. In fact there are many factors which if not suitably considered can cause all of one's processors to fail concurrently. The reader can perhaps provide more, but a few of these factors are: a clean environment free of electrical interference, fire and flood protection, reliable power sources, adequate hardware and software maintenance, trained and competent personnel, and good plant security.

Assuming these factors have been provided for, one can often achieve increased reliability by duplicating critical components. Table 1 shows the relative failure rates for different classes of computer components. Although processors are nonmechanical and thus not likely to fail, the associated peripherals may be failure prone; having separate processors, each with its own peripherals, provides an effective means of isolating problems. For example, two disk controllers on a single processor will protect against single disk failures, but it will be impossible to replace a failed disk controller without stalling the processor and shutting down the entire system.

There are many ways of configuring multiprocessor systems; most of them, however, can be classified as either parallel processing systems or on-line/standby systems.

In parallel processing systems all the processors are essentially on-line concurrently. Input data is processed by all the processors but only one controls the output. This type of system requires special hardware and is often complex and expensive. However, the switch from one controlling processor to another can be accomplished with perfect continuity. The Space Shuttle system, which consists of four identical IBM AP-101 general purpose computers, is a good example of a parallel processing system. In the Space Shuttle system outputs are determined by plebiscite (four processors are required so that if one fails, two voting against one still constitutes a majority).[1]

Not all applications are as critical as the Space Shuttle. For applications where some loss of continuity can be tolerated, the on-line/standby variety of redundant processor system can provide satisfactory reliability for less money. The systems described in this article are of the on-line/standby type; the essential features are shown in Fig. 1. Only one processor, in this case system A, is on-line and connected to sensor and operator control interfaces. The other processor is in standby mode and is ready to assume on-line functions when a switchover is executed. One or more switches are used to switch devices to either processor. Switching can be manual or automatic. System status and historical data are periodically transferred from the on-line to the standby system to assure an acceptable level of data continuity at the time of a switch. Either communication links and/or shared shortage may be used for transferring this information.

In addition to simpler hardware and generally low cost, the on-line/standby system has the following advantages over systems where all processors run on-line software continuously:

- The approach is machine independent. Virtually any vendor's equipment can be used. This is particularly advantageous for those who wish to upgrade single processor systems to multiprocessor configurations.
- The systems are loosely coupled, and it is possible to upgrade the hardware on one without affecting the other.
- Symmetrical systems are not required; witness the traffic control system in Fig. 3.
- The standby systems can be used for development while remaining ready to assume control. This of course involves some risk. Most systems, however, are upgraded or changed from time to time, and few users are

1. Sheridan, C.T., "Space Shuttle Software," DATAMATION, July 1978, pp. 128-140.

ILLUSTRATION BY KATHY JEFFERS/PHOTO BY MARTY UMANS

Designing high availability systems is challenging, since it is impossible to predict every failure mode.

fortunate enough to have a complete stand-alone computer for development.

SYSTEM DESIGN

Designing high availability systems is challenging. It is impossible to predict every failure mode—Murphy's Law clearly states that all possible failures will occur sooner or later. Multiple failures cannot be ruled out since the detection of a failed component may depend on the failure of other components; for example, a failed switch may go unnoticed until the software attempts to switch a failed sensor interface.

How then is the designer to provide maximum useful service under such uncertain conditions? Two concepts can provide guidance: fallbacks, or degraded mode of operation, and deadlocks.

Operating with any failure is a fallback, so there are conceivably as many fallbacks as there are hardware and software components that can fail. However, only a limited number of these fallback modes are self-consistent and can provide useful service.

It is a good idea to write various fallback modes into the system's functional specifications. These modes should also be demonstrated during acceptance and should be rehearsed periodically during regular operations. The ultimate fallback is no computer operation at all, and if the application is really critical this mode must be planned for.

Deadlocks are unavoidable in complex systems. Once aware of deadlocks the designer will be able to work around them and avoid the more obvious traps. There will always be some deadlocks that are unavoidable.

Some deadlocks can be avoided by careful hardware selection. For example, where possible, all the switched components should be on a single switch. In this manner, even if the switch fails, at least one processor will have access to all the on-line peripherals. If only some peripherals are switched, then the resulting configuration may preclude any of the processors from performing useful on-line functions. Also, in automatically switched systems, it is essential that a processor failure be corroborated by two independent indicators. Otherwise, a component failure could be misinterpreted as a processor failure, in which case both processors will vie for control and neither will be able to perform on-line functions. For example, in the on-line refinery system shown in Fig. 2, a watchdog timer is used to corroborate system failure if the communication link should fail.

The oil refinery system was conceived from the start as a multiprocessor system, whereas the traffic control system (Fig. 3) was upgraded from a single processor system. A comparison of these two systems

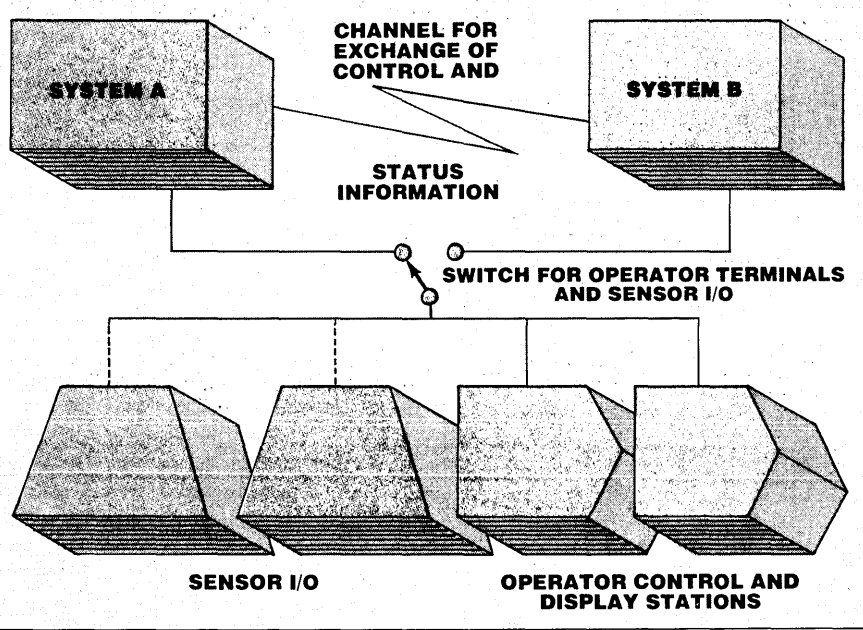
TABLE 1

COMPONENT RELIABILITY
(BASED ON PART-COUNT RELIABILITY)

TYPE	EXAMPLE	FAILURE RATES & FAILURES PER 10^6 HOURS
Solid State		
Logic Boards		1-100
	Interfaces	
	Sensor	
	Interfaces	
Moving Magnetic		
Memories	Magnetic Disks,	100-600
	Magnetic Tape	
	Printers, Switches	200-1,000
Electromechanical	Keyboards,	
Devices	Function Keys	

FIG. 1

ON-LINE/STANDBY REDUNDANT PROCESSOR SYSTEM



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Tailoring the system to meet individual requirements is easily accomplished by inserting diskettes into the processor, allowing you to define parameters such as printer authorization, screen configuration and number of devices. When you want to reconfigure the system, simply enter new parameters.

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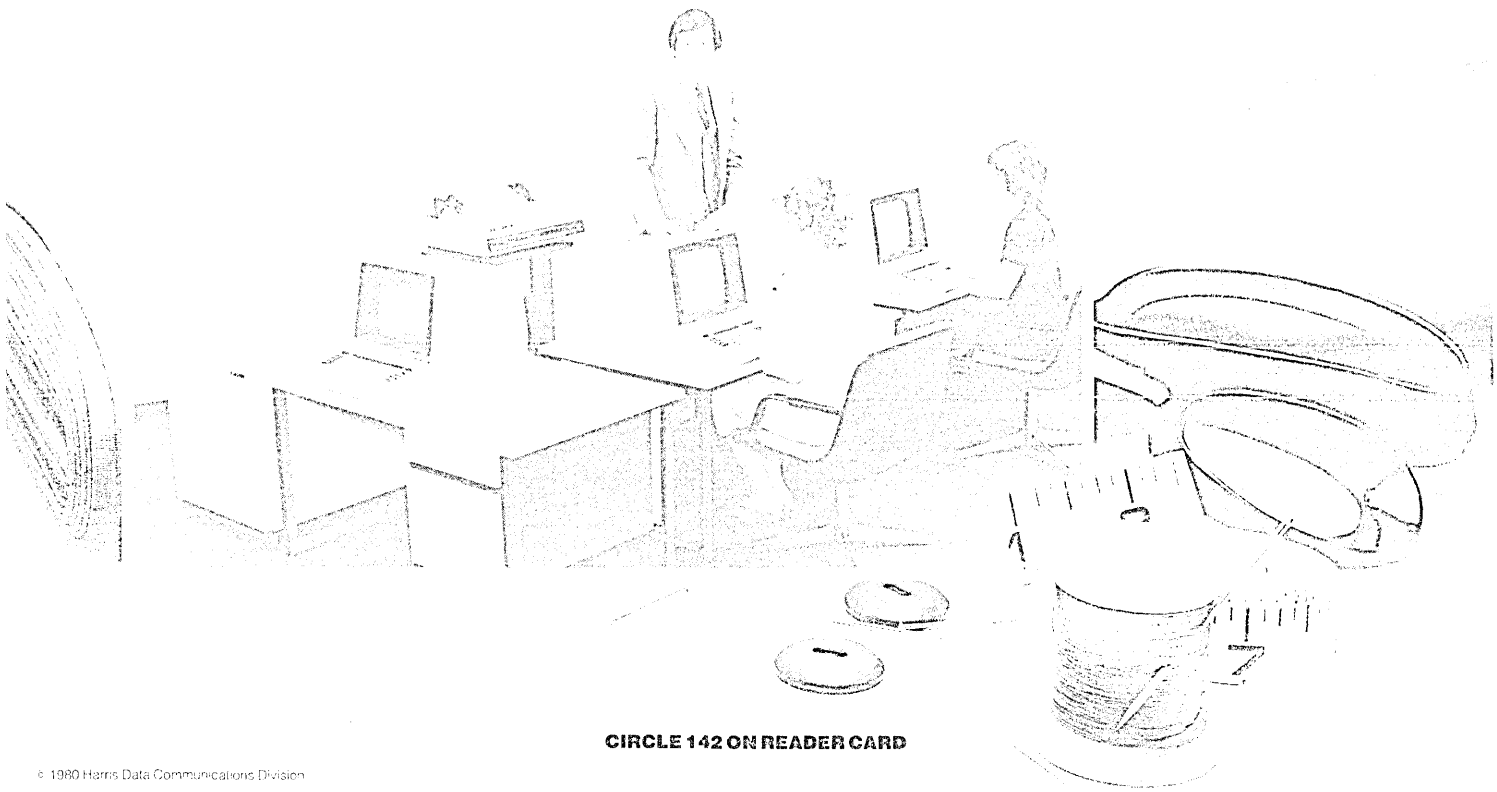

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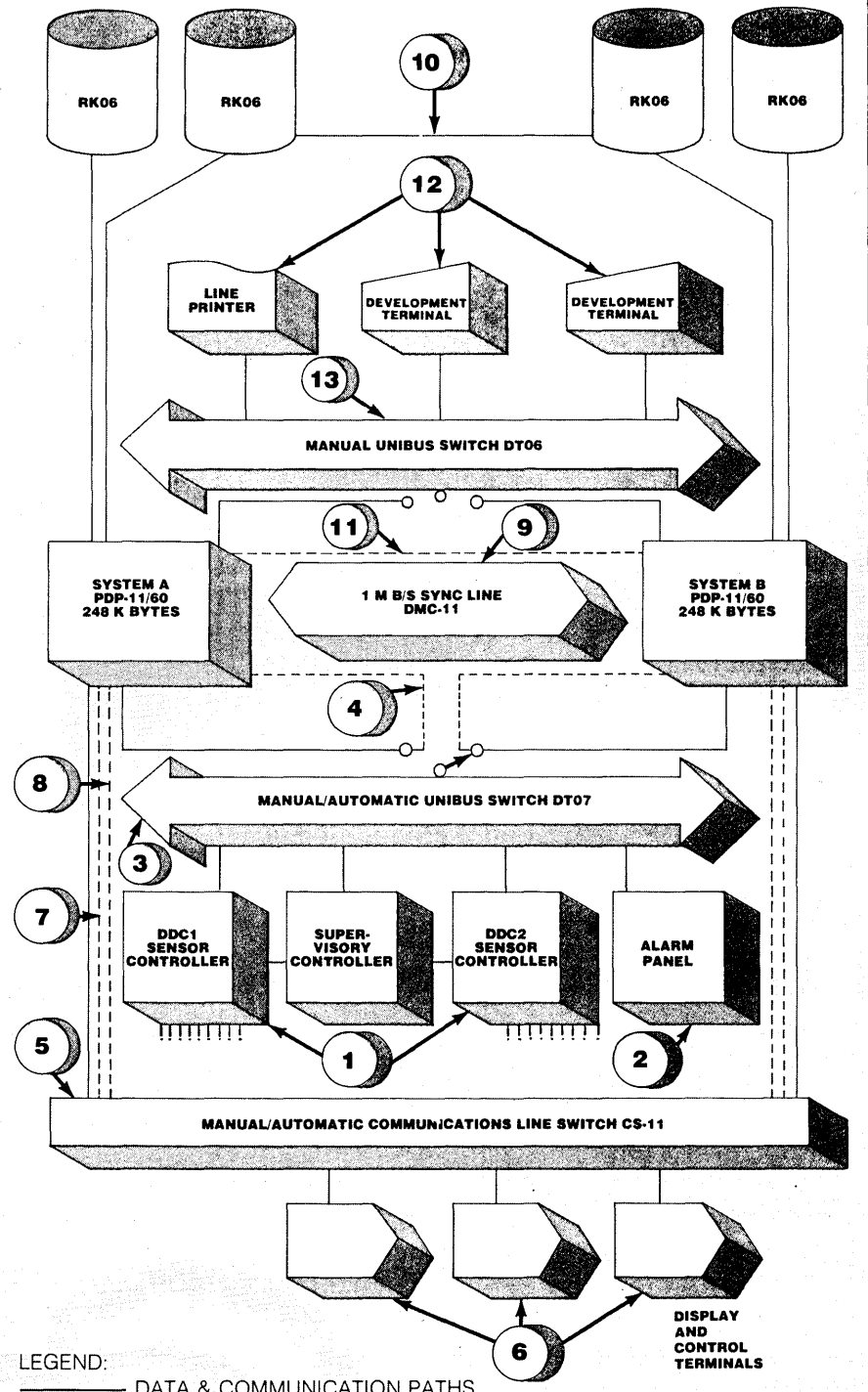
System status and process trend information is shared via a high-speed serial line.

FIG. 2

REDUNDANT OIL REFINERY PROCESS CONTROL SYSTEM



should provide useful insights for those contemplating similar ventures, so I will detail the design features of each.

In the oil refinery system (Fig. 2), all sensor I/O interface to the main computers via sensor controllers (1), which are connected to a manual/automatic unibus switch. An alarm panel (2), which notifies the operator of any system failures is connected to this same bus. Either processor has access to the switch (3). Normally the standby processor would operate the switch as part of an automatic switchover (4). However, if the switchover failed, the on-line processor could regain control. An automatic/manual line switch (5) provides access to the display and control terminals (6). Either processor can control the switch (7) or interrogate the switch to determine its position (8). The fact that two items must be switched (i.e., the bus and the line switch) is a necessary but less than desirable feature, since a deadlock is possible if only one of these items switches correctly.

System status and process trend information is shared via a high speed serial line (9). If the line fails, shareable disk drivers (10) provide an auxiliary means of sharing data.

An on-line system stall must be confirmed by at least two independent indicators, otherwise an alternating control deadlock is possible whereby each machine assumes the other has failed and both attempt to seize control. A serial line failure (at 9) would be one indication: the "watchdog" timer status line (11) provides a second failure indicator. Development terminals and printers (12) are interfaced to a manually switched bus (13).

HIGHWAY CONTROL SYSTEM

In the highway control system (Fig. 3), all critical surveillance and control data interface to the main computers via serial communication lines connected to gauged manual/automatic line switches (1). Since all the lines switch together, we avoid a deadlock situation where some of the lines are connected to one computer and some to the other. Traffic surveillance is via buried road sensors interfaced to two front-end computers (2). Traffic control is via rotating road signs which can route or divert traffic to alternate roadways (3). Operators monitor and control traffic operations via block mode crts (4).

In the automatic mode either processor can control line switching (5). Processors can also monitor switch positions (6). If the automatic control should fail, the processors can still interrogate the switch and determine the switch position. Whichever processor has access to the switched line then becomes the "on-line" system. Lines can also be switched individually as a final fallback procedure.

Essential traffic and sign position

Once aware of deadlocks, the designer will be able to work around them and avoid the more obvious traps.

status information as well as system status is transferred from the on-line system disk to the standby system via a high speed serial line (7). Shared access drives (8) provide an alternate means of transferring data, should the communication line fail.

Nonessential surveillance and control data interface to a core-only third processor, System C (9) via a digital I/O controller (10). This includes a roadmap display (11), an operator control panel (12), and an alarm panel (13). A master "time of day" clock (14) is used to synchronize time for all three computers. System C communicates with systems A and B via serial lines (15). Control and display data as well as status information are transferred over these lines. System C monitors both systems A and B and directs systems switchover, either in response to an error condition or by commands by the operator control panel.

Having one processor direct switching eliminates deadlocks caused by alternating control. However, if system C should fail, the on-line system will be determined by the position of the line switch.

CHOOSING SWITCH TYPE

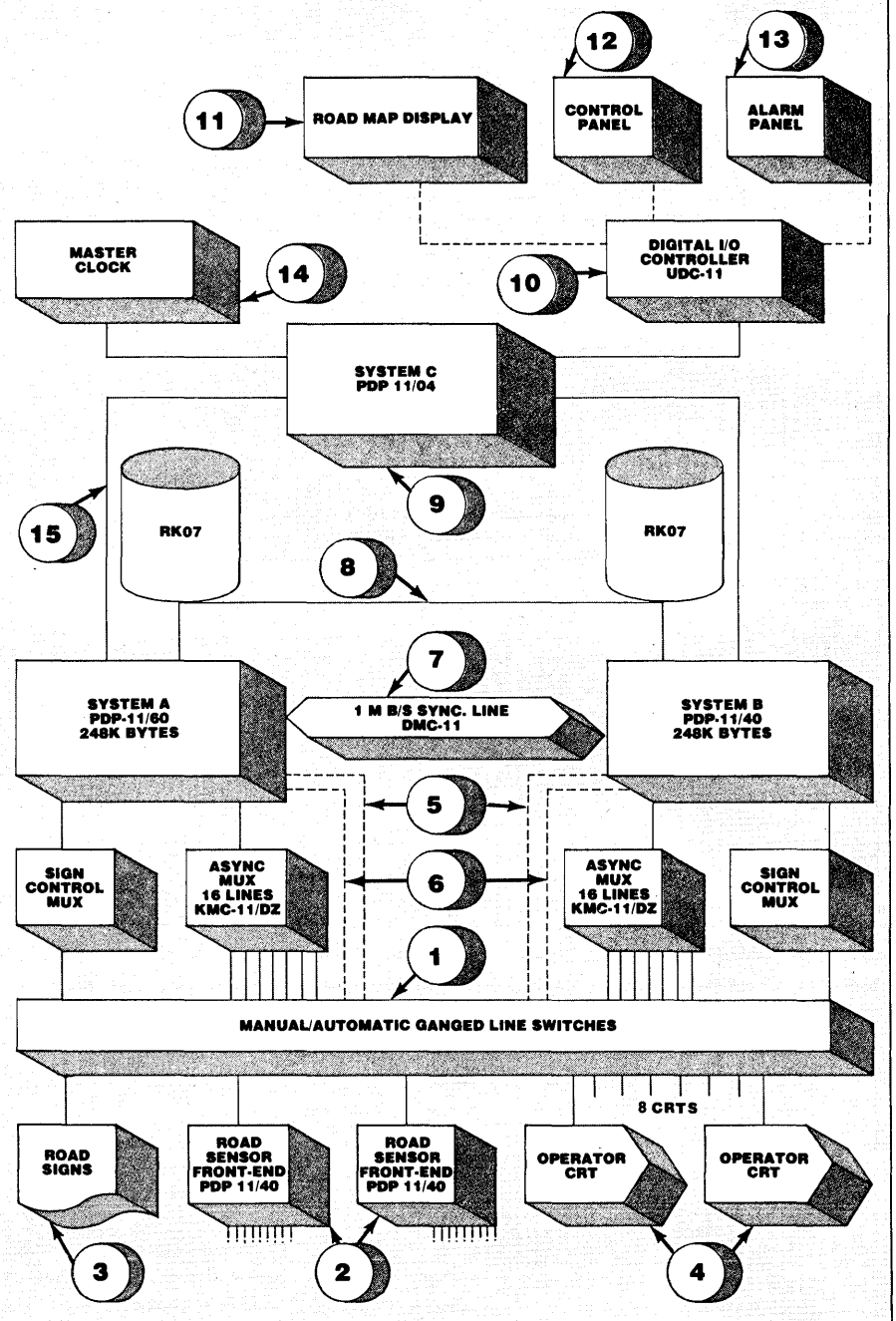
The designer may wonder whether manual or automatic switching is better for a given application. Actually the choice is more involved than a choice between manual or automatic switching; there are at least four identifiable levels of switching control: manual switching, manual switching with prompting, operator initiated switching, and automatic switching. Each succeeding level requires less operator involvement. Lower levels should be considered fallbacks when higher levels fail. Each level has advantages and disadvantages.

Level 1—Manual Switching. The operator must operate all the switches and must initiate all software processes. A highly trained operator is required. Even so, there are many opportunities for mistakes, especially given the stress induced by a system failure. The only advantage of purely manual switching is low cost.

