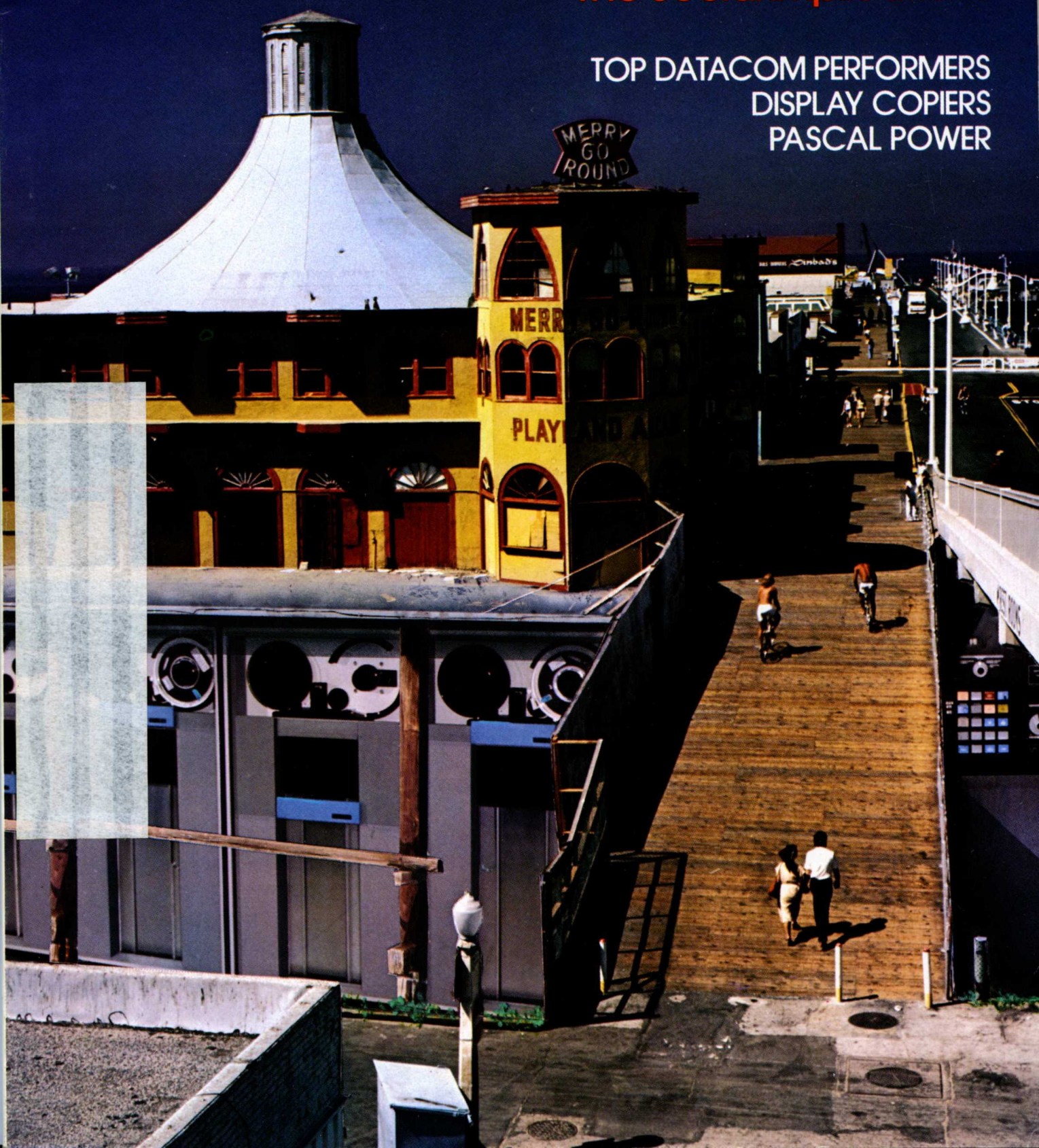
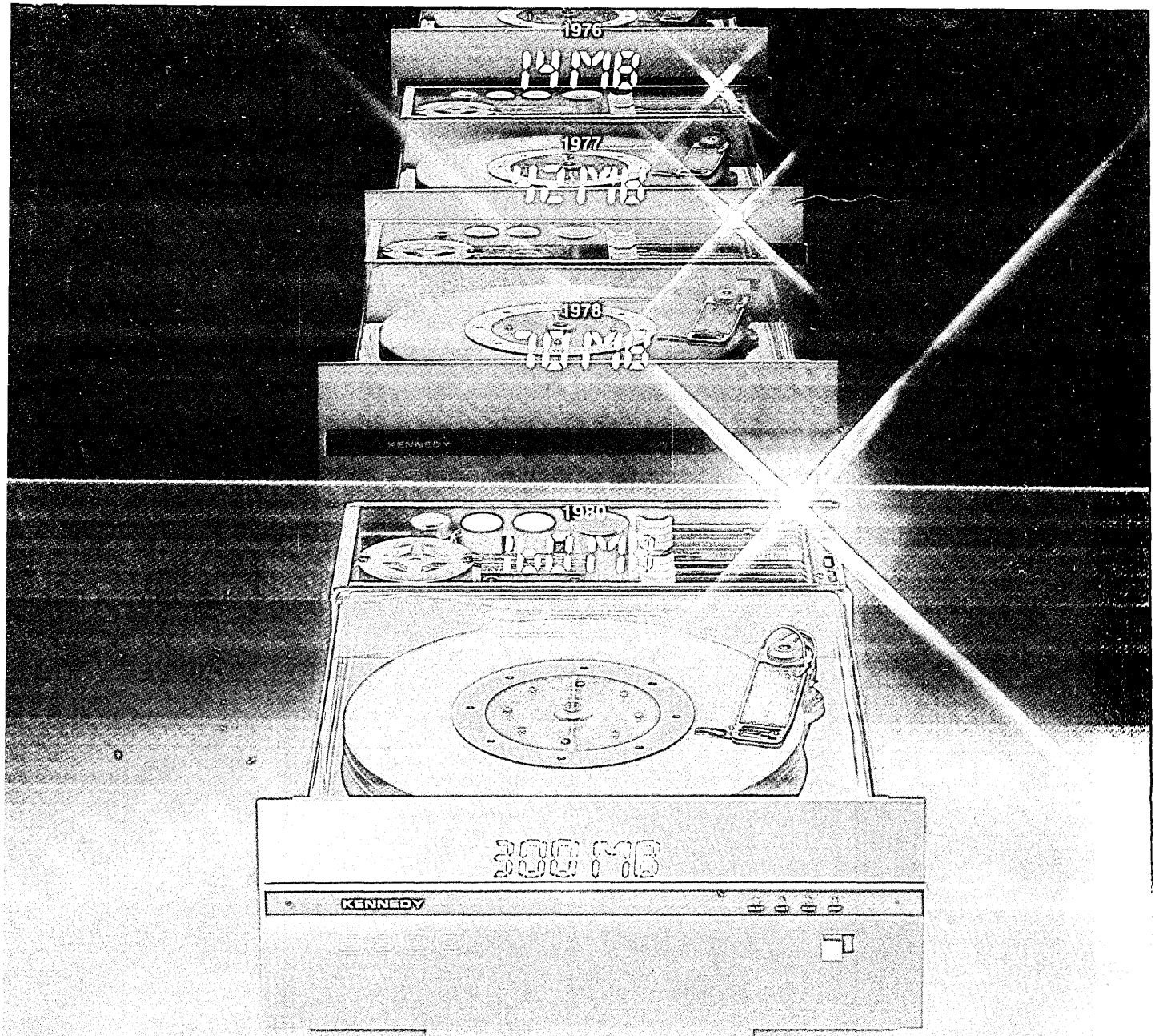
DATAMATION 79®
JULY / 3.00 U.S.A.

BEYOND DP:
The Social Implications

TOP DATACOM PERFORMERS
DISPLAY COPIERS
PASCAL POWER





We've only just begun

TECHNOLOGY

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

GROWTH

KENNEDY—QUALITY—COUNT ON IT

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Heard about this interpositioning thing between **CADO** and **AT&T?**

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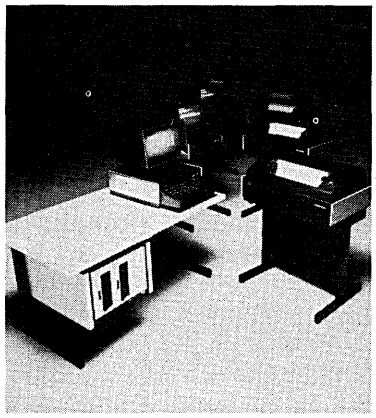
If your application requires word processing with the ability to access data files... and communications... look carefully at AT&T, CADO and interpositioning. Just put your Dataspeed 40* terminals on your phone bill... and let CADO do the rest.



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CIRCLE 103 ON READER CARD

OHIO SCIENTIFIC DOES IT AGAIN

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

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

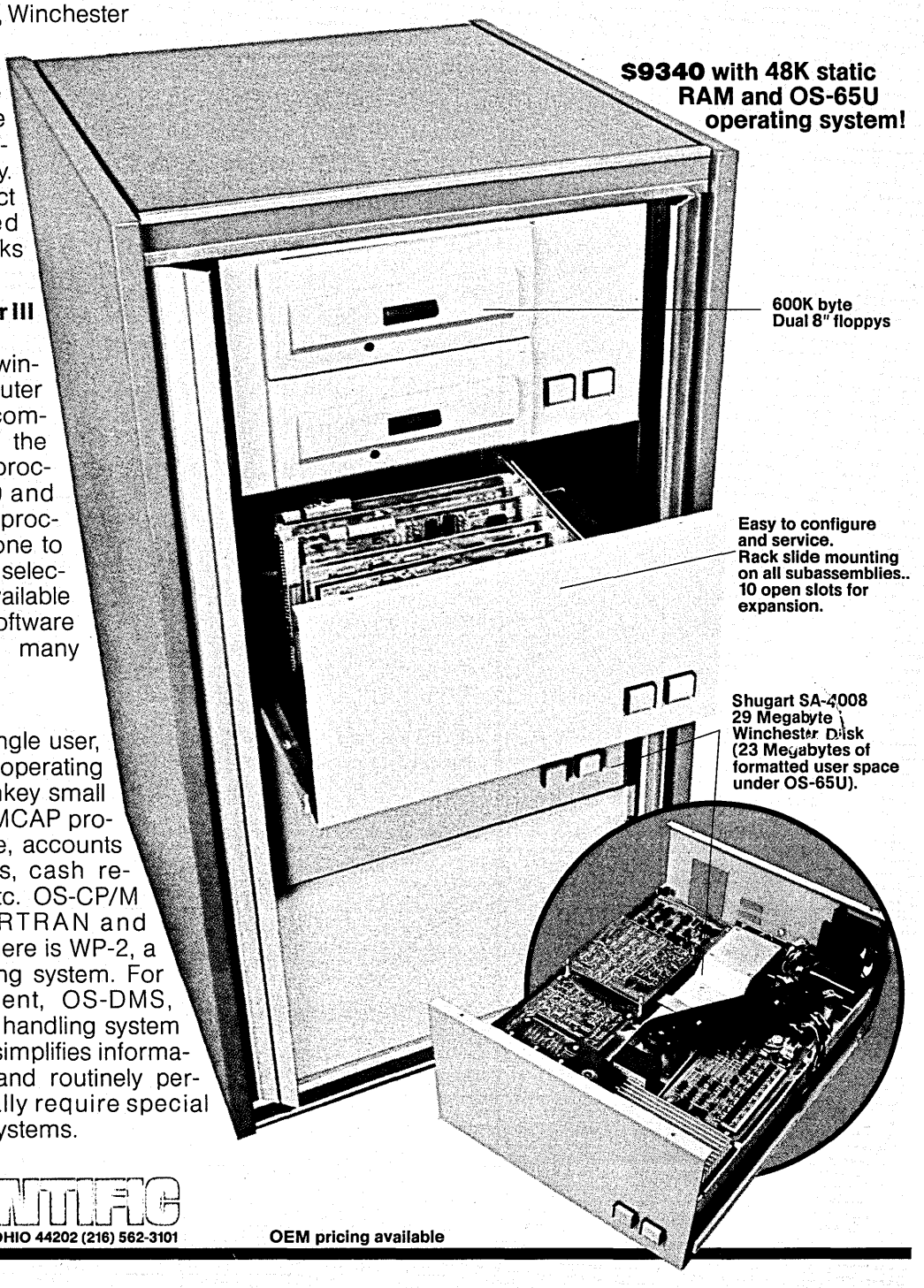
Coupled to the Challenger III Computer
Ohio Scientific's award winning Challenger III computer is a classic. It is the only computer series that utilizes the three most popular microprocessors – 6502A, 68B00 and Z-80. This tremendous processor versatility enables one to utilize a seemingly endless selection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

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

Yields the Microcomputer of the Future
With an eye toward the future, the C3-C, like all other Challenger III's was designed with provisions for future generation 16 bit microprocessors via plug-in options.

There are ten open slots for lots of I/O and multi-user operation. Truly, the Ohio Scientific C3-C is a computer with a future.

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



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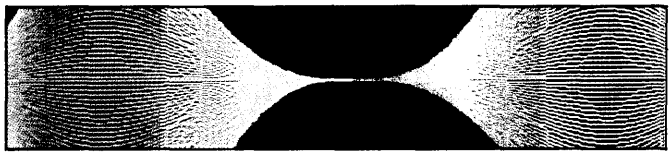
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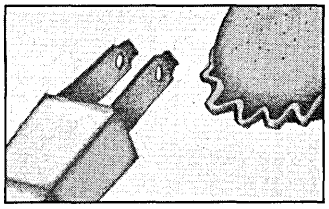
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Nancy Knottek
Price reductions for cpu's and memories, combined with new hardware offerings, spark strong demand for increased systems capacity, DATAMATION survey shows.

98 BEYOND DP: THE SOCIAL IMPLICATIONS
Three scientists from The Rand Corp. discuss with DATAMATION how the industry can take maximum advantage of technological changes.

110 PIECING TOGETHER THE DATACOM INDUSTRY
Richard A. McLaughlin
A first attempt to define and measure the fledgling data communications industry ten years after the FCC's landmark Carterfone decision.

142 PASCAL POWER
Although the language wasn't formally defined until 1971, its simplicity combined with its power for expressing complex algorithms make it a good bet for the future. **Dennis Fletcher** (p. 142) provides perspective from the standpoint of users, vendors and standards; **Robert L. Glass** (p. 146) explains how the Department of Defense is developing a single programming language for the military with Pascal as its base; **Keith Shillington** (p. 151) discusses structure, which he characterizes as the key to Pascal's problem-solving power; and **Marvin Conrad** (p. 153) finds it useful as a high-level language for micros and minis.

159 DISPLAY COPIER SURVEY
Nancy Knottek
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173 THE MICROARCHITECTURE OF UNIVAC'S 1100/60
Introduced last month at the NCC, the new processor contains a "phantom branch" mechanism to avoid lost cycles in its overlapped structure . . . and a good deal more. Design specialists from Sperry Univac explain.

COVER
The computational power and communications resources of computer technology have permeated the underpinnings of our society, but who's paying attention to the potential ramifications? Photography © 1979 by Holly Ahlberg.

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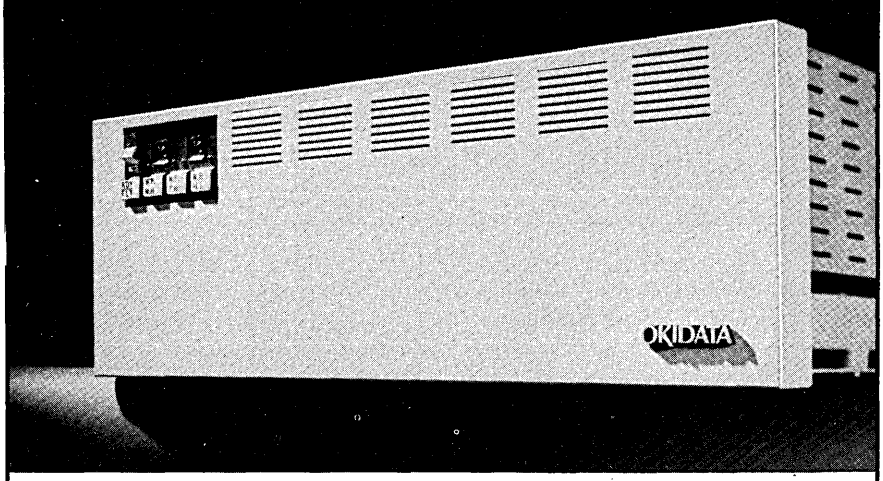
Microprocessor Systems Do More



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At Hewlett-Packard, we've participated in the growth of networking for distributed systems right from the start. So we've had time to iron out a lot of the problems that go with it.

One problem was how to implement a distributed network today without limiting the growth needs of your company tomorrow. The answer: HP's Distributed Systems/1000—an advanced, real-time interactive communications package that you can install today without worrying about what changes the future may bring. DS/1000 gives you full system-to-system communications with the design flexibility to preserve your software investment, as well as accommodate the rapid advancements in computer technologies.

Rings, strings, stars: you name it.

No matter what configuration you need, HP's "layered" software approach lets you structure your network in a way that makes sense for your applications. You can arrange HP 1000 systems in star, ring, or string configurations—or any combination of them. Information passes from one system to another through intervening network nodes on an automatic "store-and-forward" basis without special instructions in your application software. And because you can access any system by simply specifying its node number, you can use the network just as easily from a remote terminal as from a local station.

With DS/1000, you can link workstations within a department as well as connect several departments on the factory floor (incoming inspection, final test, and quality control, for example). Or, you can link local manufacturing divisions to a host IBM mainframe or HP 3000 business system in your corporate EDP center. You can even create a nationwide network to coordinate geographically dispersed information.

All together. Now.

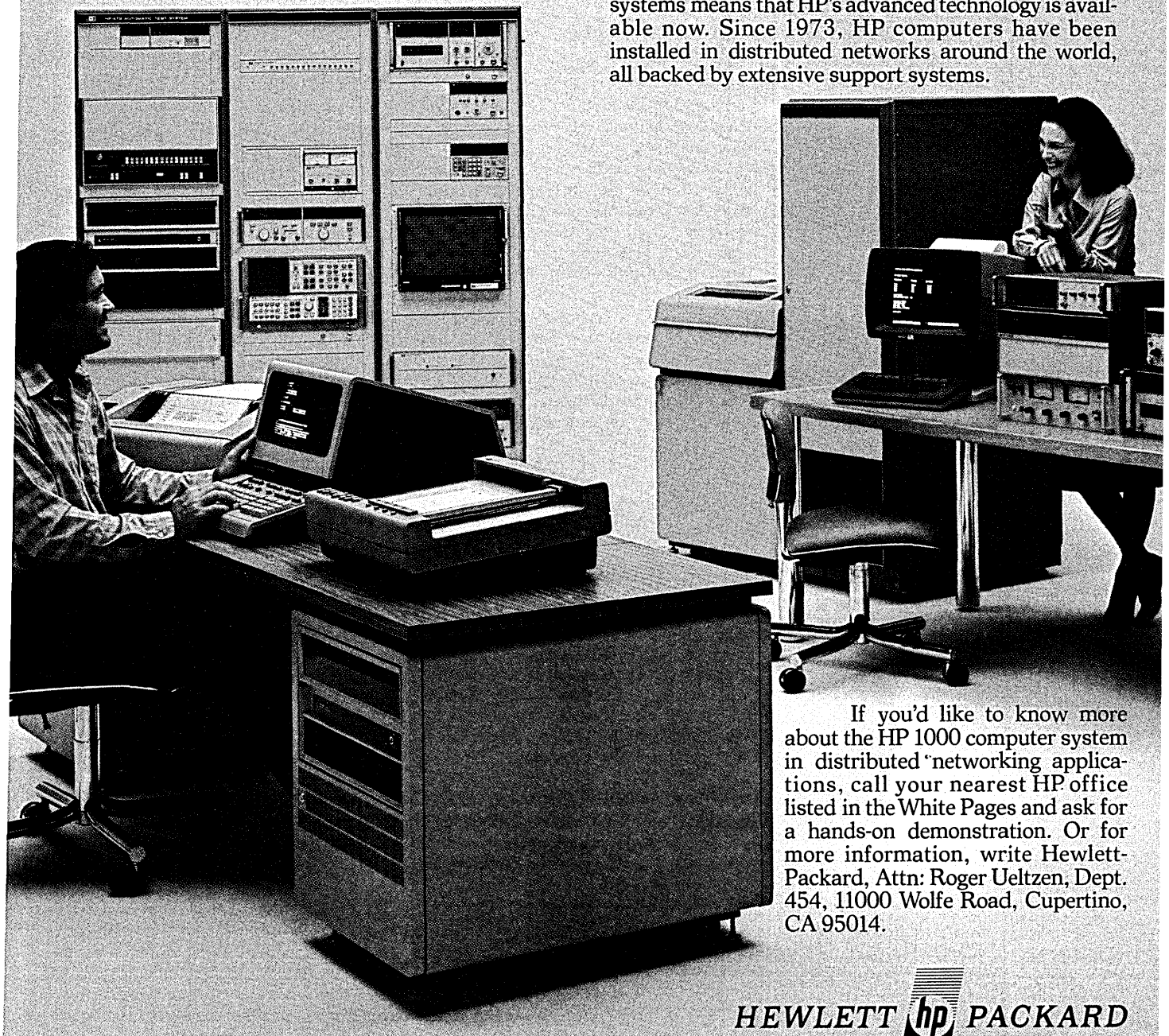
HP has a full range of real-time compatible hardware for implementing distributed computer networks—from terminals and interconnection hardware to sophisticated technical computers. A powerful data base management package with remote

22903HPDS25

network for manufacturers.
Expand tomorrow.

access capabilities will put the information you need right at your fingertips. And the modular software design will assure your orderly growth by allowing you to add to, or reconfigure, your DS/1000 network without affecting your existing programs.

Our long experience as a supplier of distributed systems means that HP's advanced technology is available now. Since 1973, HP computers have been installed in distributed networks around the world, all backed by extensive support systems.



If you'd like to know more about the HP 1000 computer system in distributed networking applications, call your nearest HP office listed in the White Pages and ask for a hands-on demonstration. Or for more information, write Hewlett-Packard, Attn: Roger Ueltzen, Dept. 454, 11000 Wolfe Road, Cupertino, CA 95014.

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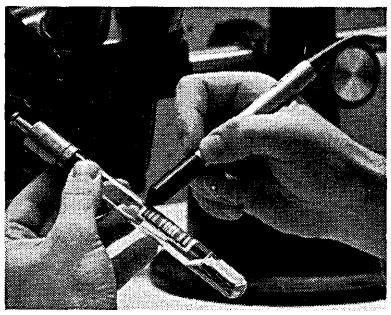

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TWENTY YEARS AGO/TEN YEARS AGO

LOOKING BACK

JULY/AUGUST 1959

"The science of computing has come of global age." That was the message for the dp world in the summer of '59 when the first International Conference on Information Processing (ICIP) was staged in Paris. Sponsored by the United Nations Education & Scientific Organization (UNESCO), the international get-together attracted 1,800 dp delegates from 37 countries. The "epoch-making conference" was also the setting for the birth of the International Federation of Information Processing Societies (IFIPS) which subsequently took over sponsorship of the ICIP conference.

Paris seemed to be the hub of international dp activity in June of 1959, hosting, in addition to the ICIP meeting, an automation exhibition—the International Exhibition of Digital Processing Units. Informally known as Auto Math 59, the exhibition captured a turnout of 10,000. Piquing everyone's interest was the display of Japanese gear, "much of which was seen for the first time in the West."

A report on the worldwide exhibit foreshadowed Japan's high technology spurt. "Key Far Eastern personalities in the computer field claimed," according to the report, "that Japan would soon be able to manufacture a considerable amount of computer equipment at stiffly competitive prices." The report went on to observe ironically that some Japanese equipment "is attempting to penetrate the U.S. market and in fact a few components used in U.S. equipment have been bought in Japan. But it will probably be some time before a real effort is made by the Japanese to invade Western markets."

JULY 1969

Highlights from the Spring Joint Computer Conference (SJCC) reflected the country's growing anti-Vietnam war sentiments. Staged in Boston, the show pulled in around 35,000 people and netted sponsor AFIPS (American Federation of Information Processing Societies) close to $500,000.

"Social consciousness," according to the wrapup story, "was the main thrust of the show." Some conference-goers capitalized on this theme, staging protests against industry and university involvement in the Vietnam war and other military projects. One particularly vocal group, Computer Professionals for Peace, repeatedly disrupted one session, verbalizing their stand and demands by uttering "some obscenities."

The SJCC exhibitor site ironically enough was Boston's War Memorial Auditorium. On hand was a flashier than usual AT&T, which plugged its data handling might with a Huntley-Brinkley act. Advanced Computer Techniques also turned up with a novel attention-getter—a recording a vintage IBM songs sung by the Association of British Secretaries of America.

The free-flowing party atmosphere of the lively SJCC was in sharp contrast to the more sombre yet optimistic mood of an article on the Washington State Penitentiary's edp school. "Learn computer programming and earn an associate's degree in applied sciences while serving time in a maximum security prison," quipped author and inmate Gordon Graham. Serving a 10-year sentence at the Walla Walla, Wash., penitentiary, Graham proudly pointed out that the dp school behind bars, which opened in 1967 under federal and state funds, had turned out paroled graduates who had gotten jobs with various state agencies and private sector companies. Penitentiary school instructor William Painter gave this advice to his inmate students: "You have to be better than men graduating from schools in a free society because you have one strike against you." ✲

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To appreciate these printers, you have to look behind the styling – at the multiplicity of thoughtful features that make Trimliner printers the industry's most reliable.

Look at the fans, for example. NEC's unique hammer cooling system provides a constant air flow to keep the hardworking hammers ultra-cool. Two additional fans provide constant heat dissipation for the compact microprocessor-based electronics. In printer design, cool means reliable. Which is why the Trimliner family delivers 50% more MTBF than competitive models.

Look at the printer band. It's electron-welded stainless steel. Most band printer bands are heat-welded. They fail more often. In five years of field usage and development, no NEC print band has *ever* failed. That's reliability.

Look at the electronics packaging. Three boards, that's all. And the totally modular electro-mechanical components. They are both designed to deliver a 30-minute MTTR – the industry's best.

Reliability is only part of the NEC Trimliner printer story. Serviceability. Print quality. Extraordinary quietness. And deliverability now. These are some of the other qualities that make Trimliner printers – and NEC's highly successful Spinwriter™ character printers – the ones to add to your system.

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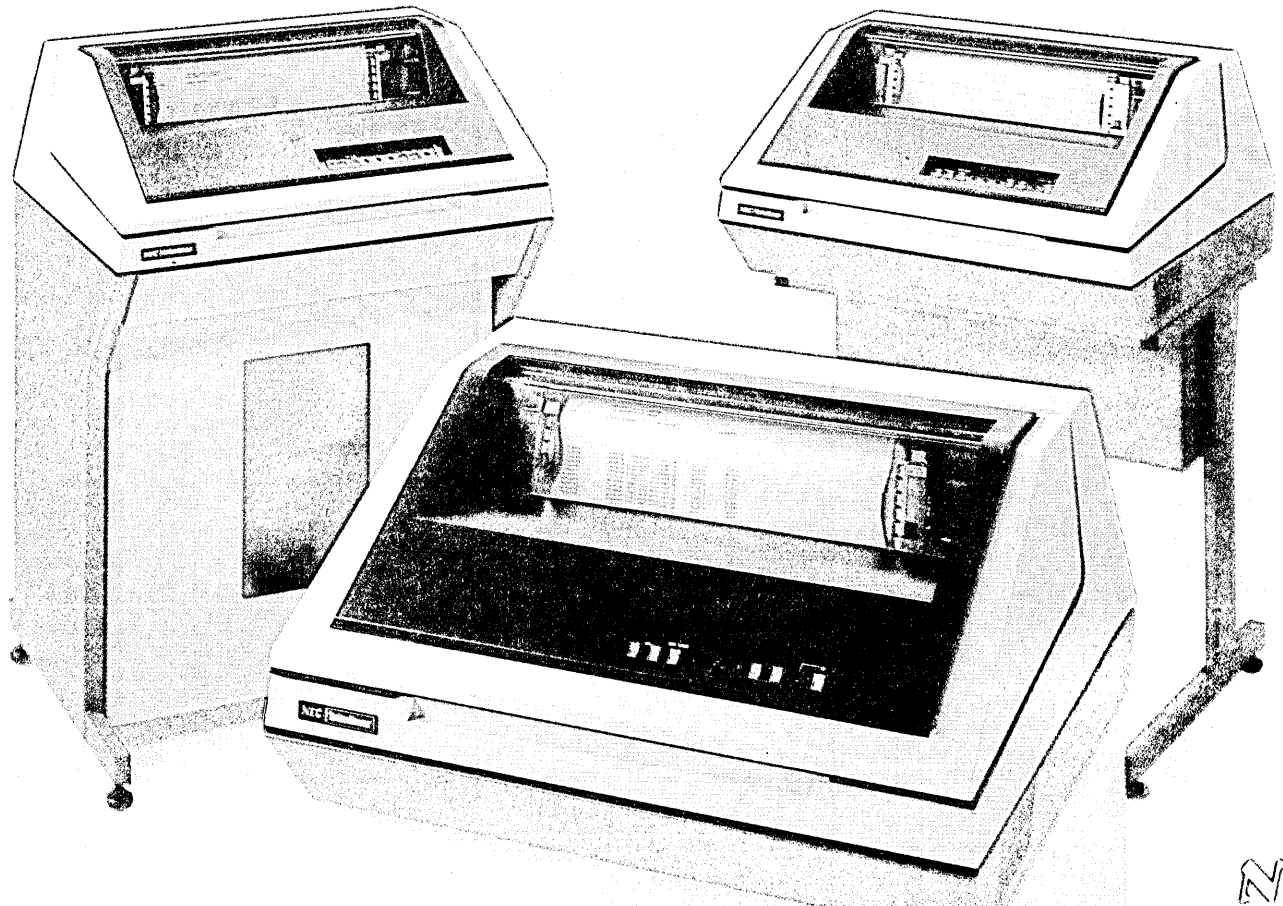

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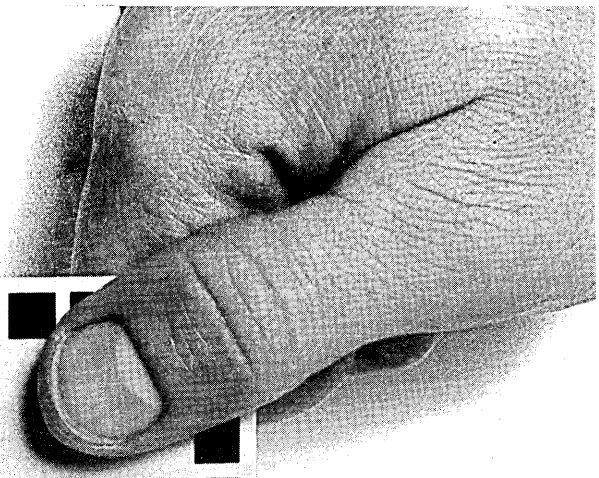

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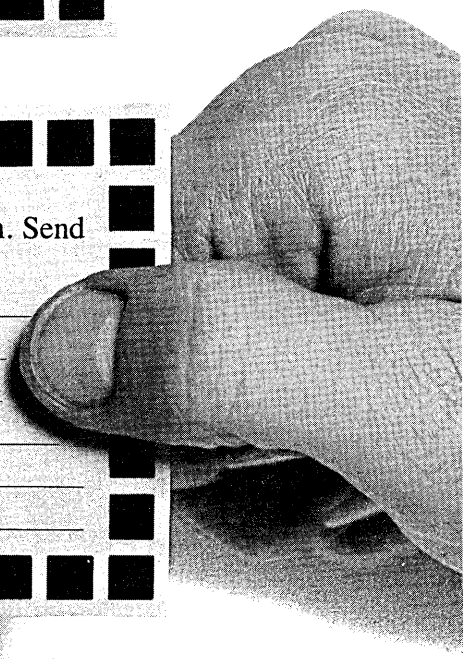

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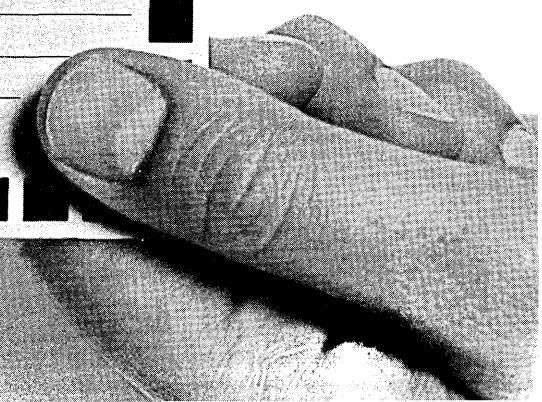
State_____ Zip_____



I understand ECLIPSE Data Systems are part of the broadest line of COBOL-compatible business systems available, and are supported by an exclusive Advanced Operating System (AOS), a full range of languages, and software tools. Please send me the complete details.

Name_____ Title_____

Company_____ Tel._____

Address_____ City_____

State_____ Zip_____

Data General

Mail to Data General Corporation, Westboro, Mass. 01581.

D779

CIRCLE 15 ON READER CARD

INTRODUCING ENVAX™ 1000

BRINGING TOMORROW'S COMPUTER AND COMMUNICATIONS TECHNOLOGIES INTO TODAY'S TERMINAL

EN-VAX:
EN: org. en-voy — a courier extraordinaire
VA: Vardon & Associates
X: abbrev: transmission ex: x-mit

ENVAX 1000 brings the office of the future to the office of today. Vardon & Associates has listened carefully to what others have been saying and writing about the requirements of the future. We have designed, tested and are now manufacturing **ENVAX 1000**, a versatile, flexible multifunctional system, which fits any office environment, regardless of size. Whether your business has a single typewriter, Telex, or multiple terminal network, **ENVAX** can expand your capabilities and improve your efficiency at costs you'll find hard to believe.

TERMINAL SELECTION

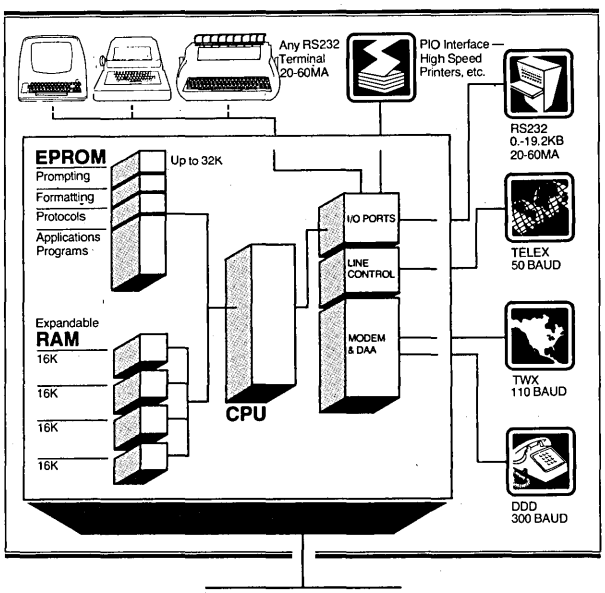
ENVAX accepts any nonintelligent RS232 terminal and provides it with the exact amount of intelligence required for the end user. This design concept allows each individual user to select the capabilities necessary for his job without the additional expense for unused and unwanted terminal features.

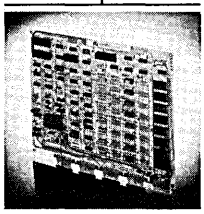
PROGRAMMING

Programming for **ENVAX** is contained in PROM of which up to 32K is available in the Series 1000. A utility package allowing simple conversational dialogue between operator and **ENVAX** comes standard with the system. This standard utility program is activated by a few easy-to-learn commands.

Formatting
Repetitive or frequently used message formats are preprogrammed in **ENVAX** to speed up operations and reduce errors.

Operator Prompting
ENVAX communicates with the operator to insure accuracy while preparing messages.





Text Editing
Full text editing capabilities allow search, insertion, and deletion at the line, word or character level.

Versatility
ENVAX fits almost any environment to function in distributed data, R.J.E., word processing or stand-alone terminal arrangements.

TELECOMMUNICATIONS FEATURES

Four I/O ports are available for communicating; public and private network capability; **ENVAX** connects direct to Telex, TWX, DDD or private line networks providing speed and language conversion under microprocessor control.

Protocol and/or Code Selection
Any private line protocol such as 81D1, 83B3, 8A1, 85A1, 3275, etc., and codes Baudot, ASCII, and EBDIC are possible with ENVAX.

Multimessage Formatting
Multiple messages may be prepared and recalled when ready for transmission.

Send/Receive Buffer
Traffic received while preparing messages in the edit mode are held in the receive buffer for later display or printout.

Auto Dial
Numbers are automatically dialed and retried up to nine times in the event the called number is busy.

Standard TELEX and TWX Functions
X-on, X-off, answerback, polling, etc., are standard with **ENVAX**.

Time and Date Insertion
Real time clock keeps track of time and date for automatic insertion at end of message.

HARDWARE FEATURES

RAM
16K to 64K of Random Access Memory available in a variety of divisions between send and receive buffers.

Modems
On-board originate/auto answer modems and DAA's require only an RJ45S jack plug for TWX and DDD connections.

Nonvolatile Memory
Battery backup retains information in memory for one hour standard. Longer BBU times available upon request.

PIO Port
Parallel interface adapter for Daisey Chain and/or other peripherals.

Diagnostics
Built-in diagnostics test all hardware components.

Technical Assistance Brokers (TAB)

Technical Assistance Brokers (T.A.B.), a division of Vardon & Associates, Inc. provides nationwide service and maintenance to over 14,000 leased/customer owned terminals in over 450 cities through the resources of over 1500 authorized service centers.

An on-line data base system provides current information on customer's equipment configuration, constant monitoring of dispatched calls to customer sites, service history and records for immediate response to any of your **ENVAX** system questions.

For tomorrow's system today call:
800-527-7700 or 214/252-7502

ENVAX trademarked by Vardon & Associates, Inc.

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vardon & associates, inc.

A Subsidiary of Pioneer Texas Corporation

930 N. Beltline, Irving, Texas 75061 In Texas: 214/252-7502 Outside Texas: 800/527-7700 TWX: 910-860-5761 Telex: 730022

Sales Offices: Dallas/Houston/Atlanta/Philadelphia/New York/Detroit/Chicago/Los Angeles/Cleveland

CIRCLE 57 ON READER CARD

THE OBVIOUS ANSWER WILL COST YOU.

A traditional fixed channel hardwired multiplexer is the obvious way to handle several asynchronous terminals on a single line. It's obvious, and highly inefficient. It will cost you more, every month.

At General DataComm, we go beyond the obvious. Our microprocessor based TDM1240 statistical multiplexer far surpasses traditional multiplexing. Doubling, tripling, even quadrupling multiplexer efficiency. It will save you more, every month.

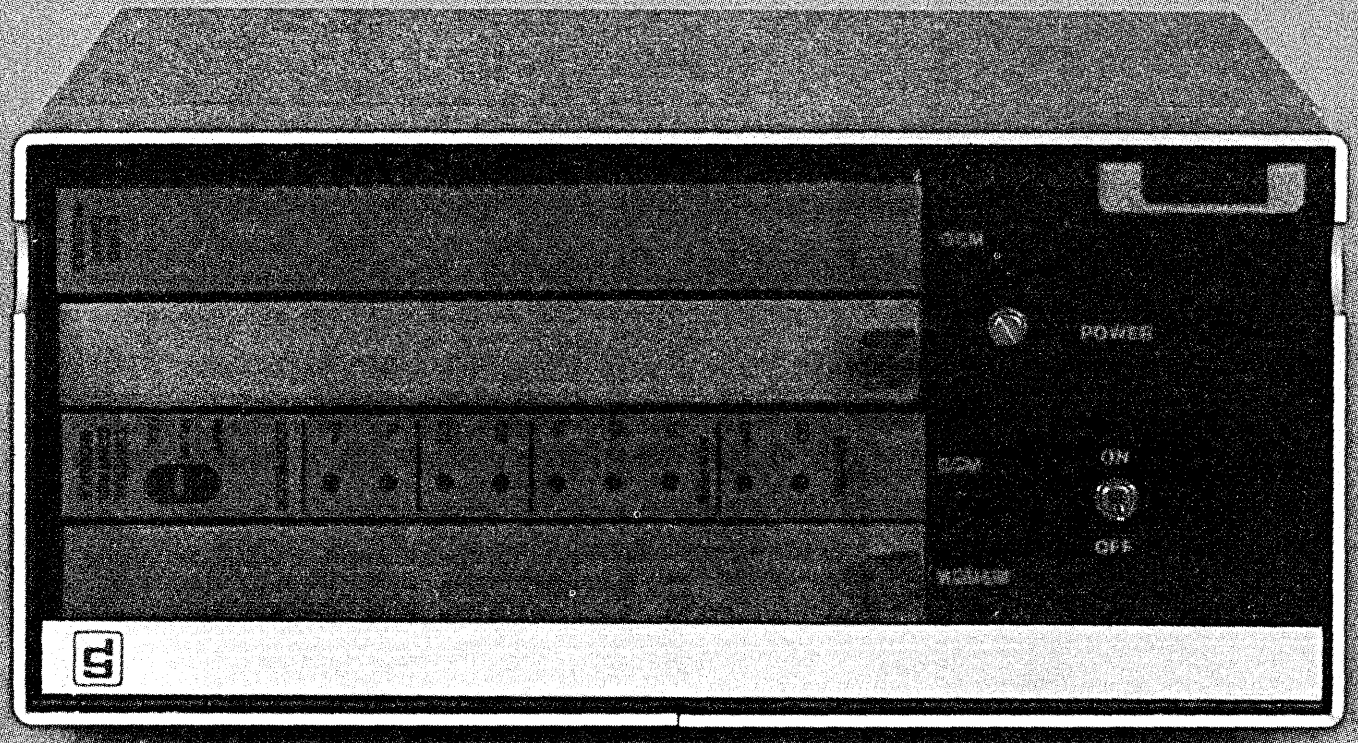
The TDM1240 uses advanced microprocessor techniques to dynamically regulate the data flow according to the load on each of the four channels. With buffer storage to accommodate temporary peak loading.

This unique concept in data management achieves an unsurpassed combination of reliability, performance, efficiency, and economy. The TDM is compact and easy to install, without any modification of existing hardware or software.

The TDM1240 and its big brother, the 16 channel TDM1241. Examples of the innovative product line that makes GDC the unquestioned leader in data communications.

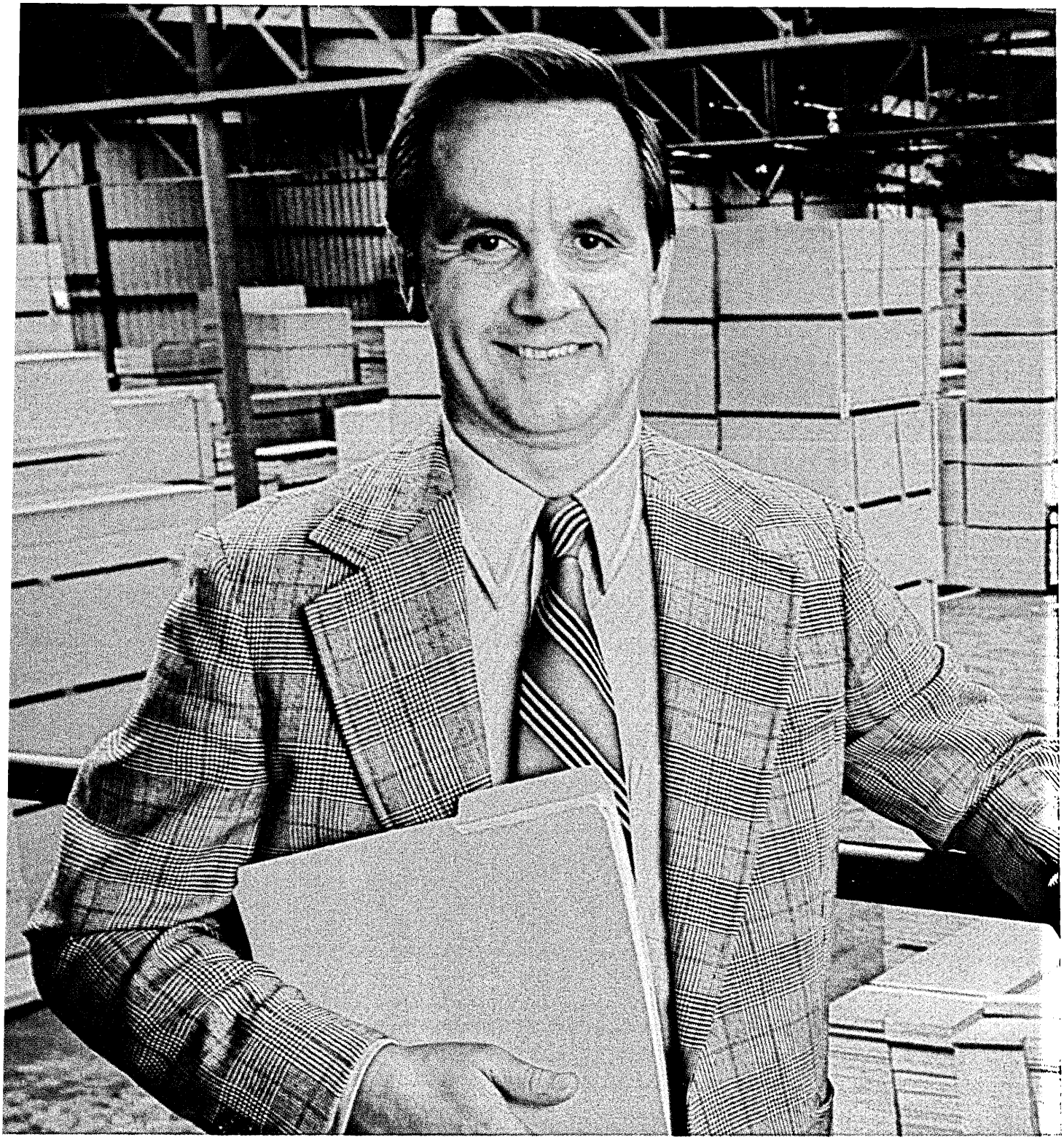
When the obvious answer will cost you more, we'll cost you less. Contact:

General DataComm Industries, Inc.,
One Kennedy Avenue,
Danbury, CT 06810.
(203) 797-0711.



The TDM1240 microprocessor based statistical multiplexer.

CIRCLE 29 ON READER CARD



"By putting the IBM Series/1 where our people are, we're giving them local control of their operations that they couldn't get through our central computers alone," says Paul Pavloff of Champion International, a major producer of building materials, papers and paper packaging.

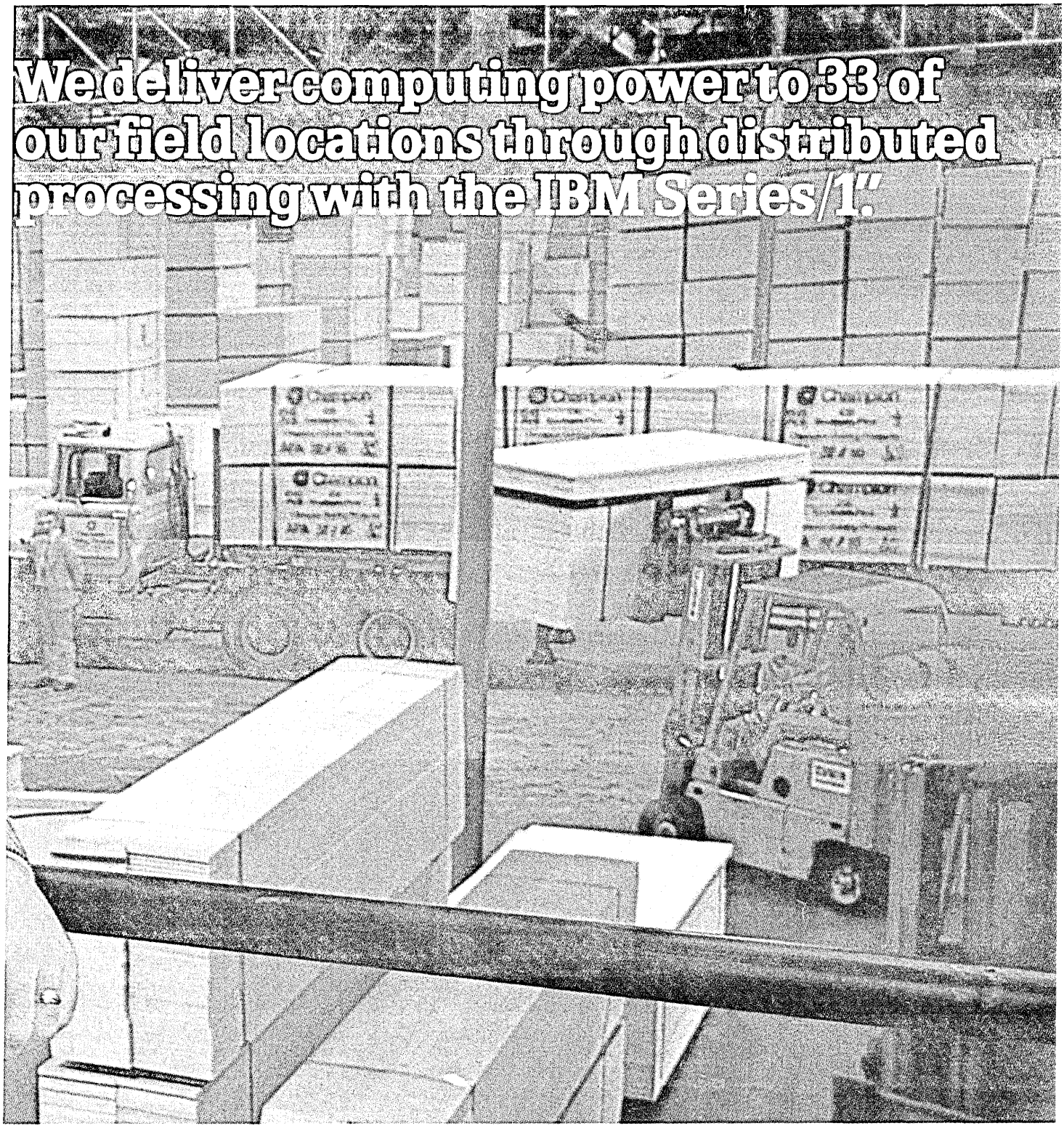
"Thirty-three Champion distribution centers now have their own Series/1 for such functions as order entry, invoicing and inventory control," he continues. "At night, each Series/1 transmits consolidated data to our large IBM computers for timely management use. And they're helping us plug profit leaks through better control of inventories and complicated pricing schedules.

"All in all, our Series/1 units start to pay for themselves from the day they go on line. By 1980, we expect to equip over 150 field locations with them."

To achieve full distributed processing capability at so many remote locations and integrate those stations with the central computer, Champion developed its own versatile data management system, including a unique programming language.

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

We deliver computing power to 33 of our field locations through distributed processing with the IBM Series/1."



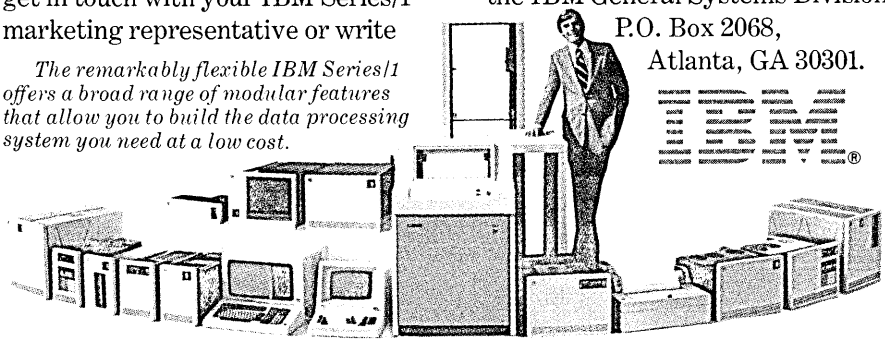
Paul Pavloff, Vice President, Management Information Systems, Champion International Corporation

nal and central information processing. It features online capability so that information is available to you at any terminal just as quickly as it's processed. And because it's modular, Series/1 is ready to grow when you are.

What's more, Series/1 is supported by an extensive service organization that enables IBM to respond promptly to your service needs, even in remote areas.

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

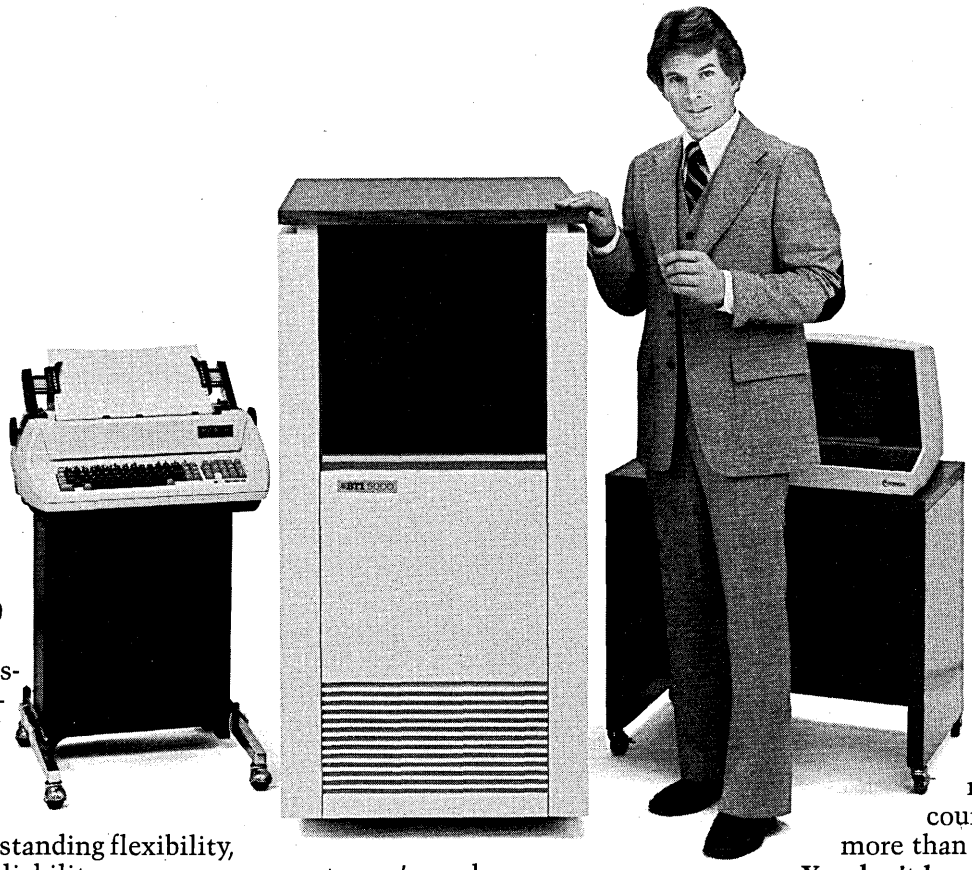
The remarkably flexible IBM Series/1 offers a broad range of modular features that allow you to build the data processing system you need at a low cost.



IBM®

A small computer can make a big difference.

BTI HAS THE OEM'S KEY TO TURNKEY SYSTEMS.



The BTI 5000 Interactive Computer System. A multi-terminal system offering large storage capacity, fast response, outstanding flexibility, and proven reliability.

All at a very affordable price. For just $38,950 you get a ready-to-go system with 29 megabytes of on-line storage, magnetic tape cartridge back-up, and eight user ports. Or, for just $2,000 more you get a 58 megabyte system.

There's a very aggressive discount structure. For example, 30% in a quantity of only 10, giving you the profit margin you need.

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

It's easy to program... BASIC-X, the 5000's very extended version of BASIC, has the advanced language facilities and interactive debugging aids to accelerate development of your application programs, so you get your product to market faster.

Your software is protected. BTI's unique "proprietary account" feature lets you install guarded programs on the systems you sell. You never lose control of it.

You can support your software easily. Dial-up access lets you maintain and upgrade your installed software from your office, giving you the freedom to sell over a wide geographic area.

The operating system is solid. BTI's highly reliable timeshare executive has been carefully refined in the course of delivering more than 1000 systems.

You don't have to support the 5000—we do. For almost a decade, we have supported every system we've shipped with our unique dial-up diagnostic service, available 24 hours a day, every day of the year. Now we have computers doing this. Health checks uncover potential problems *before* they cause a system to go down; diagnostic tests are carried out automatically. Our maintenance program works—ask any BTI OEM.

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

BTI COMPUTER SYSTEMS

BTI, 870 W. Maude Ave., Sunnyvale, CA 94086. Sales Offices: Cherry Hill, NJ (609) 662-1122; Boston, MA (617) 843-4700; Minneapolis, MN (612) 854-1122; Chicago, IL (312) 298-1177; St. Louis, MO (314) 878-8110; Dallas, TX (214) 630-2431; Sunnyvale, CA (408) 733-1122, Anaheim, CA (714) 533-7161; United Kingdom; Slough 70044.

CIRCLE 16 ON READER CARD

LOOK AHEAD

ENHANCED SERVICES FROM TELENET

Final approval of the GTE/Telenet merger sparked a full day of celebration among Telenet staff members and it may give users something to cheer about as well. With financial support now assured, insiders feel the packet carrier will get into enhanced services to cement its lead over AT&T's Advanced Communications Service (ACS).

The new offerings being considered include an electronic mail service, and use of packet radio techniques, which could offer an alternative to telephone company local loop facilities.

Although the Federal Communications Commission relaxed some of its original restrictions to the merger, GTE is still barred from Marketing Telenet services while the phone company remains free to talk to potential ACS customers. AT&T has said it is holding off on any ACS selling but "market research" activities are continuing.

The GTE/Telenet relationship is expected to set the pattern for a separate ACS subsidiary of the Bell System. But a subsidiary could be set up only after the FCC finalizes its proposed rules in the second Computer Inquiry, and also gives approval to ACS service to begin. The Inquiry rules will take many months to resolve and AT&T has yet to file a formal ACS application. Meanwhile, Telenet will use its new-found resources to blunt any future competitive impact from Ma Bell.

TERMINALS SHORTAGE

Many expect a component-short terminal industry in the last half of the year, but few distributors have been able to stockpile units to take advantage of the shortage. New products from several vendors have had more than usual startup problems--DEC's LA/34, for instance, has been troubled with faulty power supplies, logic boards and printheads; the corrupted chips of a large batch of VT/100s skewed the whole CRT market; and the LA/120 has had a plague of reportedly minor but incapacitating defects -- and across the industry lead times have been slipping badly. Teletype, for instance, is sold out for 1979 on its hot model 43.

CRIME: HOW TO DO IT

An NCC session on Computer Abuse in Universities drew an unexpected question and an equally unexpected (to the panelists anyway) reaction. The questioner wondered why more universities don't teach courses in penetrating systems. "They could lead to development of really useful designers of reliable software." The comment drew a long round of applause from the audience and a non plus reaction from the panel.

DG BEHIND THE TIMES

Computer-based editing isn't making the inroads in big newspapers that it is with the smaller ones. Latest casualty was an effort by Data General to automate the editing of the nation's third largest consumer daily, the Los Angeles Times. "I think they were trying to develop something they could sell off-the-shelf to other newspapers and we wanted something specifically tailored to our needs," said a Times spokesperson. Another source noted that most efforts at automating editorial

LOOK AHEAD

functions of large papers were "way behind schedule." Data General's efforts with the Times had been on-going for some three years and its contract was valued at approximately $5 million. The Times currently is "talking" with other vendors but is "nowhere near" negotiating stages yet. The Westboro, Mass. mini-maker, which is just beginning to think in terms of applications, won the Times pact against General Automation and System Development Corp. The Times, which has a large complement of IBM equipment, does have automated production of its advertising pages. DG was to have automated its circulation but that went by the boards even before editorial. As for the editorial automation problems, it was mostly a behind-schedule situation, said a company source.

FURTHER SQUEEZE ON DISTRIBUTORS

TI is widely rumored to be planning yet another attack on the independent terminal distributors--even as some of the more financially substantive resellers/lessors bring attorneys in to consider restraint-of-trade suits against the vendor. In February, TI cut off numerous resellers when it formed an authorized distributor network for terminal products.

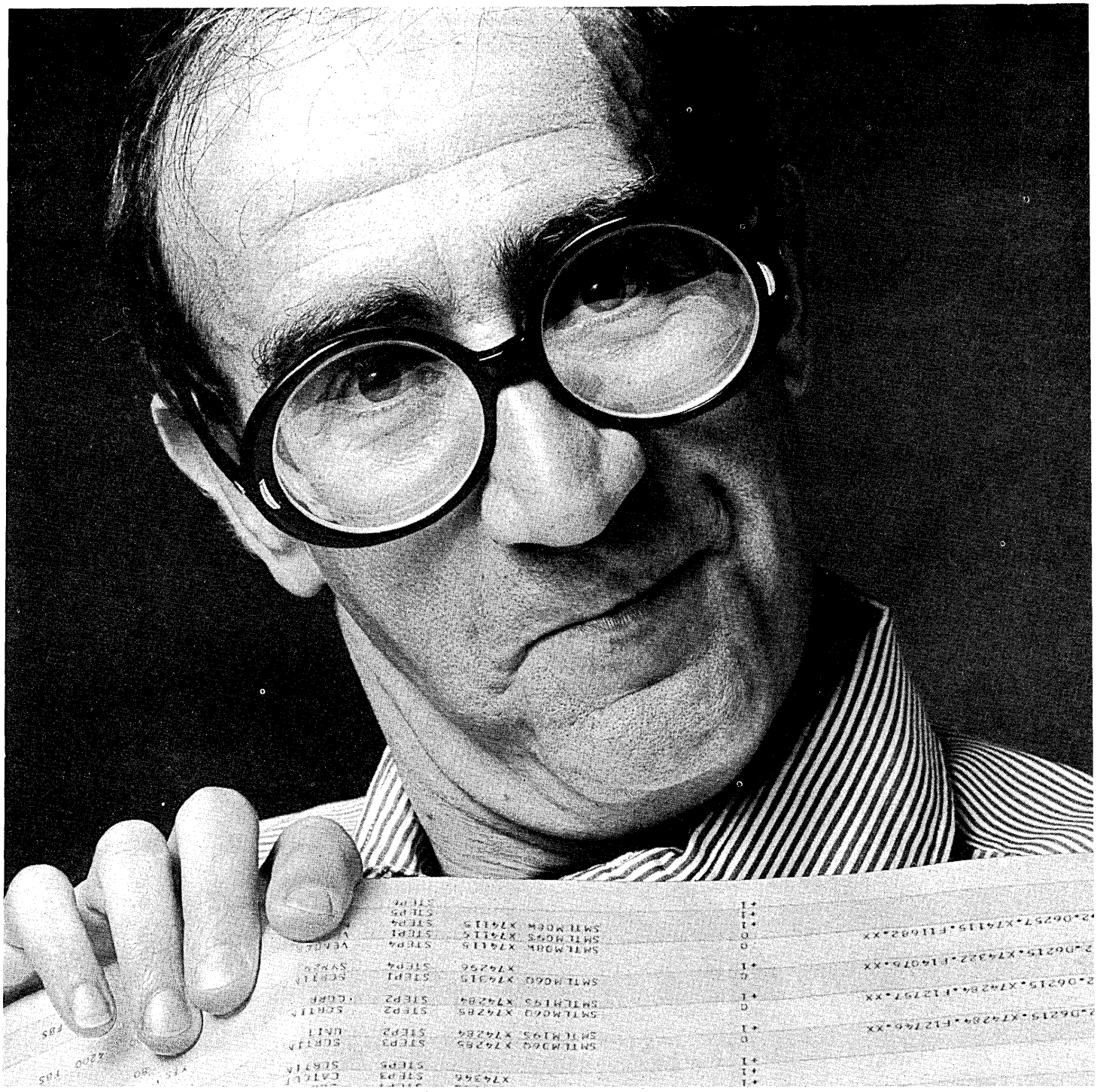
Now, new contract terms and conditions reportedly will require resellers and OEMs to report end user sales back to TI, giving TI considerably more control over the whole marketing chain and allowing the company to starve out unauthorized resellers who have been tiering -- or buying from the anointed few.

COOPERATIVE & INFORMED

The village of Oak Park, Ill. some years ago got involved in a cooperative dp operation that looked good to all concerned from the beginning. But Oak Park has dp knowledgeable citizens. When some of these learned the village was four years behind in collecting fines for parking tickets they formed an "informed citizens advisory committee." The upshot: scrapping of the cooperative deal, acquisition of a package the "citizens" adapted to the village's needs, and the putting of the village's dp onto a time-sharing service.

RUMORS AND RAW RANDOM DATA

Two leading minicomputer manufacturers are having problems bringing new products to the market. Data General is rumored to have abandoned its efforts to come out with a 32-bit machine, while DEC is reported to be experiencing delays in bringing out a smaller, less costly ($40,000 or so) version of the VAX-11/780. Sources say memory board production has been running behind schedule ... Not all shareholders of California Computer Products stock were happy with CalComp's sale to Sanders Associates. Said one, "it was done in a high-handed, hasty way" and we hear Les Kilpatrick, a founder and a principal shareholder, is trying to find a way to reverse the sale...ACM is forming a special interest group (SIG) on office automation, the latest hot button in computer industry trends. Russ Abbott, of California State Univ., Northridge, Calif., says some 250 signatures out of the 300 needed to form the SIG have been collected and the group should be in business in October.



At last. The simple report writer.

We designed our new Answer/2 to be the simplest report writer you can buy.

It's so easy to learn, non-DP people can produce their own reports after just a few hours' training.

It's so easy to use, OS and DOS programmers can retrieve and format data in a fraction of the time conventional methods require.

It's so versatile, it handles repetitive production reporting as easily as the one-time ad hoc report.

All Answer/2 products are moderately priced. And they're backed by the support capabilities of the world's leading independent supplier of computer software.

Before you buy any report writer, just call us. Or attach your business card to the coupon.

It's that simple.

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I want to know more about the *simple* report writer, Answer/2.

☐ Please send me complete information. ☐ Please have a salesman call. D779

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City_____ State_____ Zip_____

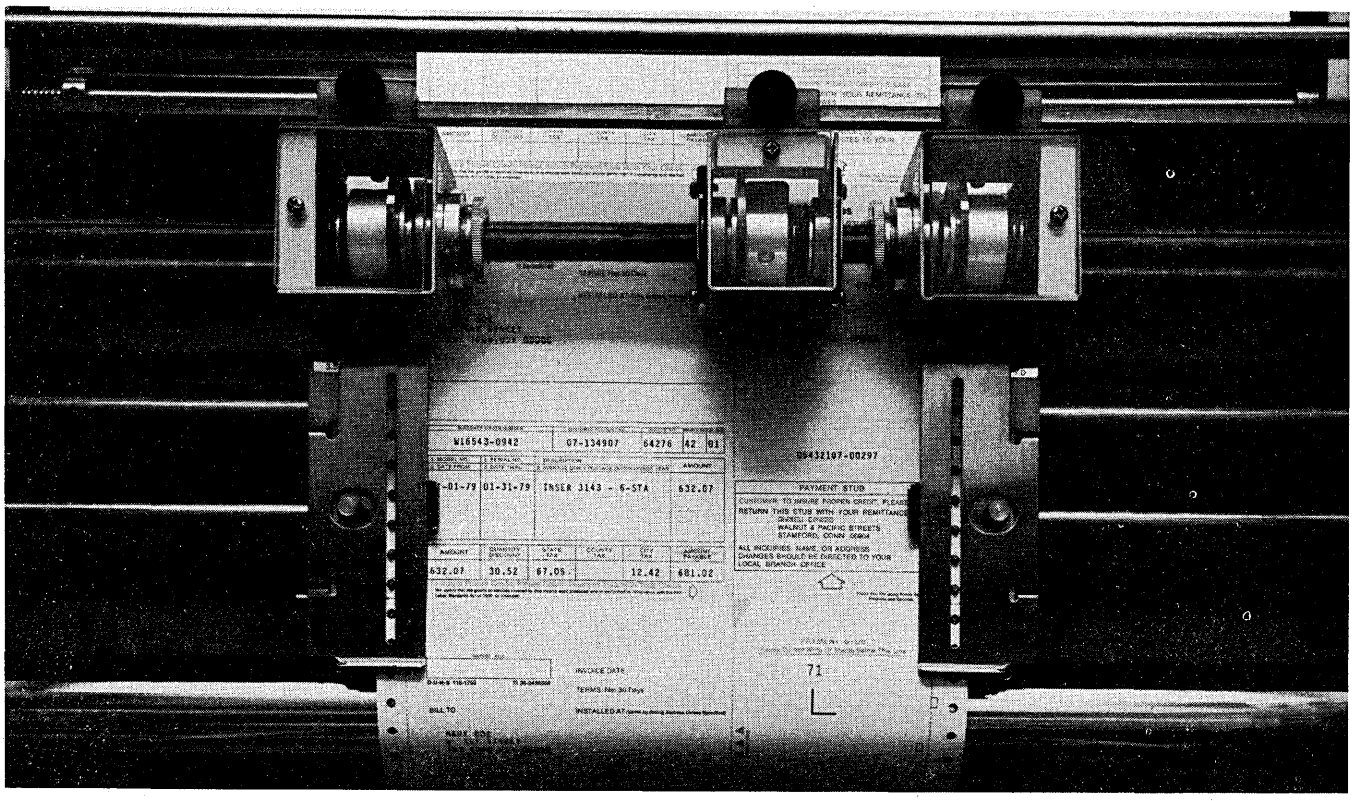
Telephone_____

Computer_____ Operating System_____

Introducing Answer/2 by Informatics.

The Information Management Company

CIRCLE 25 ON READER CARD



Minutes ago these bills were in the computer.

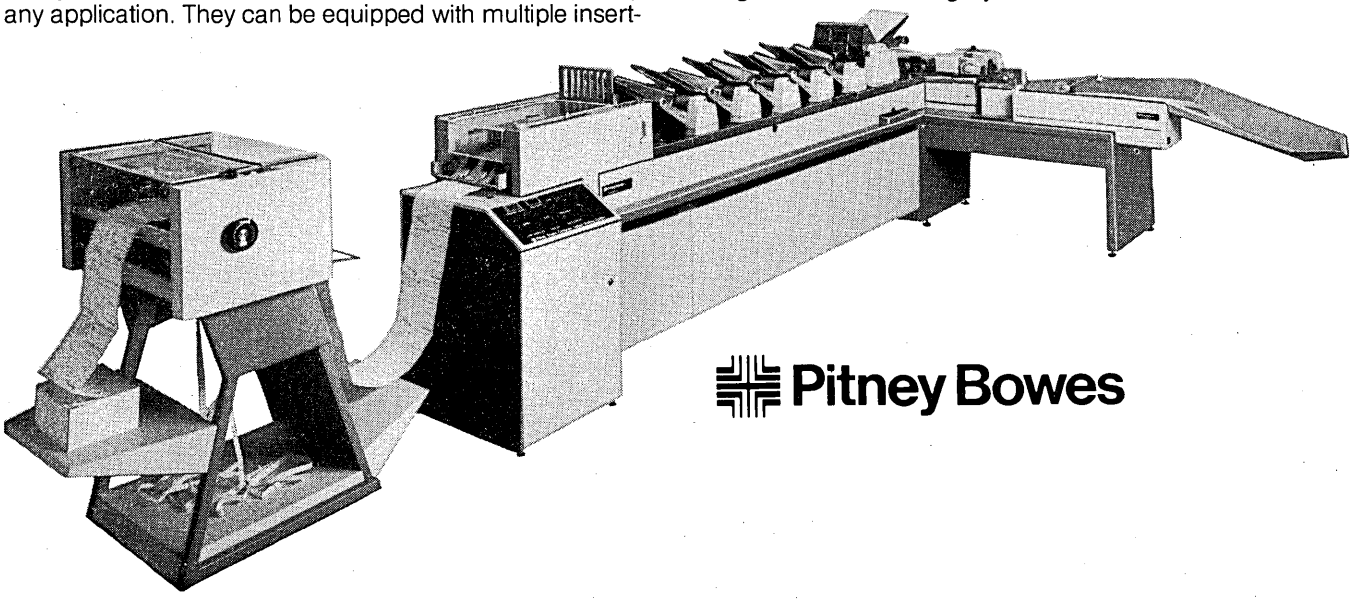
Minutes from now they'll be in the mail.

The Pitney Bowes high-speed Computer Output Mailing System takes over where your computer leaves off. It performs an entire range of forms-processing, inserting and mailing steps in one non-stop sequence, completely eliminating the stop-and-go pace that has previously hampered computer-to-mail operations.

You simply thread your continuous forms web into one end of the system, press a start button and get ready-to-mail envelopes at the other end. Bursting, folding, trimming, slitting and imprinting operations are all performed at web-fast speeds without a single manual interruption.

Systems can be custom-assembled to meet virtually any application. They can be equipped with multiple inserting stations, electronic scanning, document verification, group feeding and selective collating. And thanks to the postal service presort discount and the system's zip code sorting options, you can save 2¢ on every invoice or statement you mail first class. In short, everything you need to add real zip to transactional mailings.

For complete facts and figures, write to Pitney Bowes, 2146 Pacific Street, Stamford, CT 06904. Or call toll free anytime **800-243-5000** (in Conn. **1-800-882-5577**). Over 600 sales and service points throughout the U.S. and Canada. Postage Meters, Mailing Systems, Copiers, Labeling and Price Marking Systems.

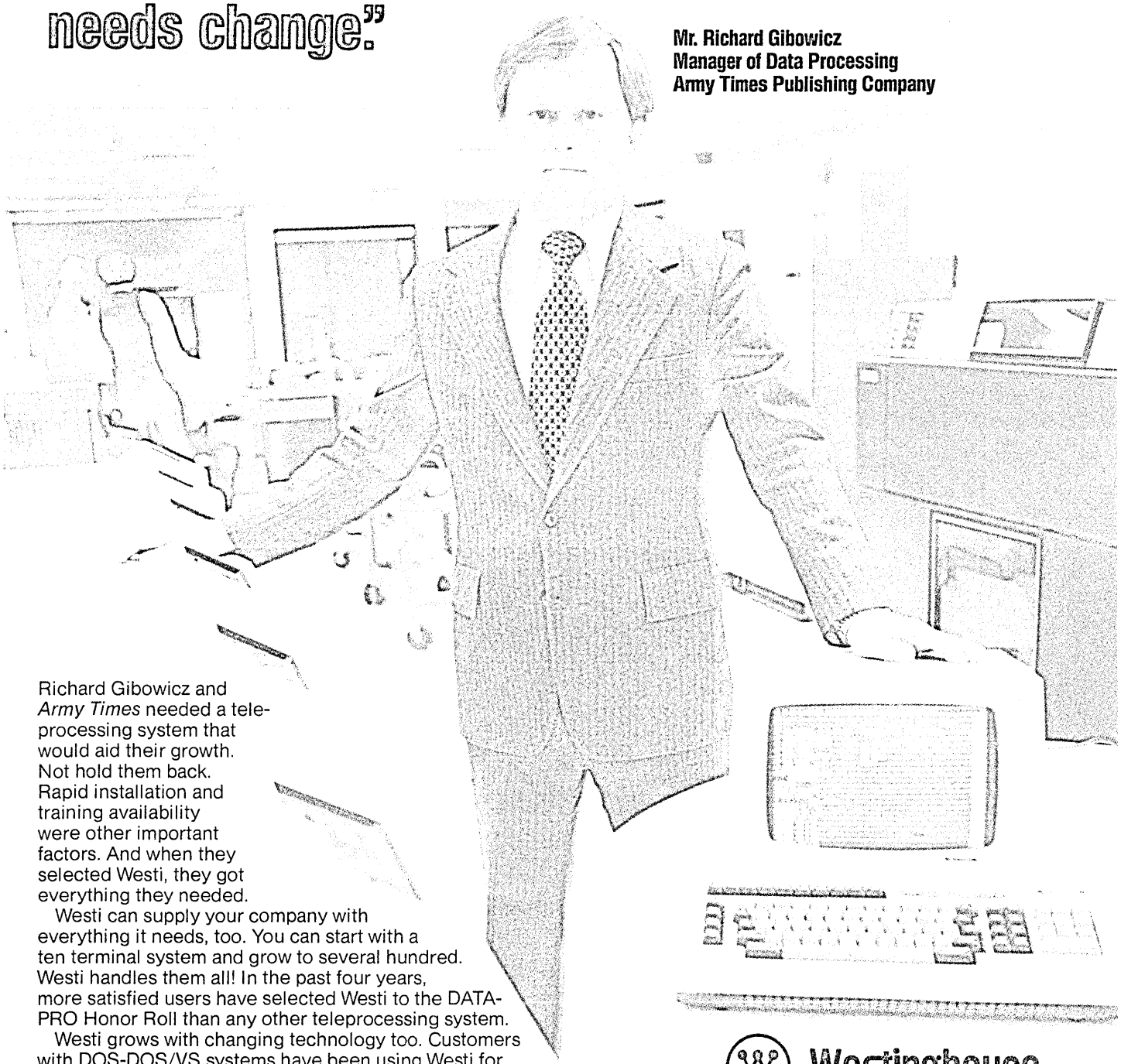


Pitney Bowes

CIRCLE 41 ON READER CARD

"Growth is the biggest single reason we selected the Westi Software System. I know it won't become obsolete as our computer needs change."

Mr. Richard Gibowicz
Manager of Data Processing
Army Times Publishing Company



Richard Gibowicz and *Army Times* needed a teleprocessing system that would aid their growth. Not hold them back. Rapid installation and training availability were other important factors. And when they selected Westi, they got everything they needed.

Westi can supply your company with everything it needs, too. You can start with a ten terminal system and grow to several hundred. Westi handles them all! In the past four years, more satisfied users have selected Westi to the DATA-PRO Honor Roll than any other teleprocessing system.

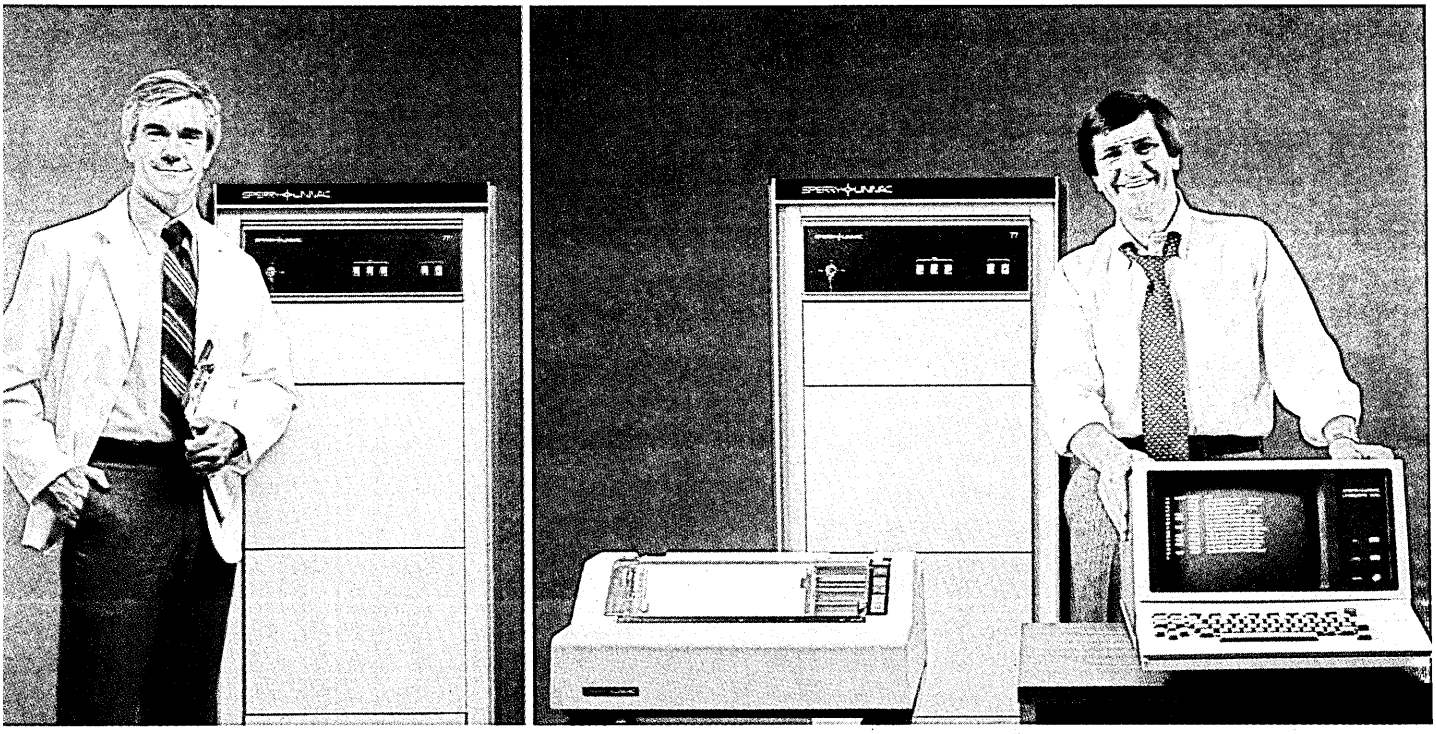
Westi grows with changing technology too. Customers with DOS-DOS/VS systems have been using Westi for years. Right now, we're making sure Westi will be ready for the new DOS/VSE and 4300 series.

Westi even helps your financial growth. It has the best payback in the industry. Most Westi users realize a return on their investment within one year. Plus, with every Westi comes a training and support staff that's unsurpassed. And if you want to increase programmer productivity even more, our on-line programming system, SCEPTER, can maximize your through-put.

Start growing with Westi today. For more information call or write: Westinghouse Electric Corporation, 2040 Ardmore Boulevard, Pittsburgh, Pa. 15221. Telephone: (412) 256-5583.

Westinghouse

CIRCLE 161 ON READER CARD



Introducing the Sperry
Designed exclusively for three

The Sperry Univac V77-800 Miniframe is the newest and most powerful mini we've ever built—a high performance, multi-use, general-purpose minicomputer system designed for both commercial and scientific data processing. It has a memory range from 128K bytes to 2 megabytes (with error correcting memory) and a 150 nanosecond CPU with integrated cache of 1024 bytes. Plus 12K bytes of user programmable writable control store.

There's an optional new high speed 64-bit floating point processor that works in conjunction with a new globally optimized ANS '77 FORTRAN.

No wonder our three most important customers think so highly of it.

OUR OEM CUSTOMERS KNOW WE DESIGNED IT JUST FOR THEM.

The Miniframe is customer microprogrammable. So an OEM can implement his own firmware packages. And with the many software packages we offer, the OEM can add all the bells and whistles he wants.

The Miniframe comes with our largest instruction set ever. So OEM's with their own software have much more flexibility in design.

The Miniframe speaks PASCAL, the powerful new language for scientific, commercial, and system programming that most competitive systems still can't speak. And of course, it also speaks COBOL, FORTRAN and RPGII.

More good news is that the Miniframe is compatible with the rest of the V77 product line.

OUR SYSTEM HOUSE CUSTOMERS KNOW WE DESIGNED IT JUST FOR THEM.

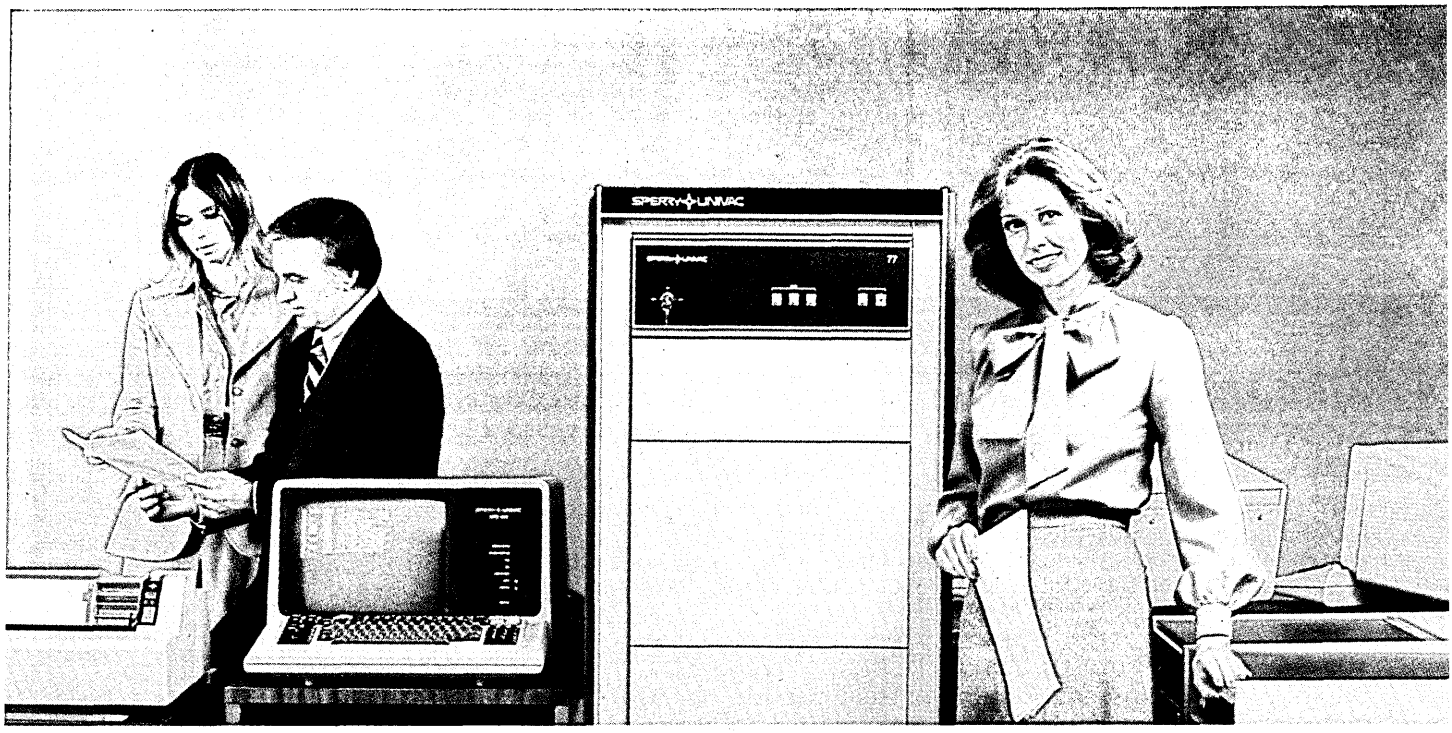
Naturally, system houses want all the features OEM's do. And more.

So we gave them more.