Level 2—Manual Switching with Prompting. The operator must still operate the switches, but the computer guides the operator through the switchover process, telling him or her what to do and in what order. The computer also confirms switch operation. In some systems the processor may detect certain failure conditions and inform the operator that a switchover to the standby system is required. Finally, the computer sequences all software operations. This level of switching requires a trained staff, but the likelihood of failures and deadlocks is much less than with a purely manual system. A reasonable interval of time is required for switchover with this approach, and on-line

FIG. 3

REDUNDANT HIGHWAY CONTROL SYSTEMS



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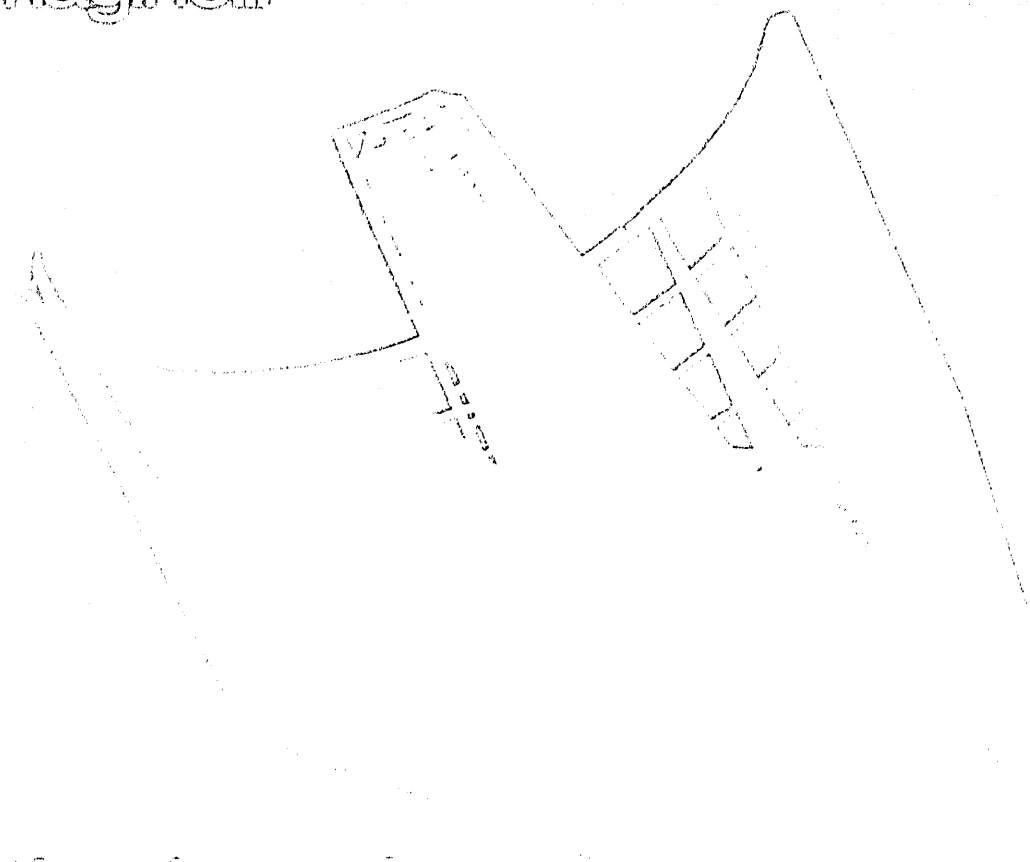
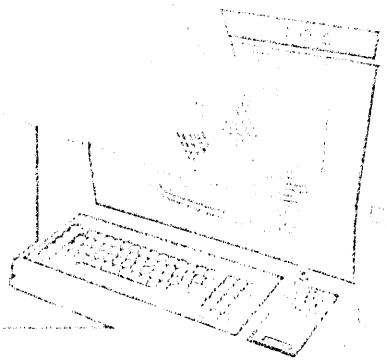


...the dynamics
of vector graphics
now in full raster color.



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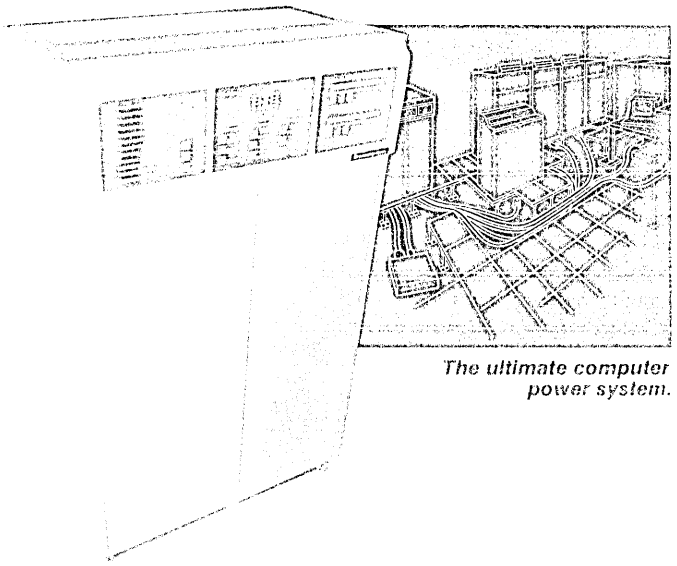

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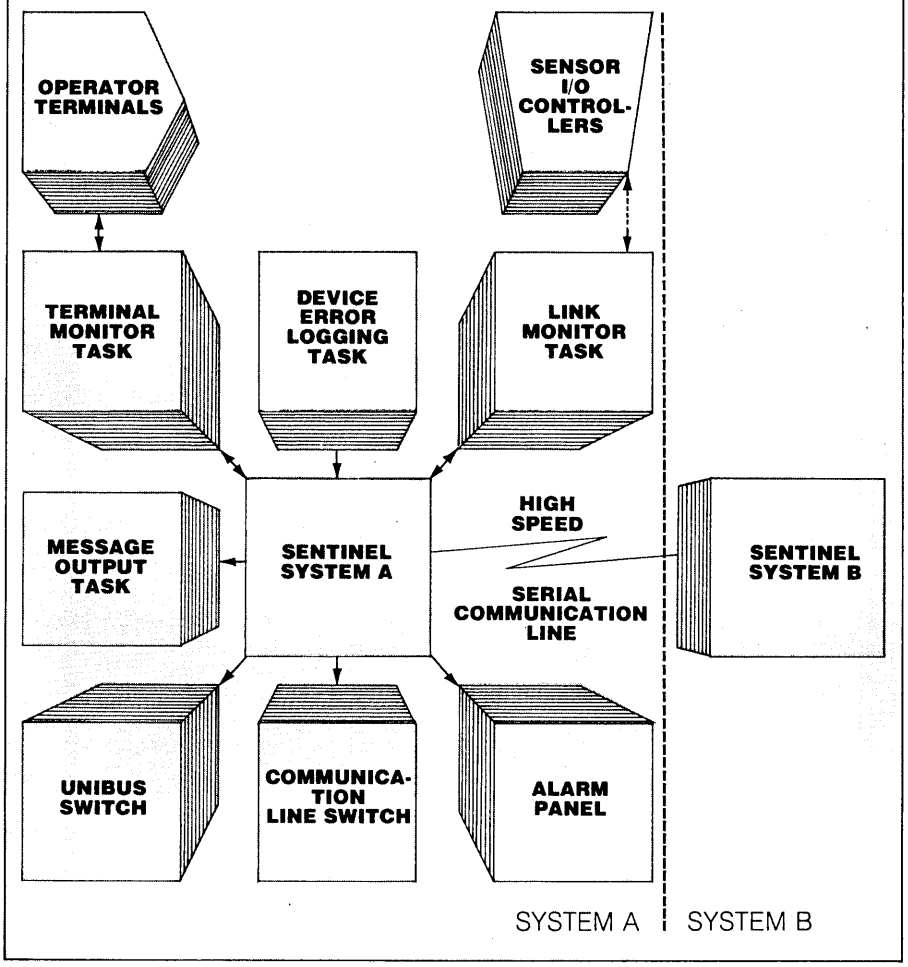
FIG. 4

SWITCHOVER LOGIC COMMUNICATION AND CONTROL PATHS



continuity will be lost during this interval. However, expensive processor controlled switches are not required.

Level 3—Operator Initiated Switching. Between this level and the previous level, the only difference is that the processor controls the switches and is thus able to sequence all the required hardware and software operations without operator intervention. The operator must still initiate a switchover, either via a typed command or a function key; however, the processor may advise the operator when a switchover is prudent. Once the switchover is initiated it can proceed rapidly and there are no opportunities for operator induced deadlocks. This level of switching may be acceptable in systems that are unattended for extended periods.

Level 4—Automatic Switchover. This level is similar to the previous level except that the processor might detect failures and determine whether these failures warrant a switchover. There are many applications where operator involvement in the decision process is mandatory so that the automatic switching would not be appropriate. Moreover, operator initiated switching must always be provided as a fallback. However, for the very little cost above that of operator initiated switching, automatic switching provides a very convenient "hands off" redundancy.

SWITCHOVER SEQUENCE

There are three stages to the switchover process. The first stage is failure detection. This phase is common to all four levels of control described above. The second stage involves decisions on whether or not a given failure warrants switching processors. In all but level 4, automatic switching, this decision is made by an operator. The third stage involves the orderly process of switching control from the on-line to the standby processor. The oil refinery system shown in Fig. 1 is a convienent example for detailing these three stages.

Stage 1, failure detection, is accomplished as shown in Fig. 4. All process I/O, communication, and operator interfaces are controlled by specific monitor tasks. These tasks in turn communicate with a supervisory task called the Sentinel. In this way all component status information is routed to a single task, the Sentinel, which in turn writes status messages on a typewriter and codes status information into a status word. In addition, failures and status indications are displayed on an alarm panel located in a prominent place in the control center.

The status information together with the time of day information is transmitted from the on-line Sentinel to its counterpart on the standby machine every 15 seconds.

All of the stage 2 switchover decision logic resides in the standby machine. This is necessary to avert deadlocks, since only the standby machine knows whether or not it is healthy enough to assume on-line control. When the standby machine receives the on-line processor's status message, it combines this information with its own status in the single status word. This status word is then processed by simple decision tree logic, the output of which is a decision to initiate a switch or not to.

Stage 3, the actual switchover sequence, is best illustrated with a stage diagram (Fig. 5). On-line states are shown on the right, standby states on the left.

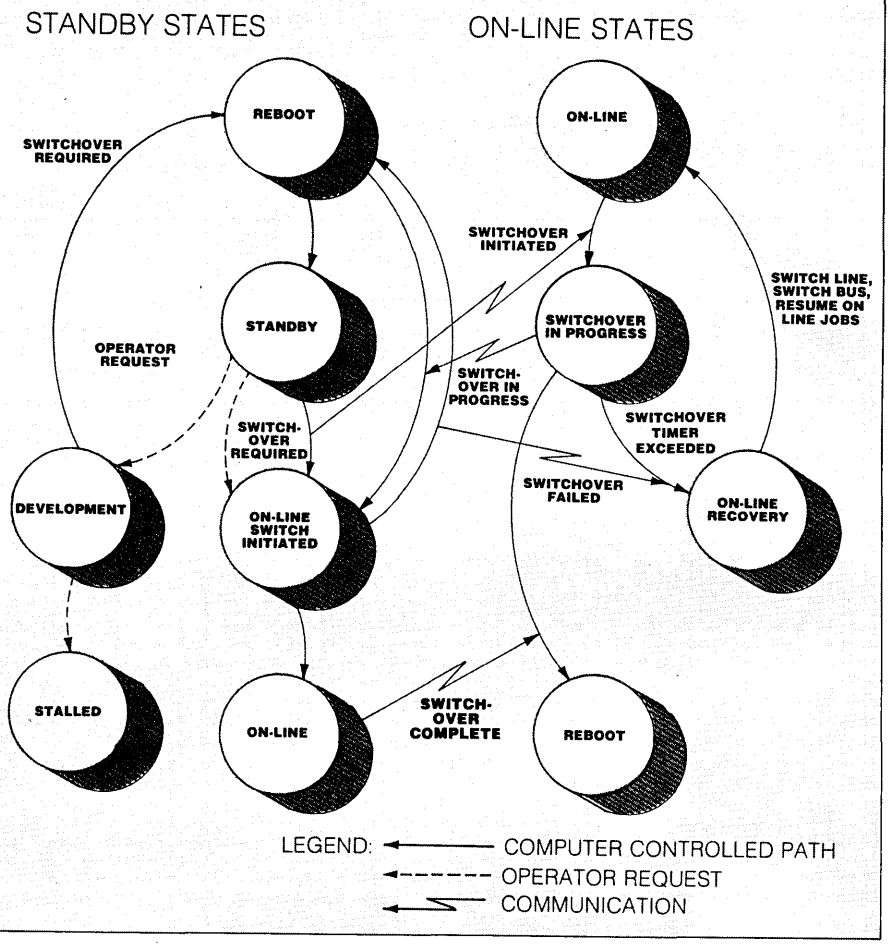
Starting with a "reboot," a processor always switches to the standby state unless the reboot was part of the switchover sequence, in which case the "switch initiated" state is entered immediately. From the standby state the operator can request a change to the "on-line switch initiated" state. If a switchover decision is made when the system is in a development state, then a fresh reboot will be required before proceeding. This is necessary to avert deadlocks, since the viability of any development system is always suspect.

In either case, when the standby enters the switchover state, a control message is transmitted to the on-line system. The on-line system enters a "switchover in the process" state, stalls all on-line jobs, and starts a five-minute switchover timer. If the standby computer is unable to complete a switchover in this alloted time, then it is assumed that the switchover has failed, and the on-line system will attempt to regain control.

While in the "on-line switch initiated" state, the standby system attempts to operate all switches and to initiate all on-line software. If it fails, a "switchover failed" message is transmitted to the on-line system, which will attempt to regain control. If it suc-

FIG. 5

SWITCHOVER STATE



ceeds, it becomes the new on-line system. The former on-line system then reboots and becomes the new standby system. The operators should notice the alarm lights that indicate the circumstances of the failure and notify maintenance so that repairs can be made before another switchover is required.

Notice that the system can only be intentionally stalled from the development state. The development state is protected with password access and this arrangement prevents unauthorized users from accidentally stalling the standby system or, worse yet, stalling the on-line system.

BEST DONE IN PHASES

Implementation of redundant systems is best done in phases, where each phase represents a complete self-consistent intermediate system. If there are problems with the more recent system, the former tested system can be quickly restored with minimum loss of on-line continuity.

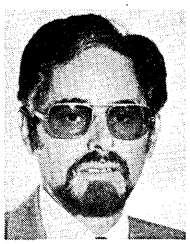
This approach reduces a complex design to a number of simpler designs and makes testing easier. For example, an automatic system will always have at least two fallback modes, manual and operator initiated switching.

The first phase would be the manual switchover. This would serve to verify the operation of hardware components and would give the operators some redundant capability while the switchover software was being developed.

Next, the operator initiated switching could be implemented and tested, and finally the fully automatic mode.

When the redundant system is fully operational, the user's confidence in the computer system will increase and he will wonder how he was able to get along for so long with only one computer. ✲

SAMUEL FELDMAN



Dr. Feldman is a software consultant and technical coordinator for Digital Equipment Corp.'s New Jersey district. He is also the district training coordinator. Feldman is the inventor of a patented digital phase lock loop, which is used in most earth station demodulators.

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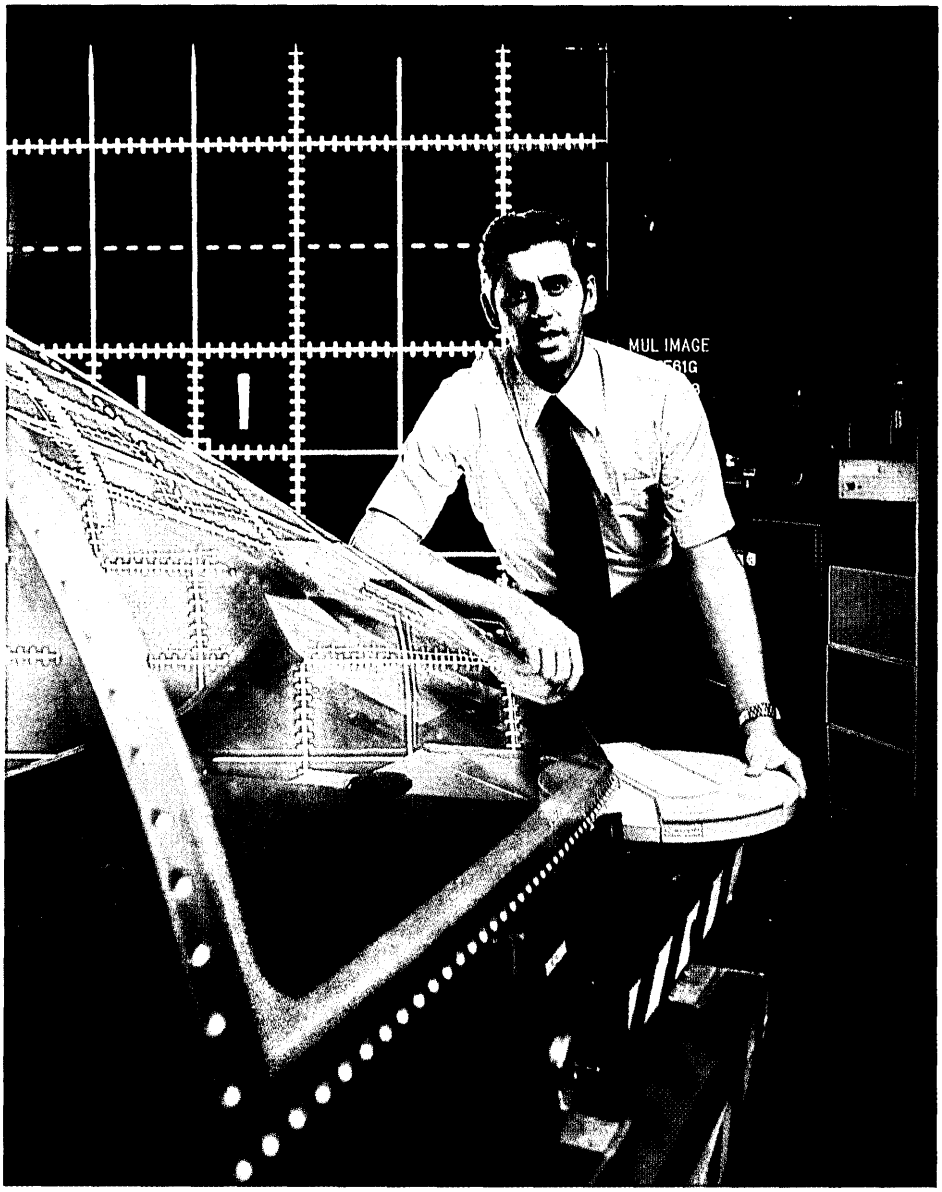

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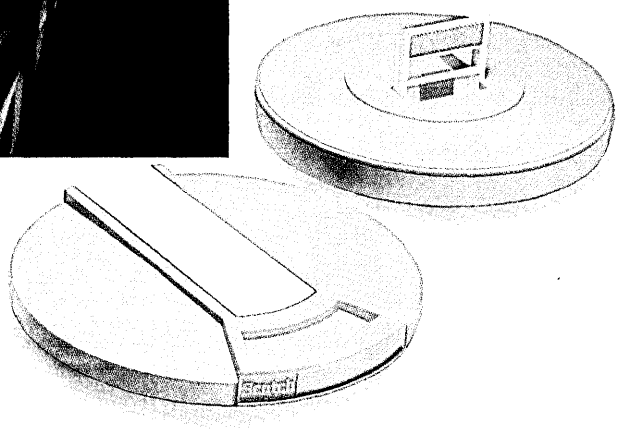

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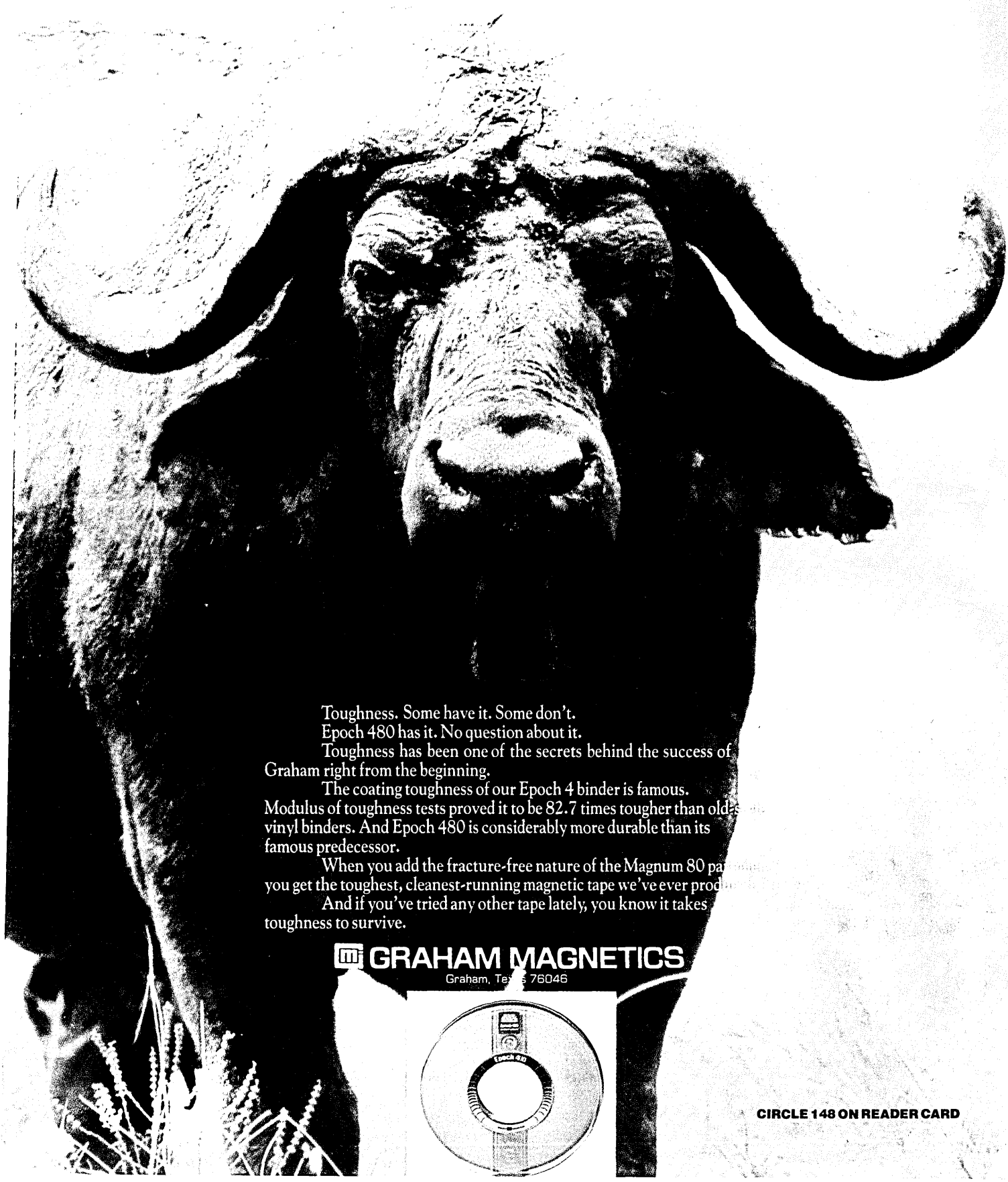

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Symmetrical multiprocessing gives large-scale computer power at a lower cost and with higher availability.

MORE POWER TO YOU

by Allan B. Wilson

Multiprocessing is a computer organization in which multiple cpus are interconnected. A multiprocessing solution can be used to satisfy different system design goals. Multiple cpus are used on spacecraft to provide high availability. If one or more cpus fail, system hardware and software assure continued system operation. Other multiprocessing design projects under way seek to provide large-computer power by using many interconnected micro or minicomputer cpus.

The basic idea is that one can obtain a minicomputer relatively inexpensively. Ten of these minis with suitable hardware and software will give large-scale computer power, but at a lower cost and with higher availability (if one of the 10 minis goes down, the remaining nine continue working while the 10th is being repaired; thus the system suffers only small degradation in service).

Another reason for multiprocessing is that it offers uniprocessor sites a means of obtaining more cpu power with little hardware or software investment. The additional cpus will be of the same type as the existing cpu, assuring hardware and software compatibility. Also, hardware maintenance is not compromised: site engineers need no additional training to deal with the new cpu, and system spares are the same.