More operating systems, for example. Choose from VORTEX or our new SUMMIT—an interactive, multi-terminal system with transaction processing and data base management. It gives you easy editing, screen formatting, and documentation aids. Plus speedy, comprehensive program development.

System houses also think PASCAL is important. Because it's more efficient, easier to maintain, expand, and modify.

The Miniframe brings systems builders a new query language called QL-77. It features inquire and report facilities. And interfaces



Univac V77-800 Miniframe.
of our very best customers.

directly to TOTAL*, the data base management system. So preprocessing and intermediate handling are a thing of the past. Finally, TOTAL also gives you complete data base access and file access security.

OUR END USER CUSTOMERS KNOW WE DESIGNED IT JUST FOR THEM.

Take all the features we designed in for OEM's and system houses and say ditto for the end user.

But we didn't stop there. We also pressed a few special hot buttons just for end users.

Consider QL-77, for example. End users will love our new query language because it reduces the amount of application programming. By storing query language procedures right in the data base file. Where they can be easily and quickly recalled and executed at any time.

Once again, SUMMIT, our new operating system, helps the end user handle transaction processing. Without any additional, expensive software. It's also the right answer for a multi-tasking, "fully-implemented" distributed processing system.

Finally, the Miniframe supports DCA and conventional protocols. So you can talk to both SPERRY UNIVAC and IBM hosts.

YOU'LL KNOW WE DESIGNED THE MINIFRAME JUST FOR YOU.

No matter what your application, no matter what your need, the Miniframe may just be the answer.

For more information, write to us at Sperry Univac Mini-Computer Operations, 2722 Michelson Drive, Irvine, California 92713. Or call (714) 833-2400, ext. 536.

In Europe, write Headquarters, Mini-Computer Operations, London NW10 8LS, England.

In Canada, write Headquarters, Mini-Computer Operations, 55 City Centre Drive, Mississauga, Ontario, L5B 1M4.

We're Sperry Univac.

And our new Miniframe is going to solve some very big problems.

SPERRY UNIVAC

SPERRY UNIVAC IS A DIVISION OF SPERRY RAND CORPORATION

*TOTAL is a registered trademark of Cincom, Inc.

CALENDAR

AUGUST

SIGGRAPH '79, August 6-10, Chicago.

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

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

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

SEPTEMBER

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

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

COMPCON Fall '79, September 4-7, Washington, D.C.

For more information write COMPCON Fall '79, P.O. Box 639, Silver Spring, MD 20901.

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

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

WESCON '79, September 18-20, San Francisco.

For more information contact Robert Myers, Communications Counsel, 999 N. Sepulveda Blvd., El Segundo, CA 90245 (213) 475-4571.

TELECOM '79, September 20-26, Geneva, Switzerland.

The 3rd World Telecommunications Exhibit. For further information contact TELECON '79, ORGEXPO, 18, quai Ernest-Ansermet, CH-1211 Geneve 4, Suisse (022) 21 95 33.

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

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

Mini/Micro Conference and Exposition, September 25-27, Anaheim.

For further information contact Robert D. Rankin, Managing Director, Mini/Micro Conference and Exposition, 5528 E. La Palma Ave., Suite 1A, Anaheim, CA 92807 (714) 528-2400.

WPOE, September 25-27, San Jose.

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

MIMI '79, September 26-29, Montreal.

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

Northeast Personal and Business Computer Show, September 28-30, Boston.

For further information contact Northeast Exposition, P.O. Box 678, Brookline Village, MA 02147, (617) 522-4467.

OCTOBER

SIGSMALL '79, October 1-3, Dallas.

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

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

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

The Eighth NASTRAN User's Colloquium, October 9-11, Kennedy Space Center, Florida.

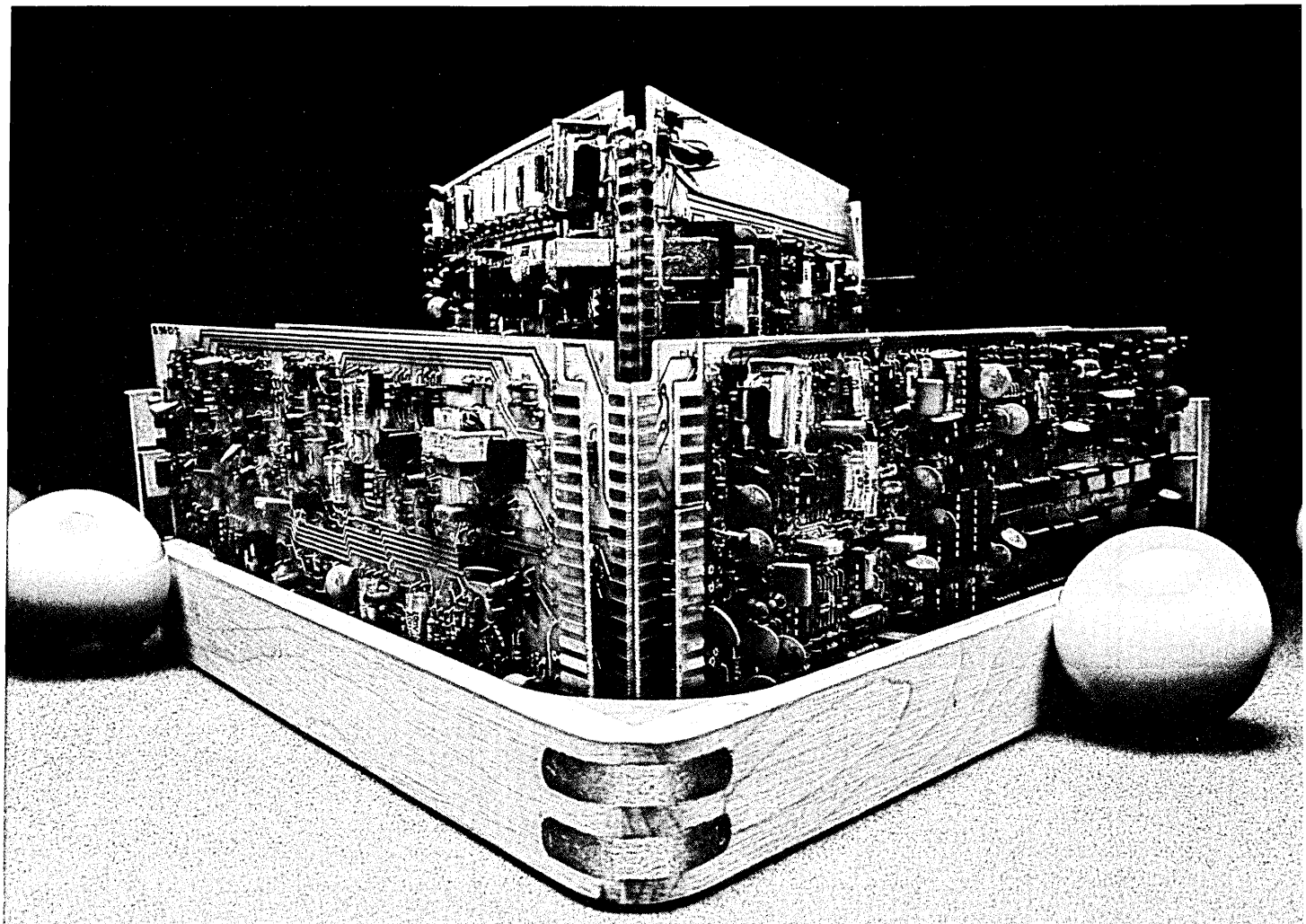
Due to conference facility security all interested persons are required to notify COSMIC of their intention to attend the Colloquim. For further information contact 8th NASTRAN User's Colloquium, COSMIC, 112 Barrow Hall, University of Georgia, Athens, GA 30602, (404) 542-3265.

1979 EMC Symposium, October 9-11, San Diego.

For further information contact Fred Nichols, 1979 IEEE-EMC Symposium, P.O. Box 17510, San Diego, CA 92117 (213) 870-9383.

INFO 79, October 15-18, New York.

The Sixth International Information Management Exposition &



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The RM-8 is the world's only modem package that accommodates up to eight channels of 4800 bps data in only 7" of vertical rack space. Lower speed modems, such as 103s, 201s and 202s may be intermixed with automatic calling units and the 4800 bps 208s.

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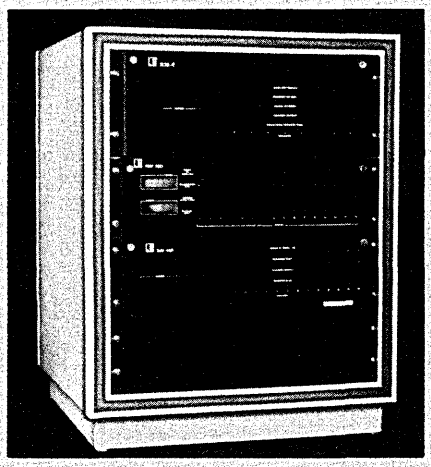

If you select the RM-16D DIRECT CONNECT configuration, you can forget about DAAs. You'll have up to 16 datacomm channels, fully certified for direct connection to the dial-up phone network, in any combination of speed from 300 to 2400 bps.

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CIRCLE 73 ON READER CARD

CALENDAR

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

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

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

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

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

ACM Annual Conference, October 29-31, Detroit.

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

Interface West, October 30-November 1, Anaheim.

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

NOVEMBER

COMPSAC 79, November 5-8, Chicago.

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

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

Over 6,000 people attended last year. Contact the Federal Computer Conference, P.O. 368 Wayland, MA 01778 (617) 358-5181.

Canadian Computer Show, November 13-15, Toronto.

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

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

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

The Third Western Educational Computing Conference, November 15-16, San Francisco.

Sponsored by the California Educational Computing Consortium (CECC). For further information contact Ron Langley, Director, Computer Center, California State University, Long Beach, 1250 Bellflower Blvd., Long Beach CA 90840, (213) 498-5459.

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

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

DECEMBER

Winter Simulation Conference, December 3-5, San Diego.

Cosponsoring WSC 79 are the National Bureau of Standards and six leading organizations sharing an interest in computer simulation. For further information contact Stan Lichtenstein, National Bureau of Standards, Washington, DC 20234, (301) 921-3181.

CALLS

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

Technical papers for the Fifth International Conference on Computer Communications, October 27-30, 1980, in Atlanta, are being solicited for presentation at the regular conference sessions and publication in the official proceedings. The conference will represent an interdisciplinary forum for discussing social, economic, political, and tehcnological implications of computer communications networks. *Six* copies of all materials must be sent by March 1, 1980 to: Dr. J. Salz, Program Chairman, ICCC '80, Bell Laboratories 1G-509, Holmdel, NJ 07733. For further information contact Wayne W. Adams, Sperry Univac C2SE10, P.O. Box 500, Blue Bell, PA 19424 (215) 542-4673. ✲

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Now one company has all the Sycor and Data 100 products to work with. And that broader choice of solutions means a better match for your particular needs. A more comprehensive solution than either company could previously offer.

Today we have more field engineers, in more places, than any comparable company.

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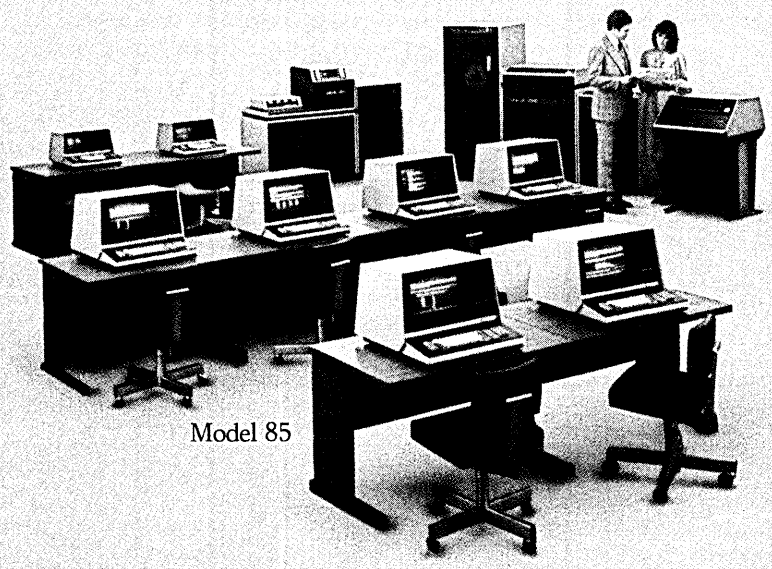
Take a look at the four ways NTSC can answer your data processing needs. For more information about any of them, write Product Marketing, Northern Telecom Systems Corporation, Box 1222, Minneapolis, MN 55440.



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For systems with a lot of throughput, and up to 16 video display work stations, the Model 85 is hard to beat. It has large disk storage capacity and can work with our Remote Job Entry or KEYBATCH® systems.

Our Model 445 is particularly cost-effective for up to eight work stations. Its Omnitask™ operating system can run up to 16 jobs concurrently—in multiple languages.

And our 405 is a most economical way to introduce distributed processing where it's never been before. In most entry level applications, it's all the processing power you need.

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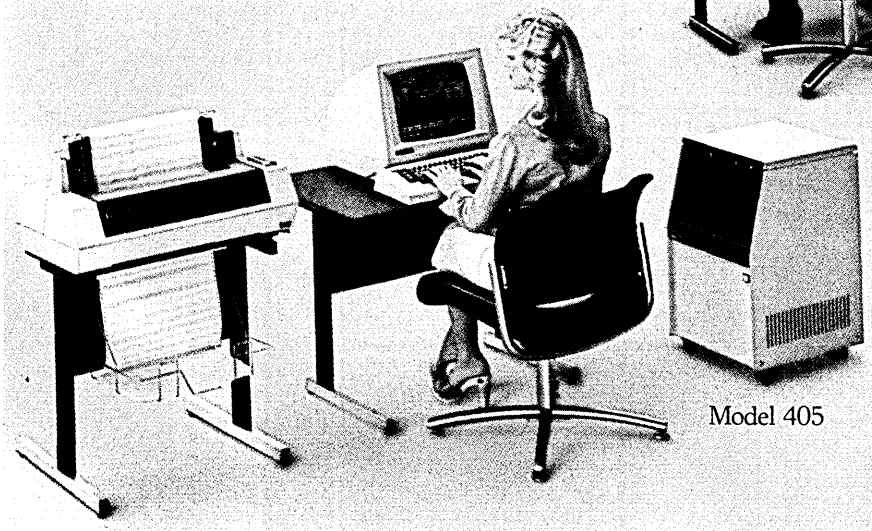

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Use our Keybatch system for key-to-disk, and you won't need additional equipment to communicate with the mainframe. So one system can replace two. Keybatch gives you this twin capability without a big sacrifice in speed. And Keybatch is compatible with all major mainframes.

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

XEROX

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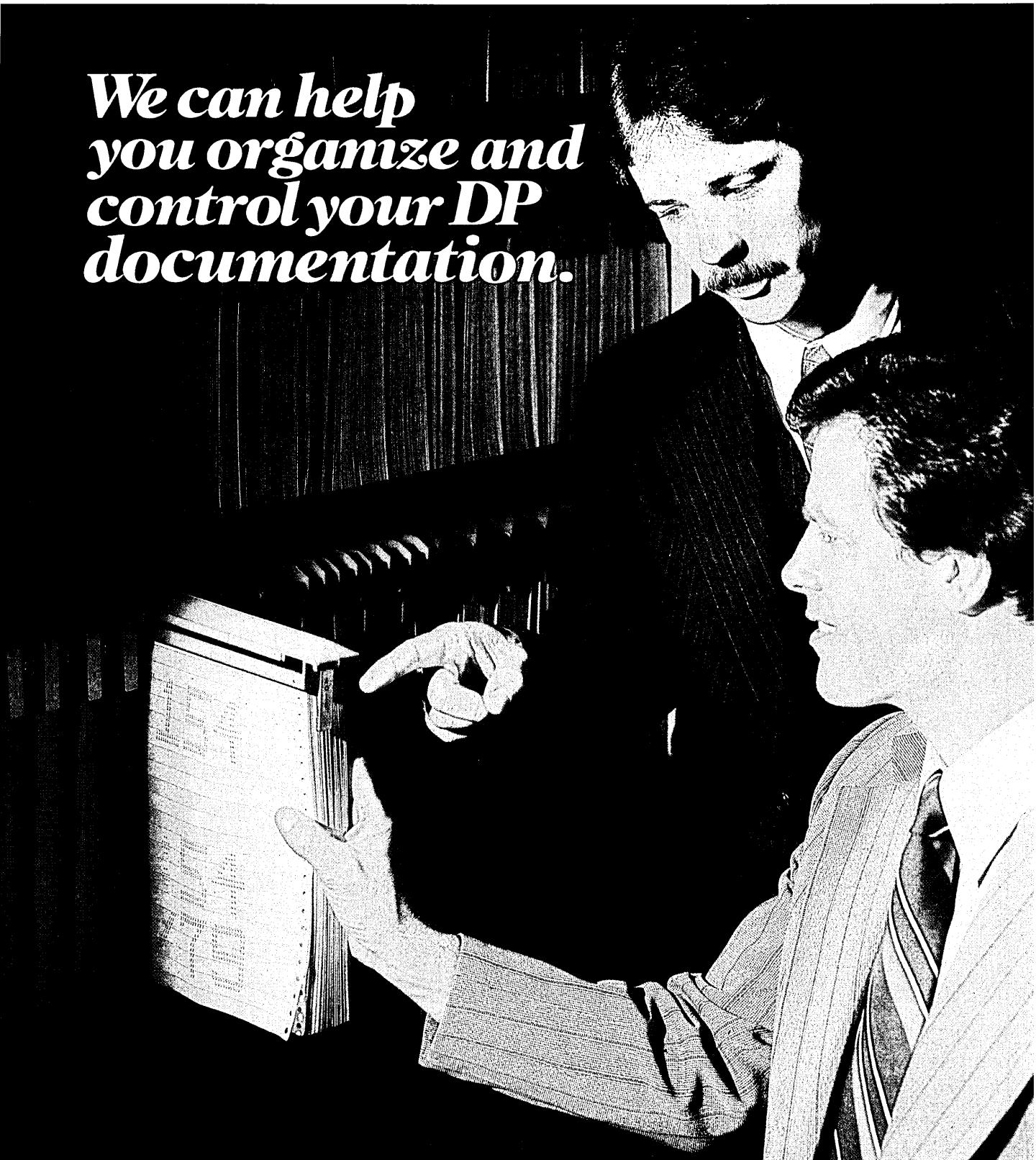

Wright Line men and women understand the problems of data processing documentation. Documentation is expensive to create, is regarded as a corporate asset by auditors but is useless if misplaced, lost or destroyed. As experts in DP filing equipment, Wright Line people can help you establish a Structured Filing™ network for better control and organization of completed and emerging documentation. The key to Structured Filing™ is the proprietary Documate™ System which provides a universal filing method for all sizes and shapes of documentation from cards to print-out.

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If you would like to know more about how the Structured Filing concept and the unique Documate System can help you accomplish better management control and organization of your D.P. documentation, circle the readers' service number or send today for a copy of our booklet "Guidelines for Establishing Structured Filing." Wright Line Inc., 160 Gold Star Boulevard, Worcester, Mass. 01606.

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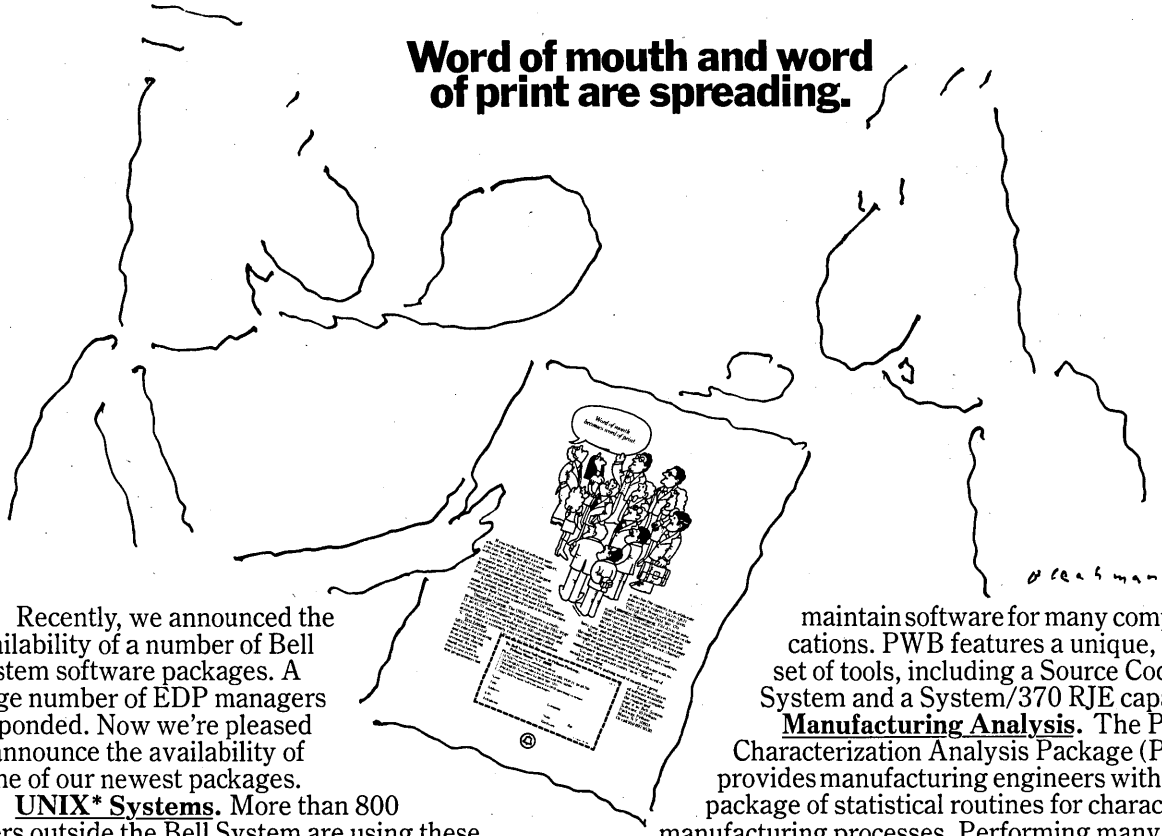
Word of mouth and word of print are spreading.



Recently, we announced the availability of a number of Bell System software packages. A large number of EDP managers responded. Now we're pleased to announce the availability of some of our newest packages.

UNIX* Systems. More than 800 users outside the Bell System are using these powerful operating systems, designed for Digital PDP-11 mini-computers. UNIX Systems are easy to use, yet flexible, featuring more than 100 user utilities.

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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. PWB features a unique, flexible set of tools, including a Source Code Control System and a System/370 RJE capability.

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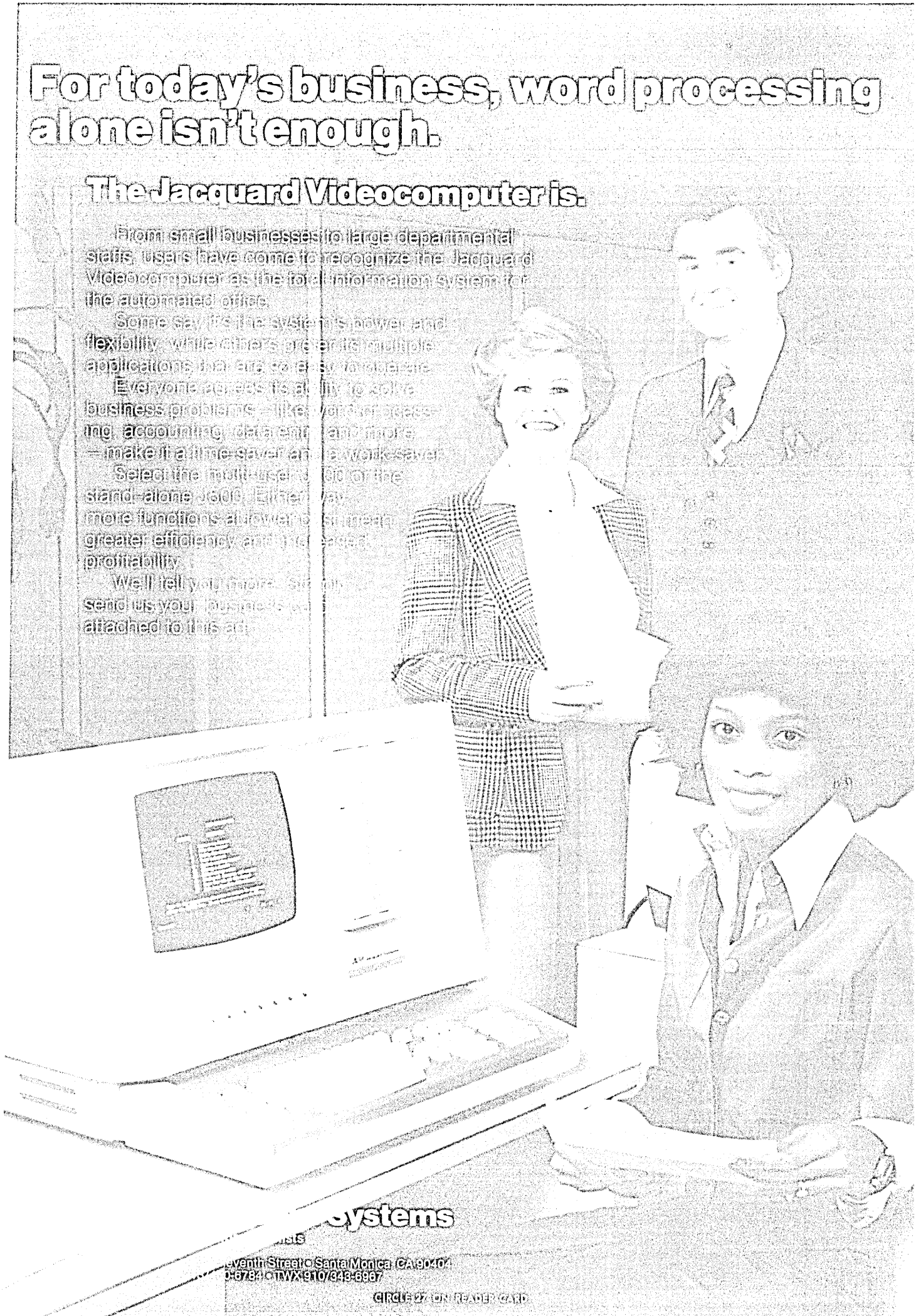
For today's business, word processing alone isn't enough.
The Jacquard Videocomputer is.
From small businesses to large departmental staffs, users have come to recognize the Jacquard Videocomputer as the total information system for the automated office.
Some say it's the system's power and flexibility, while others prefer its multiple applications that are so easy to operate.
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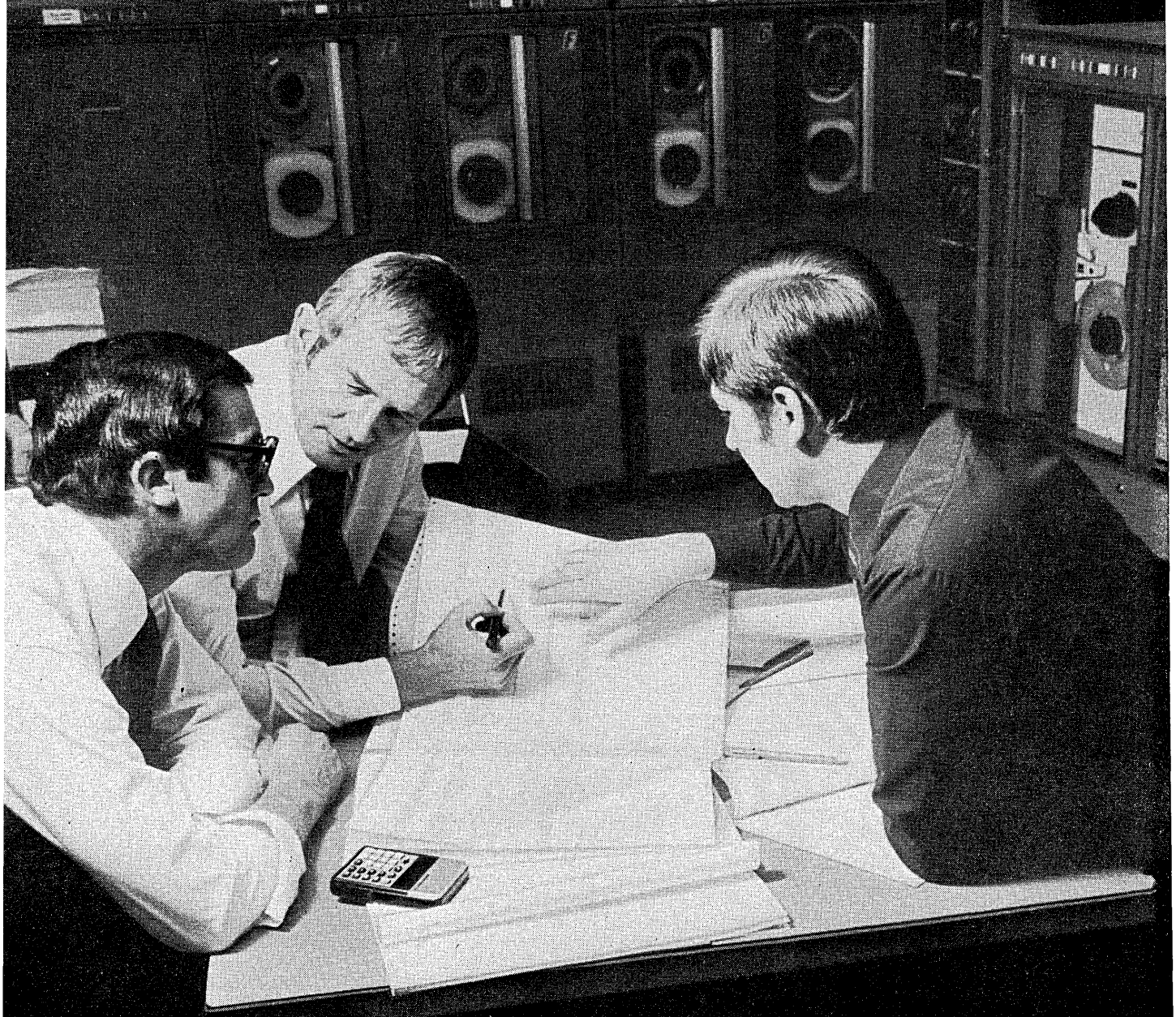

Software, hardware, systems, networks.

Planning, design, installation, management, operations, training.

All are aspects of the Cable & Wireless total capability in data handling and communications. A capability no single manufacturer can match.

Completely independent of any manufacturer, we have the widest possible choice from the world's leading suppliers. We are constantly evaluating new equipment to assess performance, reliability and value for money. Which means we can give unbiased advice, and supply the best package – possibly from several different manufacturers – to suit your specific requirements.

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The word processing capability is just one of the many benefits you get with MDS Series 21 systems. There's modularity, for instance, that provides easy expansion or modification so you can grow at your own rate. A complete range of optional peripherals includes character and line printers. Tape drives and additional disk storage give you complete freedom to configure Series 21 equipment for application needs at central or remote locations.

So if you don't have a distributed data processing system that's been taught to process words—call us.

If you do have an MDS Series 21 installation and would like it to process words—we'll teach it.

Either way, you can be sure of the high quality and service that has earned MDS recognition as an industry leader.

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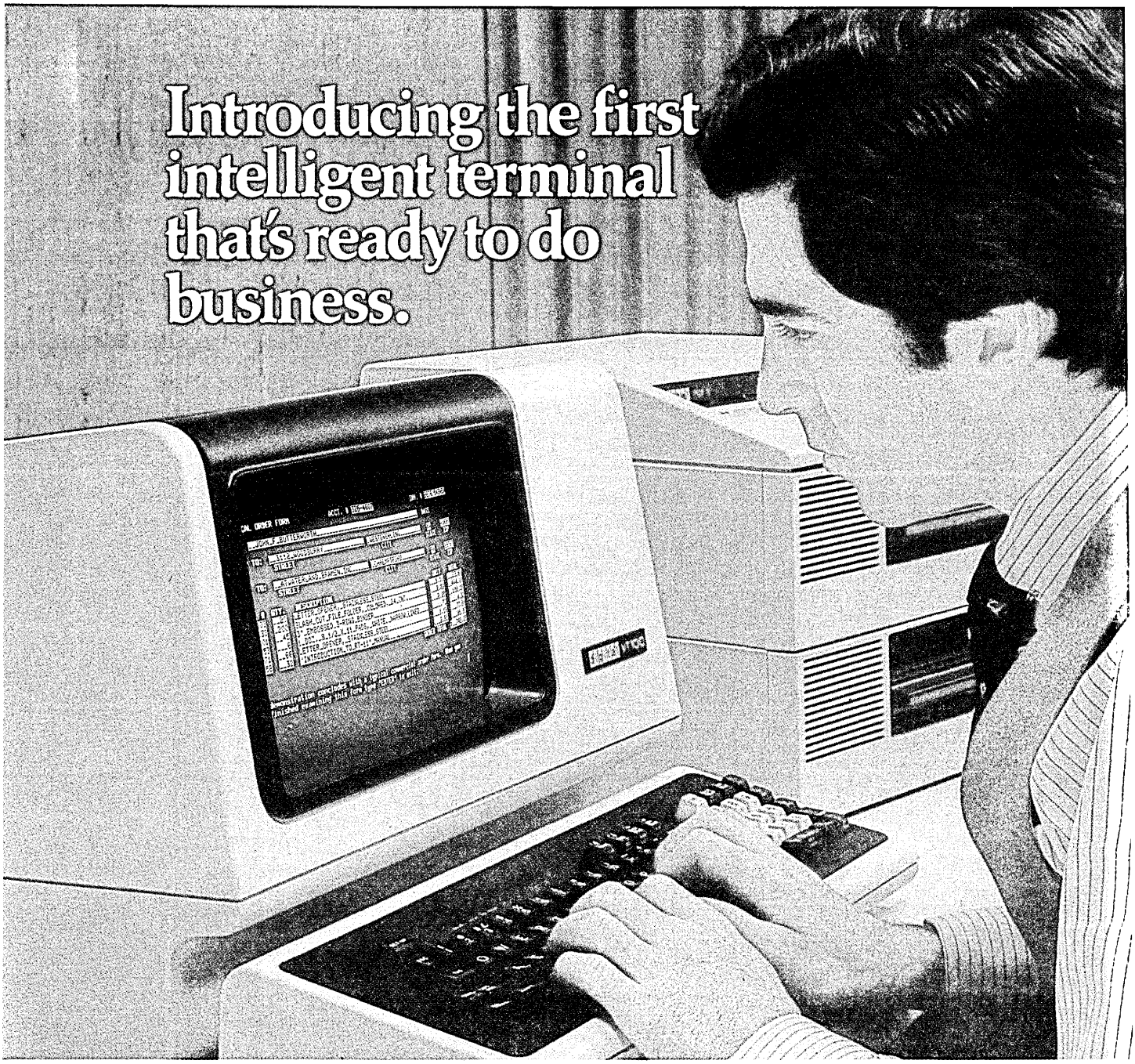

The DEC Datasystem 150 is here-with proven commercial software.

The Datasystem 150, with complete local computing capability, includes the PDT-11/150 hardware—processor, memory, and dual floppy disk drives. All designed and packaged for easy use by office personnel.

But what really separates the Datasystem 150 from every other intelligent terminal on the market is the software—our DEC Datasystem software, specially developed for business applications, and our CTS300 operating system, already at work in over 6000 installations. CTS300 includes:

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Software options include communications protocols that turn the Datasystem 150 into an intelligent networking terminal—to communicate with other computers in either on-line interactive or batch mode.

We also offer two printer options—30 cps or 180 cps—both with multiple copy capability.

But there's more to the Datasystem 150 than impressive performance. Since it's part of a whole family of compatible DEC Datasystems, it opens the way to a wide range

of system possibilities. Which makes the Datasystem 150 the perfect choice for companies with a variety of configuration needs. And for small companies on their way to becoming big companies.

The DEC Datasystem 150.

As an intelligent terminal with business capability, it simply stands alone.

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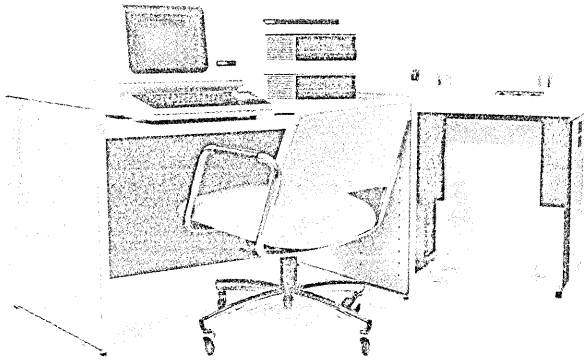

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. . . is a team of dot matrix printers that's hard to beat! Each of our twelve models meets a specific application and price/performance need . . . and every one is built and backed by the world leader in printers. With Centronics, you always have the advantage.

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ADVANTAGE: APPLICATIONS The 700 Series is already the industry's most successful team of dot matrix printers, with proven performance for all applications: microcomputer, minicomputer, small business, terminal, text preparation, data communications, and data processing systems.

ADVANTAGE: COST OF OWNERSHIP Even though they perform like superstars, our team doesn't make big-money demands. They're highly reliable in any environment. And they're ready for any tour, with the largest worldwide service organization of any printer company backing them up.

ADVANTAGE: LEADERSHIP Each member of our 700 Series team shares the Centronics tradition of leadership. We pioneered dot matrix printing, and have been ranked #1 ever since. No other company can match our strong serve in selection, performance, and value. Plus, because of our high-volume manufacturing capability, we won't fault on your delivery.

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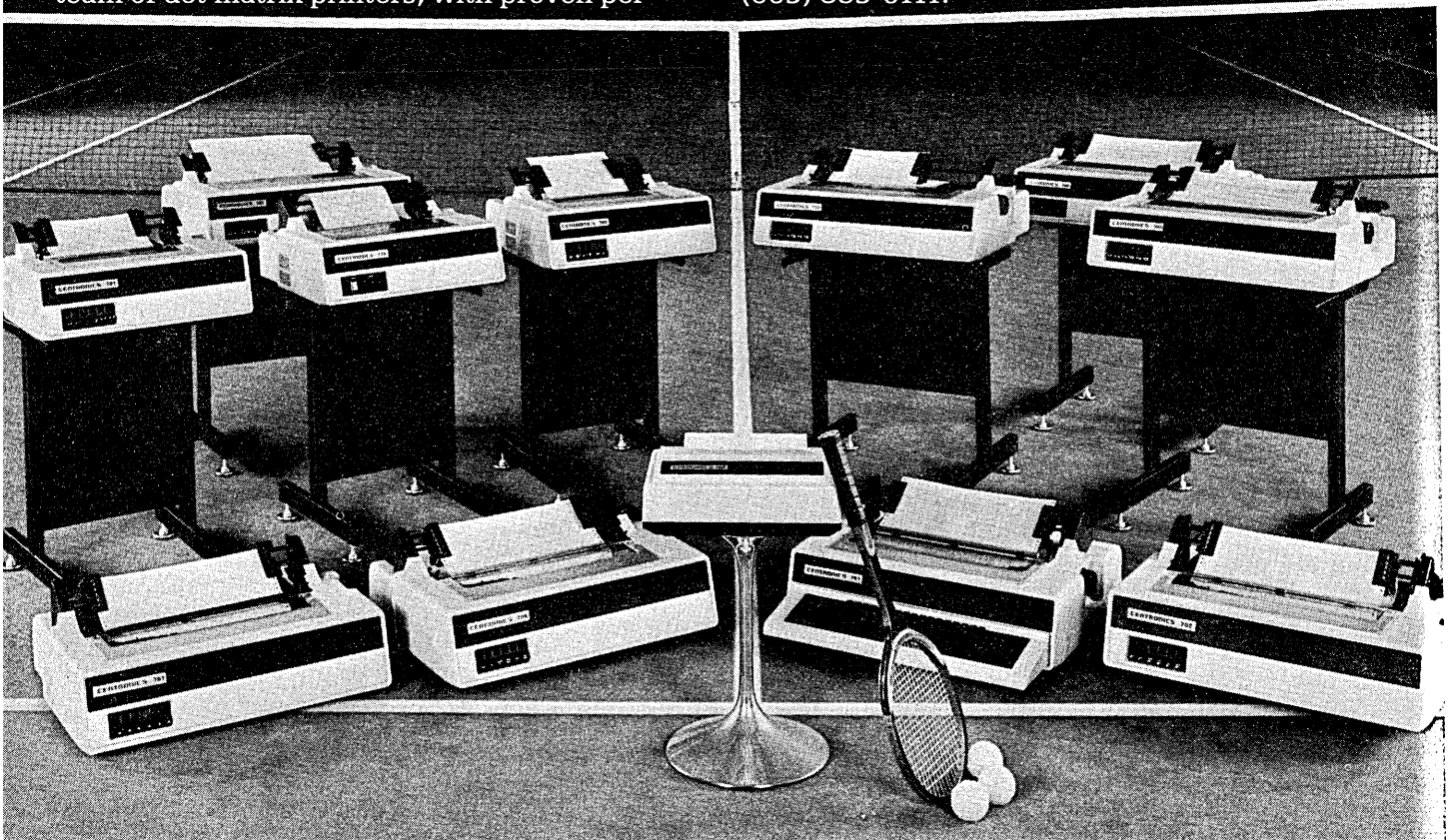

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...the advantage

CIRCLE 34 ON READER CARD

LETTERS

PACKAGE ADDITIONS

Re: "Project Control Systems Software," (June, p. 147): Several products were inadvertently omitted from my survey: VISION, a product with 17,000 activities and lots of features, from Systonetics, Inc., Anaheim; ProSys/80, from CallData; ARTEMIS, operating in an interactive environment with 32,000 activities, from Metier Management Systems, Houston; and CRAM, an extended CPM, from Tymshare.

PERRY PETERSEN
San Bruno, California

FOOLING AROUND

Re: "DP Bridges to the World," (April, p. 124): For several years, I have been disappointed with the ridiculous rigamarole and razzmatazz you have printed to assuage the April Fool spirit. So this year, I was glad to see you have given up this annual tomfoolery and reassigned the space to a lengthy report on the Pittsburgh conference. Naturally, I am very disappointed I was not able to attend. Nevertheless, I appreciate a serious computer magazine devoting extensive space to what must have been an enlightening and informative show. I am a busy man; I appreciate this editorial no-fooling-around policy.

STEFAN IRVING, M.D.
Chief School Physician
Middletown, New York

Thanks for the delicious spoofery. Convention pomposity will never be the same. Pittsburgh will, more's the pity. Congratulations to the conventioneering staff on deadly aim and a wicked follow-through. Can't wait until they're turned loose on computer periodicals.

TED SHIELDS
Beverly Hills, California

The departure from the Spartan prose so rancidly proliferated in our profession's journals was as welcome as April crocuses —especially the chapter, "Creative Consultancy." Too long have we suffered the indignities inflicted by an overabundance of buzzword hyenas. Top management, too proud to insist on enlightened communication with its dp managers, is only too gullible to the Lorelei serenade of these robber barons...

FRANK K. BINDER
Rock of Ages Corp.
Barre, Vermont

I was delighted to see the plug in the Editor's Readout for the Kaiser Engineers Planner, but I still don't think you've put it to maximum use. What you obviously need is the large version of the Planner...if you liked the 11" × 17", you'll love the 24" × 37½". With a little effort, you can fit in a conference for every day of the year, and never go to work at all.

KENDAL D. REYNOSO
Supervisor, Public Relations
Kaiser Engineers
Oakland, California

A paragraph is missing from the end of my article, "The Solution to the Software Problem," in the April Foolery section. It should read: "The inspiration for this article was a similar piece by R. Arnold Le Win from *A Stress Analysis of a Strapless Evening Gown*, Doubleday Anchor Books, Garden City, N.Y., 1969, p. 163-166."

MICHAEL R. PAIGE
TASC
Redding, Massachusetts

WHAT BLOODBATH?

Re: "Chaos in Leasing," (April, p. 52): Laton McCartney asks us to believe that IBM's 4300 announcement has precipitated a disaster in the computer leasing industry...that leasing companies have forgotten the 360 "bloodbath" that occurred when IBM brought out the 370.

It's easy to forget a "bloodbath" that never happened. Not one computer leasing company, as far as I know, went out of business due to the S/370 announcement...The well-managed companies, in fact, prospered, learning how to remarket the 360s with such success that today a high percentage of the 360s on lease in 1969 are still in use, earning considerable revenues for our member firms.

Most S/370 leases are financially structured much differently than the S/360...we see no cause to panic, and certainly no disastrous consequences in the transition from the 370 to the 4300.

JAMES F. BENTON
Executive Director
Computer Lessors Association, Inc.
Washington, D.C.

ENCOURAGING ENTREPENEURS

Re: "The Coming Showdown," (Editor's Readout, March, p. 63): The company I founded 12 years ago, which has successfully grown to the $50 to $60 million size...has recently been subjected by a larger, cash-rich company to the first step of the gulping process.

The nature of such acquisitions was perceptively characterized as "predatory." However, the implication that "predatory" has within the larger reference of an ecosystem was not fully developed.

The American economy is such an ecosystem. Businesses are born when entrepreneurs identify and assemble the resources necessary to exploit the opportunities existing companies cannot or will not exploit. By processes analogous to those in biological ecosystems, certain businesses prosper, grow and, in their turn, undergo the travails of biological organizations, including the fostering of offspring and death.

Some corporate deaths are the result of predatory actions. This is completely natural. What is unnatural is that the economy has failed to foster the creation of new businesses at a rate that assures a population large enough to ensure the survival of the species...The recent rollback of the effective capital gains tax rates should be a step forward in rejuvenating the birthrate of such ventures, and should consequently contribute to a return of equilibrium in the corporate ecosystem. Unfortunately, it will take years for its effect to be measurable. We should all hope that the ecological balance has not been irrevocably disturbed.

ROBERT H. BERNARD
Management Consultant
Westport, Connecticut

FREEDOM OF CHOICE

Re: Letters (April, p. 39): If the general management of British Leyland shares Mr. Colin's views on freedom of choice, they must recommend car buyers shop around for the subassemblies and put the vehicle together themselves. Or are there two sets of principles—one for computer systems, and another for all other systems?

J. R. BARKSDALE
San Diego, California

SWIFT'S DOMESTIC USE

Re: Look Ahead (March, p. 18): The Articles of Association of SWIFT (Society for Worldwide Interbank Financial Telecom-

munication) state that the object of the company is for the collective benefit of all its members in terms of studying, creating, utilizing, and operating telecommunication transmission and routing private, confidential, and proprietary international financial messages among members of the company.

The use of SWIFT for domestic transmission is therefore permitted as long as the message is of an international nature. As an example, a message would be one where a bank outside the U.S. initiates a payment instruction that is sent to a New York bank to make a payment to an account at a California bank. It therefore seems this international financial message could be completely transmitted via SWIFT. SWIFT need not only be used between banks in different countries.

SAMUEL NEWMAN
Vice President
Irving Trust Co.
New York, New York

GO TO, FOUL GO TO!

Re: "Writing Legible Code," by Thomas Gildersleeve (Feb., p. 191): I suppose there are as many COBOL programming styles as there are COBOL programmers, but I must question some of Gildersleeve's suggestions.

Above all I am surprised to find him using GO TO. Many programmers will agree that a hierarchically arranged procedure division, using PERFORM but not THRU or GO TO, contributes substantially to legibility.

He also states that constants don't stay constant and should therefore be set up in working storage and not as literals in the code, but his examples hardly bear this out. The quantities used to compute tax are liable to change so often that they should be read from a file maintained by the user. On the other hand, a one-byte constant moved into an end-of-file switch is hardly likely to change, and it is quicker to write it and as easy to read it as a literal in the procedure division. Even if it does have to be changed, it is surely as easy to find it and change it in the procedure division as in working storage. Longer constants such as page headings should of course be set up in working storage, especially if they are referred to at several points.

Mr. Gildersleeve also objects to switches except to indicate end of file. I have come across programs that contained an unnecessary and bewildering profusion of switches, but there are cases where there is no sensible alternative. If, for example, the result of some relatively complex operation such as a table lookup is to be tested at several points, it is best to carry out the operation at one point and set a switch that can be tested at other points.

Finally, Mr. Gildersleeve regrets the restriction of data names to 30 characters, but I have never found this a problem. Names should certainly be meaningful and consistent, but excessive length will not guarantee this. COBOL is in any case a long-winded language, and conciseness can also improve legibility.

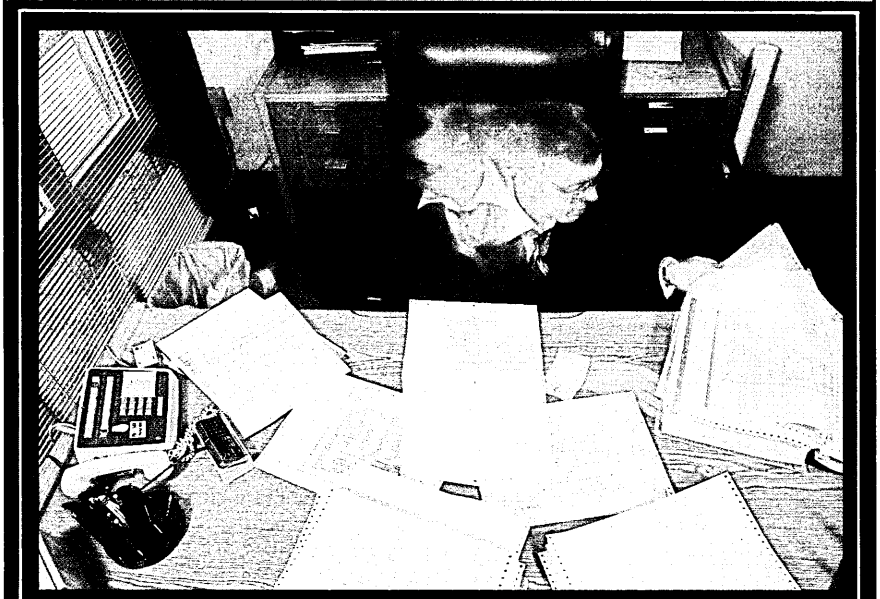
J. L. SEDDON
Rödermark, Germany

Mr. Gildersleeve replies: I admire Mr. Seddon's restraint. I stand corrected that the quantities used to compute tax should be read from a file maintained by the user.

TRUE CREDENTIALS

Re: "Certified Auditing," (April, p. 70): The article failed to properly emphasize that the EDP Auditor's Association's Certified Data Processing Auditor (CDPA) credential has already been grandfathered to more than 700 of its 3,000 members without any formal testing of the individual's skills. The Certificate in Data Processing (CDP) requires the candidate to pass a test in addition to experience requirements and paying a fee.

Data Analysis Problem No. 7
MAKING QUICK REFERENCE TO THE DATA-



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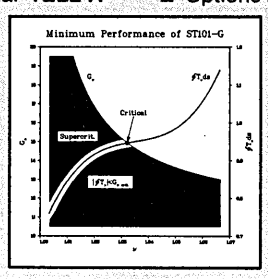

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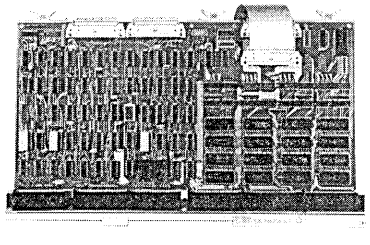

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LETTERS

It behooves anyone seeking a "certified" dp professional's service to examine the true credentials, not the paper ones.

JOHN C. GAZLAY
San Rafael, California

STATISTICAL DISTANCE

Re: "Something's Very Wrong with DP Operations Jobs," (March, p. 149): The JDS survey uses an ordinal response scale of one to seven. This scale requires the use of a nonparametric statistical test in order to ascertain if there is a significant difference between the different groups of employees who answered the questionnaire. Judging from the information given in the article on sample size, the Mann-Whitney U test seems to be appropriate. It might also be useful to apply the Moses test of extreme reactions to the answers regarding feedback on account of the relatively high degree of variance in the answers. This might indicate if there is a polarization of attitudes within a particular group of employees which are biasing the overall study results. The article indicates that Analysis of Variance was used in the analysis of the data. This would be inappropriate to apply to nonparametric data.

The problem with drawing conclusions from answers recorded on an ordinal scale is that there is no way of ascertaining the statistical distance between the different replies. For example, if respondent A gives a rating of 3 to the interval motivator "experienced meaningfulness" and respondent B gives this variable a rating of 5, we cannot say that respondent B experienced 66% more "meaningfulness." The true statistical distance may be 1% or 4,000%.

Should a nonparametric analysis show that there is a statistically significant difference between the different groups of employees it is still possible that the results are practically insignificant. The resources which could be required to carry out a "job enrichment" (or Hawthorne effect?) program to give operations personnel a few extra percentage points of "meaningfulness" might be better invested elsewhere.

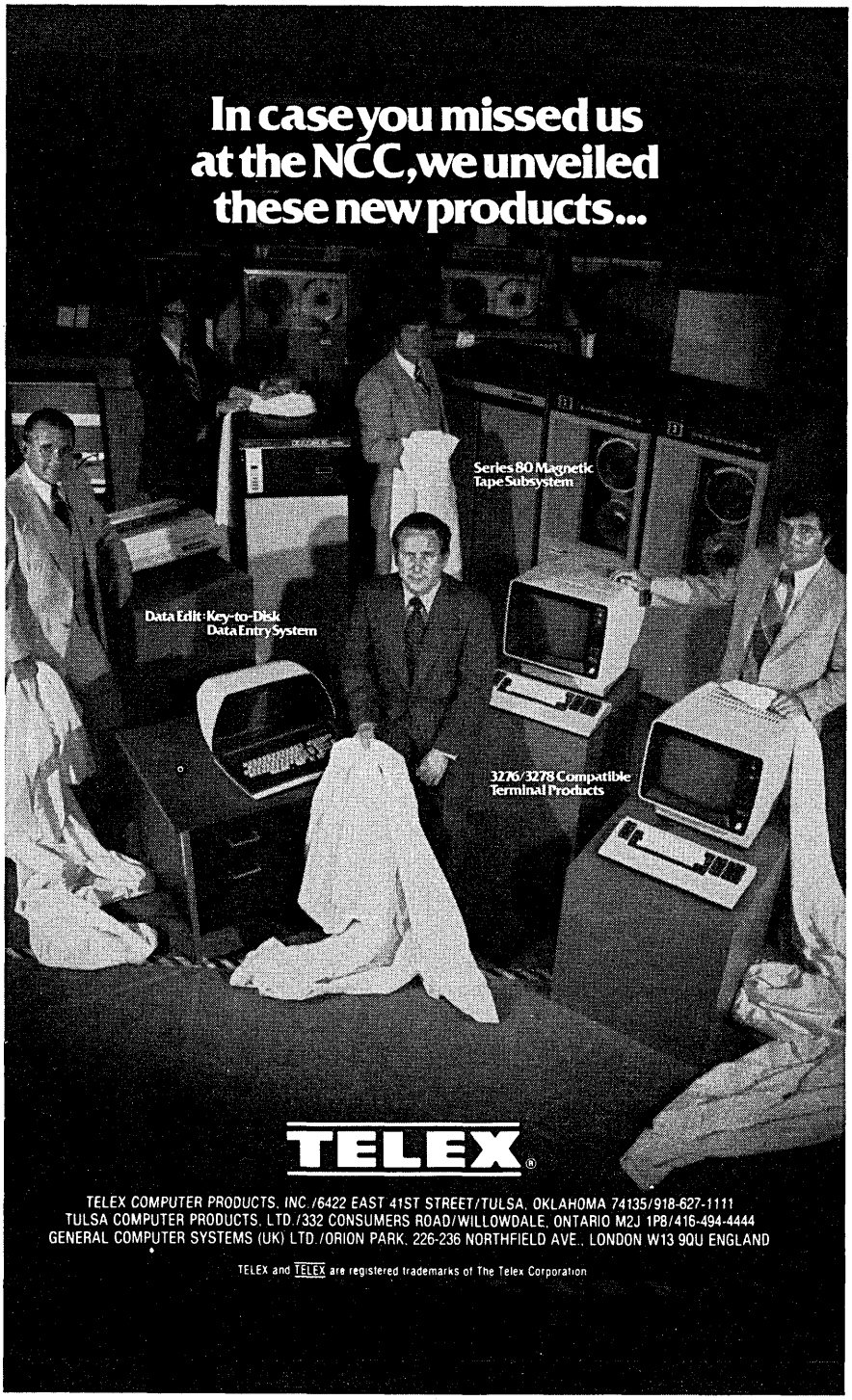
Perhaps the type of people who make their careers in dp operations have an inordinately high standard for job satisfaction.

RICHARD T. DUE
Alberta Agriculture Administration
Edmonton, Alberta, Canada

The authors reply: A principal reason for choosing the Job Diagnostic Survey (JDS) was its acceptance in the statistical realm. For those who would like further detail, see the *Journal of Applied Psychology*, 1975, Vol. 60, No. 2, pp. 159-170. That journal is quite rigorous in its statistical requirements and its referee process. JDS developers J. Richard Hackman and Greg R. Oldham substantiated the reliability and validity of their instrument in that paper entitled "Development of the Job Diagnostic Survey." They used analysis of variance and multiple regression as their principal analytical techniques. We adhere to the philosophy of statisticians like J. C. Nunnally who deplore the "flight into nonparametric statistics" during the 1950s. In his widely read book *Psychometric Theory*, Nunnally says, "In many cases these methods are so weak that they simply cannot do the job at hand. Partly as a consequence, psychologists apparently have mainly gone back to those powerful methods of analysis that take the interval seriously" (pp. 20-21).

CORRECTION

The name of Carmen E. Coleman was omitted as coauthor of "The Top Foreign Contenders" in the May 25 special issue of DATAMATION. Ms. Coleman is Coordinator of Client Support at Quantum Science Corp., where she heads research in the area of computer equipment users. ✲



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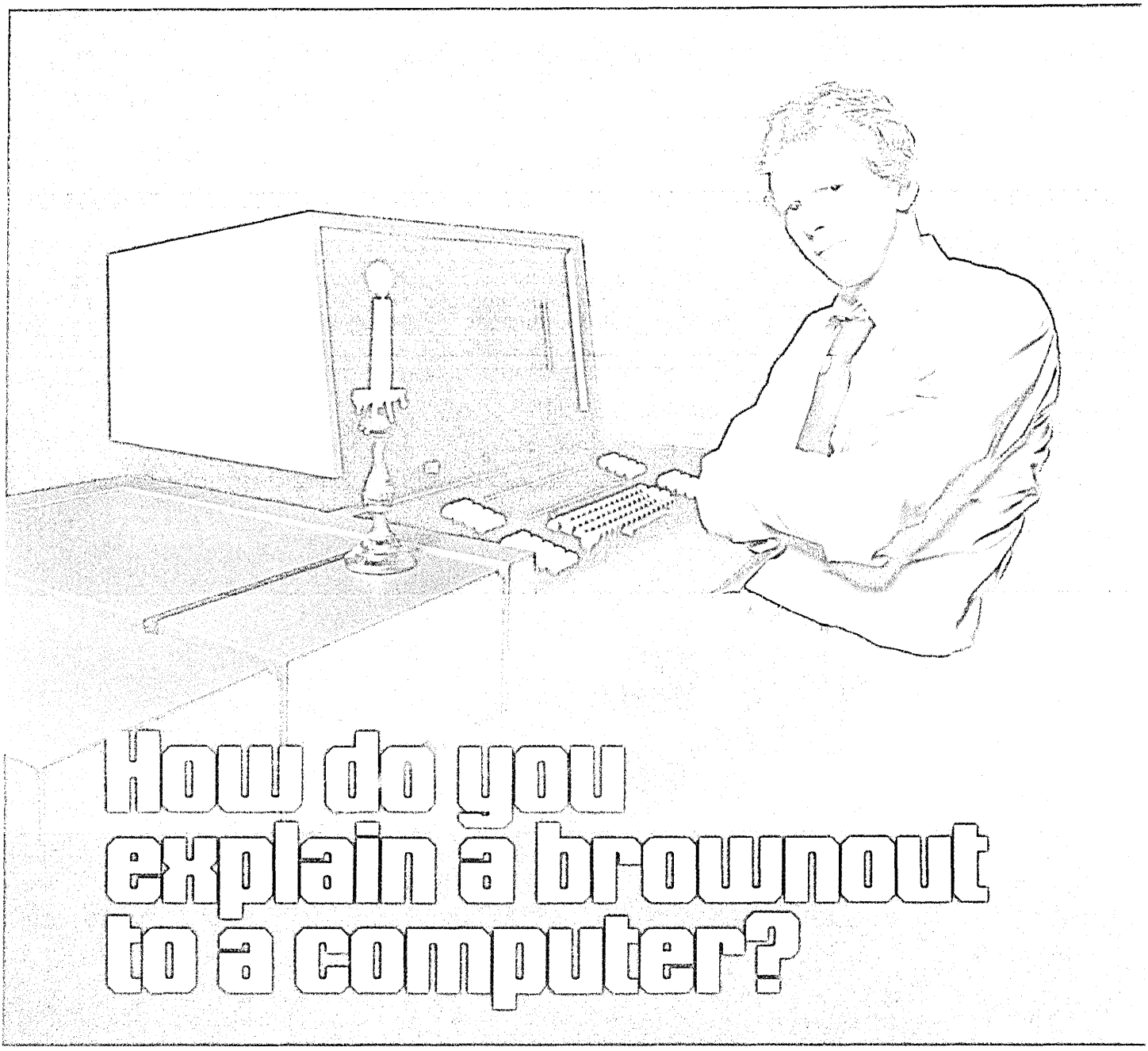

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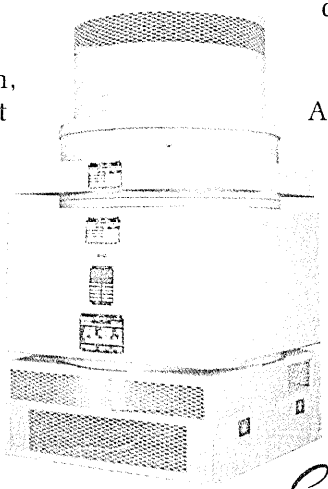

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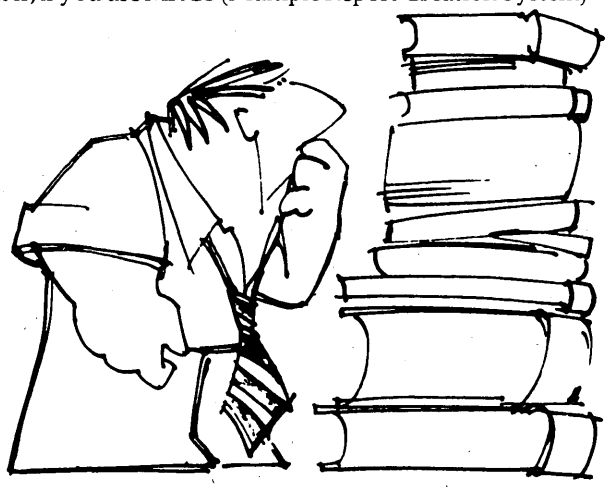

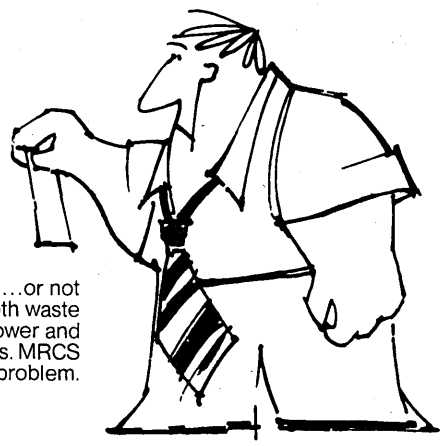

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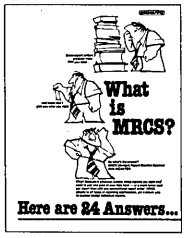

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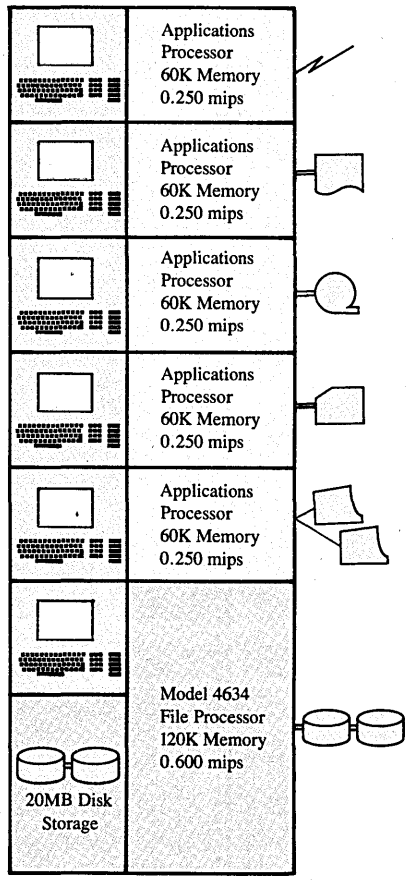

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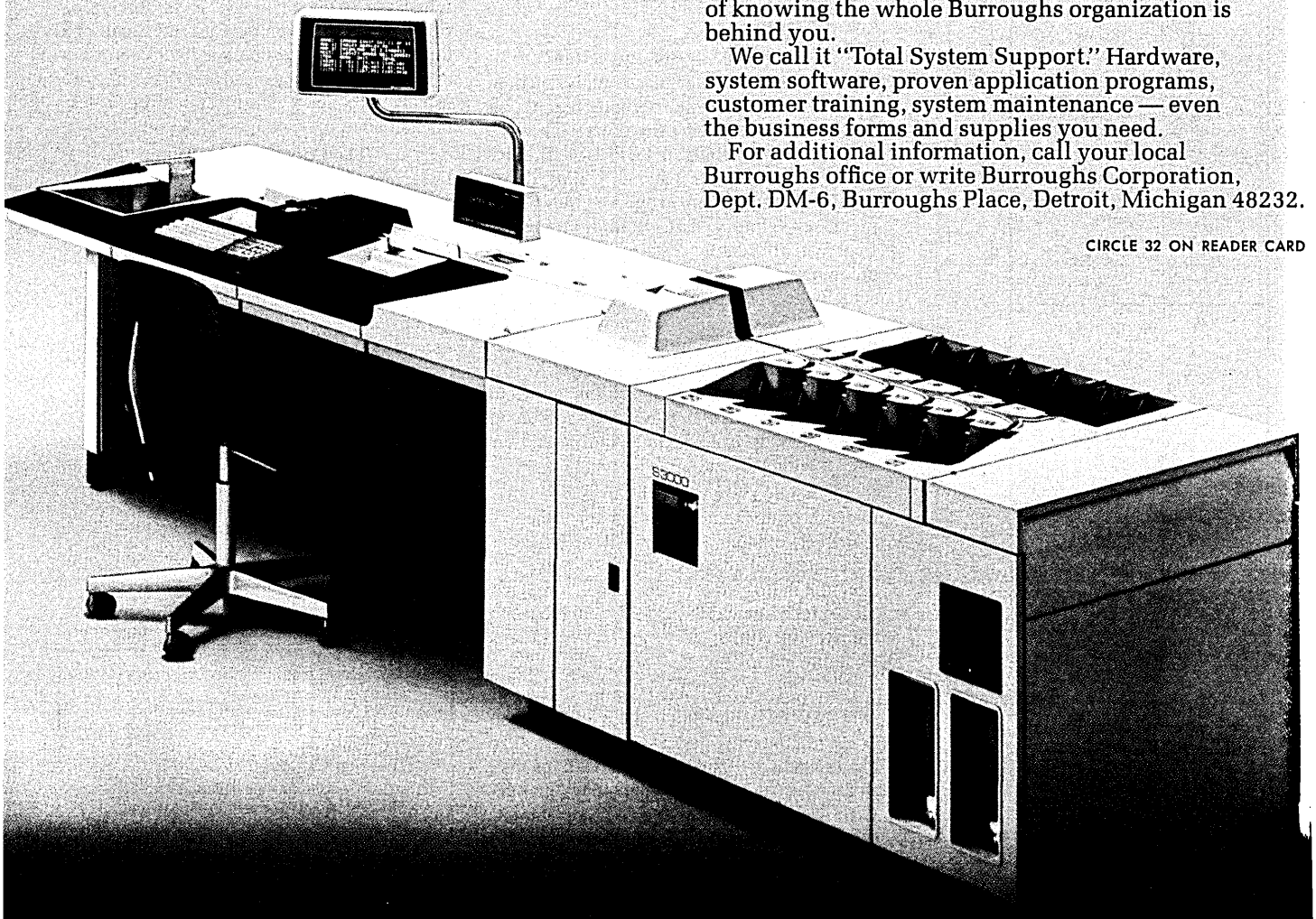

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JOHN L. KIRKLEY, EDITOR

EDITOR'S READOUT

DISTRIBUTING THE PROBLEMS

"They're waiting like a horde of expectant virgins," commented one of our consultant friends in his own inimitable way.

He was referring to the myriads of frustrated users, long disenchanted with the data processing bottleneck. Just in time distributed data processing (ddp) has come to the rescue. Computing power is available to the masses. The lethargic dp priesthood has been bypassed by the microprocessor, the mini, and the intelligent network. Happy days are here again.

Certainly happy days are here for the vendors. The industry has never looked stronger; as Laton McCartney noted in last month's Readout, despite a generally gloomy national economic picture, almost every company in the dp field is bringing in record revenues.

IBM chairman Frank Cary, fielding stockholder questions at the corporation's spring meeting, talked about an "unparalleled customer demand" for the giant's new products. And Gideon Gartner, speaking in New Orleans last April, said that IBM's order backlog for 8100, 38 and 4331 systems alone comes to over $10 billion on an "if-sold" basis.

Other mini-makers and terminal manufacturers are feeling the same surge of revenues as data processing expands into every corner of the corporation.

User budgets are up 12% to 15%; even more significantly, budgets for data communications gear is up 15% to 20%. Applications are logjammed for up to three years. No wonder ddp appears to be the bright light at the end of the tunnel.

But before we choke on all this euphoria, there's another friend of ours—a dp manager—we'd like to quote. Said he, "It never dawned on a lot of our users that dp solved problems; they thought we just created them."

And, he continued, by distributing the processing out to the user community, we are also distributing the problems.

Just a few examples.

A few years ago, AFIPS revised its security manual to include a section on distributing the risk. A central site can easily be sealed with badge readers, locks, and guards. But consider the case of an insurance company which at this moment is in the throes of distributing their computing workload to about 50 branch offices scattered around the country. The 158s at home are snug and secure. But the branch managers are managers, not dp professionals. And the mini or terminal in their offices may wind up next to the vending machines for anyone to access instead of in a secure, controlled facility.

But even the most alert dp professional can miss problems such as those having to do with the physical site. One large organization built its computer center under the cafeteria's kitchen. When some pipes broke, the employees missed lunch and dp had a soggy, shorted-out mainframe.

We heard about a recently installed distributed system that was conking out on a regular, but perplexing cycle. Investigators from the central site finally discovered that the remote mini was hooked to the same distribution transformer as the building's elevators. During peak traffic hours the elevators went up and the computer went down.

Perhaps the biggest challenge to the distributed boom is finding qualified and talented people to run the remote sites without siphoning off the capabilities of the central shop.

Once in place, those distributed systems will have all the problems of the big shop in miniature. For example, as a small programming staff grows up around the off-site mini, there will be all the brouhaha associated with pulling staff off essential development projects to patch another equally essential production program that has suddenly developed a severe spasm.

And what about standards? Will the bright young escapee from the central sweatshop want to develop his applications within standards developed by home base or will anarchy be loosed upon the world?

And what will happen when those as yet unscathed users find out that scheduling, managing priorities, maintaining documentation, coping with different operating systems and assorted vendors are as much a part of a ddp system as the wondrous shiny cabinets and the enchanting glow of the crt?

Perhaps each system should carry a little label like a cigarette package warning that distributed data processing equipment, unless handled with caution, can be hazardous to your health. ✲

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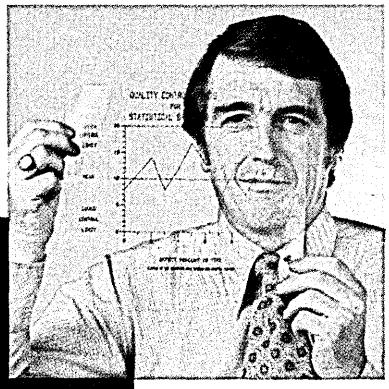

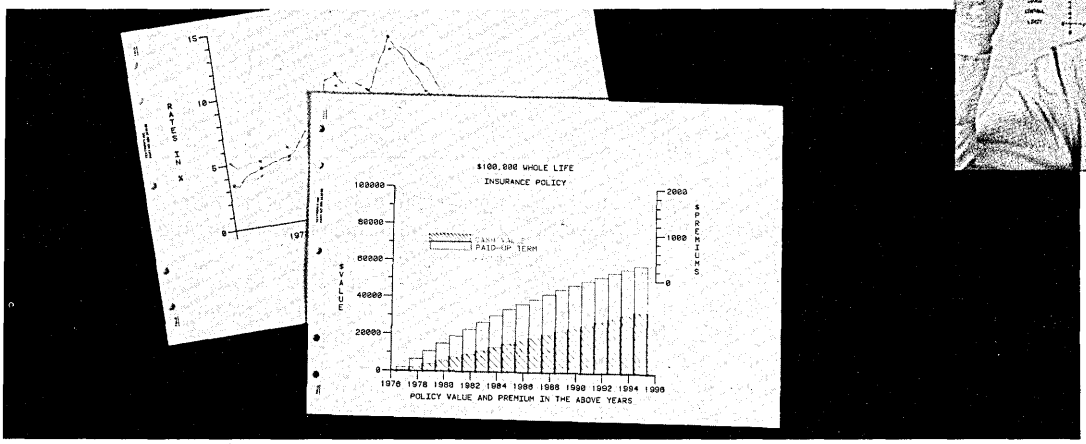

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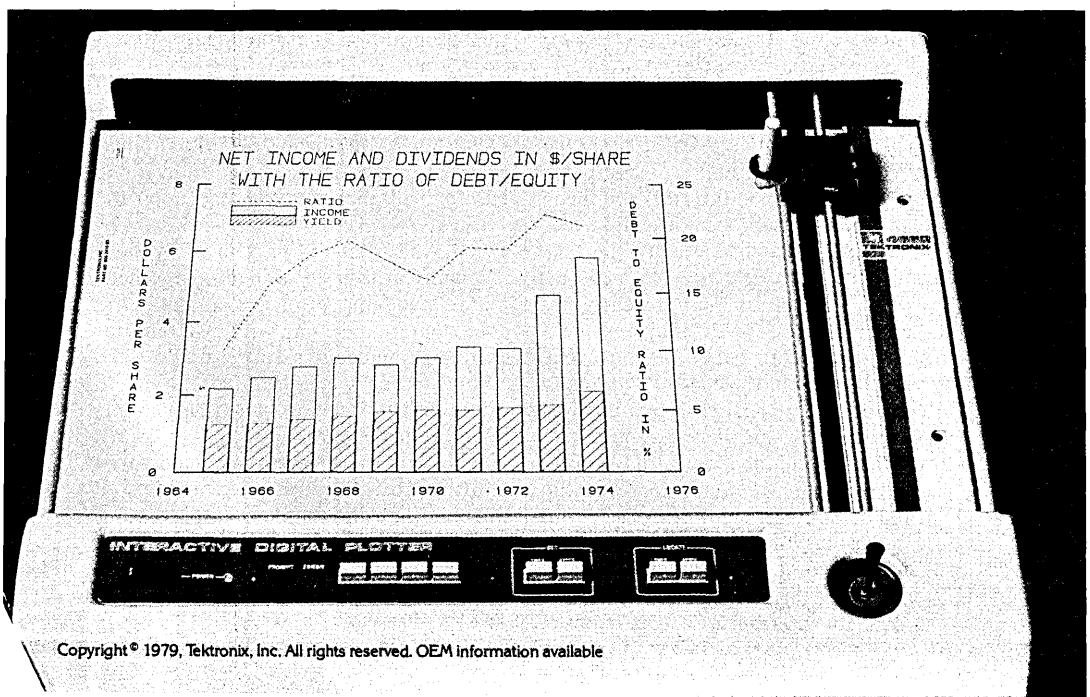

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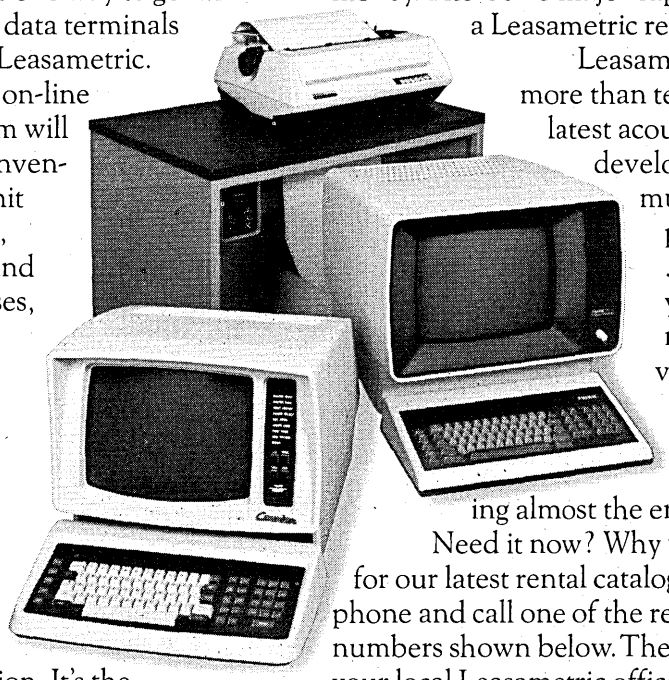

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NEWS IN PERSPECTIVE

NCC DRAWS BIG IN THE BIG APPLE

The New York conference surpassed last year's attendance in the first two days.

If bigger is better, the 1979 National Computer Conference would have to be labeled best.

Back in the Big Apple where it all started in 1973, NCC '79 attracted close to 80,000 people, a whopping increase over 57,000 plus for NCC '78 in Anaheim and easily fulfilling the "more than 60,000" predictions of the sponsoring American Federation of Information Processing Societies (AFIPS).

Several attendees compared this year's NCC to the gargantuan Hannover Fair with its permanent booths. "It's a shame some of these have to be dismantled," said one.

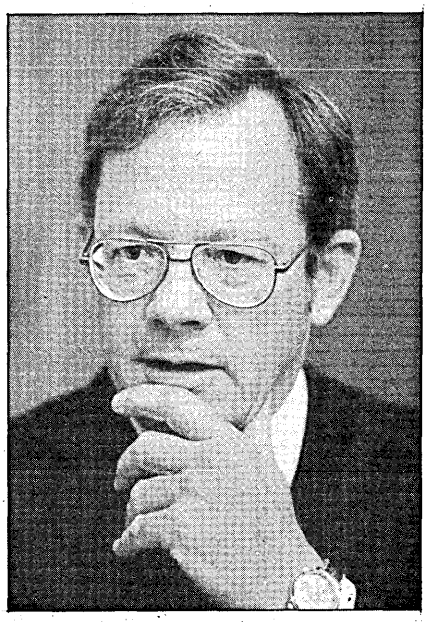
For a dozen or so AFIPS staffers who will not be moving with the organization's headquarters to Washington this fall, it was a fitting "Last Hurrah."

Attendance totals not withstanding, the aisles were maneuverable and registration lines tolerable. Preregistration of some 35,000 undoubtedly helped. "I kept hearing the numbers but I never felt crowded, not like in Anaheim," said one attendee. Another said she was glad she knew exactly what she wanted to see among the exhibits, "otherwise it would be overwhelming."

An early inkling of the show's mammoth size came Wednesday morning when conference chairman Merlin Smith announced at a press conference that it had pulled in 59,766 persons in the first two days. How to trim it was a question. Jerry Koory, a long-time NCC organizer who this year headed a committee liaison group, said the question of holding two conferences in a year frequently comes up at meetings but, he added, "it is very unlikely" that the affair would be split. He noted that a typical NCC requires the services of 1,500 volunteers and that it would be difficult to find 3,000 volunteers for two.

Ironically, the huge crowds probably contributed to a disappointing turnout for the technical program in the New York Hilton and Sheraton Centre hotels. Shuttle buses carrying persons from the Coliseum to the hotels were so jammed and so irregularly scheduled that most persons were left with the option of walking the eight blocks in New York's steamy weather or not going at all.

Program chairman Richard Merwin said he was disappointed with the turnout at most of the 152 sessions, although he said he was pleased that sessions relating to data base technology generally drew large crowds. But he said sessions with which the NCC has "experimented"—computers in law, banking and medicine—drew poorly.



JOHN R. OPEL—IBM president was keynoter at the NCC. He told a capacity crowd, "Our industry appears to be flourishing in an environment that is conducive to further growth."

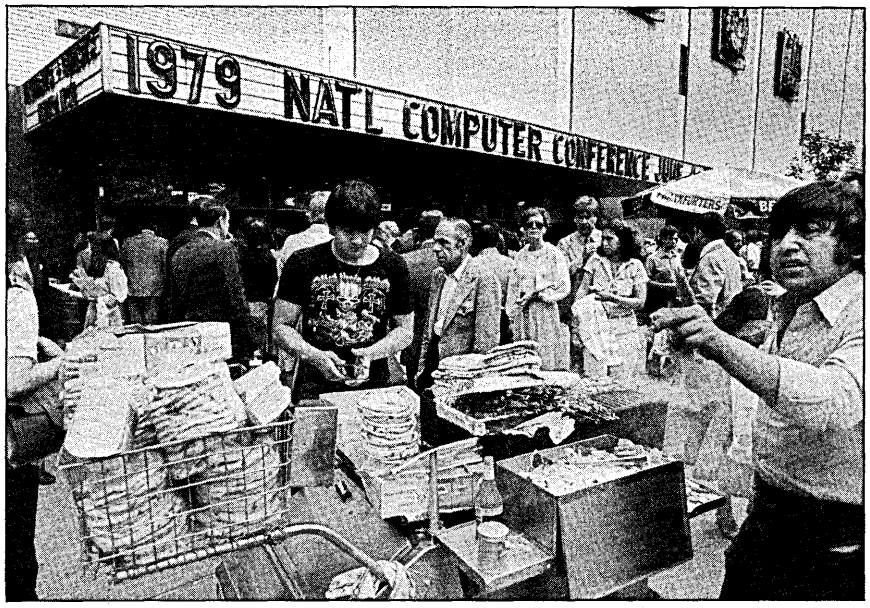
Koory said his committee had monitored each session to determine a possible new direction for future technical programs. Noting that such plenary sessions as Computers in Society and Future Directions in Computing seemed to draw heavy attendance, he said he didn't rule out the possibility of recommending sessions with broader interest.

Logistical problems should be eliminated in Anaheim next year and in Chicago in 1981 because the sessions and show are held under one roof. Don B. Medley, next year's program chairman, said his committee was wrestling with a theme for the Anaheim affair. One might be the Usability of Computers and another might be Computers and the Entertainment Industry, but that depended on the committee's assessment of a session, "Computer Technology in the Movie Industry," held Thursday, the last day of NCC week. Suzanne Landa, who organized the session, said the turnout of 100 persons was "pretty good for a Thursday."

The huge crowds probably contributed to a disappointing turnout for the technical sessions.

Conference keynoter John R. Opel, president of IBM, did better. And if what he sees for the industry also are portents for the NCC it could keep growing. "Our indus-

PAUL MIRABITO—Burroughs Corp. chairman attended NCC on opening day to assess it as a showcase for Burroughs products. He said he was pleased.



CROWDS seemed manageable despite record turnout of nearly 80,000.

try appears to be flourishing in an environment that is conducive to further growth," the IBM executive told a capacity crowd in the Grand Ballroom of the New York Hilton.

Undoubtedly AFIPS planners will be considering potential growth when stocking up for the next year's NCC. With an hour to go, at 3 p.m. in New York, persons still were registering to view exhibits at the Coliseum. But the supply of badges had run out and NCC badges were being printed on the reverse side of those from another conference.

Among the exhibitors, superlatives were flowing even on the last day. A booth staffer for Pertec Computer Corp. simply turned thumbs up when asked how he liked the show on Thursday afternoon.

Lew Kirschner of Data General called it a "super show," and reported that despite a larger booth this year, they had gotten "more qualified people" passing through than ever before. DG's maze-like booth did get "a little warm" at times, he admitted, but DGers were pleased with the "surprisingly heavy turnout on the last day."

"It's everything we could have hoped for," said a spokesman for Software AG whose putting green, promoting the firm's ADABAS data base management system, drew long lines right up till the show's final minutes.

An Ampex spokesman called the show "very active" with "a lot of interest" on the part of exhibit goers. He estimated that 50% of Ampex gawkers were "qualified" potential customers.

Gerry Johns, manager of marketing communications for Texas Instruments' Digital Systems Div., called it a no-nonsense, professional NCC with "less of a circus atmosphere than in the past." Johns added, "We all agree it is the most successful NCC to date—and I was exhibits chairman for the 1977 show in Dallas."

Louis B. Horwitz, president and chairman of Datum, Inc., called the show "great." Datum, as at NCC's past, had a magician in its booth but "he works our products into his pitch and they (attendees) stay around to look at them."

No exhibitor seemed unhappy with his location. Even those on the Coliseum's fourth floor were happy even on the final day. And over at the Hilton Hotel, where exhibit aisles were narrower making for a more crowded feeling, booth staffers seemed happy. "We're seeing the right people," said a spokesman staffing Computer Power Systems' Hilton booth.

His company chose the NCC as occasion for an announcement of a three-year contract from Burroughs Corp. under which CPS will manufacture "clean" power distribution systems designed by Burroughs. The contract is worth from $4 to $6 million in the first year.

Data General used NCC as a springboard for an announcement of its involvement in computerized biomechanical analysis. With a theme of "Computition: Computer Enhanced Performance," Data General's exhibit also was the setting for an announcement that DG had donated an Eclipse S/250 computer to the U.S. Olympics Committee.

Although most exhibitors were happy with the show, regardless of location, many worried beforehand. To make sure that crowds who surged to the second floor of the Coliseum didn't miss their exhibit on the first floor, Intertec Data Systems bought space in a tiny booth on the second floor to advertise their line of Intertube video terminals in a booth on the first floor.

And Datamedia Corp. staged a "marathon" to make sure attendees got to see the microprocessor-based video display terminals it was showing on the fourth floor. A company representative distributed entry blanks for the "Datamedia Marathon" to attendees standing in line to register. "They thought we were official NCC," said a spokesman. Those people filling out the blanks had only to make Datamedia's fourth floor booth to win a "marathon" prize—a sweatband—given out by booth staffers appropriately attired in warm-up suits.

Many of the exhibit booths at the Coliseum were spacious and well decorated, especially that of Lear Siegler's Data Products Div., which used the decor of a wharf to display its terminals. Tally Corp., which last year "retired" its traditional two-story booth and showed up this year with a one-story version, said it missed the two-story booth and will take it out of mothballs for 1980.

It was called "a no-nonsense professional NCC with less of a circus atmosphere than in the past."

One of the many show-stoppers was the booth of Billings Computer Corp., Provo, Utah. The company displayed a computer simulation of the nuclear accident in March at Harrisburg, Pa. A scale model of the reactor was the central part and the company told how it had collected data and proposed solutions to the crisis at Three Mile Island under contract to the U.S. Nu-

clear Regulatory Commission. Crowds who witnessed the demonstration later were introduced to Billings' chief products at the NCC—microcomputer-based business systems, word processors, and peripherals.

One of the more significant products introduced at NCC was PIXNET from Paradyne Corp., Largo, Fla. PIXNET extends the company's earlier PIX II version and is designed to allow IBM network users to interact with multiple IBM software applications. The company said the approach provides these capabilities with less complexity than comparable IBM configurations under Systems Network Architecture (SNA) and at costs that can be as much as 50% below those of IBM.

The show was not without its unplanned and not-so-welcome incidents. To promote her session on the use of computer technology in the movie industry, Suzanne Landa posted two life-sized cutouts of Superman and Wonder Woman on the second floor of the Coliseum. Almost immediately, someone made off with Wonder Woman. When Landa notified Coliseum security officers, she was told "too bad Superman isn't missing, because we'd have a clue right away—we'd look in the nearest phone booth." A few days later Superman was missing.

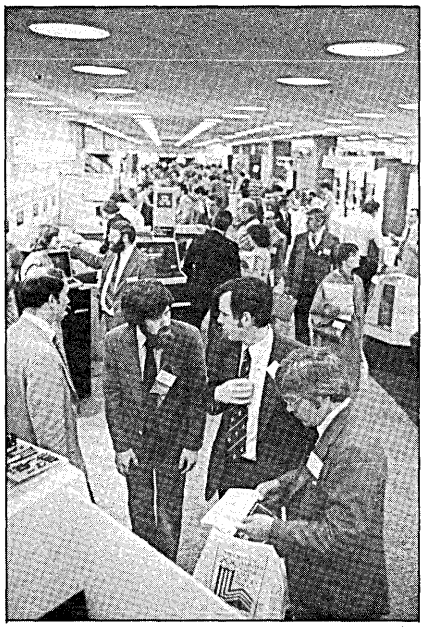
And in the too-small, always overcrowded press room a pool on the total attendance figure never came to fruition. The first $13 collected was stolen from a desk drawer.

Was it the ethics of computer people at work? Speakers and questioners alike at a session on computer abuse in universities wondered if there is such a thing. Donn B. Parker, SRI International, Menlo Park, Calif., said "Computer science departments in universities hardly even recognize the word ethics."

Tally Corp. will take its two-story booth out of mothballs for 1980.

In the same session, M. Stuart Lynn, director of the computer center at the Univ. of California at Berkeley, wondered if it was the job of the universities to teach ethics to "badly potty trained students who should know better."

And, as could be expected, the question of ethics, morality and general honesty came up in a session on Electronic Funds Transfer (EFT) and the focus was on expecting the crook and how to deter him. But the most revealing comment came from the audience. An attendee from Atlanta told a sad tale of a dinner out in New York with his wife (expensive, of course). When the bill came, he attempted to pay with his Master Charge card. "It was turned down . . . the humiliation of it." The next day, he called his bank in Atlanta and was told their computer was down and wouldn't be up for a week.

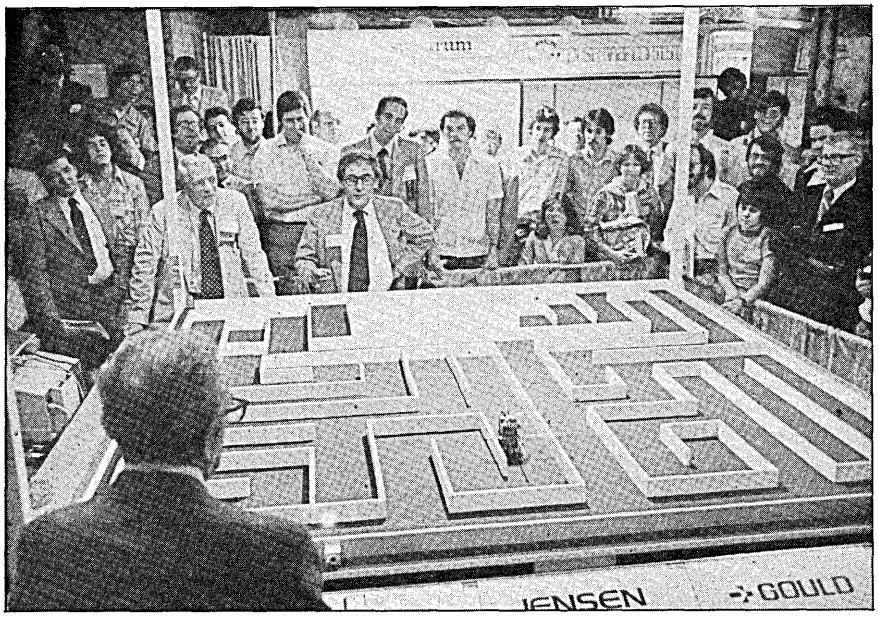


"WE'RE SEEING the right people," said an exhibitor at the Hilton Hotel where NCC held an overflow exhibit away from the Coliseum.

This sad story was opportunity to another in the same audience. A representative from Tandem computer, whose equipment is used by Eastern State Bankcard Assn. (authorization agents for Master Charge in the North East), got up and said such a situation would never come up with Tandem's back-up provisions. "Go back home and call Tandem," he advised the beleagured Georgian who was still wondering how he was going to survive financially for the rest of the week.

Perhaps his story isn't so bad if you believe in predictions made in a session on Managing Computer Security. Robert V. Jacobson, International Security Technology, Inc., New York City, looks for these dire occurrences: a major wire tap fraud will happen in the next five years; a large company will be wiped out within five years because of a disaster; and increased use of unprotected minicomputers will cause a rash of information thefts.

But some security is offered by technology. In a session on practical applications of data encryption, Michael E. Hanratty, Intersect Corp., a one-time victim of wire tapping, said there are two classes of techniques: active taps, allowing insertion of bogus data into a communications link,



THE RACIEST ROBOT rat in the land rolled to a win in the Amazing Micro Mouse Maze contest finals run at a Personal Computing Festival held in conjunction with the NCC. Moonlight Flash, one of a trio of entries submitted by Ron Dibleck, Phil Stover, and Art Boland of the Battelle Memorial Institute's Pacific Northern Research Labs in Richland, Wash., psyched out the maze in slightly under 30 seconds—29.78 seconds—its third and fastest run of three. Sister entry Moonlight Express came away with the prize for Best Learning Mouse, paring nearly a minute and a quarter off of its initial run time to finish its third traversal in 31.16 seconds. Cattywumpus, which sported a mouse-like superstructure of colored pipe cleaners, won Most Original Mouse, although it got stuck part way through the maze and did not finish. Cattywumpus is the product of collaboration between Howard Katseff of Bell Labs and Michael Sipser of the Univ. of California at Berkeley.

Claude Shannon brought proof that there's nothing really new under the sun. He showed up with an early micro mouse, an electromechanical device built circa 1950. His mouse locates a movable piece of "cheese" hidden in another maze, built on top of an aluminum enclosure housing relays.

COBOL'S ORIGINAL PLAYERS

Most of them are still active in the computer business today.

They started on May 28, 1959. By Nov. 20, it was all done except for final editing, printing and distribution. In six months, they had changed the face of the programming world and produced COBOL, the Common Business Oriented Language. It couldn't be done today. In retrospect, it barely seems possible that a handful of people from a variety of installations could create the most widely used programming language without spending years of drawing up specifications, writing detailed documentation, and advertising for comments.

NCC Pioneer Day this year celebrated their achievement. On hand for the occasion were most of the players and it was especially interesting to note that almost all still are active in computing.

Among the cast members: The friendly "godfather" from the Dept. of Defense, Charlie Phillips, without whom it couldn't have been done. Phillips did the organizing and scene setting that was required. Joe Cunningham, then of the Air Force, took charge of the steering committee. Joe Wegstein, Bureau of Standards, ran the fact finding and short range language task group and Dr. Grace Murray Hopper, then of Sperry Rand, and Robert Bemer of IBM became the technical advisers. (For purposes of this story, their affiliations are at the time of the COBOL development project. Where some of them are today is listed in the accompanying photograph.)

While there were Intermediate and Long Range Groups established, the fact finders quickly ran away with the assignment and did the job. They did it so quickly that for all time they are dubbed "The P.D.Q. Group" in the COBOL literature.

TODAY: COBOL pioneers at NCC Pioneers' Day focusing on COBOL's origins. From left: Howard Bromberg, ICT Corp., San Francisco; John L. Jones, Southern Railway Co., Atlanta, Ga.; Grace M. Hopper, Dept. of the Navy; Charles Phillips, Washington, D. C.; Jean E. Sammet, IBM Corp., Cambridge, Mass.; Norman Discount, Sperry Univac, Blue Bell, Pa.; Frances E. Holberton, National Bureau of Standards, Washington, D. C.

It's hard to remember that 20 years ago FORTRAN was only a few years old, BASIC and RPG didn't exist, and the 1401 still was six months away from announcement. Could a language be developed for business data processing? Could it be done in an open-ended fashion, oriented to problem solving and machine independent? Only 40 people were at the initial meeting but they did the job and the results are very much with us today.

Speaking 20 years after the event, Grace Hopper remembered well the work leading up to COBOL. Her own FLOWMATIC, IBM's COMTRAN and the Air Materiel Command's AIMACO were direct ancestors. The indefatigable Capt. Hopper noted that the COBOL development may have been easier by the absence of two classic killer phrases, "We've always done it this way" and "You can't do that, we tried it last year."

It wasn't all wine and roses. There were arguments and disagreements with consensus often hard to reach. Even arriving at a "sense of the meeting" wasn't always easy but it was done. In retrospect, Jean Sammet, Sylvania Electric, remembered some of the fights, compromises and criteria. If you have ever wondered why COBOL has two ways to do simple arithmetic, ADD and COMPUTE, she knows the answer. What happened to DEFINE, a macro facility?

By April 1960 the report was widely available. Theoreticians attacked the report because it hadn't been done using BNF to define the syntax. However, as Jean Sammet has pointed out, the "reasonably" formal definition employed seemed to be more than acceptable to those who had to implement COBOL compilers. The years that followed as COBOL struggled through the standards process were often more political than technical. Jack Jones, Southern Railway, and Howard Bromberg, RCA, remembered them well. An ASA standard seemed a long way in the future. As it turned out, the process was near endless with the interface between the CODASYL developers and the official standardizers being less than smooth. But, it happened.

Pioneer Day wasn't merely a chance to hear veterans telling tales of long ago. Computing historians were beginning to emerge and it is important that the recollections be set down before the memories fade. Henry Tropp, Humboldt State Univ., and Nancy Stern, Hofstra Univ., are two of the breed. Their work is beginning to get published by the Charles Babbage Institute and in the AFIPS *Annals of the History of Computing*. While Pioneer Day honors individuals and their direct contributions, perhaps it is even more important for its impact on those who read and write history.

—Philip H. Dorn

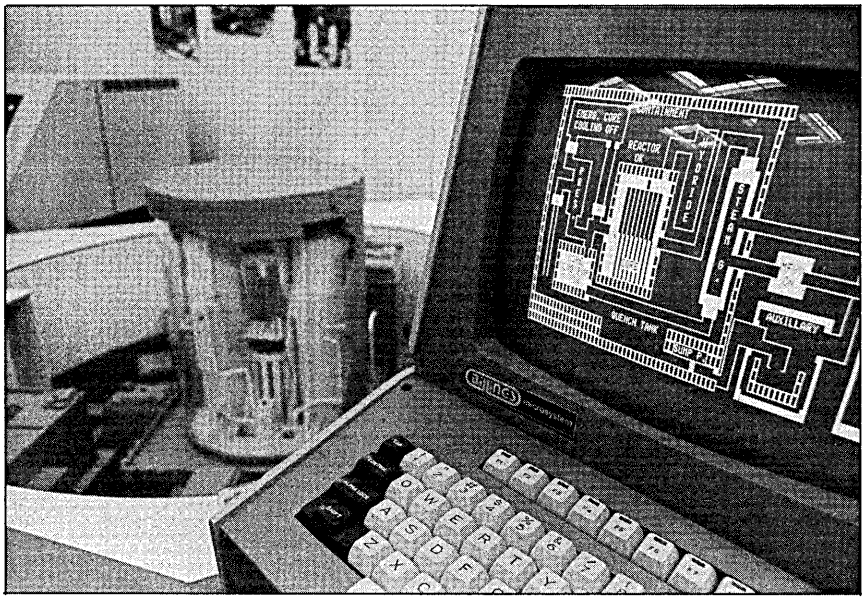
and passive taps, allowing eavesdropping only.

He and his fellow panelists described a variety of data encryption techniques and concluded that encryption does mean cost but the need is there.

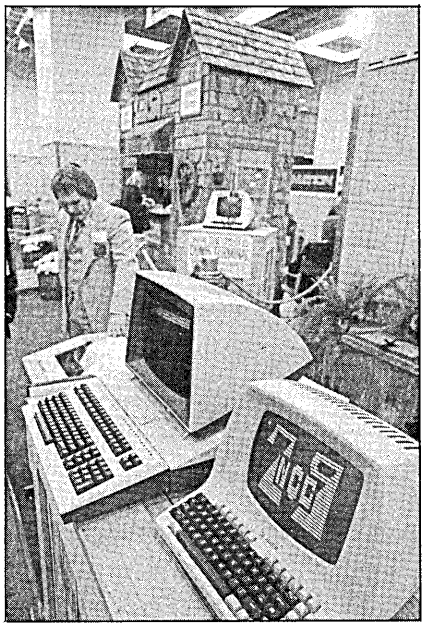
A session on international banking focused more on problems than solutions. "We have exactly the international banking system we deserve," said Charles Read, Inter-Bank Research Organization, London. "The impetus for change will come from a downright mess . . . when the mess becomes intolerable and I think it's not far away."

He and his fellow panelists were talking about back-office banking automation in multinational situations. It was not a how-to session but one of listing needs . . . central control . . . standardization.

More on the how-to level was a session on planning, acquisition, and implementation of minicomputer-based business sys-



BILLINGS COMPUTER drew crowds to its booth with its explanation of this scale model of the Three Mile Island nuclear reactor.



LEAR SIEGLER's wharf design was used to hawk firm's terminals.

tems. "Installing a business computer system for the first time is like buying your first stereo," said Howard Perkey of Howard Systems International. "The user first needs to acquaint himself with the jargon and available products." He urged clear identification of needs.

And then there's the problem of selling ideas to management. "If you want to sell a project to your management, don't forget to include the risks along with the benefits," said Herbert B. Safford of GTE Information Services, Inc., Marina del Rey, Calif. Safford, who is next year's NCC chairman, conducted his own one-and-one-half hour session on the subject of "How to Sell New Technology to Management." Among the risks of the new technology of distributed processing are that there'll be duplication of effort at both the central and remote sites. There'll also be a lack of standard controls because "central standards aren't always relative at the remote center." Safford said an alternative would be for dp people at the central site to initiate a program of standards for the remote site, or at least to provide some sort of user education at the remote site."

Management is not the only entity to be sold. The end user needs a pitch, too, and a session conducted by Vicki McConnell of Carter Hawley Hale Stores, Inc., Los Angeles zeroed in on this aspect. "You (the end user trainer) have to overcome negative public attitudes toward computers . . . to show them how computers make their jobs easier and benefit the organization . . . to emphasize the benefits. Otherwise you're throwing too much at them when they're not ready."

To many systems people, chief executive officers are counted among their end users. Do they use computers to make their decisions? An NCC panel asked this question and came up with the answer: they don't.

Herbert Z. Halbrecht of the recruiting firm of Halbrecht Associates said a survey he once took found many CEO's use manual systems with which they're comfortable and one respondent to the survey used the "war room" route and found computers to be too slow for decision making.

Said Halbrecht: "Most presidents aren't oriented to computers." One he talked with maintained a summary of variances concerning his company's plans and goals. "If a variance is spotted, the CEO telephones for an explanation. If it represents a problem, someone flies to the trouble spot. If it's really serious, the CEO flies there himself."

Tom Labreque of Chase Manhattan Bank in New York said that the problem is one of background. "Getting many of our managers to change their management style is not productive," he said, suggesting that the use of computers is for the managers of the future, those with a solid dp background.

But computer-aided decision making apparently is happening in Washington. In a session on the Domestic Information Display System (DIDS), a joint Census-NASA project designed to tap output from the federal government's massive statistical information stockpile, Edward Zimmerman, special assistant to the director of the Executive Office of the President's Office of Administration, said such a speedy setup has long been needed by the White House where "the decision cycle is often measured in seconds, minutes and hours."

On the state and local government level, money, apparently, is the big problem. "This is, after all, the anniversary of California's Proposition 13," said William DeGroff, American Management Systems, Arlington, Va., at an NCC session. He and fellow panelists painted a bleak picture of municipal dp organizations trying to do more with less money and challenged in-

JAPAN REACTION

The 16 Japanese companies exhibiting at NCC '79 were as happy with the show as their domestic counterparts, though by and large their participation was low key.

"NCC is like the Olympic games," said a staffer at the Fujitsu booth. "It is participation that counts to us this year. Everything has turned out to be just as, or more than we had expected in terms of visitors, response and inquiries."

A spokesman for Nippon Electric Co. liked this year's NCC better than the one held last year in Anaheim. "We have been quite satisfied with the high quality of visitors. Each visitor, to our eyes, has visited with his own specific objectives and individual needs. This helped us to communicate well with each one. There were very few hobbyists and students and quite a few business-oriented potential customers. This is the way a show like the NCC should be."

Spokesmen for Ai Electronics, Fujitsu, Nippon Electric and Epson America liked the New York location. "The NCC's location in New York has brought along a dual gateway—leading to a business expansion—to American and European markets and in some cases to Latin America as well. This is an unexpected bonus to us here, and it's probably a thing that would be harder to achieve elsewhere," said one. —T.U.

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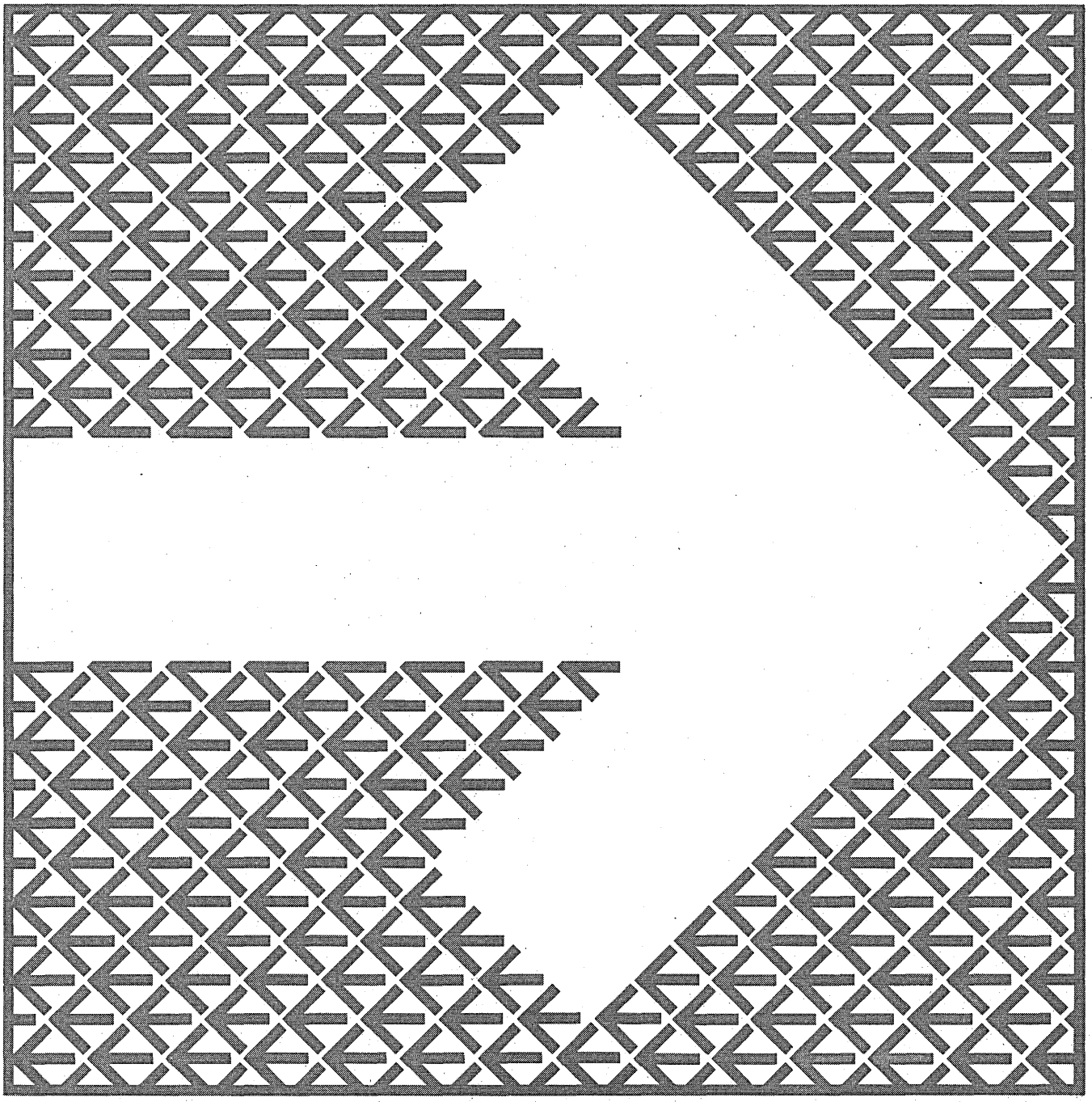

BECAUSE MANAGING DATA MEANS MANAGING CHANGE

Computer Corporation of America

dustry to help instead of adding to the problem with oversell of unneeded computer power.

They also cited personnel problems faced by local governments. "We're training grounds for industry," said DeGroff.

Personnel problems of another sort were addressed by Richard Herzfeld, Computer Devices, Burlington, Vt. In a session titled,

"Increased use of unprotected minicomputers will cause a rash of information thefts."

"Unions in Data Processing," Herzfeld dwelt, in his opening remarks, on problems he had getting union representatives to join him in the session. He wasn't successful so the entire period was given over to his personnel experiences with a union when he was a dp manager for a small Midwestern manufacturing operation. He couldn't advertise for employees but had to take bids from inexperienced but senior union people; overtime was something that had to be authorized; he got into a union grievance situation when he talked about study at home. "In the four years I worked there we ended up two years behind."

It wouldn't be an NCC without some well-chosen words from lawyers. Antitrust, of course, is a favorite legal topic and Edwin Spievack of the Washington law firm of Cohn & Marks had something to say about it. "The fine line between antitrust and regulation can't be drawn."

In a session chaired by Spievack, James Lyons of the Denver law firm Rothgerber, Appel & Powers said he believes the 90-year-old Sherman Antitrust Act, because of its "proven flexibility" over the years, will still hold up in the new world of communications (computers and communications).

Keynoter Opel worried about regulation. He worried that a limit on the growth of the computer industry could be created by

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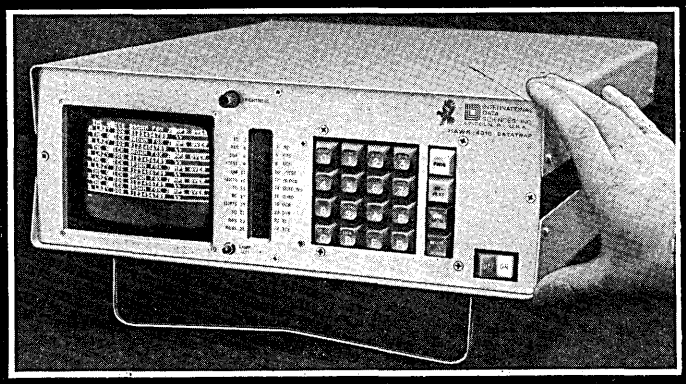

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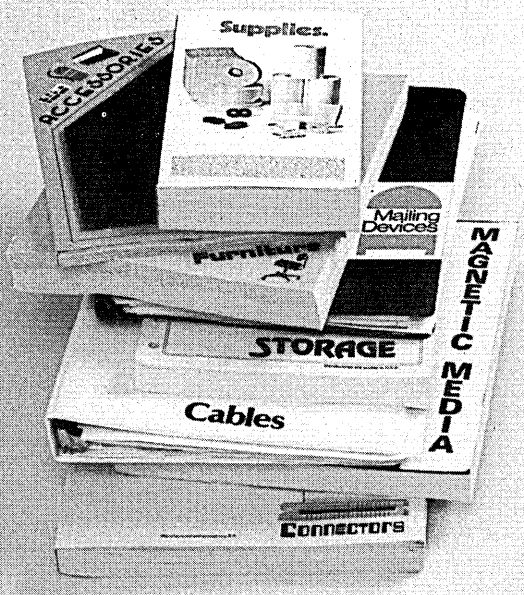

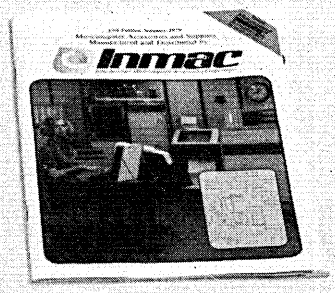

One way to order everything (all day on the phone)

Before he bought from Inmac, one customer required a pile of catalogs second only to Mt. Everest.

When the time came, he'd know just where to look for supplies.

A disk pack?
He'd go right to that 35-pound catalog under the philodendron.

A CRT stand?
Right to the furniture catalog. (Too bad he didn't read the fine print that said "2-month wait".)

EIA cables?
In the catalog that looked like last year's winning entry in the stump-the-engineer contest.

One day he needed a disk pack. And a CRT stand, 5 EIA cables, one box of thermal paper, 6 print-wheels and a harmonica ribbon.

If he didn't get them quick, he couldn't finish the Big Project. And top management was really breathing down his neck.

By the time he got all the catalogs together, figured out what would work with what, and made all the calls . . . 9 a.m. became 9 p.m.

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Never again.

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CIRCLE 23 ON READER CARD

the government attempting to restrict or regulate the computer business. "It seems to me that everyone is best served by as much open competition as possible."

Another lawyer-staffed session, on protection of proprietary rights in computer software, was one of the few at the NCC to draw and keep a standing-room-only crowd. Allan M. Lowe, Lowe, King, Price & Becker, Arlington, Va., spoke the case for patents, pointing to recent Supreme Court cases which indicate "unobvious combinations of hardware and software can be patentable."

Roger Milgrim, Milgrim, Thomaja, Jacobs & Lee, New York City, agreed that patent protection for software cannot be excluded but "the Supreme Court is chary, even hostile and the price you pay is disclosure." His favored protection—trade-secret protection.

"Most presidents aren't oriented toward computers."

Roy Saltzman, National Bureau of Standards, who espoused the copyright route, pointed out that this means is best in light of the fact that "lower costs of computer hardware are leading to increased over the counter sales of computer software." In such selling disclosure is already there and copyright, he contended, protects what is most valuable . . . the code itself.

BLAISE PASCAL was flown first class from Los Angeles to NYC to promote Pertec's new small computer, the Pascal Blaiser.

A computer industry product obviously more patentable than software, the industrial robot, was covered in an NCC session. It was noted that such robots are not intelligent yet. If robots are "to play a major role in discrete parts manufacturing operations," said Bernard Chern of the National Science Foundation, "they will have to be integrated as part of the manufacturing system. . . . They'll have to draw data from powerful geometric modeling systems and will have to be taught skill activities as well."

The usual complement of nonautomated but articulate robots were crowd pleasers in the exhibit halls.

Less obtrusive was IBM's chairman Frank Cary, who made a solitary almost unnoticed tour of the Coliseum's four floors on the show's closing day.

Presumably, both Cary and keynoter Opel got home all right. Not so those unfortunates who had booked flights on DC-10's.

For at least one NCC participant, getting there rather than getting home was the problem. It wasn't for Blaise Pascal, a life-sized dummy of the 17th century mathematician and inventor used by Pertec Computer Corp. to introduce a new small computer called the Pascal Blaiser at the NCC. Blaise flew to New York in a first class seat.

It was for Argon, DATAMATION's robot. Booked as a passenger on an American Airlines flight from Los Angeles to New York, he was boarded then bumped at the last minute. Nobody had bothered to tell the pilot about him. He made it to New York but it had to be by air freight. ✲

(This article was written by Edith Myers with reports from Tom McCusker, Linda Flato Runyan, Bill Musgrave, Becky Barna, Laton McCartney, Ron Frank, and Wendy Crisp.)

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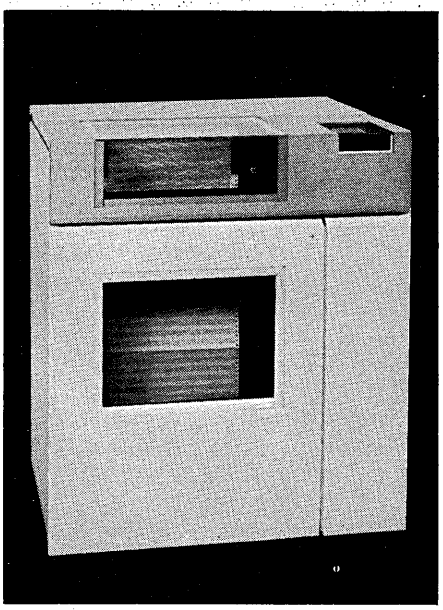

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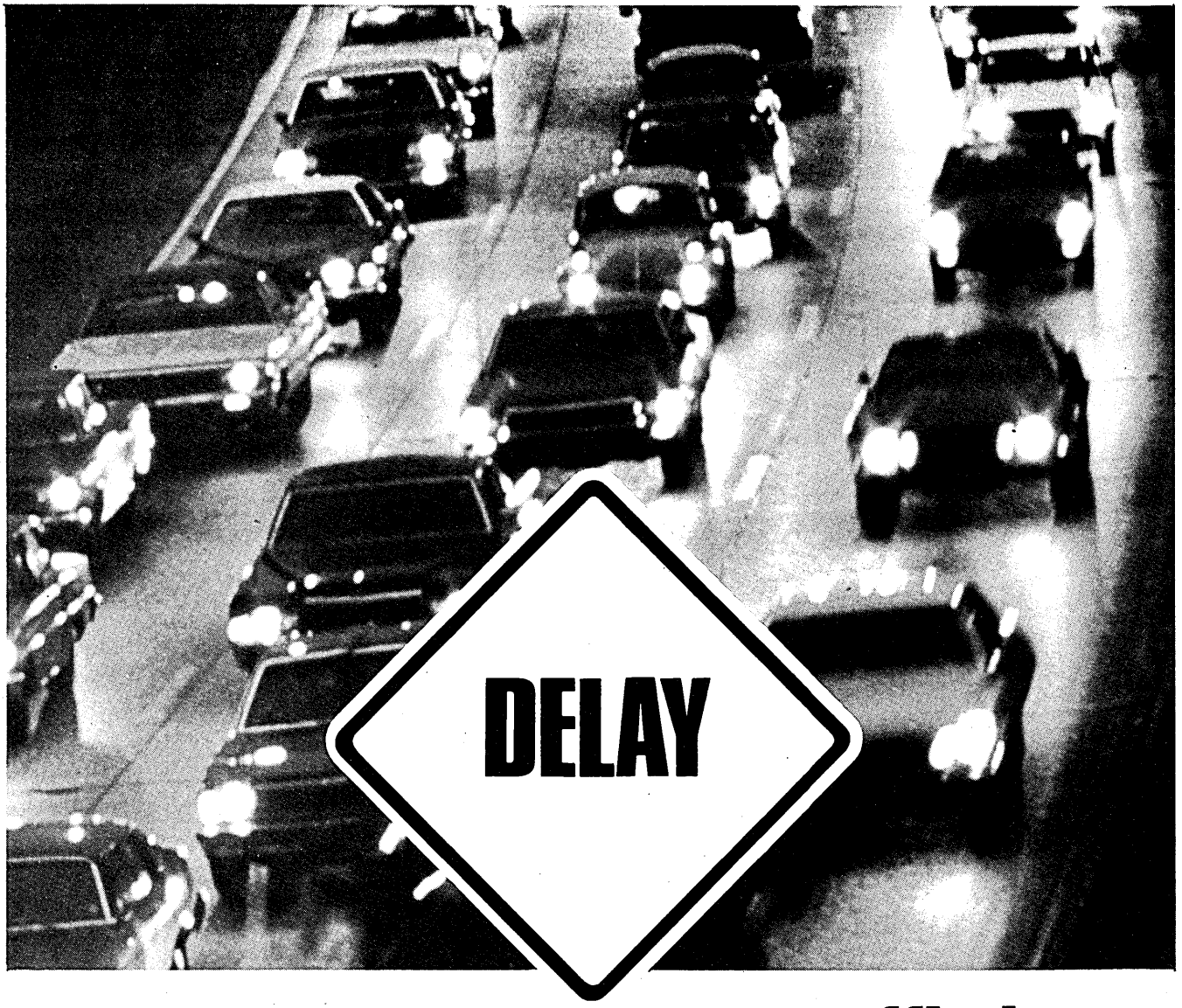

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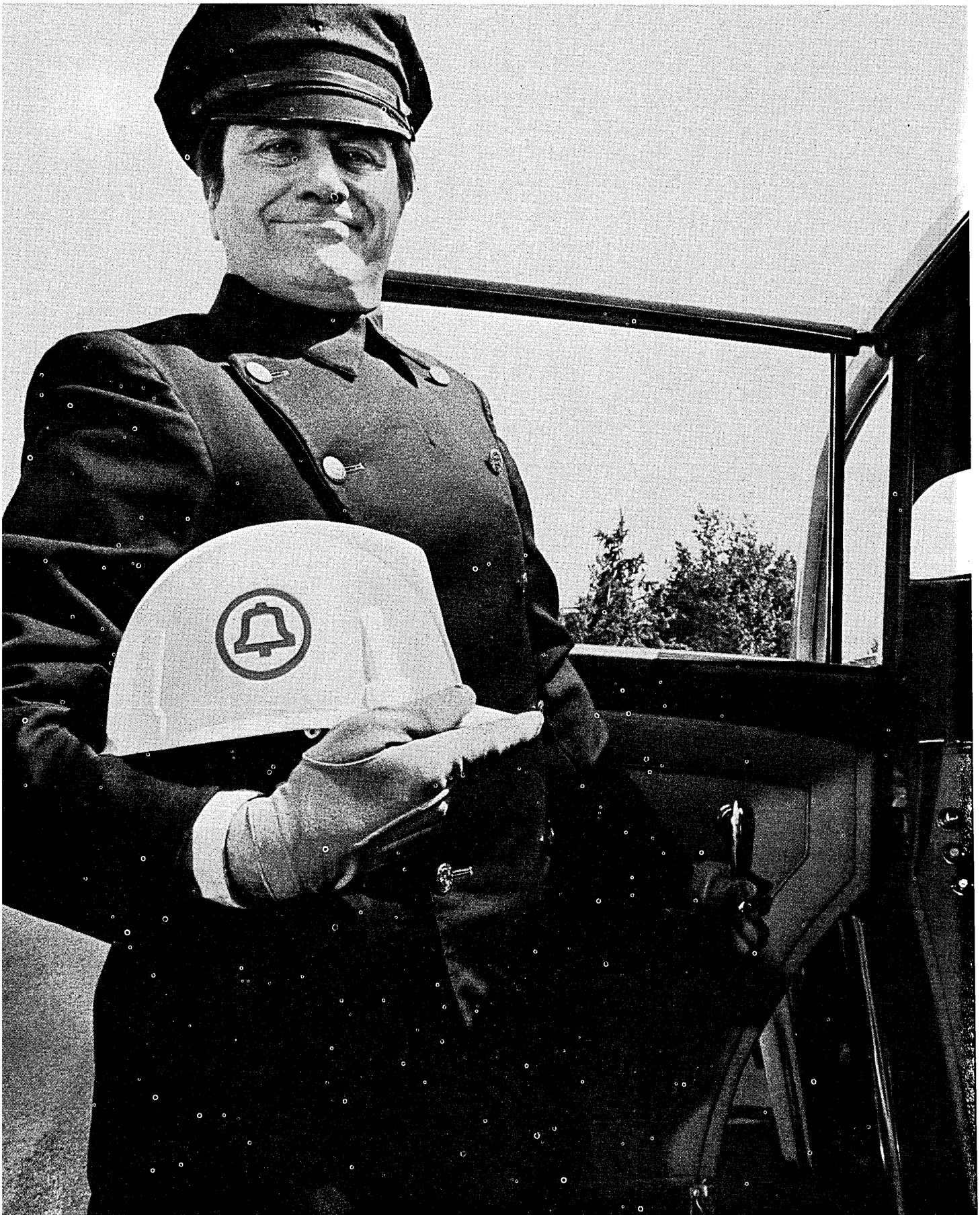
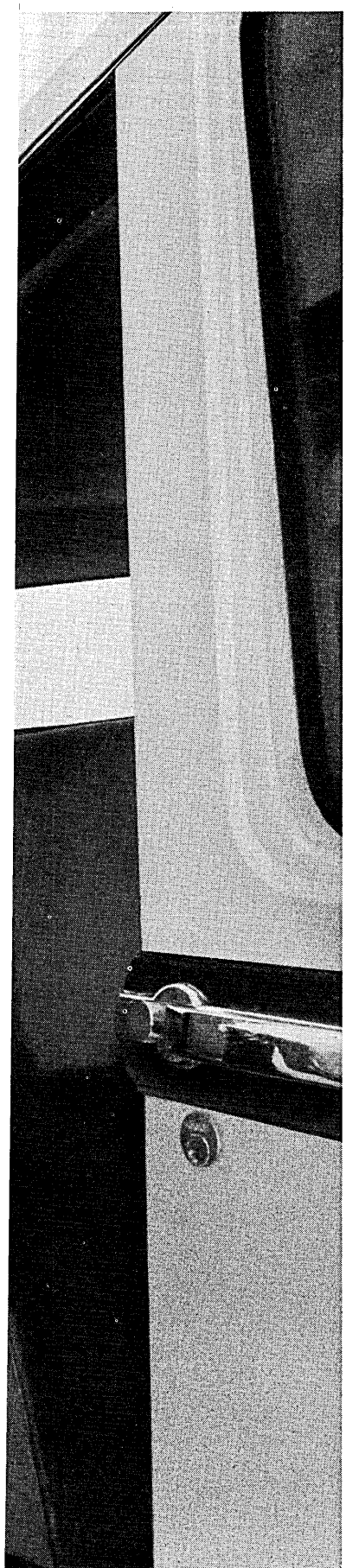
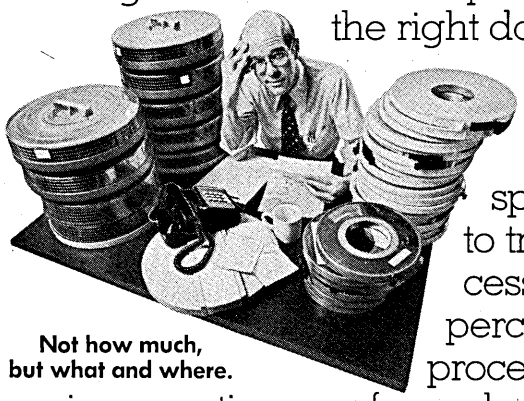


...p and delivery.



Problem Data is one thing there's no shortage of. The business problem today is getting the right data to where it's needed in a form that's useful.



Not how much, but what and where.

In fact, American businesses are now spending nearly as much to transmit data as to process it. And as much as 40 percent of the nation's data processing capability is tied up in operations performed solely for the purpose of transmitting the data.

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24/27 septembre

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PUBLICIS 602

AT&T VS. THE CCIA

Telephone spokesman says the company's policies haven't been found to be against the public interest.

Not far from the madding NCC crowd at the Coliseum, a gentlemanly debate between adversaries was staged last month in New York's Essex House Hotel.

At a meeting of the Computer & Communications Industry Assn., AT&T executive vice president Thomas E. Bolger said he welcomed the opportunity "to talk with a group that so explicitly opposes our viewpoints and so vigorously criticizes our actions." He said, "candid discussion in such a forum is almost always mutually beneficial—even with adversaries."

Bolger defended AT&T's positions regarding the evolving competitive telecommunications infrastructure. Of CCIA's concern that AT&T may not compete fairly, Bolger said, "I'm not naive enough to think that I can magically erase those concerns in a few moments." He claimed that Ma Bell's past record of service shows that "our competitive policy is to compete fairly."

Even after repeated examinations into all parts of AT&T's business by numerous bodies, Bolger asserted, "at no time have our policies been found to be against the public interest." On the "touchy and complex" issue of cross-subsidies between competitive and noncompetitive offerings, Bolger said some cross-subsidies are considered to be in the public interest. Long distance telephone revenues furnished a significant part of the revenue requirement for basic telephone service, thus keeping those rates lower than they otherwise would be. "But we completely agree that those services that are noncompetitive should not cross-subsidize competitive services," Bolger said.

CCIA thinks that fears of cross-subsidies could be allayed if AT&T were to set up separate subsidiaries for competitive and monopolistic services, an approach that has been proposed by the Congress and the Federal Communications Commission. But, Bolger said, "It is a fact of life in the bowels of AT&T all the way up to top management that we're still imbued with the belief that universal telephone service is tantamount to everything else. People tend to lose sight of that. We want to make a profit on competitive ventures to subsidize universal service." Such subsidies would not be possible, he pointed out, under the separate subsidiaries plan.

Addressing another CCIA concern—AT&T's licensing of software—Bolger said the company had three options in handling requests for software packages it had developed for internal use: (1) to deny access to the packages, "causing the requesters to redevelop similar systems at considerable expense and waste of technical and business resources"; (2) to make the software available to the world free of charge, "an option that business prudence rejects"; or (3) to make available the packages at "a reasonable fee," the option that was selected and that will remain in force.

A CCIA member said AT&T's software sales could "outstrip the independent software industry ten to one." Lee Keet, president of Turnkey Systems, Inc., thought that the telephone company should license its packages to the software industry "at large" and let that industry market directly to the end user.

Bolger said concrete suggestions are preferable to idle complaints. He said he would present these suggestions to AT&T officials.

Dr. Gordon Moore, chairman of Intel Corp., told CCIA company officers that bubble memories will carve out their own niche in computer technology. "Where nonvolatile amounts of moving-head memory are needed, bubbles will have their place. They will fill that niche—no more, no less."

He said IBM and AT&T are likely to consume increasing amounts of memory. "As an example of one place IBM has been seeking outside supplies," Moore said, "we (at Intel) have been shipping the guts of IBM memory modules.

"In fact, we are just flabbergasted by overall demand at present."

Moore said that as new demand markets constantly emerge, it's difficult to plan for expansion. "It's hard to be smart and second-guess demand." He said Intel most likely will let demand be the driving force behind plant expansion "and just hope that decision's right." —B. B.

SEMICONDUCTORS

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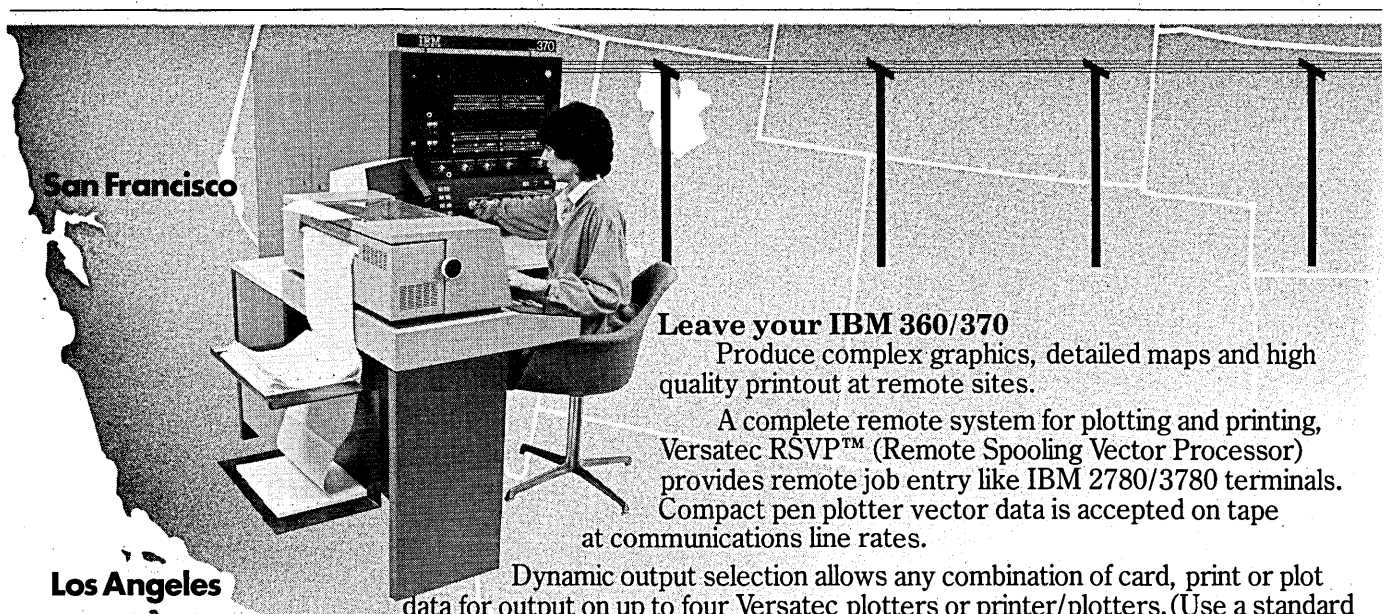

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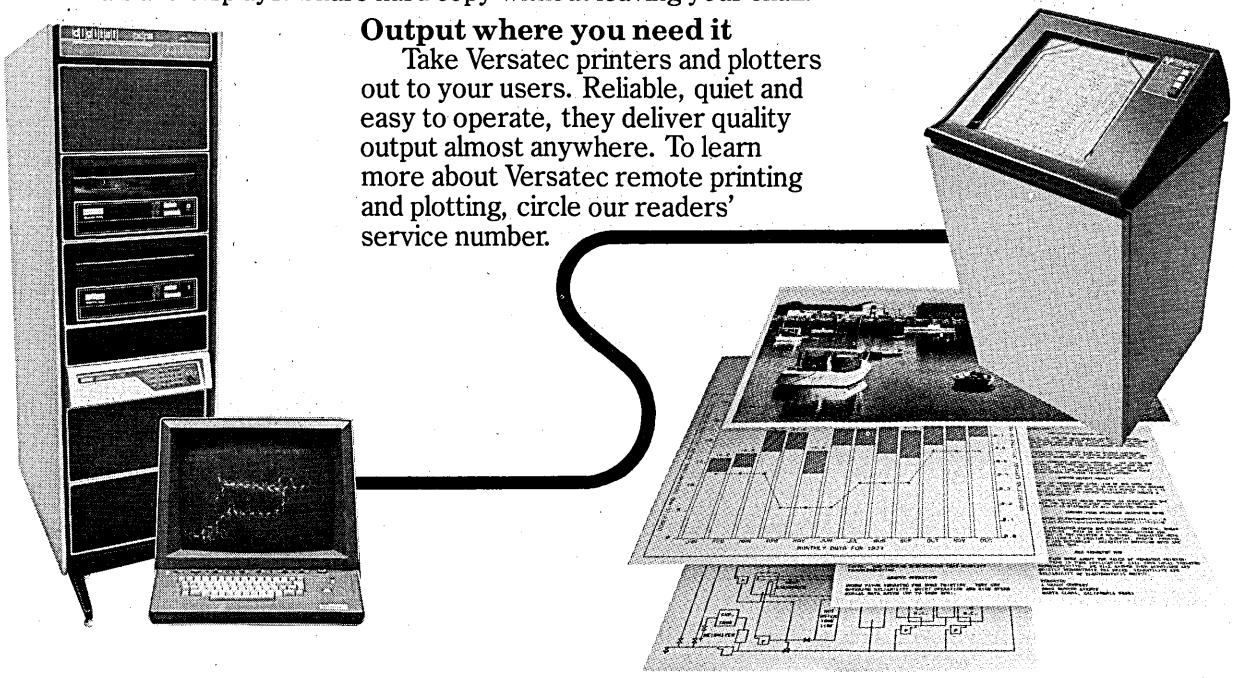

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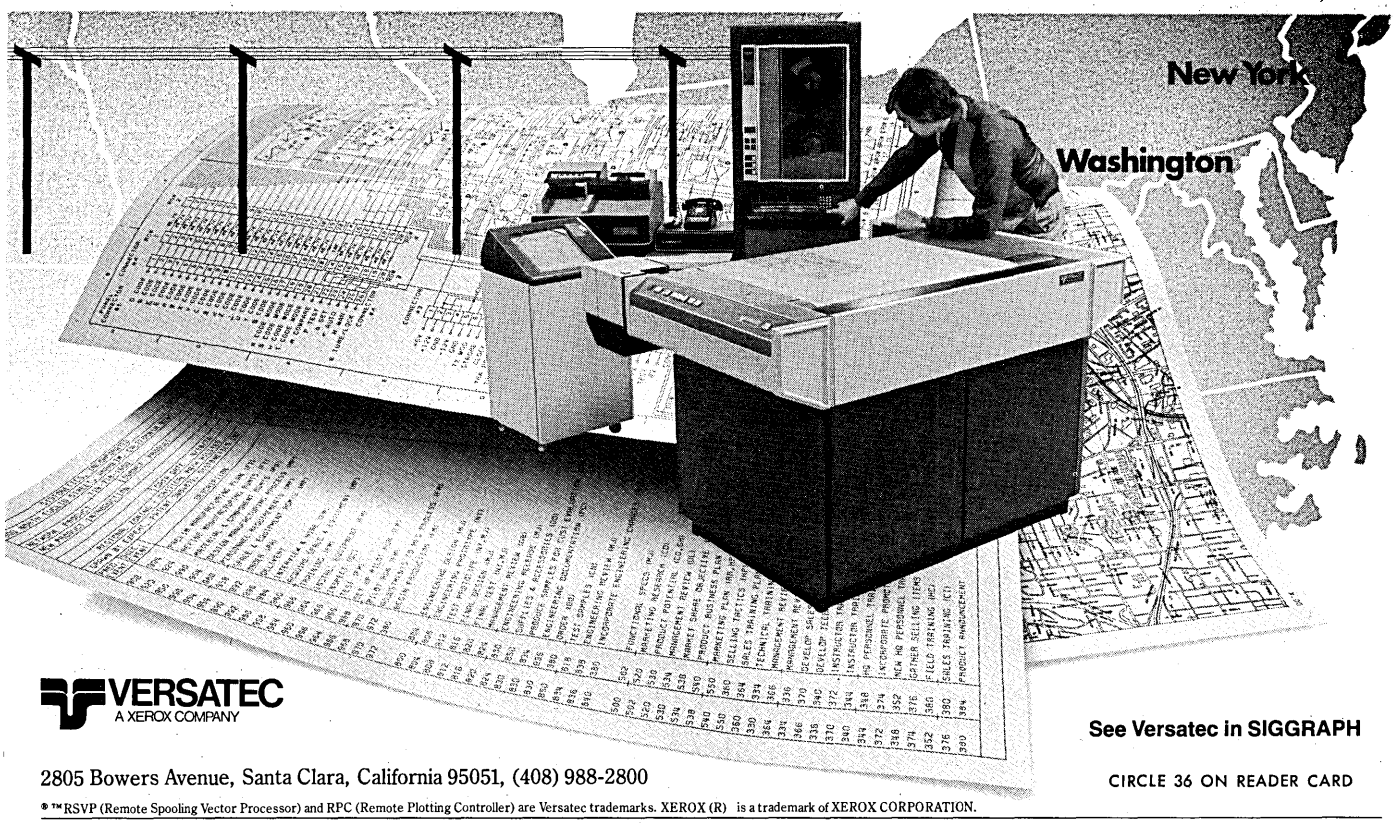

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NEWS IN PERSPECTIVE

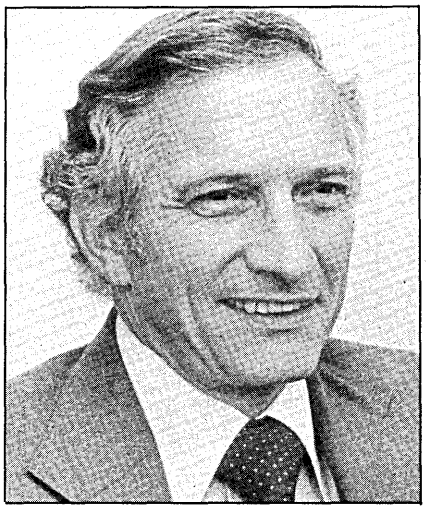
electronics companies elsewhere.

But that has changed, and there is much concern in some quarters that this does not bode well for American producers of computers and other electronic equipment.

"The cornerstone of today's market for IC's is the 16K RAM," says consultant Stanley Nehmer, "and although Japanese commercial development of the 16K RAM initially lagged behind U.S. development, low-pricing practices have allowed Japanese producers—in a period of only three years—to accumulate a U.S. market share of approximately 35% in this key, state-of-the-art semiconductor product."

That 35% figure, while perhaps surprising, is not what's significant. The fact that is still leaves 65% of the U.S. market to domestic makers is not too pertinent. The point being made was that the Japanese, coming out of nowhere, have already achieved a technical prowess in IC's on a par with the American companies that invented this game. And, it is further charged, the Japanese have used unfair pricing practices in the U.S. to achieve a very enviable market share.

The significance of this achievement is explained in an analogy by Jerry Sanders, cofounder and board chairman of Advanced Micro Devices Inc. He likens the semiconductor technology to the "crude oil" of electronics, saying that just as oil is



ROBERT N. NOYCE—Japan enterprises don't need equity market to finance growth.

key to our entire economy, semiconductors are key to computers and the growing range of electronic products, consumer and industrial.

"We had low-priced foreign oil until we became dependent upon it," Sanders says. "Then the price went up. Once again it was demonstrated that whenever someone has you in a leveraged position, you and your entire economy are at a severe disadvantage. We should not forget that lesson. If we are unable to maintain a technological superiority in the semiconductor field, we could soon find ourselves dependent on foreign sources for the electronics necessary for defense and communications systems—at risks and costs comparable to our present dependence on foreign sources of energy."

Sanders was one of four speakers who testified on behalf of the Semiconductor Industry Assn. (SIA) before the International Trade Commission in San Francisco. The subject: unfair foreign competition in semiconductors. The target: the Japanese. The objective: Congressional action on upcoming trade and tax legislation, based upon an understanding of the problems U.S. semiconductor companies face in competing with the Japanese.

The hearings coincidentally followed closely on the heels of a Commerce Dept. announcement that the U.S. trade deficit with Japan in the first quarter of this year came to $8.4 billion. It was the smallest quarterly deficit with Japan since the second quarter of '77 and the fourth quarter in a row when the imbalance had been reduced. But Stanley Nehmer, president of Economic Consulting Services Inc., pointed out in his testimony that the U.S. is also running a deficit in trade with Japan in semiconductors. He said this turnabout first occurred in 1977 when U.S. imports of

semiconductors from Japan exceeded our exports to Japan by $17 million. In 1978 the deficit grew to $45 million.

Dr. Robert Noyce, vice chairman of Intel Corp., said in Japan the government has designated the integrated circuit, telecommunications, and computer industries as being vital to the nation and thus "targeted for growth." Further, enterprises are highly leveraged through loans by banks that are closely controlled by the government.

"Japanese semiconductor enterprises are not dependent on the equity market to finance growth," Noyce noted, "and hence do not have to achieve a high rate of return in order to attract capital. The quasi-national bank credit system permits the enterprises to finance long run deficits necessary to penetrate foreign markets."

He charged the Japanese with setting a higher price for their IC's in the domestic market, where competition from foreign vendors is limited by a variety of barriers, and a much lower price in markets abroad. He said, for example, that at the end of 1978 the Japanese were selling the 16K RAM chip in Japan for $12 to $13. Their price for the same product in the U.S. market was $5 to $6, whereas U.S. manufacturers were selling the 16K here for $7 to $8.

Just as oil is key to our entire economy, semiconductors are key to computers and the growing range of electronic products.

Of course, one must not assume that American vendors were making a bundle at $7 per. At that low price, margins are very thin; it leaves very little to plow back into R&D, much less new capital equipment, and it doesn't do much to attract investors. This aspect of the business was addressed by John Nesheim, treasurer of National Semiconductor Corp.

Nesheim told of the high debt-to-equity ratio of Japanese companies, contrasted with that of their American counterparts. He said U.S. companies have double the return on equity of Japanese companies, saying that earnings of U.S. manufacturers are twice as much per doller of sales as their Japanese counterparts. And he said this level of earnings is necessary in a free market economy in order to attract fresh capital.

Repeatedly at this hearing the point was made that the problem was financial, not technical. And the speakers reiterated that what they sought was for every participant in this game to play by the same rules.

—Edward K. Yasaki

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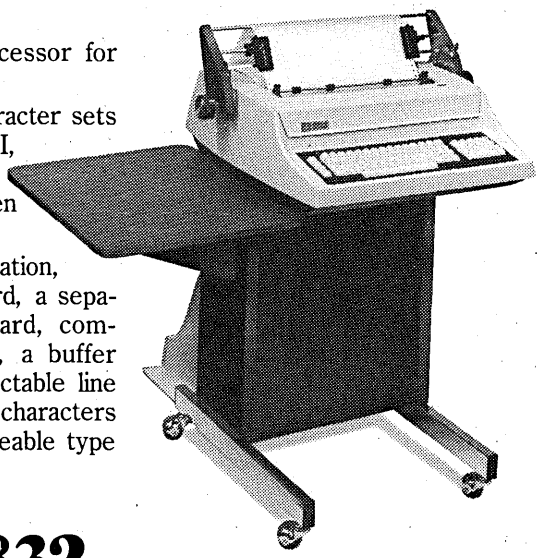

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CIRCLE 101 ON READER CARD

CAREERS

NEW INFO ROLE FOR THE FEDS

Proposal would create the information manager as an entirely new job series in government service.

"A root cause of the excessive and unnecessary paperwork burdens the government places on the public . . . is the failure of the government to deal with its own information needs as a resource."

That comment was made recently by Forest Woody Horton of the Commission on Federal Paperwork, which two years ago said the government must apply more management muscle to the way it handles information activities. Says Horton, "Information needs to be treated as an organizational resource. The management disciplines that are now applied to human resources, financial resources, and physical resources can be applied with some common sense modifications to information resources."

Early this spring, the Information Industry Assn. turned over to the Office of

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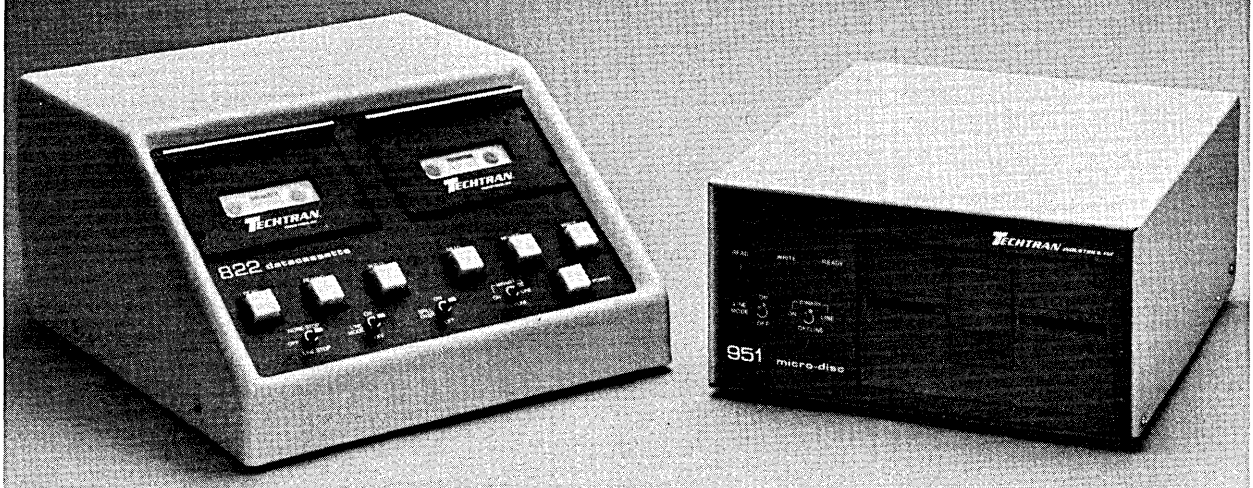

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FOREST WOODY HORTON—Many kinds of people would be acceptable for this job.

Personnel Management (formerly known as the Civil Service Administration) a proposed occupational standard for the information manager. It's the work of a year-old organization of professional information managers, called the Associated Information Managers committee which the IIA sponsored and which Horton chaired.

It proposes an entirely new job series and includes all classes of government positions from GS-9 through GS-15, that advise on, administer, supervise or perform information work. Their chores encompass libraries, computer centers and related dp programs, word processing centers, printing and publishing operations, and management information systems.

"We have financial managers, personnel managers and physical plant managers. So we're simply following the analogy through with information managers."

It would require a new breed of professionals, says Horton. "We have financial managers, personnel managers and physical plant managers. So we're simply following the analogy straight through and saying therefore we need information managers."

Serving as the principal adviser to top and middle federal managers, the so-called information manager, according to the draft proposal, would provide technical expertise and counsel on such matters as information plans, budgets and security measures. As a true resource manager, such a person would play a "broker or counselor" role, acting "as a bridge between increasingly costly, complex and diversified information handling technologies on the one hand, and larger and larger numbers of managers and users unfamiliar with the technologies, their applications, their costs and their values," the IIA standard recommends.

Specialized experience in at least two primary occupational or knowledge fields are necessary to qualify for the position as set out by the proposed standard. These include: library, archival and related sciences and technologies; statistical, actuarial, accounting, operations research and related math, research and analytical skills; technical writing and editing and related journalistic skills; and computers, telecommunications and related sciences and technologies.

"There are jobs in government," Horton said, "which ideally should be filled by persons with the information manager's qualifications; but many kinds of people," he said, "would be acceptable for these jobs." As an example, Horton cites the computer systems administrator who could fill the job of data base administrator.

After accumulating a certain amount of experience and authority in an information manager position, a person, according to Horton, could move into a loftier job. A sample job description pinpoints two such senior level positions—director of a data base management division (GS-16) and a deputy assistant secretary for information management (GS-18).

Under the computer-communications category, the draft standard cites experience in fields such as process automation, miniaturization such as micrographics, word processing, data base management systems, MIS, COM, distributed processing, networking, and video systems.

Horton admits that dpers both in and out of government may be feeling a little standoffish about the new information manager movement. They "feel they're going to rule the world anyway, so whether or not we have an information manager around is beside the point. They're not quite that arrogant," he adds diplomatically, "but I sense a feeling of polite indulgence . . . because technology is at the leading edge of this whole thing. There's no question that it is and that it's dragging everybody else along."

IIA president Paul Zurkowski sees the dpers view from a slightly different perspective. "Of all the information workers, dp people," he observes, "are probably the best positioned as a group because they have had to deal with top management in terms of capital investment decisions. They are familiar with the apparatus of running

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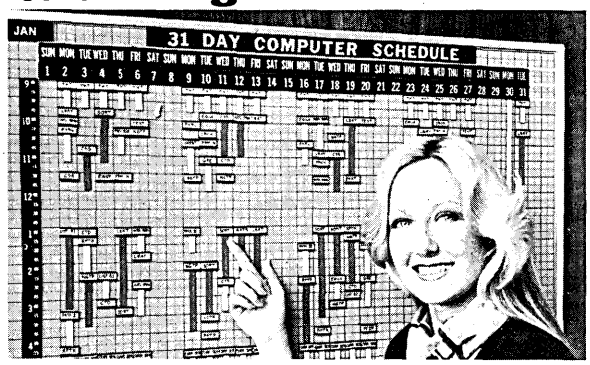

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CIRCLE 109 ON READER CARD

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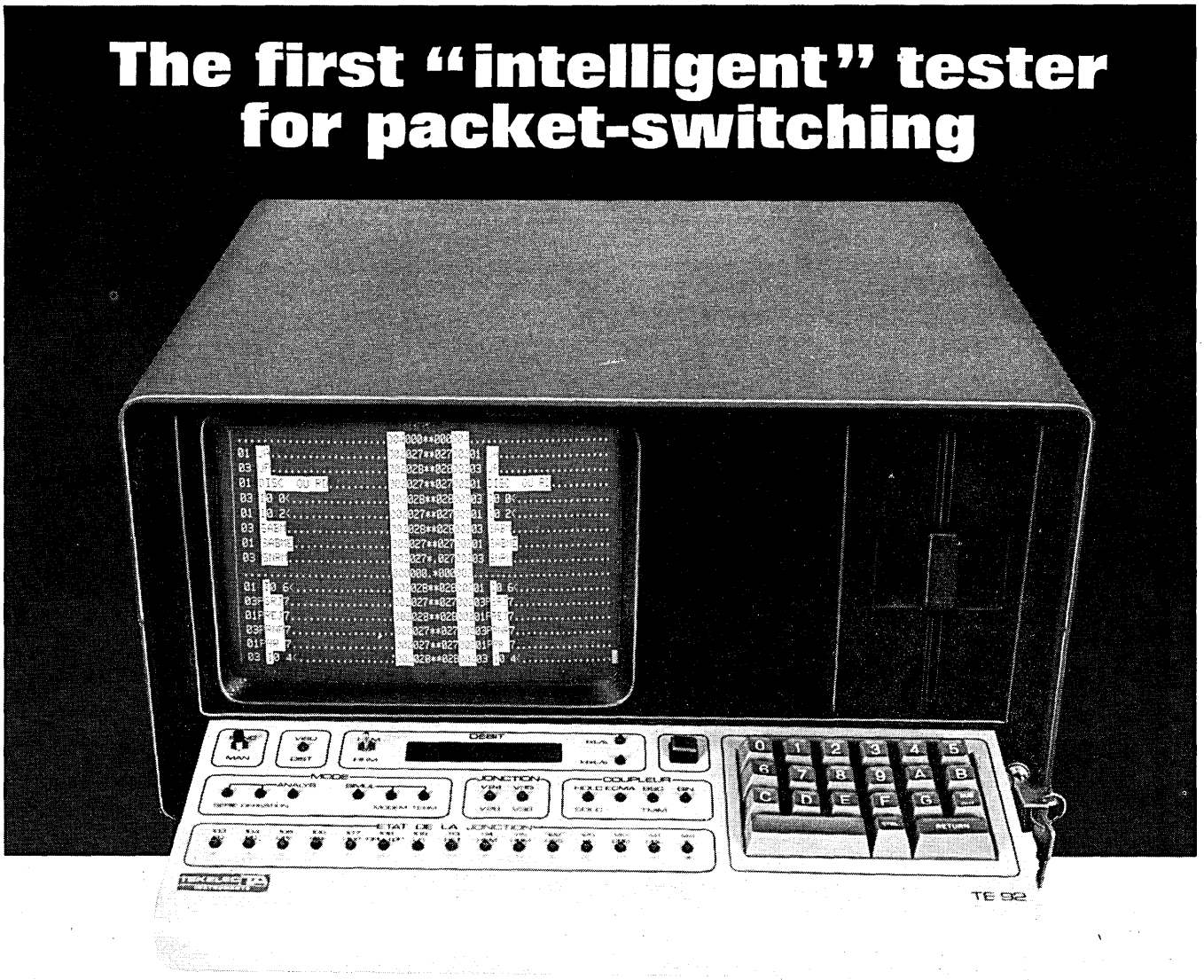

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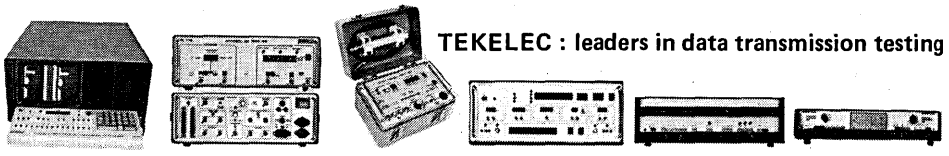

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And the Standard Edit option lets the ADM-31 clear to protected spaces, clear to unprotected nulls, and set and reset copy-print.

As if that wasn't enough, the keyboard includes a caps lock key (to lock the keyboard into upper case only).

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CIRCLE 46 ON READER CARD

an organization and they know how they fit into it."

Zurkowski says that's not true of other information workers who see more of a need than the dpers for the information manager function. Dpers may also feel this new position is "denigrating to them. If they see themselves as having that bridging role—bridging a number of information functions—then I think they would be interested. But if they see themselves as 'kings of the mountain' and they're not interested in performing that bridging role, then they won't be interested in the information manager function."

After accumulating a certain amount of experience and authority in an information manager position, a person could move into a loftier job.

Frank Carr, commissioner of the General Service Administration's Automated Data & Telecommunications Service, feels strongly that expertise in the computer and telecommunications fields should be a qualifying must for the proposed information manager position. The "strongest discipline" in the information field, says Carr, "is in the computer and telecommunications area."

"This tends to be played down," he observes, "by many people who say technicians don't know the value of information. But you can't assume that simply because a lot of technical people haven't measured up to management responsibilities and have not been able to manage information as a resource that others who do appreciate the value of information as a resource are necessarily going to be able to deal with the total ball of wax."

Carr agrees with Horton that technology is the motivating factor. "The dp and telecommunications people, mainly because of the technology and the economics associated with it, are really the driving force. All the other related information areas tend in some sense to be constraints. . . . What you want is an information manager who understands the technology and the economics, but has that additional quality to go beyond it and bridge that gap."

The fate of the standard currently is uncertain. The Office of Personnel Management has taken a characteristic stand—it's waiting for the agencies to voice a need for the occupational standard before setting to work. The draft standard, or at least its intent, has been backed by several trade and professional groups. It's also garnered some vestiges of support from Congress since the emergence of several bills aimed at beefing up the Feds' use and management of information resources.

Says Horton, "I think the strongest single cohesive element in this whole thing is for the information manager. Their sense of shared identity has emerged to the point where they will hold together. . . . Today there is a critical mass of information managers, both in government and private industry, and they are going to have their day," he insists, "regardless of whatever OPM does."

—Linda Flato Runyan

INFORMATION RESOURCE MANAGER

In late April the final report of the Federal Data Processing Reorganization Project finally made its way to President Carter's desk. Close to two years (27 man-years) of work went into the project which was orchestrated by the Office of Management and Budget. While there's been no official White House reaction to the study, defensive OMB officials claim some action will eventually be taken as a result of the report's findings. Meanwhile, OMB is still "reviewing" the report's nine key recommendations, one of which supports the information resource manager approach. The recommendation reads as follows:

> The OMB should require each department or agency of government to establish an Information Resource Manager (IRM) as an assistant to the agency head. The IRM would be accountable for the following actions leading to the efficient and effective use of information technology throughout the organization served:
>
> • Oversee the development and ongoing operation of the organization's information technology long-range planning mechanism and coordinate this planning with agency program planning.
>
> • Encourage technological innovation in the provision of service delivery by the organization, within existing budgetary, technological, and organizational resource constraints.
>
> • Monitor the delivery of services by the organization, and advise the Secretary/Administrator on the best use of information technology to increase the efficiency of such services.
>
> • Advise the agency head on areas in which the information technology can be used to increase the overall effectiveness and productivity of information processing activities in support of the organization. ✻

CIRCLE 112 ON READER CARD

Small Business Systems Surveyed

Microdata Reality Gets Top User Rating

Microdata Corp.'s Reality, Basic/Four Corp.'s Model 400 and the IBM System/3 models 6, 10 and 15 reaped the highest marks in Management Information Corp.'s (MIC) fourth annual small business systems users survey.

To assess how well small business systems are meeting users' needs, MIC polled 568 companies that use 689 small business CPU's.

Each respondent was asked to subjectively rate the vendors and their products on performance (whether stated equipment specifications have been realized), reliability (uptime vs. downtime), ease of use (amount of time necessary to train new personnel), service (maintenance) and vendor support (such as advance training and program assistance).

A four-point rating scheme was used (1 = poor, 2 = fair, 3 = good, 4 = excellent). The survey results were given as averages of the ratings assigned to each product in each of the five categories.

The Microdata Reality, Basic/Four 400 and System/3 Model 10 and Model 15 were the only small business systems to receive ratings of 3.0 or higher in all five categories.

Taking the average of all five categories, the Microdata Reality topped the field with a score of 3.66 (based on 27 respondents using 55 units). The Reality earned 3.8 in performance, 3.8 in reliability, 4.0 in ease of use, 3.4 in service and 3.3 in support.

Based on nine respondents with nine units, the average for the IBM System/3 Model 15 was 3.6. This system was rated 3.6, 3.8, 3.6, 3.7 and 3.3 in performance, reliability, ease of use, service and support, respectively.

Eight users with 17 Basic/Four 400's gave that system an overall rating of 3.5. In performance, reliability, ease of use, service and support, the system was rated 3.5, 3.4, 3.8, 3.4 and 3.4.

Following this order, the IBM System/3 Model 10 was rated 3.3, 3.5, 3.3, 3.3, and 3.3, respectively, by 34 users with 45 units. The System/3 Model 6 received 3.4, 3.7, 3.7 and 3.1 ratings in performance, reliability, service and support, respectively, by eight users with eight units.

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BANKING

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Pilot system of the American Bankers Assn. will combine paper and electronics in a funds transfer system.

A pilot program for what might be termed paper/electronics funds transfer is underway under the auspices of the American Bankers Assn.

The ABA announced what it calls its Check Safekeeping pilot at its 1979 National Operations & Automation Conference in late May in Anaheim, Calif.

What is planned, said Joseph P. Coriaci, chairman of the ABA's Check Safekeeping Task Force, "does not in any way deal with or suggest getting rid of checks. We are going to concentrate on how we might all process checks in a more efficient, effective,

"The task force will make recommendations and provide background research for the participants."

and primarily customer service oriented economic way."

Consumers enamored of canceled checks might not agree with the latter. Under the safekeeping program, a transaction would begin with a written check which would go to a payee who would deposit it in his bank. So far, traditional. But the next step is the change. The payee's bank, instead of passing the check into a check collection system from whence it would go to the payor's bank and back to the checkmaker, would instead convert the information on the check to electronic impulses which it would transmit to the payor's bank. This bank then would send the check writer a descriptive statement instead of canceled checks.

Initially, however, consumers are not involved. Only "certain" business checks and government checks will be "safeguarded" in the pilot which will involve "selected banks" in each of the 12 Federal Reserve Districts, Coriaci said.

He added that savings of approximately a nickel a check in a mature check safekeeping environment were estimated in initial research conducted by the ABA and Dr. Allen H. Lipis, president of Electronic Banking, Inc., Atlanta.

Coriaci said the paper checks would be retained by the first bank of deposit for the other institutions and inquiries or requests for copies will be supported.

The electronic transfers probably will be

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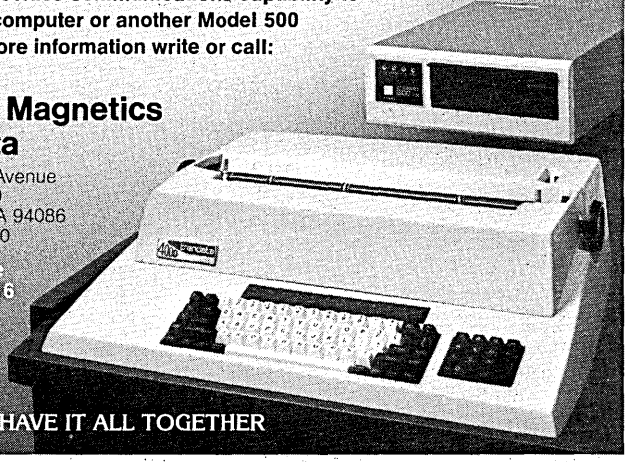
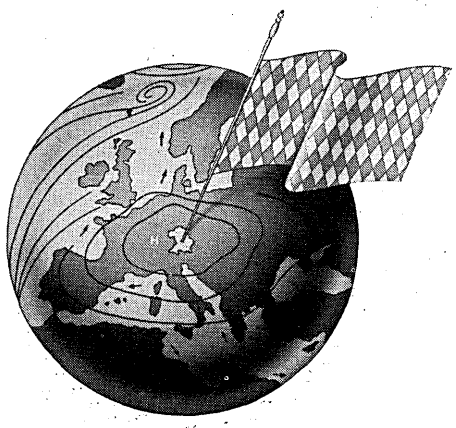


OUR TERMINALS HAVE IT ALL TOGETHER

CIRCLE 113 ON READER CARD

Weather forecast outlook for your investments in

Bavaria: bright and sunny



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Bavaria's infrastructure meets the exacting requirements of a modern industrial state. (Note that the Federal Republic of Germany has the most extensive network of autobahns or superhighways in Europe.) The international airports in Munich and Nuremberg and many strategically located airfields throughout the state link Bavaria to Europe and the world. The sources of available energy range from natural gas to nuclear power. Industrial sites with utility connections are laid out in all parts of the state.

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NEWS IN PERSPECTIVE

made via the Automated Clearing House system, the bank card networks, or the BankWire system depending upon the wishes of the participating banks.

"As project administrators," Coriaci said, "the task force will make recommendations and provide background research for the participants on issues of concern to the banking community and the banking public."

In choosing the term "community," he followed through on a thought mentioned by conference keynoter Willis W. Alexander, executive vice president of the ABA. "There's been a lot of talk about the cascading torrent of regulations facing the banking industry. I don't think it is an industry. It's incredibly diverse and potentially divisible, more like a community. Diversity is its hallmark and consensus is its goal."

And one area where consensus appears to be close is in automated cash management services or corporate EFT. "Until recently," said William J. Osterman, vice president, the Chase Manhattan Bank, "cash management was a lot of independent functions, collection, concentration, disbursement, forecasting and short-term investment of surplus cash. Today the trend is toward a fully integrated system." He said his bank's InfoCash system is one such and that other banks and service organizations are moving in the same direction.

BankWire is "assessing its overall role as an industry communications utility."

Factors giving impetus to increased use of automated cash management services include the National Automated Clearing House Assn. (NACHA), BankWire (a cooperative bank telecommunications network), FedWire and the Society for Worldwide Interbank Financial Telecommunication (SWIFT).

Status reports on all four were part of the ABA conference. John J. Housemann, vice president of NACHA and senior vice president, Irving Trust Co., reported that as of last September NACHA completed its interregional exchange network. "All ACH's are linked together and our experience has been outstanding. There have been few incidents of misdirected files. Our control procedures have been successful." He said the NACHA network handled 2½ million transactions last March and expects to handle 4 million by December and 8 million by the end of 1980.

Bernard W. Romberg, president, BankWire told the conference that his organization "is assessing its overall role as an industry communications utility. Our role is to serve our members and in the context of the changing technology, our own technology and goals must change. Our goal for the near-term is to provide an on-line payments management system, which to-

CIRCLE 130 ON READER CARD

gether with new terminal products will produce a new era of end-to-end automation—one that will address user needs for same-day availability and simplified reconcilement."

He announced five enhancements to the BankWire II system: addition of a backup switching center; a method for delivering messages to the Telex and TWX terminals of non-BankWire members; the availability of several new terminals with extended processing and peripheral capabilities; and plans to proceed with both net settlement and batch transmission as the next extensions of the systems capabilities.

Howard F. Crumb, adviser, Federal Reserve Bank of New York City, told the conference that the Federal Reserve plans a complete overhaul of its electronic communications system—the first since 1969. He said restructuring of the network will take some four years. FedWire, as the network is known, connects the 12 Federal Reserve

"Telephone bill paying is coming into its own, and is doing it in no uncertain terms."

Banks, their 25 branches, and 460 member commercial banks.

Crumb said some 100 suppliers of goods and services recently were surveyed by the Fed to determine their interest in meeting requirements for the job. He gave few details of the system's plans for the project but said the wire "would be designed to handle, at a minimum, three times the projected 1980 peak-hour volume."

SWIFT's daily transaction traffic is running at 150,000. "This year we are truly worldwide," said Carl Reuterskiold, general manager. SWIFT is in the process of adding a U.S. processing center to its two in Brussels and Amsterdam. Hong Kong and Singapore will be the first areas connected to this center. Reuterskiold expects connection to Japan in October 1980 and to South American countries in 1980 and 1981.

A simpler, closer-to-the-consumer form of EFT, telephone bill-paying, was described as a "comer" by Electronic Banking Inc.'s Lipis. "In a banking world full of systems, switches and sharing, the proprietary, personal, and private world of telephone bill payment seems quiet indeed."

But he believes telephone bill paying is "coming into its own, and is doing it in no uncertain terms. . . . It is the most competitive EFT service in Cleveland, in Pittsburgh, and in the metropolitan New York/New Jersey area."

He said a minor survey of the major telephone-bill-paying providers shows that several of them exceed 100,000 bill payment transactions per month. His company, he added, "is presently in the midst of a complete enumerative survey of telephone bill payment providers."

He characterized telephone-bill-pay-

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CIRCLE 114 ON READER CARD

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DA 7/79

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CIRCLE 145 ON READER CARD

ment as "the forerunner of the future direction of retail banking and the ultimate convenience to the consumer. It is the first of many financial services that will be offered from the home."

John F. Fisher, senior vice president, First Banc Group of Ohio, Columbus, O., looked farther into the future. "The blue sky, gee-whiz world is being put in place. Systems are evolving that will allow our customers to do our dp job, which will allow them to get at their bank accounts whenever and wherever they want to."

He said two developments are pushing banking toward the introduction of self-service: the elimination of protection from competitors and the marketplace acceptance of technology.

"Clearly, banking has been learning the procedures in the '70s to launch a major change in delivering service in the '80s. Self-service is at the heart of this change."

—Edith Myers

AIRLINES

AIRLINES COPE WITH A CRISIS

United strike, other troubles, show industry to be a remarkable computer and communications machine.

The way the U.S. airlines industry coped with crisis after crisis this spring and early summer is a testimony to its industry position as a remarkable computer and communications machine. It operates on a scale that is almost awesome to those not familiar with its unique history and characteristics.

Before the United Airlines strike of March 31, UAL was handling about 170 reservations messages per second, on a reservations network that links 11,500 terminals to an IBM 3033, swapping data with 123 3330-equivalent spindles over 135 polled lines. And although the strike closed down virtually all sales desks, bookings from travel agencies and other airlines for post-strike flights kept the system active with two to three millions calls a day.

The grounded DC-10's in early June further aggravated a just-solved problem after UAL had settled its 58-day strike by machinists. Even before the strike many U.S. carriers had been jumping from peak to peak in passenger totals, struggling to refurbish and upgrade the infrastructure to handle the holiday crisis with its predictably record number of air travelers.

But it was the United strike where the other airlines faced their critical challenge. The first impact of that strike in the airlines' electronic environment was in the overloaded circuits of Arinc, Inc., the jointly-owned electronic switching system that the airlines use for communication among themselves. Arinc's Chicago complex—hosted by six CDC Cyber 1000s and four Cyber M 1000s and two Collins 8400s—was blitzed by a rush of unexpected message traffic as United notified other airlines of flight cancellations and other carriers sought new interconnect flights for their customers.

Normally, the Arinc system handles 3.1 million to 3.2 million messages per day. With the strike, volume jumped to about 4 million.

American Airlines, with flights often parallel to United, absorbed a major percentage of the United traffic, but the Tulsa-based dp and communications service was working at the upper limits of system capacity even before the strike. American runs its operating system called ACP (Airline Control Program) on an Amdahl V/7 with eight megabytes of memory. The cpu occupancy jumped from 89% before the strike to peak at just short of 97%. Before the strike American was processing 8 million messages a day; by mid-May they were handling in excess of 10.2 million a day.

Dalton Wiley, AA's planner for real-time resources, said it was only because a number of hardware and software improvements were able to be implemented during the strike that the airline's 13,500-terminal system was able to accept the new load and stay within system capacity. AA is scheduled to upgrade to the Amdahl V/8, the largest IBM-compatible cpu, in September; but a file organization, planned prestrike, whereby 132 modules of 3350 disk storage were upgraded to 220 modules across 11 channels, increased capacity just enough to allow them to pull through the early crunch.

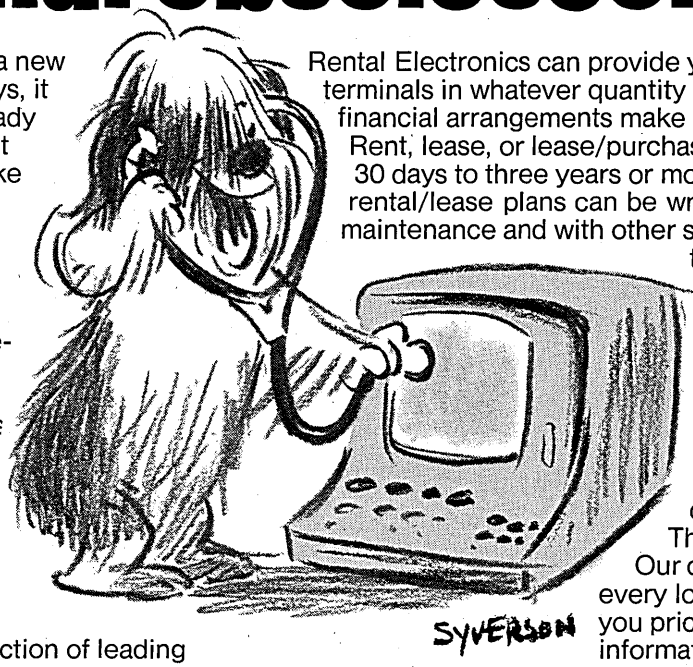
The AA system also hosts reservations systems for Air Wisconsin, Texas Interna-

By mid-May American Airlines was handling 10.2 million messages a day.

tional, Cochise, and Swift Air on the V/7 (with a second on backup), and uses six CCI CC-80's, an IBM 3750, and two Collins C-systems as communications processors. Prestrike, the sytem was handling a mean peak of 210 factored messages per second. With the strike, the figures jumped immediately in excess of 230/second, and would rise as high as 250 messages/second.

At TWA's Kansas City dp center, PARS traffic was up 50% over the previous year for the strike period, reflecting a 40% jump in TWA passenger boardings. TWA staff had the luck and foresight to move a planned cpu upgrade forward on the chance of a

How Rental Electronics helps you avoid terminal obsolescence.