Certainly one option a site with a uniprocessor system has is to acquire another independent system, that is, one with its own cpu, memory, and peripherals. Again, maintenance engineers need no additional training and spares are the same; however, there are economic inefficiencies resulting from multiple copies of the operating system, supporting software, system disks, etc. The system is also more difficult to administer. The user community must be partitioned between the two systems, so manual load balancing is necessary, and both systems must be kept current with software updates (did bug X get fixed on both systems?). Additional operators may be required.

There are two generic multiprocessing organizations: loosely coupled and tightly coupled. Loosely coupled multiprocessing connects two or more individual systems by means of a communication link (Fig. 1). Each system is capable of independent processing, but supports the link to allow at least file-system access, and perhaps task interchange for a form of load balancing. File-system access provides not only a file transfer mechanism among systems, but more generally allows a task on one system to open a file on another system. File I/O is transparent to the task so that records going to or from a file on another system are passed across the link instead of requiring direct file I/O on the task's cpu and peripherals. System software should support links of various types and speeds so the one most appropriate for a particular operating environment can be selected.

A tightly coupled multiprocessor organization (Fig. 2) has a single shared memory and a single copy of the operating system and supporting software.

MASTER/SLAVE SETUP

In the master/slave organization (Fig. 3) the master is the general-purpose cpu: it does both computation and all system I/O. The slave has no I/O devices except a console terminal and therefore is present only for computation.

In Digital's TOPS-10 master/slave organization, the slave does not take orders from the master. Both cpus execute the TOPS-10 scheduling routines looking for jobs to run; there is code to prevent both cpus from selecting the same job. The slave differs from the master when its job makes a monitor call for some system service, typically I/O. Except for some non-I/O monitor calls, the slave cannot proceed. It simply marks the job as needing the master's attention, enters the scheduler, and selects another job to run. The master, in the meantime, is working on other jobs, and when it schedules again it will find and run jobs marked as "run-on-master" by the slave. Thus the slave is a slave by virtue of the fact that it simply cannot perform all system duties and relies on the master for many services.

In terms of performance, the master/slave organization can be successful, especially if there are plenty of compute-bound jobs it can work on: as long as jobs do no master-only monitor calls, the slave can continue to run them. Availability of peripheral switches contributes to the utility of master/slave. If the slave fails, only some cpu power is lost; if the master fails, devices can be switched and the former slave reloaded as master.

As the speed of I/O devices (essentially mechanically limited) have remained constant relative to increases in cpu speed, the newer computer systems tend to be more I/O bound. For example, if a program does I/O every 10,000 instructions, a faster cpu will execute the 10,000 instructions more quickly and reach the I/O requests sooner than a slower cpu. Thus, the faster cpu spends a larger percentage of its time waiting for I/O. This phenomenon means that job mixes well-suited to master/slave multiprocessing on older cpus are not necessarily well balanced on later cpu models. Thus, the definitions of compute-bound and I/O-bound change with introduction of faster cpus, and since master/slave efficiency depends on having adequate compute-bound jobs in the mix to work on, master/slave may or may not be satisfactory when existing customers upgrade to newer cpus, or when vendor or user software characteristics tend to make software I/O-bound.

Therefore, the underlying basis for master/slave deficiencies is system architectural asymmetry, i.e., cpus are not functionally equivalent—only the master can do both computation and I/O.

Eliminating master/slave restrictions by extending full functional capabilities to all cpus has been the goal of TOPS-10's new Symmetrical Multiprocessing (SMP) organization. Notice (Figs. 3, 4) that SMP hardware configurations are quite similar to master/slave configurations except that with SMP, I/O devices can be connected to both cpus. Memory is still shared between processors and there is still a single copy of the operating system. With SMP, however, the entire monitor is reentrant and all monitor calls can be executed on all cpus. (While the SMP release officially supports only two processors, the SMP software has been designed and written to support up to six.)

Because monitor calls can be executed by any cpu, a cpu can continue to run a

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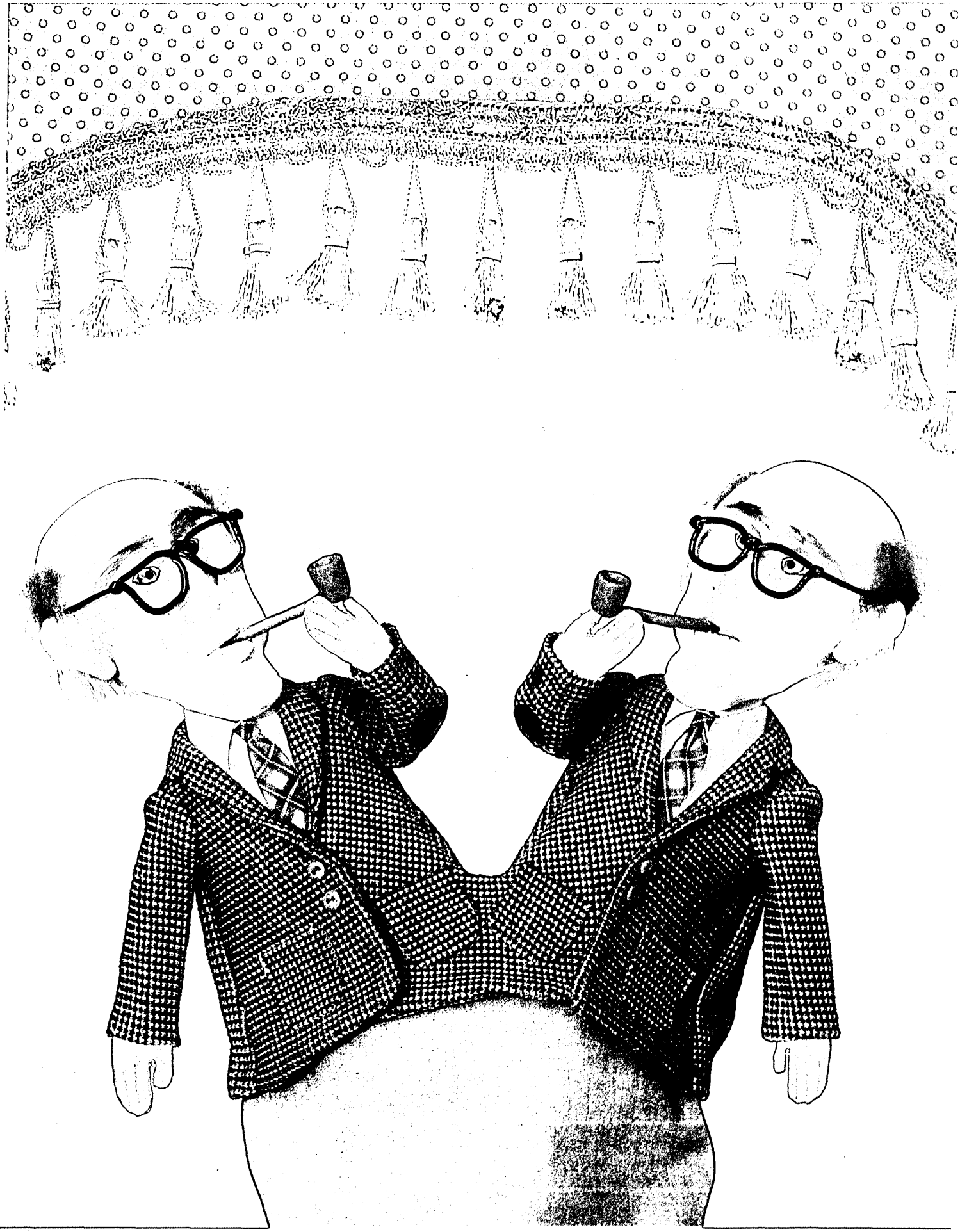


job even if the job requests I/O on devices that are connected to a different cpu in the system. A queued I/O protocol has been developed to implement this capability.

In SMP, the cpu running a job is called the executing cpu; the cpu connected to devices used by the job is called the owning cpu. If a job requests I/O to devices on the executing cpu, the request is processed by putting it in that cpu's I/O queues. If a job requires devices on a different cpu, then a request is made by the executing cpu that will cause the owning cpu to queue the request for action. Once the request is made, the executing cpu can complete the monitor call and resume the job, relying on the owning cpu to deal with the I/O transfers. Context-switching overhead is much reduced in this organization; in master/slave each I/O request on the slave requires a context-switch to the master. (Context-switching is the action of stopping execution of the currently executing job, appropriately saving its status—"context"—for later execution, scheduling to select another job to run, and setting up and starting the new job. Context-switching can take from several microseconds to several milliseconds, depending on hardware characteristics, scheduler design and implementation, and amount of context to save/restore.)

Note that SMP scheduling, both cpus executing the scheduling routines to find jobs to run, will typically result in the same job being run at different times by different cpus throughout the course of its processing. The queued I/O protocol ensures that I/O requests are handled properly regardless of which cpu executes a job or where in the system the job's files and devices are physically located.

This scheduling technique of multiple cpus working on a single queue of jobs is efficient. Queueing theory shows that multiple servers working from a single queue give better response than multiple servers and multiple queues, which would be the case in a loosely coupled multiprocessing organization or with multiple independent systems, where each cpu has its own operating system and thus its own scheduler and scheduler queue. Therefore, SMP offers automatic and dynamic load balancing, which neither of the other multi-cpu approaches provides.

Another feature of SMP permits I/O load balancing. As shown in Fig. 5, in SMP, multiported disks can have dual port access by a single cpu (also supported by the master/slave system) or by two different cpus. Load balancing is thus dynamic and automatic on dual-ported disks and yields higher availability and throughput.

FIG. 1

LOOSELY COUPLED MULTIPROCESSING

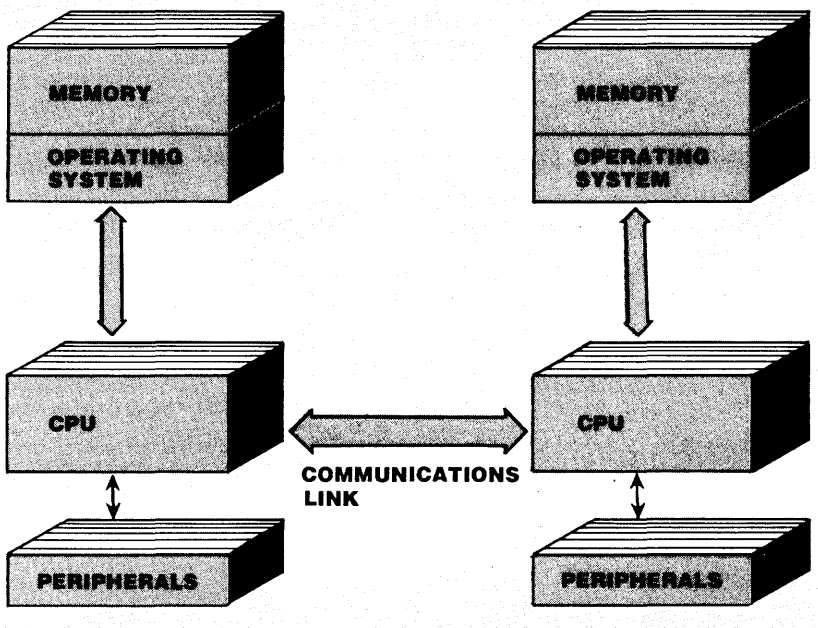
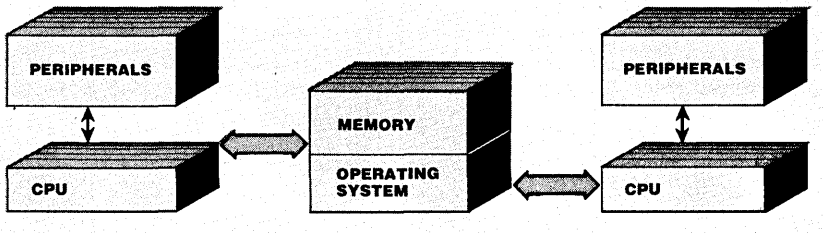


FIG. 2

TIGHTLY COUPLED MULTIPROCESSING



IMPLEMENTATION OF SMP

Scheduling in a multiprocessor system provides additional flexibility over a single-cpu system. While knowing details of the TOPS-10 scheduler is not necessary to understand the scheduling implications in SMP, a simplified description is useful. Basically, the TOPS-10 scheduler runs both periodically, driven by a clock, and when the currently executing job is finished or temporarily unable to continue (waiting for I/O completion, for example). In selecting the next job, TOPS-10 gives designated jobs and interactive work higher priority to use the cpu than "normal priority" and compute-bound work. TOPS-10 attempts to run high priority and interactive jobs when they request the cpu; other jobs are run in the background. Optionally, the system administrator can partition background jobs into classes, and allocate percentages of cpu time to individual classes.

Currently in SMP, one cpu processes work using these priorities. The other cpu, however, looks for background work first, and will process such jobs as long as they are available; designated high priority jobs and interactive jobs are serviced by this cpu only if there is no background work to do. This "asymmetric scheduling" has the basic effect that one cpu works on interactive jobs, while the other runs compute-bound jobs. If there are sufficient compute-bound jobs in the mix, the second cpu processes them with little context-switching overhead, even if there is also a heavy interactive load. The disadvantage is that if the mix is predominantly interactive, the second cpu wastes time looking for compute-bound work before it gets to the interactive jobs.

It is possible in SMP that the system administrator will be given the option of dynamically specifying symmetric or asymmetric scheduling to reflect current operating demands. Alternatively, it has been considered to have the system alter scheduling itself, based on mix characteristics.

An important aspect of scheduling in a multiprocessor environment is inter-cpu interference. For example, if both cpus enter the scheduling routines simultaneously they can compete for accesses to instructions and data, and, even more significantly, cause each other to wait for various interlocks (such

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The master/slave organization can be successful if there are plenty of compute-bound jobs it can work on.

as the one to prevent cpus from selecting the same job to run). While studies show that most scheduling is done as a result of jobs blocking for I/O or other events, and not because of periodic timer interrupts, SMP skews the clocks on all cpus to ensure that their clock interrupts occur at different times. Each cpu gets the same frequency of timer interrupts, but none occurs at the same time as interrupts on other cpus. Thus cpu clocks in SMP are intentionally skewed to prevent periodic simultaneous scheduling and attendant overhead.

While it has nothing to do with scheduling, the periodic timer interrupts which cause a cpu to run the scheduler are also the occasions on which the cpu scans a global queued-I/O request queue to see if there is I/O the cpu needs to perform for jobs run on other cpus. The requests are removed from the global queue and placed on a cpu-local queue for processing. Any jobs waiting for the requested I/O to finish are marked as runnable when a transfer completes. Thereafter, the job can be run by any available cpu in the system.

CACHE USED AS BUFFER

The memory controller portion of the KL-10 cpu (Fig. 6) coordinates memory access requests from the cpu and from peripheral devices such as disks and magnetic tapes connected via internal channels/controllers (RH20s). The cache is a 2048-word semiconductor memory that serves as a buffer for primary memory. Read references to primary memory by the cpu result in the memory controller checking to see if the referenced words are in the cache. If so, the memory controller supplies the cpu with the data directly from the cache; this results in rapid memory access times, because the five or six times slower primary memory need not be accessed.

If the requested data are not in the cache, the memory controller gets the data from primary memory, supplies them to the cpu, and places them in the cache, where they will be found on subsequent references. (Actually, accesses to primary memory and cache-fills are done in "quad-words," so that the referenced word and three adjacent words are fetched; thus speed of sequential accesses to instructions and data is improved by preloading cache locations.)

Memory write operations are done only in the cache (not in both cache and primary memory as in a write-through cache organization). The cpu has instructions to explicitly validate memory with updated cache contents ("sweep the cache"); memory validation is automatic if the memory controller needs in-use cache locations for new data. The memory controller also deals with memory accesses by the internal channel/controllers and will supply updated data from the cache on "write-from-memory" (output) transfers.

Typical program characteristics and system operation result in using data in the cache 90%-95% of the time, thus improving primary memory access times and thereby increasing cpu speed. Thus 90%-95% of cpu primary memory references are avoided, reducing contention for primary memory and eliminating many memory interference problems.

While the KL-10 cache organization is efficient with respect to primary memory accesses and improved cpu speeds, it does cause two problems. The first and most significant is that when a cpu runs a job or does anything which causes job data to be modified in its cache, the cpu must sweep its cache to validate primary memory before another cpu can run the same job. Otherwise, the new cpu could use "stale" data in primary memory because updated values would be in the other cpu's cache. The new cpu cannot recognize the data as stale, and thus would not be working with the job's proper context. Such operation is incorrect and can result in subtle bugs that are difficult to track down.

The second problem is important in terms of availability. It may be the case that a cpu has modified data in its cache for several different jobs before a sweep completes. If the cpu suffers a failure before the sweep completes, other system cpus cannot select any of these jobs since they cannot be run with respect to cache. Therefore, these jobs are effectively lost. The jobs must be manual-

FIG. 3

MASTER/SLAVE MULTIPROCESSING

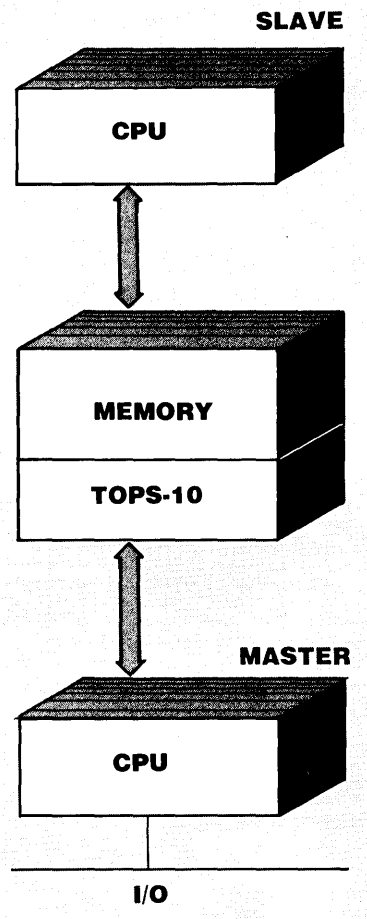
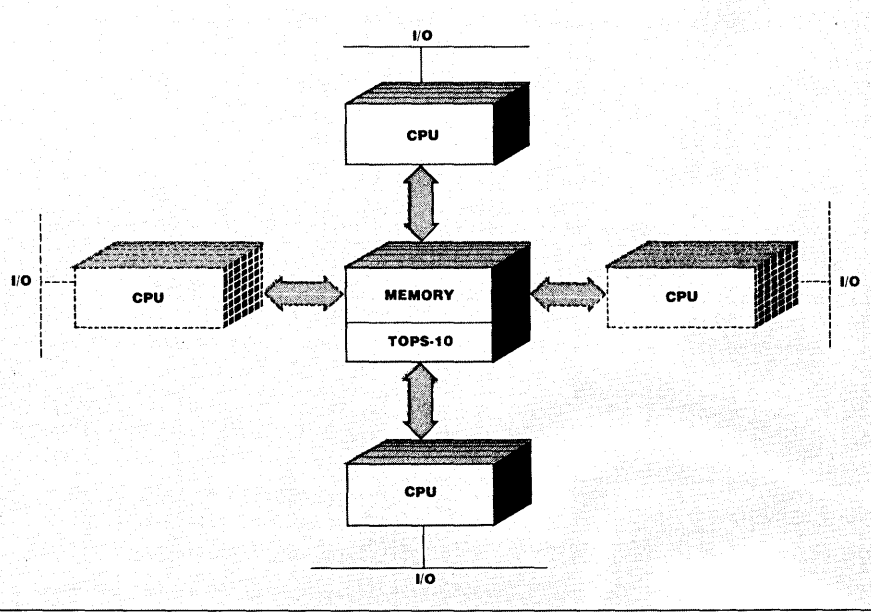


FIG. 4

SYMMETRICAL MULTIPROCESSING



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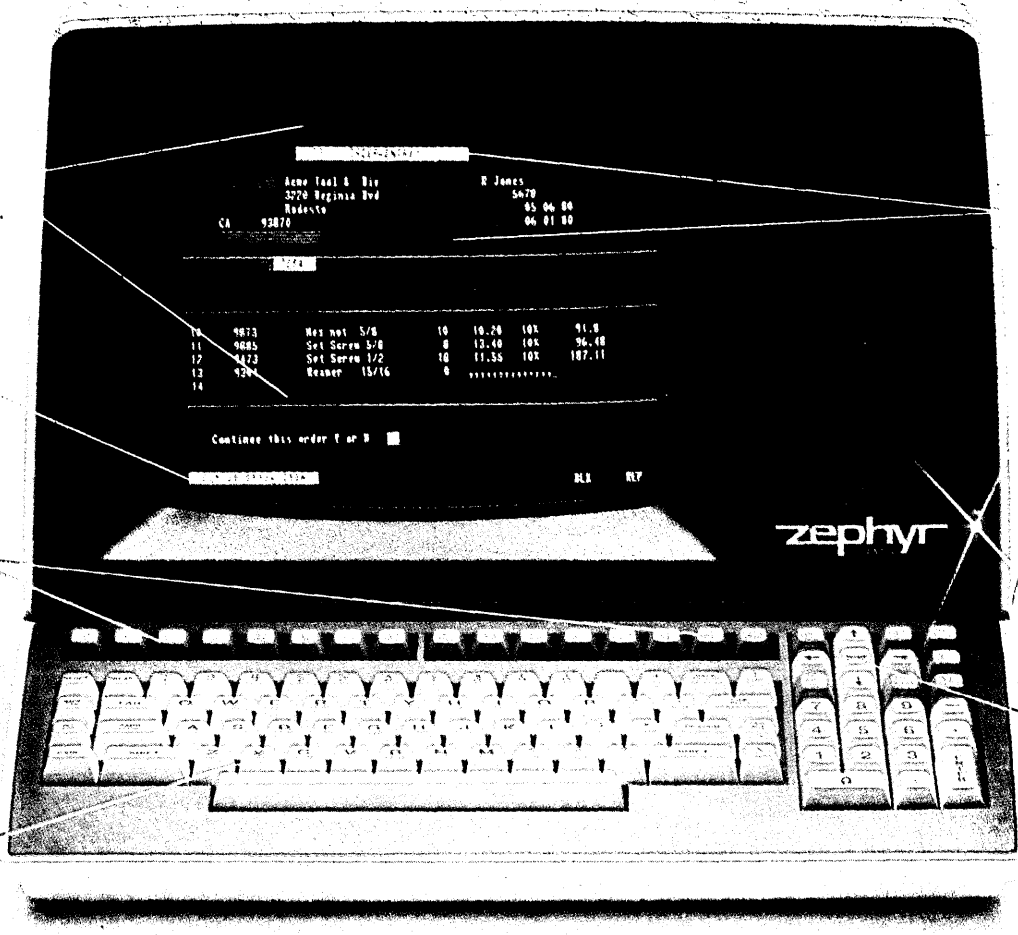

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A feature of SMP is that it permits I/O load balancing.

ly restarted from the beginning or the last checkpoint.

Thus, because of the KL-10 cache implementation, a cpu failure may cause from zero to several jobs to be lost. Nevertheless, losing a few jobs is still preferable to losing 80 to 100 jobs, as would be the case if a loosely coupled or completely independent system cpu failed.