As soon as you take delivery on a new printer or data terminal these days, it seems the next generation is already being announced. Chances are, it has capabilities that begin to make your "new" equipment obsolete. Now, thanks to Rental Electronics, you can have your terminals and highest technology, too.

Renting electronic equipment instead of buying gives you immediate delivery of state-of-the-art products with no capital investment. And since our rental prices are so low, you can easily afford to upgrade to the latest in printers and terminals as new technology arrives.

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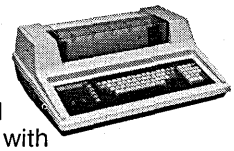
Above all, renting means flexibility. That's why Rental Electronics can provide you printers and terminals in whatever quantity with whatever financial arrangements make best sense for you. Rent, lease, or lease/purchase one to 1,000...for 30 days to three years or more. You tell us. Our rental/lease plans can be written with or without maintenance and with other special features tailored to your needs.

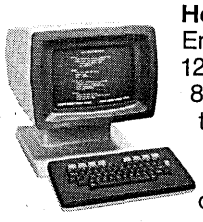
If you're interested in more information on renting printers or terminals from Rental Electronics, call one of our local rental centers today. They're listed opposite. Our on-line computers at every location let us give you price and availability information instantly, while you're still on the phone. In the meantime, check some of our featured rental offers below.

Printers and Data Terminals

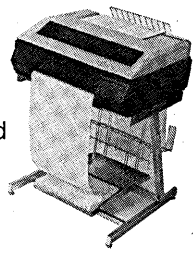
Here is a sampling of the printers and data terminals available from Rental Electronics. Call or write today about your specific needs.



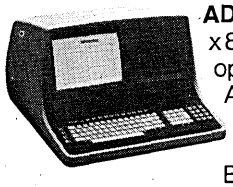
TI Model 820 Keyboard Send-Receive Data Terminal/Printer Printer operates at 150 cps on 9 x 7 wire matrix assembly printhead. Full ASCII Keyboard (ANSI-compatible) with N-key roll over. Operates in Asynchronous, USASCII, RS232C interfaces and is compatible with Bell 103, 113, 202 and 212 units. Selectable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



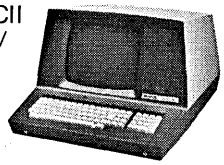
Hewlett-Packard 2621A/P Terminals Enhanced 9 x 15 dot character cell, full 128-character ASCII character set in 24 80-character lines. Two pages of continuously scrolling memory. RS232C and Bell 103A compatible. 110 to 9600 baud. 2621/P includes built-in printer operating at 120 cps.



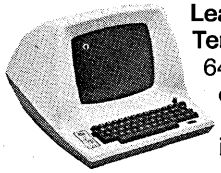
Tally T-2000 Hush-Tone Line Printer Acoustically designed enclosure. Operates at 125 (Model 2100) and 200 lines/minute (Model 2200) with standard 64 character USASCII. Line spacing switch selectable, 6 or 8 per inch.



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



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



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

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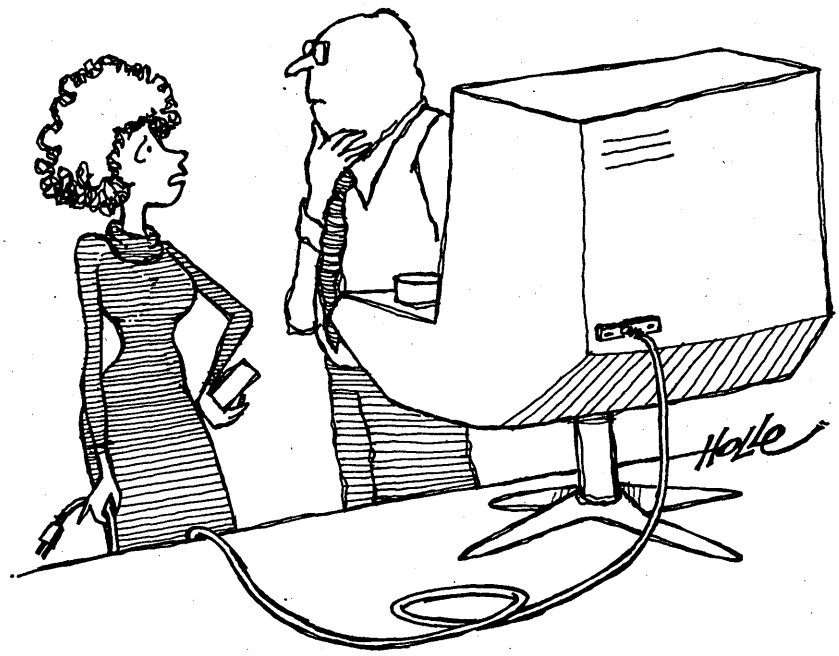
strike, moving from a 370/168 to a 3033 the very morning of the strike. TWA also expanded its file storage with the upgrade, changing from a 2314 disk-based system, with 2305 fixed-head disks and a few 3340s, to 160 modules of 3340s over 10 channels.

With 5,500 terminals on 46 communication lines, TWA saw traffic jump from a peak weighted message/second rate of 91 prestrike to 118 message/sec. during the Memorial Day booking burst. "ACP is a totally different operating system," explained Thomas Taylor at the TWA dp center; "it doesn't use VS or anything and it has tremendous throughput. Right now we're up to 4.7 milliseconds for processing costs."

Howard Hall, director of Eastern's Doral Computer Center in Miami, said that Eastern's route structure, being North-South, with few exceptions does not parallel United, so there was little direct impact on his system. "We have noted that our messages to and from other airlines via Arinc have been delayed, because Arinc was obviously swamped."

Eastern uses two 195s (one for backup) to run an ACP/PARS system for Southern, Air West, Ozark, and Piedmont; and they have a pair of 3033s, one for backup and one for their own system. Overall, TWA's ACP links with 10,300 terminals over 68



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"The instructions for the operation of the new microfilm reader are on microfilm."

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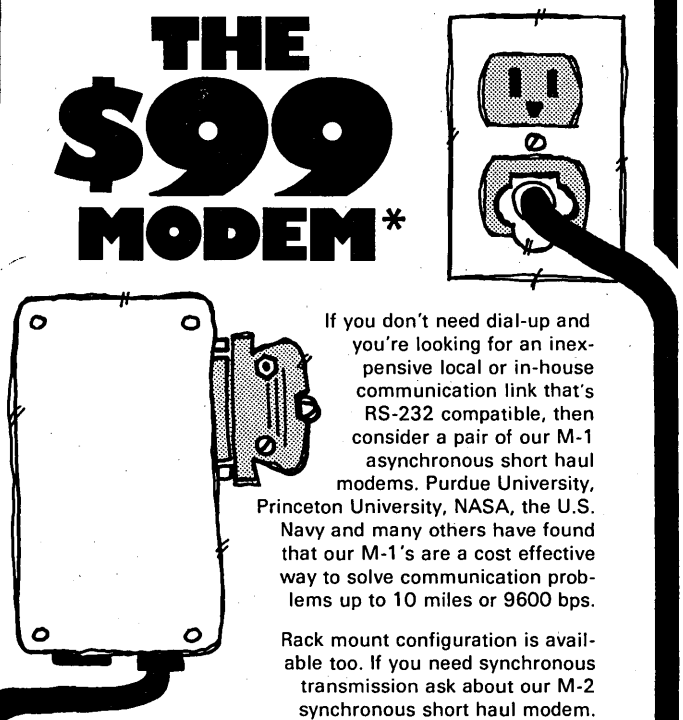

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CIRCLE 105 ON READER CARD

communication lines, and on the 3033, it has a factored mean peak message rate of 170/second.

North Central Airlines' Minneapolis-based dp center was under pressure even prestrike—and a now proposed merger with Southern Airways would increase PARS load about 70%. In January, NCA went from 360/165s to 158s, still using 360-based data collection and reduction software, planning to upgrade its 2314 files subsystem (to 3350s) in June, and the cpu to 3032 in July.

TWA upgraded from a 370/168 to a 3033 the very morning of the United strike.

The NCA system is now getting near maximum throughput—24 to 25 messages-per-second—and the old 2314 file system (which IBM designed guidelines limit to 140 accesses per second) is running between 160 and 200 access/sec. Even before the strike, said Fred Voth, assistant to the manager of computer services, "there were peak seconds we couldn't handle because of limitations on the processor. When the United strike came along, that added to these peaks, but the limitations of the processor were already scalping off the peaks, slowing itself down. Now the peaks continue to grow, but the peak seconds and peak minutes are not the multiple of the peak hour that they used to be." The United strike, he said, "came at a very bad time for us." NCA was to have brought the 3032 in-house in early June and hoped to have it, and the new file system, on-line for July 4.

Allegheny Airlines picked up enough business in the East because of the strike

The near future may hold major changes for the airlines' ACP environment.

that they had to reorganize their internal system across three cpu's to give PARS access to additional channel resources on the 168-based ACP. Normally, they use the software hypervisor (which allows two ACP's to be coresident in one cpu) to run a three-module ACP test system in the 168, but with the strike they were unable to sustain the I/O rate across two channels only, so they had to bounce the test system to another 158-3 to dedicate the third channel of the 168 to ACP. The158 normally runs MVS, some local TSO, and live IMS, but in the reorganization the IMS was moved to an Amdal V/7, where it joined MVS, TSO and batch systems.

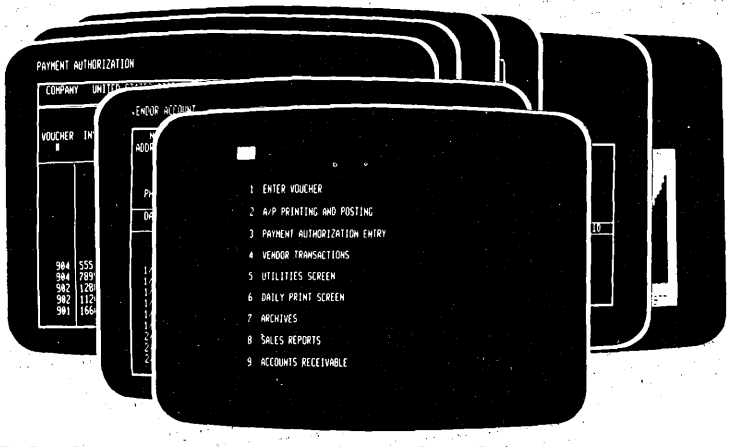
With the growth common to all the airlines in recent years—30% compounded is not uncommon—ACP managers have nightmares trying to do capacity planning. "We do try," said Allegheny's Peter Cooling, "but it's usually historic-type analysis. And of course, when we do spot a trend coming, the lead times for obtaining equipment are greater than the lead-time we get on the trend.

"We almost fell on our feet last quarter," he admitted. "Inside four months, we migrated from a 360/165 and 2314s onto a 158 and 3340s. That was in June, and we were anticipating that that machine would last us into 1980, late 1980, maybe 1981—in fact, by December we were on a 168."

The near future may hold major changes for the airlines' ACP environment, new developments that could eliminate many of their cpu-oriented troubles. A joint effort by American, Eastern, TWA, United, and IBM aimed at allowing up to four cpu's to access the same data base was last month pushed through its major development phase. Each of the four airlines involved, the most technically sophisticated U.S. carriers, have brought the results of the joint development back to their own installation for custom tailoring. American, once again in the forefront, hopes to implement the enhanced ACP design in September.

—Vin McLellan

WINDOWS TO YOUR WORLD



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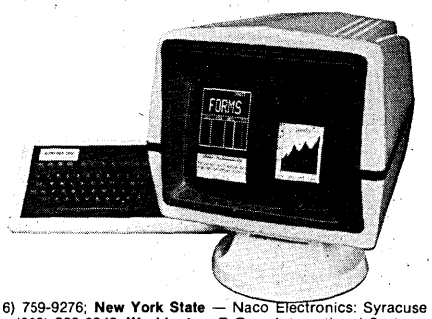

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CIRCLE 121 ON READER CARD

BENCHMARKS

NEW SBS PRESIDENT: Robert C. Hall, 48, is the new president and chief executive officer of Satellite Business Systems, the joint venture of IBM, Aetna and Comsat. Hall, an executive vice president of the

New York Stock Exchange since 1977, resigns this month to take over his new position. SBS said its current president, Philip N. Whittaker, 58, will return to IBM as vice president of the Federal Systems Div.

WOOED AGAIN: Microdata Corp., Irvine, Calif. minimaker, which saw one suitor, AM International, back away from acquisition overtures some six months ago, is being wooed again—this time by an unidentified firm—and Microdata said the talks are "very preliminary." When Microdata held its annual meeting in April, president Donald Fuller said the company would not encourage or seek any merger or acquisition because it already was in "a strong financial condition" and did not need the support a takeover could bring. Industry observers were talking of Gould and ITT as possible suitors for Microdata.

FAIRCHILD REJECTION: A proposal by Fairchild Industries to acquire Bunker Ramo in a stock deal valued at $144 million was rejected by Runker Ramo's directors. A Bunker Ramo statement said: "After study of reports from investment banking advisors and management, the board concluded that the Fairchild Industries proposal is inadequate and not in the best interests of Bunker Ramo or its shareholders; and it does not appear at this time that a business combination with Fairchild would be beneficial to Bunker Ramo or its shareholders."

MODCOMP TALKS OFF: Modular Computer Systems called off talks with two potential buyers. Company chairman John C. Lobb told stockholders at the company's annual meeting at Fort Lauderdale, Fla. headquarters that discussions with the two "had moved more slowly than expected" because of a Securities and Exchange Commission investigation into the company's previous financial reporting practices. Modcomp said it notified the two firms, which it described as "large multinational firms," that it was ending the merger discussions at the same time it broke the news to stockholders. "Both companies were disappointed," said Donald J. Bracken, Modcomp's treasurer, adding, "they're still interested."

MAGNUSON AND BOOTHE: Magnuson Systems Corp. and Boothe Computer Corp. are involved in a joint marketing venture for Magnuson's M80 family of IBM-compatible computers. Boothe has 10 sales offices including foreign operations. It primarily leases IBM computer equipment. John Schaller, Boothe's vp-marketing, said the Magnuson systems "offer both price/performance and extended machine-life advantage for Boothe's present customer base." Magnuson will continue expanding its own direct marketing operations which currently include eight regional offices.

LONG DISTANCE LASERS: Hitachi, Ltd. said it has developed a high performance laser diode with a wavelength of 1.3 microns which provides minimum transmission loss in optical fiber cables used in long distance, high capacity optical transmission systems. The firm said two types of its HLP 5000 series lasers will go on sale in Japan and world markets in September. U. S. distribution will be handled through Hitachi America, Ltd., Chicago. The company said the series of lasers will make possible optical transmission of information at rates of more than 1 gigabit per second, over distances of more than 50 kilometers, without a repeater.

BUBBLE EXCHANGE: Technical information and assistance in development of bubble memory devices will be exchanged by Burroughs Corp. and Rockwell International Corp. under an agreement which calls for an immediate and on-going transfer of information covering certain bubble memory products. Rockwell is a major supplier of high-technology products to automotive, electronics, aerospace and other industries. It conducts research in bubble memories and other electronic devices in Anaheim, Calif., and produces them in its microelectronics plant in Newport Beach. Burroughs' development of bubble devices is conducted primarily at its microcomponents center in Rancho Bernardo, Calif.

ITEL MEMORY OFFERING: Itel Corp. has a new memory offering it says is attachable to all IBM virtual storage machines from the 138 up. Itel called the offering a 16 megabyte universal memory making possible expansion beyond IBM memory limits. It's called the Itel 370/303X universal memory upgrade and uses 16K pluggable chip technology, supplied by Intersil. The company said availability is immediate.

VIEWDATA IN THE U.S.: General Telephone & Electronics Corp. has been licensed to offer Viewdata and Prestel information services in the U.S. and Canada by Insac Viewdata Inc. of New York, which was licensed by the British Post Office to market Prestel in the U.S. Viewdata is a data-based information service which enables users to view color text and graphics on a variety of subject matter, transmitted over telephone lines to video terminals. It originally was developed by the British Post Office, which changed its name to Prestel for its offering in England. Viewdata was the name given to a similar system for the American market. Insac developed software for the system specifically tailored for North America.

COMBINED MARKETING: Jacquard Systems Div. of AM International, Inc., acquired by AM last December, will take on added marketing responsibilities. The Santa Monica, Calif., operation will continue to manufacture and market its J100 and J500 shared logic multifunction small business systems and will add responsibility for marketing the AM text line of standalone word processing equipment produced and previously marketed by AM's Varityper Div. in East Hanover, N. J. AM Jacquard Systems will conduct its worldwide marketing activities through a combination of dealers and a direct sales organization.

MORE FROM FACSIMILE: Some three billion messages will be sent via facsimile equipment in 1990 by Americans compared to 200 million in 1977, said Predicasts, Inc., a Cleveland-based business information and market research firm. John J. Brock of Predicasts, author of "Facsimile Equipment & Electronic Mail," an industry study, attributes the facsimile boom to advances in and the decreasing cost of microprocessor logic, which afford both a drastic reduction in transmission time and falling equipment prices; fewer incompatability problems as a result of equipment standardization; and the development of improved transmission facilities, such as wideband communication channels and specialized facsimile networks. ✲

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North Star has quadrupled the disk capacity of the Horizon computer but prices have increased a modest 15 percent. On a dollar per byte basis, that's a bargain that is hard to beat!

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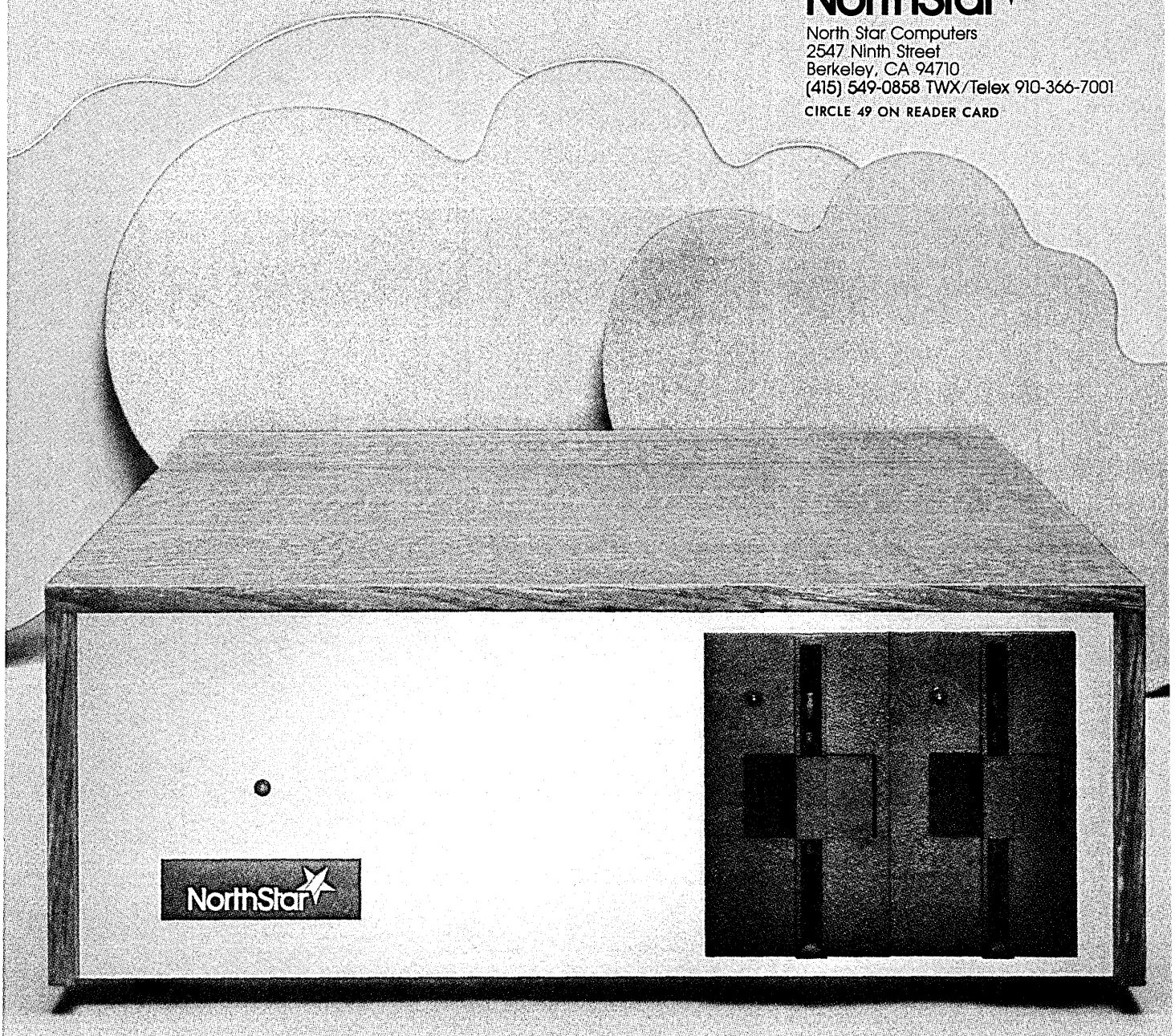
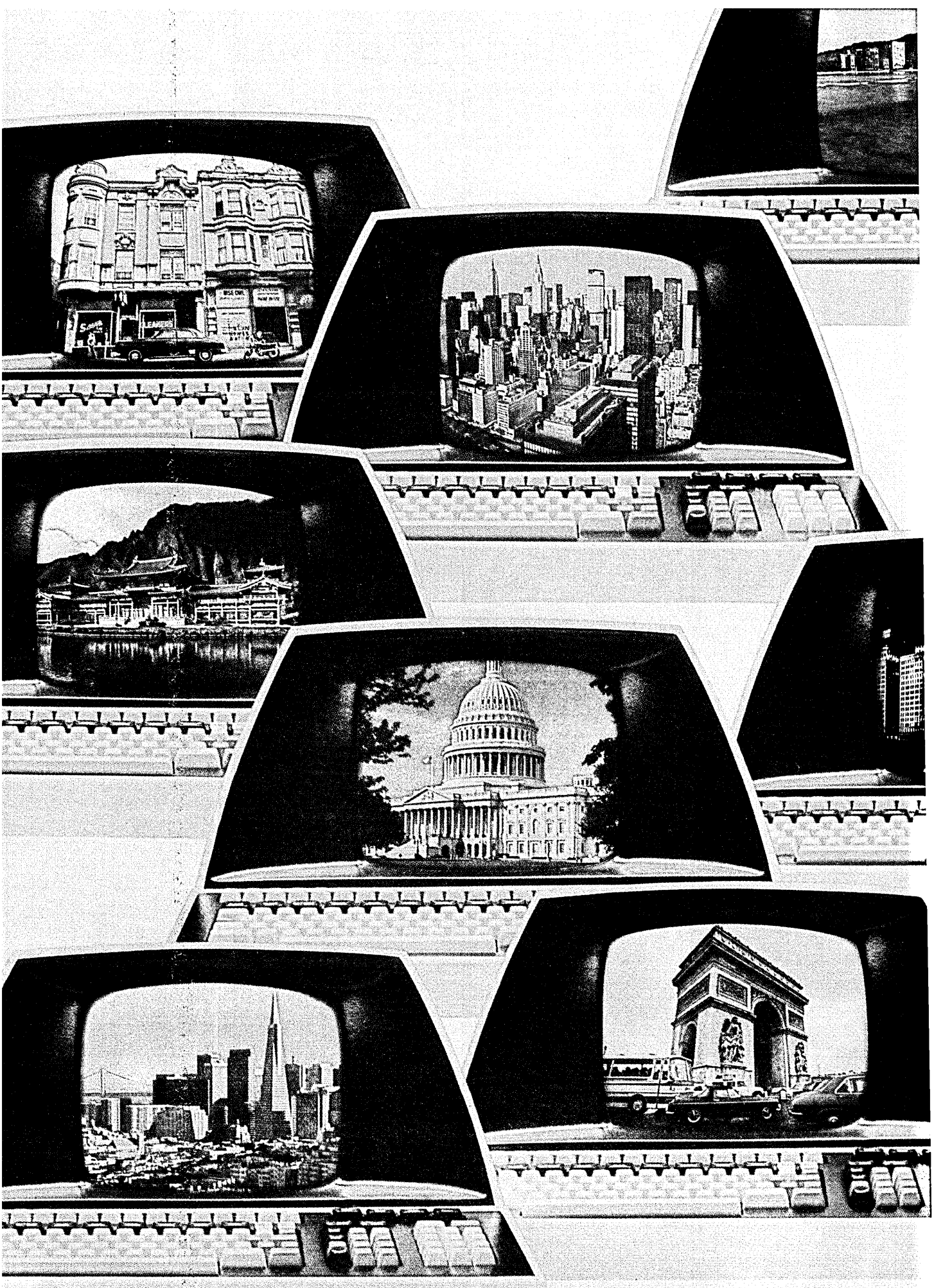
CIRCLE 49 ON READER CARD





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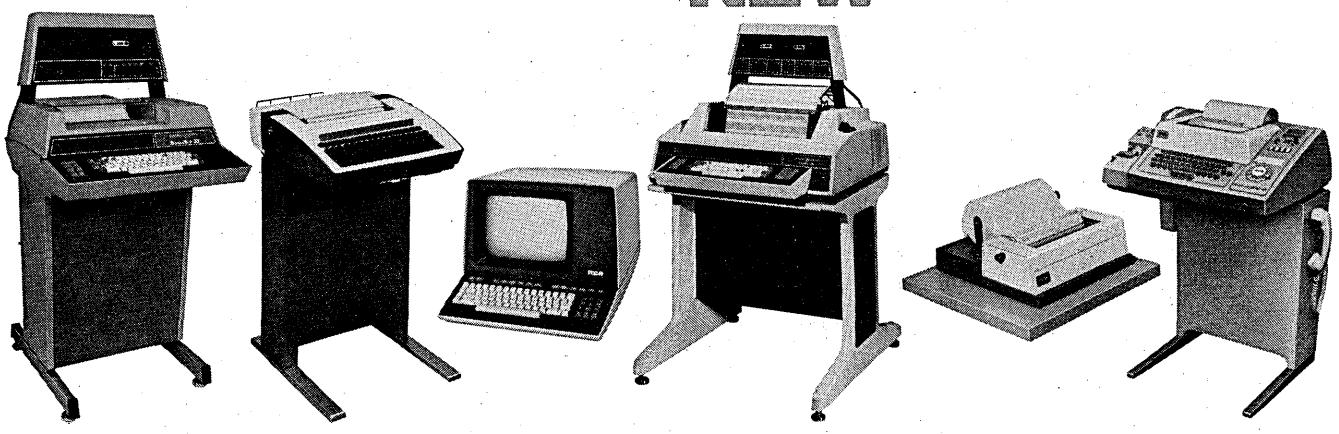

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MAINFRAME INDUSTRY SURVEY

Price reductions for cpu's and memories, combined with new hardware offerings, spark strong demand for increased systems capacity, Datamation survey shows.

The outlook for mainframe manufacturers should be bullish over the next few years, according to the 1979 Mainframe Industry Survey conducted by DATAMATION and G.S. Grumman/Cowan & Co., the Boston-based investment research firm.

Based on responses from 5,857 mainframe systems users in the U.S., the recently completed survey indicates a strong demand among users for increased systems capacity and gives an indication of user plans and reactions to new products and price reductions announced over the last 12 months.

Specifically, responses from the survey show those users contacted plan to install 2,954 mainframe systems, 11,085 disk drives, 3,917 tape drives, 59,710 terminals and 572.6MB of expansion memory. If sold, rather than leased, the mainframe systems alone would have a value of about $2.5 billion.

This demand was largely sparked by price reductions for cpu's and memories as well as the announcement of new products such as IBM's 4300, respondees indicated. Some 44% of users with IBM 370/115s through 370/148s indicated that lower prices and new hardware offerings had caused them to consider adding to their systems capacity sooner than previously planned. Some 29% of users with larger systems responded similarly.

Asked how they would expect to be set for systems capacity at 1979 year-end, 6% of the users said they would need to add another cpu, 22% asserted they would need to upgrade to larger cpu's and 21% planned to add memory and/or peripherals. About 11% said they weren't certain what they'd need at this point, while 40% said they should have enough capacity to carry through 1980.

Breaking down capacity needs by site among IBM users, the survey revealed that at 370/115-125 sites 19% of the respondents plan to add memory or peripherals, 32% will need to upgrade to larger cpu's and only 3% will put in another cpu. Demand at other IBM sites is broken out in Fig. 1.

The survey pointed up that new IBM product introductions in the low- to mid-range had sparked a customer response that was reminiscent of that accorded the 303X at the high end. Additionally, minimal prospective downward migration was evidenced in the survey data.

The survey also showed that low- to mid-range machines such as the 4300, 8100 and System/38 would be much more heavily leased than purchased. This, coupled with the inevitable wind-down of rental-to-purchase conversions, indicates that rental growth should continue to rebound for the giant computer manufacturer.

Other implications regarding IBM that can be drawn from the survey include:

- Unshipped backlogs are hefty for the next one to two years' shipments.
- There are no signs yet of any incipient overcapacity at user installations.
- More extensive IBM unbundling of software is providing an increasingly significant recurring revenue supplement.
- Dp sales remain key from a P&L standpoint, and it still appears that purchase volumes for the 303X should in large part bridge the period between the present and the next large scale system introductions.
- The primary thrust of the low- to mid-range announcements can be interpreted as an attempt to build a foundation for demand from the bottom up and, over the longer term, to lay the ground-

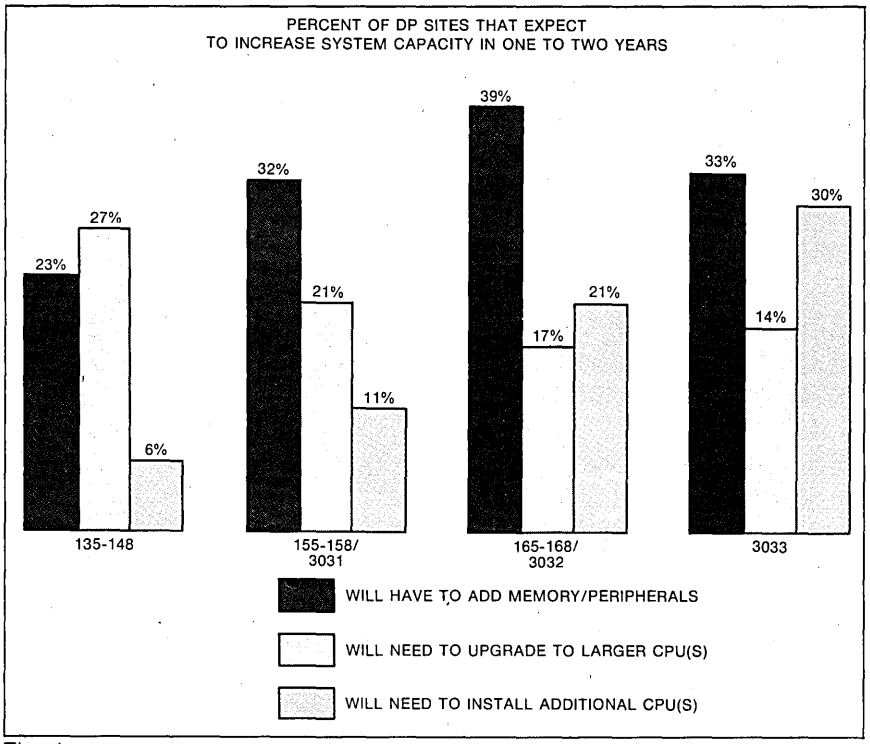


Fig. 1

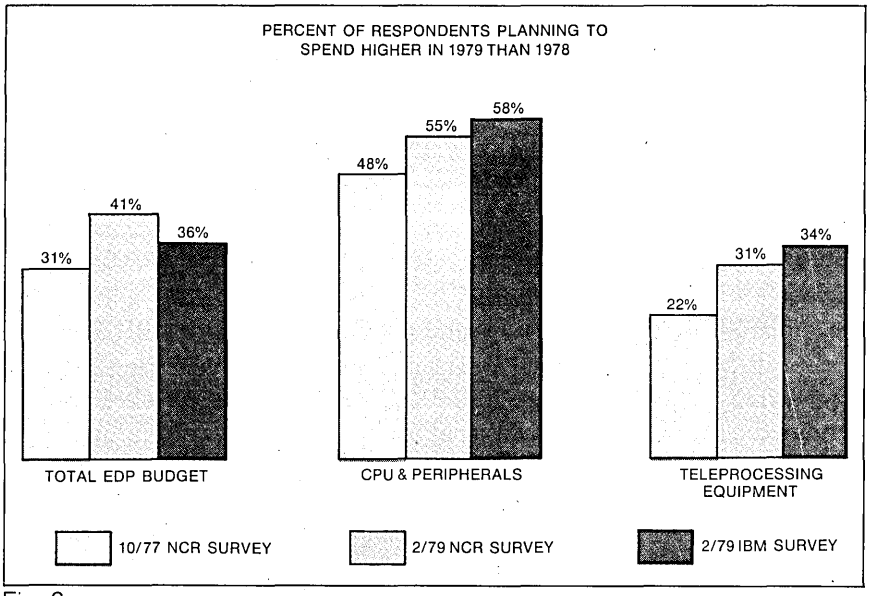


Fig. 2

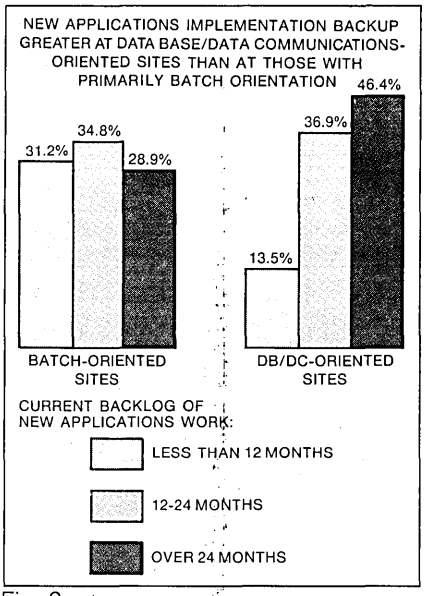


Fig. 3

work for user transition into a more and more pervasive data base and data communications environment.

With non-IBM users, many of the same conclusions can be drawn. For example, among Burroughs users it is evident that aggressively priced new products throughout the company's line have kicked off a price elastic response, bolstering the shipment outlook through 1980. Some 14% of the 549 Burroughs sites contacted believe they will need to upgrade to larger cpu's, while 23% intend to add memory and/or peripherals. Additionally, 4% will install another cpu, 14% haven't firmed up their plans yet, and 45% have adequate capacity to take them through 1980, they believe.

Over time Burroughs, like IBM, should realize a healthy new source of recurring revenue from the unbundling of its operating system software. Moreover, the survey confirms that Burrough's users, along with IBM's, are in the forefront with respect to use of advanced functionality.

Further, while the sales content of new shipments may be off slightly this year, the purchase price reductions on 800 and 700 Series cpu's are likely to stimulate substantial conversions from Burroughs' large pool of leased systems.

Univac also looks healthy given the particularly strong reception for its 1100/80s. In fact, Univac's high-end business ranks very close to that of IBM in terms of the firm's average systems rental of $21,700 a month—just a few hundred dollars below the average rental on big IBM machines and well above that of Honeywell, Burroughs, or NCR. Their average rentals amount to $17,600, $12,200 and $7,100, respectively.

Moreover, the average price of Univac systems to be installed is up sharply, reflecting the 1100/80 demand. Measured as a percentage of the installed base, the respondents' planned installation activity will be up 37% over the next 24 months, as compared to 26% in the October 1977 survey.

On the negative side of the slate, however, the study pointed up the need to meld a seemingly fractured product line —one that evidences a lack of software bridges to expedite migration. Among the respondents, for example, there was not a single instance of 90/30 users migrating to 90/60-80s. Nor was there migration from Series 70 or 90/60-80s to the 1100. Also, Univac may not yet have realized the potential of its minicomputer add-on market. While the survey indicates that Univac customers are in fact buying minis, most of its Varian group's production is slotted toward the oem market, leaving relatively few machines that can be sold as add-ons to the existing Univac base.

Responses from Honeywell sites

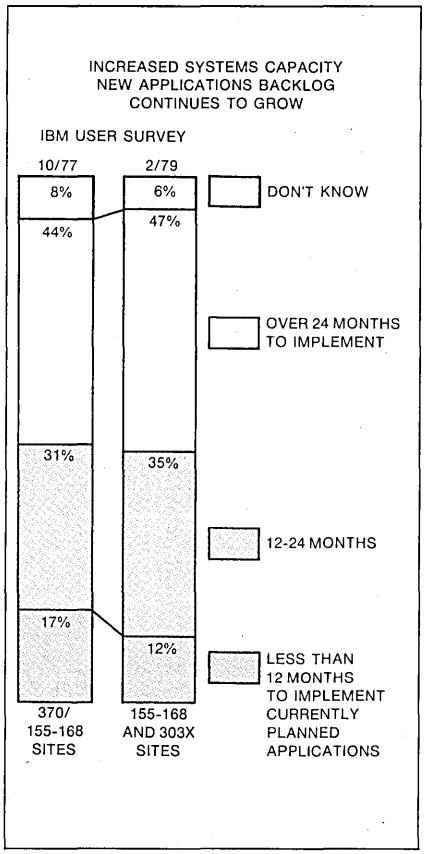


Fig. 4

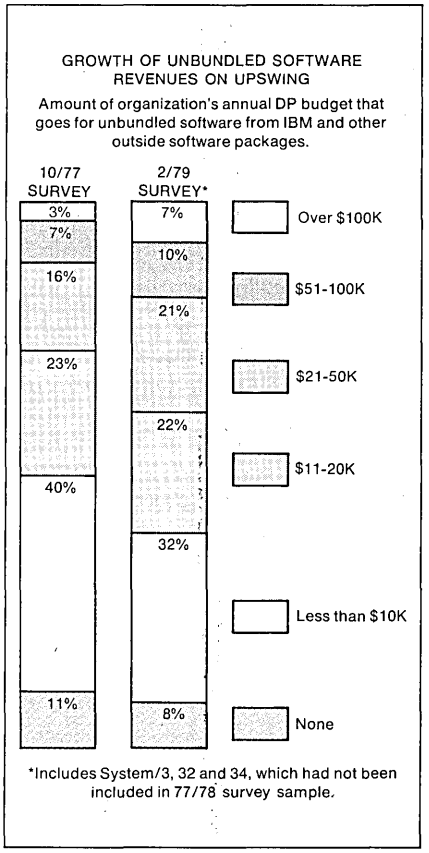


Fig. 5

The HP 2621: sim

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

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

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

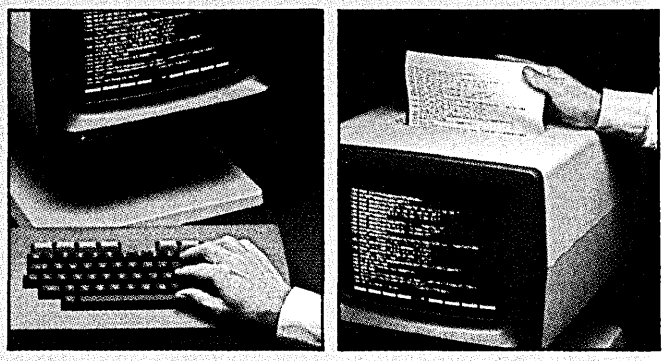
We designed the keyboard like the familiar typewriter, so you don't have to waste time relearning it. We built in eight function keys, too. These control the cursor, rolling and scrolling. And, to make life easier, they're labeled on the screen for self-test, configuration, display and editing.

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

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

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

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



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

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

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

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

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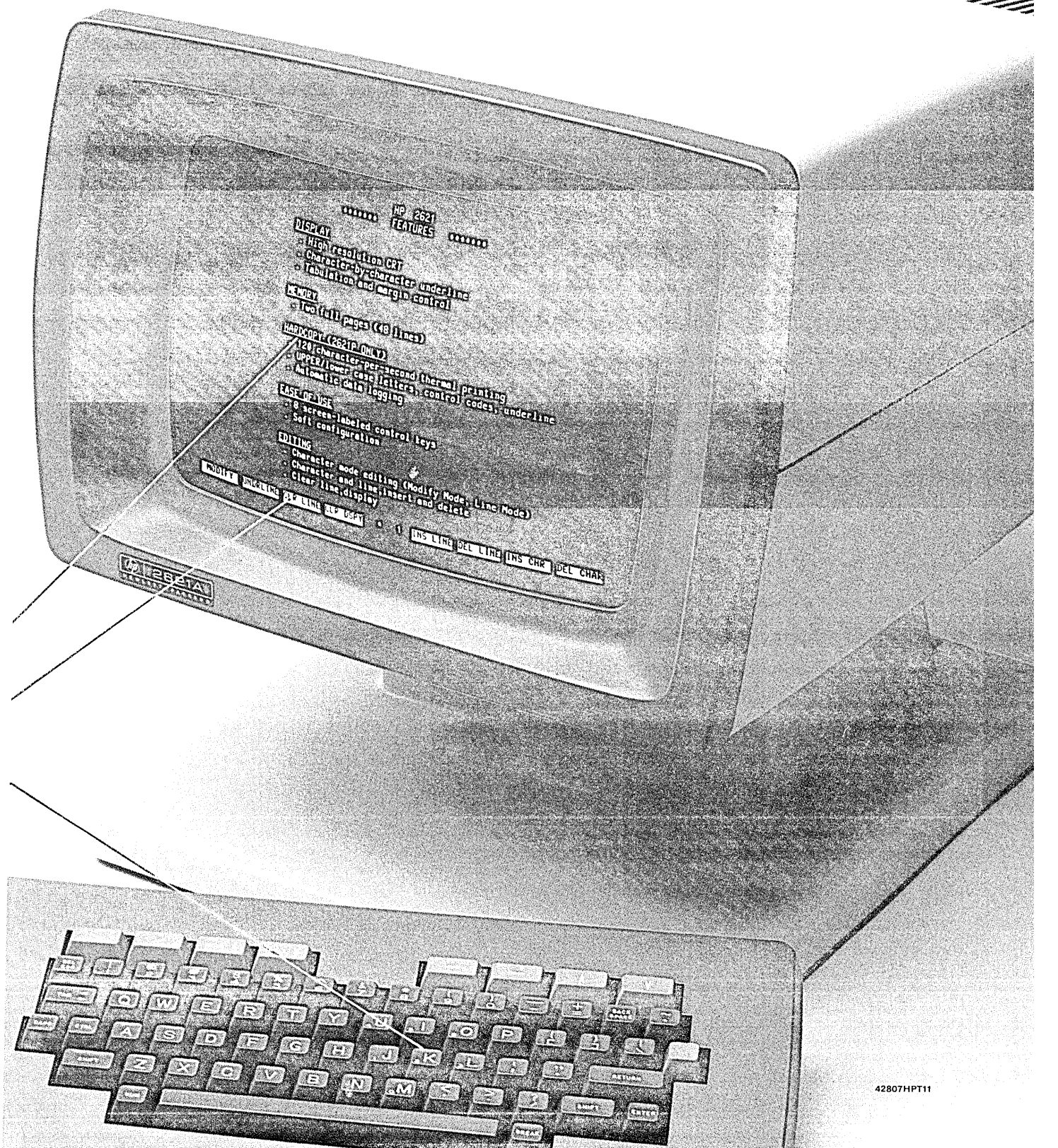

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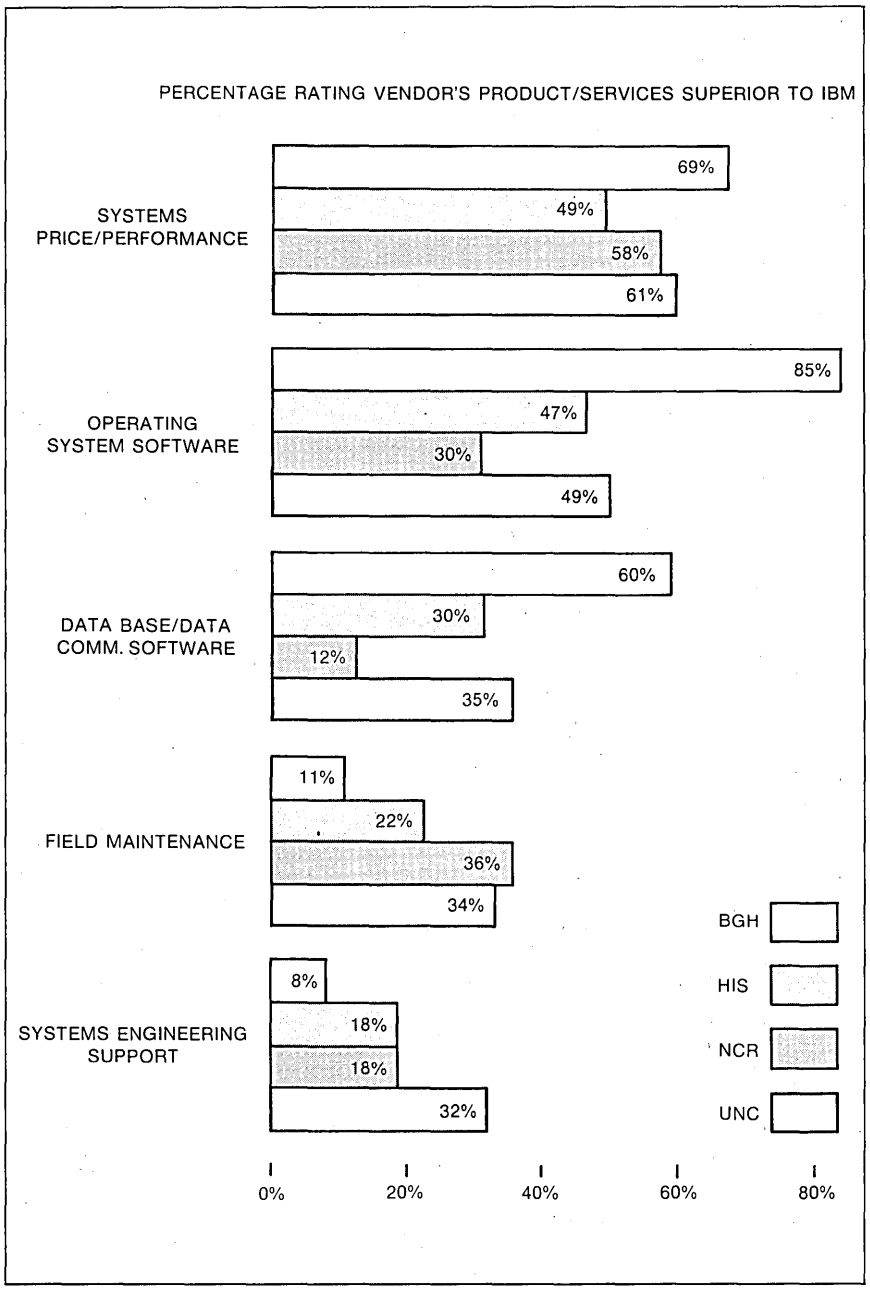

Fig. 6

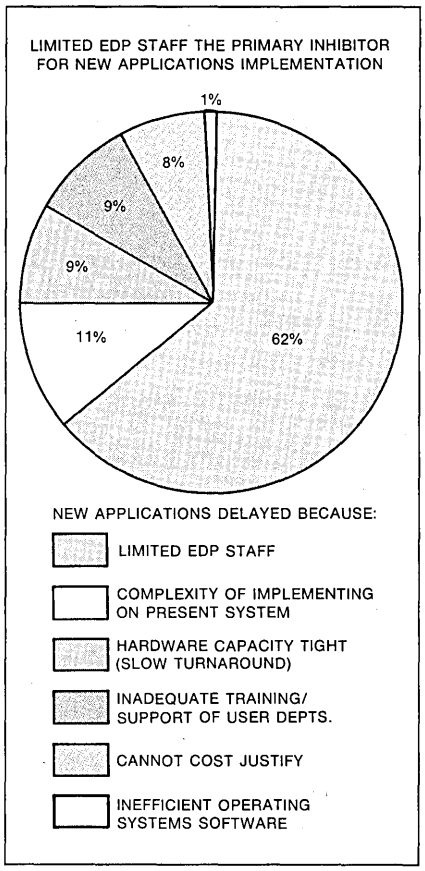

Fig. 7

show that reduced cpu and memory prices for a number of the vendor's dp products has caused users to consider bolstering systems capacity sooner than they'd anticipated. At H200/2000 sites, 15% of the respondents said they were making this consideration. At all other Honeywell sites, the figure was 26%.

Memory and/or peripherals will be added by 26% of those Honeywell sites polled. Some 14% will upgrade to larger cpu's, while 6% need to install additional cpu's.

On a negative note, the survey points up a strong resistance to Series 60 among the remaining H200/2000 users. Only 21% of this user group plans to install an S/60. Moreover, 27% of these H200/2000 users are defecting to other manufacturers, including to minicomputer vendors. The remaining 52% are at present undecided. Honeywell hopes Level 6 will help woo this recalcitrant base.

With NCR, the survey indicates that establishing a presence in the large systems marketplace is apparently a key element in that company's systems strategy. The inherent profitability at the high end of the market and the potential for a substantial "drag-along" business with peripherals, software, and data communications, may well outweigh the risk of increased competitive exposure to IBM.

The Comten acquisition is clearly consistent with this strategy, and a significantly high percentage of NCR sites show plans to increase spending for teleprocessing equipment, cpu's and peripherals. How these spending plans compare with IBM sites is indicated in Fig. 2.

The survey also shows that migration among NCR users to the 8000 Series is progressing steadily; however, disaffection expressed by a still sizable core of Century users may make the company vulnerable here as long-term leases for these machines elapse. Another key factor in NCR's future success is the productivity of its sales force. Some 42% of respondents rated the NCR sales force inferior to that of IBM.

Among all users, the survey showed surprisingly little interest in AT&T's proposed ACS service. In fact, only 13% of those polled expressed a slight interest in using ACS, and a mere 9% said they were very interested. What interest there was in ACS generally came from larger user organizations, specifically those concerns having annual revenues of over half a billion dollars.

On the other hand, nearly one-fifth of IBM respondents are now planning to use or are using SNA, a move that ostensibly was given impetus by the 8100 announcement.

Some additional findings from the survey are shown in the accompanying graphs.

—L.M.

"The proven technology of Control Data's MSS made it the better business decision for us."

W. R. Ginn, Director of Technical Support and Howard B. Wilson, General Director (right), Management Information Services, Reynolds Metals Company

Ginn: "There were many technical reasons we chose Control Data's Mass Storage System. The capacity of the cartridge more closely matched our files, and we preferred Control Data's data set concept over the virtual volume concept. We also liked the fact that we didn't have to dedicate disk packs to staging."

Wilson: "It's really a better match for our needs. Even with most of our moderately large files on MSS, we're only using about half of its 16 billion byte capacity. If we'd chosen a 25 billion byte MSS, we'd be paying for a lot of unused capacity for a long time. The Control Data MSS costs half as much, and still gives us ample capacity for future growth."

Ginn: "We're rapidly growing toward ddp and we're doing lots of remote job entry already. Of course both concepts involve the maintenance of large files centrally. Our users are happy with the improved turnaround on their jobs. With the MSS they can get at their files in seconds instead of waiting for operators to locate and load tapes."

Wilson: "We've already passed the break even point on cost just by the tape drives that we've been able to eliminate. It saves lots of operator time, enabling us to give our users all around better service. It just was the better business decision for us."

Perhaps you should investigate whether or not a Mass Storage System is the better business decision for your company. Call Control Data at 612/853-7600. Or write Control Data Corporation, HQNfiii, P.O. Box 0, Minneapolis, MN 55440.

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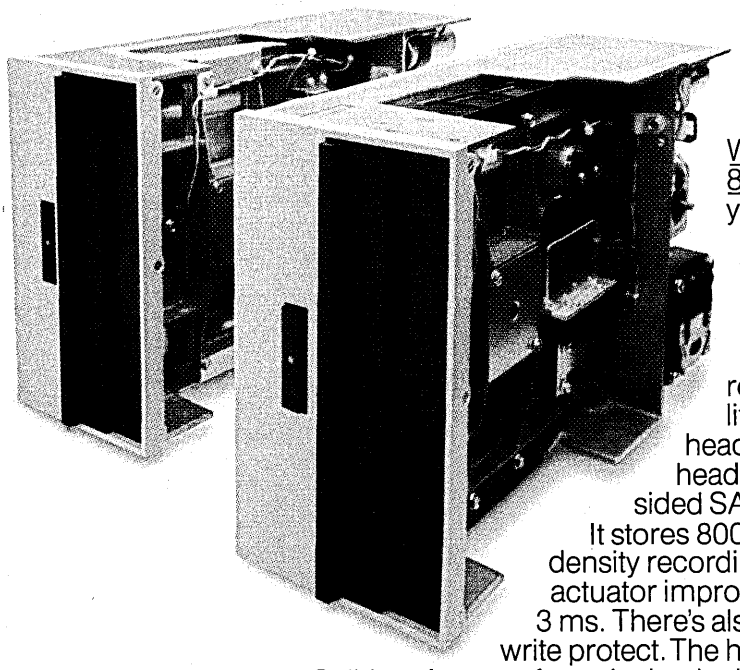

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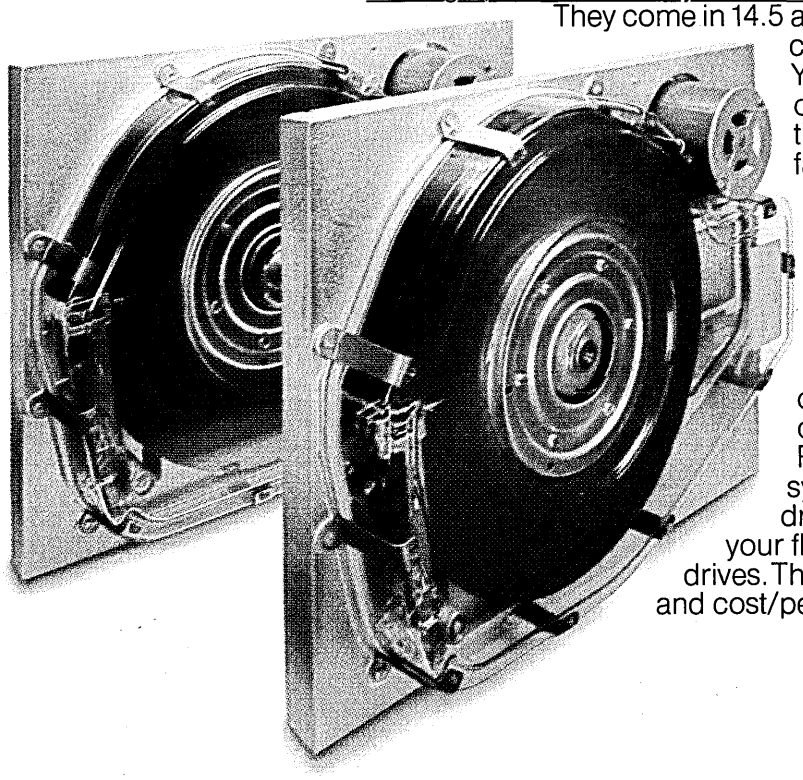

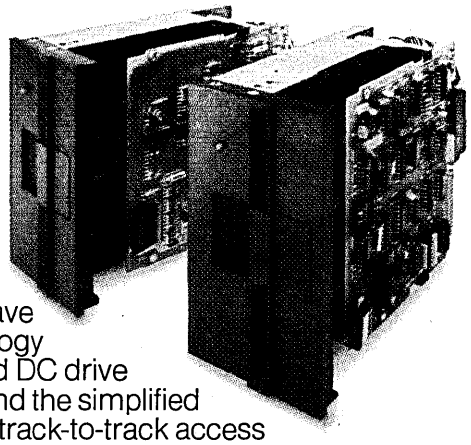

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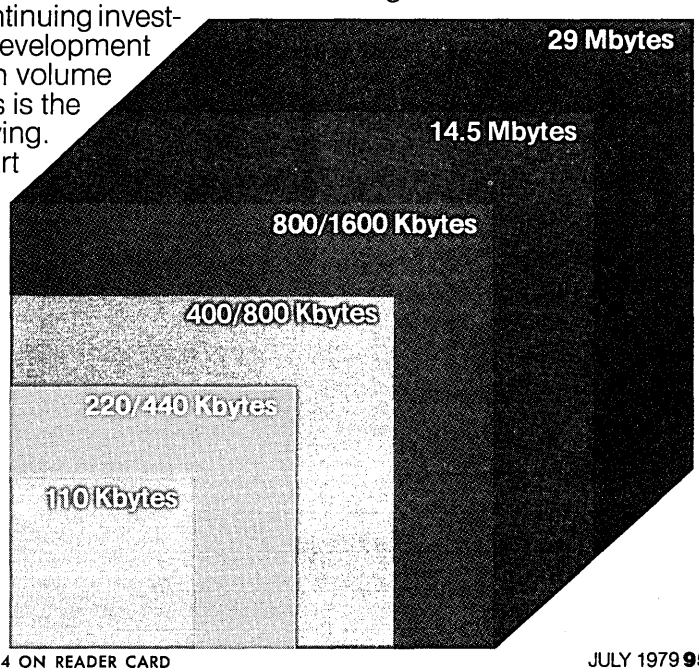

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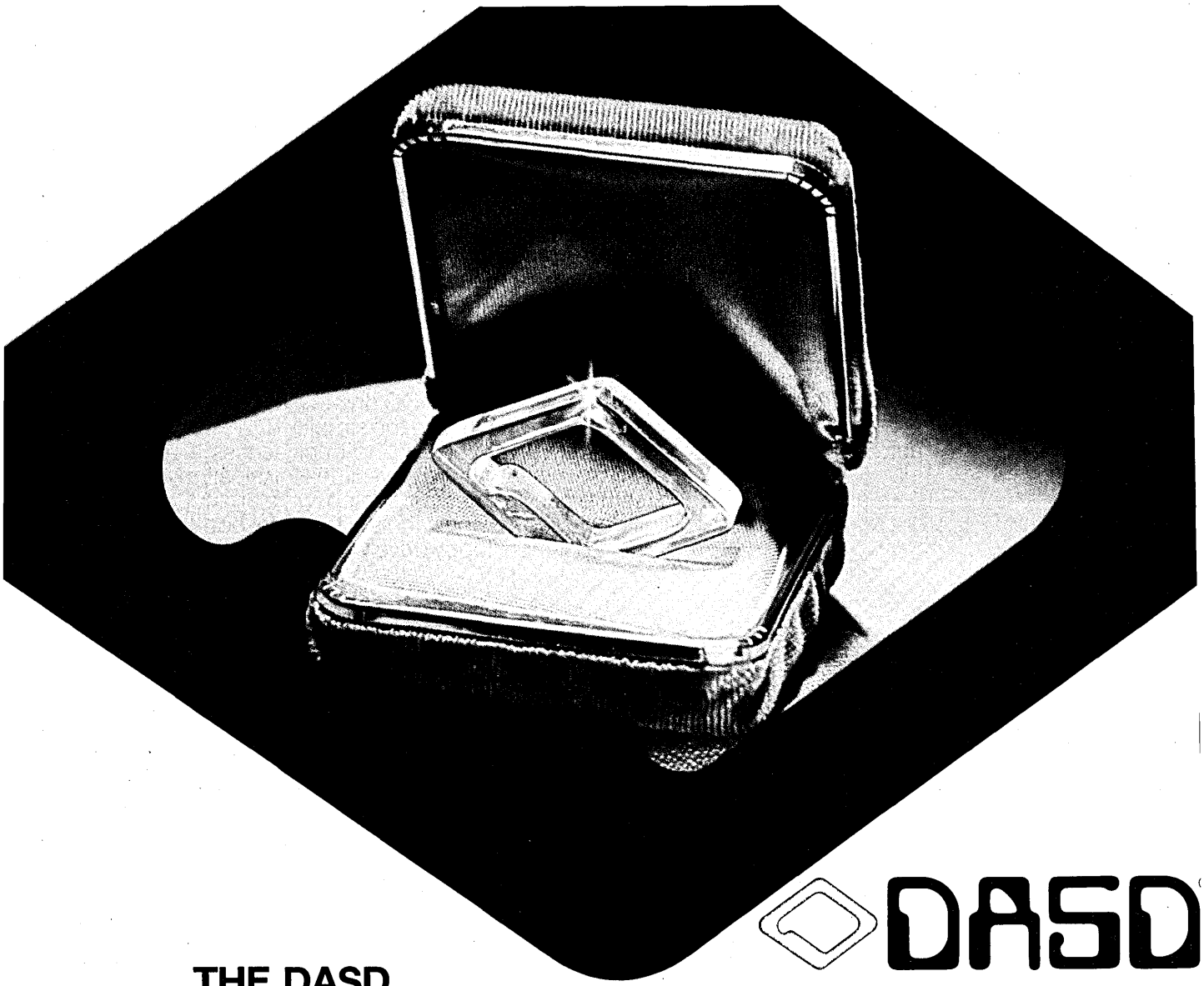

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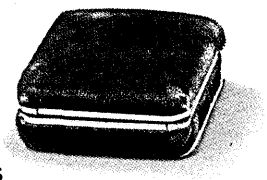

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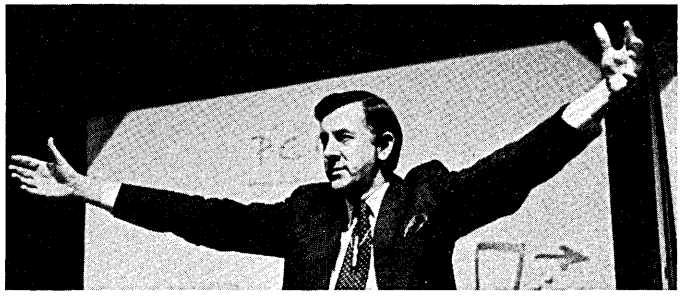

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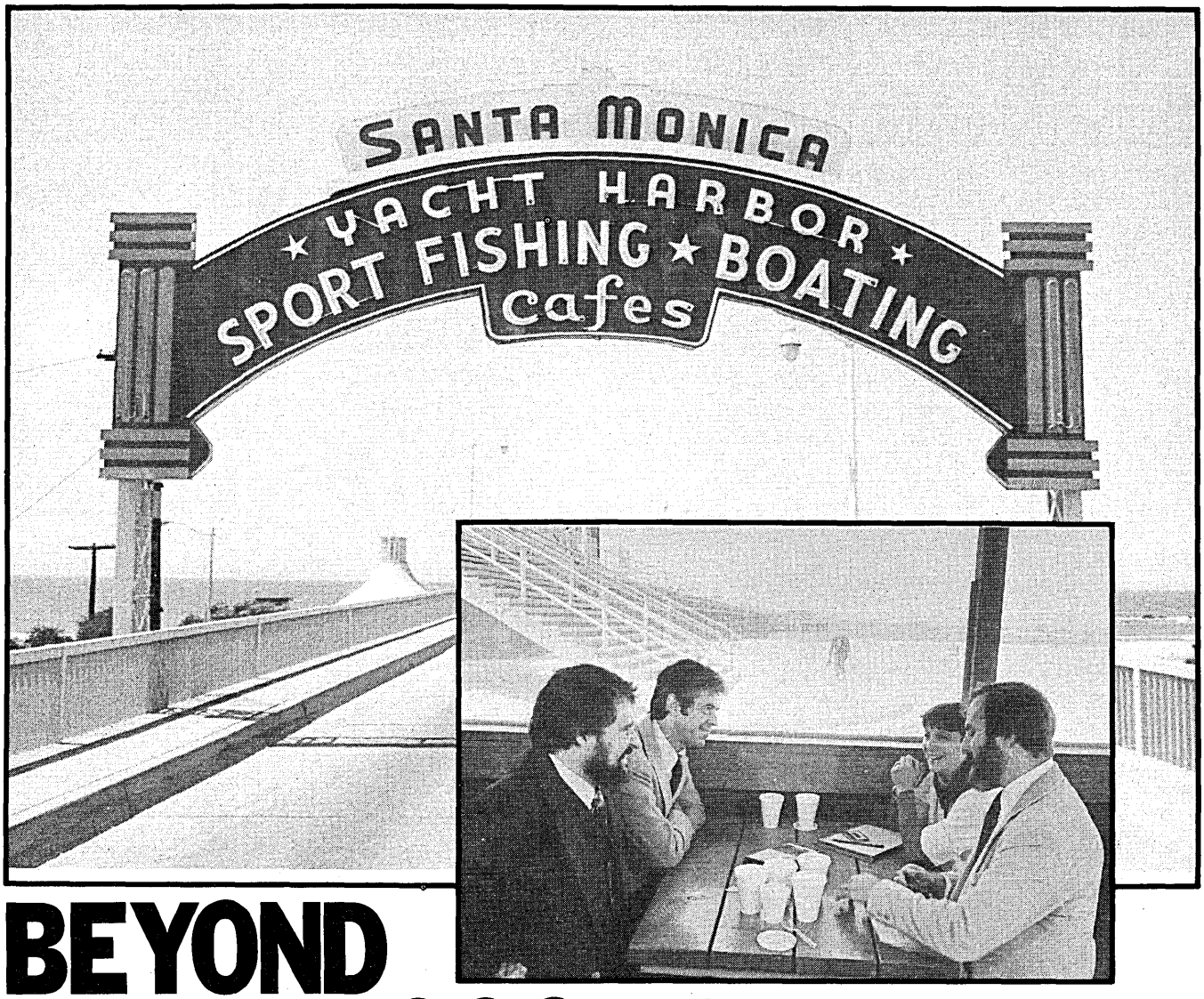


BEYOND DP: THE SOCIAL IMPLICATIONS

The technology is here; the social awareness is lagging.

If to everything there is a season, then midsummer is most certainly the season to sit by the ocean and talk of cabbages and kings and the social implications of technology. Also, we like to check in with The Rand Corporation now and then; the Santa Monica Pier is across the street from Rand; and we were able to entice three scientists to leave the tank and continue thinking on the beach.

Participating in the discussion were Bob Anderson, head of the information sciences department at Rand; Steve Glaseman, a computer scientist and lecturer on computer security and social implications; Ray Pyles, a specialist on the organizational aspects of computing systems; and Wendy Crisp, articles editor of DATAMATION.

While it is important, and even pleasant, to muse on the potential impacts of technology, the immediate impact is sometimes disconcerting. After waiting nearly an hour to order the lunch that followed our visit, we intercepted the waitress. "Oh, we're not taking orders for a while," she said. "Our computer is down."

DATAMATION: *At The Rand Corporation, you have already implemented programs and systems that are in planning stages—at best—in the commercial world. From this advanced vantage point, what problems do you foresee? What benefits? What are your concerns?*

GLASEMAN: We have a shared concern about the consequences of dramatically increased availability of computational power and communications resources to the general public. We're concerned that no one is paying sufficient attention to the potential ramifications throughout society.

PYLES: I don't think there is a technological imperative driving society as a result of computers. We've had a long history of introducing new technology—we certainly, for example, wouldn't accuse the typewriter of fundamentally changing our society. I am more comfortable with the idea that technology is leading us into a new society; that it will facilitate wider choices which increase our ability to adapt to our environment and our world; that our society may use technology to achieve a longer life, to survive longer.

GLASEMAN: Still, most of the research I've seen, or been involved in, has addressed the issue of how to go about *causing* the technological changes and not with anticipating the potential positive

and negative results. When we have computational capabilities combined with communications and can bind together homes, groups, individuals—whether they want to be or not—there is an increase in the potential for abuse. The point is: what are the regulatory issues we ought to be paying attention to *now*?

DATAMATION: *Can you give a scenario*?

GLASEMAN: Within a very short time personal computers and the knowledge required to use them effectively will be accessible to a majority of the population. When that happens we can expect major increases in the number of computer applications, and in the rate at which they are developed and distributed.

ANDERSON: Right now, a home computer sitting there is isolated, sterile. It becomes a different beast when it's hooked into a communications medium that allows it to communicate with other home computers or data processing devices. That is the fundamental change coming about—all the technology is here, and it's going to be implemented very quickly over the next 20 years.

DATAMATION: *When you say, "All the technology is here," would you be more specific? That phrase is seldom clarified.*

ANDERSON: Right. Well, publicly available commercial data networks that allow you to hook up the computer or terminal are offered to almost anyone via a local phone call. The major revolution will come with AT&T's ACS, and, for businesses, IBM's Satellite Business System. Communications capability makes a qualitative difference. Sitting at my desk, because I'm on the ARPA network, I can be in instant communication with colleagues around the country, or around the world. I can log into *The New York Times* information bank and look for articles on any subject published in the last five years; I can tap into the AP wire and have articles filtered—by certain key words—for subjects of interest. That link provides me with orders of magnitude more capability than I ever had before.

GLASEMAN: And, again, more potential for abuse. I might want to access *The New York Times* data base for a paper I am writing. On the other hand, unscrupulous individuals may also wish to discover the rates provided by my insurance company to certain groups of people—information most likely kept in computerized form and accessible to a determined technician.

PYLES: Let's also explore the concept of all businesses being highly interconnected to each other and to the government as well. Think of the potential for increased regulation. As interdependencies grow among businesses, small changes in one business may ripple through the economy and cause major dislocations at remote sites. We're already so interconnected with the world that what 20 years ago would have been a remote event in Iran is causing long lines at our gas stations and enormous social upheaval and discontent. Now, if I have a communications network between all businesses over which I can transmit 50 kilobauds, as soon as the regulatory agencies (who are currently unaware of it) become aware of it, they're going to start demanding more and more data be transmitted to them on a daily basis—or at least weekly—and they're going to start responding to this data by fine-tuning the economy...

ANDERSON: *Attempting* to fine-tune...

PYLES: Well, that's the whole point. They'll be able to fine-tune it as long as the world is static and those interdependencies are well-behaved. As soon as something dislocates—there is a strike at a Ford auto plant or General Electric has some problem acquiring materials—it may instantly impact the economy...

ANDERSON: That's one possible outcome. But if enough foresight is given to the way technology is used, there could be a different branch in the road. The use of information systems, for example, allows greater decentralization...

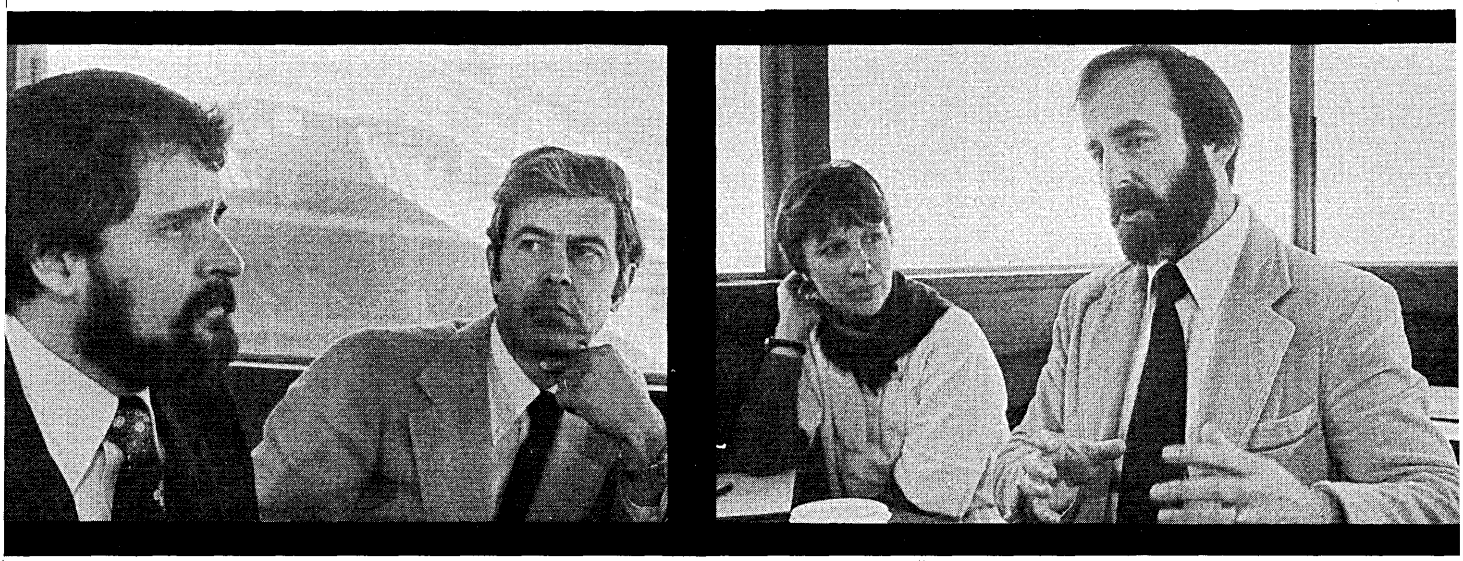
GLASEMAN: There is also a potential substitution of technology for energy; to some extent communications can replace commuting. The relative cost to a company of furnishing someone with the necessary communications equipment to work at home, as opposed to establishing an office for him in an expensive building, is an interesting tradeoff with considerable sociological implications.

PYLES: Some intermediate choices exist now. I see a tremendous opportunity for some dispersion of corporations to satellite offices where people work three out of five days a week. It not only saves in downtown office space, commute time and expense but it could provide a happier, more integrated working staff.

ANDERSON: Decentralization may become necessary for a company to attract the total staff it needs, particularly secretarial and support services. If you can decentralize to the point where you are reaching these people in the suburbs where they live, and thus eliminating their need to commute, you may be able to attract them without inflating salaries...

PYLES: The problem is teaching ourselves new habits, new ways of doing things, rather than relying on technology alone. Technology is not limiting; what is limiting is the way we work together and the way we do business. When social mechanisms change, you'll see fewer face-to-face contacts. We've seen it already with the telephone...

GLASEMAN: The trend toward decentralization to satellite offices has experienced some social inertia; so far, it hasn't represented a great cost savings. But as the cost of fuel continues to go up—and apparent-



ly it must go up rapidly and permanently for any action to be taken; then, there will be some social action. A Rand satellite office located, for example, in the San Fernando Valley north of here, might pull in a large percentage of professionals who live there.

PYLES: It also opens up opportunities for handicapped people who, either because of physical or social constraints, cannot get out to where the jobs are.

ANDERSON: Just to show how close the future is, already many people to whom we make job offers ask explicitly about the availability of home terminals as a job benefit. Rand is probably close to having to make a decision about a corporate policy on the availability of these terminals. Some of the questions that have arisen are: How are the communications costs going to be covered? When terminals are decentralized in homes, how do you handle maintenance? How do you handle insurance on corporate equipment existing in private homes? If we went to the intermediate notion of a satellite office, we could acquire a critical mass of equipment to provide maintenance services for; to provide insurance for; to provide cost-effective training of personnel for. Suddenly, it's a viable idea.

GLASEMAN: Education is also affected. It's already commonplace to sit in a classroom and get a televised lecture that's been prerecorded. Now, some universities have interactive, televised lectures, real-time, where the instructor sits at a control panel and the students, located in remote spots, are tied in with communications lines. If the student has a question, he pushes a button and a light comes on the instructor's panel. The instructor can either allow the whole "class" to hear the question, or answer privately if the student's question is "What is going on, anyway?" This interactive teaching could even bring a new dimension to foreign aid. Consider that the Peace Corps spends most of its time teaching people to farm more efficiently or build water towers. Consider training a few people and sending them to a third-world country to be the technological managers of an electronic system of mass education in the appropriate language. It's an informational dimension whereby we are able to use the technological capabilities we have developed to give third-world countries a springboard...

PYLES: I'm uncomfortable with that idea. For one thing, there is the subject of regulations, such as limitations on bandwidth. Then, there are real questions of the efficiency of sending someone a cassette and he'll know how to build a water tower...

GLASEMAN: I'm not advocating sending cassettes to people. I'm using this new concept of teaching...

PYLES: You have to be careful to provide a scheme to support the new technologies without eroding the original culture. One of the recent international innovations has been the transistor radio. Here's this guy out in the middle of the pampas, a cowboy, and he has his transistor radio, and he listens to it all the time. The biggest problem has been that these cowboys have been leaving their jobs and going back into town to get new batteries.... I believe the technological changes in society will be very slow and incremental, and that the elite in the industrialized countries will be affected first.

DATAMATION: *What is now an educationally and economically elite will soon become the technologically elite?*

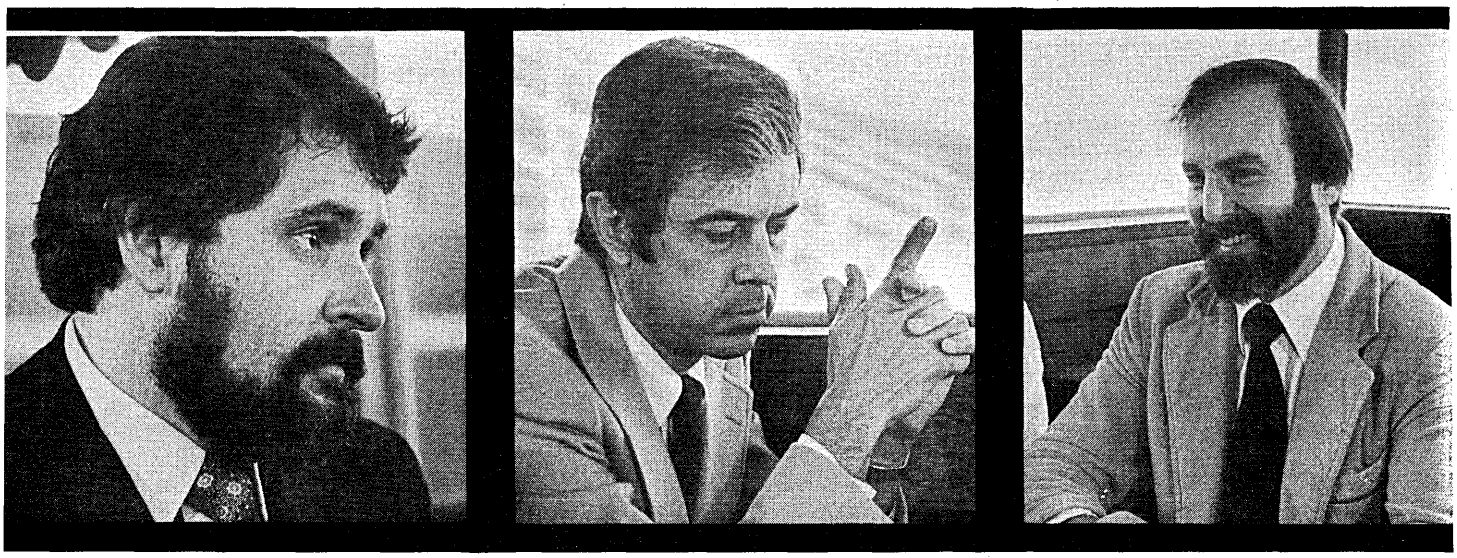
ANDERSON: There is no technological imperative for this technology to be used in the same way by everyone. At Rand, in our department, we recently installed word processing equipment we developed ourselves. In doing so, we realized that about half the secretaries wanted to learn more about the equipment, wanted to have the challenge, wanted to master new skills for greater compensation. There was another group of secretaries who were intimidated by the machines, and who didn't want to learn the technology. We found that to use the equipment effectively we needed a group of specialists who concentrated on the text editing equipment; the other secretaries handled the traditional administrative tasks. All parties are happy this way. We shouldn't see the world of the future as a place where everybody has to live in a certain way; rather, people can adapt the technology to the extent they feel comfortable.

GLASEMAN: Productivity, careers, and social events should not be measured in terms of the degree to which technology is embedded....

DATAMATION: *It still seems that people who choose not to participate—such as the secretaries who rejected the word processing training—are relegating themselves to Nowhere City. Isn't that really the only choice?*

PYLES: There *are* serious questions of social equity. For one thing who's going to pay for this widespread application of technology? And who's going to gain? If we build, for example, an electronic funds transfer system, how will that affect the person who lives in Watts or Harlem, and who can't afford the terminal and who can't get the plastic card?

GLASEMAN: Let's consider for a moment that some part of our taxes goes for implementing technology for the betterment of society. To what extent could we expect complaints: "Look, give me back that $25, and let me buy food. The hell with the terminal." It gets back to my main point: we must anticipate the bad stuff and see what structures we have now that might ameliorate the new problems. You



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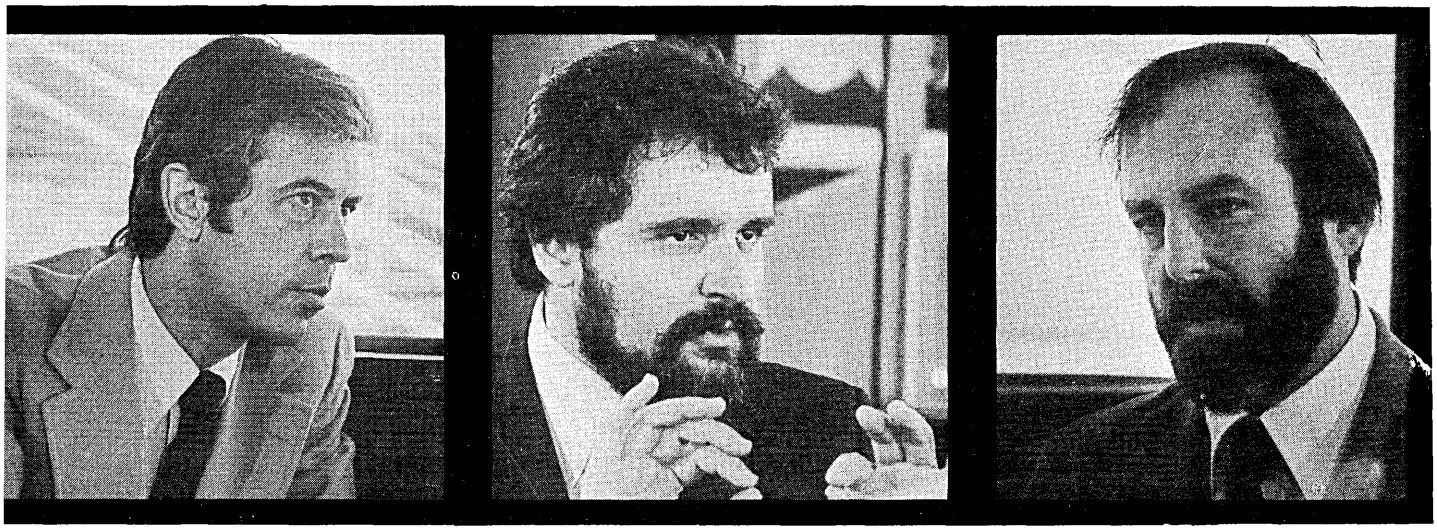

can't really legislate the diffusion of technology...

ANDERSON: I hope not. For one thing, it would be like putting a finger in the dike. The technology is too dominant a force to be channeled.

PYLES: The analogy is the atomic bombs being created by Master's degree students in every physics department in the U.S. You can't prevent it. You can keep track of certain critical materials, but you can't prevent it. Our society will just have to adjust in some unforeseen ways...

GLASEMAN: Adjustments will be necessary, too, in such value concepts as privacy. One of the great fears people have is that their privacy will be invaded. There is, as we all know, personal information we are expected to divulge if we wish to receive certain services and benefits—insurance, for example. If we are increasingly required to divulge personal information and if it becomes increasingly impossible that that information be held private, perhaps the social stigmas we attach to certain knowledge will go away; perhaps privacy itself will not be valued or encouraged.

PYLES: I would hope that technology would not so structure our society that certain people, by virtue of the fact that they want to keep their privacy, are excluded, disadvantaged...Computers should be seen as a kind of intellectual putty. We are not arguing for suppressing the technology, but for exploiting its capacity for serving people who are not in the mainstream.

GLASEMAN: The key is word is enhancement: taking maximum advantage of what technology does best and maximum advantage of what a human being does best, and developing a symbiotic relationship.

ANDERSON: There needs to be more funding to assess the potential impact of the technology. Organizations such as Congress's Office of Technology Assessment and the National Science Foundation should not look at EFTS or electronic mail piecemeal, but should raise the scope to the entire issue of the integration of computers and communications and the impact on business and society—that should be a serious theme for the coming decade. As the federal money becomes available to create a more literate and learned dialogue, the knowledge will disseminate, and will be enhanced by the market studies of private industry.

PYLES: Yes. The research shouldn't be limited to government. Business and business combines should be funding projects or ongoing programs. There's no reason why, for example, the National Association of Manufacturers shouldn't be researching the subject. Beyond that, we as individuals should encourage our professional societies to take these issues more seriously. And as dp professionals, we should expand our own awareness, investigating and experimenting with new ways to use these machines, ways that are not so utilitarian...

GLASEMAN: We have the opportunity to take an early look at the broad implications, and to do something intelligent, something structured, rather than firefighting...

PYLES: There have been some initial steps, and we should mention them: Tony Oettinger's group at Harvard, the USC Center for Futures Research, and the Institute for the Future in the Bay Area. All have done remarkable work; we are encouraging expanding and capitalizing on that research. ✲

ROBERT ANDERSON is the head of the Information Sciences Dept. at The Rand Corporation, Santa Monica, Calif. His primary research centers on the application of artificial intelligence techniques in making man-machine interface more natural and more easily tailored to individual preferences. He has been an ACM National Lecturer and adjunct associate professor of computer science at USC. Anderson received his Ph.D. in applied mathematics from Harvard Univ.

STEVE GLASEMAN is a computer scientist at Rand with primary responsibilities in the fields of command and control, computer security, data communications, and software engineering. He has lectured on computer security and the social implications of computer technology at Cal State Univ., Northridge. Glaseman holds an MS in computer systems engineering, and currently is a doctoral candidate in the Rand Graduate Institute for Policy Studies.

RAYMOND A. PYLES has designed, built, and evaluated prototype decision support systems that aid in scheduling managers and training course designers; he has also performed studies in warning communications systems, and in command and control. Pyles has an MS in systems engineering, and is now a doctoral candidate in the Annenberg School of Communications at the Univ. of Southern California.

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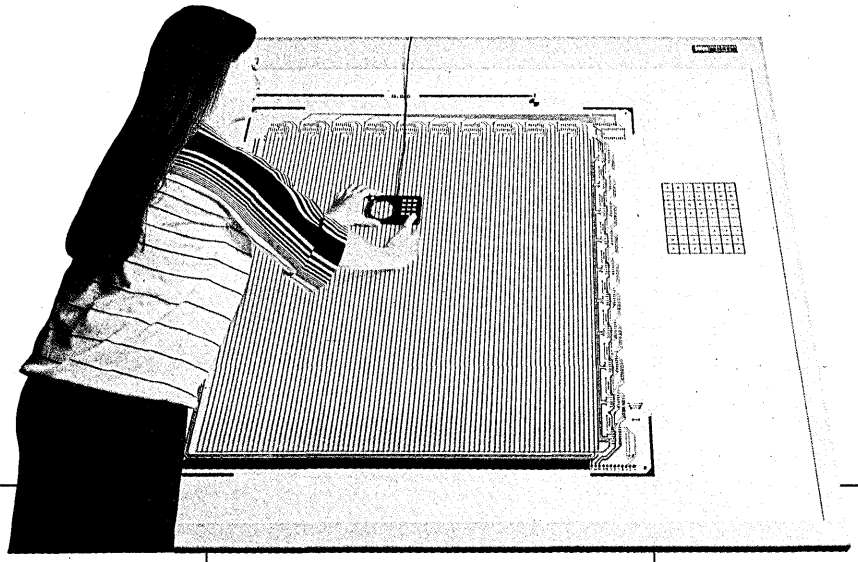

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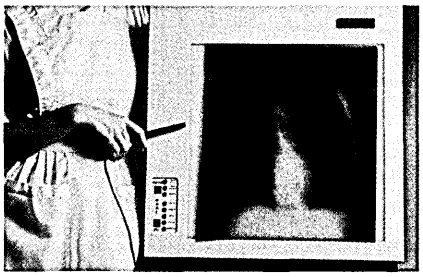

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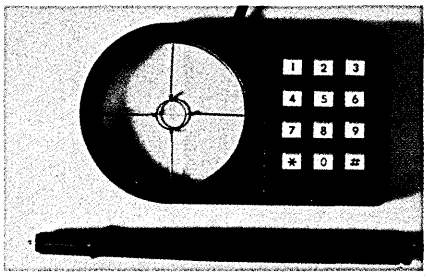

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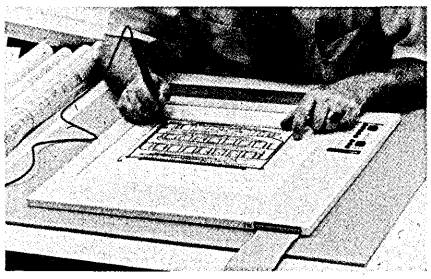

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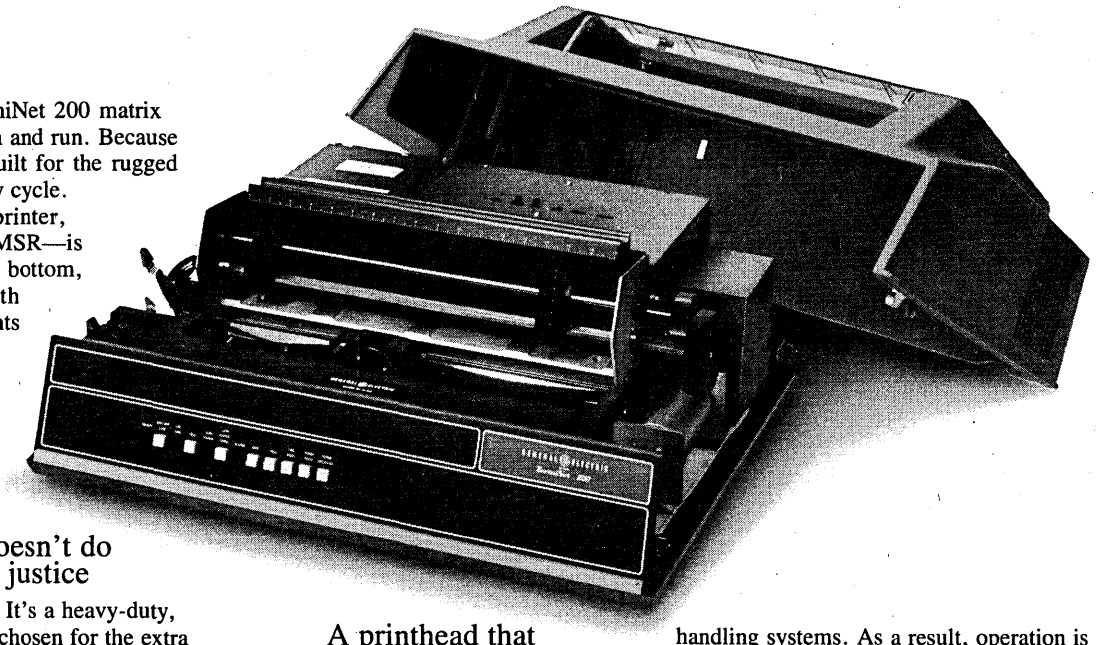

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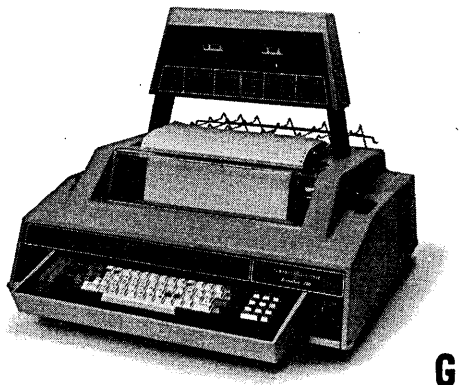

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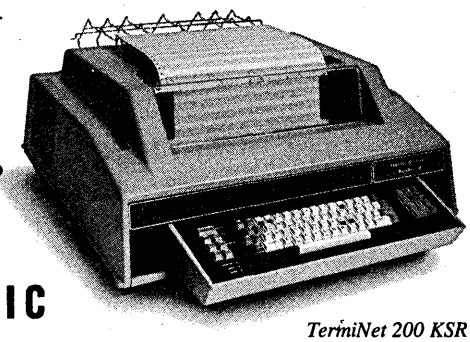

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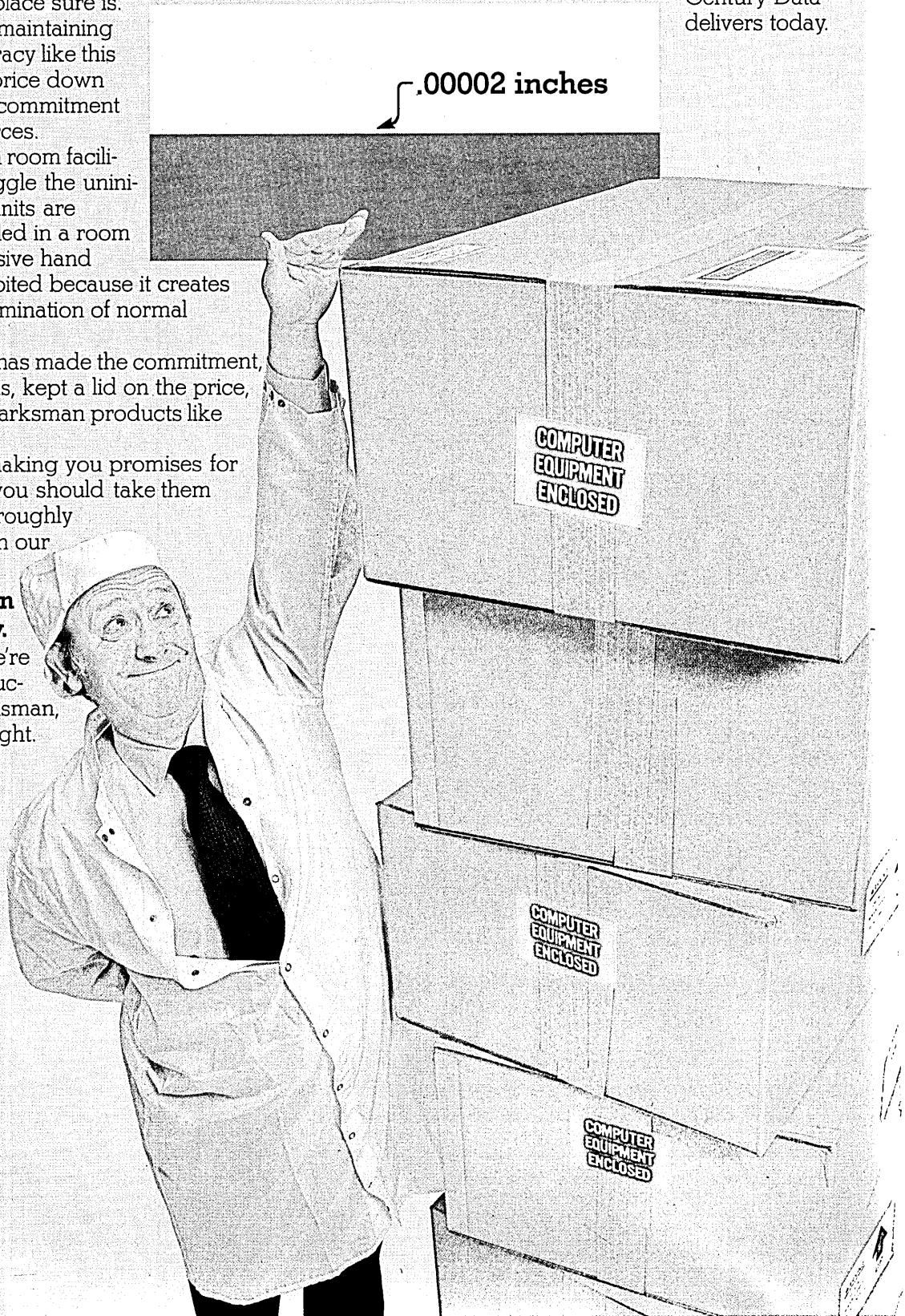

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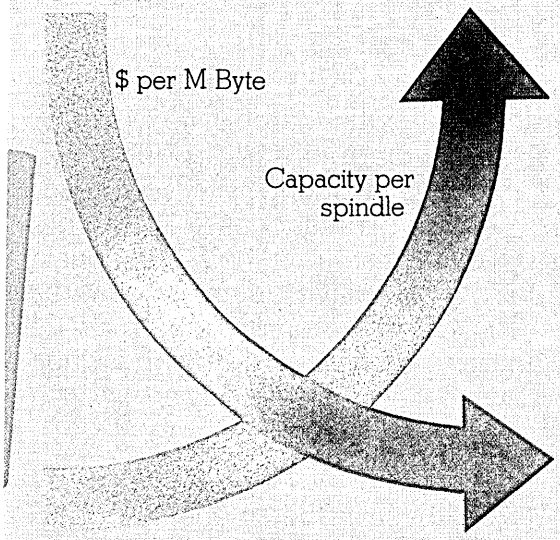

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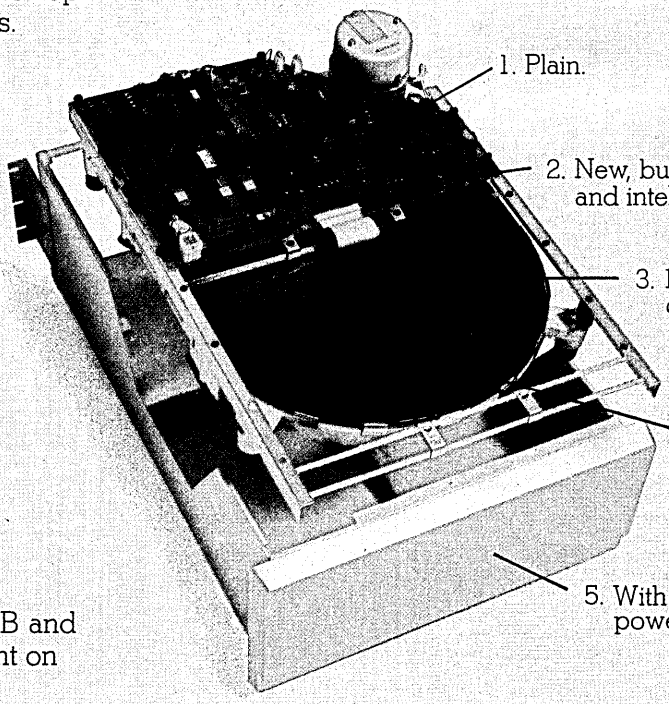
Pricing for the 40 MB Marksman is under $1800 in OEM quantities—actually less than projections on rumored smaller competitive units which will someday have only one-fourth the capacity.

High intelligence, room to grow.

To save you interfacing time and money, one Marksman model comes with a built-in microprocessor-based controller/formatter. It contains many of the interface and overhead functions normally relegated to the custom controller and CPU. That leaves you very little to do to put the whole system on-line.

It fills tall orders five ways.

You can order the Marksman plain or with everything on it.



See it tower over competition.

This Winchester is loaded. High reliability. Low price. Quick delivery. Wide variety of capacities and options.

Don't wait. Contact us today for all the facts. Century Data Systems, 1270 N. Kraemer Blvd., Anaheim, CA 92806. Phone (714) 632-7111.

WE FEEL LIKE A NEW COMPANY.

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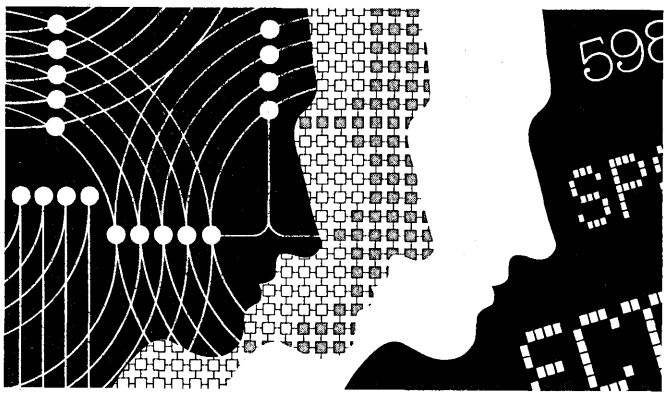
CIRCLE 33 ON READER CARD

Announcing... TIME's 5th Special Section on New Office Technologies

A Special Advertising Opportunity for Manufacturers of Business Equipment and Furniture



Sponsored by the International Word Processing Association, Partners for Profit will show how low cost *automation of words and data* can result in increased profits today for all sectors of business, large and small.

Arthur D. Little has assembled a panel of eight well-known authorities as contributing editors including Frederic Withington, Martin Ernst and Dr. Vincent Giuliano.

Twice as Big, Twice as Effective

Partners for Profit/Part I, scheduled for the November 12, 1979 issue of TIME B, will discuss specific applications in your major end user target markets: small business... professional and service areas...health and education...retailing ...communications...and more.

Part II, scheduled for the March 3, 1980 issue, will concentrate on people and productivity. How your customers, working with you, can bring new systems on line successfully... overcome people resistance...train their personnel.

Over 1,600,000 executive decision-makers will see each section of Partners for Profit in TIME B. TIME's famous demographic edition is the biggest and the best all business buy around.

Special Benefits, Special Savings

Partners for Profit offers an ideal advertising environment with these added benefits for all advertisers, FREE of charge: *You'll receive:*

- valuable new sales leads generated by two postpaid reader service cards (computerized weekly updates)
- a confidential analysis of responses to your advertisements
- a demographic/geographic analysis of section respondents including the results of a follow-up mail questionnaire
- full color reprints to send to dealers and prospective customers
- reprints of Partners for Profit will be distributed to IWP members

In addition, advertisers in Parts I and II will realize *special savings on all space units.* For further information contact your local TIME sales representative or call Charlie Craig, Business Equipment Supervisor, at (212) 841-2831.

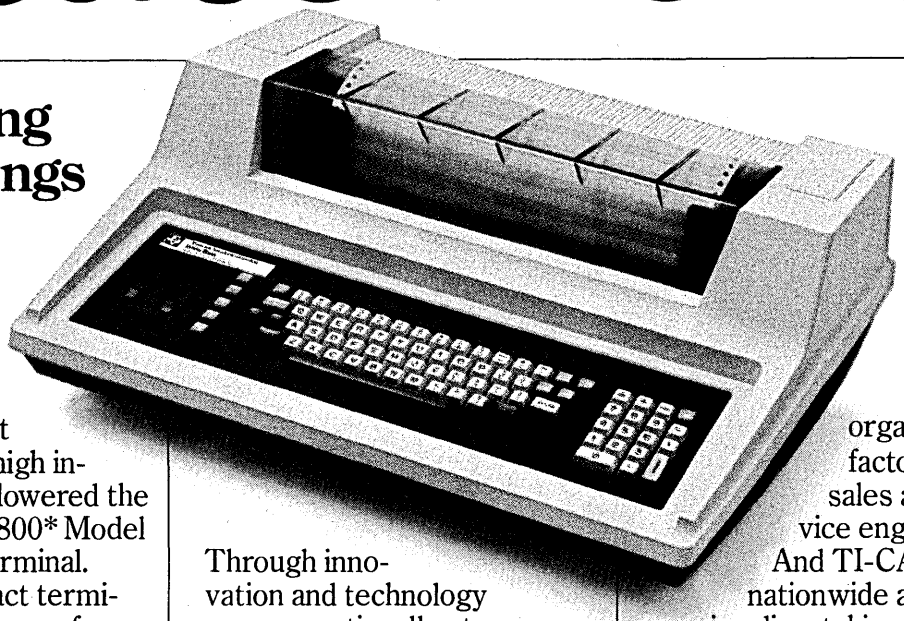
TIME

PUT TIME B TO WORK FOR YOU

CIRCLE 69 ON READER CARD

Savings Statement.

Announcing major savings on TI's 820 KSR.



Here's a statement that's sure to rate high interest. TI has just lowered the cost for the OMNI 800* Model 820 KSR impact terminal.

Now, the impact terminal that offers you more features as standard equipment is yours for less. So, you can capitalize on the 820's speedy, 150 characters-per-second printing and quiet, less-than-60-decibels performance. And you can profit, too, from such user-oriented features of the 820 as the L.E.D. Terminal Status Control panel, Answerback Memory and its legible five-copy printing capability. The 820 offers these standard features and more at substantial cost savings.

At TI our prices are constantly taking a turn for the better. It's part of our philosophy. Through innovation and technology we are continually streamlining our manufacturing and production methods, reducing our costs while maintaining our quality standards, and passing on those cost savings.

Producing quality, innovative products like the 820 KSR impact terminal is what TI is dedicated to. And TI's over 200,000 data terminals shipped worldwide are backed by the technology and reliability that comes from over 30 years of experience in the electronics industry.

Supporting TI's data terminals is the technical expertise of our worldwide organization of factory-trained sales and service engineers. And TI-CARE†, our nationwide automated service dispatching and field service management information system. That's why TI has been appointed the official computing company of the 1980 Olympic Winter Games.

XIII OLYMPIC WINTER GAMES LAKE PLACID 1980

If you would like more information on TI's lower 820 cost, contact the TI sales office nearest you, or write Texas Instruments Incorporated, P. O. Box 1444, M/S 7784, Houston, Texas 77001, or phone (713) 937-2016.

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We put computing within everyone's reach.

PIECING TOGETHER THE DATACOM INDUSTRY

by Richard A. McLaughlin, Senior Editor

Samuel F. B. Morse started it all in 1832 when he conceived the idea for the telegraph: "If the presence of electricity can be made visible in any part of a circuit, I see no reason why intelligence may not be transmitted instantaneously by electricity." Within 20 years, Western Union was formed in Rochester, New York; its business was to carry messages in coded form from one person to another over a privately controlled but publicly accessible network.

Then, in 1876, at the U.S. Centennial Exposition in Philadelphia, Alexander Graham Bell's talking machine was exhibited. Before a decade had passed, the Bell Telephone Co. had been founded; it, too, was in the business of carrying messages from one person to another, but this time the messages were in voice, as well as coded, form.

Next, an evolutionary step not recognized by too many people. In 1940, during a meeting of the American Mathematical Society at Dartmouth College in Hanover, New Hampshire, Dr. George Stibitz read a paper on the relay calculator which he had developed at a Bell Telephone Laboratory in New York City. At the conclusion of his paper, he demonstrated what his machine could do—by addressing it from Hanover through a teletypewriter connected to a telegraph circuit. It was the first time a coded transmission sent over a network was not intended to be received by another person; this time it was for a data processing machine.

After that, the developmental steps of the communications industry came in such rapid progression that several major milestones were not even recognized as they were passed. One big enough to be noted occurred in 1969, when, for the first time, as a result of the Federal Communications Commission's 1968 Carterfone decision, a message could be put into a network through a device that was not manufactured, installed, or controlled by the network operator. Once that step had been taken, it was not a new company that was formed, but an industry.

At the close of business in 1978, that industry—what we call the "data communications" industry—had had 10 years to develop... the time has come to give it a thorough examination.

But what to examine, what to include? Although even the FCC has not yet been able to define this entity to which it played midwife, publications and editors can rush in where federal commissions, courts, and Congresses fear to tread. So, in order to make a first attempt at measuring this fledgling's growth, we will define the industry—define it as 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. There probably is a better way to limit it, but this definition will have to serve until wiser men define it more precisely.

Several things live in the no-man's-land where, in the next decade, IBM and AT&T will fight their battle: modems and multiplexors, network and node controllers, communications lines and channels, computer front-ends; plus other pieces, including test and measurement equip-

ment especially developed for data, and audio response units that act like front-ends.

MODEMS AND MULTIPLEXORS

The first object a piece of data encounters usually as it leaves the terminal is some device to allow it access to the network. Here, also, the independent manufacturer of data communications equipment first confronts AT&T competition, but the competition is not as keen as a frightened independent might at first believe. Bell admits to over 400,000 data sets of its own on private line and public networks, plus another 240,000 or so Data Access Arrangements. The best estimates for the total population of these animals suggest that, together, the independents have at least as many units installed as Bell does, and may be currently shipping at a rate up to nine times the rate of new Bell installations. (Our sources peg the size of the combined market between $220 and $290 million for 1978.)

Bell makes a great deal more money doing it, since each new installation is an addition to its rental base rather than a one-time sale, but prospects look encouraging for the independents.

Multiplexors fall 'way over on the independents' side. The 1978 market is estimated at $40 to $60 million for the independents. Due for an increasing share of this pork barrel are the time-division multiplexors (TDM's) and statistical multiplexors. There will be some blurring of the lines, too, as the smart multiplexors take on functions we now ascribe to node controllers.

The real market for multiplexors is relatively easy for an independent to enter because it is highly concentrated: as much as half is confined to the remote dp service firms; a third is U.S. industry and government combined; and the rest is exports. There simply are not many users who can realize sufficient financial advantages from high density line sharing over public networks—or even in-house—to be able to afford a multiplexor. The average user settles for modem splitters, port contention units, or new microprocessor-based network/node controllers.

NETWORK/NODE CONTROLLERS

In a sophisticated network, the next box the data stream sees is a node controller. Now, when is a network controller not a computer front-end? One answer is: when there is no host computer nearby. Or, when the communications box is only loosely coupled to the nearby cpu. Because "loosely" is up for definitional grabs, some manufacturers class part of their output as front-ends and part as network controllers, even though the boxes look identical sitting on the shipping dock. The big players here are Comten and CCI.

COMMUNICATION CARRIERS

The realm of the carriers is one of microwave, satellites, copper lines, and submarine cables. It is populated by six major, overlapping classes: the common carriers that provide telephone service; the international common carriers; the domestic record carrier(s) that handles(s) things like telegrams; the international record carriers; the satellite carriers; and the specialized carriers such as packet network operators.

Although the FCC is busy opening these classes to increased competition, the current positions are well known: Bell and the independent telephone operating companies for domestic common carriers; ITT as the international common carrier of note; Western Union Corp. as the primary domestic record carrier; ITT Worldcom, RCA Globcom, Western Union International, TRT, and FTC as the international record carriers; American Satellite Corp., Western Union, RCA Americom, and Communications Satellite Corp. as the airborne carriers (Comsat, however, does not sell its services directly to the public); and operators such as Tymnet, Telenet, MCI, and others in the "specialized" group.

The carriers pull in a great amount of money for carrying data. Still, what the carriers take in cannot be as large an amount as we have imagined. The 5% to 7% figures often quoted for the carriers' share of the data communications industry have never been well defined, and we now believe those numbers may include Telex and TWX services, which are person-to-person communications and therefore do not fit our definition of *data* communications. Facsimile isn't data either, nor is tv or broadcasting, whether done in digital form or not.

In short, the bulk of today's communications business is still one of carrying voice. It won't always be that way, however. There's a reason for IBM to want to be in Satellite Business Systems, Xerox in XTEN, and others to stake out turf—and the reason is business communications: electronic mail, digitized voice and images, office automation, teleconferencing, and more. Business communications is the future for IBM, Xerox, the telephone companies, Western Union, the business system manufacturers, and many others. That's why the jockeying for position; that's why Computer Inquiry II; that's why the new Communications Act activity. That's also why the data communications industry, although presently a $2 to $3 billion midget, demands so much attention.

SBS, if allowed to fly at all, won't be operational until 1981, and XTEN wasn't around for 1978 business. All other major carriers that sell to the public are included in our roundup. Since none yet split out revenues by data versus voice, the numbers presented are our best estimates. We looked long at AT&T, especially after seeing we hadn't hit the magic 5% to 7% slot, but once satisfied, we used its marker as a scale against which to measure the others.

COMPUTER FRONT-ENDS

Coming in from the transmission medium, the piece of flying data may find a multiplexor, modem, and network controller in its path to the cpu. Then it comes to the computer's front-end, and here we admit to having our biggest problem in sizing the companies and the market. The problem is that computer makers don't want anyone to see how many, or how few, front-ends they are selling. The numbers are surely smaller than we expected to find.

We took our best shot at figuring the sales of mainframes over the year, checking computer census figures and published revenue data, estimating how many front-ends go out per cpu (it isn't one-to-one), figuring average costs, and doing a lot of math. As in figuring carrier revenues by looking most closely at AT&T, we carefully analyzed IBM and applied some rules of thumb and market percentages to help us home in on the others. Yet, we are printing the estimates with our fingers crossed.

Note that minicomputers with data communications software have not been included.

ETC. & OTHERS

The final slice of the pie is a mixed one, and includes important vendors and some critical equipment. Here, for example, we'll find instrumentation for monitoring data lines. We have excluded those products that work perfectly well on analog transmissions, like oscilloscopes and their modern pocket-sized equivalents, and recounted only that gear

THE TOP 50 U.S. MANUFACTURERS IN THE DATA COMMUNICATIONS INDUSTRY

Estimates

RANK	COMPANY	TOTAL DATA COMMUNICATIONS REVENUES $K	DATA COMMUNICATIONS PRODUCT REVENUES (% of total)	PERCENTAGE OF DATA COMMUNICATIONS REVENUES ATTRIBUTABLE TO MAIN PRODUCT CATEGORIES			
				NETWORK/NODE CONTROLLERS	COMPUTER FRONT-ENDS	MODEMS/ MULTIPLEXORS	OTHER
1.	IBM	$144,000	<1.0%	0%	100%	0%	0%
2.	Motorola	$66,200	3.0%	0%	0%	90%	10%
3.	Racal-Milgo	$63,000	100.0%	0%	0%	70%	30%
4.	Comten	$46,649	90.4%	20%	80%	0%	0%
5.	General DataComm	$31,169	100.0%	0%	0%	90%	10%
6.	Paradyne	$25,899	100.0%	0%	30%	70%	0%
7.	Rixon	$22,000	100.0%	0%	0%	90%	10%
8.	Northern Telecom	$20,000	5.0%	0%	0%	0%	100%
9.	Burroughs	$18,800	1.0%	12%	88%	0%	0%
10.	Computer Communications	$17,129	100.0%	0%	100%	0%	0%
11.	Honeywell	$16,500	1.0%	0%	100%	0%	0%
12.	Control Data	$15,800	<1.0%	0%	100%	0%	0%
13.	Sperry Rand	$15,600	<<1.0%	0%	100%	0%	0%
14.	Hewlett-Packard	$14,800	<1.0%	0%	0%	0%	100%
15.	Infotron Systems	$14,387	100.0%	0%	0%	100%	0%
16.	Intertel	$12,500	100.0%	0%	0%	60%	40%
17.	NCR	$12,200	<1.0%	0%	100%	0%	0%
18.	Racal-Vadic	$12,000	100.0%	0%	0%	100%	0%
19.	Timeplex	$11,517	100.0%	0%	0%	100%	0%
20.	TRAN Telecommunications	$11,293	95.0%	40%	0%	50%	10%
21.	Periphonics	$11,000	100.0%	0%	100%	0%	0%
22.	Bolt Beranek & Newman	$10,550	35.0%	35%	0%	0%	65%
23.	Memorex	$8,750	5.0%	0%	100%	0%	0%
24.	Tektronix	$8,607	1.0%	0%	0%	0%	100%
25.	Anderson Jacobson	$7,615	28.0%	0%	0%	100%	0%
26.	M/A-COM	$7,160	7.2%	49%	23%	28%	0%
27.	Dynatech	$6,600	34.3%	0%	0%	0%	100%
28.	T-Bar	$6,350	50.0%	0%	0%	0%	100%
29.	Penril	$5,620	40.0%	0%	0%	100%	0%
30.	Micom Systems	$5,400	100.0%	0%	0%	100%	0%
31.	Atlantic Research	$4,970	11.0%	0%	0%	0%	100%
32.	Rockwell International	$4,500	<<1.0%	0%	0%	100%	0%
33.	International Data Sciences	$3,700	100.0%	0%	0%	0%	100%
34.	Prentice	$3,500	100.0%	0%	0%	100%	0%
35.	United Technologies	$3,500	<<1.0%	0%	0%	100%	0%
36.	Plessey	$3,400	2.0%	90%	1%	0%	9%
37.	Gandalf Data	$3,300	100.0%	0%	0%	100%	0%
38.	ComData	$3,014	100.0%	0%	0%	100%	0%
39.	Coherent Communications	$3,000	100.0%	0%	0%	100%	0%
40.	Wavetek	$2,567	10.0%	0%	0%	0%	100%
41.	Data Access	$2,415	15.0%	0%	0%	100%	0%
42.	Interactive Systems	$2,250	75.0%	0%	0%	80%	20%
43.	L. E. Walz	$2,025	90.0%	0%	0%	0%	100%
44.	Novation	$2,000	100.0%	0%	0%	100%	0%
45.	Federal Screw Works	$1,970	4.0%	0%	0%	0%	100%
46.	Harvey Hubbell	$1,967	<1.0%	0%	0%	100%	0%
47.	Datastream Communications	$1,800	100.0%	30%	45%	20%	5%
48.	Carterfone Communications	$1,610	12.5%	0%	0%	100%	0%
49.	Omnitec Data	$1,600	100.0%	0%	0%	100%	0%
50.	Digital Communications	$1,427	100.0%	30%	25%	40%	5%

Estimates and Reported Data

TOTAL U.S. REVENUES (% of total)	1977 TOTAL REVENUES $K	1978 TOTAL REVENUES $K	1978 NET INCOME (LOSS) $K	NUMBER OF EMPLOYEES	FISCAL YEAR END	Q†
47.6%	$18,133,184	$21,076,089	$3,110,568	325,517	Dec. 31	A
77.0%	$1,853,514	$2,219,744	$125,182	68,000	Dec. 31	A
85.0%	$52,900	$63,000		1,900	March 31	R
85.0%	$36,320	$51,621	$6,869	1,400	Dec. 31	R
87.2%	$5,744,000	$5,668,800	$473,800	114,000	Sept. 30	A
92.7%	$20,122	$31,169	$2,274	662	Sept. 30	A
83.0%	$15,358	$25,899	$3,087	625	Dec. 31	A
66.0%	$16,000	$22,000	$1,980	380	Dec. 31	R
85.0%	$13,522	$17,129	$1,106	340	June 30	A
74.5%	$2,911,100	$3,547,800	$201,400	86,328	Dec. 31	A
58.4%	$2,126,822	$2,460,002	$253,364	54,638	Dec. 31	A
56.6%	$1,360,000	$1,728,000	$153,000	42,400	Oct. 31	A
90.0%	$9,000	$14,387	$4,209	200	Dec. 31	R
85.0%	$8,448	$12,500	—	275	Oct. 1	E
67.0%	$2,301,456	$2,738,327	$166,962	45,950	Dec. 31	A
53.4%	$2,311,939	$2,610,520	$193,731	62,000	Dec. 31	A
92.0%	$8,700	$12,000	—	270	April 30	E
65.0%	$3,292,186	$3,674,157	$176,619	88,275	March 31	A
67.0%	$8,020	$11,517	$545	278	June 30	A
50.0%	$10,800	$11,887	($2,722)	500	June 30	R
95.0%	$10,000	$11,000	—	200	Dec. 31	R
100.0%	$26,573	$30,185	($397)	816	June 30	R
55.0%	$450,112	$633,266	$50,197	11,085	Dec. 31	A
63.7%	$454,958	$598,886	$56,846	19,147	May 27	A
96.0%	$183,825	$402,390	$26,190	12,607	Dec. 31	R
83.8%	$20,921	$26,834	$1,330	641	March 31	A
88.8%	$74,121	$99,317	$6,095	2,907	Sept. 30	A
73.2%	$14,991	$19,247	$1,508	250	March 31	A
88.0%	$9,359	$12,667	$1,101	335	Dec. 31	A
95.0%	$10,021	$14,050	$1,178	600	July 31	R
90.0%	$1,200	$5,400	>$600	125	March 31	R
95.0%	$32,675	$45,183	$1,357	1,061	Dec. 31	A
100.0%	$2,900	$3,700	—	—	July 31	E
90.0%	$2,200	$3,500	$500	45	April 30	E
63.0%	$5,550,670	$6,265,218	$234,144	152,213	Dec. 31	A
90.0%	$150,000	$174,000	$7,300	17,000	March 31	E
100.0%	$1,500	$3,300	—	115	July 31	E
100.0%	$2,525	$3,014	—	70	June 30	E
90.0%	$2,254	$3,000	$333	75	Dec. 31	E
67.0%	$18,953	$25,667	$1,608	677	Sept. 30	A
100.0%	$6,601	$16,101	$1,117	200	Aug. 31	A
90.0%	$3,100	$3,000	—	64	Dec. 31	E
100.0%	$2,000	$2,250	$100	7	Oct. 1	R
90.0%	—	$2,000	—	60	Jan. 31	E
100.0%	$47,801	$49,269	$2,819	840	June 30	A
80.5%	$211,024	$260,118	$20,521	8,400	Dec. 31	A
100.0%	$101	$1,800	—	20	Sept. 1	R
100.0%	$10,776	$12,900	—	270	March 31	E
100.0%	$1,200	$1,600	$100	50	June 30	E
100.0%	$1,180	$1,427	$72	39	June 30	R

Q†: Source of revenue and income data, A = audited report, R = unaudited report, E = estimated

PIECING TOGETHER...

which, without dp transmissions, would have no useful place in life. In other words, we've eliminated devices that measure electronic functions and left in those that look at message content.

Also stashed in this section are tech control centers and their equipment. Not too many years ago, network analysis was left to the phone companies, sometimes with less than desirable results. Now, very large users have their own centers for fault-tracing. They also have their own mechanisms for patching lines together or putting spare modems on line. Sometimes these "mechanisms" resemble the patch panels we used to wire tab equipment (we called it "programming"), but if the product is anything over that level of sophistication, it's probably in this category.

Unexpected entries are the product lines of Cognitronics, Wavetek, and Votrax: audio response units, clearly intended for communication with a person, but clearly *not* intended for person-to-person communications. Many of these products are sold to phone companies (especially those from Cognitronics) and used in non-dp applications, so they are not counted as revenue producers in the data communications industry. For those that do perform dp application tasks, this category is the best place to roost.

Excluded from this survey is anything that smacks of telephony, anything that wouldn't have a role to play if all data died tomorrow morning. Number one on this list is the PBX, even the programmable variety. (We can afford this exclusion for 1978 business listings, but not for much longer, as PABX's are expected to blend and become one with network/node controllers and multiplexors.)

Also out in the cold is any product or service either not offered to or not of much interest to the general public—satellite modems and telephone switching gear (even if digital), and the products of such companies as California Microwave, Earinon, and the component makers.

LUMPING IT ALL

Although every reasonable precaution has been applied in its assembly, neither the whole nor the parts of this examination come with a guarantee. Some figures are clearly to be more trusted than others. We are quite certain of the accuracy of figures for publicly-held companies doing business in one nicely defined category, as is true of many modem makers. We are less confident in some results for privately-held companies, even those that confided in us, or for publicly-held firms that don't segment their business operations in financial reporting.

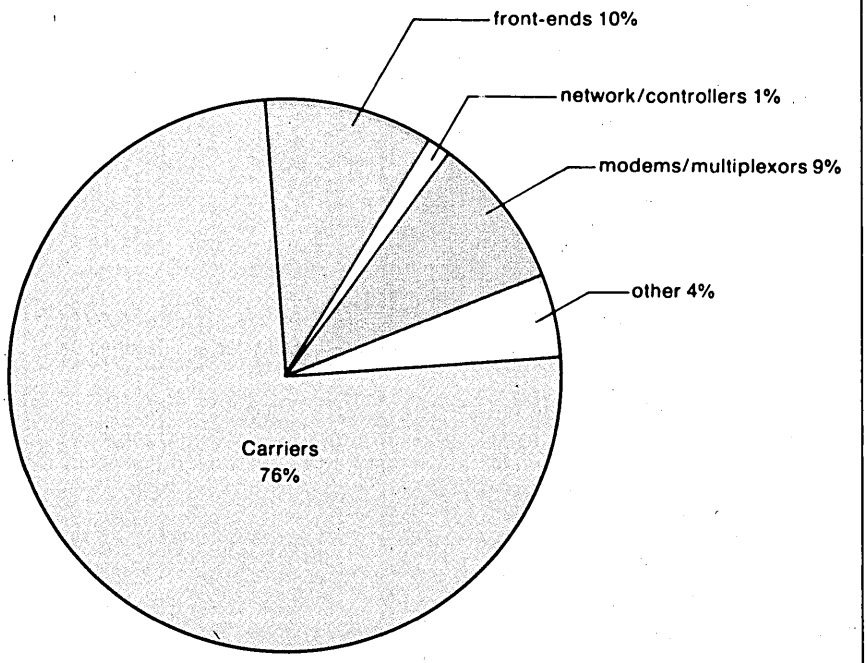
Still, the numbers are correct in their proportions if not in their absolute dimensions. Together, they represent at least the bulk of what is out there between the terminal controller at one site and the cpu at another.

In many cases, the figures are smaller than we felt comfortable with, but they stood up to some tests of reasonableness, and so they are left for inspection. All the companies were polled for the data, and the estimates either discussed with them or returned to them for verification —but we don't pretend that they all cooperated.

How big is it all? The collected revenues of the firms analyzed here come to $270 million for modems and multiplexors; $32 million for network/node controllers; $2,392 million for the carriers (leaving out Comsat, to avoid double-counting); $305 million for front-ends; and $114 million for "other"; a total of $3,113 million. Not very big yet, but watch this space for future expansion.

See what you started, Sam? ✲

THE SIZE OF THE SLICES



The aggregate product and service revenues for the companies presented here plus those of 14 more second-tier firms lead to the above estimates for the industry's proportions. As suspected, the carriers have most of the business. (Ma Bell's share alone is 56% of the total pie.)

SOURCES

In addition to hundreds of annual reports, 10Ks, and reports filed with the FCC, the following sources were used in compiling this report. Not all of them were used in developing estimates, but all provided useful background and are gratefully acknowledged:

Arnold Bernhard & Co., Inc., New York, *Value Line Investment Survey*

Bache Halsey Stuart Shields Inc., Mass., *Institutional Researchers*

Berglund & Smith, New Jersey, *Consultants in Data Communications*

Computer Intelligence Corp., La Jolla, Calif., *Computer Census Data*

Dun & Bradstreet, Inc., New York, *Institutional Researchers*

Federal Communications Commission, *Statistics of Communications Common Carriers*

Frost & Sullivan, Inc., New York, *Market Researchers*

Martel Firing & Associates, San Francisco, *Data Communications Industry Consultants*

Montgomery Phister, Jr., The Santa Monica Publishing Co., Santa Monica, Calif., *Data Processing Technology and Economics*

Telephony Publishing Corp., Ill., *U.S. Business & Residential Telephones current statistics & future growth* ✲

THE MANUFACTURERS

In most cases, the manufacturers are listed under the name by which they do their audited financial reporting. Often this is the name of a parent company, and thus "Federal Screw Works" is listed instead of "Votrax." In cases where a subsidiary name is listed instead of the parent, either the parent was not a U.S. firm (as in the case of Milgo and Vadic, which are considered separately), or the subsidiary provided the information directly, or we had a better handle on what the subsidiary was doing than we did on the parent.

The reporting was done on a fiscal year basis, where a company's reporting cycle is different from the calendar year. In an upmarket like this one, such reporting can work to the disadvantage of some firm's rankings, as they are reporting revenues from an earlier, less productive period. (Univac is a case in point.) Business done in a fiscal year which ends on March 31, for example, is for sales through March 31, 1978—a year ago.

Finally, some companies are reporting negative incomes—we urge caution about classing these as "losers" in any way; they are probably pioneers instead, spending money on development and staking out new market territories.

1. International Business Machines Corporation

Armonk, NY 10504
(914) 765-1900

IBM's revenues from 370X front-end processors alone make it a giant in the data communications industry. If all goes well for the firm's efforts in Satellite Business Systems, it may become a carrier as well. And no matter what happens in the courts or before the Federal Communications Commission with SBS, in a few years its programmable PBX's may also be found in the data communications column. For now, the 370X product line alone musters revenues of an estimated $144 million. (Modems don't add much.) Less than 1% of IBM's total business, the figure is enough to rank IBM at the very top in this industry, too.

2. Motorola, Inc.

Motorola Center, 1303 E. Algonquin Road, Schaumburg, IL 60196
(312) 397-5000

In 1978 Motorola celebrated its 50th year, and what seems like its 50th encounter with the data processing and data communications industries. It acquired Codex in 1977, and Universal Data Systems in December 1978. Both companies have been in the data communications industry: Codex with modems, multiplexors, and network processors; Universal with modems and data transmission test equipment. Both are largely buried within Motorola's consolidated accounting systems by now, but we'd estimate Codex's 1978 revenues at $60.2 million, and UDS' at $6 million.

3. Racal-Milgo, Inc.

8600 N.W. 41st Street, Miami, FL 33166
(305) 592-8600

Like Cable & Wireless, and like Plessey, Racal Electronics Limited is placing the British flag on U.S. turf through acquisitions. Milgo joined its camp in 1977. The firm has been around since 1955, and currently makes its markets in modems (medium, high-speed, wide-band, and short-haul) and in network diagnostic equipment. Its business revenues for 1978 is said to be $63 million. (1979's, as of March 31, should be $80 million.)

4. Comten, Inc.

1950 W. County Road B2, St. Paul, MN 55113
(612) 633-8130

Very few companies presently make more money in data communications then Comten does. Those that do, like IBM and ATT, are giants that obtain only a small portion of their revenues from data communications, while most of Comten's funds come from this industry. Started in 1968 with seed money from the software house Comress, the company was originally called Comcet but was forced to change its name due to confusion claimed by Comsat, the communications satellite firm.

The offspring later became more successful than its parent, and Comress was folded into Comten; thus, computer performance measurement products and software remain a portion of the firm's line.

The last year for which an annual report will be issued was 1977, as the firm is being acquired by NCR. Business figures for 1978 have been released, however, and they show a $2.4 million one-time cross-licensing payment from IBM which has been included in our estimate of $46.6 million for data communications revenue.

5. General DataComm Industries, Inc.

One Kennedy Avenue, Danbury, CT 06810
(203) 797-0711

General DataComm now claims to have the largest product base in the industry, to be shipping more data sets than any other two companies combined (including Western Electric, Bell's own supplier), and to being the principal supplier of data sets for Canada. It also claims to have 25% of the low-speed modem market. Not bad for a company that started in 1969.

It makes modems, multiplexors, network diagnostic equipment, and test equipment, and those products brought in over $31.1 million for GDC last year.

6. Paradyne Corporation

8550 Ulmerton Road, Largo, FL 33541
(813) 536-4771

Paradyne has been in the industry since 1969. Its product line includes modems (medium-speed, high-speed, wideband, short-haul) plus end-to-end data communications systems that replace 270X/370Xs and make remote terminals look like local per-

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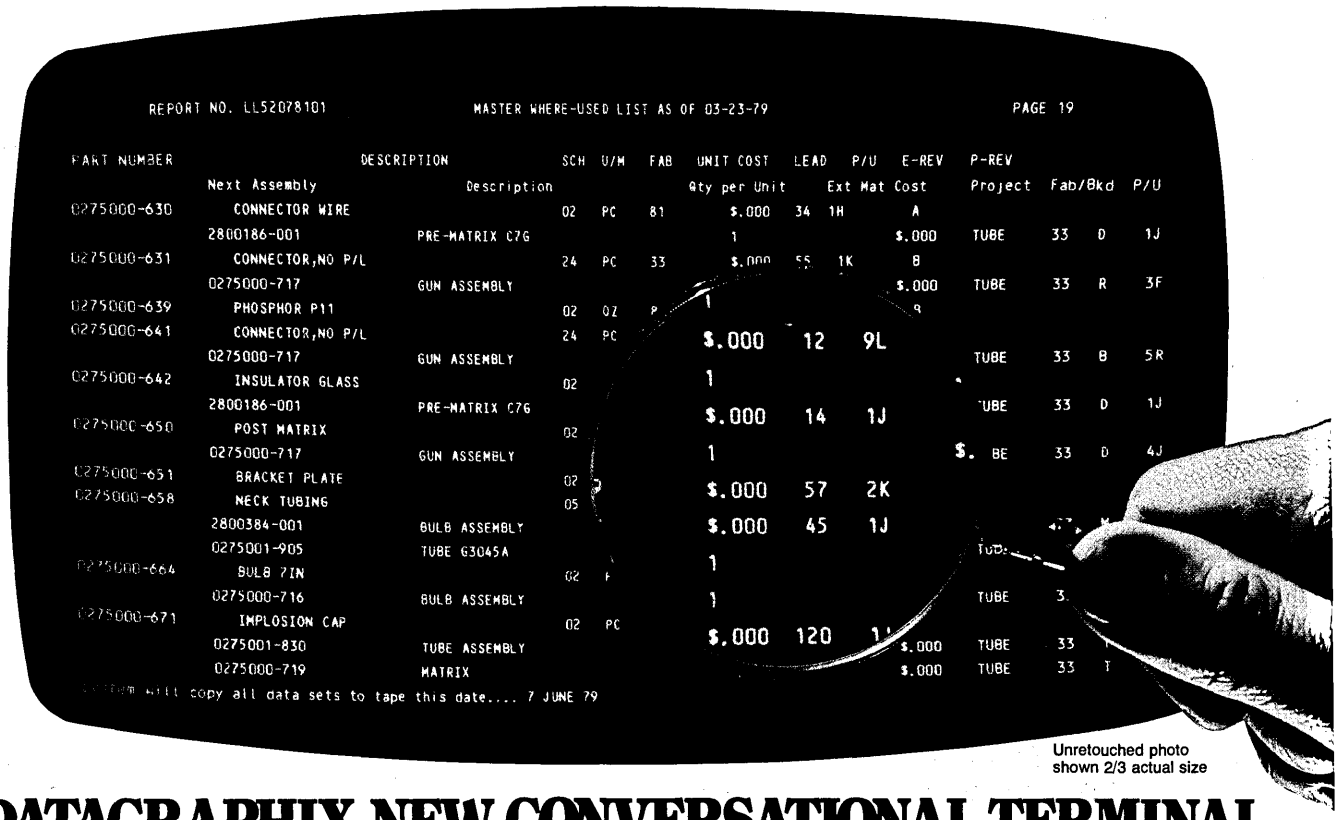

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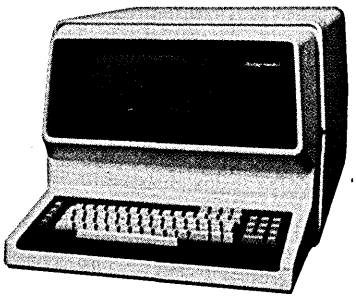

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ipherals. One of the bigger names in the business, its 1978 revenues ran $25.9 million.

7. Rixon, Inc.
2120 Industrial Parkway, Silver Spring, MD 20904
(301) 622-2121

Rixon is one of the truly buried companies of the world, as far as financial reporting is concerned. It is held by Sangamo, which is held by Weston, which is held by Schlumberger. It manages to do very well in spite of all this, rolling up revenues of $22 million for 1978 business (mostly in low-, medium-, and high-speed modems).

8. Northern Telecom Inc.
International Plaza, Nashville, TN 37217
(615) 361-3500

Northern Telecom Ltd. is Canada's equivalent to Western Electric, and second only to its American counterpart in the production of telecommunications equipment. Don't look now, but it has recently made some major inroads to the U.S. marketplace through two American subsidiaries: Northern Telecom Systems, Inc., and Northern Telecom Inc. The former owns Data 100 and Sycor now; the latter owns Spectron Corp., among others, a manufacturer of data transmission test equipment and line drivers. Spectron's business is all that can be recounted here as data communications, but that is estimated at $20 million.

9. Burroughs Corporation
Burroughs Place, Detroit, MI 48232
(313) 972-8026

Burroughs is second to IBM in the dp equipment business, and now claims to have 25,000 computers at work or on order (not counting 140,000 business minis and smart terminals). It is a principal supplier of node controllers to the SWIFT network, also. Still, some of its bigness in data communications must be in teller terminals, terminal controllers, and in B1800 processors doing network tasks, because we cannot identify where it would have stashed large numbers of front-end processors. The firm does claim to manufacture its own modems, however, and this increases its data communications ledger.

More importantly, the company is 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; thus our low estimate for 1978 won't stay low. Another important development was the 1978 introduction of Burroughs Networking Architecture, which will help it place more data communications boxes with big price tags.

For 1978 we estimate, with fingers crossed, that Big B produced data communications revenues of $18.8 million (out of an Information Systems business of $1,524 million).

10. Computer Communications, Inc.
2610 Columbia Street, Torrance, CA 90503
(213) 320-9101

CCI is one of the industry's happiest turnabout stories. A period in its history, around 1973 when it was in the terminal business as well as in data communications, saw the firm in dire straits. Since then, it has concentrated on communications front-ends and has grown to challenge Comten and IBM—although it is much smaller than either of those companies.

At one time CCI had an agreement with Memorex for sales of its CC-80 product, but that agreement was allowed to die by mutual consent in 1977, with the only lasting result that Memorex now builds a version of the CC-80 which it labels the 1380. Whatever the past, revenues for 1978 looked pretty good at $17.1 million.

11. Honeywell Inc.
Honeywell Plaza, Minneapolis, MN 55408
(612) 870-5200

Honeywell's communications front-ends claim an ancestry going back at least to the joint project between General Electric and Dartmouth which led to the BASIC language and time-sharing. Although HIS's smaller computers have integrated communications, its large-scale machines have had separate communications boxes at least through the beginning of the third generation when those large-scale machines still wore GE labels (and beat IBM into the third-generation marketplace).

Honeywell takes a slightly different tack on its FEP's too, allowing the direct attachment of disks, for instance, to log communications traffic independently.

The main part of HIS's current front-end business is in attaching such devices to Level 66 and Level 68 hardware, a task we believe brought in about $16.5 million last year (of an Information Systems business of $1,293.6 million).

The firm also owns Spectronics (which is developing fiberoptic data communications gear but is not yet a significant data communications revenue generator) and a Florida branch that builds such things as modems (primarily for the military).

12. Control Data Corporation
8100 34th Avenue South, Minneapolis, MN 55420
(612) 853-8100

CDC's computer business seems to be in a turnaround mode, not that it was doing especially poorly in '77. Sales were up nearly a quarter, largely on the strength of peripherals but also on the strength of big Cyber sales, and earnings doubled. Orders for large-scale machines were up 36%, and data communications should move up right along with that, since the relevant products are front-end processors.

We estimate that front-ends brought $15.8 million to CDC's coffers in 1978, less than 1% of CDC's $1,867,826,000 in computers, but nice just the same. (The rest of CDC's $2.7 billion business is in credit and finance.)

Nearing production status at the computer factory is a 100 million instructions/second Cyber 203, adding to the territory the company has staked out on the supercomputer side; we wonder what kind of a front-end that will get.

13. Sperry Rand Corporation
1290 Avenue of the Americas, New York, NY 10019
(212) 956-2121

Sperry Univac claims an installed computer base of $9.9 billion, second in the industry. Its nearly $2 billion in computer revenues still place it well behind Burroughs, however, on that journal column. As with the other mainframers, its data communications related revenues come from front-ends, primarily the Distributed Communications Processor (DCP) which connects to anything in Univac's line from a 9060 up. At the rate the 1100 systems are going in, plus the top-end 90s, we estimate a data communications revenue of $15.6 million. (The small business done in modems does not materially affect this figure.)

14. Hewlett-Packard Company
1501 Page Mill Road, Palo Alto, CA 94304
(415) 493-1501

HP's test and measurement equipment produced larger revenues last year than its dp products did, but only a small portion (about 5%) of the test and measurement gear is thought to be data-specific. Still, 5% of $740 million done in that area in 1978 runs up to $14.8 million, making it a rather big factor in the data communications arena.

THE MANUFACTURERS

15. Infotron Systems Corporation
Cherry Hill Industrial Center, Cherry Hill, NJ 08003
(609) 424-9400

Infotron has been in business since 1969. Its line includes multiplexors, port contention units, low- and high-speed modems, plus a very small amount of data-specific test equipment. Privately held, it produced revenues of about $14.4 million in 1978.

16. Intertel, Inc.
6 Vine Brook Park, Burlington, MA 01803
(617) 273-0950

Intertel was established in 1969, and makes its living as a manufacturer of modems in the 1200baud to 9600baud class, and of network monitoring and diagnostic equipment. The latter is its microprocessor based EMS 1 series, which provides for automatic or manual monitoring of data communications lines, plus patching, hot spares, etc. Together the product lines are claimed to have brought in approximately $12.5 million in fiscal 1978.

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

NCR has three entries in the data communications business, all through front-end processors. One is through its own in-house sales for the 1969-vintage 621 front-end (a not-really programmable device) and the 1976-era Model 721. The second is through Data Pathing (which it has owned since 1976) and that company's bisynch-compatible Systems 15 and 150. The third is through Comten, the biggest independent maker of such devices, which it acquired early this year.

Comten's 1978 business was done under its own name, and thus is listed separately. We estimate that Data Pathing and NCR internal sales combined ran no more than $12.2 million.

18. Racal-Vadic, Inc.
222 Caspian Drive, Sunnyvale, CA 94086
(408) 744-0810

Having seen that Milgo liked being part of the Racal camp, Vadic decided to jump in also, and did so in April 1978, just before the end of its fiscal year on April 30. Its products are low- and medium-speed modems, and tend to complement rather than overlap Milgo's lines. We estimate Vadic's 1978 revenues to be $12.0 million. (The new fiscal year imposed by Racal, as of March 31, 1979, should be closer to $20 million for 12 months.)

19. Timeplex, Inc.
100 Commerce Way, Hackensack, NJ 07601
(201) 646-1155

Timeplex produces multiplexors and concentrators as its main product line, which it augments with low- and medium-speed modems. Established in 1969, it is publicly held and racked up $11.5 million in 1978 data communications revenues.

20. TRAN Telecommunications Corporation
2500 Walnut Ave., Marina del Rey, CA 90291
(213) 822-3202

TRAN is a networking company that has had an impact on the data communications industry much greater than its size would suggest. Among other accomplishments, it designed and implemented the Canadian digital network, Dataroute, and is in the process of constructing another with Pacific Bell for the State of California. Its ambitious development programs were partly responsible for keeping the firm in the red for 1978 in spite of $11.2 million in data communications; 1979, with sales nearer $20 million, will be a different story.

21. Periphonics Corporation
75 Orville Drive, Bohemia, NY 11716
(516) 567-1000

Periphonics has done pretty well for itself by specializing in communications front-ends, which are sold to the banking industry, among others. One of the smaller participants in that field, the privately held firm still laid claim to $11 million in revenues for 1978.

22. Bolt Beranek & Newman
50 Moulton Street, Cambridge, MA 02138
(617) 492-4841

BB&N is the operator of the ARPANET, the pioneer packet-switching network. It was also the founder of Telenet, and held nearly a quarter of that firm's stock at the close of BB&N's fiscal 1978 (but will no longer have it after the GTE purchase of Telenet is final).

BB&N's business is split into "acoustics" and "computer technology." The latter includes a branch for "systems," where the ARPANET management, the Pluribus network/node controller hardware sales, and private network construction portions of the revenue are collected.

We estimate that $10.6 million came from those parts in 1978, most of which still related to ARPA and network building.

23. Memorex Corporation
San Tomas at Central Expressway, Santa Clara, CA 95052
(408) 987-1000

Memorex's presence in the data communications industry comes from its construction of IBM-compatible communications controllers, the 1270 and 1380 (the latter of which it builds under permanent license from Computer Communications, Inc.) We estimated $8.7 million for its data communications revenues for 1978.

24. Tektronix, Inc.
Box 500, Beaverton, OR 97077
(503) 644-0161

Tektronix is in two business: 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. Figured at 2% of that revenue, 1978 data communications business was a healthy $8.6 million.

25. Anderson Jacobson, Inc.
521 Charcot Ave., San Jose, CA 95131
(408) 263-8520

Formed in 1967 to manufacture an acoustic couple, AJ claims the title of the world's leading supplier of such devices. It also builds a variety of modems. Its second year in business saw the introduction of terminals in its product line, however, and these now account for the biggest slice of its revenues. Recently the firm has gone off into small business systems as well, with the result that coupler and modems now bring in just over a quarter of the firm's $28.8 million gross take—roughly $7.6 million.

26. M/A-Com, Inc.
South Avenue, Burlington, MA 01803
(617) 272-3000

Until April 1978, M/A-Com's name was Microwave Associates, Inc. It changed its title just after acquiring Digital Communications Corporation in February. The parent company is into microwave, CATV, broadcast, and other forms of telecommunications. Not all of DCC's $17.9 million for 1978 was from end user data-related applications either. Some, for example, was for satellite communications equipment sold to the carriers; the company has already been tagged as a contributor to Xerox's development of XTEN. General purpose, end-user data communications

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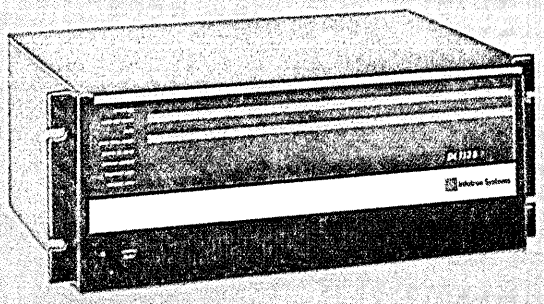
Modems



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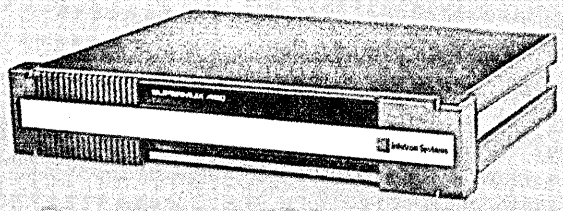

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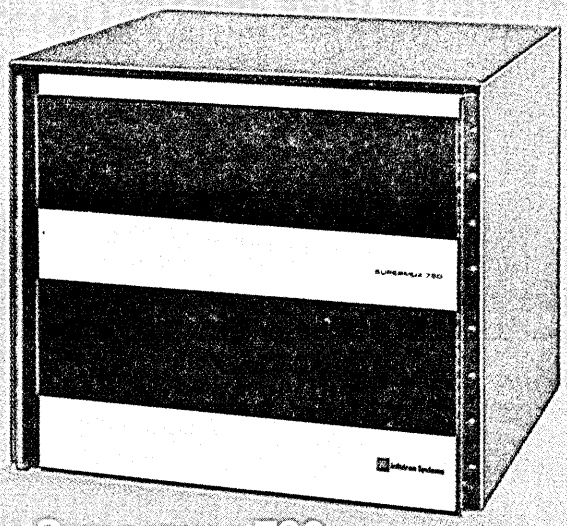

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Performance Index	1.0	1.1	3.7	6.0
Comparable IBM System	138	138	148	158
Operating System	Multi-User Interactive	BATCH	BATCH	Multi-User Interactive
System Expandability	DP, WP, TP	DP, TP	DP, TP	DP, WP, TP
Cache Memory	N/A	8K Bytes	8K Bytes	32K Bytes
Memory Range	128K– 512K	512K– 1 MEG	2 MEG– 4 MEG	256K– 2 MEG
On-Line Disk Storage	2.3 Billion Bytes	9 Billion Bytes	18 Billion Bytes	4.6 Billion Bytes
Delivery Date	10 Weeks	1-2 Years	1-2 Years	12 Months

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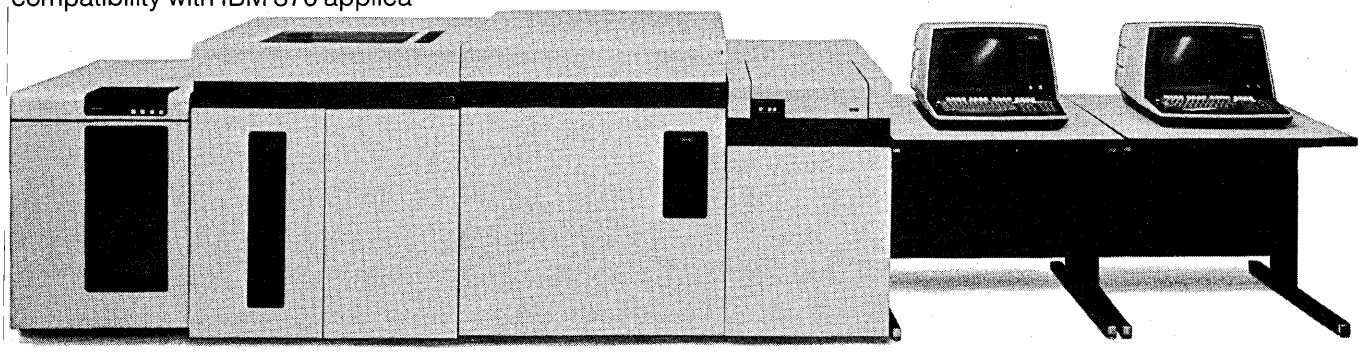

*Industry Analysis Report for Executives, Advanced Computer Techniques Corporation, New York, New York.

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(modems, statistical multiplexors, communications processors) is thought to be about 40% of DCC's business, or $7.2 million for 1978.

27. T- Bar Incorporated
141 Danbury Road, Wilton, CT 06897
(203) 762-8351

T-Bar makes switches that are used in switching peripherals from one processor to another, and in switching communications lines. About half its revenues come from each side of the house, and this yields a 1978 data communications revenue figure of over $6.3 million.

28. Penril Corporation
5520 Randolph Road, Rockville, MD 20852
(301) 881-8151

Penril has become well known in data communications for its broad range of modems, but it actually makes 60% of its revenues from less closely related test equipment and other hardware, including power supplies. Its 1978 modem revenues are estimated at $5.6 million.

29. Micom Systems, Inc.
9551 Irondale Ave., Chatsworth, CA 91311
(213) 882-6890

Micom is a privately-held corporation in the business of manufacturing statistical multiplexors, port concentrators, error detection and correction devices, line drivers, and related data communications pieces. When founded in 1973, the company specialized in custom data communications systems, and only introducted its first standard products at the end of 1977, at which time its business reportedly shot from $1.2 million to $5.4 —largely on the strength of its low cost statistical multiplexor.

30. Atlantic Research Corporation
5390 Cherokee Avenue, Alexandria, VA 22314
(703) 354-3400

AR operates in a wide variety of business segments, ranging from solid propellant rocket motors, to electromagnetic engineering, to digital communications equipment. Much of its digital communications equipment, however, is not specifically for data transmission. Only its construction of tech control centers and data transmission test equipment put it in the data communications industry—with a near-$5 million share.

31. Rockwell International Corporation
600 Grant Street, Pittsburgh, PA 15219
(412) 565-2902

Rockwell is another of those huge conglomerates with fingers in the data communications pie. The firm makes everything from the Space Shuttle Orbiter to printing presses to home appliances. Its representative in the data communications realm is its Collins Communications Switching Div., maker of the C-System for computer front-ending.

Only a fraction of even that one division's $ billion business is in data communications, however. The aging C-System now is usually sold to existing customers needing more power, or to the European banking community—whose needs it is uniquely suited to. New business from the division, like its Financial System, tends not to be general purpose, but industry specific. Hence our estimate of only $4.5 million.

32. Dynatech Corporation
16 New England Executive Park, Burlington, MA 01803
(617) 272-3304

Dynatech Data Systems, in Springfield, Virginia, is the operating entity which produces for the data communications industry. Related products are for tech control, especially in monitoring and simulating data transmissions. The corporation's other lines are in medical and R&D fields. 1978 data communications revenues: $4.4 million.

33. International Data Sciences Inc.
7 Wellington Road, Lincoln, RI 02865
(401) 333-6200

IDS sprang full-grown into business in 1968, the year of the Carterfone decision, with a line of data-specific communications test equipment—at a time when few customers knew what such stuff was and even fewer suspected they needed it. The company's most familiar product line is probably the Rangerider line diagnostic series, to which it has recently added the MiniTech tech control and protocol monitoring device. Together the products brought the firm about $3.7 million in fiscal 1978.

34. Prentice Corporation
795 San Antonio Road, Palo Alto, CA 94303
(415) 494-7225

Prentice's business is in short-haul modems, where it estimates it has 25% of the market. A privately-held company, it does not release its financial data, but we estimate its 1978 revenues at over $3.5 million.

35. United Technologies Corporation
United Technologies Building, Hartford, CT 06101
(203) 728-7000

Already a multifaceted conglomerate—owner of Otis (the elevator manufacturer), Pratt & Whitney (the aircraft engine maker), and Sikorsky Aircraft among many others—United added Ambac Industries, Inc. to its holdings last July. At $234 million, Ambac itself was no midget; with 14 subsidiaries, it was nearly as diversified as United. One of those subs is its Tele-Dynamics Div., and part of Tele-Dynamics' revenues come from the manufacture of modems—roughly $3.5 million's worth for 1978.

36. Plessey, Inc.
1275 Bloomfield Ave., Fairfield, NJ 07006
(201) 227-1106

Plessey, Inc. is a subsidiary of Plessey Company Limited, the British firm that is active in all kinds of communications-related fields from radar to telephony. The U.S. arm brought in revenues of approximately $174 million for 1978, but only those of its Fairfield Plessey Div. are of interest here. That division brought in end user sales of some $3.4 million on the strength of its DMS/660 digital store and forward message switch and its new Data Line Controller (a micro-processor based device for handling data line protocols and conversions).

37. Gandalf Data Inc.
1019 S. Noel Street, Wheeling, IL 60090
(312) 541-6060

Gandalf Data Inc. is the business end of a Canadian company. The "parent" does design work, but the U.S. branch does the manufacturing and selling for the U.S. market. Its products include modem eliminators and short-haul modems which can have multichannel interfaces, a segment of the industry which pulled in an estimated $3.3 million for the U.S. arm last year.

38. ComData Corporation
8115 Monticello, Skokie, IL 60076
(312) 677-3900

ComData is a privately-held corporation in the business of manufacturing multiplexors, acoustic couplers, and modems of all speed groups. It, like so many firms in this business, was established in late 1968, after the Carterfone decision. Since then, it has developed its operations to above the $3 million mark.

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THE MANUFACTURERS

39. Coherent Communications Systems Corp.
85D Hoffman Lane, Central Islip, NY 11722
(516) 582-4044

This firm is a quiet manufacturer of frequency division multiplexors, slow- and medium-speed modems. In business since late 1968, it tallied up sales of approximately $3 million for 1978.

40. Wavetek
9045 Balboa Ave., San Diego, CA 92123
(714) 279-2200

Wavetek is another split-personality company, with one side in the test and measurement business and the other in voice response systems and software. The latter is the smaller, accounting for 16% of revenues. We estimate its data applications revenues for 1978 at $2.6 million.

41. Data Access Systems, Inc.
100 Route 46, Mountain Lakes, NJ 07046
(201) 335-3322

DAS is primarily a distributor of terminals, but it manufactures its own acoustic couplers and modems, almost as a sideline, and these have accounted for estimated 1978 revenues of $2.4 million—making this firm's "sideline" a bigger business than many modem-makers main lines.

42. Interactive Systems Inc.
3980 Varsity Drive, Ann Arbor, MI 48104
(313) 973-1500

ISI is in the business of building coax cable networks for carrying voice, data, and video in-plant. So far, it's an unusual business to be in, but it should become more familiar as the "wired corporation" comes into its own. Most of the pieces of such nets are already familiar: modems, multiplexors, and intelligent multiplexors which front-end the cpu. The data side of the business is said to account for roughly 75% of the revenues, $2.3 million.

43. L. E. Walz & Associates, Inc.
128 Rumson Road, Massapequa, NY 11758
(516) 798-3119

Walz's operating subsidiary is ADS Corporation, a developer of tech control centers. The firm's work is done primarily in the New York City area, and primarily through subcontractors. A minor sideline is the work done in manufacturing cables, which accounts for about 10% of the revenues, leaving $2 million from the tech control business.

44. Novation, Inc.
18664 Oxnard Street, Tarzana, CA 91356
(213) 996-5060

Novation is a privately-held firm that has been on the scene since 1969. Its products are modems (to 1200baud) and acoustic couplers (to 300baud), a segment of the market from which it sliced a $2 million share in 1978.

45. Federal Screw Works
3401 Martin Ave., Detroit, MI 48210
(313) 841-8400

Just as its name implies, FSW produces a lot of screws, also bolts, nuts, locknuts, and voice response systems. Its data communications division is Votrax, and its products are used in telephone systems, communications for verbally impaired persons, and in data applications—a role leading to an estimated $2.0 million in data communications revenues for 1978.

46. Harvey Hubbell Incorporated
584 Derby Milford Road, Orange, CT 06477
(203) 789-1100

Hubbell's Pulse Communications Div. (Pulsecom), the data communications entity, is so deeply buried in the conglomerate that it isn't even listed separately under the "Other" category in the firm's annual report. Still its modem and alternate voice/data products brought in nearly $2 million for 1978.

47. Datastream Communications, Inc.
430 Valley Drive, Brisbane, CA 94005
(415) 468-3310

The products this company builds are 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 is intended to provide. Established in 1974, the firm is privately held and said to have done about $1.8 million in 1978.

48. Carterfone Communications Corporation
1111 W. Mockingbird Lane, Dallas, TX 75247
(214) 630-9700

Thomas Carter, the founder of Carterfone, may legitimately be considered the father of the interconnect industry. It was his action, filing an antitrust action against AT&T and other phone companies, which resulted in the FCC's 1968 Carterfone decision.

Ironically, Carter was not fighting his battle for a data communications product, but for a coupler which linked two-way radios with telephones so that mobile radio operators could reach someone by phone.

Since then, Carterfone has indeed become a presence in the data communications and dp industries. Its revenues come primarily from the customizing and leasing of terminals, from computer system maintenance, and from couplers and modems.

The company has become a subsidiary of Cable & Wireless Limited, gobbled up by the communications conglomerate in January 1978. Cable & Wireless is acclaimed for laying the world's first submarine communications cable, which it put underwater between Malta and Alexandria in 1868—just 100 years prior to Carterfone's pioneering.

As a C&W subsidiary, C'fone has ceased issuing annual reports, but based on its 1977 reporting and trends, we estimate the firm did just over $1.6 million in the couple and modem business in 1978.

49. Omnitec Data
2405 South 20th Street, Phoenix, AZ 85034
(602) 258-8244

Omnitec claims to be the country's second largest manufacturer of acoustic couplers, having seesawed back and forth with Anderson Jacobson over the last 14 years. Founded in 1966, Omnitec is one of the oldest companies in this business. Its product line includes low- and medium-speed modems, as well as the couplers. Now a part of Bastion-Blessing, which, in turn, is a part of Nytronics, Omnitec's revenues are consolidated for reporting purposes, but company estimates peg its fiscal 1978 revenue at $1.6 million.

50. Digital Communications Associates, Inc.
135 Technology Drive, Norcross, GA 30092
(404) 448-1400

DCA believes it is in the data plumbing business. It builds products for character oriented terminal networks, including microprocessor based statistical multiplexors, minicomputer based front-end processors and network/node controllers, plus some DEC-specialized products for terminal support and network connection. In the business since 1972, its fiscal 1978 revenues were $1.4 million. (Calendar year figures were closer to $2M.) ✲

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THE CARRIERS

The business of the carriers listed represents essentially *all* of the data transmission revenue generated in the U.S. or between the U.S. and other nations. Communications is a regulated game, and the number of players has been limited. There are more telephone operating companies, but Bell alone has approximately 79% of all phones, and together the top six account for the vast majority of subscribers.

1. American Telephone and Telegraph Company
195 Broadway, New York, NY 10007
(212) 393-9800

AT&T, "The System," the empire, is also the fortress wall one must breach before understanding the mysteries of the data communications industry. Ninety-four years after being fathered by Alexander the inventor, and 10 years after the Carterfone decision opened the way for "foreign attachments" to connect to her telephone lines, the matriarch remains a far greater power in the fledgling data communications industry than IBM ever dreamt of being in data processing.

As a regulated entity, Ma Bell must yield to the FCC, and to the world, much more information about herself and her business than most firms ever do. Yet what she gives, she gives with such "subtle confusions" that her apron is never lifted. Care to know how many telephones she has? She will even tell you how many are disconnected but still sitting at subscriber locations: 1,734,324 at the end of 1977. Or how many telephone poles? 17,072,191. But how many lines carry data? Or how many are conditioned to carry data? Or how much money does she make in the data communications industry? She has "no way of knowing."

Industry wisdom (probably a self-contradictory term) says that between 5% and 7% of Bell's revenues come from data. But is that 5% to 7% including Teletype revenues? Including Western Electric's outside sales?

Since nearly 95% of Western Electric's product goes to the Bell System, and since most of it is not modems or multiplexors, we can largely discount the business WE does outside of Bell's own family.

Teletype isn't so easily discounted. Great numbers of its products have been shipped to Bell facilities over the years and have shown up in tariffed services; more than 50,000 probably went to teletypewriter message services, including the TWX service sold to Western Union in 1971. Bell does maintain a count of "telegraph stations," which we suspect are primarily data terminals, but the count is much smaller than we would expect—something over 100,000 units. We have counted up the number of Data Access Arrangements (there are about 240,000 of those little gems around) and data sets she admits to having (400,000), and used those figures as one starting point for figuring transmission volumes and such.

We will use our best estimates for it all, spinning a thread from the figures we can get hold of, attaching one end of it to estimates of independent modem construction, another to the FCC filings, breaching the wall as a spider would, by climbing over or squeezing through cracks. We say 4% of her dollars come from data transmission, another 0.5% from tariffed products, including data sets and Teletypes used in data transmission. That would make $1.8 billion or so for 1978. We invite her to show us our errors.

2. General Telephone & Electronics Corporation
One Stamford Forum, Stamford, CT 06904
(203) 357-3797

GTE is Number Two in the telephone business, and in a strange parallel to the data processing industry, has almost the same percentage of Bell's business as Burroughs has of IBM's. (There's an immutable natural law in there somewhere.) Fortunately for the sake of GTE's pride, telephones are only about half the com-

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LA180 DECprinter I, RO	1,995	190	104	70
VT100 CRT DECscope	1,695	162	88	59
VT132 CRT DECscope	1,895	181	97	66
TI745 Portable Terminal	1,875	179	98	66
TI765 Bubble Memory Term.	2,795	267	145	98
TI810 RO Printer	1,895	181	99	66
TI820 KSR Printer	2,395	229	125	84
ADM3A CRT Terminal	875	84	46	31
QUME Letter Quality KSR	3,195	306	166	112
QUME Letter Quality RO	2,795	268	145	98
HAZELTINE 1410 CRT	895	86	47	32
HAZELTINE 1500 CRT	1,195	115	62	42
HAZELTINE 1520 CRT	1,595	152	83	56
DataProducts 2230	7,900	755	410	277
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pany's business; the rest is in tv's, consumer electronic products, etc. Applying the same kind of percentage against its telephone revenues as we did for AT&T, roughly 4.5%, we arrive at 1978 data revenues of about $207 million.

Next year's figures will look far more impressive for data communications, however, as they will include the revenues of GTE's new subsidiary, Telenet; the partnership will make GTE a far bigger competitor, proportionately, in data than it is in voice.

3. Western Union Corporation
One Lake Street, Upper Saddle River, NJ 07458
(201) 825-5000

"Western Union." The name conjures up images of boys on bicycles delivering telegrams, and of old men wearing green eyeshades.

The images are both right and wrong. Western Union has indeed been around for a long time, 126 years, and has seen the days of green eyeshades. But it also has two satellites of its own (with a third, for NASA, going up soon), 32 computer centers for service operations, a 9,000 mile microwave network which reaches into most U.S. cities, the start of a wideband data and secure voice network for the DOD to complement the military's Autodin network, and on-line data base services for news and for stock trading.

Its 1978 annual report puts it all in perspective: "Most analysts and business forecasters agree that telecommunications will be one of the fastest growing industries in the 1980s. This growth will result from the accelerating convergence of data processing and telecommunications, coupled with the growing need to transmit information electronically rather than moving it around in hard-copy form."

We all knew that the office of the future, electronic mail, electronic funds transfer, and these other telecommunications functions we see coming together were going to require great amounts of telecommunications services. And somehow we all thought that was Bell's domain. But most of those things are *record* store and forward operations, and good old Western Union is the only domestic record carrier.

WU claims that the bulk of its $168.8 million leased systems business is in private data transmission networks. Another $54 million is in National Sharedata's bank dp and EFT network, Telestat System's on-line data base services, and PR Newswire Association's on-line news services (which can feed directly into other data bases).

Not counting TWX, Telex, or WU's own manufacturing of time-division multiplexors, concentrators, and the like, almost one quarter of the company's revenues still look like data communications in an almost pure sense. That's $171.9 million. Throw away the eyeshades.

4. United Telecommunications, Inc.
Box 11315, Plaza Station, Kansas City, MO 64112
(913) 676-3343

United has a unique mix of resources to apply to the business of the future. Its telephone system is the third largest in the nation, although a healthy step down from GTE, which is second. Where GTE has over 16 million phones, United has something over 4 million. But that's not all it has. It also has United Computing Systems, the computing service organization—which, incidentally did $76.1 million last year. And add to that a 24% share of a modem manufacturer called Rixon. Plus some software sales through the service bureau. Plus Calma, the interactive graphics system manufacturer, whose financials are consolidated with UCS.

There is as yet no office equipment or business system maker in the mix, but it's an interesting set of ingredients which someone, someday, will build into something. For now, for 1978, the data communications revenues resulting from data transmission should run at about $48.8 million, without Rixon, which reports separately.

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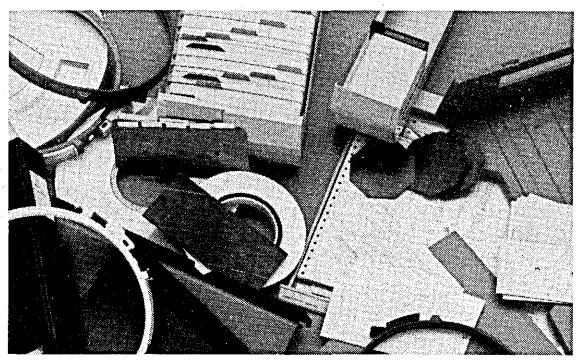

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5. Tymshare, Inc.
20705 Valley Green Drive, Cupertino, CA 95014
(408) 446-6000

In early 1977, Tymshare spun off its data communications network from its data processing service organization, making it a special common carrier. Although Tymnet is treated as a separate entity in some respects, perhaps by FCC edict, its revenues are consolidated with those of its parent.

Tymshare has been in an acquisition mode for some years—picking up TRW's Validata credit verification operation most recently, and the Autax tax processing service plus the Medical Information Inc. hospital dp service business in 1978—and all this should put extra traffic onto Tymnet.

We estimate that Tymnet's data communications business brought in $16.5 million last year—a good portion of which was rebilled by Tymshare to its dp customers.

6. Central Telephone & Utilities Corporation
O'Hare Plaza, 5725 East River Road, Chicago, IL 60631
(312) 399-2500

CTU is the fifth largest phone system in the U.S., having passed the one million-installed mark just this year. The biggest portion of its business is done in Nevada, followed by Florida and Illinois. The company is also in the utilities business, as its name implies. Partly because of its service locations, and partly due to its revenues from light and power, we estimate that only about 2.5% of its revenue comes from data related services—roughly $16.2 million—and that may be high.

7. Continental Telephone Corporation
56 Perimeter Center East, Atlanta, GA 30346
(404) 393-2323

Continental is the nation's fourth largest phone company, with nearly three million phones in service. Its business is primarily in domestic telephony, but it does have an international branch active in the Middle East, some foreign subsidiaries, and even a data processing services subsidiary, ConTel Data Services. But Continental is a small-community telephone company, not one which handles heavy metropolitan area business. Thus we estimate its data carrying revenues at 2% of all transmission, roughly $14.9 million for 1978.

8. RCA Corporation
30 Rockefeller Plaza, New York, NY 10020
(212) 598-5900

Among the many other branches of its 1978 business, RCA had three satellite communications arms: RCA Alaska Communications Inc., RCA American Communications Inc., and RCA Global Communications Inc. Together their revenues were $324.2 million. Alascom could be presumed to carry very little data, due to its primary function of bringing telephone service to our northernmost state; that system is being sold to Pacific Power & Light Co. and will no longer show up on RCA's ledgers anyway. Americom receives less than 8% of its revenues from voice *and* data together, we estimate, so Globcom, at $171 million, is the entity most likely to succeed in carrying much data at all. We estimate that the triumvirate gathered in $14.7 million in data revenues last year.

9. ITT World Communications Inc.
67 Broad Street, New York, NY 10004
(212) 797-3300

ITT stands for International Telephone and Telegraph Company, but thinking of the firm as a telephone company is about like thinking of IBM as a typewriter manufacturer. ITT owns the Sheraton hotel chain, Hartford Fire Insurance, O. M. Scott & Sons (the lawn care people), and dozens of other companies, including the bakers of Wonder bread and Hostess cakes.

Of its $19.4 billion business, the part we are concerned about is ITT Worldcom, which did over $157 million in the international communications business last year. As an international records carrier, it offers Telex, telegram, leased channel, and "other" services between the U.S. and other countries. The "other" category includes universal data transmission service, among others, a packet-switching medium.

ITT is going in the right direction for tomorrow's business. It has picked up Courier Terminal Systems and Qume during the last 12 months, putting it into the data processing and office automation fields, and also has a small microwave carrier called United States Transmission Systems. ITT's Domestic Transmission Systems Com-Pak facsimile network will be operational this year, and terminal to computer services will be offered on it in 1980. Also up the pike this year is the ITT Corporate Communications Services, a long distance calling network.

For 1978, however, Worldcom was the major data communications revenue provider. We estimate its contribution as $12.6 million.

10. Communications Satellite Corporation
950 L'Enfant Plaza, Washington, D.C. 20024
(202) 554-6000

Comsat is a carrier's carrier, and is included only for reference. It makes most of its living by leasing satellite channels to the common carriers, including to AT&T. As the U.S. agent for Intelsat, it provides the medium for international traffic going to or coming from the U.S. through the sky. More than half its revenues come from Intelsat; the rest is from Comstar, a domestic satellite series, and Marisat, a marine communications program. Marisat carries very little data, and is not included here. The others, due to the nature of the airborne communications business, are estimated at 8% each—just double Bell's transmission estimate—for a 1978 total of $11.4 million.

11. Graphic Scanning Corp.
99 West Sheffield Ave., Englewood, NJ 07631

Unraveling the revenues of Graphic Scanning and its communications carrier subsidiary Graphnet, would require a Computer Inquiry III. The main portion of the corporate business is done in receiving unstructured customer data, compiling and formatting it, selecting a route and carrier for its transmission, translating the outgoing message to a format and protocol for whatever terminal or computer is to receive it, and transmitting it over other carriers' lines. Only a limited amount of the functions performed, 10% Graphic claims, are pure data processing, like data base update; and no inquiry response is said to be supported.

The company did roughly $9.1 million in the (basically) transmission business in fiscal '78. Other businesses include radio paging, using its own subsidiary radio common carrier, and telecommunications systems, through another subsidiary, Comnet.

12. Telenet Communications Corporation
1050 17th Street NW, Washington, DC 20036
(202) 637-7900

Telenet is our one, pure data communications carrier. It does no data processing of the form Graphic Scanning does, so it is easier to categorize. It does sell products, but they are data communications switches and turnkey networks; and, in fact, it has sold these packet-switching systems to the three major international records carriers (RCA Globcom, ITT Worldcom, and Western Union International—somehow the fourth one, TRT, got left out, perhaps because TRT has its own switch-building subsidiary).

Telenet's network is of the packet-switching variety and so is of less utility for facsimile, voice, or other traffic. It supports X.25 transmission protocol, and this makes it attractive to the IRC's.