A cache sweep serial number scheme is used to keep track of primary memory currency with respect to cache. Every time a cpu completes a sweep of its cache, it increments its cache sweep serial number. When a job is stopped or requests I/O, the current cpu and cache sweep serial numbers are saved. The operating system can tell if a cache sweep has completed a job by comparing the current cache sweep serial number for the cpu with the saved value. If the current cache sweep serial number for the cpu is greater than the saved value, at least one sweep (and a single one is sufficient) has completed. Thus the system can safely manipulate the job, knowing that primary memory is up-to-date.

If during a cpu's scheduling cycle, jobs are available to run but cannot be run because cache has not been swept for them yet, the scheduling cpu keeps track of this "cache lost time" as a cpu operational statistic. High cache lost time is bad, because it means that a cpu is available to run jobs but has to remain idle since jobs cannot be run with respect to cache. To minimize cache lost time, a cpu can request that another cpu sweep its cache, thereby updating primary memory with cache data from jobs the other cpu has processed. Every major scheduling cycle, each cpu honors any sweep requests from other cpus (one sweep suffices for all requests). To further reduce cache lost time, if a cpu selects a job to run and is context-switching from another job, it starts a cache sweep so that the "old" job will become runnable with respect to cache on other cpus when the sweep completes (in about 250 microseconds).

The cache implementation does permit cache to be enabled or disabled for each page in memory. This facility allows the monitor to "uncache," i.e., selectively disable cache for pages containing certain monitor data for which sweeps would be impractical. Terminal I/O buffers and cpu cache sweep serial numbers are examples of data stored in uncached pages. Accesses to such data are relatively infrequent, so no large cpu speed or primary memory access penalties are incurred.

FIG. 5
MULTIPORTED DISKS IN SMP

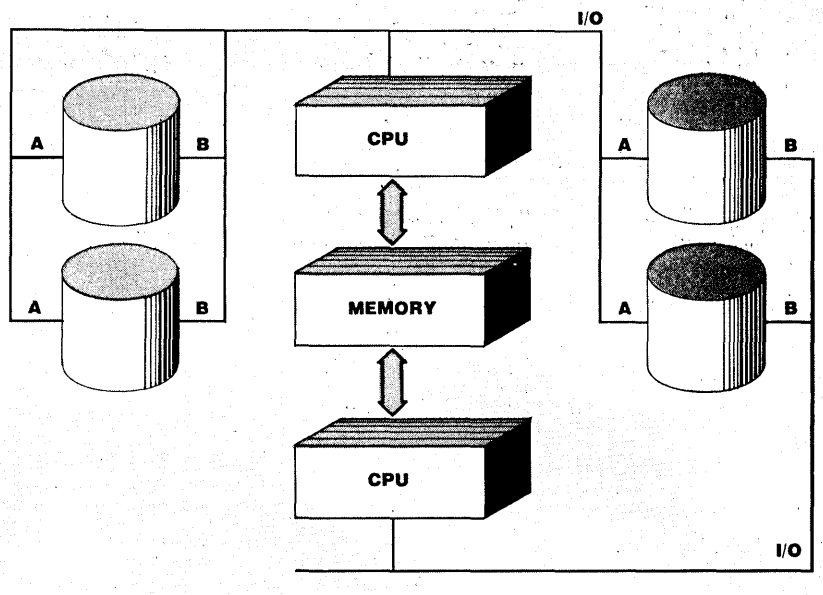
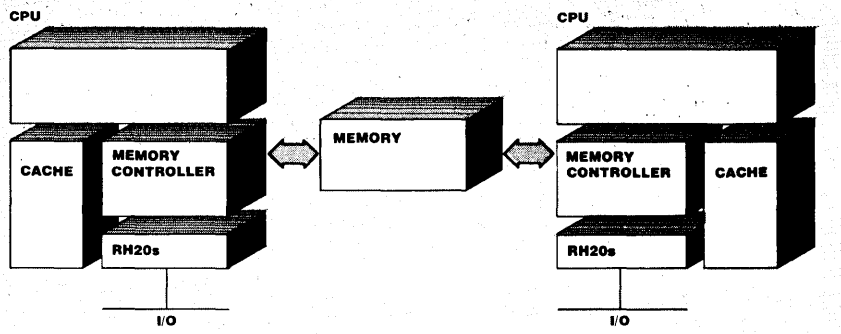


FIG. 6
KL-10 CACHE ORGANIZATION



RINGING A CPU'S DOORBELL

Cpus in SMP communicate continually since a single copy of the operating system is shared among all cpus. Accessing and modifying global values such as job status information is a common form of communication. Reading another cpu's cache sweep serial number is a typical example of one cpu needing specific information about another cpu. However, there is no cpu hardware such as a "doorbell" for one cpu to interrupt another cpu or get its attention. The design and implementation of SMP revealed that for scheduling or cache management no such doorbell is necessary. In fact, a hardware doorbell would only be useful during emergencies ("I'm dying" or "get out of my way").

Rather than implement a hardware doorbell, a software doorbell was chosen for SMP. The basic mechanism allows a cpu to ring another cpu's doorbell, or the doorbells of all other cpus, on a "significant event," such as cache sweep done (jobs can be run with respect to cache), I/O done (job can be run because I/O request has been satisfied), and queued-I/O request made (I/O to do for job run on another cpu).

A cpu has to "listen" for a doorbell; a doorbell will not interrupt or otherwise disturb a cpu. Currently, the only time a cpu pays attention to doorbells is when it is idle, that is, when it has scheduled, found nothing to do, and runs the "null job" until something happens to make work available.

This software doorbell implementation is good in that a cpu is not taken away from useful work with interruptions. A nega-

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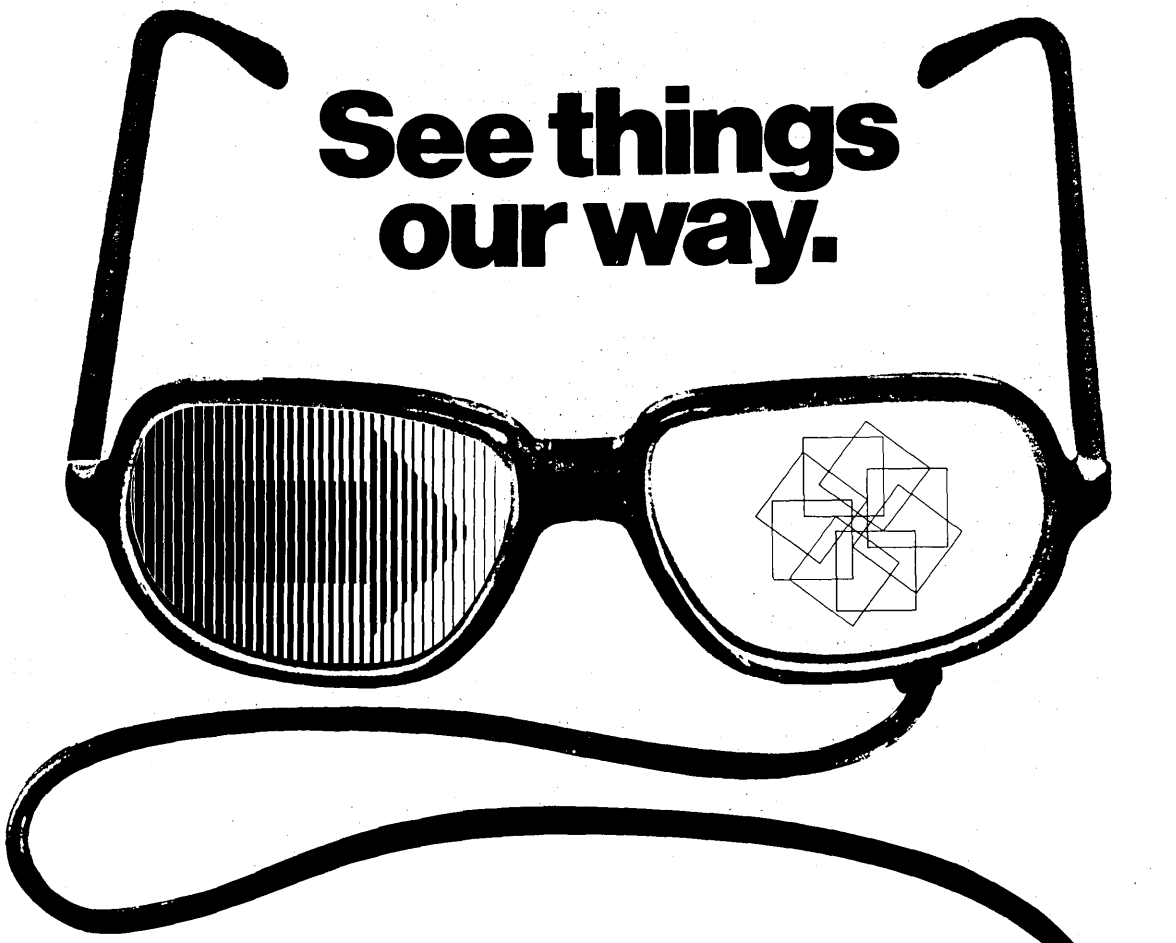

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SMP is administratively simpler and more economical than multiple independent systems or loosely coupled microprocessors.

tive aspect is that a cpu may look for work to do as the result of a doorbell yet find nothing to do. While looking for work to do, it holds interlocks and increases memory contention, and thereby possibly interferes with other cpus that do have work to do.

Route-through and multipathing extend the utility and availability of SMP systems. Route-through means that intermediate nodes pass along data destined for other nodes in the network; multipathing allows alternate paths to destination nodes such that a failure in one path does not prevent the arrival of messages through an alternate path (transparent to users).

Redundancy, or duplication of critical components, increases availability by providing additional units to handle a particular function should one unit fail; the failing unit can be repaired while the backup units assume the workload. The master/slave system provides cpu redundancy but requires additional operator action for switching and reloading after certain failures.

SMP has better inherent availability than master/slave. In SMP, all devices can be duplicated and placed on all cpus. Thus any device in an SMP system can fail (''single point failure'') and the system can still provide all critical functions and services. With dual-ported disks, failure of a cpu, channel, controller, or disk port will not prevent the system from accessing the data base through the other path. Such operation is automatic and the operator is notified of the failure so corrective maintenance can be scheduled.

Memory parity errors are rare, but will be automatically retried up to three times per word. A hard error, that is, an access unsuccessful on all retries, causes the associated job to be stopped and an error message issued to the user if the access is to a private page. A hard error in a shared page causes the system to get a new copy from the disk area used for shared pages and continue automatically. Parity errors within the monitor itself are also handled. If the situation warrants it, the operating system moves itself into better memory.

The operating system logs all system errors and failures so that the system administrator and maintenance personnel have a history of system operation and can detect trends. Components configured into and out of the system are also logged.

Finally, SMP is administratively simpler and more economic than multiple independent systems or loosely coupled multiprocessors. No resources are wasted in multiple copies of the operating system, supporting software, system disk areas, etc. Keeping software versions current on multiple systems, partitioning the user community among systems, and manual load balancing are all avoided. ✲

ALLAN B. WILSON

Mr. Wilson is currently international marketing manager for the Laboratory Data Products Group of Digital Equipment Corp., Marlborough, MA. He has held positions in software development and technical support, and his primary technical interests are operating systems, communications, and computer architecture.

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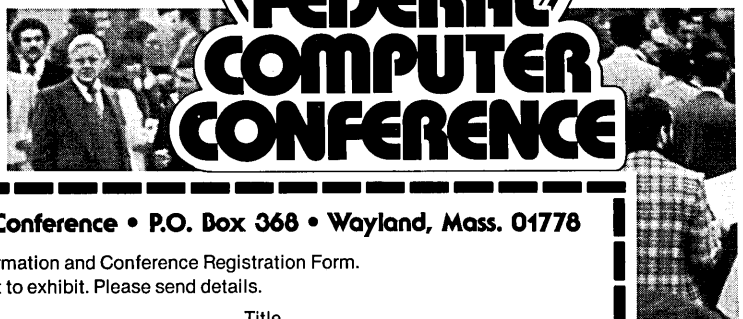

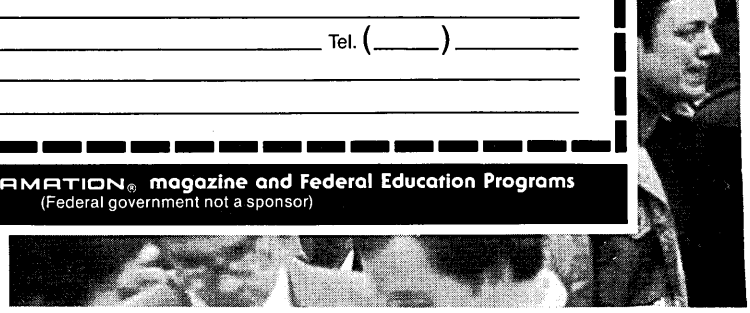

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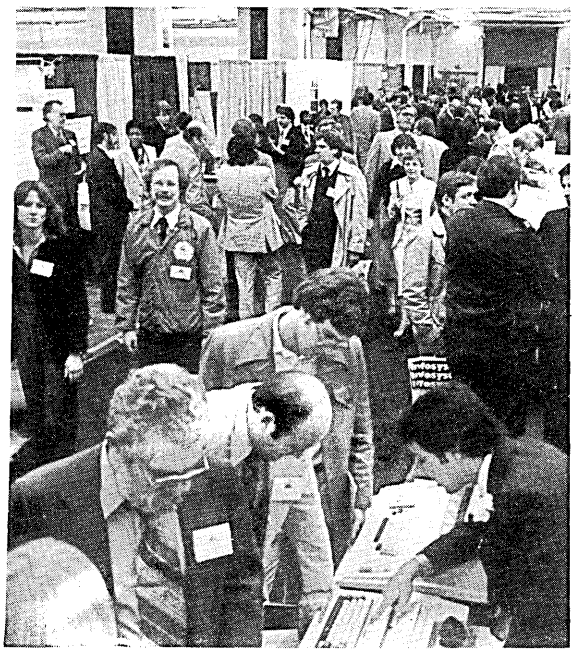

PEOPLE

SAND IN HIS SHOES

A nationwide network of field support, including parts and repair vans, is what's keeping Sorbus, Inc., the domestic service subsidiary of Management Assistance Inc., at record revenues.

"I believe the wave is coming . . . there will be alternative ways of service other than personal appearance of the service representative. Sorbus, for example, has a van fleet that provides mobile service to 12 U.S. cities," says Stephen J. Keane, president of Sorbus. "The idea is to get the customer up and running—and get out."

Sorbus's field support consists of over 80,000 pieces of information processing equipment, ranging from simple printers and video display terminals to large scale IBM systems and including MAI's Basic Four business computers, Wordstream word processing systems, and G Series terminals and printers. Operating from 160 locations nationwide with major support facilities in King of Prussia, Pa., and Orange County, Calif., the field organization provides remedial and preventive maintenance, systems reconfiguration, modification and reconditioning services, and memory and printed circuit repairs.

Keane's background covers more than 25 years of experience in diversified engineering, manufacturing, and marketing assignments in the aerospace and dp industries. Keane earned his BS in mechanical engineering from the Polytechnic Institute of New York in 1954 and an MS in management from Columbia University in 1960. His first assignment in the commercial dp business was at Potter Instrument Co., where he started in 1962. Keane remembers when he was approached by Max Palevsky, who wanted Potter to sell his fledgling Scientific Data Systems a printer on credit. Keane turned him down. A year later, Keane was banging on his door, begging for SDS's business. In 1969, he was one of the founders and president of Bucode, a company engaged in the design and manufacture of magnetic tape systems for the oem market. "You get the sand in your shoes for running your own company and Sorbus is absolutely like that—MAI gives its subsidiaries a great deal of autonomy."

STEPHEN J. KEANE—The idea is to get the customer up and running.

In 1973 Bucode was acquired by Mohawk Data Sciences, at which time Keane became vice president at Mohawk responsible for oem, distributor, and supply business activities until June 1977. In July of that year Keane was appointed president of Sorbus and in August 1979 he was elected a vice president of Management Assistance Inc.

Keane believes that personnel management in the service business is critical. "Incentive programs, such as Sorbus's Magna program, result in only a 5% to 8% turnover in the field force; since the Magna program has been in effect, 50% of the participants have been promoted."

Sorbus supports IBM System/3, 3270 terminals, 370s, MAI's products (Basic/Four) and "other manufacturers," in which there are 50 contracts. The company has 10,000 end-user customers, and, as far as IBM equipment goes, "Our only customers are people who own the equipment —either directly or through third-party leasing. About 20% of IBM users fall into this category. Our company's real strength is not only in servicing major metropolitan areas, but also in servicing the secondary cities—Harrisburg, Albany, Sacramento, Austin . . . a total of 160 areas nationwide."

Tying together all the areas is a Technical Information Center (TIC), which is staffed with specialists who are ready to assist service representatives who are encountering unusual problems in diagnosing system malfunction. The TIC provides the field organization with engineering change information, reference manuals listing potential service problems, planning data for design and configuration of equipment, parts catalogs, technical information bulletins, and information for specification of equipment and service tools.

In addition to supplying parts and pickup, Sorbus initiated a Field Inventory System (FIS), which became fully operational during fiscal 1979. When a part is required, service personnel have an inventory of over 90,000 types of data processing hardware to pull from. With its seven Basic/Four system 700s at King of Prussia connected to interactive video display terminals in the field, a service representative is in communication with 2,900 parts locations nationwide and can learn in seconds where parts are available.

How do new machines affect a service company? "People prefer products with some field history; they're better off in avoiding the early engineering problems. We're still servicing 7090s and 1401s. People didn't realize how long they would last. When you purchase a machine you tend to hold on to it.

"Today's economic environment will not affect basic business. We're getting our market share and our business is countercyclical. Third-party leasing is cheaper, users tend to be multivendor, have site responsibility, systems experience, and some capability to define the problems."

Since 1972, when Sorbus became a subsidiary of MAI, it has had a 15% to 18% annual growth. With revenues up 29% from 1978 and with Sorbus representing 26% of MAI's total revenues, Stephen J. Keane proves that house calls are still popular and growing. *

Wang's 2200 Series Small Business Computers deliver custom solutions to specific business problems.

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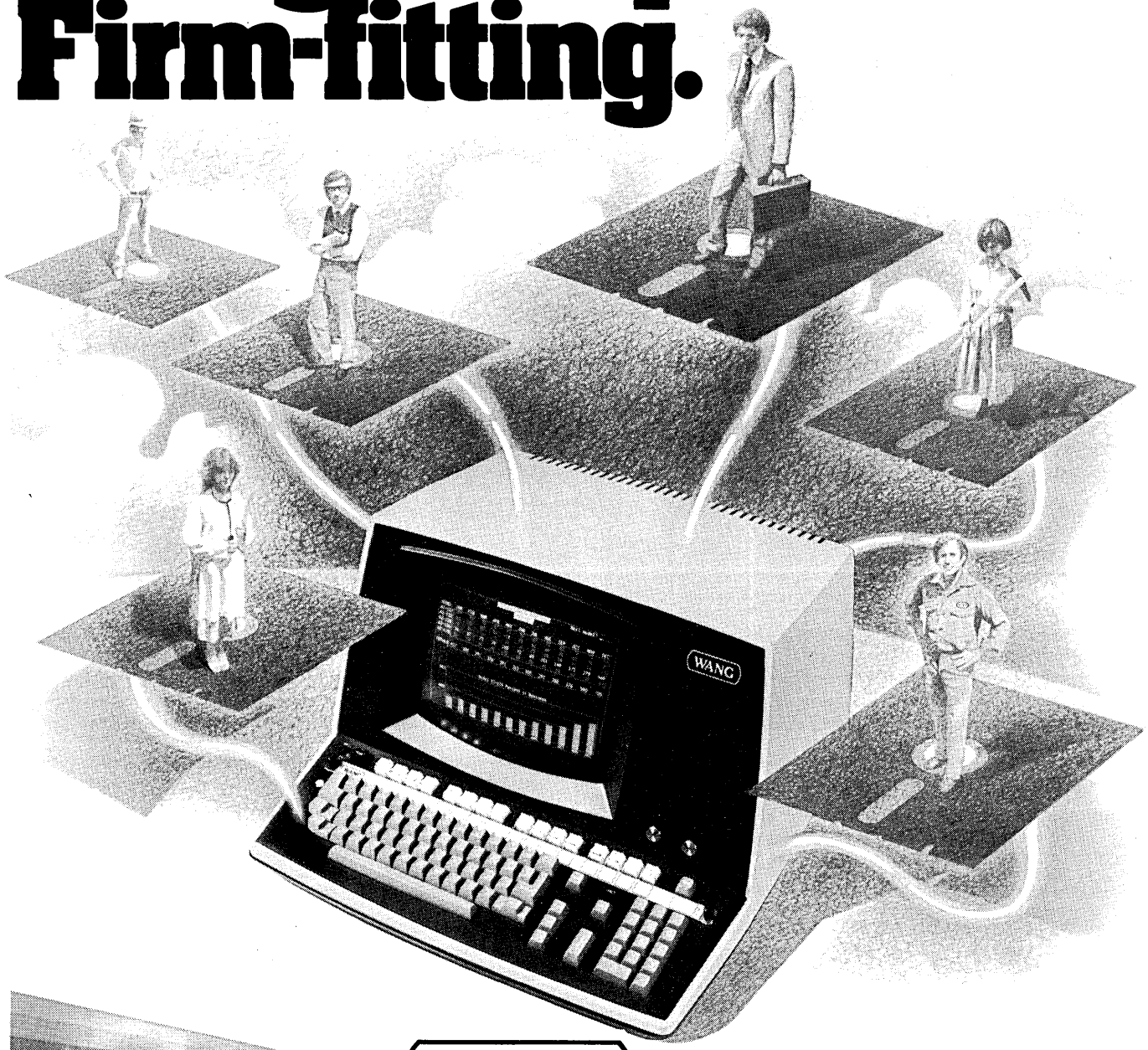

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CIRCLE 155 ON READER CARD

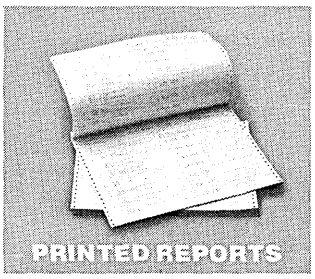
VIS1ON Reg S M puts project management at your fingertips.

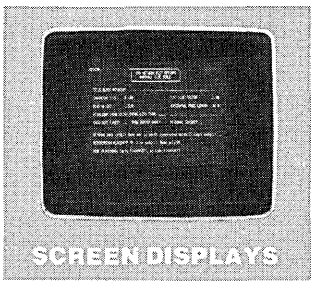
For effective project management and control you need up-to-the-minute information at your fingertips. You need reports presented fast and accurately in a variety of formats. You need **one** easy-to-use system that does it all. You need VIS1ON.

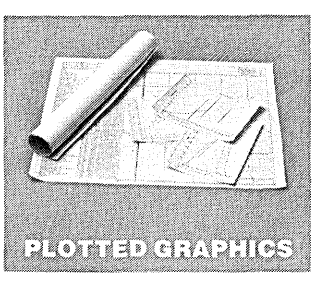
VIS1ON DOES IT ALL.
With VIS1ON you can: ■ Develop project plans and schedules. ■ Monitor, control and update information (interactive or batch). ■ Do cost analysis and resource allocation. ■ Perform "what if" simulations. ■ Produce EZPERT graphics (networks, barcharts, X-Y graphs). ■ And much more.