1978 business is the last which will be separately reported, we presume, as GTE has found Telenet to be an attractive plum. Its third year of operation, 1978, saw Telenet Communications Corporation (the sole active subsidiary) pull in double its 1977 business, $8.9 million. 1979's revenues, though more difficult to iso-

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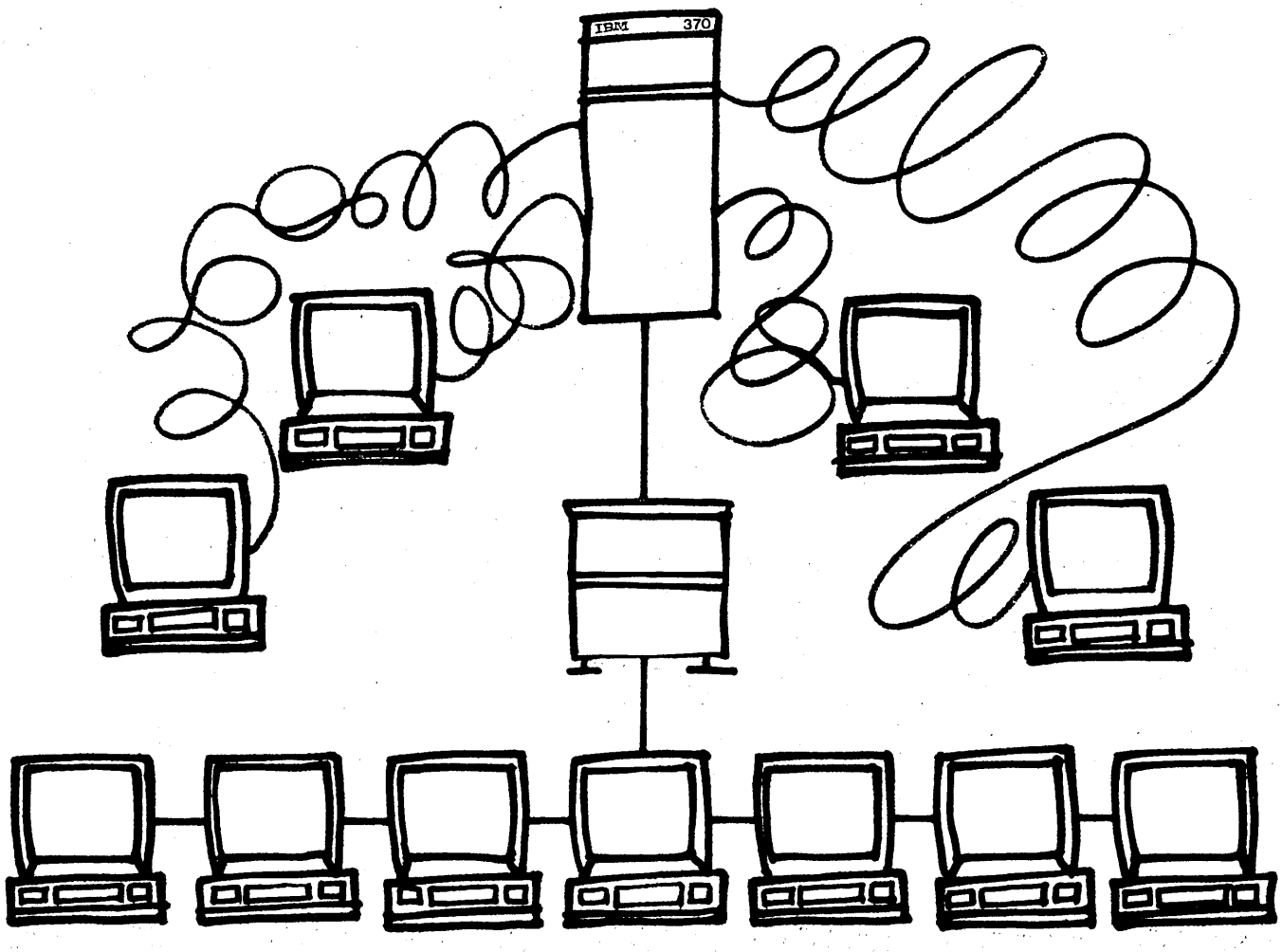

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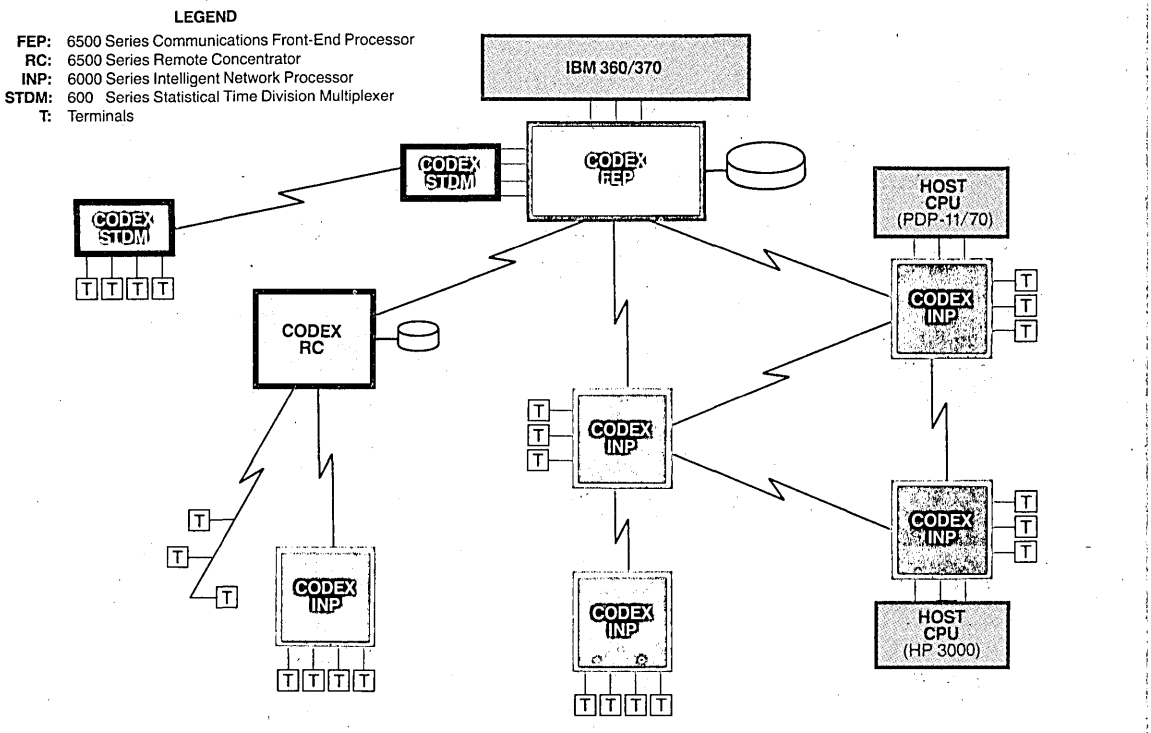

CIRCLE 26 ON READER CARD

THE CARRIERS

Estimates and Reported Data

RANK	COMPANY	DATA COMMUNICATIONS REVENUE $K	DATA COMMUNICATIONS REVENUE (% of total)	1977 TOTAL REVENUES $K	1978 TOTAL REVENUES $K
1.	AT&T	$1,845,000	4.5%	$36,494,806	$40,993,356
2.	GT&E	$206,960	2.4%	$7,666,020	$8,723,483
3.	Western Union Corp.	$171,900	25.0%	$650,460	$687,777
4.	United Telecommunications	$48,800	3.4%	$1,221,727	$1,433,006
5.	Tymshare	$16,500	11.0%	$101,174	$149,559
6.	Central Telephone	$16,200	2.5%	$570,889	$649,642
7.	Continental Telephone	$14,939	2.0%	$642,518	$913,684
8.	RCA	$14,680	<<1.0%	$5,923,400	$6,648,000
9.	ITT	$12,570	8.0%	$136,819	$157,134
10.	Comsat	$11,366	6.2%	$168,187	$184,570
11.	Graphic Scanning	$9,112	43.0%	$15,939	$20,985
12.	Telenet	$8,883	100.0%	$4,060	$8,883
13.	Rochester Telephone	$7,770	4.7%	$148,019	$163,645
14.	SP Communications	$4,990	10.0%	$32,000	$49,900
15.	WUI	$4,600	3.5%	$112,640	$131,363
16.	MCI	$3,702	5.0%	$62,759	$74,049
17.	American Satellite	$3,565	35.0%	$9,127	$10,186
18.	United Brands	$1,200	0.0%	$2,421,941*	$2,724,282
19.	FTC Communications	$647	12.0%	$4,887	$5,390

late, should further increase as the firm begins to take advantage of GTE's capital.

13. Rochester Telephone Corporation
100 Midtown Plaza, Rochester, NY 14646
(716) 325-9851

Rochester is the seventh largest phone company. Its holdings are mostly in New York State. Because its metropolitan connections are proportionately higher than most telcos, we estimate that it did $7.8 million in data carrying last year.

14. Southern Pacific Communications Company
One Adrian Court, Burlingame, CA 94010
(415) 692-5600

This subsidiary of the Southern Pacific Company operates a microwave communications network which it augments with satellite services. In operation since 1973, it purchased the remains of Datran in 1976. SPCommunications has been thwarted in its attempts to offer switched intercity service in addition to its leased lines, due to AT&T opposition, and blocked from becoming profitable, due to AT&T's lowering of long distance rates once SPC got going.

The firm's circuits link 40 metropolitan areas, carrying fax, voice, and data. It uses a digital switching system and two of its services are specially aimed at data: Sprint, a voice and data service that ties to the subscriber's existing phone system; and Datadial, which is purely for data. We estimate that it did nearly $5 million in data carrying last year.

15. WUI, Inc.
One WUI Plaza, New York, NY 10004
(212) 363-6400

WUI's major subsidiary is Western Union International, Inc., an international record carrier spun off from Western Union Corp. in 1963. It is number three in the IRC business, behind RCA Globcom and ITT Worldcom. Through submarine cables and channels leased from Comsat, it delivers cablegrams, Telex, marine communications, tv, and mixed data/voice/facsimile between the U.S. and other nations. It also does a minor business in data base inquiry between the U.S. and U.K.

Here at home it's in a different form of communications business: telephone answering, and both radio and mobile paging services.

We estimate it does somewhat less data business than the other IRC's, and peg the amount at $4.6 million for '78. Next year it might be playing a different role, however, as its management has sold the place to Xerox, making it a likely connector in the coming XTEN business communication system.

16. MCI Communications Corporation
1150 17th Street NW, Washington, DC 20036
(202) 872-1600

MCI is a long distance carrier employing microwave circuits to serve business users. The company recognized that 32 U.S. metropolitan areas account for half of all long distance revenues, something between $4 and $5 billion per year in 1978. Due to the FCC's opening up of long distance transmission to competition, MCI and other carriers are able to go after the market.

In 1978, this firm was able to bring in just over $74 million as its share. Most of that revenue comes from carrying voice traffic, but we estimate that $3.7 million stemmed from data.

17. American Satellite Corporation
20301 Century Blvd., Germantown, MD 20767
(301) 428-6000

ASC is one of the holdings of Fairchild Industries. It has been a satellite carrier since 1974, leasing channels from Western Union Telegraph Co. Among its claims to fame in data communications is having provided the first commercial computer to computer service via satellite, in October 1974.

American is heavily into data transmission, as well as commercial broadcasting, fax, teletypewriter, etc. It offers two basic types of service, leased lines through its own earth stations and customer-site dedicated earth stations. The latter service is brand new, and through the end of 1978 only nine circuits had been installed—for Sperry Univac, Boeing, and Western Bancorp.

Satellite services are all still relatively new, and not necessarily

1978 NET INCOME (LOSS) $K	NUMBER OF EMPLOYEES	FISCAL YEAR END
$5,272,606	984,000	Dec. 31
$593,811	214,000	Dec. 31
$45,655	11,423	Dec. 31
$160,321	26,127	Dec. 31
$10,594	2,750	Dec. 31
$73,795	11,398	Dec. 31
$97,559	17,244	Dec. 31
$450,000	111,000	Dec. 31
$36,011	1,249	Dec. 31
$34,238	1,400	Dec. 31
$2,332	394	June 30
($4,972)	200	Dec. 31
$23,209	2,784	Dec. 31
($1,800)	700	Dec. 31
$16,042	2,600	Dec. 31
$5,190	1,000	March 31
($6,793)	>200	Dec. 31
$12,598	46,000	June 30**
$54	127	Dec. 31

*for fiscal year ending Dec. 31, 1977
**new fiscal year

expected to yet pay their own way. In ASC's case, 1978 revenues ran to nearly $10.2 million, and losses to nearly $6.8 million. Approximately 35% of those revenues, $3.6 million, come from data transmission, some of which is in the form of mixed data/voice.

18. United Brands Company
1271 Avenue of the Americas, New York, NY 10020
(212) 397-4000

United Brands is the company that brings you Chiquita bananas, A&W root beer, Morrell hams, and, among others, TRT Telecommunications Corporation and TRT Data Products.

The telecommunications part is the nation's fourth, and by far the smallest, international record carrier. It has some routes to Europe, and now to Australia, but most of its circuits go straight south from the U.S. to the real banana republics. In fact, TRT's real first name was Tropical Radio Telegraph.

The Data Products part until recently was called Norfield Electronics. It builds message switching systems for data, Telex, and TWX. It too is small, having done about $2 million selling the message switches (and maybe a few minicomputers) to telco and commercial customers in 1978—only half of which were probably placed in data applications.

Adding TRT's tiny percentage of southbound data traffic to its switch business would probably bring United Brands' revenue from data communications to $1.2 million.

19. FTCCommunications, Inc.
25 Broad Street, New York, NY 10004
(212) 747-5670

FTCC began life in 1879 as the French Telegraph Cable Company, the U.S. office of a French corporation, CFCT, of which it is still a subsidiary. The company went into business as an international telegraph carrier, using submarine cables, and even had its own cableship fleet. It is now an international record carrier and a communications carrier as defined in the U.S. Communications Satellite Act of 1962. Its offerings include telegraphic leased line, voice grade alternate voice/data, and a 1200 or 2400baud DATEL service to Europe. It estimates its 1978 data traffic as being responsible for $647,000 of its revenues. ✻

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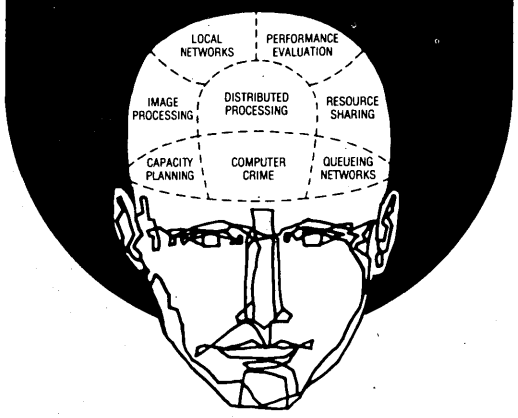

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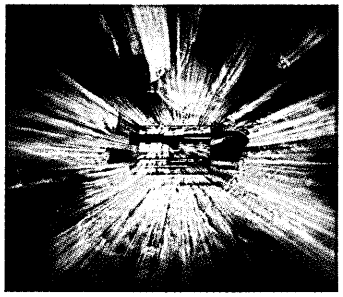

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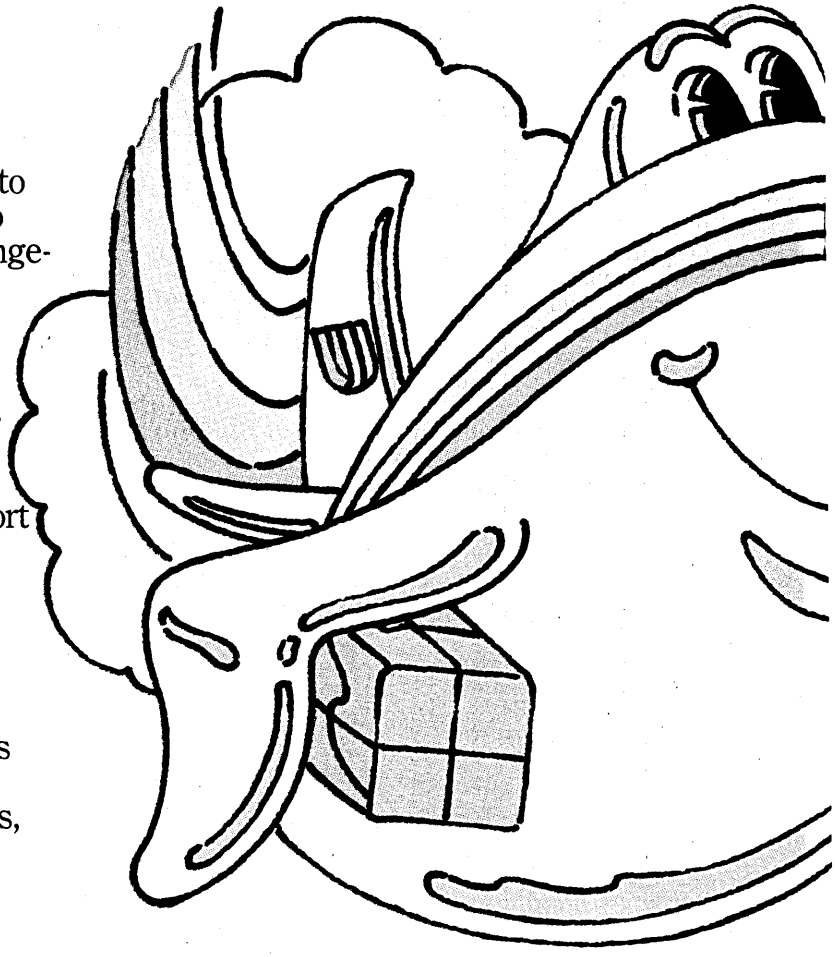

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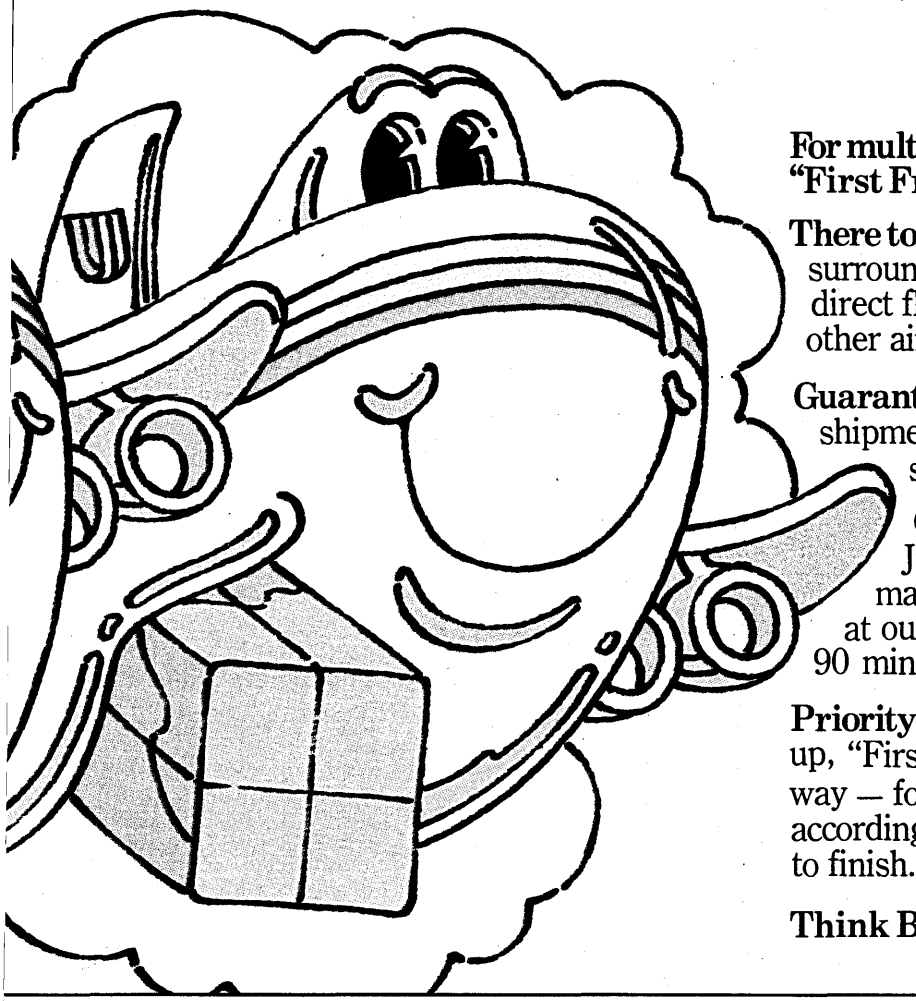

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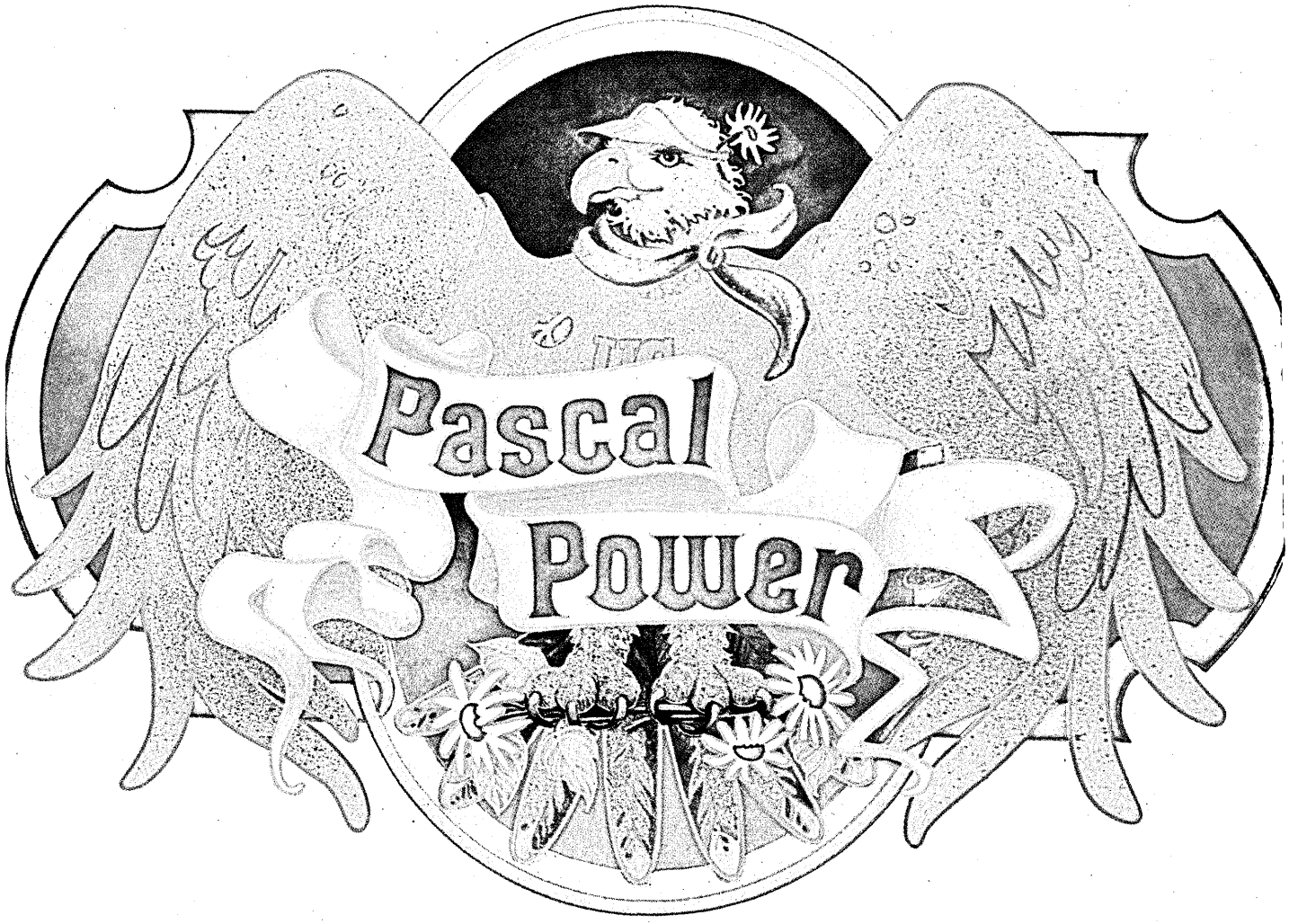


USERS LOVE IT, VENDORS ARE GETTING THE MESSAGE, AND STANDARDS ARE ON THE WAY

"Pascal is what PL/1 should have been." That's the way Ed Barkmeyer of the National Bureau of Standards describes this fastest growing of new computer languages. "It's one of the few cases where the academic community came up with the language, and it was then adopted by the business community—the other example, of course, was BASIC." Andy Mickel, coordinator for the Pascal Users Group, says, "Pascal is a general-purpose, but not all-purpose, language with a small number of simple, powerful, and non-overlapping features."

Pascal, a relative newcomer to the high-level language scene, was proposed in 1968 by Niklaus Wirth of the Federal Institute of Technology (ETH) in Zurich, Switzerland. In 1970 it was implemented as a compiler on a CDC 6400 system by Urs Ammann and co-workers at ETH as a 4,100-statement Pascal program.

By 1971 the language was formally defined. Over the next seven years, continual changes made the language less machine-dependent. Also, a compiler was developed that produced P-code for a hypothetical "Pascal machine" which allowed Pascal to be adapted to machines as diverse as the IBM 360, PDP-11, DECsystem 10, Univac 1108, and numerous microprocessors. Pascal's simplicity, as well as its power for expressing complex algorithms, established it as a language well suited to teaching both computer programming and writing systems software. By 1977 the P-code interpreter further established Pascal as a major language for microcomputers.

The accelerated growth of Pascal has continued unabated; by December 1978, *Pascal News No. 13* reported 110 different Pascal compilers, including eleven for the PDP-11. Today, Pascal exists for all hardware from micros to supercomputers and its range of uses has broadened considerably from its original roles in systems programming and teaching programming. Current uses of Pascal range from real-time processing for NASA's Deep Space Network to general ledger systems on a minicomputer.

Pascal is a high-level procedural language. Using a natural English language syntax and allowing free-form coding, it fits somewhere between the poles of FORTRAN and COBOL, most resembling

Algol and PL/1.

A *de facto* standard has existed for Pascal in the form of *Pascal: User Manual and Report* by Kathleen Jensen and Niklaus Wirth which presents both a definition of standard Pascal and how to use it. This book has held the language together and provided a base for the growth of specific extensions. The language can be divided into a definition of what is *standard* Pascal (at present, the Pascal Report part of the Jensen/Wirth book does this) and its extensions. For the latter, there is a great deal of development activity but little consensus on its direction. We will discuss further in this article the present effort to formally define an international standard for Pascal.

Pascal is a natural for structured programming; it is used to teach structured programming more than any other language. It was the first major language to be developed after the concepts of structured programming became prevalent. As such, Pascal enforces many of the nonstandard rules of structured programming; for example, clear definition of all variables and constants in a program is ensured by sections that define them at the *front* of the program. Readability is enhanced by data names (labels) that can be any length and apply equally to all constants, variables, complex data structures (including records and files), procedures, and functions. Top-down programming style is accommodated with the use of procedures and functions that can be invoked just by using them in the main-line routine. The ability to determine exactly what the program will do is ensured through the introduction of control structures which eliminates the need to use GOTO.

Pascal uses a block structure similar to Algol (Fig. 1). Each Pascal program is made up from one or more of these blocks. A *heading* names the block and gives the parameters it uses. Every block has two main parts, for definitions and program logic. The definitions part has five specific sections that describe everything *before* the program logic is presented. The definitions sections specify labels, constants, data types, variables and subroutines (functions and procedures). The program logic, in what is called the statement part, is the actual algorithmic expression of the block in source code. Thus, data definitions in Pascal are segregated from the algorithm, preventing the definition of constants and variables from appearing within the processing steps. Since subprograms are in the same block structure, they can be nested within each other and each can carry its own set of parameters and local variables.

As a result of these language design features, programs written in Pascal tend to be more readable by others and more straightforward in design. The result is programs that are easier to code, debug, and maintain.

BLAISE PASCAL (1623-1662)

A French mathematician and philosopher, Pascal invented, at the age of 19, a calculating device using the ratchet and pin principle that could add and subtract eight digits, and handle multiplication and division through successive additions and subtractions. According to legend, he developed what he called his Arithmetic Engine so his father, who was a tax collector, could have more time to play ball with him. During the next ten years he built 50 more Arithmetic Engines, and is considered the father of the modern adding machine. In 1654, Pascal prepared two papers laying the foundations of probability theory and integral calculus. His theorem of Projective Geometry was developed when he was 16. Niklaus Wirth, author of the Pascal language, named the language after the Frenchman out of respect for his accomplishments.

WHO USES PASCAL?

Such a description of Pascal would imply that its endorsement by programmers and vendors would be strong and growing. While this has been true of programmers almost from Pascal's inception, its acceptance by vendors has been more cautious, particularly among mainframe vendors who, for the most part, have reserved adoption of its use for writing their own systems software rather than providing it for use by their customers.

Although the language itself is available to run on all the big mainframes (Amdahl, Burroughs, CDC, IBM, Honeywell, Itel, NCR, and Univac) as well as most other large minis and almost every microcomputer, the source of the compilers is a different story. To date, only a few of the mainframers offer Pascal to their users. The majority of Pascal implementations, in the form of compilers or interpreters, are marketed by proprietary software firms, universities, and users.

Even though many vendors, including most mainframers, do not support a Pascal implementation for customers, they seem to be using it increasingly for their own systems programming. During the last year, Pascal has spread to new minicomputers at a rapid rate. It has been a reality on most microcomputers since a universal Pascal was developed at the Univ. of California at San Diego.

Other than its growth, the most encouraging issue about Pascal is the widespread agreement on what should constitute Pascal. Formalization of this standard will be winding through the international review process in 1979, with the strong likelihood of an international standard before the end of the year. What will take considerably longer is the definition of Pascal extensions to either add capabilities not present in standard Pascal or to enhance what is already there. Extensions already exist as a formal part of most Pascal implementations and thus are known to the Pascal community. Others are yet to be defined, let alone implemented. To understand why extensions are such a vital issue, it is important to realize that the standard Pascal does not have fixed point and decimal arithmetic, direct and indexed file access, data base interfaces, and normal types of printer editing for business applications built into it. Other limitations are arrays that have to be described at the time of compilation rather than via parameters and, on some smaller implementations, the necessity to recompile an entire program if one module is changed or added. Jim Miner, who is the chairman of the ANSI Task Group subcommmittee looking at Pascal extensions, states: "Implementors have already begun adding extensions, including direct access files, character string handling, fixed-point arithmetic, and formatted I/O." Rusty Whitney, president of Oregon Software (which offers an extended Pascal compiler, OMSI PASCAL-1, to run on any 32K PDP-11 processor), reports that its compiler includes random access file handling, a FORTRAN interface, process control extensions, and a high-level debug feature. One of Oregon Software's customers, Interactive Technology, Inc., has written its own data base interface, editing options, and index file access with OMSI PASCAL-1. The British have developed a working draft of a Pascal standard which is likely to become the international standard. But the ANSI committee on Pascal extensions will probably emerge as the leader in defining extensions to this standard. Because Pascal's simplicity is a key to its popularity, a great number of extensions would seriously detract from its value, particularly as a way to teach good programming practices.

The definition of extensions is further clouded by one of Pascal's most powerful capabilities: to define procedures and functions that by themselves can provide additional capabilities for any programmer who chooses to write or use them. For example, some users define procedures outside of their Pascal programs to perform direct access I/O. Other users write I/O formatting routines in

standard Pascal. There are many who feel this approach would allow Pascal to continue to grow as a language while still staying clean, straightforward, and simple. Still others feel that the extensions are needed to lift Pascal out of the context of a teaching language into a rich enough implementation to be useful as a production language for scientific and commercial uses.

BRITISH DRAFT STANDARD

Pascal is about to enter a new era as efforts for its standardization draw to what appears to be a rapid and successful conclusion. In 1976, the British Standards Institution (BSI) formed a group to prepare a draft definition of Pascal based on the language definition in Jensen and Wirth's book. The Pascal report section was vague in some areas leaving too much open to interpretation by compiler writers preparing new implementations of the language. Under the direction of Dr. Tony Addyman of the Univ. of Manchester, England, the BSI proposed a working draft of a Pascal standard that formalized and clarified the Pascal report. BSI submitted this to the International Standards Organization (ISO) for consideration by the international Pascal user and implementor community.

The BSI working draft caught ANSI off-guard. It reacted by establishing, in September 1978, X3J9 as the Technical Committee on Programming Language Pascal and bypassing the study group usually formed prior to the programming language technical committees. X3J9 has moved its initial target date for a Pascal language standard from 1984 up to mid-1979 and joined its efforts with those of the IEEE Pascal Standards Committee. Bruce Ravenel, the IEEE's committee liaison to the X3J9 ANSI committee, reports that the marriage of the two groups' efforts to review the BSI working draft Pascal standard is functioning smoothly. A joint meeting of X3J9 and the IEEE Pascal Standards Committee members was held at the Univ. of Colorado in Boulder on April 26-27 of this year. The purpose of that meeting was to review U.S. responses to the BSI proposal. X3J9 and the IEEE Pascal Language Committee then prepared separate responses to the BSI proposal. Since ANSI is the official representative for the ISO in the U.S., the X3J9 response was sent back to Britain through ISO channels along with those of other ISO member nations. The IEEE response to the standard was sent directly to the BSI group. Bill Price, chairman of the X3J9 Technical Review Task Group responsible for drafting the ANSI reaction (and therefore the official international U.S. response), says, "Our response indicated the BSI working draft Pascal standard was a good piece of work, sound in general and acceptable with a few detailed changes." Two of the more significant changes clarified the wording of the rules for naming conventions and strengthened the compil-

PASCAL USERS' GROUP

Founded in October 1975, this group has a worldwide membership of over 3,300 users in 47 countries. Its main office is at the Univ. of Minnesota in Minneapolis with other offices in Southampton, England, and Hobart, Tasmania (Australia). Under the direction of Andy Mickel at the Univ. of Minnesota, the group provides its members a quarterly publication, *Pascal News*, as a forum for members ideas. The publication is the main communication vehicle for PUG, although PUG also has informal groups that meet periodically. Besides editorials and program listings, the *News* covers Pascal events, books and articles reviews, history applications, users articles, members' open correspondence, and extensive information on Pascal implementations, distributors and documentation. PUG also coordinates the International Working Groups on Pascal Extensions, advised by Niklaus Wirth, and reports on activities of the group.

USER REPORTS

Pascal users seem to be in universal agreement in their enthusiasm for the language. Here are some examples.

Science: The Univ. of Minnesota uses Pascal extensively in its Social Science Research Facilities Center. More than a hundred students and faculty use programs written in Pascal to perform statistical and cartographic data manipulating analyses, and human/machine simulations. The programs run on the university's three central CDC mainframes (Cyber 74, Cyber 172, and 6400), several Terak LSI-11 computers and a PDP-8 graphics system. One typical program written for social science students and faculty produces an inverted data base in batch mode and allows users to perform statistical analysis interactively, on data files including voter surveys. During the 1977-78 academic year the job mix on the three CDC machines (in thousands) was SNOBOL (50), COBOL (150), Pascal (270) and FORTRAN (980). The Pascal jobs showed the highest growth rate (60% a year) while FORTRAN growth has been flat. The university also uses Pascal as the first programming language for its computer science students.

Aerospace: Jet Propulsion Laboratory in Pasadena, administered for NASA by the California Institute of Technology, uses Pascal extensively in its Deep Space Network (DSN) Programming System. Booth Hartley, group supervisor of the DSN programming project, reports that Pascal was selected as a systems programming language for two main reasons: (1) It handles the data processed by DSN effectively by limiting use of data to those routines requiring it; and (2) standard Pascal by nature is fairly independent of the numerous different types of hardware being used by JPL. The Deep Space Network Programming System handles the capture and transmission of data to and from unmanned spacecraft. This includes the Voyager 1 satellite now on its way from Jupiter to Saturn. One of JPL's objectives in the DSN programming project is to improve its software engineering practices. It has developed an extended form of BASIC, MBASIC, that will run on several different types of computers around the world. "The MBASIC programs must be transparent to our hardware, and we're writing both its interpreters and compilers for our equipment in Pascal," notes Hartley. JPL and NASA Langley also use Pascal to write and maintain the support software for HAL/S, the real-time language in the DSN project that will run on MODCOMP-2 computers tied to tracking stations around the world.

Business: Interactive Technology, Inc., a Portland, Oregon software house selling turnkey accounting systems based on PDP-11's, developed its own hierarchical data base manager called Realtime Databank Management (RDM). RDM is imbedded in turnkey software so that it is transparent to the user. Bruce Johnson, the developer of RDM, says that Pascal has switched the design/programming ratio from 2:8 with BASIC, FORTRAN, COBOL, and DIBIL to a ratio of 8:2 with Pascal. "Pascal forces us to do the design and program planning thoroughly. You don't write programs in Pascal that you can't come back to later," says Johnson. ITI says it had six PDP-11 systems built around its RDM data base installed by April 1979. It estimates that Pascal has increased the productivity of its programmers fourfold. Its largest problem now is to find user documentation specialists to keep up with the application developers. The demand for Pascal in the Portland area is strong enough that ITI plans to offer separate courses on Pascal business and process control planners.

er test for noncompliance with standard Pascal. A unanimous resolution passed in Boulder requested BSI not to add enhancements to Pascal in the next draft of the proposed standard until adoption of an international standard.

Once the BSI Pascal Standards Group (designated DPS/13/4) receives responses in England to its working draft standard, it will prepare a proposed Pascal standard which will go back through the ISO channels and the entire review process will be repeated. Approval of the proposed standard would establish an international standard for Pascal through the auspices of the ISO. The objective of the BSI is to have the standard in place by January 1, 1980. X3J9 plans to institute a separate study to evaluate the standard as an American national standard, with the likelihood that it would be passed with few or no changes. Beyond 1980, the Pascal Extensions Task Group of X3J9 would evaluate proposed changes and extensions to the language both for international and American adoption.

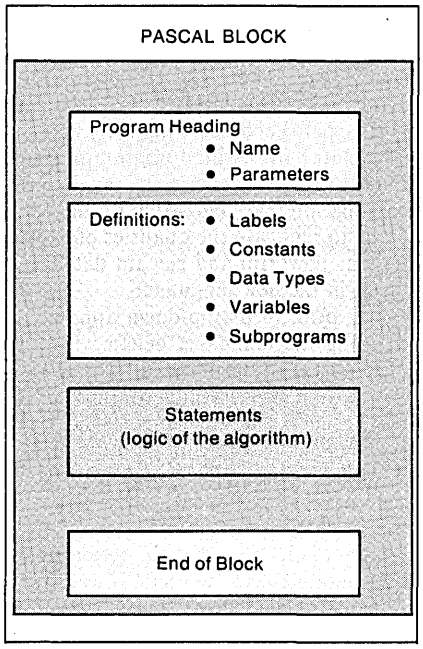
Many implementers have a big stake in the outcome of the standards efforts. A large amount of Pascal code exists that has been built up since 1972. Some vendors may find it necessary to revise their language implementations. This is particularly true if Pascal becomes a standard language within the federal government. Barkmeyer of the National Bureau of Standards (NBS) points out "NBS selected Pascal for a study as a vehicle for federal software in scientific and systems programming in order to minimize the cost of machine migration." Presently, COBOL is the only language with a federal standard (FIPS 21-1). Technically, any federal agency that can use COBOL for an application and does not want to, must submit to NBS a request for a waiver. Unofficially, both FORTRAN and BASIC have been accepted for years, and current NBS standardzation efforts are expected by Barkmeyer to result in federal standards for FORTRAN and BASIC this year. The adoption of Pascal as an approved standard within the federal government would allow it to join the growing Federal Standard Language family. This would lend further legitimacy to Pascal and open up a new, larger market for Pascal implementations.

Adoption of the BSI working draft standard for Pascal this June, and the subsequent BSI proposed Pascal standard in 1980 by member nations of the ISO appears likely.

The next crucial phase in the evolution of Pascal will be the standardization of Extended Pascal, the first phase of which will probably take place by 1982. This extended standard, and the validation methodology for comparing a specific Pascal implementation to the standard, would open the way for vendors to evolve a common enriched Pascal capable of serving a growing array of users. If the National Bureau of Standards and GSA follow through with a timely federal validation standard for Pascal, it will have evolved into a commonly recognized standard in just nine years. And if that happens, it will score a big one for computer science academicians, who initially embraced this newcomer and foresaw its long-range implications.

—Dennis Fletcher

Dennis Fletcher began his dp career with IBM as a Systems Engineer, participating in the development of RPG, Applicator Customizer, and other languages for the System/360. After 11 years as a consultant, he recently joined Informatics Inc., as a product manager in the Implementation Systems Product Management office responsible for high-level nonprocedural languages.



ANSI X3J9

The American National Standards Institute (ANSI) includes a Technical Committee (X3) that proposes and reviews proposed language standards. X3J9 is the Technical Committee on Programming Language Pascal that reports to the X3 parent committee. X3J9 is also the American link to the International Standards Organization (ISO), which is coordinating efforts to define an international language standard for Pascal. The secretariat function for X3J9 is being handled by CBEMA in Washington, D.C.

X3J9 performs the work of soliciting public reaction in the U.S. to the proposed British Standards Institution's working draft of a Pascal standard, evaluating that reaction, and preparing the official U.S. response to the BSI draft standard. The response is forwarded to the X3 parent group in ANSI for review, and forwarded to the BSI through ISO, which is collecting similar reactions from member nations Canada, France, Italy, Germany, Sweden, U.S.S.R., Japan, and Australia.

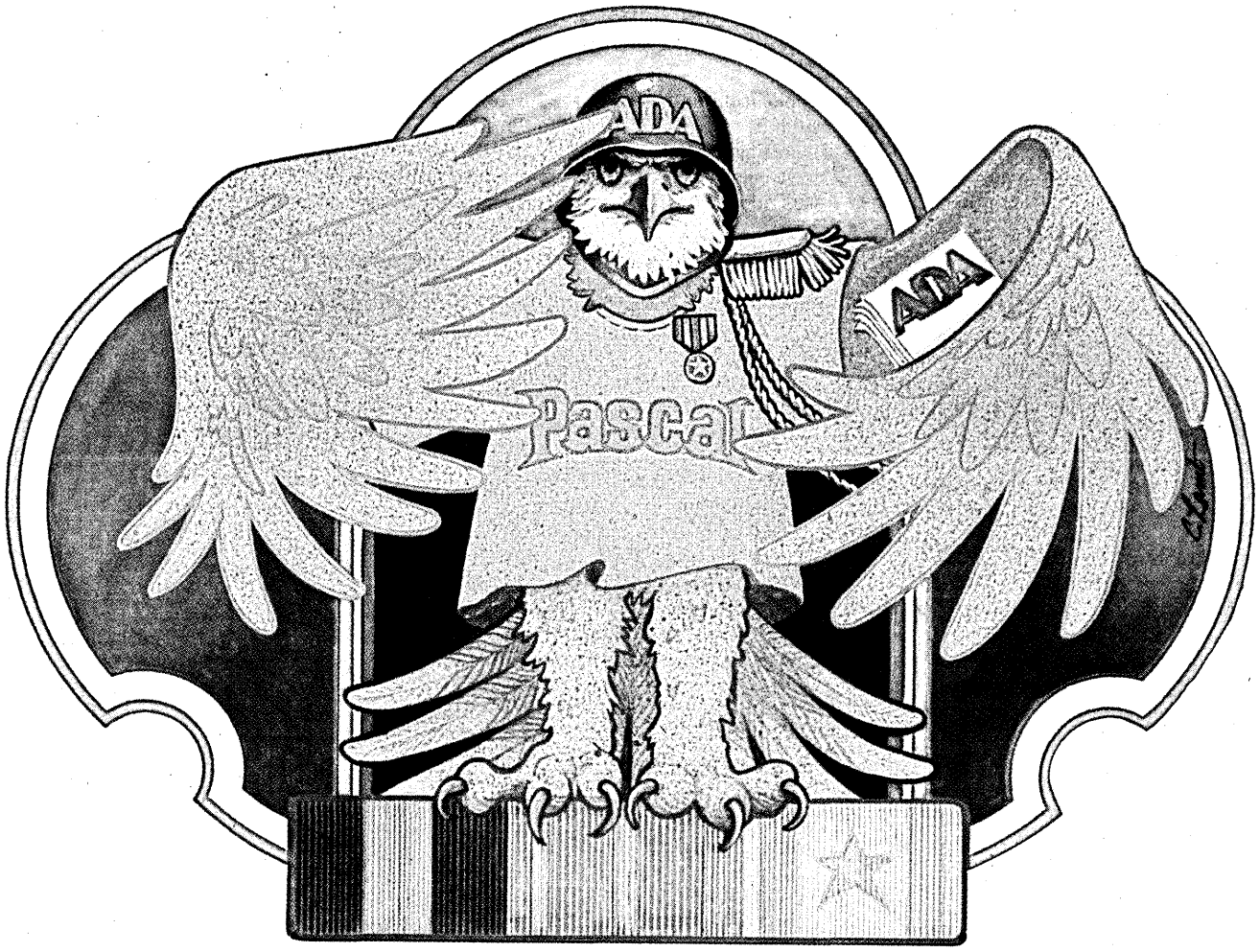
So far, X3J9 has four task groups (subcommittees) of either official or proposed status. Each task group plays a key part in the definition of a language standard. All except the last are a normal part of any ANSI language standards effort.

Procedures Task Group: Chaired by Barry Smith of Oregon Software, it proposed rules for the operation of X3J9. It has proposed that all work be done in committees, and that discussion at X3J9 working conferences (open to the public) be reserved for voting on proposals.

Technical Review Committee: Chaired by Bill Price of Tektronix, this group is reviewing the BSI working draft Pascal standard and the responses of others to the working draft in order to prepare the official U.S. response to ISO. Compilation of the response took place at an open meeting at the Univ. of Colorado at Boulder on April 26-27. Another meeting is scheduled this month to review an expected final revision from BSI on the proposed Pascal language standard.

Extensions Committee: Chaired by Jim Miner of the Univ. of Minnesota and the Pascal Users' Group, this not-yet-official subcommittee is charged with reviewing the entire array of proposed extensions to the BSI working draft Pascal standard. It will probably take this group up to 18 months to define a proposed set of Pascal language extensions. Key areas are: I/O and file handling, storage allocation and management, multitasking, communications, and data base. The big issue is how far the group can go without robbing Pascal of its simplicity and coherence.

Validation Committee: A proposed subcommittee. No current chairman. The group would propose a validation procedure for determining if a given compiler fit the Pascal language standard (assuming agreement is found on one). This effort would include participation by the National Bureau of Standards to define the FIPS specs for Pascal compilers sold to the federal government.



FROM PASCAL TO PEBBLEMAN... AND BEYOND

It is almost the inverse of the Biblical tale of the Tower of Babel. DOD, seeing lack of communication and sharing among software folk, has decreed that a common language be invented to provide for "understanding one another's speech." And the result, it fervently hopes, is that "nothing will be impossible" for the software developers of the common-language future.

DOD carved out a fairly limited domain; it elected to work a specific problem area, that of so-called "embedded-computer systems."

"Embedded-computer systems" are those computer systems contained in larger systems; for example, a spacecraft that contains a computer which monitors navigational and flight control actions; or a rapid-transit vehicle that contains a computer to control its acceleration-deceleration actions. Typically, embedded-computer systems are applied to real-time tasks in highly critical environments.

How much like other applications is the embedded-computer system? Or, put more bluntly, will the new DOD language be useful to the ordinary programmer?

The answer, emerging from DOD's study of the requirements for programming languages across a number of application areas, is, surprisingly, "yes." The new DOD language could conceivably have an impact on programmers well outside of the embedded-computer system area. Scientific programmers, for example, should find it capable of solving their problems in a manner considerably more satisfying than FORTRAN. System programmers, including those who write the compiler for the language itself, should find it at least adequate for their tasks. Real-time programmers should find it a cut above anything currently available, particularly if their problems involve parallel processing. Only the business data processing programmer may find the new language to be of purely passing interest. No attempt has been made to replicate the qualities of COBOL, such as powerful and elegant data structures, in the new language.

DOD, in its top-down approach to defining the language, began with a requirements-gathering exercise across the application areas which it thought the new language might support. "The surprising result," according to Lt. Col. William A. Whitaker, Defense Advanced Research Projects Agency, who has headed the language development since its inception in 1975, "was that the requirements so generated were identical. It was impossible to single out different sets of requirements for different communities. All

users needed input/output, real-time capability, strong data typing for compiler checking, modularity, etc." The implications of that finding are important. It is possible to define one language to support all application areas. That does not, of course, imply that it is *desirable*. PL/1, the last decade's attempt to provide a universal language solution, cannot be called a successful language; it has been resoundingly ignored by a high percentage of programmers.

THE NAME IS ADA

The name of the new language is Ada, named for Ada Augusta, the Countess of Lovelace, who was the world's first programmer. She assisted Charles Babbage in his pioneering work 150 years ago with the first "computers," the Difference Engine and the Analytical Engine.

The name Ada was not chosen without struggle. The only schedule which slipped significantly was the choice of the name. After months of indecision, in which one or more of the approving bodies rejected each candidate name proposed, it began to appear that no one's choice, the name "DOD-1" which had been used spontaneously as an abbreviated handle for the language, might become the *de facto* name. However, when Ada was suggested and explained, support gradually grew. In November, following an approval process which even included contacting descendants of the Countess of Lovelace in England, the choice was formally announced—nine months behind schedule.

Put yourself in the position of the DOD in 1975. You're spending around $3 billion a year on computer software, and software needs are predicted to rise, perhaps dramatically. You have three major armed service branches not especially noted for their ability to work cooperatively. Each of those services has a flock of computer programming languages which they have used and/or developed over the years, some of them suspiciously redundant. It is becoming obvious that high-order languages are the wave of the future, even in application domains which still resist their use. And computer hardware costs are continuing to decline.

With all those trends and forces at work, the DOD decided that it was time for action. The inherent inefficiency of an HOL (high-order language) vs. assembler code, variously indentified as being in the 5% to 50% bracket (but usually defined to be around 20%), was becoming tolerable in the light of reduced hardware costs. The life-cycle benefits of an HOL were well known, and so was the value of a common HOL. The time had obviously come to apply some language discipline. Although the task of achieving commonality among the tri-services had always been a formidable one, the potential payoff made the DOD act. It formed a High Order Language Working Group (HOLWG) to begin the task of defining the needed language.

The official position of the DOD is spoken in so-called "DOD Directives." The first directive relevant to this discussion, known as 5000.29, required the use of HOL's: "DOD-approved high-order programmng languages will be used to develop Defense systems software unless it is demonstrated that none of the approved HOL's are cost effective or technically practical over the system life cycle." Furthermore, to be sure some teeth evolved in the use of HOL's, 5000.29 also specified "Each DOD-approved HOL will be assigned to a designated control agent."

Following on the heels of 5000.29 came another DOD directive, 5000.31. Where the first directive established the philosophy and discipline of using HOL's, the second one got specific: seven existing tri-services languages were identified as the *only* acceptable languages for Defense systems software. Placed on the list were FORTRAN and COBOL, and five traditional tri-services languages — TACPOL for the Army, CMS-2 and SPL/1 for the Navy, and JOVIAL J3 and J73 for the Air Force. These languages were identified as the "interim list of DOD approved high order programming languages," with the implication that as time went on the list would be narrowed to Ada (when it arrived), FORTRAN, and COBOL.

With its directives firmly in place, HOLWG formulated requirements for the new DOD language. An orderly top-down approach to language definition had been launched. The process was: identify the requirements for such a language; scrub those requirements by iterating them through all communities of interest; select four contractors to design candidate languages meeting the requirements; of those four, select two contractors to refine their languages and implement prototype language processors; pick a winner from that pair; evaluate and refine the winning language based on both study and experimental application; build the support tools for the language (for example, production-quality compilers); and finally place it on the 5000.31 list of approved languages. The total plan, as defined, spanned the five years from 1975 to mid-1980. The winning language, "Green," was selected in April 1979.

FIRST CUT IS THE STRAWMAN

An interesting piece of lightheartedness began the project; the initial cut at the language requirements was called, not too surprisingly, "Strawman." A strawman, colloquially, is a target set up more to draw commentary than to be a polished final product. And the Strawman requirements definition was meant to be, and succeeded at being, precisely that. Strawman was sent to the military departments, other government agencies, the academic community, industry, and to a number of technical experts outside the U.S. All of them reviewed the requirements.

When the results of studying the comments on Strawman were folded into the requirements, the next iteration was given another whimsical name—Woodenman. Woodenman, following its review cycle, became Tinman. Tinman, subject to the most extensive review of all, gave way to Ironman. And Ironman, following both a review and a focusing effort, became Steelman.

In parallel with the requirements definition activity, another study was begun by the HOLWG to determine if the early sets of requirements definitions could indeed lead to a usable language, and to see if there was such a language already lurking in the wings. A large number of existing languages were chosen for this study—23 of them were studied formally, and a number of others less formally. The set, which of course included the languages on the DOD Interim List, were FORTRAN, COBOL PL/1, HAL/S, TACPOL, CMS-2, SPL/1, JOVIAL J3B and J73, ALGOL 68, CORAL 66, Pascal, SIMULA 67, LIS, LTR, RTL/2, EUCLID, PDL2, PEARL, MORAL and EL-1.

Following the analysis of the requirements and the existing languages, several conclusions were reached by HOLWG: among all the languages considered, none was found that satisfied the requirements so well that it could be adopted as the common language; all evaluators felt that the development of a single language satisfying the requirements was a desirable goal; the consensus of the evaluators was that such a language was feasible; almost all the evaluators felt that the language design process should start from an existing base language; most of the languages studied were excluded from the list of appropriate base languages; and finally, Pascal, PL/1, and ALGOL 68 were chosen as the acceptable candidate base languages.

Now, the competitive process be-

gan. A Request For Proposal (RFP) was issued to select competitors for the initial language design. When the smoke had cleared, the list of four winning companies contained a few predictables and a few surprises. Softech and Intermetrics, well known in domestic language and compiler circles, were no surprise. SRI-International, which had evolved from Stanford Research Institute in California, was somewhat more of a surprise but still explainable on the basis of its academic history. But the real surprise, at least to domestic compiler/language watchers, was Cii-Honeywell Bull, a European company affiliated with the U.S. Honeywell Corp. The most significant surprise, however, was that all four of the winning contractors had selected Pascal as their base language. Whether this base commonality was deliberate or accidental, the course had been further refined—the new DOD language was going to be a derivative of Pascal.

The language design effort began in mid-1977 and reached the pick-a-winner point in the spring of 1978. Eighty volunteer review teams eagerly poured over the prototype designs. These teams were again chosen on the basis of interest

AND THE WINNER IS . . . GREEN

More than four intensive years of development of a common DOD tri-services computer programming language has led to a final decision. In late April the government selected a winner—the Green language, defined by Cii-Honeywell Bull. Features of the winning language are defined below:

A program is a sequence of units which can be compiled separately. Units may be subprograms (which define executable algorithms), package modules (which define collections of entities) or task modules (which define concurrent computations).

Program units. A subprogram is the basic unit for expressing an algorithm, and can be a procedure or function, with or without parameters.

A package module can be used to define a common pool of data and types, a collection of related subprograms, or encapsulated types with associated operations. Portions of a package can be hidden from the user, thus allowing access only to the logical properties expressed by the package module.

A task module is similar to a package module, but with capabilities for parallel processing.

Declarations and statements. Each program unit generally contains a declarative part, which defines its logical entities, and a sequence of statements, which define its execution.

The declarative part associates names with declared entities. A name may denote a type, a constant, or a variable. A declarative part also introduces the names and parameters of other subprograms, task modules, and package modules to be used in the program unit.

Statements describe actions to be performed: assignments; subprogram call and return; if-then-else if-else; case-when; for/while-loop; exit; goto; assert (a self-check capability).

Certain statements are only applicable to tasks. An initiate statement specifies that one or more tasks may begin execution concurrently with the initiating task. An entry call, which appears as a normal subprogram call, specifies that a task is ready for a rendezvous with another task containing the declaration of the entry. An accept statement within the other task specifies the actions (if any) to be executed when the corresponding entry is called. After the rendezvous is completed, both the calling task and the task containing the entry may continue their execution in parallel. A select statement allows a selective wait for one of several alternative rendezvous.

Execution of a program unit may lead to exceptional situations (e.g., a computation exceeds the maximum allowed value of a number, or the value of a variable is uninitialized). Exception handlers describing the actions to be taken when these situations arise may be specified.

Data types. Every object in the language has a type, which defines its logical properties and the operations that can be performed on it. There are four basic classes of types: scalar, composite, access, and private.

The scalar types INTEGER, BOOLEAN, and CHARACTER are predefined. Approximate computation can be performed using floating point types or inexact fixed point types. Enumeration types provide for defining problem dependent types with discrete values (e.g., character sets).

Composite types allow definitions of arrays and records. A record is an object with named components of possibly different types. Alternative record structures can be defined by having a variant part within a record type.

Access types allow the construction of complex data structures that are created dynamically.

Private types can be defined in a package module that hides irrelevant structural details.

The concept of a type is refined with the "subtype," to constrain the set of allowed values in a type. Subtypes can define subranges of scalar types, arrays with a limited set of index values, and records with a particular variant.

Lexical structure. The language has a 95 character ASCII set, and a basic 55 character subset to be used when necessary. Names may be any number of (alphanumeric and underscore) characters in length. There are reserved words. Comments are preceeded by "—". Compile time directives are given by "pragmas."

Other facilities. Representation specifications can be used to relate data types to computer characteristics (e.g., packing density, or even specific bit layout).

Machine code may be inserted by a prescribed and constrained format.

Finally, the language includes facilities for separate compilation, generic (that is, parameterized) program units, and both user level and machine level input-output.

Example:

```
function FACTORIAL (N: INTEGER) return FLOAT is
begin
   if N = 1 then                          —SPECIAL CASE FOR FACTORIAL OF ONE—
      return 1.0;
   else return FLOAT (N)*                 — RECURSIVE CALL FOR NORMAL CASE—
      FACTORIAL (N-1);
   end if;
exception                                 —HANDLER FOR OVERFLOW EXCEPTION—
   when OVERFLOW = >
      return FLOAT' LARGE;
end FACTORIAL;
```

from industry, government, the academic community, and several continents. Somehow, out of the review verbiage, the four contenders were narrowed to two. On the basis of a pair of effective language design proposals—some say they were clearly superior to the other two—the runoff participants became Intermetrics and Cii-Honeywell Bull, the "Red" and "Green" languages.

Languages, of course, are of little value without a programming environment in which to use them. Traditionally their environment has meant at least compilers, link editors, loaders, and perhaps assemblers. DOD now began asking the question, "Is that a sufficient definition of the environment?"

In the tradition of the Strawman-Steelman whimsy, a prototype environment definition was called Sandman. Following its first review, it became Pebbleman. Using a somewhat different approach, Lt. Col. Whitaker set up a series of workshops to review the environment definition and focus its requirements results. In mid-1978 one workshop was held at the Univ. of California at Irvine. In the fall, another was held at Elgin Air Force Base. Both reviews spawned an enormous volume of commentary, which again had to be sifted and evaluated by the DOD review team. As of this writing, the environment definition continues to evolve toward a late 1979 resolution. The focus is on a strong central language control agency, and on a comprehensive family of Ada support tools, probably significantly more powerful than any prior language has had available. If this focus is fulfilled, those tools alone could conceivably draw a number of less-than-enthusiastic Ada language evaluators into the fold of Ada users.

In the midst of this orderly-appearing process, however, the forces of controversy have been swirling. Perhaps the first shot was fired by computing activist and former ACM president Dr. H.R.J. Grosch, who wondered aloud why the DOD was inventing another language. A year or two passed, and Professor Edsger Dijkstra, who had meanwhile gained great stature for his early work in the theoretical foundations of structured programming, blasted the four competitive DOD designs in an informal professional journal, the *SIGPLAN Notices*. Dijkstra didn't like either the process through which the languages were designed—he would have preferred the use of small teams of language designers in a noncompetitive environment and without schedule constraints—or the language candidates themselves, which he said were all inevitably going to be inferior to Pascal.

ADA — THE SCHEDULE

Formation of HOLWG	Jan. 1975
Strawman	Apr. 1975
Woodenman	Aug. 1975
DOD Directive 5000.29	Apr. 1976
DOD Directive 5000.31	Nov. 1976
Ironman	Jan. 1977
RFP Issued	Apr. 1977
Ironman Revised	July 1977
Contracts Awarded	July 1977
Competition Narrowed	Apr. 1978
Steelman	June 1978
Pebbleman	June 1978
Language Selection	Apr. 1979
Validation Results	Oct. 1979
Refinement Begins	Dec. 1979
Army Compiler	May 1981

ARMY LEAPS ABOARD ADA BANDWAGON

Meanwhile, the enthusiasm for Ada within the tri-services itself was mixed. The Army, for reasons which will become clear later, lithely leaped aboard the Ada bandwagon. The Navy and the Air Force, however, showed intense preoccupation with their existing interim-approved languages and discussed only in rather vague and distant terms the future of using Ada.

Then, in November 1978, when the two language competitors exposed their still-evolving languages to one of the last in a series of scheduled review board meetings, a little DOD in-house panic began to appear. The language designs, even in their evolving refinement, had some rough edges. One language competitor, according to review scuttlebutt, had thrown away his earlier design, started all over, and was playing a difficult game of catch-up. One of the languages had a distinctly theoretical flavor and raised the fear of being unusable in the anomaly-ridden world of practical problem solution; the other, far more pragmatic, raised the fear of losing the theoretical foundations which had made the base language Pascal so revered.

Meanwhile, the tri-services are wrestling with the key question of "When?" The Army, with only one language on the interim-approved list, and very little investment in that, has begun the process of procuring an Ada compiler. Fitting its procurement to the language design schedule like a glove to a hand, the Army has scheduled the award of the contract even as we speak—to coincide with the language selection—and expects to have its compiler delivered in the 1981 time frame. That process is fraught with risk—the new language will undoubtedly evolve as its experimental users discover inoperative, uncomfortable or just plain awful glitches, and the Army compiler will have to flex. Additionally, the Army has chosen to implement the compiler on a newly evolving military standard computer hardware definition which happens to be a minicomputer (based on the DEC PDP 11/70, and compatible with the Programmer's Workbench and Unix Operating Systems), which means that it will also have to contend with the flexing of the hardware and the problems of putting a major language on a mini machine.

Nevertheless, the Army gets points for courage and cooperativeness. Someone has to shake down the new language, and no one can shake it down like honest-to-goodness-project users.

The Navy, meanwhile, is heavily invested in the interim language CMS-2 and appears to be continuing on a stable if somewhat obsolescent course in pursuing it. Even their newer approved language, SPL/1, appears to have little project usage. With a further investment in government owned CMS-2 compilers—the Navy furnishes them to contractors as Government Furnished Equipment—it may well wait for the Army to flush the bugs out of Ada.

The Air Force, on the other hand, has an even more difficult position. The selection of JOVIAL J3 and J73 on the interim list was accompanied by a good deal of internal strife. Backers of a JOVIAL variant named J3B, which had evolved parallel to J73 and had more project usage, wanted J3B to be on that interim list. DOD, however, held firm on restricting the Air Force to only two such approved languages, and the battle waged inside the confines of the Air Force. A resolution was finally forced late in 1978, with the definition of a modified version of JOVIAL J73 to incorporate both J73 and J3B features (and incidentally, to be upward compatible with neither). As a result of this internal struggle, the Air Force has taken over-the-shoulder glances at Ada, and is developing a plan for its implementation (perhaps in fiscal year 1980), but is unlikely to confront it head-on in the near future. Some Air Force people talk about going Ada in four to ten years. No way, says Lt. Col. Whitaker, will they be allowed to take that long.

Several years ago, the British Ministry of Defense, encountering the same kinds of babble problems, defined the language CORAL 66 as its common solution for all MOD real-time applications. HOLWG has maintained ongoing contact with the British team, and the British have assigned a senior technical expert to HOLWG to provide both technical input and exchange. Similar efforts have been begun more recently in the German and

French governments, where the languages PEARL and LTR, respectively, have been chosen. The Japanese government is pursuing a similar activity.

THE FUTURE OF ADA It is HOLWG's intention to subject the new language to an elaborate testing process by rewriting a number of existing well-defined programs or systems to demonstrate its applicability and advantages. That process, which should also flush out some needed language revisions, begins with a formal Ada training course.

It is also HOLWG's intention to procure a number of production compilers from different sources—the Army's is just the first funded one to be identified. Many academic institutions are talking about implementations. Some hardware and software vendors are beginning them, also. Firmware of language-related capabilities is a definite possibility; England and Germany already have preimplementation studies under contract. It is even possible that there could be an Ada implementation by the end of 1979, according to Lt. Col. Whitaker. The goal, in any case, is to maximize the availability, and thus the attractiveness, of the new language. Further, it is HOLWG's and DOD's intention to begin paring the interim language list as early as 1981. If any of the tri-services are still entrenched in their existing languages at that point, fireworks may be expected.

It is in the less tangible elements of the future that the crystal ball becomes somewhat more clouded. For one thing, the language will be unstable for awhile. Glitches will turn up, and language revisions—hopefully, upward-compatible—will be required to solve them. This is a critical time. If the language is too unstable, it will fail.

For another thing, the compilers will be unstable for awhile. New compilers seem to be the most error-prone of all software. It is not unusual for a competently-built, well-designed compiler to turn 500 to 1,000 errors in its first several years of heavy usage by professional programmers. It is essential early compilers be responsibly maintained. Failure to do so could cause the language itself to fail.

The Ada language control people will have a very difficult task. They must attract the reluctant services, hold the language stable but correct, press firmly for early stability (historically, it has been seen that a language can fail simply because it took too long to standardize), and not let multiple implementations create language anomalies by different interpretations of the language. Historically, this latter problem has seldom, if ever, been solved. It may not cause a language to fail, but it destroys portability.

Also, the thrust of the language could be weakened if the Navy and Air Force do not chart a timely course for getting aboard Ada. A great deal of political maneuvering, well below the level of journalistic exposure, can be expected over the next several years. Again, this effort is, of course, a microcosm of the well-known problem of getting the services to agree on any kind of commonality.

—Robert L. Glass

ADA'S REQUIREMENTS

Strong typing. The language is strongly typed. This means that all data items must be declared, and in any context where type matching is meaningful, such as arithmetic expressions and procedure parameter passing, provision must be made for verifying type correspondence and inhibiting failure to type correspond. This requirement caused a surprising number of major problems for the language designers.

Precision. The programmer specifies his desired precision, such as that of a floating point number, in a machine-independent manner—e.g., 10 decimal digits, rather than "double precision." A particular compiler will translate the programmer-specified precision into a hardware precision.

Fixed point operations. Steelman required an "exact representation" fixed point, which is a rather different concept from most traditional implementations of fixed point. This concept also gave the language designers considerable trouble; one of them chose to violate the requirement and provide the more traditional inexact representation, and the other team chose to avoid the requirement entirely.

Encapsulated definition. The cluster or module concept is provided, where a limited domain data base and its associated procedures are isolated for safety reasons from the remainder of the program except via explicit importing or exporting of the cluster/module. This concept has become central to the philosophy of the Ada language.

Parallel processing. This "multitasking" facility provides for programs to be specified such that portions of them may be executed in parallel (e.g., by a distributed system). The Ada language provision in this area will probably be considered to advance the state of the theoretical, as well as the pragmatic, art.

Composite type. Ada provides both a data structure capability, and the ability to utilize programmer-defined types.

Exception handling. A facility is provided so that system or programmer defined exceptions, such as end of file or divide check or range violations, may be detected, with control given to programmer-coded handlers to service them.

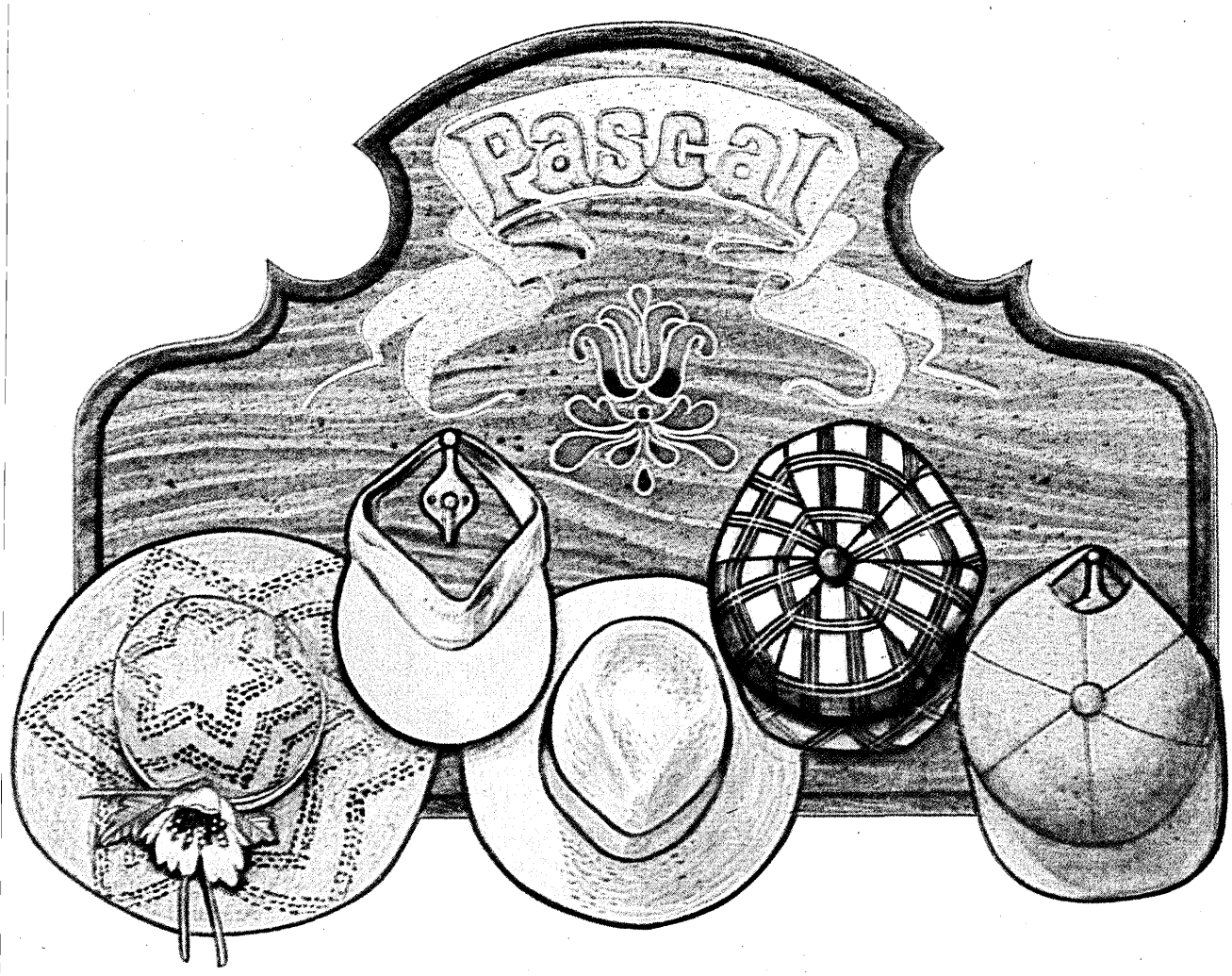
Generic definitions. Procedures and other program entities may be programmed to allow more than one version of the entity to be compiled. For example, one square root procedure which was generic might generate both a floating point and a fixed point version, based on the type of data which could be passed to it.

Machine-dependent facilities. The programmer may specify environment-specific things, such as word length, or the kind of data packing, or (under controlled circumstances) machine language code.

ADA VS. PASCAL

"The main source of inspiration for the (Ada) language is the programming language Pascal and its later derivatives. Pascal itself only meets a small part of the Steelman requirements. Merely to attempt to extend Pascal would have been neither feasible nor a desirable approach ... the elegance that Pascal derives from its careful adaptation to its problem domain could (not) be retained in such an approach ... Hence, a goal in the design of the (Ada) language was to retain the Pascal spirit of simplicity and elegance but not necessarily the form of each Pascal feature, since the problem domain defined by the Steelman requirements is much more ambitious." — *Rationale for the Design of the Green Programming Language.*

Bob Glass is president of Computing Trends, a consulting firm and publishing house. He is also the author of *Software Reliability Guidebook*, just published by Prentice-Hall, and three humorous books on computing people and projects. He has participated in several DOD language review sessions, and has an interest in languages dating back to his article, "An Elementary Level Discussion of Compiler/Interpreter Writing," in *ACM Surveys*, Vol. 1 No. 1.



STRUCTURE: THE KEY TO PASCAL'S PROBLEM-SOLVING POWER

Teaching is the goal of the Univ. od California at San Diego, and the goal of the university's Institute for Information Systems is to develop tools for teaching science. Even more specific is the goal of Professor Kenneth L. Bowles, to teach "An Introduction to Problem Solving, Using Pascal."

Things were not always as they are now. As a freshman some six years ago, I took the university's introductory computer science course, then taught using extended ALGOL on a Burroughs B6700. This class was taught in the traditional manner.

But in the fall of 1975, Dr. Bowles introduced a new course, radically different from its predecessors. It was taught using a new programming language—Pascal—and it was taught in a different style—the Keller Plan. Under the Keller Plan (a self-paced teaching method) students are given a set of objectives, and a school quarter in which to achieve these objectives.

Pascal was designed by Nicklaus Wirth. Wirth intended the language to be both a convenient means to teach programming and a useful language for developing large programs. In designing Pascal, Wirth set several goals: 1) to provide a notation capable of expressing the fundamental concepts and structures of programming in a systematic and precise way while taking into account new insights into systematic methods of program development; 2) to show that a language rich in program and data structuring facilities can be implemented by an efficient, moderate-size compiler; 3) to demonstrate that using a machine-independent language to describe a compiler increases ability to reliably read and verify without a loss in efficiency; 4) to gain insights into the methods of organizing large programs and managing software products; 5) to provide a "homemade" tool that can (due to its modularity and systematic design) be easily adapted to changing needs.

This last point proved important to our introductory class. At UCSD, we have used Pascal to create our Pascal System. We kept the student in mind while developing a (relatively) hardware-independent system.

All too often, when a student first approaches a computer, he is greeted with a simple punctuation mark (a period, asterisk, question mark, or other symbol), or a terse message such as READY or COMMAND. Our system greets the student by asking for the name of his disk. UCSD Pascal gives all disk volumes a seven-character name, so students are free to call their disks BILL, or JAN, or TOBOR. Next, the system says:

Welcome TOBOR, to UCSD Pascal
Version II.0a

The system then fills the top line of the screen with the promptline

Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug, ? [II.0]

When the student types any of the above capital letters preceding a left paren, the system calls the appropriate subsystem. For instance, if the student types "E" the system will call the editor. At this point, the promptline will change to

Edit: A(djust, C(opy, D(elete, F(ind, I(nsert, J(ump, R(eplace, Q(uit, X(change, Z(ap [E.6]

and the rest of the screen will be filled from the student's workfile.

The promptline tells the user what part of the system currently is running, as well as what commands the system will recognize. Even seasoned users find the promptlines helpful, particularly when searching for an infrequently-used command.

Promptlines aren't the only means to invoke a subsystem. When the compiler finds a syntax error, it will take one of two actions, depending on who the system is set up for. For student use, the compiler will call the editor, placing the cursor near the error. An English error description will be displayed on the top line of the screen. On the other hand, if the system is configured for program development, a syntax error will cause the display of the error context—three or four lines—and the error number. At this point the user can opt to continue the compilation, to escape to the operating system, or to enter the editor as is done in the student mode of use.

While the UCSD Pascal System attempts to build a friendly relationship with the user, its relationship to the hardware is rather platonic. Computers, and particularly low-cost microcomputers, are changing so rapidly that today the right computer for education costs twice as much as the right computer will cost tomorrow. And tomorrow's computer may well have radically different architecture.

PROTECTING SOFTWARE INVESTMENT

Recognizing the uncertain nature of tomorrow's hardware and the desirability of protecting our investment in software, we designed our system for easy transportation among differing computers. When new computers become available, we want to be able to move our teaching software (i.e., automated quiz programs) and all of the system software (i.e., compiler, editor) with as little effort as possible. If the system was written in native assembler for each new machine, each implementation would take roughly as much time as the first. On the other hand, writing the system itself in Pascal (which compiles to an intermediate P-code executed by a machine-dependent interpreter) greatly enhances its portability. It usually takes us about six man-months to write a new interpreter. Of course, any of the remaining software that takes advantage of machine dependencies will need rewriting, but there are generally few of these comprising very little code.

This work in portability fits nicely with our other major goal at the university: research. We are interested in finding better ways to perform the programming task, and methods to make programs less and less dependent on hardware.

Our work in portability has been quite practical for us. Since receiving our first compiler, we have moved from mainframe, to minicomputer, to microcomputer.

Our first Pascal compiler came from Per Brinch Hansen's group at the Univ. of Southern California. This preportable compiler was followed in short order by the P2 portable compiler from the Univ. of Colorado. A handful of graduate and undergraduate students, working from the two imported compilers, put together an interpreter for our B6700. Soon after, the compiler was adapted to produce B6700 machine code. The first time Dr. Bowles taught his new course, his students did their programming assignments in batch mode on the B6700.

At about the same time, UCSD acquired nine PDP-11 systems earmarked for use in this course. The first minicomputer implementation of UCSD Pascal barely was ready for use in the classes beginning in January 1976. This version of Pascal had a number of personality traits that have since disappeared. Among the more irritating were a program-size limit of roughly 200 lines of Pascal, and an editor that could be too helpful. Additionally, this implementation was maintained by cross-compiling from B6700 to the PDP-11. The editor had an in-depth knowledge of Pascal, and could format the user's program; the editor also recognized undeclared identifiers. This was nice, because it caught spelling errors, but it also meant a user couldn't enter a program until all declarations were provided.

By October 1976, we had severed all ties between the B6700 and our PDP-11's. We had written an entirely new operating system, including compiler, file handler, and P-code interpreter. The PDP-11 Pascal compiler compiled itself, and there were screams of joy. Our search for a smaller, cheaper, and more powerful computer continued. Also at this time, interest in our work grew, and there were requests for copies of the software from users outside the university.

For us, summer is the most productive time, as our student help can work full time for three months. In August 1977, we showed our first public offering, Version I.3. We sent 36 copies of version I.3 to outside users; the software consisted of two floppy disks with all source code for the entire system and interpreter. Unfortunately, the 130 pages of documentation were very poorly organized.

The second public release of our Pascal System, version I.4, was slightly more than a month behind schedule for PDP-11 and LSI-11 users. Those awaiting the 8080 and Z80 version, promised at the same time as the minicomputer version, were disappointed until March 1978. Version I.4 was our first opportunity to show off the machine independence of our system: changing machines entailed only a change of interpreter code file and bootstrap file. The remaining code files for the rest of the system remain unchanged. The I.4 users' manual was both enlarged and improved, and the software had grown to four diskettes for DEC machines, and five for microcomputers.

Promised for delivery in September 1978, version I.5 made it into the mail in December. Personnel disruptions, due to the resumption of classes, integrating a large number of interdependent software modules, and making it all fit on the target machine, caused the delays. Once finals were over, we cleared up our backlog of better than 200 orders. At this point, the software had expanded to fill another diskette, and the documentation had grown to a bound, 300-page book.

As things now stand, in early summer 1979, we have shipped more than 700 copies of our software (which has been duplicated an untold number of times in the field), and our mailing list comprises 3,300 names. Our support and maintenance group will have to move off campus; we're negotiating to get the politics of the move worked out.

To the question "Why Pascal?", the shortest and best answer is "structure." The language has data structuring capabilities that shift a great deal of work from the programmer to the compiler. Correctly written Pascal programs show a structure akin to the problem being solved.

We have made two changes to Pascal involving structure. Our implementation puts greater restrictions on the use of the GOTO statement, limiting them to the lexiographical level at which the label is declared. We also have added an EXIT procedure, which takes a function as a parameter and terminates that procedure.

— Keith Shillington

A HIGH-LEVEL LANGUAGE FOR MICROS AND MINIS

Improvements in integrated circuit technology have vastly expanded microprocessor capabilities, and it is now far more convenient to implement system designs using software rather than hardwired logic. To complement this, we must now look for more efficient and less costly methods of developing and maintaining software.

Most microprocessors are now restricted to the use of low-level assembly languages that are structured to the architecture of the computer. Assembly language programs are slow and cumbersome to write and even more difficult to modify. One method by which we can improve software development techniques then is to use a high-level language to write microprocessor programs. The use of a high-level programming language can greatly reduce initial program development costs and long-term program maintenance costs, and provide for greater software transportability.

Not all high-level languages (HLL's) are easily adaptable to use in microsystems development. High-level languages are, for the most part, designed for use on large computers, and algorithms executed on the larger, more traditional computing systems are purposely insulated from the hardware by a general purpose operating system. For the applications serviced by most micros, however, a traditional operating system may be several times larger than the entire application. All HLL's require structured modification to be made compatible with a microprocessor-based system; with some, the modification required makes its use infeasible.

In comparing the various high-level languages now available, Texas Instruments has concluded that Pascal seems to be the most promising. It is relatively easy to learn and easy to read, and it generally promotes good programming and design techniques.

With some modification, we have made Pascal readily compatible with the needs of microprocessor-based systems, and it has proven to be an invaluable tool for design implementation.

Perhaps the most frequently mentioned advantage of HLL over assembly language is that in using HLL, a programmer can generate at least twice as much code per unit of time. But while this is a true advantage, it becomes largely insignificant if we take a broader view and consider total life-cycle costs of a computer-based product. Because of current programmer shortages, combined with the use of antiquated techniques, software costs may now constitute as much as 80% to 90% of total product cost. Of the total life-cycle costs of software, however, 70% occurs after the initial product release. Therefore, the greatest cost reduction is achieved by implementing a clean, well-structured, well-documented initial design, thereby reducing the total maintenance effort. The immediate impact of a well-structured HLL implementation is fewer logic errors, and these are generally easy to locate and direct. The long-run advantage is that a new programmer unfamiliar with the original design can easily pick up the current release of a program and quickly understand it well enough to

correct a problem or add a feature. A 5% reduction in sustaining costs is generally more cost effective than a 50% reduction in software generation.

An added benefit of HLL implementation is transportability, and this will become even more significant as new, more efficient microprocessors appear on the market. With the accelerated growth of integrated circuit technology, algorithms will have a far greater life expectancy than the hardware on which they are executed. In product upgrades, for instance, 80% to 95% of the application functions from the old products are carried forward to the new product. While it is more true of some HLL's than others, a function expressed in a HLL is generally portable to a different processor by implementing the appropriate HLL support on the new processor.

In a typical microcomputer application, the program may consist of as few as five or six basic routines which are repeatedly executed in response to changes in the operating environment. In controlling a chemical processing system, for example, the computer receives inputs such as temperatures, pressures, and flow rates from transducers installed in the process lines. As inputs are received, the computer processes and stores the data, calculates whatever adjustments are required, and issues signals as appropriate to the various devices which control the system. Many applications are, of course, far more complex than this example, but generally, microprocessors are used for direct and immediate control of a highly localized environment.

Most microprocessors are applied in very special purpose (hybrid) environments which require that the application have direct input/output interface capability and a structure that permits preemptive priority servicing of requests.

Further, typical microprocessor application may be replicated hundreds, or even thousands of times. For this reason, cost considerations usually dictate that memory requirements be minimized. Because of memory constraint, use of a large, general-purpose operating system is generally out of the question.

Software in microsystems is usually stored in ROM. A ROM cannot be altered during operation but can be read from or executed an unlimited number of times. To support this requirement of microcomputer applications, the high-level language must generate nonself-modifying code in a module which is separate from the variables associated with the module. This is commonly called ROM/RAM partitioned code, and is available in many existing HLL implementations.

The various high-level languages

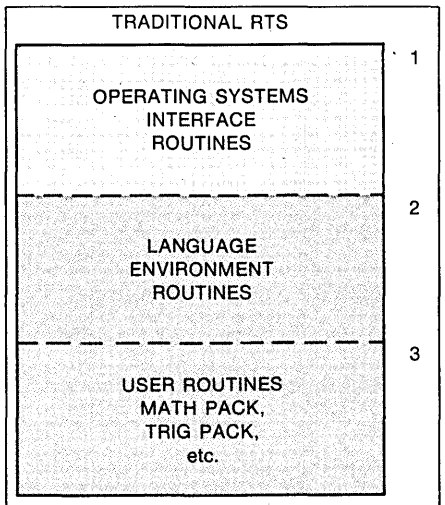


Fig. 1.

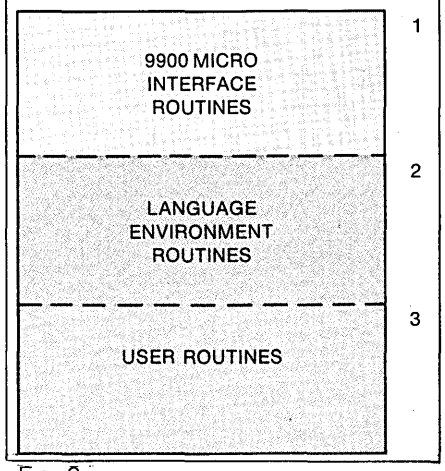


Fig. 2.

currently in use were designed for general-purpose computer systems equipped with resource management and relatively large memory and storage capacities.

The language support traditionally includes a requirement that the operating system will protect and shield its algorithms from the hardware environment. Preemptive servicing is accomplished by separating the service components of the application into several disjoint tasks which are then scheduled by the operating system. For these reasons it has not been really practical to use high-level programming languages for microcomputer systems.

SPACE/SPEED PENALTIES

While using a high-level language for micro applications does afford many cost saving advantages, there are some sacrifices that must be made. The primary disadvantage of using a high-level language is that the HLL algorithm is generally less efficient in both speed and space than its functional equivalent coded in assembler language. For this reason, most microprocessor programs have traditionally been written in native machine-level assembly language. Because of steadily decreasing memory costs and steadily increasing microprocessor power, however, this factor is becoming less important. Assembly language is difficult to learn and read and requires intimate familiarity with machine architecture. Furthermore, assembly languages are so tightly coupled to the specific processor for which they are designed that algorithms written in assembly language cannot be translated to the instruction set and architecture of another processor. Though funtional equivalency is possible, it's generally achieved only by executing separate design, implementation, and checkout efforts for each different architecture.

Micro TIP is a superset of the original language defined by Jensen and Wirth in the *Pascal Users Report* published in 1976. Our improvements were largely confined to two general areas: closure/refinement of loose areas in the original Pascal definition, and extensions for microprocessor-based systems.

All changes are constrained to maintain the simplicity and symmetry of the original definition. The first category of changes generally are not visible to the user, they exist primarily to allow the compiler to perform additional program verification prior to program execution.

Provisions for hybrid systems generation are addressed on two fronts: the language feature set, and the language run-time support library.

Texas Instruments conducted an extensive study of the current available high-level programming languages and while no language is without some deficiencies, Pascal ranked far higher in most of the categories that we considered than any of the others.

- Pascal has features which make it readily adaptable to systems and applications programming. It is "strongly typed," requiring explicit data declaration. Pascal forces complete data base design before actual coding of the source program begins. Each constant and variable must be explicitly defined before the algorithm is implemented. This allows for extensive program verification during compilation and encourages a more complete initial design. As a consequence, most logic errors can be found and corrected before the program is initially executed.

- Pascal's structure encourages "top down" design and implementation. This feature provides for ease of learning since its syntax is consistent with analytical thought processes.

- The language is specifically designed to conceal the architecture of the machine from the programmer which provides greater transportability.

- Pascal is a relatively simple language which can be implemented on a small minicomputer and is broadly accepted by both academic and industrial users.

• The existing program, procedure, and function levels of the language have been expanded to include two additional levels of program structure, which are the system and process levels of structure.

The rules for "scoping of variables" have been extended to include the two new structural levels. Programs and processes are considered separately schedulable sites of execution and can be executed "concurrently" with other processes. A program is defined as a special-case, level one process. Processes are defined statically at the source level, but are dynamically activated by other processes via calls to "STARTPROCESS." A process may be activated by any other process which is within the scope of definition of the process to be activated.

Processes are synchronized by means of semaphores, which are merely variables known to two or more processes and to the system scheduler. The semaphore is used by one process to SIGNAL another process that a "change of state" has occurred. The process that is WAITing on that semaphore will then be reactivated to process the change of state. In Micro TIP, both hardware and software semaphores are used. Hardware semaphores are used to coordinate internal processes with external events, and are implemented by the interrupt structure of the TI 9900 microprocessor. An internal process, for example, may "WAITINTERRUPT" for an external device controller to change states. Then, when the external controller does change states, it will SIGNAL the change by posting an interrupt to the processor.

Software semaphores are established as needed by calls to INIT_SEMAPHORE. The total set of primitives added for software semaphore management are:

WAIT: Wait for a change of state in some other internal process.

SIGNAL: Signal a change of state in some other internal process.

CWAIT: Wait only if at least one other process has signaled.

CSIGNAL: Signal only if some other process is waiting.

SEMA_STATE: Poll the status of a particular semaphore.

The run-time support library changes are best understood by contrasting the organizations of traditional versus run-time support (RTS) libraries. Traditionally, any RTS routine belongs to one of three categories (see Fig. 1). The only routines of which the user is explicitly aware are user routines (sine, cosine, square root, etc.) in Group 3. The language environment routines (Group 2) are implicitly included in each program and consist of management routines for such things as interroutine linkage, pro-

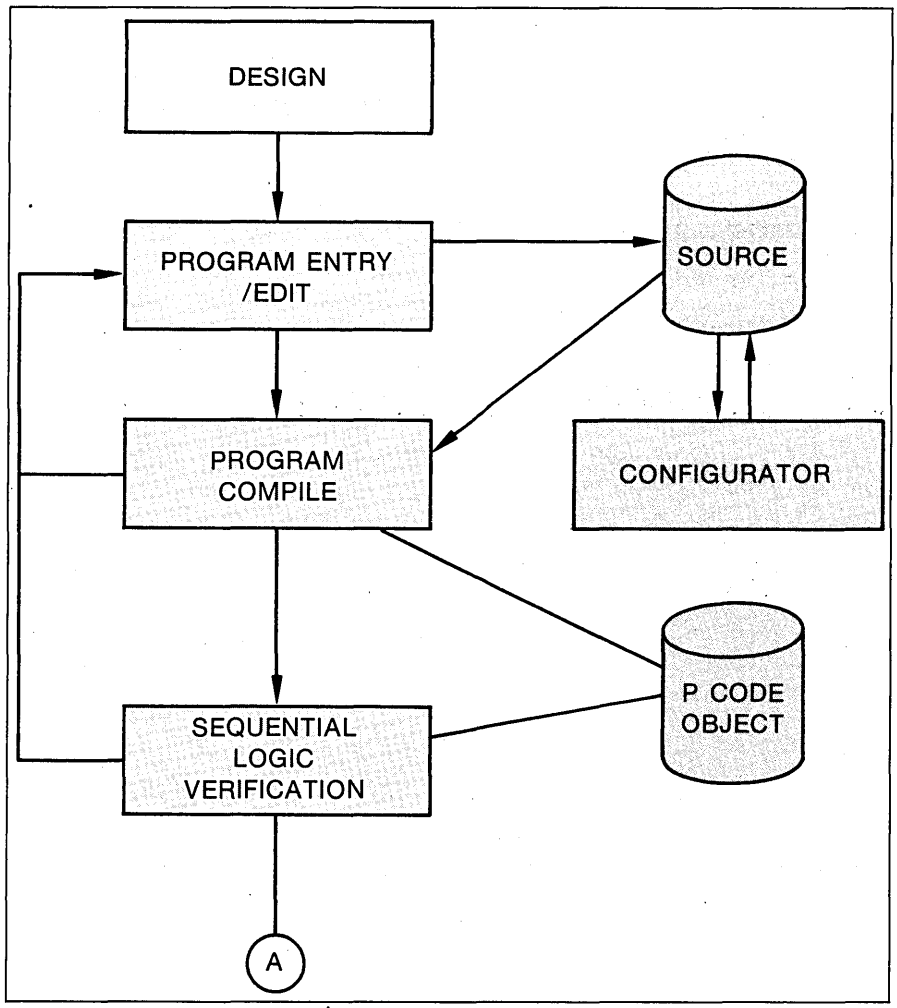


Fig. 3.

gram local memory, program variables, etc. Group 1 routines are those which interface directly with the operating system, issuing service calls and processing exception conditions. In Micro TIP, the Group 2 routines are virtually the same as traditional Pascal RTS. Group 1 routines, however, interface directly to the hardware environment, as opposed to that established by an operating system. They perform functions such as default processing for power up, power fail, and other hardware exception conditions. They also perform functions such as default system initialization, system global memory management, process scheduling by priority, interrupt decoding, etc. Collectively, these routines comprise a "barebones" executive. These routines enable the execution of a Pascal encoded algorithm in a "standalone" environment (in the absence of a general-purpose operating system).

Group 3 Micro TIP routines have been augmented to include some functions normally associated with operating system services. These include:

• A real-time clock providing time of day and delays from 10msec to 24 days.

• Mailbox management for interprocess messages.

• Interprocess communications via standard Pascal file primitives.

• Process destroyer.

SUPPORT SYSTEMS

The support system required to develop programs for microprocessor systems is generally far more expensive than the configuration required to support the application. In some cases, the actual operating characteristics of the target system can be fairly closely duplicated in the development system, and some designs are developed in this manner. Usually, however, they require a far longer time to complete and the software is not always reliable. The software instability is usually attributable to differences in system timing, and/or to insert differences in simulated or prototyped interface characteristics. It is generally not possible to thoroughly debug a microprocessor application program in other than its exact target environment.

Where development costs and schedules are an important consideration, the system is developed on a host computer designed to maximize programmer efficiency. The fully developed, partially debugged algorithm can then be loaded into the target environment electronically (data links, in circuit microprocessor emulators, etc.) or manually (EPROMS).

Micro TIP program development is supported on the TI 990 minicomputer development systems, which are available in both the floppy and hard disk versions. These systems are designed to maximize

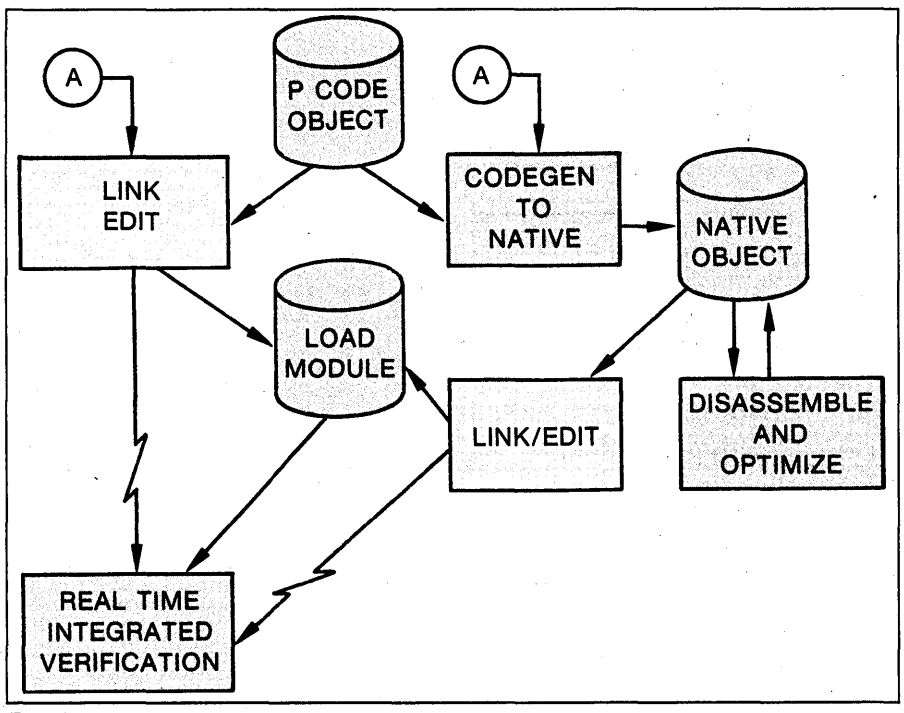


Fig. 4.

engineering productivity in all phases of product development.

The use of Micro TIP primarily improves efficiency in the design and support phases. For program preparation, a new screen-oriented editor is provided with Micro TIP. As program text is entered, it is automatically indented to indicate structural resting levels, and may be immediately verified to conform to Pascal syntax rules. Text entry errors may be interactively corrected and resubmitted.

Program debug of Micro TIP algorithms is carried out in two stages: sequential logic verification, and real-time integrated verification. All Micro TIP programs are compiled to an intermediate pseudo-code (P-code) at which point each procedure and function may be interpretively executed on the host. The user may interact with the execution at the Pascal statement level to verify that the sequential operation of the function or procedure is correct. When a logic error is detected, the "configurator" utility is provided to allow recompilation of the corrected procedure or function after editing. Because of the structured nature of Pascal program syntax, it would be necessary to recompile the entire target application if the configurator were not available.

After the individual pieces of the target have been verified, the user has the option to execute the system in the target environment either by P-code interpretive execution, or 9900 native code direct execution. The method used depends on the space/speed requirements of the target environment. P-code is more compact than native code, requiring only half as much space in the target system. Direct execution, however, is approximately seven times faster than interpretive execution and has a minimum run-time support size of 2K bytes. The minimum run-time support size for the interpretive execution mode is 12K bytes (see Fig.5).

The final phase of development is the real-time integrated checkout which should only be performed in the target system. The most efficient and cost-effective method of checking the system is the Advanced Microprocessor Prototyping Lab (AMPL) in-circuit emulation method. AMPL is a standard TI 990 computer peripheral configured in the I/O space of the host development system. The outboard side of AMPL contains a connector which plugs into the target system socket reserved for the 9900 microprocessor.

	DIRECT	INTERPRETIVE
SPACE	2	1
SPEED	7	1
MIN. SIZE	2K	12K

Fig. 5.

When inserted in the socket, AMPL is the exact electronic equivalent of the 9900 except that it may be interactively monitored and controlled by the host system. Special host software is provided with Micro TIP to perform AMPL debug of Micro TIP algorithms. This software is cognizant of the concurrent nature of the algorithm, the Micro TIP environment, and the system level data structures associated with both. The software provides debug facilities such as process level entry/exit and trace/ breakpoint. These are mandatory for executing an integrated test in a multiprocess environment. The standard AMPL software provides for loading the target with the application load module and for interactive control of the target with a procedure-oriented control language. The syntax of the AMPL control language is patterned after Pascal and allows the user to construct single word commands unique to the immediate application. These commands may be debug oriented (with engineering formatted responses) or quality assurance oriented (with manufacturing go/no-go type responses).

Most microprocessor manufacturers have offered their oem customers a "real-time executive" for use with their microprocessor. At the same time, many oem customers have not been able to use the vendor's executive in a hybrid application. The reasons for this situation are obvious. In order for the executive to have wide oem market appeal, the manufacturer includes general-purpose features. The very act of including a wide variety of general-purpose features in a highly integrated software package negates the desirability of using that package in a specific, highly tailored oem product.

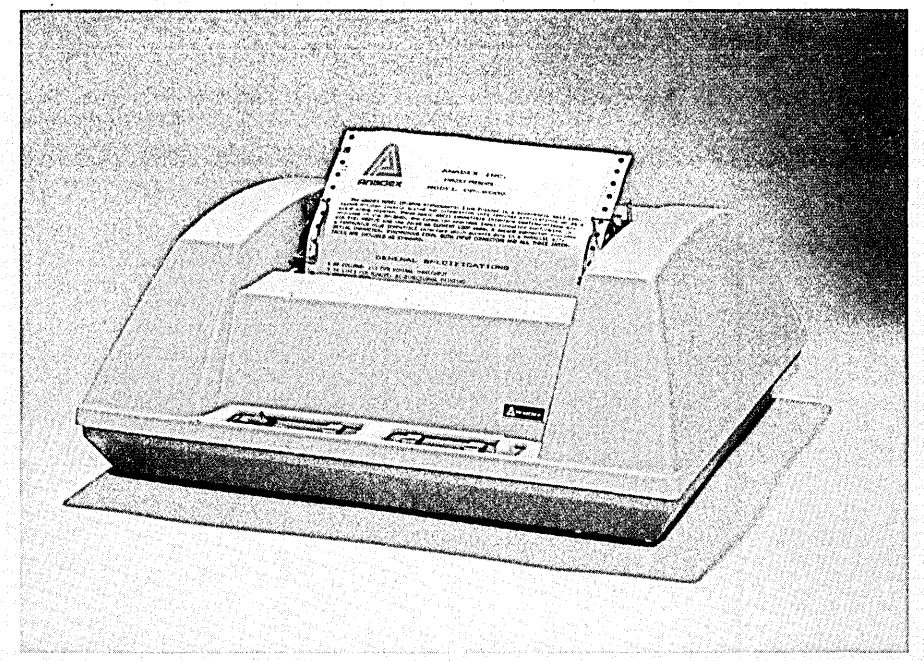
Providing Micro TIP for systems *and* applications programming permits packaging "executive functions" as modules on the Micro TIP run-time support library in the same fashion as other functions such as sine, cosine, and square root. Further, because the executive functions are coded in Pascal, the source from which they are derived can be provided to the oem for custom tailoring to application specific needs. A customer thus generates a tailored executive, specific for his application, by linking appropriate modules from the Micro TIP executive library, modifying modules where required, and adding additional modules written to conform to system interface conventions. These conventions are established by the Micro TIP compiler and code generator.

There appears to be a surge of support for Pascal unequalled by that for any other language in the past (including COBOL, FORTRAN, and ALGOL). This is due, in large part, to the wide academic acceptance and propagation of Pascal. More recently, however, the industry's giants are being prodded by profit and loss statements to address the soaring costs of software and are pouring investment dollars into researching more efficient software techniques. Pascal, though it has some imperfections, appropriately addresses those areas which account for the bulk of software expenditures.

—Marvin Conrad

Marvin Conrad, currently manager of microprocessor software product development in the semiconductor division of Texas Instruments, has extensive design and managerial experience in operating system development efforts for the CDC 6000 series computers at Control Data Corp. and the TI advanced scientific computer. In 1975 he staffed and executed the AMPL project. Currently he is involved with TI study groups.

The Anadex 80 Column Printer.

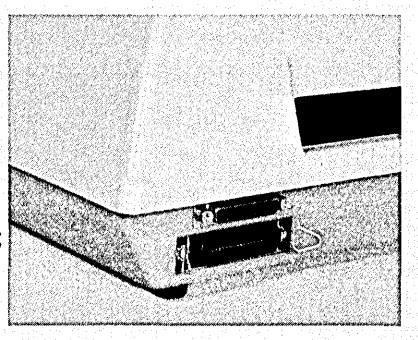


First check the specs. Then check the price.

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

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

☑ Check the Interface
Included at no extra cost, are two input connectors (see photo) that provide three basic ASCII compatible interfaces: EIA Std. RS232C, for interfacing at up to 9600 Baud with most mini-computers and modems; the 20/60 ma current drive mode required by Teletype® ASR33-35 printers; and the parallel-bit, serial character synchronous Centronics compatible interface.



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

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

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

☑ Check Convenience
For operating ease, the DP-8000 accepts paper through the rear or bottom of the unit, provides programmable Skip Over Perforation control, and Out of Paper indication and logic signal. And movable sprockets allow the use of forms or paper from under 3 inches to 9½ inches wide.

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

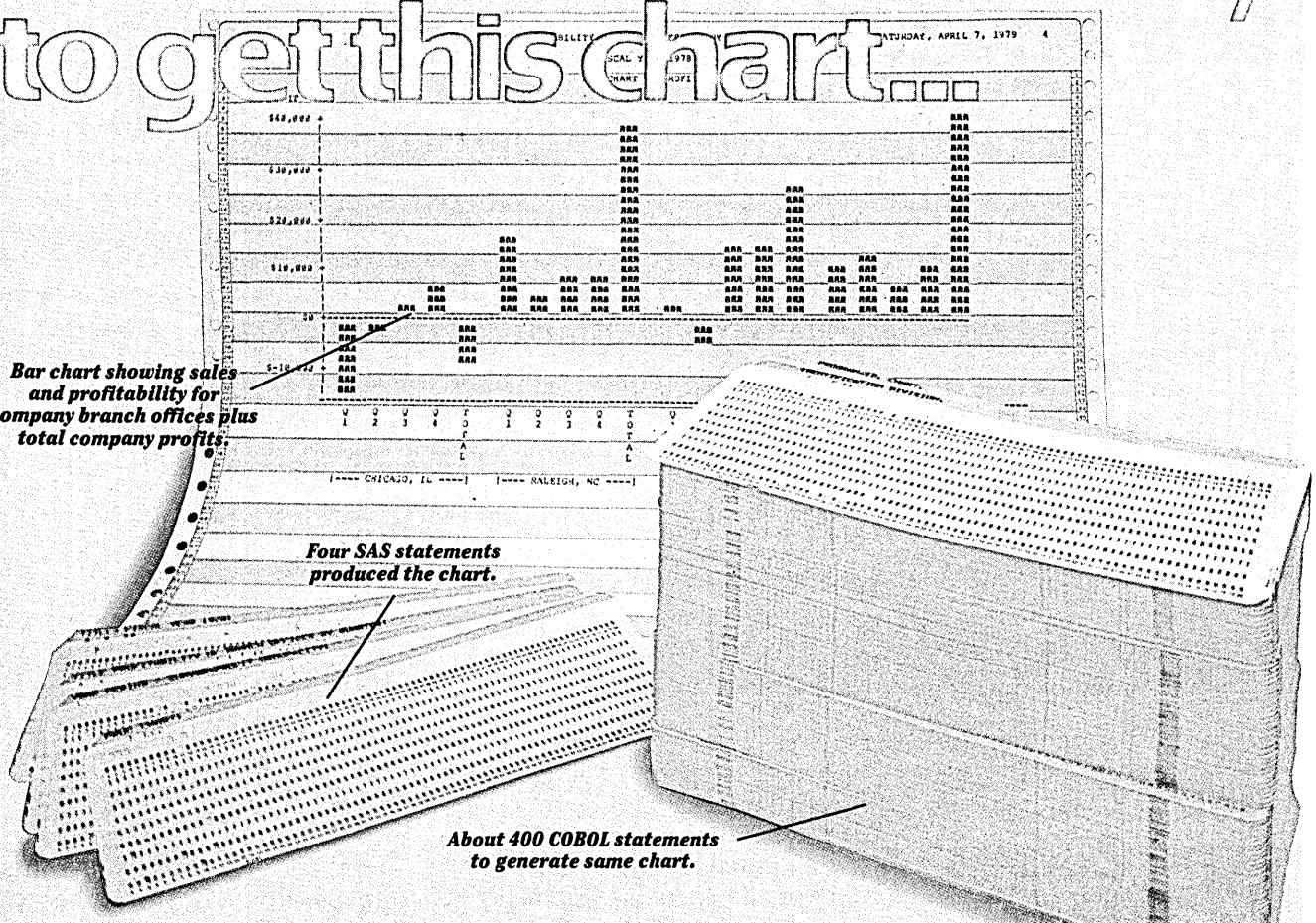
Once you've checked out the performance and price, we think you'll agree that the DP-8000 is definitely worth checking into. Contact us today for complete details and a demonstration.

Anadex®

ANADEX, INC. • 9825 DeSoto Avenue • Chatsworth, CA 91311, U.S.A. • Tel: 213/998-8010 • TWX 910-494-2761
ANADEX, LTD. • Dorna House, Guildford Road • West End, Woking, Surrey GU24 9PW, England • Tel: Chobham (09905) 6333 • Telex: 858762 ANADEX G

CIRCLE 24 ON READER CARD

The most efficient way to get this chart...



is with 4 statements instead of 400.

SAS is a powerful software system that can increase your productivity. In the programming task shown here, 4 SAS statements produced the same chart as 400 COBOL statements. That's a typical example of how SAS can help you produce results faster.

But there's more. SAS can increase productivity two ways.

First, SAS has a complete library of prewritten programs which can be used by all levels of employees for routine jobs. With a few English-like commands almost anyone can use SAS for data analysis, market research, financial reports, summary statistics, charts, plots, personnel reports and many other jobs.

With SAS handling all that, programmers are free to use SAS a second way – as a higher-level programming language. Unlike most other software systems, SAS is not limited to prewritten routines. A programmer can use SAS to eliminate the tedious steps in a complex task.

However it's used, SAS increases productivity because SAS saves time. With SAS you'll be telling the computer what you want instead of how to do what you want.

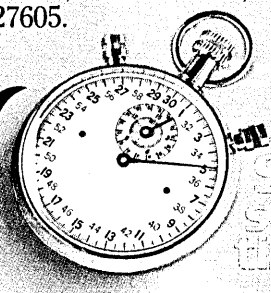
Running interactively under TSO and in batch, SAS is now increasing productivity at more than 700 OS and OS/VS sites. And users at those sites have put SAS on the Datapro Honor Roll for the third consecutive year.

There's another nice thing about SAS. The cost. You can add SAS to your dp staff for about 1/4 the cost of a new person. And after the first year it's even less than that.

To find out more, just write or call. It could be the beginning of a very productive relationship.

SAS Institute Inc., PO Box 10066, Raleigh, North Carolina 27605.
919/834-4381.

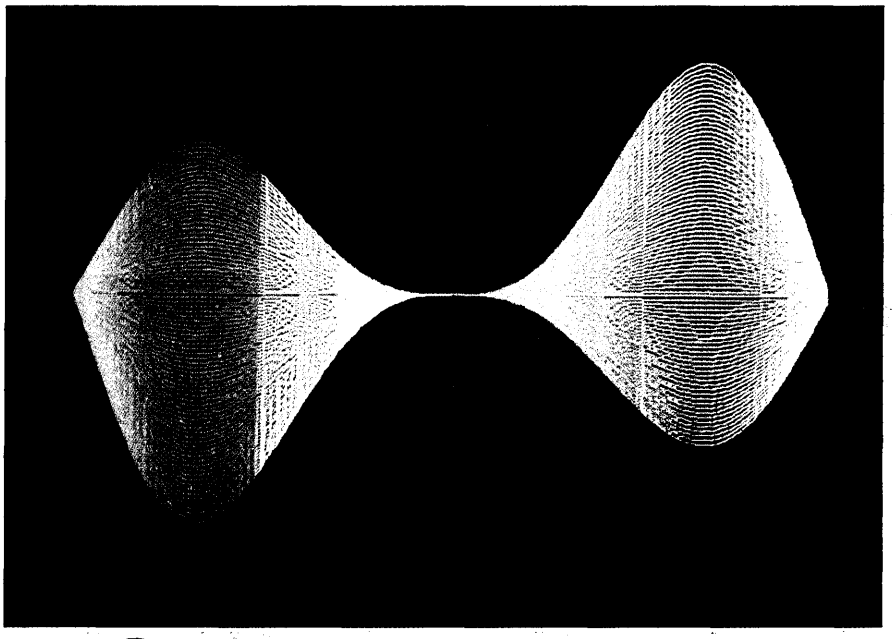
SAS



SAS saves time.

CIRCLE 37 ON READER CARD

The shift in the use of graphic terminals from scientific and engineering uses to practical business tools is well on its way, and so is the demand for accompanying low cost peripheral printers.



DISPLAY COPIER SURVEY

by Nancy Knottek, Surveys Editor

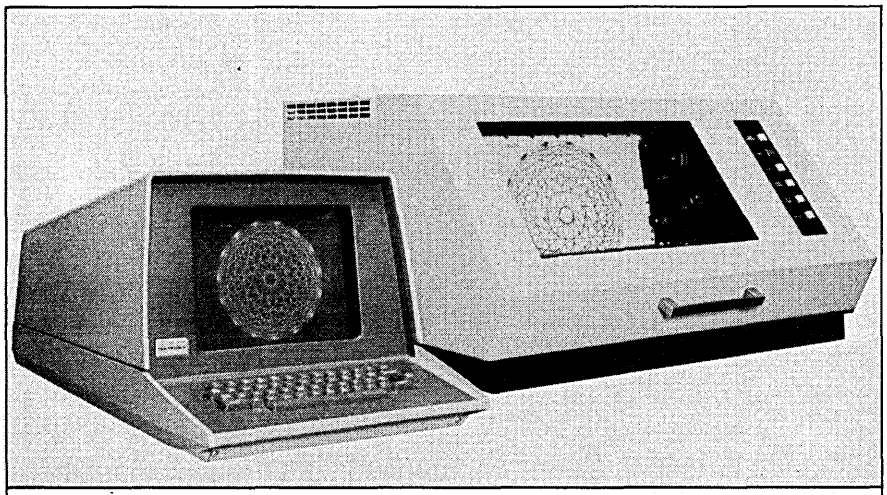
The falling cost of electronic components has helped reduce the price of graphic terminals sufficiently for them to compete with straight alphanumeric terminals in the business data processing market. Sales are increasing, undoubtedly spurred on by business users who have become enamored with the ability to reduce a long, boring report to an easy-to-read graph on a terminal screen. Thus, the shift in the use of graphic terminals from scientific and engineering uses to practical business applications is well on its way, and so is the demand for low cost peripheral printers to go along with them.

As peripheral devices, these hardcopy graphic printers usually must attach directly to the terminal and be driven by it, and be inexpensive enough to be used at a terminal site for "convenience copies." By definition, then, they must be "image copies," capable of reproducing screen contents in hardcopy form without an interpretation process involving cpu overhead or software support.

Industry jargon for this kind of copy is video or crt dump, which implies their creation directly from a screen image. Since most graphic terminals use a raster display tube, they're also called raster dumps. The most popular exception to raster scanned graphics is offered by Tektronix, which produces terminals using a phosphorous storage tube that until recently offered cost savings over raster tubes. But these tubes tend to wear out quickly and have lost their price advantage with the drop in electronics costs, so that Tektronix now also uses raster tubes in its newer models. However, the past popularity of the Tektronix storage tube has caused most graphic printer vendors to offer devices to work with either type of display.

Since the graphic printer market is just beginning, it follows that the first participants were those which had similar devices that required little redesigning. So products currently available use one of two design approaches, both variations of existing equipment: dot matrix character printers and printer/plotters.

And since the technology involved in producing graphics from a crt screen is fundamentally the same as that used to produce characters, dot matrix printer manufacturers have simply revamped existing printers to allow them to print all areas shown on a screen, rather than automatically skipping spaces between characters and between lines. They print bit streams rather than character streams. The change is made in firmware or hard-



Many of the display copiers have been adapted from matrix printers and printer/plotters, like this model which Trilog adapts from a Printronix impact line printer.

The basic intent of the crt dump printers is to provide a convenience copy of screen contents. To be effective in this role, they should be inexpensive, easily interfaced to their crt host, and quick. The thermal printing HP7245A is typical of the breed.

ware and requires slightly more memory and the sacrifice of some speed.

Dot matrix printer/plotter manufacturers had to do even less to modify their machines to print the screen image directly and added what amounts to little more than an interface board.

Like all printers, graphic printers employ a wide variety of printing techniques. Although ink jet is not yet represented, impact, thermal, and electrostatic printers are available, again depending for the most part on what was used in the original equipment before it was modified for screen dumping.

Again because the market is so new, and is dependent on another relatively new market, that for business graphics displays, some industry people aren't sure that the graphics hardcopy market will ever fully materialize. As a result, vendors are not exactly scrambling to introduce products. Many seem unwilling to invest any development money in products that are not guaranteed to produce immediate high volume sales.

Texas Instruments, for one, says the market is not big enough, and for its size requires too much R&D even to bother converting printers for it. Perkin-Elmer is a little less certain. It has just introduced its first graphic product, the "Beaver" 3500 intelligent terminal that features limited business graphics, and P-E's marketers say they'll wait and see if there is a market before further committing to graphics.

THE CURRENT CONTENDERS

It is the graphics terminal manufacturers, anxious to keep existing users happy and hoping to generate new sales, that are leading the way in the image copier market.

Tektronix, one company which has been pioneering the use of graphics in business, offers four models, two for use with their proprietary storage tube terminals and two designed for their newer raster scan models. Hewlett-Packard has three to choose from, each manufactured by a different division in the company and each using a different design approach: the model 2631G dot matrix impact printer, the 9876A thermal printer, and the 7245A thermal printer/plotter.

Printer/plotter manufacturers are also early marketers since they are already committed to graphics and have so little conversion to do to provide direct terminal copying. Versatec has three series to choose from, all electrostatic devices. The company markets the 210 and 230 series desktop units and a brand new standalone model which can serve up to

DISPLAY COPIERS

Manufacturer	Benson-Varian	Dunn Instruments	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard
Model highlights	Series 9000	631 Color Camera	9876A Thermal Graphics Printer	HP 2631G Graphics Printer	7245A Plotter Printer
1st shipment/ # shipped	Date and # shipped NG	4/79 New Product	1/79 New Product	12/78 NG	6/78 NG
Physical size (hxwxd)	22½ x 26¼ x 38 inches	38.7 x 38.7 x 113.2 cm	6 x 13.75 x 17.5 inches	8.5 x 25.2 x 18.5 inches	7.9 x 17.4 x 19 inches
Interfaces available	Varian S-260 for Tektronix and S-170 for all other terminals	All raster scan color graphics with R-G-B output	IEEE 488; 8-bit parallel	HP1B (IEEE 488)	HP 1B (IEEE 488)
Printing					
Print mechanism	Electrostatic	Camera with crt	Thermal	Dot Matrix, impact	Thermal
Print speed	4 inches/sec	Up to 30 prints/hour or 60 slides/hour	60 inches/min	180 cps (character mode)	Approx. 720 x 360 dots/min
Paper feed mechanism	Pinch roller, stepping motor	Film Holder	(Graphics) Friction Platen	Tractor	Pin Feed
Image size	8½ x 11 to 17 x 22 inches	8 x 10 inch or 35 mm slides	7.28 inches wide x any length	10 x 5 inches	6.8 x 3.5 inches raster/8½ x 11 inches vector
Resolution (horiz. & vert.)	200 x 100 dots/inch	1400 lines	77 dots/inch	72 x 72 dots/inch	106/dots/inch
Paper & supplies					
Paper type	Dielectric coated	Polaroid 808 film	Thermal	Up to 6-part forms	Thermal
Paper size	8½, 11, 14⅞, 22 inch roll	NA	8½ inch roll	1.25 to 15.75 inches roll	8½ x 24 inches
Supplies	Toner, concentrate	NA	None	Ribbon cartridges	None
Pricing					
Unit price	Interfaces $1,200 - 2,850 Electrostatic Plotter $8,550 - 23,550 (+1,200 - 2,850 interface)	$12,000 (+$4,000 for 35mm option)	$3,500	$4,250	$4,600 (+$250 raster option)
1 year lease	Leases not offered	Leases not offered	Leases not offered	$223/month	$242.50/month
Supplies prices	NG	NA	$12.50/roll (300 ft long)	$45 (package of 3 ribbons)	$15.00/roll
Maintenance price	NG	NA	$21.00/month	$34/month	NG
Comments					

Manufacturer	Houston Instrument	Tekronix	Tektronix	Trilog	Trilog
Model highlights		4631 Hard Copy Units	4632 Video Hard Copy Unit	Colorplot 100	P-300G
1st shipment/ # shipped	NG	Date and # shipped NG	Date and # shipped NG	5/79 New Product	6/78 100 shipped
Physical size (hxwxd)	27 x 14 x 20¼ inches	11 x 16 x 25½ inches	11 x 16 x 25½ inches	—	41 x 30 x 25 inches
Interfaces available		Tektronix DVST only.	Most digital video sources	Industrial Data Terminals Chromatics, Intelligent Systems, etc.	Tektronix 4000 Series
Printing					
Print mechanism	Electrostatic	Dry Silver Photographic	Dry Silver photographic	Raster Matrix Impact	Raster Matrix Impact
Print speed	10 sec for first copy	18 sec for first copy, then 8 sec/copy	18 sec for first copy, then 10 sec/copy	approx. 3 min/copy	Approx. 45 sec/copy
Paper feed mechanism	Stepper Motor	Mechanical drive roller	Mechanical drive roller	Tractor	Tractors
Image size	10.2 x 7.8 inches (8610) 7.2 x 3.6 inches (8640)	8¾ x 6¾ inches	8.4 x 6.3 inches	13 x 10 inches	13 x 10 inches
Resolution (horiz. & vert.)	100 dots/inch	200 points/inch	200 points/inch	100 x 100 dots/inch	60 x 72 dots/inch
Paper & supplies					
Paper Type	Electrographic	3M Brand Type 7770	3M Brand Type 7770	Plain paper	Plain
Paper size	11 inch roll	8½ inch roll	8½ inch roll	4-16 inch roll	16 inch roll
Supplies	Liquid Toner	None	None	3-color ribbon	Standard ribbons
Pricing					
Unit price	$4,495-4,995	$4,495	$4,595	$9,980	$6,955
1-year lease	$225-250/month	$270/month	$276/month	Leases not offered	Leases not offered
Supplies prices	$18-30/roll paper; $3/quart toner	$50/500 ft roll, $180/4 rolls	$50/500 ft roll, $180/4 rolls	0.5¢/copy	0.5¢/copy
Maintenance price	Designed specifically for crt dumps	$51/month	$51/month	Less than $100 per month	Less than $90.00/month
Comments			Will copy gray scale image from Tektronix 4027 Color Graphics Terminal.		

Manufacturer	Trilog	Versatec	Versatec	Versatec	Xerox
Model highlights	T-100G	210 Hard Copy Controller	230 Series Hard Copy Controller	Model 1640/1641	6500 Color Graphics Printer
1st shipment/ # shipped	10/78 50 shipped	1977 # shipped NG	1972 # shipped NG	1977 & 1978 # shipped NG	8/78 # shipped NG
Physical size (hxwxd)	41 x 30 x 25 inches	3.5 x 19 x 22 inches	1¾ x 17 x 18 inches max	38 x 23 x 18 inches	46 x 42 x 46 inches
Interfaces available	Tektronix 4000 Series	Most Digital Video Sources	Tektronix Storage Tubes	Most digital video sources	Ramtek, Tektronix, Chromatics, etc.
Printing					
Print mechanism	Raster Matrix Impact	Elecrostatic	Electrostatic	Electrostatic	color xerographic
Print speed	Approx. 45 sec/copy	8 sec/copy, min.	12-70 sec/copy	Approx. 10 sec	192 prints/hour
Paper feed mechanism	Tractors	Differential Roller	Differential Roller	Differential Roller	Sheet fed
Image size	13 x 10 inches	Depends on Source	4.8 x 6.4 to 40.96 x 30.72 inches	Max 10 inch width	6.5 x 13¾ inches max.
Resolution (horiz. & vert.)	100 x 100 dots/inch	Equal to Source	2048 x 1536 copied	Equal to source	100 lines/inch; 100 points/inch
Paper & supplies					
Paper type	Plain Paper	Electrographic	Electrographic	Electrographic	Bond, overhead transparencies
Paper size	4-16 inch roll	8-72 inch roll	8½-72 inch roll	11 inch roll	8½ x 11 or 8½ x 14 inches
Supplies	Standard Ribbon	Liquid Toner	Liquid Toner	Liquid Toner	Cyan, magenta, and yellow dry toners and developers
Pricing					
Unit price	$8,205	$3,500	$1,300 to 2,300	$10,500 (1640); 11,000 (1641)	$25,000
1-year lease	Leases not offered	Leases not offered	Leases not offered	Leases not offered	not leased
Supplies prices	0.5¢/copy	0.2-0.3¢/copy	0.2-0.3¢/copy	0.2-0.3¢/copy	0.4½-0.5¢/copy
Maintenance price	Less than $100/month	$50/month	$30 to 40/month	$120/month	$200/month
Comments		Uses various Versatec printer/plotters.	Uses various Versatec printer/plotters.	1640 is for H-P terminals; 1641 is general purpose.	Interfaces not offered by Xerox Corp.

eight terminals. The company also has the distinction of offering the lowest cost unit available to date; one of the 230 models sells for just $1,300.

Varian, which was acquired by a European plotter manufacturer in February and is now known as Benson-Varian, offers the 9000 series electrostatic printer/plotters, and has had its terminal interface out for approximately two years.

Other current market participants are smaller companies which can better manage limited production or choose to gamble on a new market since they don't have a significant share of an existing one. Trilog, a fairly new company, fits this category. Started by ex-Printronix employees, the firm markets modified versions of Printronix printer/plotters which have been adapted to interface with Tektronix 4000 series displays.

Seeing the need for such an interface for previously installed Printronix users, Trilog also offers the Graphic Adapter Board alone to convert a standard Printronix unit for terminal output. The company is also just about ready to introduce the Color Plot 100, again based on a Printronix printer/plotter, but able to print in three colors; it will be one of the few terminal-controlled printers to use color.

Houston Instrument took a different route to market from the vendors already mentioned; it designed a unit from the ground up. The prototype was shown at the NCC last year, but production models were first shipped about March of this year. And a new desktop unit, the 8640, was announced the first week in May. The 8600 series are electrostatic copiers with the 8640 designed for Hewlett-Packard 2640 series crt's and the 8610 able to work with Tektronix storage tubes.

IN LIVING COLOR

Two companies offering unique, specialized products should also be discussed. Both market terminal hardcopy devices for color graphic displays, but while one is actively pursuing the market, the other is offering a product established in the copier field which has been adapted to terminal output without much marketing effort being devoted to the new application.

The latter is Xerox. Its 6500 Color Graphics Printer, also introduced at last year's NCC, is a variation of the 6500 copier. It produces high resolution color graphics using three primary colors on bond paper at the rate of 192 prints/hour. It interfaces directly to a host cpu or to an interactive graphics terminal such as those offered by Ramtek, Chromatics, Tektronix, and others. But Xerox doesn't supply the interface necessary for terminal connection. The user must purchase that from the terminal manufacturer, if one is offered, or build his own.

However, the $25,000 price tag the 6500 carries pretty much limits its use to host connections, since most users won't want to spend that much money on a printer to provide output from a single terminal.

The other interesting color product is offered by Dunn Instruments. Formerly in the medical imagery market, Dunn recently introduced its Model 631 Color Camera to the data processing industry for use with color graphics displays. The camera interfaces to all raster scan color graphics terminals and produces 8-color 8x10-inch photographic prints at up to 30/hour. The camera sells for $12,000 and also features a 35mm slide option for $4,000 more.

Dunn is initially working with Ramtek Corp., which praises the camera highly, but has just received its first production unit. If all continues to go well, the 631 could herald new markets for camera systems and, along with the Xerox 6500, offer competition to printer vendors. (The color graphic used on page 159 was printed from a 35mm color slide produced by the Dunn 631 and was chosen as an example of the range of graphic output available.)

Xerox and Dunn, in turn, are seeing an immediate response from Trilog, which in May introduced a far less expensive color unit employing impact printing and a 3-color ribbon—simple, but effective.

As with any new market, these first crt dump product offerings are divergent in design, printing method, output, and price. The user has quite a choice if he wants to save the beautiful picture he's just created for posterity—copy it on a printer which is a slave to the crt, or on a printer/plotter for a bigger copy, or in color on plain bond paper, or as a photograph or 35mm slide. Of course, the decision will depend in part on whether the drawing is worth as much as $25,000 or "only" as little as $1,300. ✱

VENDOR INDEX

For additional information regarding the products listed in this survey, please contact the vendors directly, either at the addresses shown below or by circling the appropriate number on the reader service card bound into this issue.

Benson-Varian
Subsidiary of Benson S.A.
385 Ravendale Dr.
Mountain View, CA 94043
5 U.S. Sales/Service Offices
Foreign Office located in Paris
Distribution worldwide
Sales Manager, Western Region,
Robert Britt
(415) 965-9900
FOR DATA CIRCLE 380 ON READER CARD

Dunn Instruments
52 Colin P. Kelly Jr. St.
San Francisco, CA 94107
A. Mason Killebrew Jr., VP, Marketing
(415) 957-1600
FOR DATA CIRCLE 381 ON READER CARD

Hewlett-Packard
1501 Page Mill Road
Palo Alto, CA 94304
Inquiries Manager
(208) 376-6000
FOR DATA CIRCLE 382 ON READER CARD

Houston Instrument
Subsidiary of Bausch & Lomb
One Houston Square
Austin, TX 78753
Jim Raska, Product Manager
(512) 837-2820 X572
FOR DATA CIRCLE 383 ON READER CARD

Trilog, Inc.
16750 Hale Ave.
Irvine, CA 92714
86 U.S. Sales/Service Offices
Foreign Offices Europe, Australia, Japan
Raymond F. Melsa, VP, Marketing
(714) 549-4079
FOR DATA CIRCLE 384 ON READER CARD

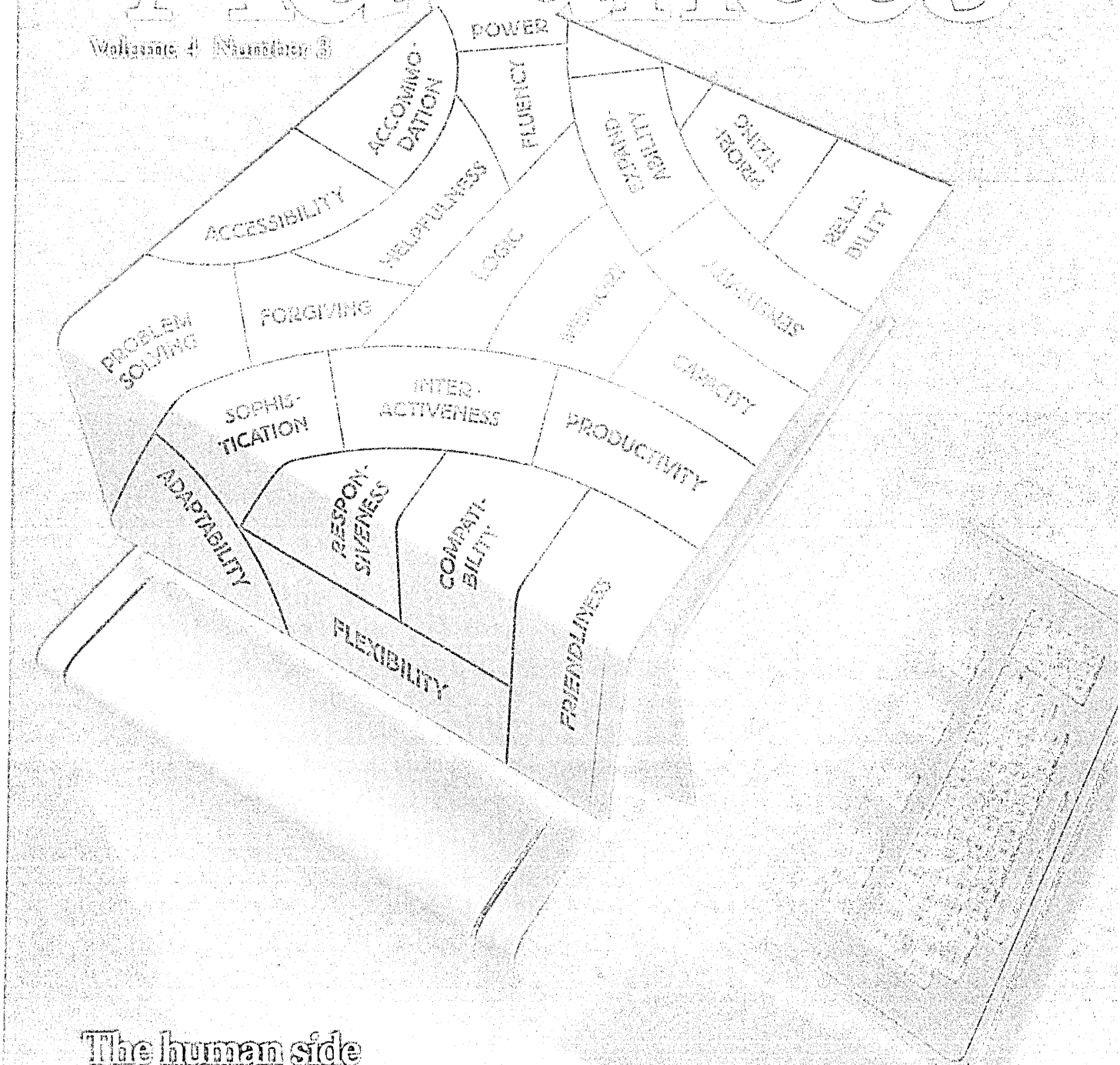
Versatec, Inc.
Subsidiary of Xerox Corp.
2805 Bowers Ave.
Santa Clara, CA 95051
Foreign Offices located in United Kingdom and Germany
Bruce Fihe, Systems Marketing Specialist
(408) 988-2800 X365
FOR DATA CIRCLE 385 ON READER CARD

Tektronix, Inc.
Box 500
Beaverton, OR 97077
45 U.S. Sales/Service Offices
Foreign Offices located in Canada, Holland, Japan, and Australia
(800) 547-1512, or (503) 644-9051
FOR DATA CIRCLE 386 ON READER CARD

Hewlett-Packard

Computer Advances

Volume 4 Number 3



The human side of computers

Business computers: breaking down the barriers

"We have to create a place in the human environment where machine contribution is so acceptable and comfortable that it looks as if it has always been there. Still, that same environment has to be a home setting, a living setting, a social setting that doesn't lose any of its sensitivity to the communication arts.

"Successful work environments are like good nightclubs. They are energy centers. They draw people and enterprise and become extremely lively places for transactions between people, and for meaningful events.

"How we incorporate the fabulous potential for computers into the living environment is vitally important. You can almost assign computers human attributes. Then you can decide what natural accesses people should have to this fabulous machine/person."

Robert Propst,
President of Herman Miller
Research Corporation

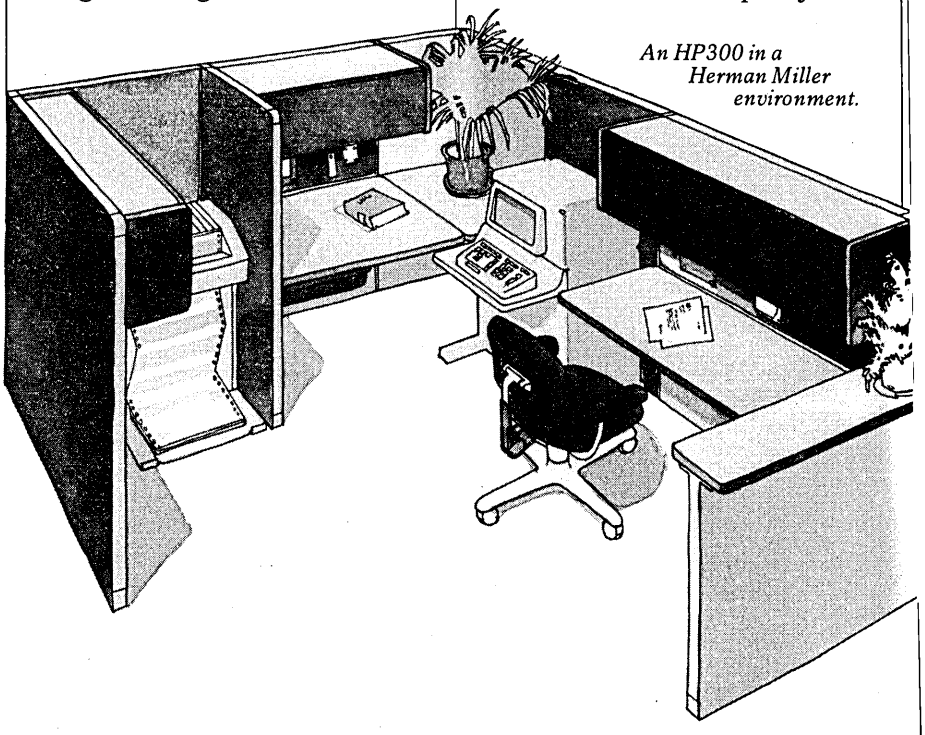
Office environments that accommodate the new collaborations between people and computers have a great effect upon productivity. This idea has captured the attention and imagination of Herman Miller, Inc.— leaders in planning open spaces in office and manufacturing environments. Their product, "Action Office," was originated by Robert Propst, President of Herman Miller Research Corporation.

Hewlett-Packard and Herman Miller are both interested in learning as much as possible about the human/computer/environment interfaces. We are each committed to developing and managing an accommodating, effective, working environment in this age of accelerated technological change.

"Action Factory," an innovative manufacturing environment, is now being tested in the HP300 manufacturing area. Through the intelligent use of vertical space, and a careful awareness of the handling and flow of materials, this flexible system provides a quality environment that also demonstrates cost savings and efficiencies.

Extending the reach

As more and more computer systems are being distributed to the mainstream activities of an enterprise, they are reaching users less sophisticated in their use. Continuing advances in hardware and software technology are now making systems more accessible to these uninitiated users. There is much more capacity and



An HP300 in a Herman Miller environment.

power available for systems to accommodate a more human interface.

For example, Hewlett-Packard is committed to various LSI strategies—among them Silicon-on-Sapphire which has successfully achieved higher and higher circuit densities. Not only are we packaging more and more on a chip, but more components per board and per system. These achievements have contributed greatly to our ability to produce portable, friendly business systems.

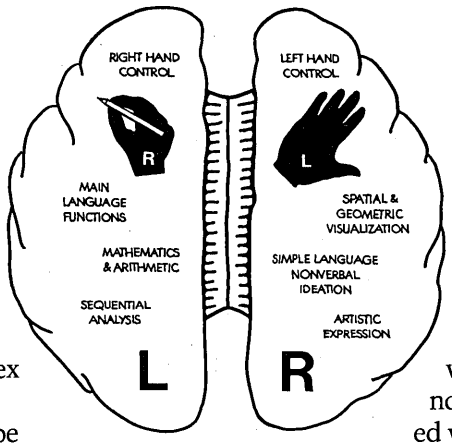
"Hewlett-Packard is working to make its products far more powerful and useful to the 'uninitiated' manager and knowledgeable worker."

Paul Ely
Vice President and General Manager
Computer Systems Group

Sit down; solve your problem

Our goal is to eliminate barriers that exist between people and their computers. No one, computer professional or not, should have to learn extraneous protocols. We want users to concentrate on solving their problems and not on learning about the intricacies of a machine. So, we "delegate" tasks. Those which are judgemental or intuitive in nature are left to the users. And, those which can be handled easily by the computer are done by the computer. In fact, we are designing "operatorless" systems which relieve the user from any burden of managing the system.

Designing a more human interface to systems is as complex as the variety of people who will be using them. What a first-time user considers helpful, an experienced programmer finds unnecessary. We have resolved that our systems must be easy for everybody to use.



Functions of left and right hemispheres of the brain. (See "Numbers to Pictures," page 5.)

The human factors

One important consideration to the human/computer interface is that the computer "speak" to you in a language that meets your level of computer sophistication.

The computer can be, in effect, an intelligent assistant using techniques like leading and prompting the user with softkeys, aiding with memory joggers and "HELP" commands, forgiving the inevitable spelling input errors, and reporting error messages as words—not numbers.

"Part of designing a system to be friendly is getting our engineers and industrial designers to work—not our customers."

Fred Wenninger
Lab Manager for
Desktop Computer Division

We also want to ensure that our computers do not interfere with the way people work naturally. One work phenomenon can be reenacted with the exciting "windowing" capability of the HP300's interactive display station.

Notice how you function at your desk. Since many parameters, each from a different source, are needed to make a decision, papers are spread out in front of you. As you need one specific item, it is brought into nearer focus.

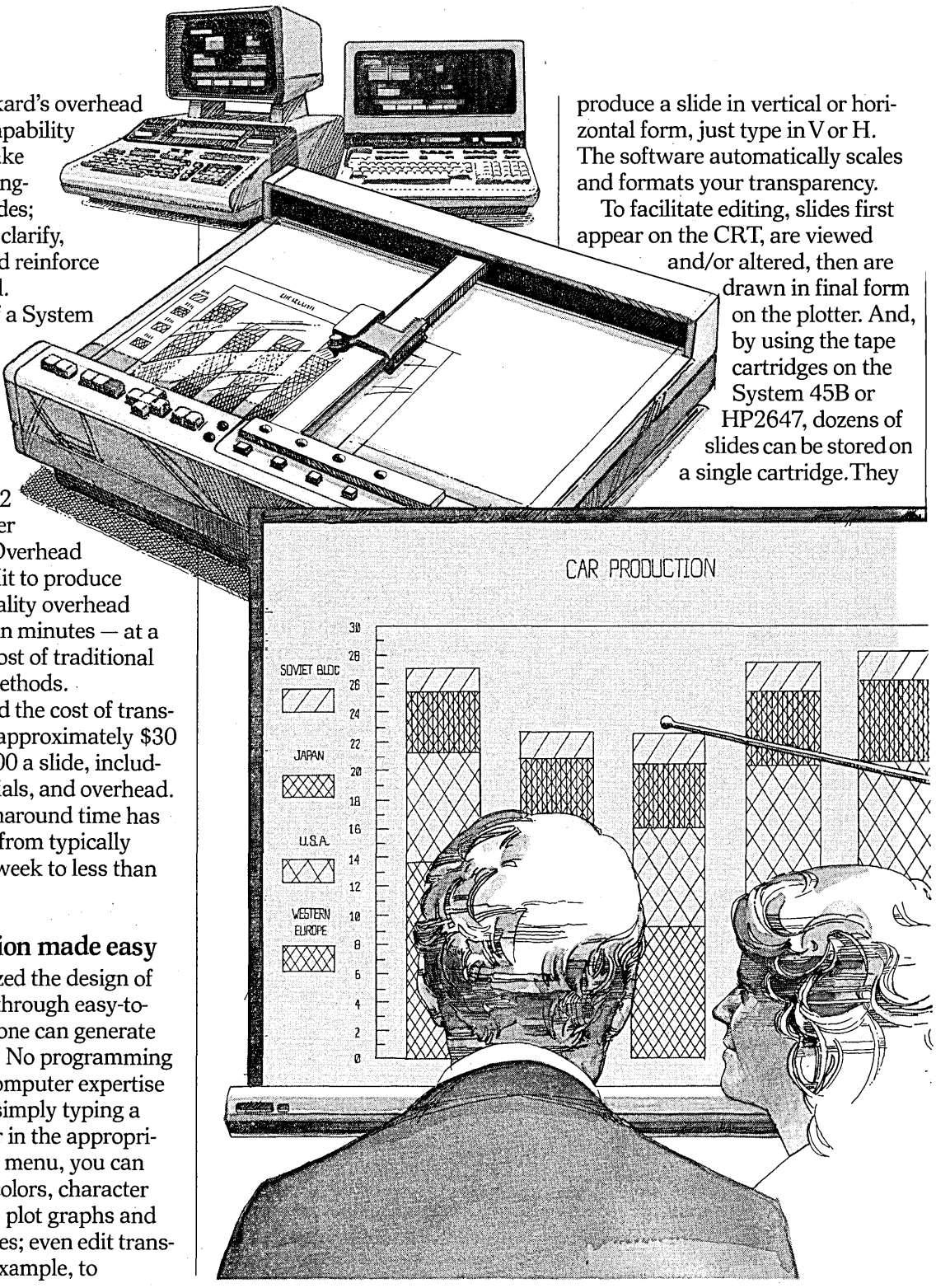
"Computers should do what the user wants. Users shouldn't have to do what the computer expects."

Jim Cockrum
General Systems Division R&D Manager

Similarly with the HP300, segments of several files can be concurrently displayed, each in a "window," or rectangular section of the screen. You can scroll horizontally or vertically through each of these files simultaneously. This window approach allows you to "shuffle" through material and bring in new information as needed. Windowing introduces programming without hard copy

Continued on page 5

The do-it-yourself Transparency Kit



Hewlett-Packard's overhead transparency capability is the tool to make effective, meaningful overhead slides; visual aids that clarify, supplement, and reinforce spoken material.

The power of a System 45B desktop computer or an HP2647 intelligent graphics terminal is combined with the HP9872 four color plotter and HP's new Overhead Transparency Kit to produce professional quality overhead transparencies in minutes — at a fraction of the cost of traditional photographic methods.

We've reduced the cost of transparencies from approximately $30 to less than $3.00 a slide, including labor, materials, and overhead. In addition, turnaround time has been shortened from typically three days or a week to less than 15 minutes.

Slide generation made easy

We've optimized the design of transparencies through easy-to-use menus; anyone can generate overhead slides. No programming knowledge or computer expertise is required. By simply typing a number or letter in the appropriate space on the menu, you can select multiple colors, character sizes, and fonts; plot graphs and charts; draw lines; even edit transparencies. For example, to produce a slide in vertical or horizontal form, just type in V or H. The software automatically scales and formats your transparency.

To facilitate editing, slides first appear on the CRT, are viewed and/or altered, then are drawn in final form on the plotter. And, by using the tape cartridges on the System 45B or HP2647, dozens of slides can be stored on a single cartridge. They

Breaking down the barriers

can be recalled, updated, or deleted as necessary.

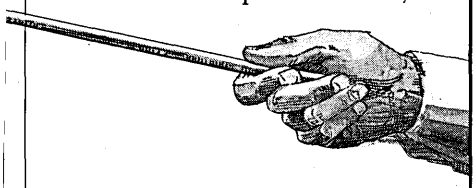
High quality transparencies

The quality of a transparency is only as good as the materials used to draw it. In graphics plotting, the pen is a most critical link. So, we design, make and carefully test our precision pens which come in seven permanent colors and two widths. The pen inks are carefully formulated for easy-starting flow, fast drying, and non-smearing.

Low cost

Depending upon the type, variety, and volume of slides generated, either the System 45B or HP2647 can be cost justified as a dedicated, stand-alone transparency generator.

For example, HP's Desktop Computer Division uses about 400 overhead transparencies a month for new product tours,



management presentations, and customer training. Producing these by traditional methods would cost over $100,000 a year. With a System 45B dedicated to this task, costs have been reduced to approximately $14,500!

For more information on HP's overhead transparency capability, check A for the System 45B desktop computer; B for the HP2647 intelligent graphics terminal.

Continued from page 3

listings. Paperless systems is another of our goals.

Numbers to pictures

Graphics is another essential addition to simplyfying the dialogue between the user and the computer system. A primary task of any computer system is to communicate stored data — typically formatted as columns and tables of numbers. Some theorize that it is difficult for people to assimilate data in this form, for the human brain doesn't have the ability to derive patterns and trends from such listings.

> "I view my job not only as R&D — Research and Development, but also as 'RD' — Responsible Development."
>
> Jim Cockrum
> General Systems Division R&D Manager

There are indications that two fundamentally different cognitive modes reside in separate parts of the brain. The left hemisphere has the ability to process symbolic information: written and spoken language, mathematics, musical notation. The right hemisphere specializes in non-verbal tasks such as visualization of spatial objects, recognition of patterns and various forms of artistic expression*.

The translation of numeric data into graphical form is a very powerful format for communicating, for it utilizes the capability of the right hemisphere to recognize and compare patterns and interrelationships. Plus, graphics takes full advantage of the inherent data capacity of the visual channel — about 10,000 times that used when reading columnar data. Graphic representation, then, provides a level of insight that is difficult to achieve through the analysis of only printed numeric data.

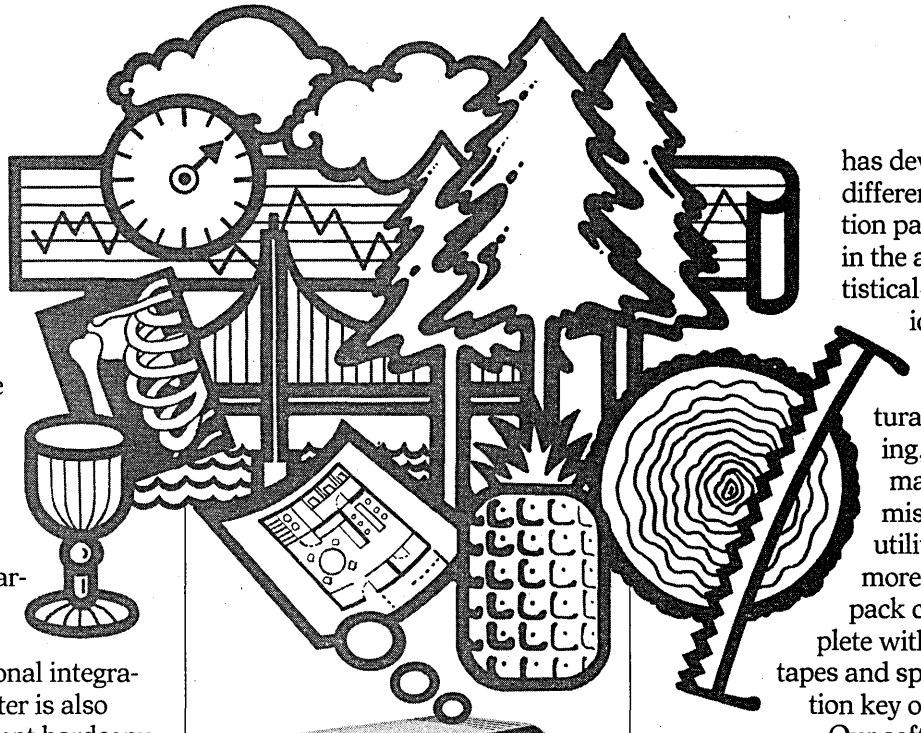
Increased productivity

The net effect of removing obstacles from the interface between users and their computers is an increase in people's productivity — important as labor costs soar and programmers become more scarce. But even more important is that people feel the computer is working with them and not against them.

> "Previously, our concern was primarily with machine efficiency. Now that systems cost less, our concern is to help people get their job done in the best possible manner."
>
> David Crockett
> Program Manager for the HP300

*Left/right relationships apply to right handed individuals with normal developmental histories. Those who are left-handed tend to be the mirror image.

The System 45B brings it all together



Hewlett-Packard's System 45B desktop computer puts problem-solving power right where you need it most—on your desk. In one compact package are the ingredients for interactive computing: a resident, LSI, ROM-based operating system; a large user memory; tape cartridge storage; CRT; keyboard; and I/O capabilities. An optional integrated thermal line printer is also available for convenient hardcopy.

Large memory, more power

Advanced semiconductor technology makes the System 45B a leader in desktop computer memory size. Through the use of 16K-bit RAMs, 449K bytes of powerful read/write memory can be at your command. Complex applications requiring large amounts of memory, such as structural analysis, can now be performed more efficiently.

The System 45B's 120K-byte operating system resides internally on 64K-bit NMOS ROMs. Additional ROM space of 672K bytes is available for system performance/capability add-ons. Currently available are Advanced Programming, Mass Storage, I/O, and Graphics ROMs.

The System 45B's versatile graphics capabilities quickly simplify the visualization of solutions through high-resolution plots, charts, graphs, curves, and histograms. Even overhead transparencies can be produced in minutes using an HP9872 four-color plotter (see p. 4).

Problem solving software

To get from problem to total solution faster, Hewlett-Packard has developed 45 different application packs for use in the areas of statistical and numerical analysis, electrical and structural engineering, business management, miscellaneous utilities, and more. Each pack comes complete with program tapes and special function key overlays.

Our software may provide solutions or convenient building blocks for specialized program development. Or users can write their own software for applications ranging from X-ray analysis to architecture; from timber harvesting to designing fine crystal stemware.

Since both systems use HP Enhanced BASIC, programs developed on the System 45A are transportable to the System 45B. System upgrade kits are also available to turn your System 45A into a System 45B—an expandable problem-solver that supports HP's full line of plug compatible input, mass storage and output peripherals.

Check C on the reply card for more information on the System 45B. Prices start at $12,500.* OEM discounts are available.

*U.S. prices only

The HP250 reaches out

More than a terminal

Hewlett-Packard's new, innovative remote console capability, REMOTE/250, now extends the powerful, problem-solving characteristics of the HP 250 small business system to multiple users.

REMOTE/250s may look like terminals, but these CRT/keyboard workstations are functionally identical to the main system console. Each utilizes IMAGE/QUERY data base management, FORMS, REPORT WRITER, HP Business BASIC, and user programmable softkey capabilities. Even application development and program editing can be performed. Programs developed on any REMOTE/250 can be run on the main system or other remote consoles.

Remote consoles allow concurrent, independent program execution by dedicating consoles to particular tasks. For improved performance, memory space competition has been eliminated by giving each console its own independent memory partition of either 32K or 64K bytes. And for expansion, up to five remote consoles, asynchronous data communications, and a choice of discs, printers, and memory sizes are supported.

Software packages

Two new HP250 software packages, MFG/250 (Manufacturing) and OM/250 (Order Management), are available to help improve the effectiveness of distribution and materials control.

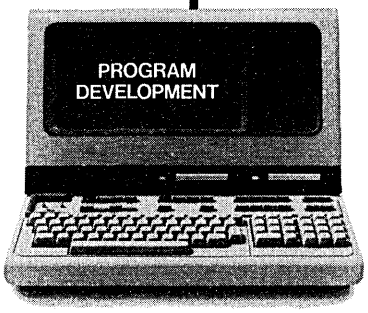
These application packages are menu-driven to lead users step-by-step through system operations. Both can be tailored. Just define and set specific parameters. Also, software can easily be configured to the existing HP250 mass storage configuration.

Maximize profits

OM/250 was designed with one goal in mind: to help maximize profits for manufacturers and distributors. OM/250 interactively helps manage current assets, increase productivity, and improve customer service by supporting LIFO, FIFO and weighted average inventory methods; addressing up to five discounts, mark-ups, and price quantity breaks; and analyzing sales by customer, salesperson, and product class.

Minimize inventory

By providing an automated means of mainstreaming inventory and bill of material records, MFG/250 helps cut inventory investment and increase production efficiency. MFG/250 performs turnover analysis, excess inventory and bill of material reporting, and simulated stock picking. "What if" product costing and a 30-level bill of material are also included.



The HP250 and its software are sold through qualified Hewlett-Packard OEMs. OEM quantity discounts are available. **For more information, check D on the reply card. OEMs check E.**

Good things come in prize-winning packages

The goal for any shipping package is to get a product safely to its destination. While packaging engineers for the new HP300 departmental computer were defining their objectives for a rugged, low-cost (under $100) shipping package, the production engineers were investigating how to assemble and transport a 260 pound computer system from one production area to another.

Because of the HP300's weight and height (54 inches tall), metal roller lines—typically used in manufacturing areas—were not only impractical, but dangerous. Movable, reusable carts or wagons were considered, but storage was space consuming and expensive.

Both design teams conferred. Their innovative solution: add removable caster wheels to the shipping pallet, making it an in-plant transport module. After assembling the HP300, the wheels are removed and the transport module becomes the shipping base.

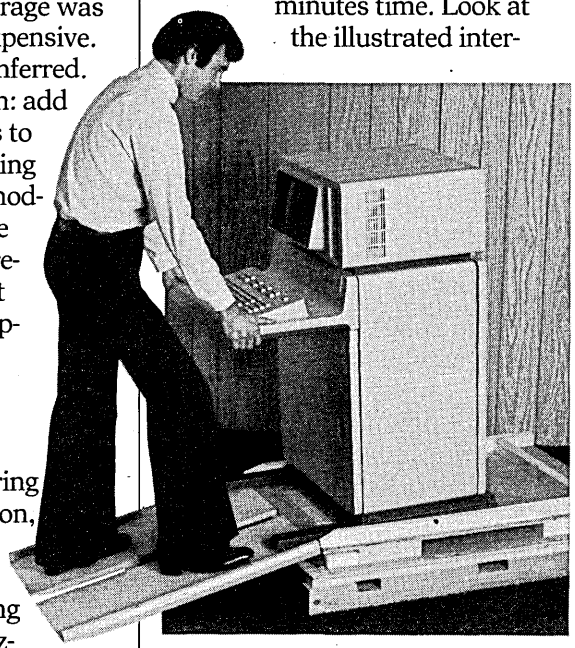
A package that can take it

As rough handling during shipment is not uncommon, the HP300 package was designed to withstand 30 Gs of shock. A floating suspension system, utilizing two types of foam, enables the packaged computer to withstand such punishment.

To ensure ruggedness, packaged HP300s were subjected to grueling tests. All applicable Federal and Hewlett-Packard packaging standards were exceeded. Tests included four 27-inch corner-wise drops, excessive vibration, and exposure to a wide range of humidity and temperature parameters. Even two sample cross-country shipments were made using the roughest forms of shipment we knew—air freight and trucks. Stress to the HP300s, gauged by accelerometers, was virtually non-existent.

Ready in five minutes

When an HP300 is received, all that is needed to unpack it is a wrench, a screwdriver, and five minutes time. Look at the illustrated international "no text" unpacking instructions, pop off the metal clips holding together the shipping pallet and the cardboard housing, and you're ready to unload.



Open the cardboard cover's front door—no need to worry about low ceilings or low-hanging fixtures—and put the convenient unloading ramp into place. Remove two hold-down clamps and simply roll the HP300 out in "wheelbarrow" fashion.

The best-of-show

Our customers are not the only ones who appreciate the convenience and simplicity of the HP300 packaging. The Society of Packaging and Handling Engineers awarded the HP300 first place in general packaging and proclaimed it best-of-show at their 33rd Annual International Packaging and Handling Design Competition. Their decision was based on originality of design, innovative use of materials, contributions to efficiency in manufacturing, internal plant handling, shipping, and customer ease-of-use.

Check F on the reply card for more information on the HP300 small business system.

Computer Advances is written to inform professionals of the latest technical contributions from Hewlett-Packard. You are invited to receive issues at your place of business or residence. Write Carol Scheifele, Editor, Computer Advances, Hewlett-Packard, 11000 Wolfe Rd., Cupertino CA 95014.

HEWLETT hp PACKARD

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Introduced last month at the NCC, the new processor contains a "phantom branch" mechanism to avoid lost cycles in its overlapped structure . . . and a good deal more.

THE MICROARCHITECTURE OF UNIVAC'S 1100/60

Several alternative LSI implementation approaches are available as potential candidates for use in a processor. These include custom, semicustom, gate array, hybrid (multichip), and multimicroprocessor. With respect to the objective of implementing a medium performance LSI version of an existing processor macroarchitecture, each has drawbacks which include various combinations of high design costs, long design time, part type proliferation, low speed, inefficient use of chip area, high cost, and pin count limitation.

A multimicroprocessor design technique has been implemented in the Sperry Univac 1100/60. A significant feature of this technique is that it allows the implementation of existing macroarchitectures without the software base. This software compatability is achieved with improvements in cost/performance, and allows a large amount of duplicated logic to be economically incorporated into the system to achieve a high degree of fault detection.

It was recognized from the beginning that simply ganging sufficient microprocessors to form a full-word arithmetic logic unit would fall short of the performance target. Many possibilities of achieving higher performance were investigated. The approach that appeared most promising was to provide multiple microinstruction execution units that would concurrently execute parts of a macroinstruction. Thus, each macroinstruction would be decomposed into a set of atomic operations. Atomic operations that can be executed concurrently are identified and are executed in parallel on separate microinstruction execution units. To increase performance still further, execution of microinstructions is overlapped and a unique branching scheme is used to avoid lost microcycles due to conditional branching in the microcode.

To reduce costs, the inputs and outputs of the microinstruction execution units are bussed. This eliminates the need for logic to steer the information in and out of these execution units. Investigations indicated that the use of common input and output buses would not significantly impact performance. In addition to saving gating logic, the input bussing allows the use of a single shifter and the

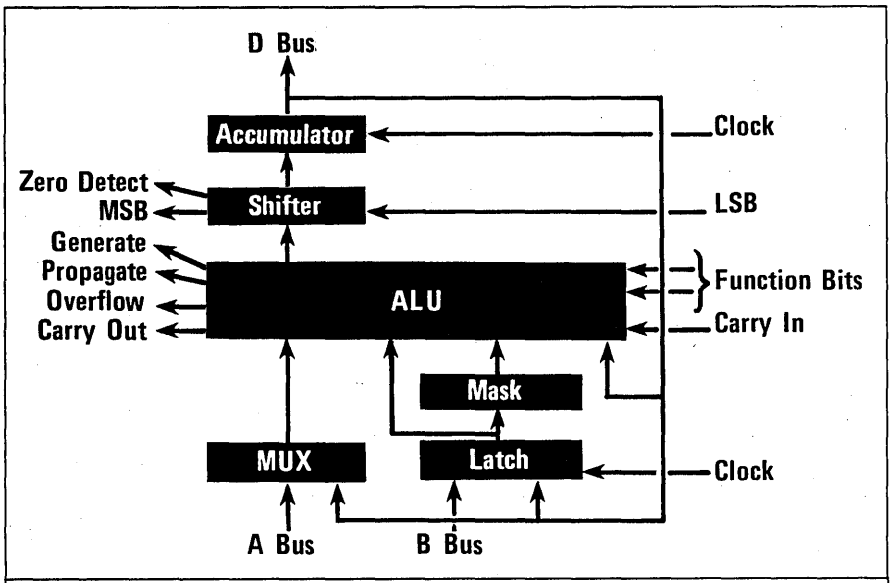

Fig. 1. 10800 Microprocessor

output bussing makes it economically viable to duplicate the microinstruction execution units and compare results at a single point.

The fastest available microprocessor slice, the Motorola 10800, was selected as the LSI building block for the 1100/60. It is a 4-bit slice using 10K ECL technology. None of the companion chips designed specifically to be used with the 10800 (e.g., control chip) were used. The surrounding logic is composed of conventional MECL 10K components with heavy emphasis on using four- and eight-input multiplexor chips and various PROM's and RAM's.

Fig. 1 is a simplified diagram of the 10800 showing the paths that are actually used in the 1100/60. The basic instruction repertoire consists of add, subtract, complement, shift one bit, AND, OR, exclusive OR, and NOT. More complex functions such as multiply and divide are achieved by microprogramming. The mask network shown in Fig. 1 allows a Boolean function to precede an arithmetic function during the same microcycle; this capability is used heavily to attain speed. The constraint of shifting only one bit per cycle is a severe one and necessitates a high-speed shifter. Shifting is a pin-limited function; thus it is a general problem with all bit-sliced microprocessors. Two notable differences between the 10800 microprocessor slice and a more conventional ALU slice are the inclusion of the latch on the B bus and the internal accumulator. The A bus does not have a latch, necessitating an external register composed of ECL flip-flops. The D bus can be disabled by a function bit so that a wired OR can be used on the output bus.

The timing specification of a chip as complex as this one (350 equivalent gates, LSI by any standard) is not simple. Some appreciation of the speed can be obtained from the fact that an add instruction, A+B to D, typically takes 40ns. Of more interest when emulating a 36-bit wide system is the fact that the propagate and generate signals (to carry a lookahead network) are available after only 24ns typical.

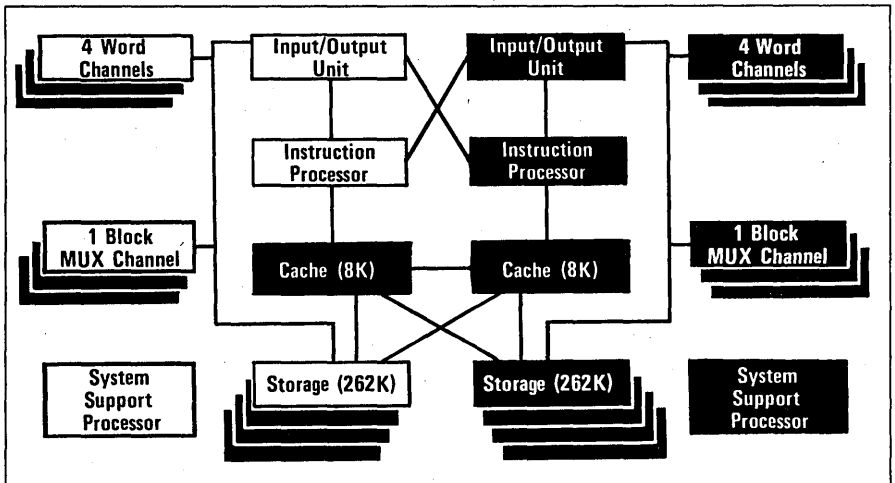

Fig. 2. White boxes show minimum configuration

1100 SERIES MACRO-ARCHITECTURE

The 1100 series architecture has been described elsewhere in some detail. The more limited purpose here is to describe enough of the 1100 Series architecture to be able to understand the multimicroprocessor implementation described below. This series, introduced with the 1107 system in 1962, is based on 36-bit instruction and operand words.

The instruction word is divided into seven fields. The *f*-field indicates the operation to be performed and specifies how the remaining fields are to be interpreted. The *j*-field either controls partial word transfers to and from storage, or it acts as an extension to the *f*-field in defining the operation to be performed.

The *a*-field selects one or more locations in the General Register Set (GRS) to provide one of the operands for each instruction. The GRS is a 128-location, high-speed random access storage in the processor. There are three primary types of registers in the GRS: the X registers are used for storage operand address indexing, the A registers are used as general purpose arithmetic registers, and the B registers are used as a special purpose working registers. An 1100 Series macroinstruction can specify operands from either one register and a main storage location, or from two registers. Most instructions operate on full or partial single-precision, 36-bit operands. However, some instructions use double precision, 72-bit operands.

The *x*-field in the instruction word specifies a GRS register to be used for storage address indexing. The X register contains two fields. One field is used as an address modifier, and the other field is used as an increment value to the modifier field. The contents of the modifier field of the X register is added to the contents of the *u*-field of the instruction to form a relative storage address. If the resultant address is less than 128, the source for both of the operands for the instruction is GRS. Otherwise it is added to a base register to form an absolute operand storage

address.

The one-bit *h*-field indicates when the X register selected by the instruction is to be automatically incremented when the instruction is executed. When $h=1$, the two fields are added and the result is used to replace the former value of the modifier field.

The *i*-field specifies indirect addressing. When this one-bit field is set, the data word read from the location specified by the address is used to form recursively another absolute operand storage address until the *i*-field of the new word is not set.

As with all 1100 Series systems delivered since 1968, the 1100/60 (see Fig. 2) is available in multiprocessor configurations. Each system support processor incorporates a maintenance processor and a console. Each instruction processor executes the 1100 Series instruction repertoire and, in addition, has new decimal and variable-length field manipulation instructions. These new instructions increase the execution speed of COBOL, and improve the execution speed of a number of other software packages. An optional 8K-word cache buffer can be supplied with each instruction processor. Each input/output unit supports up to 12-word channels and up to three block multiplexor channels, and has a direct interface main storage.

Physical packaging is very compact, with the instruction processor, I/O unit, cache buffer, and one million words of main storage fitting into a single cabinet 2.0 meters long by 0.75 meters wide. The instruction processor and cache hardware are ECL, the I/O unit is TTL, and main storage is 16K-bit MOS. Standard 1100 Series peripherals can be used with 1100/60. The speed of a unit instruction processor with a cache is about 1.3 times that of an 1108.

THE 1160's MICRO-ARCHITECTURE

With respect to the research design, the 1100/60 uses the extended instruction repertoire of the Univac 1100/80 rather than the 1108 instruction repertoire. Also, the four-base-register addressing of the 1100/80 is used rather than the two-base-register addressing of the 1108.

Seven half-word microinstruction execution units are required to minimize the address calculation time of the 1108. Because the 1100/60 has twice as many active segments, even more microinstruction units would be required. To avoid introducing a large number of microinstruction units, most of which would be used only for addressing, and to allow macroinstruction overlap, it was decided to use dedicated logic to perform address calculations. This change reduced the number of microinstruction execution units to two, and allowed overlapping at both the microinstruction and macroinstruction levels.

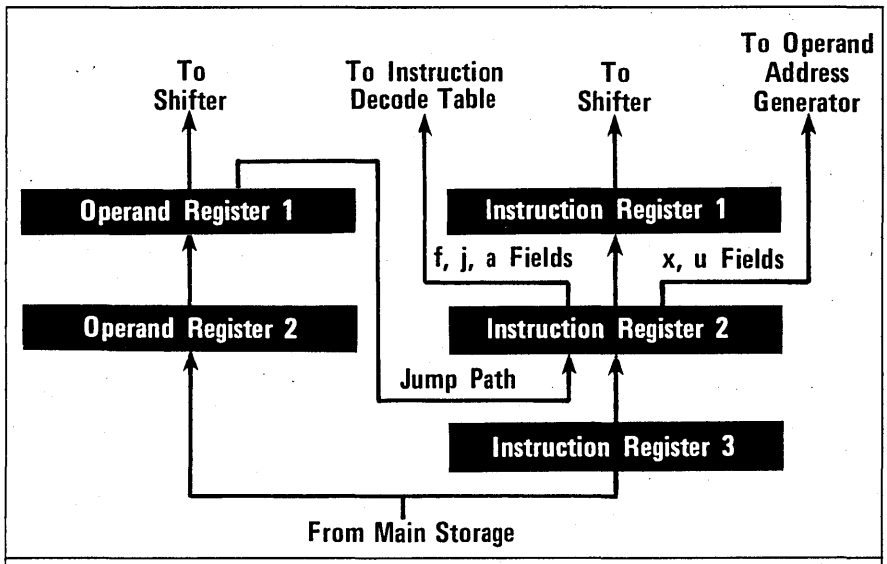

Fig. 3. Instruction and Operand Registers

The 1100/60 microarchitecture consists of a microexecution section and a storage address generation section. The microexecution section consists of two 36-bit microinstruction execution units. Each microinstruction execution unit contains a subprocessor constructed from nine 4-bit microprocessors and associated control circuitry.

The storage address generator employs four sets of base address and limits checkers which operate in parallel to allow four base additions and limits violation checks to be done simultaneously. The storage address generator operates in 116ns cycles, the same as microinstruction execution.

Operand address generation can take one or two microcycles. In the first microcycle, the *u*-field of the macroinstruction is used as a relative operand address and added to all four bases simultaneously. Within the same cycle, limits checking is performed and the proper absolute operand address is selected. If the relative address is less than 128, a designator bit is set which will be interrogated later by microde to indicate that the operand must be fetched from the GRS.

While these operations are taking place, a text of the index (x) field in the microinstruction is made. If the x-field is zero, the absolute address generated by the operation just described is used to fetch the operand. If the x-field is nonzero, the x register is read up, the contents of the modifier field are added to u to form a new relative address, and a second absolute operand address generation takes place. Two cycles are required when x is nonzero.

Instruction address generation is similar to operand address generation. The relative address of the previous instruction is kept in a holding register. A new instruction address is generated by adding one to the contents of this holding register to form a new relative instruction address, adding all four bases to the new relative address, and checking against the limits registers to select the absolute instruction address. The entire instruction address generation takes one microcycle.

Instruction and operand address generation takes place alternately in the same base adder and limits checker hardware. Requests are made until the operand and instruction registers are full as described below.

Besides the base adders and limits checkers, the storage address generator contains instructions and operand buff registers. Fig. 3 shows the operand and instruction registers. There is one storage interface port in the processor. As each request is made, the storage address generator determines whether it is a request for an instruction or for an operand. When a word comes into the processor from storage, it is routed into an operand or instruction register by control signals from the storage address generator.

Instruction Register 1 contains the macroinstruction (program instruction) currently being executed by the microcode in the processor. The next instruc-

tion to be executed is contained in Instruction Register 2. The *x*- and *u*-fields from this macroinstruction are used in the storage address generation procedure described above. While the microcode is executing the macroinstruction in Register 1, the storage address generator fetches the operand for the instruction contained in Register 2. The next macroinstruction beyond that one is contained in Register 3. Thus it is possible for three macroinstructions to be resident in the processor simultaneously.

Operand Register 1 contains the operand for the instruction currently being executed in the microcode. Operand Register 2 normally contains the operand for the next instruction. Thus operands for two instructions can be resident at one time: Operand Register 1, containing the operand for the instruction currently residing in instruction Register 1; and Operand Register 2, containing the operand for the instruction currently in Instruction Register 2.

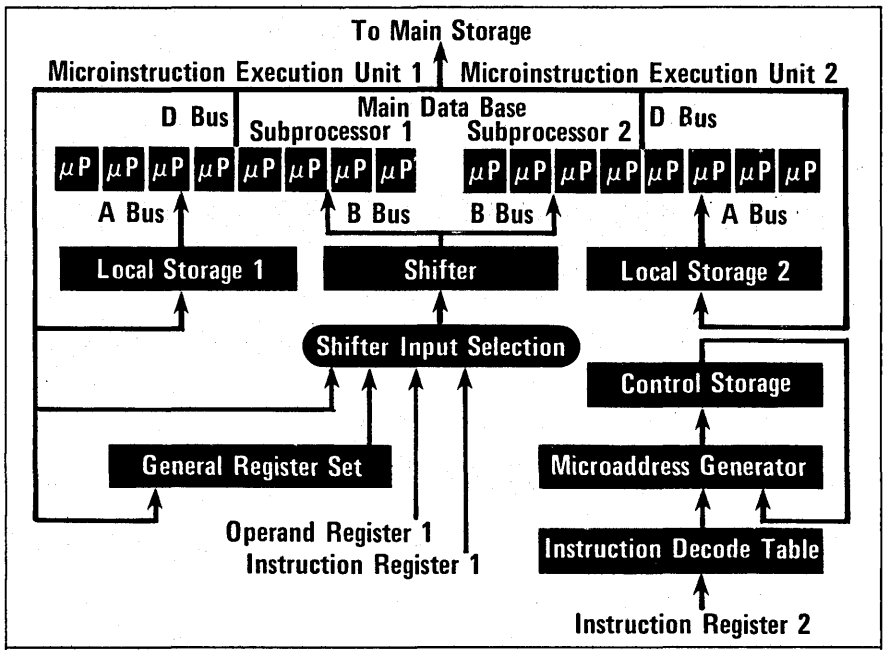

Fig. 4. Microexecution Section

MICRO-EXECUTION SECTION

When a jump or multiple operand instruction is performed, the operand registers function somewhat differently. Fig. 4 is a diagram of the microexecution section. The two subprocessors drive a single main databus which can feed main storage, the GRS, the local storage for each subprocessor, or the shifter input selector. The A bus input to each subprocessor is driven by a dedicated 256-location local storage. The B bus inputs are driven by a common 36-bit, high speed shifter.

Each 1100/60 macroinstruction is executed by a series of microinstructions. While each new macroinstruction is in Register 2 undergoing storage address generation, the *f, j,* and *a*-fields are used to generate the address of the first microinstruction of the routine which will execute the macroinstruction. This is done through the use of a 256-location, 40-bit instruction Decode Table containing one location for each macroinstruction in the 1100/60 instruction repertoire.

The output of the instruction Decode Table consists of three fields. The first field is an 11-bit *class base,* the second field is an 11-bit *instruction vector,* and the third field contains control bits. To minimize the total number of microinstructions required to execute all of the macroinstructions in the 1100/60, the execution of each macroinstruction is divided into two microroutines. The first microroutine starts at the class base address. At any point during the execution of the macroinstruction, a second microroutine may be started at the microaddress instruction vector. This allows the use of fewer total microinstructions because most macroinstructions may use a common class base microroutine and require only one or two unique microinstructions. The control bits (which can be unique to each macroinstruction) can modify the operation of the microcode in such a way that a single microroutine can be used for more than one macroinstruction, allowing further reduction in the total number of microinstructions.

When the microcode completes the execution of the current macroinstruction, the next macroinstruction to be executed is transferred from Instruction Register 2 into Instruction Register 1. Then, microroutine to execute the instruction is started at the class base address from the Instruction Decode Table.

Four 116ns microcycles are required for the completion of each microinstruction. To obtain an effective microinstruction time of 116ns, microinstructions are overlapped four deep. Fig. 5 shows the microinstruction overlap of our four typical microinstructions.