WITH VIS1ON IT'S EASY.
Utilizing VIS1ON's CRT terminal—guided by preformatted displays—you work in plain English. There are no complicated program languages to learn. VIS1ON asks the questions, you fill in the blanks, then VIS1ON gives you output three ways: Printed Reports, Screen Displays, Plotted Graphics. (A Report Writer & Query module is also available for free format reports and displays.)

THERE'S SYSTEM VERSATILITY TOO.
With our family of hardware and software we can tailor VIS1ON to big company, small company or distributed processing needs. A single operating system and plug-in upgrades of CPU's, peripherals and controllers means we can grow with your needs to support from 1 to 63 simultaneous users. In addition, VIS1ON can be easily integrated into your existing data processing system. VIS1ON provides RJE communications to IBM, CDC, UNIVAC and Honeywell; and can also emulate and support IBM 3271/3277 Display Systems.







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CIRCLE 156 ON READER CARD

HARDWARE

OFF-LINE

Gambling chips aren't the only chips to be found in casinos these days. Semiconductor chips have come to mean money to the firms supplying the gambling industry.

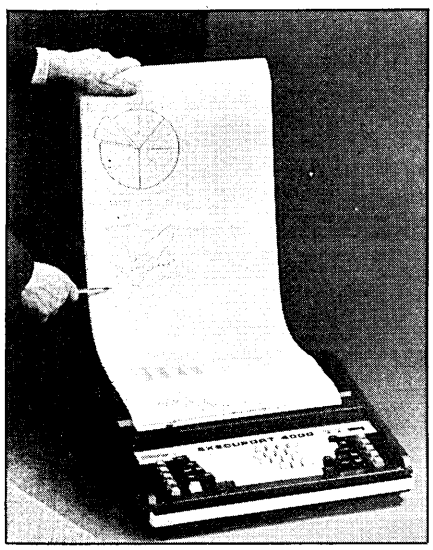
Nevada's Gaming Commission has approved a microprocessor-based conversion package for slot machines. Summit Systems, Inc., developer of the system, believes that modified slot machines will need less maintenance and will prove to be harder to cheat (we've heard that most of a slot machine's innards are comprised of security and anticheating functions). Additionally, converted slots are compatible with a cost accounting and security system developed by Summit.

Also drawing a bead on the slot machine upgrade market, Advanced Patent Technology, Inc., and Microbar Systems Inc. have announced an agreement in principle giving APT exclusive marketing rights to Microbar's Electronic Gaming Control System. The agreement covers all countries except England and Australia. Built to APT's specifications, the system includes Individual Controller Units located in each slot machine, handheld Record Collection Units, and a Record Conversion Computer. The system will be tested at the Colorado Belle Casino, opening the first of July, in Laughlin, Nev.

Cii Honeywell Bull, the French computer maker, has entered into a multiyear oem contract with Floating Point Systems, the Beaverton, Ore., array processor company. This is Floating Point's largest international contract to date, with revenues projected to fall between $15 million and $20 million.

PORTABLE TERMINAL

The Execuport 4000G wide carriage portable terminal adds business graphics capabilities to this vendor's 136 column upper/lower case ASCII terminals. In graphics mode, the thermal printer can produce plots, bar charts, histograms, pie charts and other images useful for business presentations; output can be made directly onto

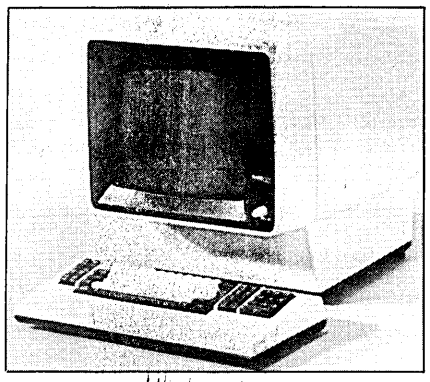


transparent film for immediate use with an overhead projector. Lines can be drawn in any direction, with a graphics resolution of 1,920 points per square inch (40 by 48). Alphanumeric output uses the 128 character ASCII set, while graphics are generated with a modified ASCII code with graphics characters. The 4000G operates at 30cps and includes an acoustic coupler. In singles, it sells for $3,795. COMPUTER TRANSCEIVER SYSTEMS, INC., Paramus, N.J.

FOR DATA CIRCLE 310 ON READER CARD

TERMINALS

A Teletype-compatible terminal and a 3278-compatible unit, both targeted against IBM offerings, are the latest offerings in this vendor's terminal line. The vendor's model 310, destined to compete with IBM's 3101, is an ASCII terminal capable of displaying 24 lines of 80 characters on its 15 inch diagonal screen; a 25th line is provided for status



information. The terminal has a detached keyboard with numeric keypad and programmable function keys. Interfacing can be RS232 or current loop, with full- or half-duplex communications at speeds ranging from 110bps to 9600bps; an auxiliary RS232 port is optional. A single 310 sells for $1,250, with quantity discounting dropping the price to $900 per unit in lots of 100 or more.

Complementing the vendor's 3278-compatible model 278, the model 278E is a compact 9 inch diagonal terminal designed for use in cramped quarters—it needs only 21 inches of depth at the workplace. It has a 1,920-character screen (24 lines of 80 characters) with a 25th status line. It has most 3278 features, except for a light pen. It can work with its vendor's TC 276 controller, or IBM's 3276 or 3274. Printer support is provided. Field formatting capabilities include protected and unprotected, alphanumeric, normal intensity, intensified fields, nondisplay, and numeric lock. In unit quantities, the 278E sells for $2,200. Leases are offered. TELEX COMPUTER PRODUCTS, INC., Tulsa, Okla.

FOR DATA CIRCLE 311 ON READER CARD

PORTABLE DATA ENTRY TERMINAL

This vendor of portable terminals has extended its handheld data entry line to include a new entry-level terminal, the model 66. Compatible with the vendor's 77 and 88 series terminals, the model 66 is aimed at electronic ordering and inventory management applications. Operating from four AA

batteries, the model 66 allows data entry from its calculator-style keyboard or optional optical wand scanner. The 1 lb. 6 oz. terminal has a 12-digit display, and is offered with either 4KB or 8KB of memory. It can communicate with a host computer via a number of the vendor's communications modules, including an acoustic coupler. Communications can use either eight-bit ASCII codes or five-bit codes; data rates range from 300bps to 1200bps. A single model 66 with 4KB of memory sells for $460, while an 8KB model 66 is $560. Quantity discounts are offered on the terminal and its related communications and wand scanner options. MSI DATA CORP., Costa Mesa, Calif.

FOR DATA CIRCLE 301 ON READER CARD

PLUG-COMPATIBLE MAINFRAMES

Replacing the vendor's previously announced VMX 200 and VMX 400 plug-compatible mainframes, this vendor's QMX 6300 series consists of three processors, the largest of which is said to provide 170% the performance of IBM's 4300 series. The microcoded systems are said to support all 360 and 370 operating and applications software, while retaining the flexibility for future performance enhancements. Main memory sizes range from ½MB to 4MB.

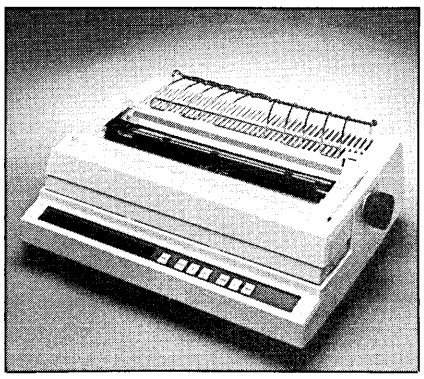
The first model scheduled for shipment, the QMX 6336, reportedly offers 130% the performance of a 370/148, placing it in the middle of IBM's 4300 series. It supports from 1MB to 4MB of main memory cycling at 495nsec per 8 bytes; the processor cycle time is said to be 175nsec to 350nsec, with simultaneous multiple instruction processing. The basic QMX 6336 comes with one-byte multiplexor channel (50KBps) and two block mutiplexors (2MBps per channel in burst mode). Two block multiplexors can be added as options. The aggregate data rate is in excess of 8MBps. QMX 6336 pricing ranges from $163,000 to $212,000.

The smaller 6333 provides 1.7 times the processing power of an IBM 4331 and supports from ½MB to 2MB of memory, 1-byte multiplexor and two block multiplexors. Pricing ranges from $98,000 to $123,000. The 6343, said to be 10% more powerful than a 4341, has yet to be priced. NANODATA COMPUTER CORP., Buffalo, N.Y.

FOR DATA CIRCLE 302 ON READER CARD

DAISYWHEEL PRINTER

Intended for oems building systems for word processing, data processing, and communications applications, the Model 630 impact printer can use either plastic or metallized daisywheels. Printing speeds range from 32cps (standard English font and text) to 40cps, depending on the print wheel and output text. Users can select print wheels from the more than 100 metal and



plastic daisywheels offered from the vendor, including 10-pitch, 12-pitch, and true proportional spacing. The 630 accepts ASCII characters via serial interfaces at speeds ranging from 110bps to 4800bps (20mA or 60mA current loop) and to 9600bps (RS232); an oem printer interface provides eight bidirectional data lines and six unidirectional control lines. In 10 pitch, the 630 can print up to 132 characters per line; column spacing is variable in 1/120th-inch increments and line spacing is variable in 1/48th-inch increments. The basic mechanism, with control electronics and microprocessor interface (for oems) sells for $860 in quantities of 500; a packaged 630, with communications interface, control panel, power supply, and packaging, sells for $1,705 in quantities of 500. DIABLO SYSTEMS INC., A Xerox Co., Hayward, Calif.

FOR DATA CIRCLE 303 ON READER CARD

HANDPRINT DATA ENTRY

A few years back, this British company introduced a handprint data entry system consisting of a number of work stations connected to a minicomputer that actually handled character recognition. Now, the firm has done away with the minicomputer, and incorporated all recognition logic into the microprocessor-based Micropad handprint data entry terminal. As the user writes (most likely on a preprinted form), his pen strokes are digitized and recognized by the Micropad. The unit recognizes ordinary handprinted characters, numerals, and special characters. The Micropad has a 40-character display, allowing the user to verify that the terminal has correctly recognized his input. Both RS232 and 20mA current loop interfaces are provided for connection to a host computer. The vendor is in the process of setting up a U.S. subsidiary to market the Micropad, and it is looking for interested oems. The end-user price in the U.S. is targeted at $3,500. QUEST AUTOMATION LTD., Wimborne, Dorset, England.

FOR DATA CIRCLE 304 ON READER CARD

MODEM

This modem maker has made yet one more move guaranteed to keep it off of Ma Bell's Christmas list: it has introduced its ModemPhone, a telephone with integral low speed modem. Available in either touchtone or rotary dial versions, the ModemPhone can function as a regular telephone or as a 103A/

HARDWARE SPOTLIGHT

SMALL SYSTEMS

Reinforcing its position in the small business computer market, this vendor has come up with two new small computers, a recasting of its first-time-user PCS system, a disk multiplexor, and an applications program generator. The single-user 2200 SVP and multi-user 2200 LVP both support the vendor's BASIC-II programming language. The SVP starts off with a 32KB processor, crt terminal (including business graphics capabilities), and a single-sided, double-density diskette drive capable of storing 500KB on a diskette. The system can be expanded to 64KB of memory; other options include an additional diskette drive, 2MB or 4MB (formatted) of Winchester disk storage, and a 120cps printer. System pricing ranges from $12,000 to $20,000.

Up to four concurrent users can be accommodated by the 2200 LVP. User memory sizes range from 32KB to 128KB; the operating system uses an additional, separate 60KB of memory. System prices range from $15,000 to $35,000, with a typical single user 32KB system, including 1MB of floppy storage, 4MB of Winchester disk, crt terminal, and 120cps printer, priced in the $17,500 to $19,000 range. Both SVP and LVP support a variety of communications protocols.

The low end of the 2200 series is now the PCS-111, which supersedes the PCS-II. The BASIC speaking computer differs from its predecessor model by including a single-sided, double-density minifloppy drive with a 140KB capacity. Only a 32KB version is offered; a second diskette drive can be added. Pricing is the same as for the PCS-II, ranging from $6,500 to $10,500.

Up to three cpus of the 2200 VP/MVP/LVP line can share disk storage using the 2280 disk multiplexor. The 2280 supports one or two drives, each with formatted capacities of 26MB, 51MB, or 80MB. Each drive has a 13MB removable cartridge disk, with the remainder of its capacity on fixed disks. The 2280 sells for $2,000, plus $500 for each cpu supported.

The Inquiry Data Entry Access System—IDEAS—is a set of utilities that are said to allow even nonprogrammers to develop complete data entry, inquiry, file management, and report generating applications without using BASIC. Essentially a program generator, IDEAS runs on the 2200 series of small business computers. It licenses for $1,000. WANG LABORATORIES, INC., Lowell, Mass.

FOR DATA CIRCLE 300 ON READER CARD

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Drafting-like plot quality—that's the whole idea behind the new CPS-14 and 15 digital plotting systems. Make us prove it. Just take a look at the output from the CPS-14 and 15...you'll see plot quality comparable to or exceeding that of competitive plotters costing twice as much.

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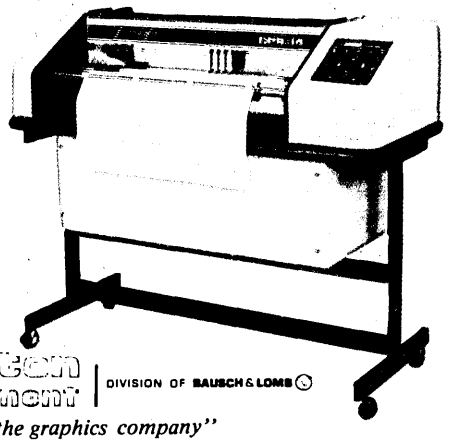

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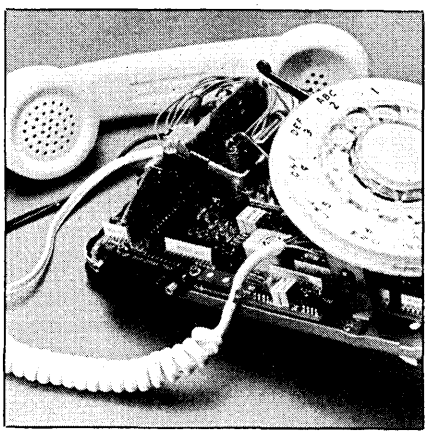
HARDWARE



103J (as well as 113A through D) compatible modem. The VA103 ModemPhone is FCC-registered, and plugs into either a telephone company voice jack (RJ11C) or a programmable data jack (RJ41S or 45C). The modem itself has a wall-plug transformer for its power supply. An RS232 25-pin connector provides an interface to the user's terminal equipment.

The basic ModemPhone operates in full duplex at speeds ranging to 300bps; auto originate/answer is offered as an option for an additional $80. A basic (originate only) dial phone version sells for $250, and a touchtone version is $300. RACAL-VADIC, Sunnyvale, Calif.

FOR DATA CIRCLE 305 ON READER CARD

MAINFRAMES

In the wake of its acquisition of Itel's computer operations last fall, this vendor has announced a pair of 370-compatible mainframes falling in the performance spectrum between IBM's 4341 and its 370/158-3. Known as the AS/3000 series, the systems are manufactured by National Semiconductor's San Diego-based Computer Products Group. IBM-compatible firmware assists are included with the machines; popular IBM operating systems, including DOS/VSE, VS/1, MVS, VM/370, DOS, and OS, are supported by the AS/3000s. Both machines support five channels, have machine cycle times of 115 nsec, and memory cycle times of 690 nsec and 920 nsec (read and write, respectively). The entry level AS/3000N, rated a shade faster than a 4341, has 8KB of cache, and main memory sizes ranging from 2MB to 4MB. The AS/3000 is said to have performance equivalent to a 158-3; it has 16KB of cache and memory sizes ranging from 2MB to 8MB. An AS/3000N can be upgraded to an AS/3000 in the field.

Two support offerings were announced with the AS/3000s. The Central Program Support Service provides subscribers with 24 hour a day, seven day a week telephone assistance through a toll-free phone number; Local Program Support Service is offered to users desiring help from a local system support representative. Local support goes for $600 per month, central support is included in the machine's maintenance charge. With 2MB and five channels, an AS/3000N sells for $325,000 and an AS/3000 goes for $425,000; maintenance is $1,550 per month and $1,650 per month, respectively. Additional memory goes for $50,000 per megabyte. NATIONAL ADVANCED SYSTEMS, Palo Alto, Calif.

FOR DATA CIRCLE 312 ON READER CARD

MICROCOMPUTER BOARDS

A low-end, single-board, 8-bit microcomputer and a more powerful general purpose 16-bit micro-on-a-board are the first two products built around this vendor's new 96-line bus structure; both boards have 96-pin high-density connectors that will allow them to work with future boards (I/O, memory, etc.) designed for the new bus.

The low-end, Z8-based board seems well suited for built-in controller applications and other dedicated uses. A BASIC/DEBUG interpreter is included on the board; additionally, the board supports up to 8KB of RAM, ROM, or EPROM in any combination. The board operates off a single +5 volt power supply, and includes two counter/timers, five 8-bit parallel I/O ports, and a programmable asynchronous port capable of meeting RS422 or RS423 interface standards. The board sells for $695, or $795

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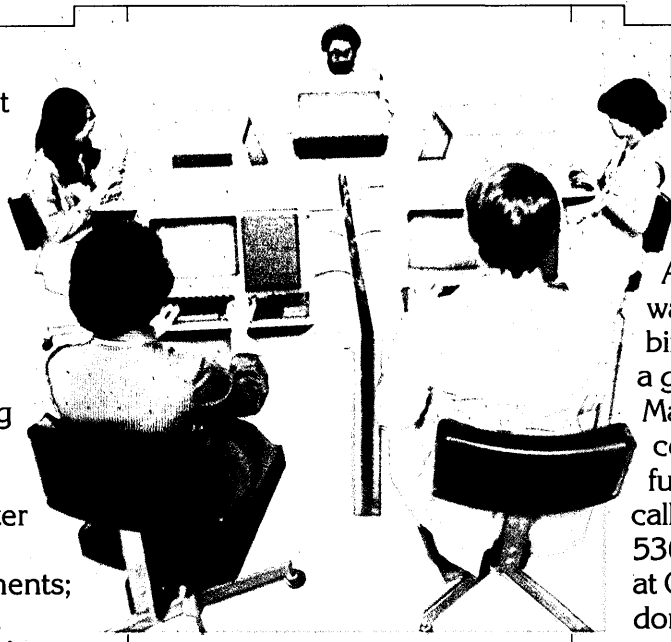
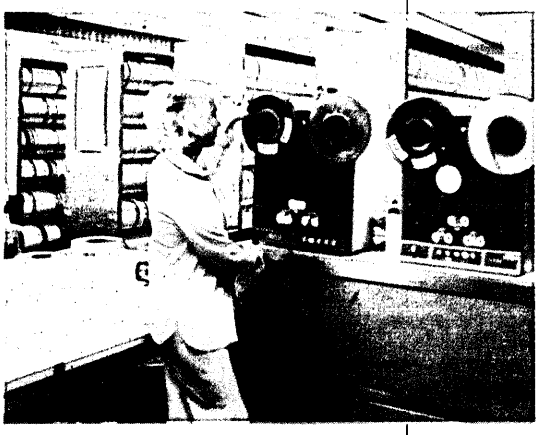


large-scale processing networks...or horizontal microcode for special processors. TRW's work-study fellowship in Computer Architecture and Software Engineering combines half-time salary with a generous stipend for a Master's at UCLA—contact Lori Brown. For full-time opportunities, call Bob Chambers (213) 536-3081. Or write them at One Space Park, Redondo Beach, CA 90278.



weapon system software and related disciplines, such as office automation for government applications.

To reduce the cost and risk involved in this state-of-the-art work, TRW has developed a large library of labor-saving software tools. In fact, designing new tools is another activity that may whet your appetite. You may want to help develop architectures, protocols, and operating and applications systems for very

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For applications requiring much more in the way of computing capabilities, the 16-bit Z8000 microcomputer board can be used as the basis of a computer system or as a node in a hierarchy of processors. The board includes 32KB of RAM (with parity), and room for an additional 8KB of RAM or ROM. The board's Z8001 microprocessor can address up to 8MB of memory. An onboard Z80A-S10 (serial I/O) controller provides two flexible serial I/O channels that can be independently programmed to support a variety of asynchronous or synchronous protocols, including bisync, SDLC, HDLC, and X.25; RS422 and RS423 also are supported. In singles, the Z8000 MPU board sells for $2,295. ZILOG, Cupertino, Calif.

FOR DATA CIRCLE 306 ON READER CARD

CRT TERMINAL

The VP 800/A is an intelligent crt terminal capable of emulating most currently available terminals; either the operator or host computer can specify the terminal's operating characteristics (parity, transmission rates, etc.). The VP 800/A can display 24 lines of 80 characters or 28 lines of 132 characters; in either instance, an additional line is provided for status information. Split-screen capabilities and a line-drawing character set are standard. The unit's

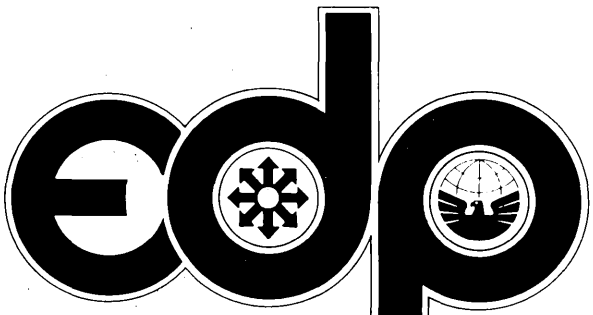
memory is packed for efficiency, and can be expanded to 32KB. The keyboard includes user-programmable function keys and a numeric keypad. Two RS232 ports are provided, allowing data communications at speeds of up to 19.2Kbps, as well as support for an auxiliary printer. A proprietary word processing package also is offered by the vendor. A basic VP 800/A with 8KB of memory, sells for $2,250, with discounts offered to oems and distributors. DIRECT INC.., Sunnyvale, Calif.

FOR DATA CIRCLE 307 ON READER CARD

PORTABLE SMART TERMINAL

Last year at NCC, this vendor introduced a programmable portable thermal printing terminal, dubbed the PRO. This year, the vendor has brought out a complementary offering, the model 1206/PAT (Programmed Applications Terminal) that , while not supporting program development, executes programs prepared on the PRO. This allows even non-dp types to use the PAT without being tempted to change its programming. Programs can be loaded through the PAT's integral tape drive, or down-line loaded. All operating characteristics are under program control, so an untrained user can't gum up the works by changing a switch position. Programs and data files can be transmitted via the unit's RS232 interface or its integral modem and acoustic coupler. The 1206/PAT includes 32KB of ROM and 32KB of RAM workspace; it can execute programs written in either BASIC or Motorola 6800 assembly language. The 17-pound PAT includes an 80-column, 50cps, upper/lower case ASCII thermal printer; options include switch selectable 80-column printing, integral bar-code reader, and a diskette operating system capable of supporting up to 1.44MB of minidiskette storage. The 1206/PAT sells for $5,195, quantity one. Deliveries are slated for the third quarter of this year. COMPUTER DEVICES, INC., Burlington, Mass.

FOR DATA CIRCLE 308 ON READER CARD



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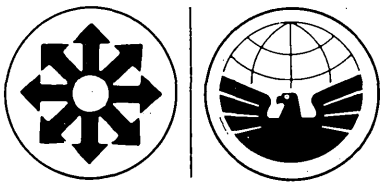

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CIRCLE 164 ON READER CARD

SOFTWARE AND SERVICES

UPDATES

Vintage humor from the annals of computing past: Roger A. Hopkins, vp at Information Associates International, unearthed a gem hidden in the 1961 IBM publication of the Reference Manual, IBM 7070/7074 Utility Programs. The general description of the tape print program informs users that "alphameric characters in the tape record will be printed in single-digit form, e.g., an I for an I, a 2 for a 2." Hopkins says this is the only bit of humor he's found in his collection of IBM manuals, and he wonders if anyone else can provide more examples.

Early on, observers of the emerging market for personal computer software pointed out the many problems a vendor faces when trying to protect software from unauthorized duplication and resale. Palo Alto-based Nestar Systems says it is now the victim of bootleggers in Europe. Nestar's BASIC Toolkit, a set of utility commands for the popular Commodore PET personal computer, reportedly is being sold on magnetic media; Nestar sells its version burned into ROM. In addition to the legal and ethical problems involved, Nestar says the unauthorized copies are incorrectly relocated into RAM, and may cause malfunctions under certain conditions. Caveat emptor.

Southern Pacific Communications Co. (SPCC) has applied to the FCC for authority to build and operate a $200 million domestic communications satellite system. The dual-band satellites proposed are said to have twice the capacity of any domestic satellites currently in use or announced. If approved, the first satellite should be launched by the end of 1982.

SOFTWARE SPOTLIGHT

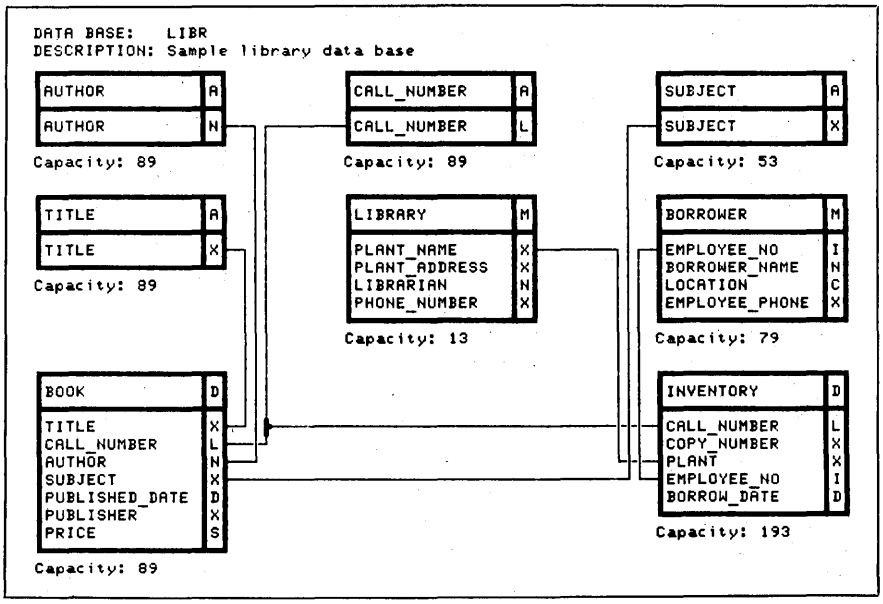
DESKTOP DBMS

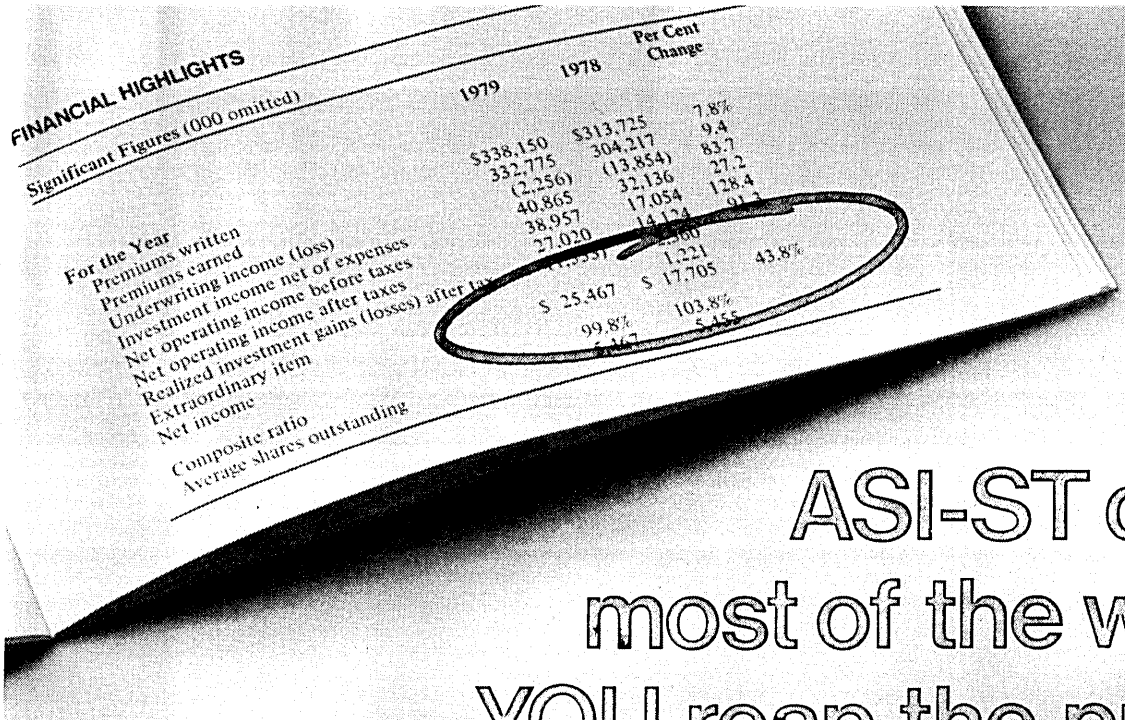
Patterned after the IMAGE/3000 data base management system for this vendor's 3000 series computers, IMAGE/45 brings data base management to users of the desktop Series 9800 System 45. In addition to the set of system routines and statements for manipulating data base structures provided by IMAGE, users can interact with data bases through QUERY/45, an inquiry program that is intended to save users from having to write customized applications programs.

IMAGE runs on a 45B or 45C with at least 187KB of memory, mass storage ROM, and a pair of floppy disk drives; additional floppies and hard disks are supported. IMAGE itself is supplied in a pair of plug-in ROMs containing the code for enhanced BASIC statements for data base manipulation and maintenance. Depending on available storage, the system can handle a data base with up to 32 data sets, each having up to two levels of data files. Each data set can have up to 32,767 entries, depending on the length of each (1,022 bytes per entry maximum); data bases can contain up to 268MB. Multiple volume data bases are supported, allowing even an entry-level twin-floppy system to have a data base in excess of the available on-line storage capacity. Imbedded pointers logically connect records into chained lists; up to 16 index files can reference a detail data set, and up to 16 details can be referenced to one master. File accesses are controlled by passwords, which can authorize different access modes (read-only or read-write) for each individual.

QUERY consists of roughly 500KB of BASIC code (making use of IMAGE enhancements). In addition to providing an inquiry mechanism, QUERY can be used to create data bases, data entry routines, and with an optional software link, select data for processing by existing System 45 statistics packages. A very interesting feature of the System 45 DBMS is its ability to use the system's printer to display a graphic map of the user's data base, including the links between related data records. The data base management package is priced at $5,000. HEWLETT-PACKARD CO., Palo Alto, Calif.

FOR DATA CIRCLE 325 ON READER CARD





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- Using ASI-ST, AMERICAN EXPRESS COMPANY recently required only four minutes of CPU time to process over 12 million records. AMEX also uses ASI-ST with IMS.
- CORNING GLASS WORKS now executes an average of more than 16,000 ASI-ST runs monthly against TOTAL data bases and standard files.
- UNION CARBIDE's usage of ASI-ST averages over 6,000 runs per month at each of its worldwide data centers where ASI-ST is used with IMS.

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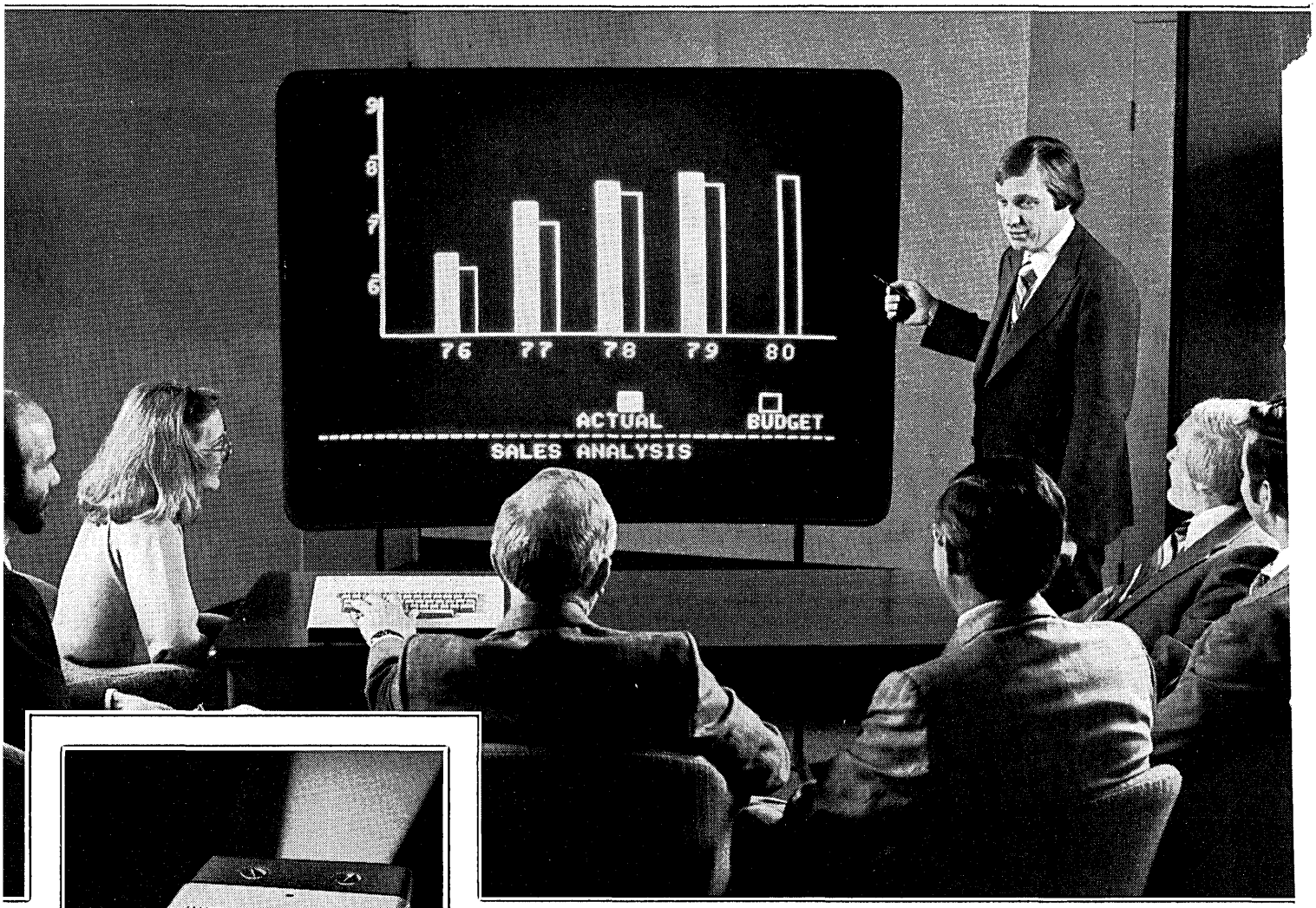
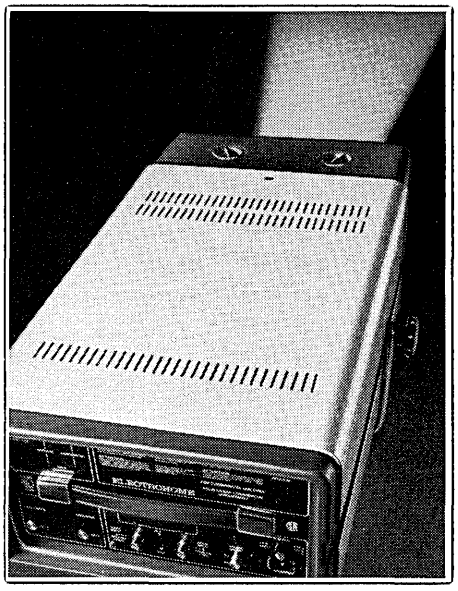
IF YOUR DATA PRESENTATIONS HAVE OUTGROWN THE SMALL SCREEN, READ ON.





Some will settle for small CRT presentations. Anyone who knows anything about getting to groups, won't.

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It synchronizes with almost all CRT-type computer terminals. This means you can punch up your presentations onto a big screen that commands the room.

We wouldn't begin to tell you how to use it – you're limited only by your imagination. What you should know is that it's lightweight and compact. That says portability.

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CIRCLE 166 ON READER CARD

OFFICE AUTOMATION

Office automation is one of today's promising new markets, and this computer vendor has come up with an Office Automation System targeted at large users such as Fortune 1,000 companies and government agencies. The system comprises software for word processing, management communications and support, and advanced text management, as well as new hardware: two terminals and a letter-quality printer. The entire package works on the vendor's line of 32-bit computers.

Interaction with the office automation system requires use of one of the two new terminals. The PT65 administrative workstation ($4,800) is an intelligent terminal that handles many word processing functions locally, while the PT45 management workstation ($2,600) is a block mode terminal that will find its place in management locations away from heavy word processing and editing. Both terminals can access the computer system's dp facilities.

Word processing is human engineered to be key (as opposed to command) oriented, with functions selected through menus and function keys; as a safety feature, operations deemed "destructive" (of the text) are invoked by pressing both the shift key and the desired function key. An operator at an administrative terminal can create and edit documents, protect areas of a

page from alteration, and do cut-and-paste operations. The word processing software includes standard features such as page numbering and converting documents from one page format to another, as well as such niceties as automatically handling footnotes, which can be placed at the bottom of the current page or at the end of the document or chapter. The workstation's local intelligence offloads the host, providing consistent response times. The administrative terminal has a 24-line by 80-character display. Through the use of both horizontal and vertical scrolling, an operator can work on documents having pages as wide as 158 characters and as long as 66 lines. The word processing software goes for $15,000. Utility programs can translate word processing files into data processing formats, and vice versa.

The management work station sports fewer function keys than the administrative workstation and includes a memory good for two pages (80 characters by 24 lines). It should find its place primarily in the area of management communications and support, which includes electronic mail, document filing and retrieval, maintaining a manager's personal appointments calendar, and scheduling meetings. Electronic mail can be sent to more than one recipient; the system maintains a single copy of the message that can be routed to each addressee. Recipients can annotate messages and send them on to others unless the originator has flagged the communication as confidential. Mail can be sent to users on remote systems by using the vendor's networking package, logging onto the remote system, and then sending the mail. The management communications and support software is priced at $15,000.

A 60,000-word dictionary, used for proofreading, hyphenating, and word-by-word language translation, is an integral part of the advanced text management package. The dictionary can be used to scan a document for misspelled words, with unrecognized words either displayed on the terminal's screen or listed in a printed report. Hyphenation happens at print time (using the dictionary), so end-of-line hyphenations are not present in the actual document on file. The advanced text man-

agement system is priced at $10,000.

For letter-quality output, the 3175 impact printer ($6,000) provides printing at 55cps. Initial deliveries of the Office Automation System begin next month. PRIME COMPUTER, INC., Newton, Mass.

FOR DATA CIRCLE 326 ON READER CARD

PERFORMANCE ANALYSIS

Capture/MVS, a performance analysis and reporting package, helps users analyze their MVS system's performance and identify high overhead areas; it can also generate input files compatible with the vendor's predictive performance modeling package, BEST/1. Capture/MVS directly processes job accounting information from SNF records and resource utilization data from RMF records. The package breaks out total processing activity (for any user-selected interval) into the various workloads represented by batch, TSO, IMS, CICS, and other categories. Reports include information on cpu time per transaction for Task Control Block (TCB) processing and system overhead, I/O processing and EXCP counts per transaction for each device and channel, capture ratios (total cpu time divided by TCB time) for each workload, and overhead percentages for the cpu, and each I/O device and channel. With Capture/MVS, users can take base-line readings and see how changes in workload affect system utilization. Capture/MVS carries a price tag of $6,500. BGS SYSTEMS, INC., Lincoln, Mass.

FOR DATA CIRCLE 327 ON READER CARD

ALMANAC

For Apple II personal computers (with at least 32KB of memory, Disk II, and Applesoft II in ROM), a package called the Almanac provides calendar and time calculations (of use to most), and a variety of general astronomy functions (primarily of interest to amateur astronomers).

Calendar calculations include printing calendar pages for any given month (even before the Gregorian calendar reformation), day of week calculations, calculation to and from Julian date, and the calculation of when Easter falls.

Astronomers should find sidereal time calculations, sunrise and sunset determination, and calculation of the phases of the moon of use in their hobby. The package also can calculate the dates and times of lunar and solar eclipses. A high resolution graphics model of the solar system can be used to display the location of the planets at a specified time. Finally, a software real-time clock can handle time zone adjustments (except political anomalies), and Universal (Greenwich) Time. Supplied on diskette, the Almanac sells for $29.95. WILLIAMSVILLE PUBLISHING CO., Fredonia, N.Y.

FOR DATA CIRCLE 328 ON READER CARD

DATA BASE SYSTEM

Access, a data base management tool for use on PDP-11s running RSTS/E, comprises a data dictionary, file handler, screen formatter, and report query language. The menu-driven system allows the user to define file structures, screen layouts, and report formats. Access loads these descriptions into a dictionary and builds the data base. Linking between screens and files is automatic; screen formats can specify default values and edit checking. A multiple-key file structure allows data retrieval based on any key value; a sorted list of alternate keys can be generated to speed retrieval. The report generator can accept up to 100 logical conditions for record selection; the output can be presorted, with user-defined breakpoints and subtotals. Data security features allow the restriction of data usage by program, terminal location, operator number, or data in a record. A program generator can create skeletal BASIC programs to speed applications development. A binary license and documentation for Access goes for $9,800; update support is $2,500 per year. Leases are offered. LOGICAL SYSTEMS, La Jolla, Calif.

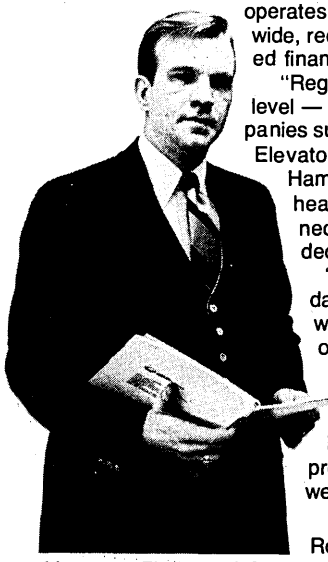
FOR DATA CIRCLE 329 ON READER CARD

"United Technologies uses the same Financial Reporting System in Bogota, Paris, and the Corporate Office."

"Here in the Corporate Treasurer's office, we use Software International's General Ledger and Accounts Payable systems to support the financial activities of six of the smaller UTC subsidiary companies. In addition, we have taken advantage of the accounts payable system to use it for Job Order Costing, maintaining complete traceability for specific contracts. The combination of Ledger and Payables provides an effective reporting tool, particularly useful in budgeting applications."

John Gritman
Manager of Financial Services
United Technologies Corporation

"United Technologies Corporation, managing a 5.5 billion dollar business which employs over 138,000 people and operates more than 180 plants worldwide, requires responsive, standardized financial control.



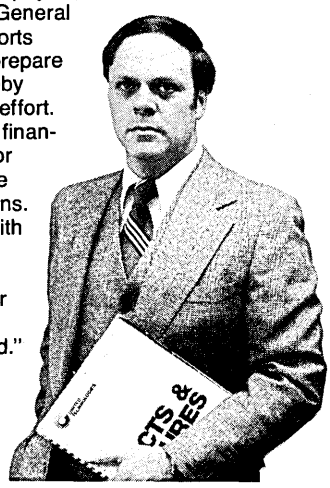
"Regardless of the decision-making level — from operations at UTC companies such as Pratt & Whitney, Otis Elevator, Essex, Sikorsky Aircraft and Hamilton Standard — to corporate headquarters, we get the details necessary for day-to-day decision-making.

"We also complete the consolidation of the corporation's worldwide financial statements on the same day that the books are closed.

"The General Ledger and Accounts Payable Financial Reporting products provide us with the software we need."

Roger E. Brady
Manager, Financial Information Systems
United Technologies Corporation

"An illustration of the General Ledger's flexibility is its operation in Bogota. Annually, the Colombian Government requires a detailed report of all payments made to vendors. One of the General Ledger system's standard reports enables the Bogota office to prepare this report automatically, thereby eliminating significant clerical effort. The system can also produce financial reports in either Spanish or English, as well as perform the necessary currency conversions. "Naturally, all user-interface with the system is in Spanish. Yet this is the same system that operates in English — or other native languages — at other UTC facilities around the world."



Jerome Kelly
Manager, Management Information Systems
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CIRCLE 171 ON READER CARD

The 7 most common mistakes made in designing computer room environment.

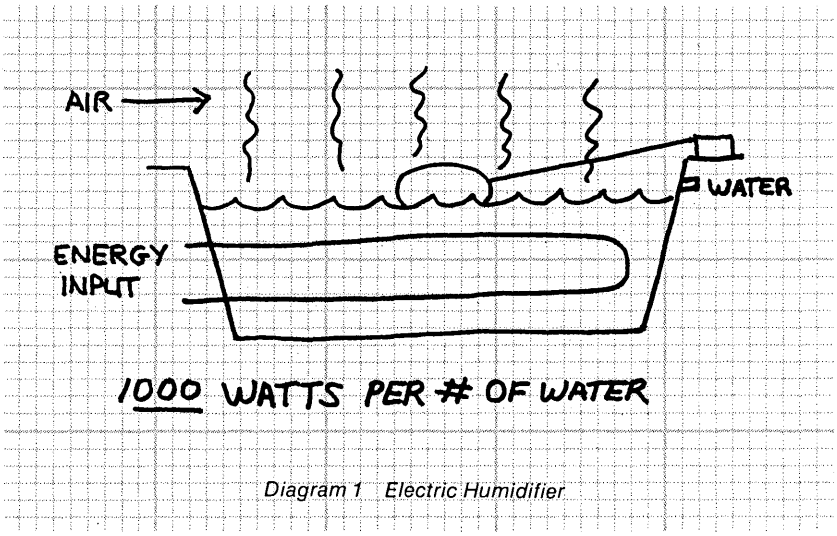


Diagram 1 Electric Humidifier

Mistake No. 5 Using unnecessary power for humidification.

All computer manufacturers recommend that relative humidity be maintained at 50% ± 5% in the computer room. A humidifier must be used to maintain the 50% requirement to offset air changes and equipment dehumidification.

Electric humidifiers of the immersion heater (Diagram 1), or quartz lamp variety, flash water to vapor which is used to add humidity to the air. These have a number of disadvantages: costly electric energy is used; the cooling load is increased due to the added heat; they are difficult to maintain; the components are expensive; operating costs are higher; and they are unreliable because if the humidistat sticks, steam is generated continuously causing over-humidification.

The EDPAC Solution

The panel humidifier (Diagram 2) used in EDPAC process cooling systems provides moisture by simultaneously passing air and water through an evaporative pad. The heat necessary for water vaporization comes from two sources: warm water (up to 140°F.) from a hot-gas-to-water heat exchanger and adiabatic heat transfer from the air stream.

In addition to the EDPAC humidifier being nonelectric in nature, the heat removed from the air stream reduces the number of compressor hours and lowers costs.

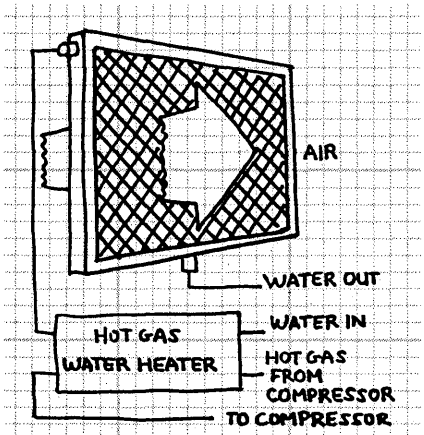


Diagram 2 EDPAC Panel Humidifier

EXAMPLE: Typical 50-ton data center requiring average humidification of 20 lbs./hr. for about eight months.

	EDPAC Evaporative Panel Humidifier	Electric Immersion or Quartz Lamp Humidifier
Btu/h required for humidification	19,600	22,640
Heat from electricity	None	27,610
Heat from water	8,800	None
Heat from air stream	8,800	None
Heat added to air stream	None	4,970
kW Required at 82% Efficiency	None	8.1
Power cost over ten years based on 5¢ per kilowatt hour doubling in ten year period	0	$34,992

In addition, the electric heater adds 4970 Btu/h to the air stream. The evaporative panel humidifier cools the air stream!

For a brochure detailing the solutions to all seven "mistakes," contact your local EDPAC representative or write to the address below.

EDPAC

Energy Efficient Process Cooling for Computers

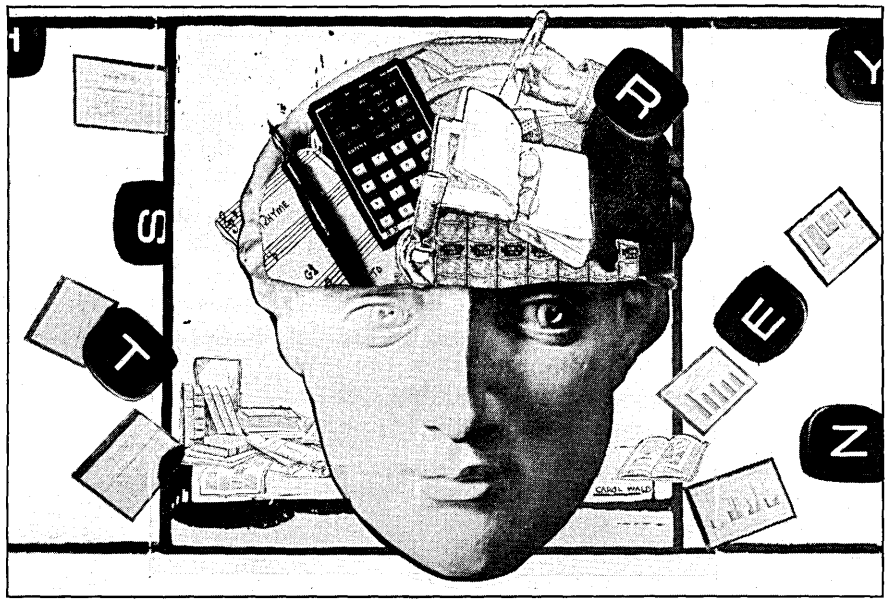
EDPAC is a product of AC Manufacturing Company, Cherry Hill, New Jersey 08034, Telephone (609) 428-9800

EDPAC also offers products for mini-computer rooms and water-cooled computers.

CIRCLE 172 ON READER CARD

SOURCE DATA

BOOKS



CONCISE NOTES ON SOFTWARE ENGINEERING
by Tom de Marco

PROGRAM MODIFICATION
by Jean-Dominique Warnier

THE ART OF SOFTWARE TESTING
By Glenford J. Meyers

A hoary joke among editors is the author's preface that begins, "This book fills a much needed gap." Here are three gap fillers from the volatile literature of programming techniques.

Tom de Marco is the guy who wrote *Structured Analysis and Systems Specification*, a rich and charming book that captures much of the flavor of his Yourdon seminars. What he has given us this time is much slimmer, a glass of chablis as it were. *Concise Notes* as a title is an understatement; shorn of its comprehensive bibliography and a vermiform appendix, it consists of 57 pages that attempt to summarize the varied fields that comprise what is now called software engineering.

As an overview, it's not bad. De Marco understands better than most what are truly important contributions to the field, so his emphasis is well placed. He does, however, linger much more over structured analysis and structured coding than over topics others might consider at least as important; since these are among his specialties, one can understand his bias.

Comprehensive it's not. But for someone in the market for a quick overview of the field, it's worth an hour's study. Yourdon Press, New York (1979, 104 pp., $6).

Jean-Dominique Warnier is known among the cognoscenti as one of the pioneers of the data structuring approach to orderly program design. His *Logical Construction of Programs* is dry reading and was slow to be translated from the French; nevertheless, it inspired the likes of Michael Jackson and Ken Orr to develop their more commercially packaged versions of his techniques.

Now Warnier is breaking new ground by trying to teach program modification. Managers of software shops should breathe a collective sigh that this long neglected discipline is finally addressed, and they should hand out a few copies of this book to their more receptive programmers. Perhaps some of it will be digested.

While this is the meatiest of the three offerings, it is unfortunately the driest, akin to overcooked roast beef. Warnier makes the reader work for his insights. In this case there are four comprehensive programming problems that all too accurately reflect the tedious workload of commercial shops. Each is designed in an orderly fashion, then attacked with one or more believable sets of changes, which are also worked into the original design.

The greatest contribution of this book is the recognition that often the very structure of a program must be altered to accommodate a change, whereas programmers go to great lengths to preserve a bad structure in the face of all attacks. The worst flaw is that Warnier, like most wizards in this field, is blind to the limitations of his model; he can't see where his ingenious foresight has paved over difficulties that innocents are sure to stumble over. Couple this with his penchant for writing loops upside down (a weakness shared by Ken Orr, for some mystical reason), and one has a recipe for potential disaster in the field. Martinus Nijhoff, Boston (1978, 160 pp., paper, $21.50).

Glenford J. Myers is IBM's resident guru on matters of programmer productivity and a perennial generator of books on related topics. His *Reliable Programming Through Composite Design* beat everyone else to press with the first detailed composition of what is now called structured design.

This time he is taking on *The Art of Software Testing*, a much more nebulous field than design, albeit no less important. The lesson that comes through from reading this book is that software testing barely qualifies as an art; it is nowhere near a science despite oodles of money spent by government and large industries.

Unfortunately, the lesson comes through only slowly, kind of like eating tapioca. The best chapter is the last, which communicates the bad news about the state of this art with a pleasant economy of words and a rich sprinkling of references. Wiley-

ILLUSTRATION BY CAROL WALD

Interscience, New York (1979, 177 pp., $17.95).

So much for the three course meal, and back to the gap metaphor. The gap in question is the one that always exists between theory and practice, between teaching and everyday living. Many people have preached the gospel of improved programmer productivity (this reviewer included); few have faced the problems of getting code out and supporting it in all its dreary detail.

Each of these books is an attempt to cross the gap by sacrificing some theoretical purity for a bit more practical believability. Whether the attempts are successful or whether they merely dilute the message remains to be seen. It could well be that the gap is much needed.

—P.J. Plauger

DOCUMENTATION STANDARDS AND PROCEDURES FOR ONLINE SYSTEMS
by Martin Rubin

Let's clean up this documentation mess, I often want to shout at corporations. Let's get serious about this business!

Most batch processing computer systems will usually have some sort of functional operations guides. Often enough, any updates are only understood by an in-group of operators and appear in the margins in four colors of ink. But the well-documented on-line system, one that can be readily understood by all users, is a bit of a rarity. Now comes a book that provides a clear start.

Everyone directly involved in dp wants and needs good documentation. Non-dp management doesn't always understand why documentation, on-line or otherwise, is really so important. Corporations that staff technical writers or who have had the foresight to keep their documentation and standards abreast of developments are at an advantage. But a company deeply involved in just keeping a large system alive and well will often put documentation last. It lies in the slough pile and then rears its head, sometimes after years of development, when a time-sharing system is to be marketed or a lucrative turnkey system already has potential users needing procedure guides. Consultants are called in, handed a four week deadline and a small sheaf of outdated material on a very large system. And then, of course, the problems start developing.

Rubin says he considers his book "a starting point in the development of standards which are tailored to on-line systems." He has done an excellent job. Chapters cover project planning and review, system development, documentation aids, operations, data base, man-machine dialogue, and data communications. The chapter layout itself can be used as a model for run books, overviews, procedure guides, and the like.

The author starts right at square one in structuring his documentation procedures: for example, in the chapter "Data Base" he begins, "The Data Base Administrator is an individual whose prime responsibility is to design and manage data base operations." But he proceeds quickly and logically to system monitoring and system reorganization in the same chapter. Rubin is very clear and precise, without being overly detailed; excellent qualities for dp documentation. This book is not just for beginners or for those faced with a crisis in their documentation closet.

The author expresses the hope that his book "will inspire organizations to review their existing standards and procedures, and initiate major revisions." This is quite probable because the standards he presents are broad enough to be adapted by different kinds of staff organizations as well as other hardware and software environments.

This is not the complete book on online documentation, nor is it intended to be, but is a very necessary addition to any data center library. I only wish it were twice as long; perhaps Rubin has a sequel. Van Nostrand Reinhold Co., New York (1979, 251 pp., $21.95).

—Sally Williams-Haik

INFORMATION MANAGEMENT SYSTEMS/VIRTUAL STORAGE
by Myles E. Walsh

The problem with writing a book on a subject about which a lot of other books have been written is that you are inevitably judged to some extent by what your predecessors have done and said. This is good news if you think of news things to say, or new ways to say them; it's bad news if you don't.

First the bad news. In any treatment of data base management systems (DBMS), certain topics are simply mandatory. One of these is the concept of data independence. The improved capacity for maintenance of application systems that data independence can provide is seen by many as one of the major productivity benefits of a DBMS. Yet the topic is entirely avoided by Walsh—it is not even listed in the index. This is a serious omission.

Now for the good news. As Walsh explains in the introductory section, the level of this book falls somewhere between the idealized vision of a James Martin seminar and the nuts-and-bolts perspective of a systems programmer. What is left between these extremes is practical how-to in using and managing IMS/VS, IBM's DBMS. As a practical guide for managers, the book hits its mark.

Walsh is at his best speaking directly to the generation of computer professionals that came of age before the data base revolution of the late '70s, and in many cases before the explosion in commercial data processing that occurred in the 1960s. There is a critical need in the industry to bring these seasoned and capable veterans, now often found among dp management, up to speed on data base. Walsh successfully avoids the increasingly abstract language of contemporary dp thinking and talks straight to these practitioners.

Overall, Walsh's style is easy and not unlively, and only slightly more rigorous than the conversation one might hear at cocktail hour during a dp conference. His language is unconsciously sprinkled with dp-isms of an earlier era. While some technical specifics escape uncaptured, the main messages come through. Generous illustrations and quotations from other data base experts help in this regard.

One of the most important of these messages is the chapter on data dictionary systems. Few books on data base systems have done as much on this vitally important management topic. Also well done are the chapters on using IMS and on staffing, educating, and organizing the IMS shop. Walsh's comments in these areas have the force of "battlefield conditions" (his description), rather than a textbook or theoretical treatment. Walsh's comments on the IMS management issue should be well worth reading even for those who don't entirely agree with his view.

A number of technical sections complement the book's management topics, including chapters on IMS data base and data communication facilities, the IMS DB/DC Data Dictionary, and IMS utilities. Chapters, on other DBMSs and data base futures, as well as appendices on master terminal operations, are also presented.

The book is not appropriate for the person who is primarily a technician. IMS is a complex system—on this point everyone but the staunchest IBMer agrees—and simplified discussions cannot do its technical features justice. But for the manager who must come to grips with IMS (and all available evidence suggests that IMS is here to stay), this book is an excellent place to start.

Despite some glaring errors (DBMS-11, for example, is not offered by Burroughs but rather by DEC) and some questionable editing (some figures are labeled and other are not), Mr. Walsh's book is overall an excellent source for managers who need to do their homework on data base and IMS/VS.

—Ronald G. Ross

REPORTS AND REFERENCES

IC UPDATE

A new report has been published on the semiconductor industry and its growing relevance to business. Entitled *Status '80: A Report on the Integrated Circuit Industry*, the volume is exceptionally well done. Clear writing, informative illustrations, and a spectacularly nice printing job in soft brown tones make the report pleasant to

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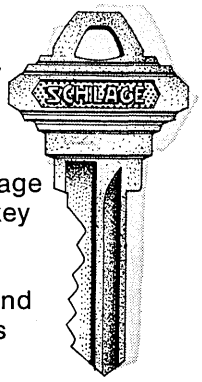

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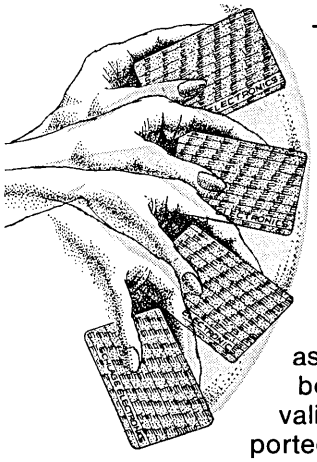

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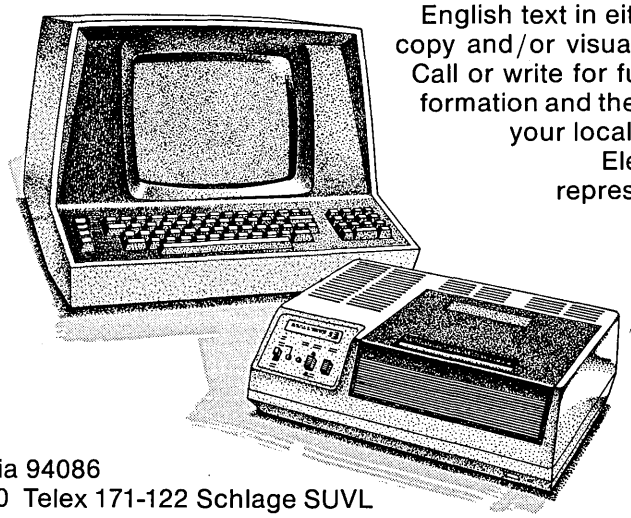

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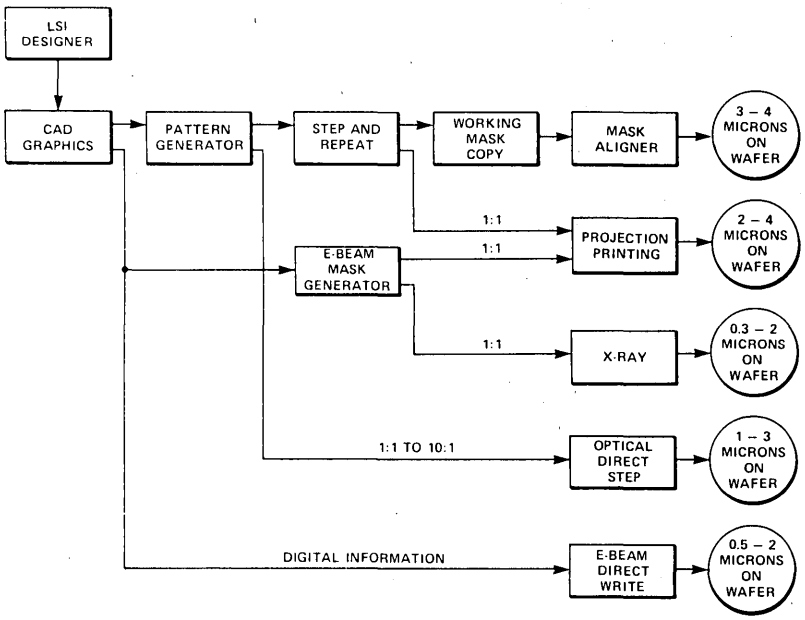
read, while the technical content is straightforward and comprehensive.

The first chapter outlines the international IC market, beginning with 1979 financial results and detailing the present business climate, including discussion of inflation, pricing, new products, inventories, investment, manufacturing resources, consumption, and foreign influence.

The IC markets in computers and data communications, consumer products, industrial applications, telephony, and military/aerospace are all discussed. Suppliers are profiled and extensive coverage is given to captive suppliers, those IC manufacturers supplying only in-house needs. The report points out that the open and captive markets are beginning to merge, as evidenced by IBM's search for parts to supplement its internal production. The technology of IC fabrication is also covered.

This figure from the chapter on the economics of IC manufacturing correlates to a table which compares costs of the different wafer patterning systems shown and includes information on typical wafer throughput and resolution capability. The statistics show a great disparity between types of wafer with respect to depreciation per completed wafer—about $1.33 for the projection printer to $50 per wafer for an E-beam direct writing system. This is one reason, it is pointed out, that major investments in capital equipment will be required for future processing technologies. $95. Integrated Circuit Engineering Corp., 6710 East Camelback Rd., Suite 211, Scottsdale, AZ 85251, (602) 945-4564.

WAFER PATTERNING SYSTEMS



MICROCOMPUTER BUSINESS SYSTEM DEVELOPMENT

A marvelously written if unattractive handbook on microcomputer systems analysis and design and programming is available from this consultant programmer who also offers a few TRS-80 software packages. The book's appearance is due to its having been

Wang 2200 Development Group

2200 Systems Software and I/O Firmware Development

The Wang 2200 development group provides a unique opportunity to participate in and actively contribute to the overall product development of the very popular 2200 series minicomputer. One very interactive team of systems programmers and microprogrammers is responsible for the systems specification, design, and development of the system software and CPU and peripheral firmware. The net result is one of the most powerful and interactive small computers available today, (and one of the most popular, over 40,000 installed). Many opportunities are now available to participate in the development of operating systems, COBOL and BASIC languages, file management, data base management, I/O controller firmware, systems interface firmware on one of the most exciting minicomputers on the market.

Systems I/O Designer/ Programmers

We have several positions open in a group which designs and implements firmware for new I/O devices and interfaces. These interfaces will be progressively more intelligent, distributing the burden of a multiprogramming operating system, and providing more high level features than ever before on our powerful small business computer. These people will work in a small interactive group with vertical systems responsibility. Coding will be at a number of levels, including high level language, interpreter microcode, operating system microcode, microprocessor code, and hardware sequencer instructions. Responsibility will range from language definition through hardware specification. All phases of design, coding, and debugging are included; we provide a good opportunity to understand an entire product.

An entry level candidate should have a degree in either engineering, computer science, or math, with adequate course work in operating systems principles. A senior level candidate should have several years in either operating systems or in microprocessor firmware design, preferably both. Some hardware background is very helpful, but direct digital design experience is not a prerequisite.

Systems Support Programmers/ Firmware Programmers

We are looking for people who wish to become involved in a software support capacity with a minicomputer development group. Positions are available in the design and coding of systems utilities in upper level languages. Candidates should have a working knowledge of BASIC or FORTRAN. Positions are also open in the design and coding of firmware for a variety of microprocessors (8080, Z80, etc.). Some experience with coding in a low level mnemonic assembly language is necessary, and a basic familiarity with hardware would be helpful.

Candidates would be working on a variety of projects involving both upper and lower level languages. The relatively small size of the support groups affords an excellent opportunity for individual project responsibility with a successful, growing company.

Candidates should have a degree in Computer Science or one to two years relevant experience.

Language Development

Openings exist at both the entry and senior levels in the design, development, and support of microprogrammed language interpreters for Wang 2200 minicomputers. Functional enhancements are currently being made on an advanced BASIC, and development of a COBOL processor is just beginning. Emphasis is on developing a high performance interactive system for the small business and distributed processing markets.

The small group environment is emphasized providing the opportunity for a high level of individual responsibility and visibility. Interaction with all 2200 development groups is encouraged.

The candidate should have a technical degree; 1-5 years assembly or microprogramming experience; knowledge of BASIC, COBOL, and interpreter design; and an understanding of Operating Systems.

Systems Diagnostic Programmer

The successful candidate will join a small group whose responsibilities include Performance Analysis, Internal Quality Assurance, Special Testing, and Systems Diagnostics.

The candidate will have responsibility for evaluating existing and defining/coding new diagnostics in such areas as Remote, CPU and selected Peripheral diagnostics.

This opportunity exists in a small department with good communication between all functions enabling one to broaden their awareness and horizons.

The ideal candidate should have a technical degree (BSCS, BSEE), assembly and some higher level language, some experience with micro-processor based software and some prior diagnostic experience with CPU and peripheral devices (e.g. intelligent controllers, terminals, disks).

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reproduced from rather poor quality matrix printer output. This has however enabled the book to be produced quite inexpensively —it is selling for a mere $2.95.

The handbook is mostly for TRS-80 users. It is largely addressed to consultants, but is likely to prove valuable to anyone trying to construct a microcomputer business system.

The writing is exceptionally clear and the presentation reflects a well-organized and detailed understanding of the systems development process in the context of real life. For example, " . . . installation . . . can be the most traumatic experience of the system development cycle because this is where the phrase 'Oh, I thought you said . . . ' is most frequently heard." Special emphasis of the handbook is on random files, random accessing techniques, and optional file structures. *Lemonade or Champagne: The Anatomy of a Microcomputer System*. Nepenthe Programs, 3014 Biggs Ct., National City, CA 92050.

EIA DIRECTORY

This year's Electronic Industries Association Trade Directory and Membership list is now available. Member company descriptions include corporate division locations, phone numbers, top management personnel, products manufactured, trade names and EIA divisional assignments. EIA officers and committees are also detailed. $10. EIA, 2001 Eye St. N.W., Washington, DC 20006, (202) 457-4981.

SMALL BUSINESS COMPUTER SELECTION

A basic guide called *Computer Selection Handbook* attempts to detail the small business computer installation process from goal setting through vendor selection all the way to systems management. The guide claims to be useful to "data processing professionals and their clients," though aimed at a thoroughly nontechnical audience. Much of the handbook consists of checklists and questionnaires for assessing and cataloging vendor interaction and for keeping track of system specifications and operations. $35. Decision Resources Corp., 28203 Ridgefern Ct., Rancho Palos Verdes, CA 90274, (213) 377-3533.

PERIODICALS

COMMUNICATIONS MANAGEMENT

A monthly newsletter devoted to networking and communications will focus on management issues. The new publication, *Trends in Communications Management*, is a companion to this publisher's *Trends in Communications Regulation*.

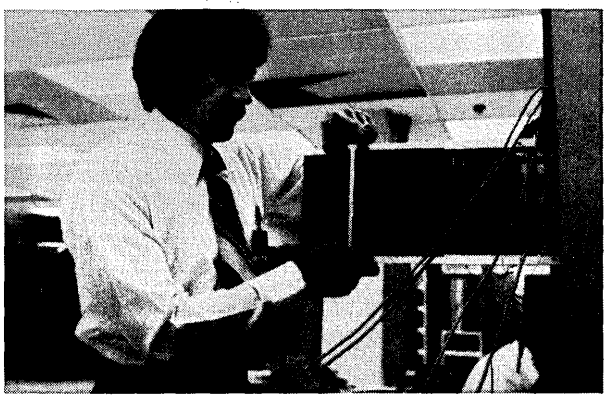
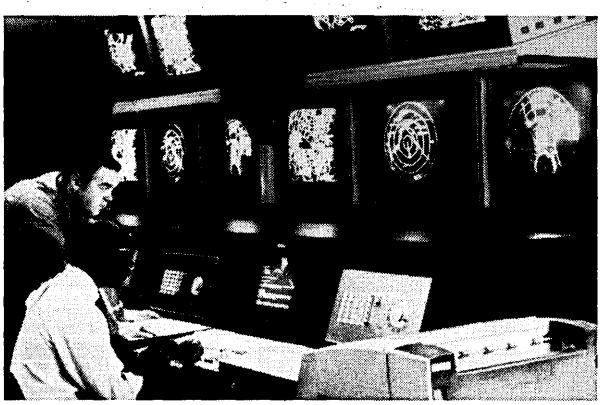
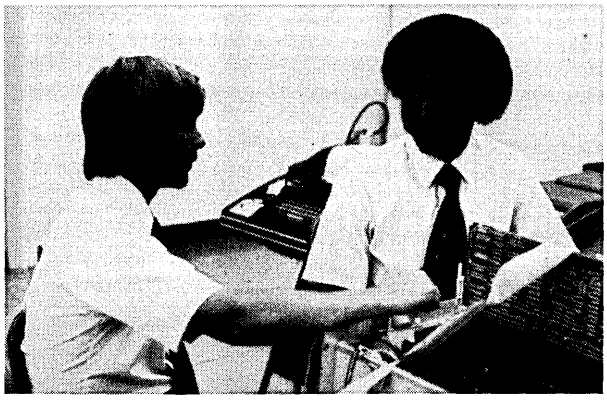
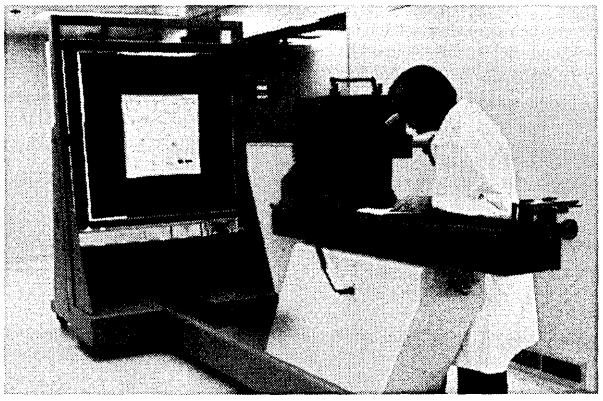
The first issue is a practical and thorough discussion of how to do a quick feasibility study when considering a cbx-dependent tie-line network. Upcoming issues are expected to feature case studies, surveys on "the functional evolution and training of telecom managers," and articles by guest authors.

Annual subscription, $48. Economics and Technology, Inc., 101 Tremont St., Boston, MA 02108, (800) 225-2496 [in Massachusetts call (617) 423-3780].

EFT

A special issue of the *Computer/Law Journal* has been published on the subject of electronic funds transfer systems. Articles include "Terminal-Based EFT Services: The Need for Uniform Federal Legislation," by Theresa A. Einhorn, coauthor of *The Law of EFT*; "A Legal Framework for Check Truncation," by George White, vice president, Chase Manhattan Bank; "Competitive Implications of EFT," by James Pierce, professor of economics, University of California at Berkeley; and "Implications of the Informational Nature of Payment," by James L. Brown, director, Center for Consumer Affairs, University of Wisconsin at Milwaukee.

The single issue, $16 ($17 outside the U.S.), The Center for Computer/Law, 530 West Sixth St., 10th floor, Los Angeles, CA 90014, (213) 623-3321.

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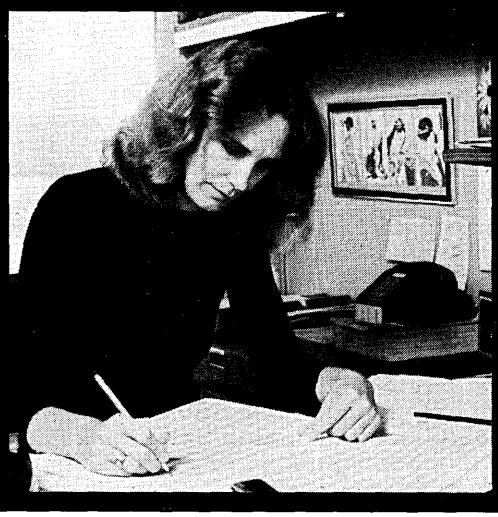

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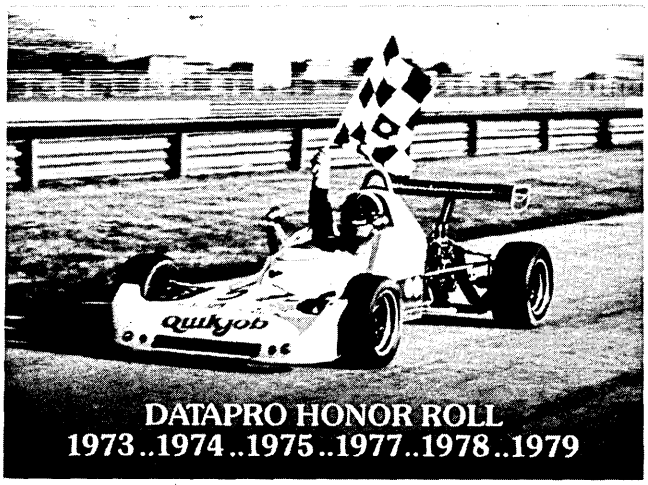

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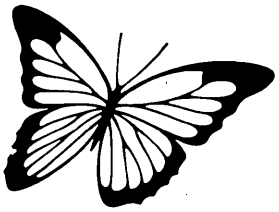

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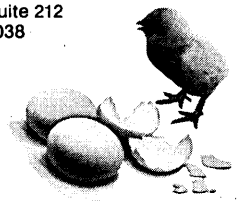

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READERS' FORUM

GUIDING COLLEGE CAREER PROGRAMS

In July, the computing community will see the publication of a timely and important report. The Association for Computing Machinery intends to publish, in a single volume, the final versions of the separate Recommendations and Guidelines for Community and Junior College Career Programs in (1) Computer Programming, (2) Data Entry, and (3) Computer Operations.

Work on the first of these reports started in 1975, under the auspices of the Community and Junior College Subcommittee (CAJC) of the Curriculum Committee on Computer Education (C3E), of the ACM. Each of the three reports has progressed through roughly the same stages. Each appeared first as a "working paper," for the purpose of eliciting comments and criticisms from the computing community. After each working paper was modified on the basis of selected responses, it then had to be submitted to C3E, the parent committee, for final approval. In each case, the repeating cycles of draft—review—revise have taken close to three years for completion, and have required the dedicated participation of a great many volunteers and the availability of extensive free services.

In addition to some lively discussion, the guidelines should also prompt some constructive suggestions for implementation. For, as the guidelines emphasize, they have been prepared to allow flexible use by implementing organizations. A given item in a content outline, for example, may require some details before it can be useful to an instructor preparing a course.

As an example of suggestions that implementors of these guidelines might find helpful, I will take two issues that are becoming increasingly important to all computer users—computerized databanks, privacy, and fairness; and computer crime and computer security—and examine their treatment in detail.

As one would expect, the coverage of these two topics varies greatly among the three component guidelines. While privacy and crime/security receive only scant attention in the Computer Programming and Data Entry Guidelines (not mentioned at all in the Objectives, and appearing once and twice, respectively, in the Content Outline), they are given an important position in the Computer Operator Guidelines: they are mentioned in the introduction, again in the Objectives, and finally as items in the Content Outline.

Privacy and crime/security issues are first mentioned in the Working Paper's Introduction:

"This entry-level operator must be prepared to learn both the regulations of, and the implications of, the problems in the area of privacy and security, and be prepared to function in an ethical and moral manner in a complex environment" [p. 2];

"The growth of new and more complex methods of computer crime places increased pressure on the operator to monitor informational security and to be watchful for unauthorized uses of the system. Lastly, the increased interest in privacy of the individual places a greater responsibility upon the computer operator, not only for personal ethical and moral action, but for maintaining it in others in the job environment who have easy access" [Section 1.1, p. 4].

Taken together, these two statements set the proper framework for the subsequent discussion. They approximately separate the "privacy" issue (citizens' concerns about the routine collection, storage, and dissemination of valuable personal data) from the "security" question (how to protect computer systems from unauthorized use, especially where such use constitutes a crime). And the first of the two statements places the proper emphasis on the growing body of "regulations" in these areas. While there surely is an " . . . increased interest in privacy . . . ," of more direct and immediate concern to people in computer operations is the federal, state, and even local legislation which specifies how personal data is to be collected, stored, and disseminated.

The privacy and security topics are referred to twice in the Working Paper's Section 3, Goals and Objectives of Operations Curriculum. Under the heading Additional Operations Skills, we find:

"Recognize the necessity for, and know common procedures for computer recovery, security, and backup procedures" [3.2, C.5, p. 9].

The necessity for recovery and backup procedures is of an entirely different order than the necessity for security. Recovery and backup procedures specify actions to be taken when security fails; as such, they are integral components of any adequate security plan. The need for security is a far more global consideration, which may actually vary depending upon the nature of the data handled by the system. Later, under Personal and Social Skills, we read:

"Develop an awareness of the operator's responsibilities in data security and integrity" [3.4, A.1, p. 10].

Again, the computer operator's responsibilities in data security and integrity are of several kinds: (a) responsibility for overall professional conduct in the performance of his/her job; (b) responsibility to the particular needs of the employer; and (c) responsibility to observe the applicable laws. Clearly, the computer operator can face a serious decision when one of these responsibilities is in conflict with the others (a situation which arose most clearly in the Equity Funding fraud case).

Section 5 of the Working Paper contains the recommended Program Content in the form of a topical outline. Under 5.1, Required Computer Operations Related Topics, appears the following:

"F. Data Handling . . .
4. Security
   a. Data Confidentiality
   b. Access Limitations
   c. Security Equipment (fireproof safes, etc.)
   d. Backup
   e. External and Internal Labels, Passwords" [p. 15].

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Unfortunately, the problems of security are difficult to cover in five items, especially when both *physical* security (as represented by "fireproof safes") and operating security (as enhanced by a system of "passwords") are indiscriminately mixed. And does "access limitations" refer to physical access (locks on doors), or operational access (authorization matrices)? The confidential nature of data in the system may be very important, and an adequate security plan must include measures to prevent unauthorized access to that data. But it should also be mentioned that highly successful frauds have been perpetrated without regard to the confidential status of stored data, by simply setting up spurious accounts and funneling assets into them, for the benefit of the defrauders. Here, then, is an area which could use some amplification when one attempts to convert the Guidelines topical outline into an actual course.

The second reference to privacy and security issues occurs in Section 5.2, Required Computer Operator Environment, where there appears the following:

"Computers in the Organization: A. Data Processing within the Organization . . .

3. Social Impact of the Computer
   a. Job Security
   b. Conformity and Dehumanizing of their [?] Jobs
   c. The Possibility of Complete Dependency on Computerized Data
   d. The Problem of Incorrect Computerized Data" [p. 22].

Without commenting on the adequacy of the above four items to cover the topic of computer impact on society, let us examine 3.d, "The Problem of Incorrect Computerized Data." Because computerized data systems are routinely used to make decisions that can have devastating effects on people's lives, incorrect computerized data can unfairly penalize the data subject. But the problem of incorrect (or, better, inaccurate, untimely, or incomplete) data arises in at least three different contexts. How the inaccurate data were acquired in the first place is a problem in the area of *data collection*. Some routine data collection practices are guaranteed to produce inaccurate data. Often data are collected which bear no reasonable relationship to the decision-making purpose for which they are used. On the other hand, whether or not data subjects are allowed to examine their records, and challenge any inaccuracies they

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discover, is a problem in the area of *record access*. When one organization *disseminates* inaccurate data to other organizations, the problem then becomes: what responsibility does the disseminating organization have to follow up by disseminating the correction?

What appears, then, to be one problem, turns out, upon analysis, to be a set of different problems, where the differences are a function of which particular phase of computer system operations is being addressed. Because there are other problems in the "privacy" area which share this characteristic, experience shows that it is more productive to organize the material by operational context. Thus the instructor will find it easier to discuss all of the problems which arise in connection with data collection, then those that concern record access, and then the problems in data dissemination.

To complete the picture, the student should then be introduced to the legislation in these areas. Under Privacy, the student should be familiar with the Fair Credit Reporting Act, the Privacy Act of 1974, the Family Educational Rights and Privacy Act of 1974, and the Financial Institutions Regulatory Act of 1978. Under Security, the Federal Computer Systems Protection Act (S. 240, introduced by Sen. Ribicoff) is a model, which several states have emulated.

Ironically, one result of taking these suggestions seriously is to place an even greater responsibility upon an already undercompensated instructorate. Community and junior colleges already face the problem of finding and retaining competent instructors, especially in an environment where, in a short time after graduation, the student is earning a better salary than the instructor. To require that these instructors become knowledgeable in additional areas, such as laws relating to privacy and security, may not be very realistic.

—James L. Rogers

TURNAROUND, TIMESHARING, AND TOLERANCE

As I write this, two compiler contracts—worth well over $2 million—are stalled.

They are stalled because the compiler validation system—probably a $50,000 contract—is also stalled.

The validator is stalled because it is being checked out on a batch computer system with one week turnaround.

For want of a nail, the war was lost.

This story is a familiar one to anyone in the computing field. Try as we will to point our fingers elsewhere, the moving fingers return to "turnaround" as the crisis point of most batch software development. It has been the crisis point for so long that the literature doesn't even bother to discuss it as a problem anymore. "Turnaround is bad—so what else is new?" is the prevailing attitude.

But there is a difference between the attitude and this story. The validator developers are going to move their checkout to an entirely different computer, one with a timesharing system. And, as we all know, their turnaround will drop from days to seconds. Of course, there will be pain connected with that transition. Moving even a validator system from one computer to another is not a trouble-free process. But on balance, the stalled validator, once moved, will rapidly be checked out.

All of that is well understood. Batch turnaround is notoriously bad; timesharing turnaround, by contrast, is almost unfailingly good.

Did anyone ever ask, "Why?" The question seems dumb. "Of course, timesharing turnaround is better," you may be thinking. "That's what timesharing is all about."

In the spirit of intellectual inquiry, though, let's for the moment assume the "why" question is not dumb. Let's explore the

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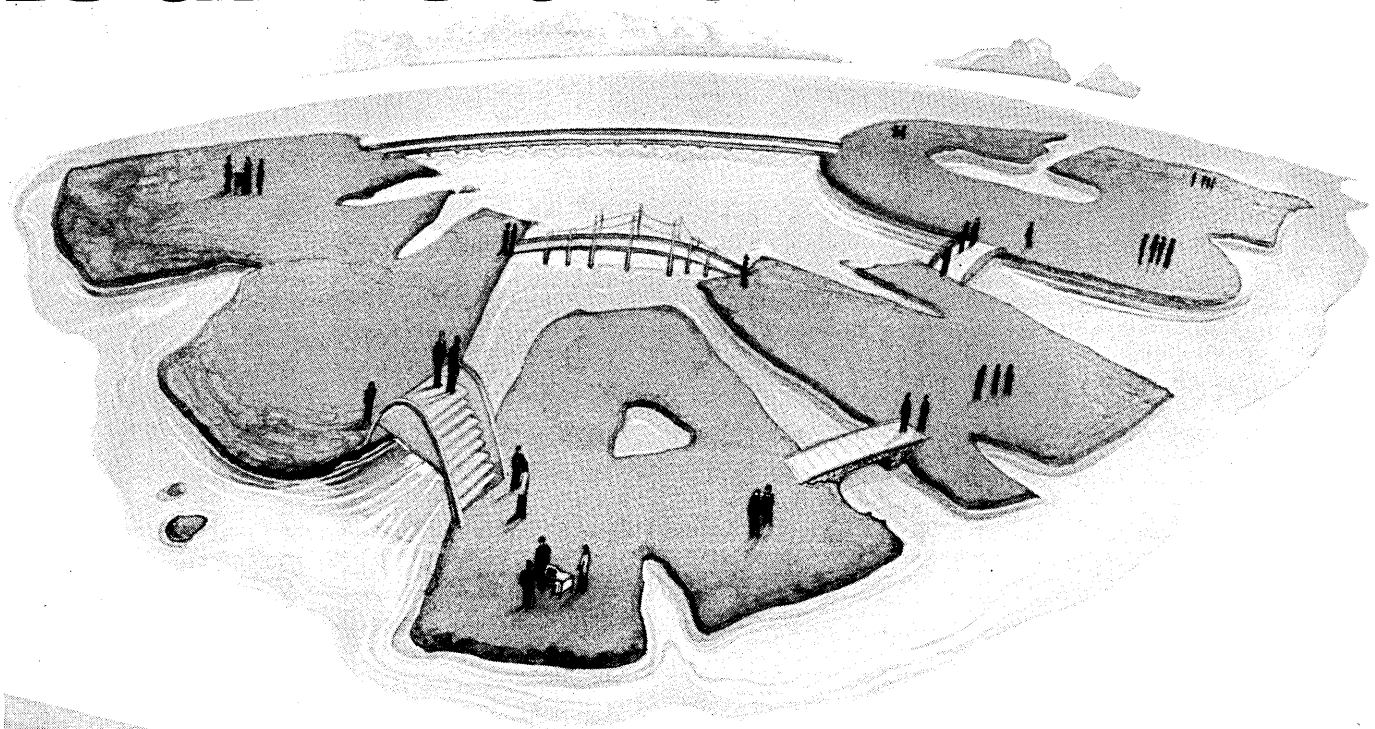

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question of turnaround one step further.

Why is batch turnaround bad? The answer, most of us would agree, is that the computer has become saturated with work.

What happens, then, when a timesharing computer gets saturated with work?

Pause. The answer should be, of course, that the timesharing turnaround gets bad. Instead of one second turnaround, 10 second turnaround . . . or one minute . . . or 15 minutes. The evolution from good turnaround on a lightly loaded computer to bad turnaround on a heavily loaded computer should, by all reason, proceed in the same manner for timesharing as for batch.

We know it does not.

Now we are prepared to ask the question again. It is not dumb. Why is batch turnaround notoriously bad, and timesharing turnaround almost unfailingly good?

We asked this question, with this background, of several experienced software professionals. They answered, "Because timesharing users will not tolerate bad turnaround."

This is a sociological answer, not a technical one. The technology of software may have developed the timesharing system as a problem solution, this answer says, but in the long term it is sociological considerations and not technical ones that determine the success of timesharing. And in this case, the answer says, the sociology favors timesharing.

There is no need to explain why timesharing users will not tolerate bad turnaround. Any software professional who has experienced timesharing knows that the human tolerance level erodes rapidly as the seconds tick by.

There is, perhaps, some need to explain why batch users *will* tolerate bad turnaround. Once a batch user bids his job goodbye at the submittal window, he knows he must begin another activity . . . too much time will pass by (an hour, a day, a week) to sit and wait. Therefore, adding another hour or day to the turnaround is a tolerable annoyance. The batch user tolerates the erosion of his turnaround a percentage at a time.

Since the intolerant timesharing user insists that his turnaround not erode, his computer resources, as a result, evolve to satisfy that requirement.

Tolerance, we are all taught, is a laudable trait, but overdone it can be an affront to common sense.

—Robert L. Glass
Seattle, Washington

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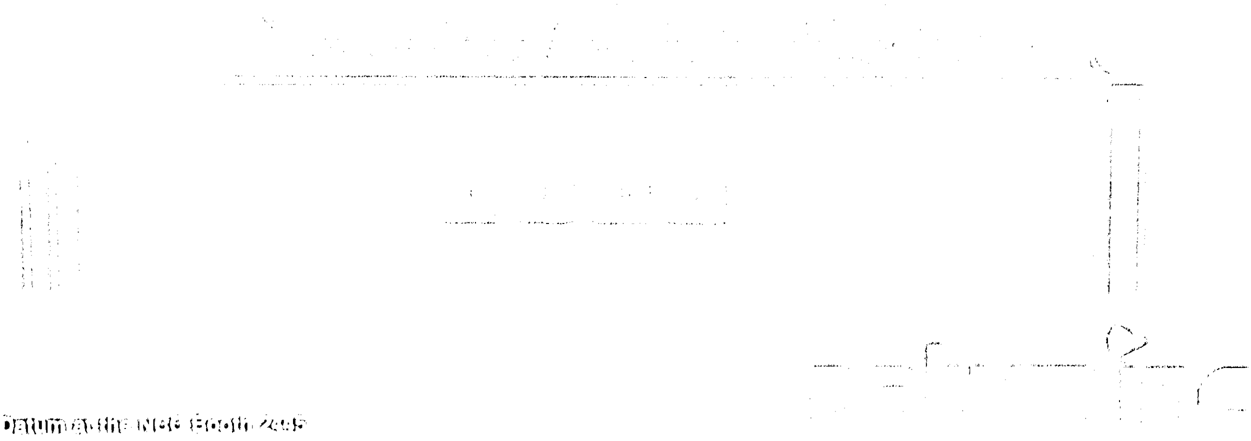

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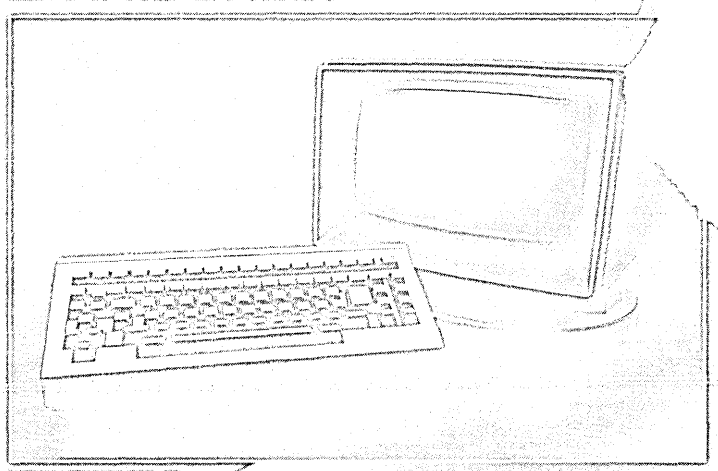

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