During cycle 1, the address for microinstruction is generated using fields contained in microinstruction n-1 combined with variables generated by the results of execution of microinstruction n-2. In cycle 2, microinstruction n is fetched from control store and used to control the setup of the data which will be presented to the subprocessors for use during the execution portion of the microinstruction.

During cycle 3, the execution for microinstruction n takes place. An arithmetic or logic function is performed which combines the data loaded into the A and B bus latches for each subprocessor at the end of cycle 2 with the data placed in the accumulators as a result of the execution during cycle 2 for microinstruction n-1. The results of executions are loaded into the accumulator registers toward the end of cycle 3. At the beginning of cycle 4, the contents of the accumulator register in one of the subprocessors is chosen to drive the main databus from where it may be loaded into the GRS or local store, sent to the main storage unit as data, or written into one of several other internal registers. Also during cycle 4, variables which result from the execution of microinstruction may be used to select the address for microinstruction n+2 and the functions may be executed for microinstruction n+1.

Decisions concerning microaddress generation, microfunction selection, and results storage are made under microcode control using the *logic function generator* which is a complex selector circuit controlled by the fields in the microinstructions. The fields specify the variables to be applied to the logic function generator and one of the 16 logic functions to be performed. The variables can either be static variables representing processor state information, or dynamic variables, such as subprocessor zero detect or sign bit.

PHANTOM BRANCH The logic function generator allows each subprocessor to select between two function codes during each cycle without altering the microinstruction sequence. Since this mechanism gives an apparent branch capability on each cycle without altering the microinstruction sequence, this conditional control capability is called "phantom branch." Besides creating an independent control capability, the phantom branch minimizes wasted cycles.

There are several ways in which the phantom branch can be employed to decrease the time required to execute macroinstruction. One improvement is realized by making independent real branch and phantom branch decisions during execution of any microinstruction. This capability makes it possible to shorten the path lengths required to execute a macroinstruction.

Another speed improvement due to phantom branching is that the execution functions are chosen at a later point during the execution of the microinstruction than the address is generated. This may be illustrated by observing Fig. 5.

Operation	Cycle 1	Cycle 2	Cycle 3	Cycle 4
Generate microaddress	n	n + 1	n + 2	
Set up data	n − 1	n	n + 1	n + 2
Execute microinstruction		n − 1	n	n + 1
Store results			n − 1	n

Fig. 5. Microinstruction Overlap

The address for microinstruction n must be chosen as a result of the execution for microinstruction n-2 at the end of cycle 1, but the execution functions for microinstruction n are chosen as a result of the execution microinstruction n-1 at the end of cycle 2. If a new function must be selected based on results from microinstruction n-1, it can be done a cycle earlier using the phantom branch than would be possible if the function were selected using a real branch. This allows shorter microinstruction sequences and makes possible extremely tight microinstruction loops for the performance of repetitive operations, such as multiply and divide.

Since each microinstruction contains two possible microfunctions for each subprocessor, one microinstruction is often able to do the work of two. In any given cycle, only one of the execution functions may be selected, but in another use of the same microinstruction, the other execution function may be used. This allows one microinstruction to often do the work of two and allows a reduction in the total number of microinstructions.

As an example of the ways in

which this microarchitecture may be used, the execution of an ADD macroinstruction will be described. When an ADD instruction is performed, the macroinstruction is brought into Instruction Register 3 by the storage address generator. When the macroinstruction is loaded into Instruction Register 2, an operand address generation is performed and an operand is fetched from storage, if necessary. When the previous macroinstruction completes, execution of the ADD will begin if there are no outstanding interrupt or clock update service requests. Execution begins at the class base address from the Instruction Decode Table, and at the same time the macroinstruction is transferred from Instruction Register 2 into Instruction Register 1. The next macroinstruction can then be loaded into Instruction Register 2 so that its operand address generation and fetching can be done.

The ADD macroinstruction uses the load instruction class base. The first microinstruction performs a number of functions. If the operand from storage is available, it is brought in through the shifter from Operand Register 1 and shifted if necessary as defined by the *j*-field. The operand is then masked with constants from the local storage (selected under *j*-field control) for each subprocessor and the results are placed in the accumulators during the execution portion of the first microinstruction. At the end of the setup cycle for this microinstruction, the second microinstruction is selected. A check is made to see if the operand should come from a GRS location. If so, control is transferred to a GRS read microinstruction which reads the operand from GRS rather than from storage. If the operand does not come from GRS, a check is made to see if the storage operand is resident in the processor. If it is not, control is transferred to a microinstruction which waits for the storage operand. When the operand is available in the processor, control is transferred to the ADD *instruction vector* routine. In the first microinstruction of this new routine an operand is read from GRS and added to the first operand which was previously placed in the accumulators. Then a second microinstruction stores the result of the add into the A register in the GRS and the first microinstruction or interrupt routine is selected.

An ADD macroinstruction will be performed by as few as three microinstructions in 348ns if the storage operand is available in Operand Register 1 when the execution begins. The first microinstruction brings the storage operand through the shifter and places it into the accumulators in the subprocessors. The second microinstruction adds the GDS operand to the storage operand and places the result in the accumulators. The third microinstruction stores the results back into GRS. If the first operand comes from GRS, the execution time will be increased by one microinstruction.

The multiprocessor approach is a cost-effective way to incorporate off-the-shelf LSI into a medium scale computer system while retaining software compatability. The phantom branch mechanism has been introduced as a way to substantially increase the effectiveness of a microinstruction by providing decision points late in the microcycle to select functions performed in the next microinstruction. ✲

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Contributing to this article were the following employees of Sperry Univac: Lewis A. Boone, senior logician with design responsibility for the 1100/60 cpu; Dr. George A. Champine, director, advanced systems, for large scale commercial computer systems; and Dr. Barry A. Borgerson, director, research and technology, Sperry Univac research.

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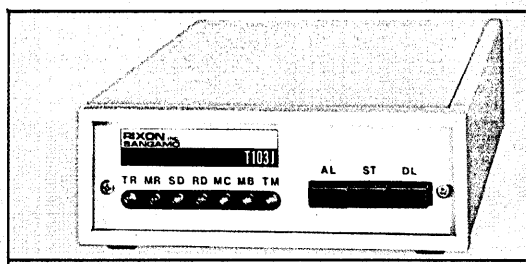

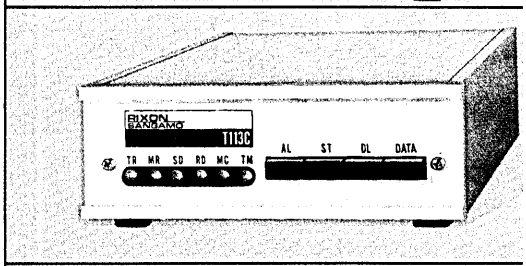

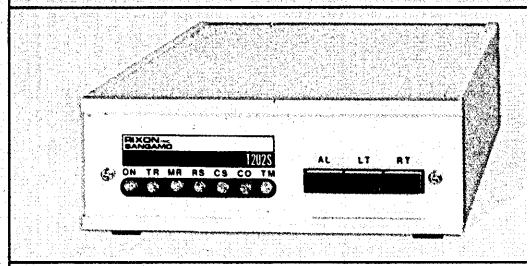

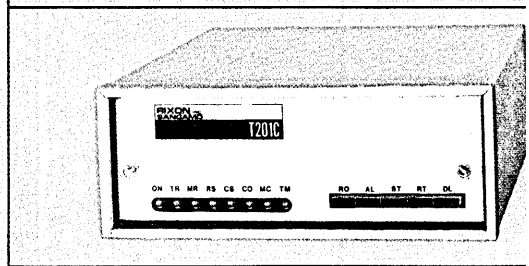

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CIRCLE 63 ON READER CARD

HARDWARE

OFF-LINE

Coconut, a powerful handheld computing engine, should roll out of Hewlett-Packard's Corvalis plant by the end of summer. This may well be an encore to the act originally started by the HP-65 programmable handheld. Coconut uses a liquid crystal display and can accept magnetic program strips prepared for HP-67s and 97s. Pricing should look like $300 to start, with a full-blown unit weighing in at around $700. Also expected before year-end: Capricorn, the much-rumored personal computer entry from HP. Personal/professional seems to be the favored description at HP.

Intel, through its subsidiary Intel Magnetics, entered the bubble memory market in a big way with a 1-megabit chip. The chip is known as the 7110; LSI support chips were announced with the 7110. The 7110 chip organizes data into 2,048 pages of 512 bits each; each page is processed as 64 8-bit bytes. Prototyping kits will be available for roughly $2,000 this fall.

Storage Technology shipped the first of its 2305-plug compatible STC 4305 solid state disks to Neodata Services, Inc., a Boulder, Colo., subsidiary of A. C. Nielsen Co. Neodata will use the charge-coupled device mass storage unit with its IBM 3033. Neodata's 21 April shipment is considered an engineering shipment; manufacturing shipments are to begin this summer.

IBM's General Systems Div. pared the purchase price for its System/32 by 30%, its 5100 by 11% to 17%, and its 5110 by 12% to 17%. Related I/O equipment also was reduced in price.

BUBBLE MEMORY

Bubble memory has yet to beat the pricing offered for floppy disks, but in harsh environments the price differential may be of little importance considering the expense and inconvenience of servicing a mechanical storage device. This vendor's add-in bubble memory storage system for DEC's LSI-11 microcomputers is intended for applications such as process control where relatively small amounts of reliable, nonvolatile mass storage is needed. The system consists of a microprocessor-based controller board (MBC-11, $650) and up to 16 bubble memory modules (MBB-11, $950), each containing 46KB of storage. The controller forms an interface to the LSI-11's bus, and it manages the bubble storage modules as if they were sections of a floppy disk. With six bubble modules, the system has the capacity of a single-density, full-sized diskette. Treating the bubble memory as if it was a diskette provides compatibility with existing operating system software. BUBBL-TEC, Div. of PC/M, Inc., San Ramon, Calif.

FOR DATA CIRCLE 421 ON READER CARD

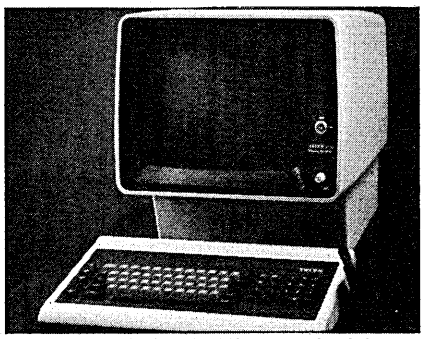
MAINFRAMES

Built with multiple microprocessors, this vendor's 1100/60 line of mainframes comprises six models; four "unit processors," and two multiprocessors. The entry-level unit processor model C1 uses the basic 1100-series instruction set, while the entry-level model C2 extends the instruction set with functions for high-level business oriented languages and system software. Models H1 and H2, also unit processors, include add cache and multiprocessor capability with either the basic or extended instruction set. H1 and H2 can be configured into multiprocessors, in a fully redundant, tightly coupled manner. The processors can be field upgraded to any larger configuration, including multiprocessors. Unit processor complexes are housed in a single cabinet containing processor, I/O unit, and storage; multiprocessors are built of two intercabled unit processor complexes. Unit processors can be configured with 512K of 36-bit words up to 1M words; multiprocessors have from 1M words to 2M words. Memory increments are available in 256K word expansions. The I/O unit includes a block multiplexor channel, and four 36-bit wide word channels. The I/O unit can be expanded to three block multiplexor and eight word channels, or two block multiplexor and 12 word channels per unit processor. An optional integrated hardware performance monitor lets the user monitor system performance and tune it for maximum throughput. On a five-year lease, an entry level model C1 goes for $6,015 per month; the same 512K word C1 sells for $318,975. Additional 256K word blocks of memory lease for $575 per month and sell for $30,475. Maintenance charges start at $1,150 per month. Software, priced separately, is expected to carry typical charges ranging from $2,000 per month up to $5,000 per month (on a multiprocessor). Customer benchmarking begins in October, with deliveries slated for this coming January. SPERRY UNIVAC, Blue Bell, Penn.

FOR DATA CIRCLE 422 ON READER CARD

3270 ALTERNATIVE

Said to offer more capabilities in a package roughly 20% smaller than a 3270, the TC277-D can be configured with an optional response-time indicator and any of seven keyboards (six common typewriter and data entry keyboards, and a special keyboard with separate 10-key numeric cluster and 12 special function keys). The response-time indicator measures four delays: response to last transmission, longest response, fastest response, and average response (for an operator-selected set of



past transmissions). The terminal has a tiltable 24-line by 80-character display, and a 25th line for status messages. The TC277-D display is compatible with IBM's 3271 and 3272 controllers (it works as a Level B device on IBM 3274 controllers) and with this vendor's TC371, TC271, and TC272 controllers. Pricing starts at $2,200 in the unit's basic configuration; leasing plans also are offered. TELEX TERMINAL COMMUNICATIONS, Div. of Telex Computer Products, Inc., Raleigh, N.C.

FOR DATA CIRCLE 423 ON READER CARD

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Spectron introduces the D-901 DATASCOPE

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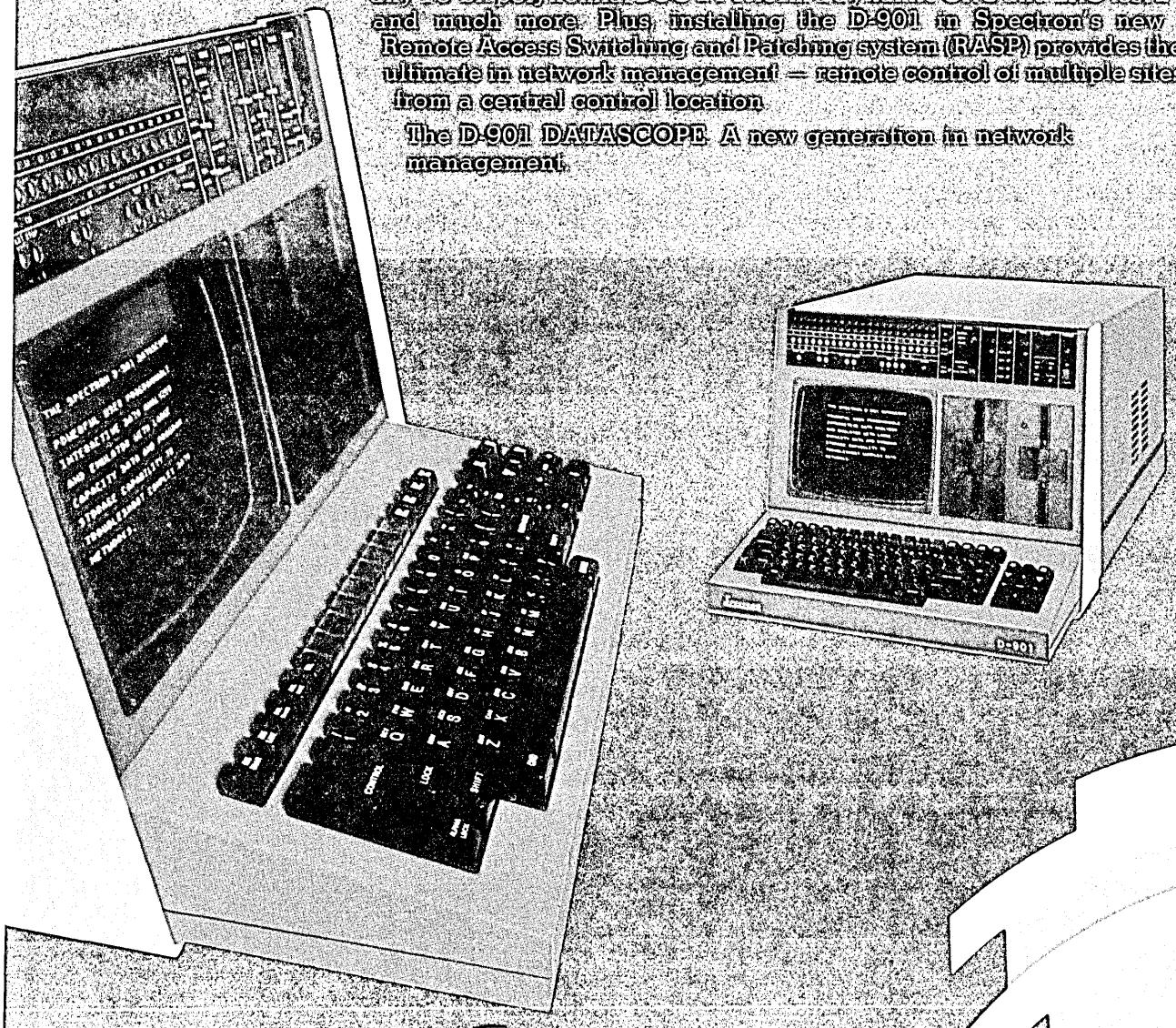

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CIRCLE 267 ON READER CARD

HARDWARE

COMPUTERS

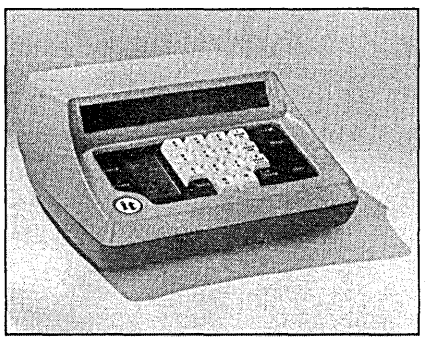
Two top-end packaged computer systems, based on a new top-of-the-line minicomputer, graced this vendor's NCC booth in New York last month. The two packaged systems, members of the DS990 commercial computer systems family, are the DS990 models 20 and 30; both are based on the 990/12 minicomputer, an upward compatible processor in the 990 minicomputer line. DS990 models 20 and 30 are both multiterminal systems running under the vendor's DX10 operating system; other supporting software includes BASIC, COBOL, FORTRAN, Pascal, and RPG II language processors, TIFORM crt management, and a data base management system. Both systems can accommodate about 20 terminals, depending on the application's response time and memory requirements. The two differ in mass storage: the model 20 can handle up to four DS50 50MB disk drives, while the model 30 can have up to four DS200 200MB drives. In minimum configurations of 256KB processor, two model 911 crt terminals, one disk drive (50MB for the model 20 and 200MB for the 30), and mag tape for backup, a model 20 sells for $64,500 and a model 30 for $77,400.

Central to both models 20 and 30, the 990/12 minicomputer is said to be three times as fast as the previous top-of-the-line 990/10 in pure computation, and about 1.5 to 2 times as fast when processing a typical application. The processor can support up to 2MB of main memory and, optionally, 2KB of cache (cache is standard on the configured models 20 and 30). The 990/12 processor executes all of the 990/10's instructions, in addition to 71 new instructions. Quantity 25 prices for a 256KB 990/10 are $19,598 (without cache) and $22,948 (with cache). Deliveries for the mini and packaged systems begin in the fourth quarter; for discounting purposes, 990 series purchases are treated in aggregate. TEXAS INSTRUMENTS INC., Austin, Texas.

FOR DATA CIRCLE 424 ON READER CARD

TERMINAL

Intended for use by personnel having little or no previous computer experience, the model 736 terminal can be used for order entry, inventory control, point of sale credit verification, inventory control, and other applications. The ASCII terminal has eight prompting messages that can be lighted to guide the operator; a hand-held OCR-A reading wand can be added as an option. The 736 can display up to 16 digits, as required by the application. The unit communicates at speeds of up to 1200bps via an RS232 interface. INTERFACE TECHNOLOGY, INC., St. Louis, Missouri.



FOR DATA CIRCLE 425 ON READER CARD

HARDWARE SPOTLIGHT

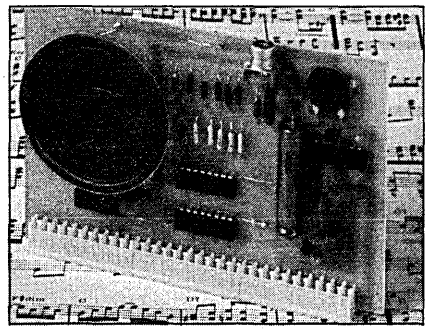
SOLID STATE DISK

With the current uncertainty in the IBM plug compatible market, this vendor is moving toward more proprietary products. First off is the Fast Access Storage Technology (FAST) 3805, a RAM-based semiconductor mass memory that emulates IBM's 2305/2835 and 3350/3830 disk subsystems. The units can be had in 12MB to 72MB configurations, although in 2305 emulation mode only 11.2MB of each 12MB increment is used. An integral microcomputer, based on the vendor's 16-bit 8086, controls the entire shooting match. It takes care of controlling the mass store, talking with the host, and maintaining a maintenance log. Single- and double-bit errors are detected and corrected, and memory segments containing more than a predetermined number of errors are moved to spare areas of memory (similar to using a spare track to replace a bad track on a disk pack). The microcomputer continuously cycles through memory checking for bad areas, using its sparing capability when questionable memory segments are identified. The microcomputer also formats the system when it's powered up, creating labels and VTOC's (including a dummy file to account for the space missing in 3350-emulation). On the performance side, the FAST-3805 has an average latency of 0.4msec, and a channel-limited transfer rate ranging from 1.5MBps to 4.0MBps (with optional two-byte wide feature). Other options include up to three additional controllers (capable of simultaneous operation), two channel switches, remote configuration (via an RS232 interface), and an extended cable length of 200 feet (100 feet is the standard distance allowed between a FAST-3805 and the channel). Configured for 2305 emulation, a 12MB, single controller FAST-3805 goes for $4,305 per month on a 24-month lease, or $130,500 for outright purchase. A 48MB system, with two two-byte wide controllers and two channel switches, leases for $16,790 per month, and sells for $507,920. Deliveries are slated for the fourth quarter of this year. INTEL COMMERCIAL SYSTEMS, Div. of Intel Corp., Phoenix, Ariz.

FOR DATA CIRCLE 420 ON READER CARD

MUSIC BOARD

Occupying one slot on the SS-50 bus of a Southwest Technical Products 6800-based microcomputer, the model 68 mu-

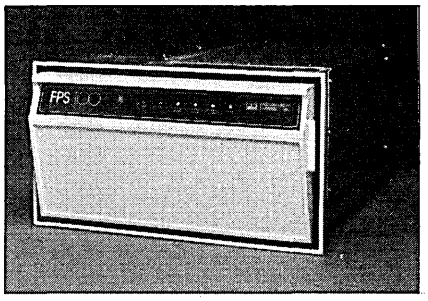


sic board allows computer generation of sounds, such as melodies and rhythms, or game sound effects. The $59.95 music board includes address decoding, D/A conversion, and audio amplification circuitry, as well as its own speaker. The board also has a volume control and an output jack for feeding the audio signal to another speaker or an audio system. Software support includes a BASIC program for writing musical scores, and an assembly language routine for program execution. Fourteen tunes, ranging from "The Entertainer" (the Scott Joplin rag used as the theme for the movie "The Sting") to Chopin's Minute Waltz, are available on cassette for $15.95 or diskette for $19.95. PERCOM DATA CO., INC., Garland, Texas.

FOR DATA CIRCLE 426 ON READER CARD

ARRAY PROCESSOR

Designed for the oem market, the FPS-100 Arithmetic Processor is a "mini-sized" array processor for use with Data General Novas and Digital Equipment PDP-11 minicomputers. Capable of performing up to eight million floating point operations per second (with 38-bit data), the FPS-100 is said to address such real-time applications as signal processing, image processing, and process control. With parallel memories, and separate pipelined floating point adder and multiplier logic, the FPS-100 can produce one product and one sum in each 250nsec cycle. The FPS-100 can support up to 64K words of 38-bit data memory, an additional 4.5K words of 38-bit ROM or 8K words of RAM for storing constants, and a control memory of 4K 64-bit words of program memory. The FPS-100, upward compatible with the vendor's existing AP-120B array processors, runs the Super 100 real-time operat-



ing system; a FORTRAN compiler, assembler, and vector function chainer are available for applications development. The vendor also has program libraries covering Fast Fourier Transforms, vector multiplication, signal processing, and other functions. A basic FPS-100, sans software, sells for $16,728 in oem quantities of 100. This includes 1Kword of program memory, 2.5Kword of ROM table (constant) memory, and 8Kword of data memory. Deliveries are slated for the fourth calendar quarter of this year. FLOATING POINT SYSTEMS, INC., Portland, Ore.

FOR DATA CIRCLE 427 ON READER CARD

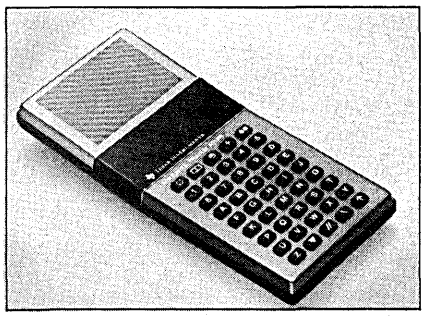
TUBELESS TERMINAL

The KTM-2/80 keyboard terminal module provides the basis for a crt terminal. Adding video monitor, power supply, and cabinetry completes the terminal. The KTM-2/80 includes a full upper- and lowercase ASCII keyboard, the logic required for driving a 24-line by 80-character video display, and RS232 interface. The board also provides 128 graphics characters, reverse video, absolute and relative cursor positioning, erase partial line, erase partial screen, and erase full screen functions. Data rates range from 110bps to 9600bps, with even, odd, or no parity. The KTM-2/80 sells for $424. SYNERTEK SYSTEMS CORP., Sunnyvale, Calif.

FOR DATA CIRCLE 428 ON READER CARD

TALKING TRANSLATOR

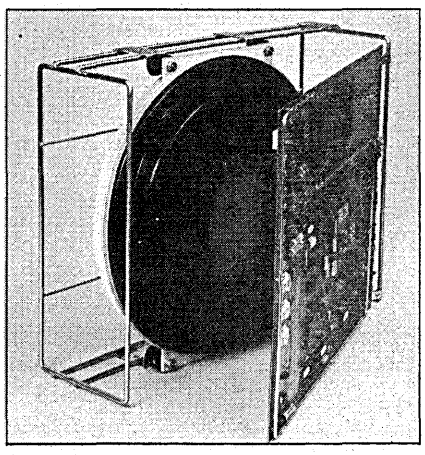
Pocket calculator-size electronic language translators haven't been with us for all that long, and now one of the real movers and shakers of consumer (to name one of its specialties) electronics has carried things a step further by adding speech synthesis (a´la Speak & Spell). The talking Language Translator uses solid-state modules for English, French, German, and Spanish (Japanese and Chinese also are coming). Each module will contain about 1,000 words, half of which will be spoken and displayed, the remainder will be displayed only. The translator also speaks everyday phrases, and can combine phrases, such as "Do you have," with words. The Language Translator's vocabulary includes 65 basic phrases (statements, questions, and partial phrases), basic adjectives, foods, travel terms, time, numbers, and dates. As for accents, Spanish sounds as the language is spoken in the Americas and Mexico, and French uses a Parisian accent. The Language Translator will be available in September for a suggested retail price of $250. Language modules will retail for $50, with English and Spanish initially available in September, French and German in the fourth quarter, and Japanese and Chinese in the first quarter of next year. TEXAS INSTRUMENTS INC., Lubbock, Texas.



FOR DATA CIRCLE 429 ON READER CARD

OEM DISK

Intended for oem's needing medium capacity disks for small business systems, word processors, communications systems and other products, the Diskos 3350 is a 33MB Winchester disk drive. Larger



66MB and 154MB versions are said to be on the way. An imbedded microprocessor controls head-seek operations, and internal control functions; it also performs diagnostics and self-test functions, and controls power sequencing within the drive. The Diskos 3350 sells for $3,000 for an oem evaluation unit; a power supply can be included in the package for an additional $400. PRIAM CORP., Cupertino, Calif.

FOR DATA CIRCLE 430 ON READER CARD

TERMINALS

Two receive-only and a keyboard send-receive terminal have joined this vendor's Omni 800 Electronic Data Terminal family. The model 820 RO printer offers 150cps printing (and throughput of about 120cps), and the models 825 RO and 825 KSR can print at up to 75cps (throughput peaks at 60cps). All three of the bidirectional dot-matrix impact printers have RS232 interfaces as standard equipment, with 20mA current loop interfaces optional. The 820 has a 1,280 character buffer, while the 820s make do with 256 character buffers. All three use the full ASCII character set, and can print lines as wide as 132 characters. Field upgrades can transform the slower 825s into 820s. The 820, which accepts data at rates ranging from 110bps for 9600bps, sells for $1,995. The 825 terminals accept data at rates of up to 600bps; the 825 RO sells for $1,565, and the 825 KSR is $1,695. Deliveries begin in October. TEXAS INSTRUMENTS INC., Houston, Texas.

FOR DATA CIRCLE 435 ON READER CARD

MODEMS

Two synchronous modems, designed for incorporation into this vendor's 1000 and 3000 computer systems, are being manufactured by the vendor with cooperation from Paradyne Corp. The model 37210T is a 4800bps modem for use over dial up or leased lines; the model 37220T is a 9600bps modem for use on leased lines. The 4800bps modem can operate in half-duplex, full-duplex, or multi-drop modes. The 9600bps modem is intended for full-duplex point-to-point communications; it has a 4800bps fallback mode if line quality deteriorates severely. The 4800bps 37210T sells for $4,350; adding a DAA and auto answer adds $510 to the price and a remote command (auto loopback) option is an additional $400. The 9600bps 37220T sells for $6,150. End-user quantity discounts range to 23%. HEWLETT-PACKARD CO., Palo Alto, Calif.

FOR DATA CIRCLE 431 ON READER CARD

CALCULATORS

Ever lose your place in the midst of a long calculation on your trusty hand-held? This vendor's models EL-5100 and EL-5101 may be for you. Each allows a problem to be input as an algebraic formula; a scrolling LCD dot-matrix display can be used for editing and verifying your keystrokes. As many as 80 entries can be made, and formulas can be recalled and edited in either direction. The EL-5100 has a 24-character display, 61 keystroke functions, and 10 data storage registers; it can handle up to 15 levels of parentheses and eight levels of pending operations. It has a suggested list price of $99.95. The $79.95 EL-5101 has a 16-character display, storage for up to 48 steps, and six data registers. Both models retain data and programs when turned off. SHARP ELECTRONICS CORP., Paramus, N.J. ✲

FOR DATA CIRCLE 433 ON READER CARD

SOFTWARE AND SERVICES

UPDATES

As hardware costs drop, software costs are growing at ten times the rate, according to David Brandin, executive director of Computer Science and Technology Div. at SRI International. "No technological breakthroughs are on the horizon that will save companies from being squeezed by increasing programmer costs," said Brandin, addressing a group of dp execs at an SRI-sponsored briefing in New York. Brandin held out hope that with the right edp organization and tools of software engineering, programming productivity could double.

Tymnet has certified Tandem Computers' NonStop systems as host computers for connection to the Tymnet network using X.25 protocol. Tandem's AXCESS software package allowed connection to Tymnet's X.25 gateway software.

American Express is moving toward development of an advanced reservation and accounting system for its Travel Service network of nearly 1,000 offices worldwide. The company has signed an agreement with American Airlines to jointly develop a multiple access reservation system based on the airline's Sabre system. The company also signed a letter of understanding with United Airlines for development of a similar system based on United's Apollo system. At completion, the system will provide American Express' network with point of sale multiaccess reservation and accounting capabilities.

Every computer site on Datamation magazine's mailing list has just been sent a questionnaire asking for user opinions of software packages. The mailing is part of the joint project we conduct each year with Datapro Research Corp. Since more responses mean more helpful results for everyone, please locate and return your firm's copy as soon as possible.

DESIGN TOOL

An Automated Design Facility (ADF) has been added to this vendor's Automated Systems Design Facility, Pride-ASDM. The ADF runs along with Pride-ASDM on mainframes and large minis from a number of vendors, including IBM, Hewlett-Packard, Burroughs, Honeywell, and DEC. Intended to automate systems design, ADF requires the systems analyst to define user requirements and output specifications; ADF takes this data and analyzes it in reference to the Pride-ASDM data dictionary. ADF performs data flow analysis, evaluates data structures and all systems within the total environment; the output is a suggested system design. If ADF finds it has incomplete information, it notifies that analyst so he can make needed corrections. ADF also, upon a request from the analyst, prepares documentation, including system design manuals, administrative manuals, computer run books, and program specifications. Flow charts also are printed. ADF requires use of the Pride Systems Design Methodology and the Pride-Logick generalized systems and data dictionary. ADF consists of two subsystems: one for output analysis and systems design ($7,000), the other for documentation ($4,000). Both can be had for $9,000; Pride-ASDM goes for $32,500. M. BRYCE & ASSOCIATES, INC., Cincinnati, Ohio.

FOR DATA CIRCLE 407 ON READER CARD

MICROCOMPUTER SYSTEM SOFTWARE

An operating system and two compilers have been developed to support this vendor's microNova. The Micron operating system (compatible with the Advanced Operating System, AOS, used on the vendor's larger Eclipse-series) supports a Pascal compiler (MP/Pascal) and a FORTRAN IV compiler (MP/FORTRAN). For program development, Micron runs on the original microNova, and the recently announced MP/100 and MP/200 microcomputer systems with disk or diskette subsystems; Micron provides a run-time environment on any of the vendor's processors based on microNova chip technology, be it chip, board, or complete system. Micron can exploit the availability of PROM; indeed, Micron itself can be burned into PROM for a run-time system without magnetic peripherals. Micron carries a $1,500 license fee. MP/Pascal uses Wirth's Pascal as a basis, and adds extensions for the production programming environment. MP/Pascal can generate code destined to be loaded into PROM. Compatibility between Micron and AOS allows programs developed on larger Eclipse computers to execute on a microNova. MP/Pascal has a license fee of $1,000. MP/FORTRAN IV licenses for $500. DATA GENERAL CORP., Westboro, Mass.

FOR DATA CIRCLE 408 ON READER CARD

TRS-80 PASCAL

UCSD Pascal, subject of an article elsewhere in this issue, has been implemented on the popular Radio Shack TRS-80 microcomputer. The implementation is said to include all of UCSD's features. The developmental package includes a Pascal compiler, a Z80 assembler, and screen editor; it requires a 48KB TRS-80 with up to four minidiskette drives. The package is priced at $150. FMG CORP., Fort Worth, Texas.

FOR DATA CIRCLE 410 ON READER CARD

BILL OF MATERIALS

A bill of materials processor has joined this vendor's product line of business applications software written for Data General's packaged small business systems (CS30 and up). Written in interactive COBOL, the BOMP is an n-level processor capable of imploding and exploding bills of material. The package produces a number of standard reports, including bills of material, gross materials demand, inventory valuation reports, and a where used report. The BOMP carries a perpetual license fee of $7,500. INFORMATION PROCESSING DIRECTIONS, INC., Northbrook, Ill.

FOR DATA CIRCLE 411 ON READER CARD

PERSONAL COMPUTER PACKAGES

A new operating system release, and a variety of user-contributed programs have been released for the Apple II personal computer. The Disk Utility Pack contains DOS 3.2, the latest operating system (UPDATE) which converts an existing DOS to version 3.2 without disturbing other programs on the diskette, Applesoft CHAIN which lets one BASIC program initiate another and allows passing data between the programs, and a RENUMBER/MERGE routine which combines several extended BASIC routines into a single program. The Disk Utility Pack sells for $25.

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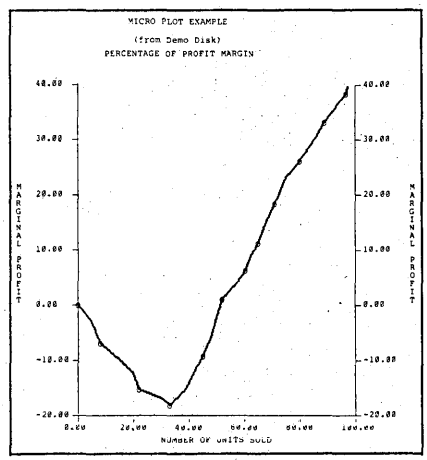
SOFTWARE AND SERVICES

SOFTWARE SPOTLIGHT

DAISYWHEEL PLOTTING

Micro Plot, a set of FORTRAN routines, allows users of 8080- and Z80-based microcomputers to exploit the graphics capabilities present in daisywheel printers. Callable from applications written in FORTRAN, COBOL, or assembler, Micro Plot uses the daisywheel printer as an incremental plotter. The package draws lines and curves with a series of closely spaced periods; horizontal and vertical lines are drawn rapidly with the horizontal underscore or vertical bar characters, respectively. Titles and captions can be placed anywhere on the plot. The Micro Plot library includes routines for pseudo pen movements, scaling, drawing axis lines with titles and scale, and printing a string of characters at any given plotting location and at any angle. The package was compiled under Cromemco's FORTRAN IV compiler, and is supplied as relocatable files compatible with Microsoft FORTRAN IV, and Cromemco and Microsoft COBOL. In a CP/M or CDOS environment, at least 32KB of memory is needed; large plot programs may require more memory. The vendor says the system can be adapted to any system with a FORTRAN compiler. The package, on full-size or minidiskette, sells for $395. DATA CAPITAL AND WHOLESALE, San Leandro, Calif.



FOR DATA CIRCLE 406 ON READER CARD

contained in volumes three through five of the vendor's Software Bank, announced concurrently with the Disk Utility Pack. Among the software bank programs are: File Cabinet, a record keeping and personal directory system; Character Generator, a high-resolution graphics program; and California Driver's Test, a simulation of the actual exam. Programs from the library sell for $2 each, or $10 for a diskette full; the user must supply a blank diskette. With the purchase of any Software Bank program, the user also receives a 90-page manual describing programs in the Software Bank. APPLE COMPUTER, INC., Cupertino, Calif.

FOR DATA CIRCLE 409 ON READER CARD

STRUCTURED FORTRAN

Developed to help programmers build better programs, the NASA Structured FORTRAN preprocessor implements a number of structured programming constructs. The principal structures supported are: IF...THEN...ELSE, OR ... IF, DO... WHILE, FOR, and TEST CASE. The FOR construct is an iterative structure which terminates when the index reaches a specific value. TEST CASE checks an expression against a parameter string; when a match is found, an associated block of code is executed. As input, the preprocessor accepts a mix of structured FORTRAN and ANSI standard FORTRAN; output is machine independent ANSI FORTRAN suitable for compiling using the host's standard FORTRAN compiler. The preprocessor itself comes in ANSI standard FORTRAN, written on 9-track, 800bpi tape in EBCDIC card images; on a 370 the preprocessor is said to use roughly 90KB. The program sells for $770. COMPUTER SOFTWARE MANAGEMENT AND INFORMATION CENTER, Univ. of Georgia Computer Center, Athens, Georgia.

FOR DATA CIRCLE 412 ON READER CARD

DEVELOPMENT SYSTEM

The Hybrid Development System, for North Star microcomputers, helps users write programs with intermixed BASIC and assembly language routines. Advantages cited include being able to code critical program segments in assembler for faster execution, and using assembler as an aid to protecting proprietary software. The Hybrid Development System includes an interactive assembler/editor, and modifications to North Star BASIC to support communication between BASIC and assembler routines. BASIC is modified to allow an unlimited number of parameters in the CALL function. Also, the address of a BASIC variable is returned by enclosing the variable name in square brackets, making it easier to use BASIC variables or strings in assembler routines. The system requires at least 24KB of memory. Supplied on a 5-inch diskette, with documentation, the package sells for $40. ALLEN ASHLEY, Pasadena, Calif.

FOR DATA CIRCLE 413 ON READER CARD

DOCUMENTATION

DYL-DOC is an automated documentation system for use with this vendor's DYL-260 report writer and file management system for IBM mainframes. The software generates documentation for any DYL-260 program. The documentation is formatted for 8½ X 11 pages, suitable for three-ring binders; cross-reference listings are included in the documentation. DYL-260, with the DYL-DOC option, can be leased for $126 per month on a three-year plan. DYLAKOR SOFTWARE SYSTEMS, INC., Encino, Calif.

FOR DATA CIRCLE 414 ON READER CARD

CLIENT BILLING

Written for the Radio Shack TRS-80 personal computer, this client billing/work-in-process package can handle up to 999 clients, 99 employees, 99 precoded activities and 3,000 outstanding transactions. The user interacts with the system (and can access all data) from the TRS-80 video display; hardcopy reports are printed on command. The system also maintains year-to-date totals for time and dollar-amount fields for clients, employees, and activities. The software needs a 48KB Level II TRS-80, with three minidiskette drives, and a line printer. The package sells for $450, including three diskettes of codes, sample data for training, sample reports and source documents, and user's manual. The user's manual is available separately for $40 (which can be applied to the purchase of the package). SMALL BUSINESS SYSTEMS GROUP, Dunstable, Mass.

FOR DATA CIRCLE 415 ON READER CARD

RPG II

This vendor's RPG II is said to be compatible with IBM System/3 RPG II; programs can be moved from a batch System/3 to this vendor's interactive systems with minimal conversion effort. For use under the VULCAN virtual memory operating system, RPG II includes support for sequential, indexed sequential, and direct access data files. It also offers special input functions, look ahead fields, bit setting, and/or operators, automatic field numbering, and COBOL-compatible subroutine calls. RPG II carries a $2,500 license fee, including the first year's software updates and maintenance. HARRIS CORP., Computer Systems Div., Fort Lauderdale, Fla.

FOR DATA CIRCLE 416 ON READER CARD

DBMS

RAMIS II, the data base management system, has been brought up on NCSS's 3200 minicomputer. The system includes an English-like nonprocedural language for report preparation and records management. The NCSS implementation provides all RAMIS II capabilities; the system is said to be well suited to distributed processing, as RAMIS applications running on any machine can be transferred to the 3200. A typical 3200 installation for supporting eight to 32 active terminals, carries a price ranging from $200,000 to $400,000, including RAMIS. MATHEMATICA PRODUCTS GROUP, Div. of Mathematica, Inc., Princeton, N.J. ✲

FOR DATA CIRCLE 417 ON READER CARD

TYMES OF TYMSHARE

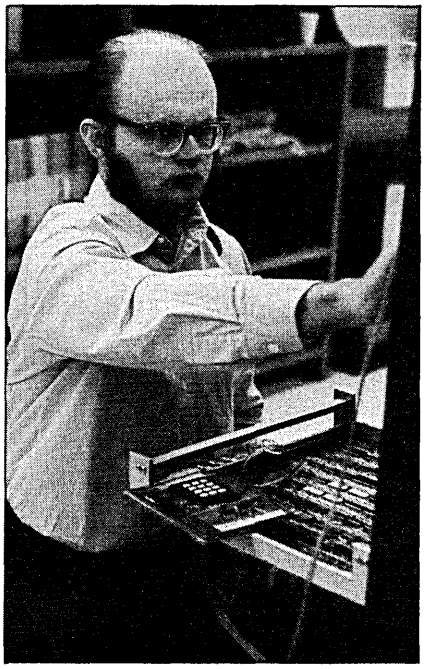
People chuckle at some of life's coincidences. There is, for example, a fellow named La Roy Tymes working at Tymshare. It turns out Tymshare was not named after Tymes, although he was one of the service company's early employees. It also turns out that Tymes is the designer of the company's communications network, Tymnet. And, at the danger of heaping improbabilities upon coincidences, there is nothing in his background to indicate that at the age of 26, in 1968, he would sit down and conceive Tymnet and then go on to plan and implement the industry's first operational virtual circuit, packet transmission network — and today the nation's largest public packet network.

Tymes joined the company when it had three SDS 940 computers. "They occasionally kept one on the air for several hours at a time," he now says wryly, noting that they had yet to have one run an entire day without some sort of calamity.

A college dropout, in 1963 Tymes left Michigan and became a computer operator at the Lawrence Radiation Labs in Livermore, Calif. While there, he received his bachelor's degree in math from California State Univ. in Hayward, and became a programmer of numerically controlled machines. He went on to receive his masters in math and joined two-year-old Tymshare Inc., now based in Cupertino, Calif.

"Back then, Tymnet existed only in my head," he says. "And I started the network project under a slim budget and stringent deadlines." Tymes comprised the company's communications R&D department, wrote all the network's original code, and almost singlehandedly created the first virtual circuit data network.

"I want, first of all, to correct a common error in terminology," he says. "While Tymnet is a packet transmission network, it is not a packet switched network." With packet switching technology, he explains, packets are of a fixed length and contain data from a single customer; space within that packet length cannot be shared by another message originator, and that can mean more overhead.



LA ROY TYMES—"To me, it all looks very much the same."

By contrast, Tymnet's packets are of a variable length and can contain data from numerous users. Further, logical records associated with each user may also vary in length. "This approach was chosen because of the emphasis on low-speed interactive terminals and because we felt that computer costs were more likely to decline than line costs. Looking back, it's clear this was a good decision."

At first, of course, Tymshare had no network, only SDS 940s with direct dial-up. It got into remote access by doing time division multiplexing on the old Data Machines 620/i minicomputer. This extended its customer base into areas where there was no nearby computer center.

"I wanted to eliminate the need for the 940's attendant customer terminal equipment (CTE) gear, which was then needed to serialize and deserialize characters," explains Tymes. "So one day my colleague Norm Hardy and I devised a scheme on the blackboard in which the 620/i's were to act as concentrators, first for serializing and deserializing characters, and then to pack characters into records so the data could be written directly into the memory of the SDS 940."

He convinced Tymshare cofounder and president Tom O'Rourke of the scheme's feasibility, and the company ordered three more 940s, but without the CTE gear. "This was my first taste of not only implementing a concept and making it work, but to work under the gun and produce on schedule," says Tymes. "We were operating on a financial shoestring in 1969, and if my scheme didn't work, the 940s without the CTE gear would be worthless." Of course, it did work.

In time the 620/i's were made to recognize terminal characteristics, such as baud rates, when a user first accessed the network. This allowed Tymshare to serve terminals running at 110 baud through 300 on the same telephone rotary. "I'm not sure, but I think we were the first to do that," he says. "I think General Electric had tried to do that earlier but declared it impossible."

In 1970 Tymshare created the first network in which particular ports on each 620/i were mapped to particular ports on corresponding 940s. The network supervisor, running on the 940s, was developed. And the nodes, or communications processors, evolved from the Varian 620/i to the V72 and V77 through Interdata 732s to something now called Tymnet Engines, designed and built in-house. Tymshare's common carrier subsidiary, Tymnet Inc., began offering carrier services in April 1977.

Tymnet Engines, nodes in the network now called Tymnet II, are installed at the rate of three a week. More than 500 nodes are expected to be in by the end of this year.

For a young man from a rural community in Michigan, Tymes has come a long way. "Before I came to Tymshare I was primarily a FORTRAN programmer," he says. "I went from there to systems programming and to microcode and from there to hardware. Now I'm designing my own integrated circuits." And it is this freewheeling spirit, combined with an intellectual curiosity, that helps explain his rapid progression across disciplines. He notes that the computer industry is rigidly divided between people who write programs and those who design hardware. He calls this an "invisible bridge" that neither side crosses.

But Tymes sees the hardware side as nothing more than some silicon and copper and a few other materials that must somehow be organized to perform a

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function. "And whether an algorithm is expressed in FORTRAN or machine language or microcode or gates or whatever, it's a matter of what's available to work with and what your skills happen to be. Designing an algorithm in TTL is every bit programming as is designing it in FORTRAN."

Tymes, whose interests range from growing orchids to hang gliding to somehow growing large synthetic diamonds, the latter a "someday" thing, says burning programs into PROM's is only a step removed from programming in machine language, but it's a step most programmers don't take. "And that's what I have some difficulty understanding—that there should be such a well defined barrier between hardware and software. To me, it all looks very much the same. It's a spectrum. And I don't really see any discontinuities in that spectrum."

Nor is the chief architect of Tymnet conventional in his thinking about the nation's telephone company. Far from being critical of the Bell System, Tymes says, "I think the phone company has done an absolutely incredible job of tying the world together." Does that mean he also likes Ma Bell's newly proposed Advanced Communications Service? "I think ACS is absurd," he replies, saying it would be obsolete before it becomes operational. "I don't see it doing anything that Tymnet isn't already doing." He says if he had dictatorial powers over the nation's phone system, he would have AT&T concentrate on building an all-digital network. "Because I think that's the best way to increase its value to the human race."

HE LIKES SMALL BUSINESS

In the late '60s, IBM introduced a computer for scientific and engineering applications which required FORTRAN as a programming language. It gained widespread acceptance in the business community but most business programmers were not familiar with FORTRAN.

For a young firm in Atlanta, whose major partners and staff were engineers, the development spelled opportunity. Waverly Graham formed Technical Analysis Corp. in 1965 while he was working for a PhD in nuclear engineering at Georgia Institute of Technology. Set to join the faculty at Georgia, he knew that he'd have to neglect a primary interest, applying scientific methods to business problems, unless he could find an outlet in consulting activities.

"There's a lot more business programming to be done than engineering and scientific programming," says Graham. "For us, that IBM development was a serendipitous thing. We used some of my graduate students as staff on a part time basis. Our programming contracts allowed us to build a revenue base for the company."

Graham himself worked part time for five years to build TAC before taking over as president. For the last five years, TAC's sales volume has been growing at the rate of at least 50% annually. At the end of the last fiscal year sales were $4.1 million.

Graham read about time-sharing that Dartmouth and General Electric promoted in partnership, and went to the Dartmouth campus to learn more about it and its possible benefits to his customers. At that time, the closest time-sharing computer was in New York City. TAC bought wholesale time blocks and retailed them in Georgia. As the systems moved closer to Atlanta, to Bethesda, Md., and Raleigh, N.C., TAC bought blocks in those cities.

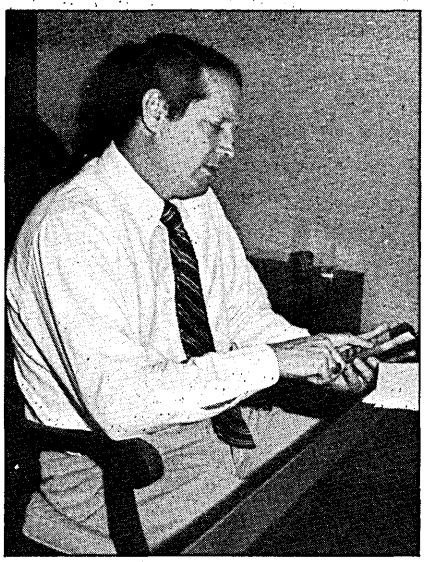
"Finally we developed enough of a base that our supplier in Raleigh put a system in here," said Graham. "It was the first local Atlanta time-sharing offering and we were the franchised marketing organization."

TAC lacked the capital to be competitive, so it returned to its consulting activity. Shortly thereafter, TAC began working with a minicomputer, a logical outgrowth of time-sharing.

"Without the economies of scale available to a large business, we have to live by our wits in terms of our advanced technical capabilities," Graham explained. "That frequently puts us into new areas, sometimes in development, although we don't have a large development budget. Usually there is some company sufficiently interested in applying new technology so we can get some trade-off and be able to have some portion of the new development underwritten by a customer."

TAC's largest single development and production project has been for Olan Mills, a portrait studio company. The long association began when TAC replaced an IBM System/7. The application involved quality control instrumentation which measures color balance in films. Since that beginning project, TAC has put the 160 printers in the company's four production plans under microcomputer control. The five-year project to fully automate the color portrait printers has resulted in a doubling in throughput for a single machine and a reduction in the reprint ratio.

TAC serves a base of industries including a wholesale furniture company, oil companies, several printing companies and a number of bottling companies. The firm has also targeted the paper and textile industries as potential markets.



WAVERLY GRAHAM—"You've got to have interesting projects or you won't keep good people."

"Most 70-man firms would probably be more concentrated in a single industry than we are," said Graham. "We have the breadth and capability that allows us to be a complete turnkey vendor and still be a small business."

Graham believes a project best demonstrating that capability is a paper mill in Tennessee. "We used dual redundant systems, Hewlett-Packard minicomputers, for production and inventory control systems at the dry end of a paper mill to control inventory, shipping and accounting information for rolls of paper. Because data collection terminals of the correct characteristics were not available, we had to design and build a special label printer to print large sized labels and then integrate this into a single system that is expected to operate 24 hours per day, seven days a week."

Another system the firm prepared was for production control of nuclear fuel rods at a fuel fabrication facility in South Carolina. This one-year project involved dual processors and multiple data input stations.

"Our goal is to keep a substantial amount of the interesting first-time development work and to increase the proportion of the more profitable repeat business," Graham said. "You've got to have interesting projects or you won't keep good people. ✱

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Stephen G. Jerritts
Vice President & General Manager, USISG

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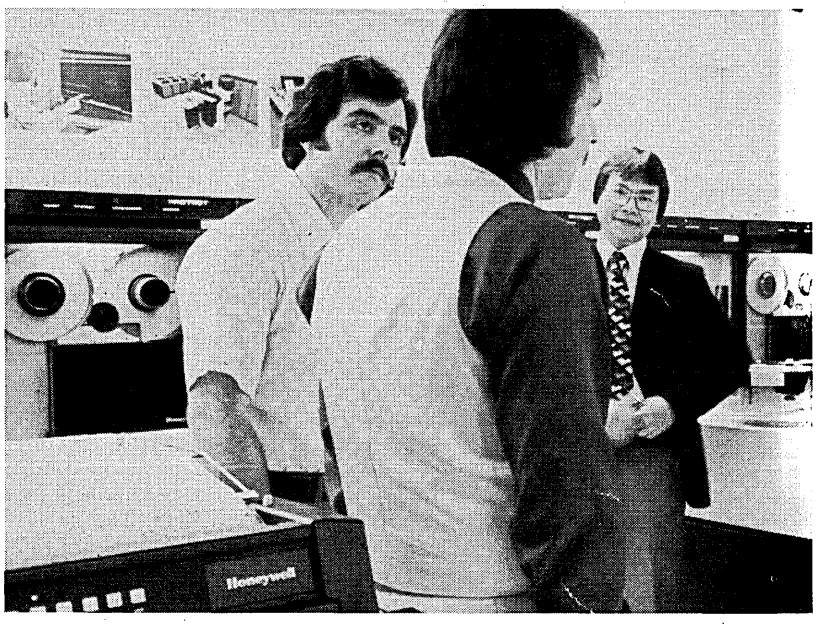

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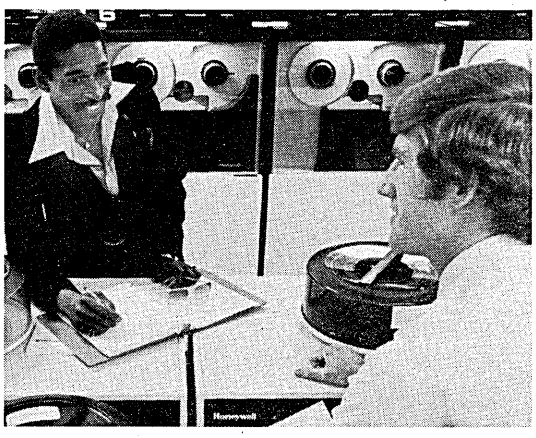

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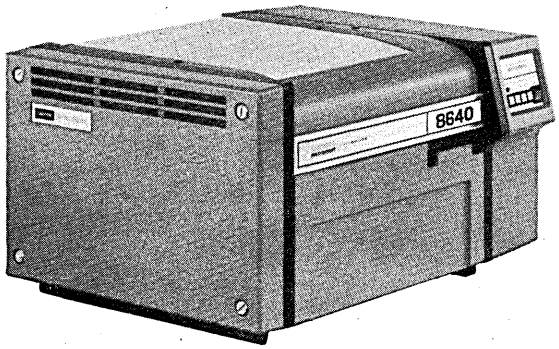

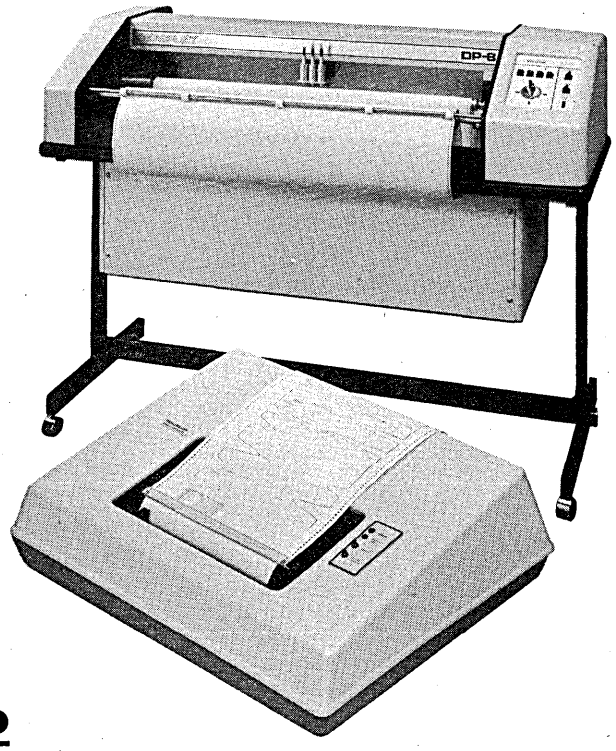

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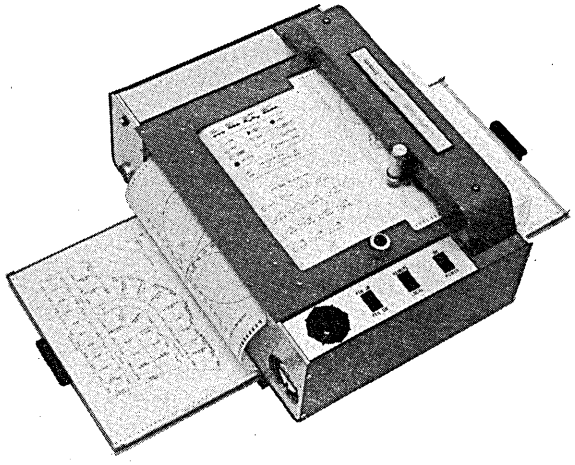

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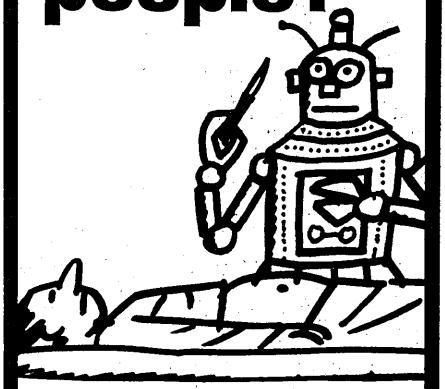

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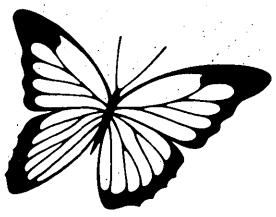

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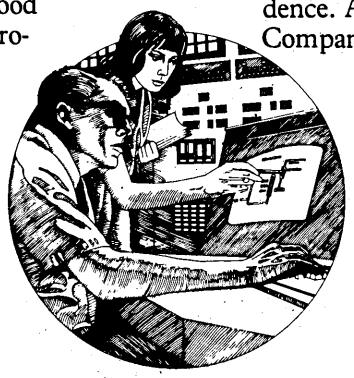

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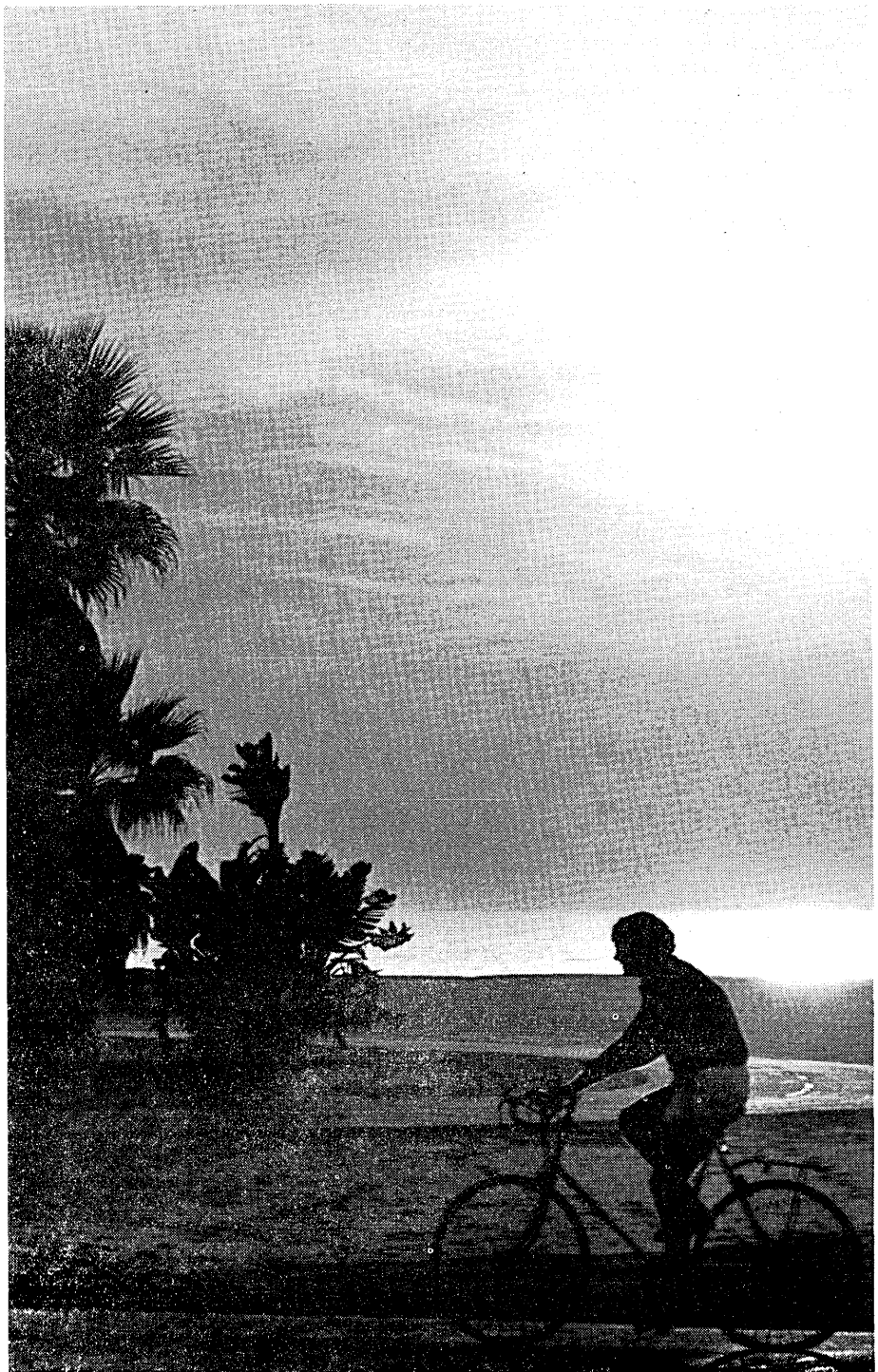

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CIRCLE 218 ON READER CARD

SOURCE DATA

BOOKS

COMMUNICATIONS SATELLITE SYSTEMS by James Martin

An invitation to review a James Martin book produces a unique emotional response: an initial feeling of flattery is quickly overcome by sheer terror. Reviewing a James Martin book for members of the data processing industry is tantamount to reviewing the National Anthem for the VFW.

Communications Satellite Systems turned out to be an exceptionally difficult book to review. Mr. Martin's earlier books, aimed at a readership comprised of programmers, systems analysts and other software specialists, always emphasized software (while other information may have been presented). That cannot be said about *Communications Satellite Systems*. It is safe to say that very few individuals that read, enjoyed and benefited from Mr. Martin's earlier publications would have the same reaction to this book. In the introductory chapter, The Promise of Space, Mr. Martin gives a very brief history of satellites and discusses usage, present and future. The reader is lulled into the mistaken belief that the remaining chapters will tell him what satellites will do for him. It doesn't take long for disillusionment to set in.

The next chapter gives the reader a better clue what to expect. It consists, essentially, of an overview of the technical aspects of satellite usage *and the satellites themselves*. The author includes a brief discussion of the well-known satellite delay and then discusses such things as transponders, earth stations, antennas and satellite attitude control. As part of the discussion of spot-beam antennas (as opposed to omni-directional), a graph is given which shows "relative beam strength in decibels" as a function of the antenna angle subtended at the satellite. This seems to be of minimal interest (if any) to a systems analyst.

Subsequent paragraphs continue in this vein and give an excellent (and accurate) description of satellite hardware theory. The reader learns how to select orbit altitudes and inclinations. The inner-workings of a traveling wave tube power amplifier are explained. The effects of cosmic and solar noise are discussed.

Part 2 of the book gives a similar discussion of ground station equipment. The reader learns about analog to digital conversion and is given some rather hefty mathematics that relate error probability and transmission efficiency on satellite channels. Transmission probability can be calculated provided that the reader has the capability of raising epsilon to a negative power. (Epsilon is an engineering constant which, like pi, can be carried out to an infinite number of decimal places. It is equal to approximately 2.718 and is the base of natural logarithms.)

Communications Satellite Systems, then, is of little or no value to typical data processing personnel, but that is not to say it is without merit. The book is extremely well written and contains an accurate description of communications satellite hardware theory. Rather than telling data processing personnel how to use satellites, the book tells engineers how to serve the interests of the data processing industry. In my opinion, the book should be mandatory reading for college seniors majoring in electrical engineering, physics, or a similar discipline. Such individuals intending to become involved in the satellite communications field will be saved years that would be required to pick up the necessary information bit by bit. Prentice-Hall (1978, 416 pp., $35).

—George M. Dick

TWO NEW APL BOOKS

In his book *Applied APL Programming* (Prentice Hall, 308 pp., $12.95), Professor William R. LePage has produced a high quality introduction to APL. In addition to providing a firm foundation for APL users, my reading concurs with Professor LePage's expectation that even people with considerable knowledge of APL will find much useful information in the relatively sophisticated treatments of the later chapters.

Dr. Arnold O. Allen has taken a less traveled route in his fine book *Probability, Statistics and Queueing Theory with Computer Science Applications* (Academic Press, 390 pp., $29.50). Based on his belief in APL as the ideal choice of a programming language in his discipline, he has included 29 APL programs to assist the student. His book is a happy blend of theory, good examples and problems, and applications.

Professor LePage does a fine job of emphasizing the abilities of APL in concept formulation. As he points out, and as both he and Dr. Allen have demonstrated, with APL it's a small gap between the computer instructions and the human concept of a problem solution.

Although it is not of earthshaking consequence, the title of Professor LePage's book will be somewhat misleading to APL practitioners, since they will expect to find a wide variety of application programs and techniques.

Even though, in my opinion, there can never be too many books about APL, it is hoped that APL authors will soon turn from producing APL introductions and concentrate on documenting the wealth of APL applications that are becoming widely known but are currently unpublished. Dr. Allen's book is a good example of such needed documentation. My further hope is that in the process of documenting the available APL applications, future authors will exhibit many concise functions and will use the APL notation in the symbolic formulation of concepts. Continued effort in this direction will result in shorter, more effective presentations.

I recommend Professor LePage's book for use in any APL class and recommend Dr. Allen's book to statisticians and computer scientists. Both books are excellent and professional works.

—J.W. Bergquist

REPORTS AND REFERENCES

DIRECTORY OF SOFTWARE

The 36th edition of the *ICP Software Directory*, indexed by function, by vendor, and by hardware or language, is now available. There is also an alphabetical index of advertisers. The semiannual publication has recently been expanded to five volumes: Data Processing Management; Business Management: Cross Industry Applications; Business Management: Industry Specific Applications; Mini-Small Business Systems: Cross Industry, and Mini-Small Business Systems: Industry Specific. The report includes a two-page questionnaire, "Evaluating Software Packages." The Locator, a toll-free phone service prepared to research requests for particular software applications, is avail-

able at no charge with any annual subscription.

Prices: One volume, $65; two volumes, $104; three volumes, $156; four volumes, $208, and all five for $260. International Computer Programs, Inc., 9000 Keystone Crossing, Indianapolis, IN 46240 (317) 844-7461.

AUERBACH SHORT FORM

DataWorld, Auerbach's four volume loose-leaf reference service, covering the most popular and actively marketed international systems, has been their best seller in the technology line. Designed for quick reference, the volumes contain tutorials, comparison charts, and product reports including prices, about general-purpose computer systems, small business computers, minicomputers, peripherals, data handling, system support software, applications software, and data communications, among others. Volume 4, on data communications, contains a new section on graphics terminals.

The volumes are updated monthly. June updates will include reports on IBM's 4300, and Nippon's ACOS series 800 and 900 mainframes. July updates will include reports on the Siemans 7800, NCR 8000, Cyber 17700, and ICL 8950 and 8959 data entry systems.

$485. Auerbach Publishers, Inc., 6560 North Park Dr., Pennsauken, NJ 08109 (609) 662-2070.

COMMUNICATING WP

"The most successful communications with word processors is now taking place in systems that were originally conceived of as data entry and intelligent terminals networks, supporting the primarily arithmetic-oriented data processing, rather than the word oriented text editing, tasks." This quote is from IRD's report "Communicating Word Processors," which calls the products "an immature delivery system" and emphasizes the necessity for new networks and switching systems. The "communications infrastructure" is seen by IRD as being developed through new network offerings from SBS, Xerox, and, potentially, Graphnet, Tymshare, Microband, Western Union, and GTE (Telenet), among others.

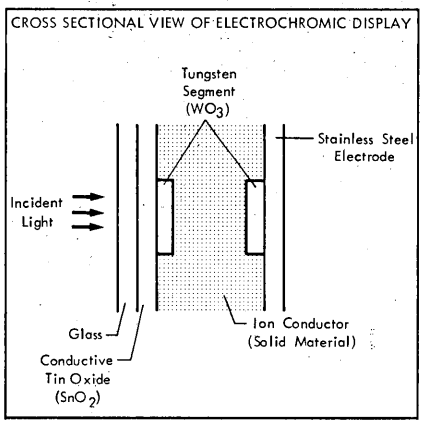
The report reviews the structure of the communicating word processing industry, by supplier, including a look at potential entrants. There is a section on the impact of regulation and one on the problem of standards. The report also details product characteristics, and briefly discusses the problem of standards. The relation of communicating word processors to products such as facsimile, photocomposition and the intelligent copier/printer is also discussed.

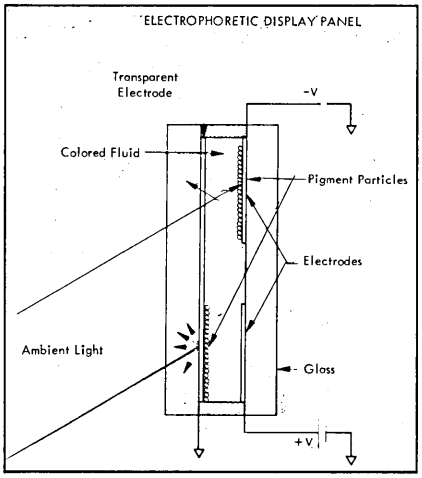
The 202-page report sells for $1,285.

Also recently available from IRD is the report "Facsimile Markets," which concentrates on fax technology, applications, and past and present markets. The report also emphasizes the emergence of wideband facsimile systems and the international market. $895. International Resource Development Inc., 30 High Street, Norwalk, CT 06851 (203) 866-6914.

DISPLAY TECHNOLOGIES

A report scheduled for delivery at the end of 1979, "Display Technology and Market Forecast," will examine "innovative technologies standing in the wings," announced Gnostic Concepts. The report will forecast the market through 1987.





Shown here are diagrams of two relatively well known new technologies, electrochromic and electrophoretic displays. The report will cost $15,000. Gnostic Concepts Inc., 2710 Sand Hill Road, Menlo Park, CA 94025 (415) 854-4672.

DATACOMM STANDARDS

A new volume entitled "Data Communications Standards Library" contains a complete description of IBM's Binary Synchronous Communications and an AT&T description of their ACS Host and Terminal Functional interface. Also contained are six EIA RS standards, including three that deal with the new implementation of the data communication interface to replace RS-232-C as the U.S. standard. Also included are industrial bulletins from the Electronics Industries Association: IB No. 5, Signal Quality at Digital Interface; IB No. 9, Applications Notes for EIA RS-232-C; and IB No. 12, Application Notes on Interconnection between interface circuits using RS-449 and RS-232-C.

The 330-page is $85, from Remark International, 4 Sycamore Drive, Woodbury, NY 11797 (516) 367-3806.

CPT AND WP

An in-depth economic analysis of CPT, one of the few companies entirely specializing in word processing, is available from Martin Simpson. The 42-page report, entitled "CPT and the Word Processing Industry—1978-1984," gives estimates of CPT installed products, revenue analysis by product, common stock data, and addresses other pertinent aspects of the corporation, such as management, manufacturing, and R&D. $195. Martin Simpson Research Associates, Inc., 63 Wall Street, New York, NY 10005.

INTELLIGENT COPIERS

SBS offers the report "Intelligent Copiers & Image Printers for the Office of the Future." The executive summary announces, "The IBM 6670 and Wang Image Printer announcements will force responses from many vendors, including those who did not plan to introduce products before 1982." The report is said to forecast that standalone copiers and high-speed printers will be supplanted by the intelligent copier with the help of value-added networks. The 200-page report sells for $1,500. Strategic Business Services, 4320 Stevens Creek Blvd., Suite 215, San Jose, CA 95129 (408) 243-8121.

DATAPRO ON COMMUNICATIONS

Two loose-leaf volumes, monthly supplements, a newsletter, and use of Datapro's telephone inquiry service make up the new offering from Datapro entitled "Datapro Communications Solutions." Topic areas said to be covered include: narrowband/voice-grade/wideband channels, half-duplex/full-duplex, asynchronous/synchronous, analog vs. digital transmissions, protocols and codes, multiplexing/concentrating, switched vs. private line services, and public vs. customized private networks, and planning and management. A vendor index and glossary are included. Datapro is at 1805 Underwood Blvd., Delran, NJ 08075 (609) 764-0100.

SOFTWARE PITFALLS

A new report entitled "Improving EDP Software Production" is aimed at mana-

gers responsible for software projects. "The potential for error or deliberate misuse of computer systems increases," claims the report, "as end users become more involved in programming and as communication links increase remote access to central site computer facilities."

"In the programming phase," the report asserts, "software management assures that appropriate technical choices are made, and that high quality workmanship is applied in producing code to meet the Design Specifications. This phase often is merged with design and so may have no distinguishable starting point."

The report recommends project teams, including peer reviews, and discusses roles and duties of the team, as well as conditions under which the team is necessitated. Structured programming techniques are also recommended, as are software tools such as preprocessors and tools for debugging and testing.

Software problems originate most frequently in the analysis of requirements and the design of software, according to the report, leading to the conclusion that the primary quality controls for the initiation and definition phases are system requirements documents and technical reviews.

The report is $5. From Reymont Associates, 29 Reymont Ave., Rye, NY 10580 (914) 967-8185.

VENDOR LITERATURE

DESKTOP COMPUTER

"Is there a low-cost microcomputer that is not a toy?" asks this eight-page, color brochure. This vendor answers that its portable computer with bubble memory fits the bill. The brochure includes a covers-off illustration of the unit, annotated with descriptions of its various features. Applications are discussed, as is the unit's operating system, business BASIC language processor, and application packages. A discussion of bubble memory technology rounds out the booklet. FINDEX, Los Angeles, Calif.

FOR DATA CIRCLE 400 ON READER CARD

COMMUNICATIONS

A four-page brochure, illustrated with photographs and block diagrams, explains this vendor's model 610 Intelligent Port Selector. The brochure explains the 610's capabilities and how it works. Block diagrams show various configurations. A table of specifications is provided. MICOM SYSTEMS, INC., Chatsworth, Calif.

FOR DATA CIRCLE 401 ON READER CARD

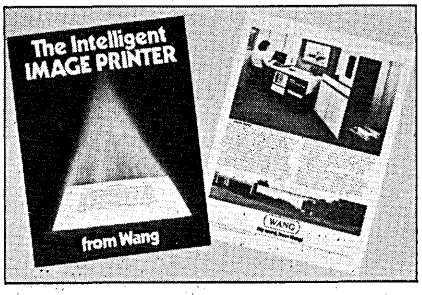
WORD PROCESSING

A two-page, four-color data sheet describes this vendor's 8000 series of word processing systems. Highlights of the system are detailed, features listed, and specs provided. CPT CORP., Hopkins, Minn.

FOR DATA CIRCLE 402 ON READER CARD

PAGE PRINTER

This vendor's recently announced Image Printer is described in a six-page, illustrated flier. Describing the Image Printer as "A Revolutionary Office Printer," the



brochure provides a description of the technology, and the functions the printer can provide. The brochure also explains how the printer fits into existing office automation projects. A final entry provides a brief company profile. WANG LABORATORIES, INC., Lowell, Mass.

FOR COPY CIRCLE 379 ON READER CARD

ACCESS CONTROL

"Access Control Systems," an illustrated, 80-page booklet covers the history of electronic security systems, access control devices, and case histories. Systems discussed range from simple lock-and-key to computer based systems. The four-section booklet begins with statistics on business losses due to crime. The operation and capabilities of access control devices are detailed in the second section. Section III comprises 12 case histories, ranging from power plants to office buildings. Section IV is a glossary. CARDKEY SYSTEMS, Div. of Greer Hydraulics, Inc., Chatsworth, Calif.

FOR DATA CIRCLE 403 ON READER CARD

CRT TERMINAL

This vendor's "Concept 100" ASCII crt terminal is described in a two-page product sheet. Illustrated with a photograph of the unit and a drawing of its keyboard, the flier discusses applications and features. Specifications are given for the display and keyboard; and standard functions, operating modes, and options are detailed. HUMAN DESIGNED SYSTEMS, INC., Philadelphia, Penn.

FOR DATA CIRCLE 404 ON READER CARD

COMMUNICATIONS

A full-color brochure describes this vendor's Micro500 Error Controller. Capitalizing "oranges" theme in another of its brochures, the Micro500 features a sister

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DIGITIZER

Applications, technical data, and warranty information on this vendor's Hi Pad digitizer are provided by an eight-page, four-color brochure. Both personal computing and professional uses are explored. Technical information includes formats available for output, interfacing requirements, and a table of specs. Ordering information includes pricing for the basic digitizer and its options, as well as shipping costs if ordered directly from the factory. A company profile, its two-year service agreement, and its limited warranty are provided. A companion plotter, the Hi Plot, is briefly described. HOUSTON INSTRUMENT, Austin, Texas.

FOR COPY CIRCLE 376 ON READER CARD

COMMUNICATIONS SYSTEM

An eight-page, illustrated booklet describes this vendor's CS 780 Data Communications System. The booklet gives a brief overview of the product, and then discusses on-line and off-line operation, as well as key-to-disk and printing applications. Two pages are devoted to specifications. DECISION DATA COMPUTER CORP., Horsham, Penn.

FOR DATA CIRCLE 405 ON READER CARD

PERIODICALS

DP CAREERS

A new monthly newsletter called *Computer Opportunities* is being offered by Datasearch Inc. Ventures such as consulting, software packages, contract programming, systems houses, dealerships, services and microcomputer enterprises are covered. A yearly subscription is $36. Datasearch Inc., 4954 William Arnold Road, Memphis, TN 38117 (901) 761-9090.

APPLE FOR THE TEACHER

Apple offers "The Personal Computer Magazine and Catalog." The first issue has a theme of Computers in Education, featuring articles on such subjects as choosing a classroom microcomputer, convincing your school that a computer is a good idea, learning aids for the handicapped, and how to interpret computer jargon. The theme of the June 1 issue is business. The quarterly magazine/catalog is free from Apple Computer, Inc. via Regis McKenna Publications, 348 Waverly Street, Palo Alto, CA 94301. ❋

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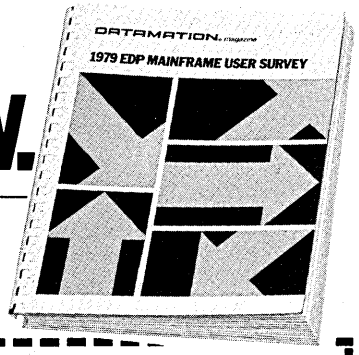

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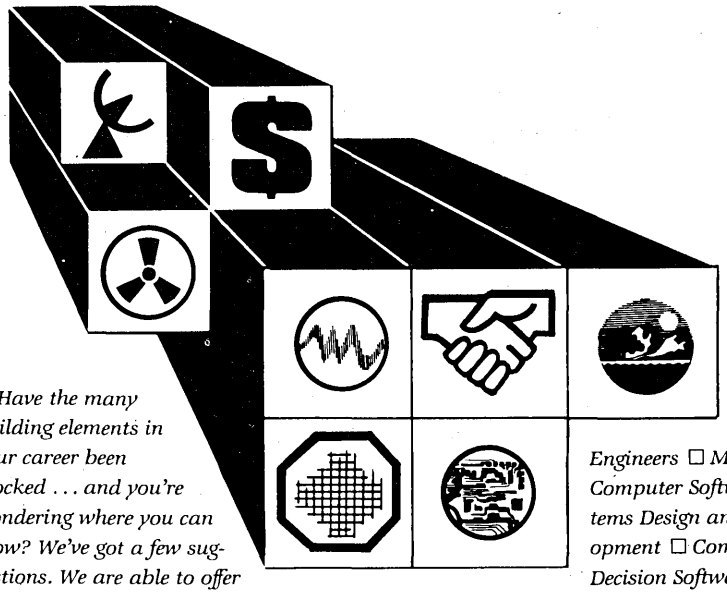

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In honor of their Pioneer Venus mission success, Hughes and NASA's Ames Research Center have received the Nelson P. Jackson Aerospace Award from the National Space Club. The award is made annually to the firm most responsible during the preceding year for outstanding contributions to the space, missile, and aircraft fields. Hughes designed and built the five spacecraft that penetrated the Venusian atmosphere last December, as well as the vehicle that was placed in orbit around the planet and continues to send information to Earth. Ames manages the project. Hughes previously won the award in 1968 for its Surveyor moon landers.

All three types of U.S.-built wide-body jetliners will carry Hughes passenger entertainment and service equipment now that Pan American World Airways has ordered the system for its new Lockheed L-1011s. The system, transmitting multiplexed signals at rates up to 5 million bits per second, provides stereo music and movie sound tracks, plus reading light and flight attendant call service. An earlier system is standard equipment on all McDonnell Douglas DC-10s. Also, 14 operators of Boeing 747s, citing high reliability and low operating costs, have chosen the system as either original or replacement equipment.

Old pastel masterpieces may retain their beauty with help from modern electronics, specifically from an electrostatic plate that prevents the chalky pigment from flaking. The plate consists of positive and negative circuits laminated in plastic. When placed behind a drawing and given a 10,000-volt potential, it generates a field of static electricity that holds the pastel particles to the surface of the paper. The unit and painting are enclosed in a dust-free frame to prevent contamination. Tests to date indicate the plate is superior to existing conservation methods because it virtually stops flaking. Also, unlike spray fixatives, it does not alter certain colors. Hughes built the plate at the request of the Conservation Center of the Los Angeles County Museum of Art. The Armand Hammer Foundation provided funds.

Hughes Industrial Electronics Group -- with locations in Carlsbad, Irvine, Newport Beach, Torrance, and Sylmar, California -- is seeking engineers, computer scientists, and physicists. Products include image processors/sensors, lasers, microelectronic production equipment, computer graphics, automated circuit testers, microelectronic devices, frequency control devices, microelectronic communication systems, facility management systems, electronic modules, connecting devices, flexible circuitry, solar cells/simulators, microwave traveling-wave tubes, microwave tube amplifiers, microwave solid-state products, microwave communications systems, and thermal products. Send resume to: John G. Wilhite, Hughes Aircraft Company, IEG-SE, P.O. Box 2999, Torrance, CA 90509.

A new traveling-wave tube amplifier (TWTA) designed for satellite communications uses offers high efficiency in a rugged but lightweight package. The device, designated Model 1264H, originally was developed and built by Hughes for the Tracking and Data Relay Satellite System. It operates in the range from 3.7 to 4.2 gigahertz with output power of 5.5 watts. Other specifications: saturated gain of 55 dB, an operating life of 10 years, and weight of three pounds.

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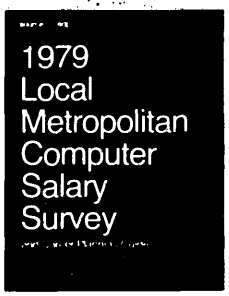

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READERS' FORUM

AUTOMATION: THE ROAD TO SURVIVAL

The DATAMATION article "The Automated Office: The Road to Disaster?" (Nov. 15, p. 154) pointed out that increasing automation may foster permanent and irrevocable unemployment. Automated equipment either directly replaces the employee, eliminates the need for the goods he produces or increases productivity so that fewer employees are needed.

In one variation or another, the computer, or microelectronic components, will now perform as low-cost high-reliability control devices for manufacturing and office applications. Mechanical, electrical and pneumatic control devices being built by thousands of workers will no longer be needed. The disappearance of these control devices will be accompanied by the disappearance of the jobs of the workers who built them.

Higher productivity of automated office equipment will have its effects, too. Word processing equipment makes one typist as productive as, perhaps, two. Fewer typists will be needed. In many firms, electronic transmission of data to and from users will replace the normal process of sending letters and documents through the mails. The electronic process will eliminate jobs involved with mail pickup, mail sorting and mail transportation.

"The Road to Disaster?" points out that the problem of this type of personnel dislocation is more than simply a specific job loss: it is permanent unemployment. Individuals with a lifetime of employment experience will find that their experience is no longer needed. A report written by the senior advisor to the French Finance Ministry is cited to amplify this point. The report "predicts that in banking and insurance possibly some 30% of all employees will lose their jobs in the next 10 years due to automation." In casting doubt upon the availability of other jobs, the article suggests that those in the electronics industry refuse to believe that they are creating a problem. "The classic data processing industry response has always been that if these dislocations were to have taken place, we would have already seen the effects, because automation has been an ongoing process for 100 years," the article notes. The possibility of new jobs becoming available through development of cottage industry is considered unlikely, according to Professor Cherns of the U.K.

In summary, the reader is led to conclude that short-term unemployment trends are likely and long-term unemployment trends are almost inevitable.

This intriguing analysis appears to be based on several assumptions:

1. The present number, size and types of organizations that provide employment will remain essentially unchanged. Hence, new jobs will not be created.

2. Present information supplied to organizations is not adequate and/or not fully utilized. The implication is that additional information will not be provided and/or used. Thus, no new jobs will be created.

I believe these two assumptions are not realistic, as shown in the following examples.

The social and economic organization of any society is always subject to change. The development of the microelectronics industry itself has led to the employment of engineers for design, technicians for fabrication and testing, and office workers to administer the new business. Silicon Valley in California is an example of this change. An obvious conclusion that needs little elaboration is that some new organizations and new jobs are being created.

There is no reason to assume that the total quantity of goods and services produced by the U.S. or, for that matter, the world economy has reached any fixed upper bounds. Total production can be increased, creating new employment opportunities.

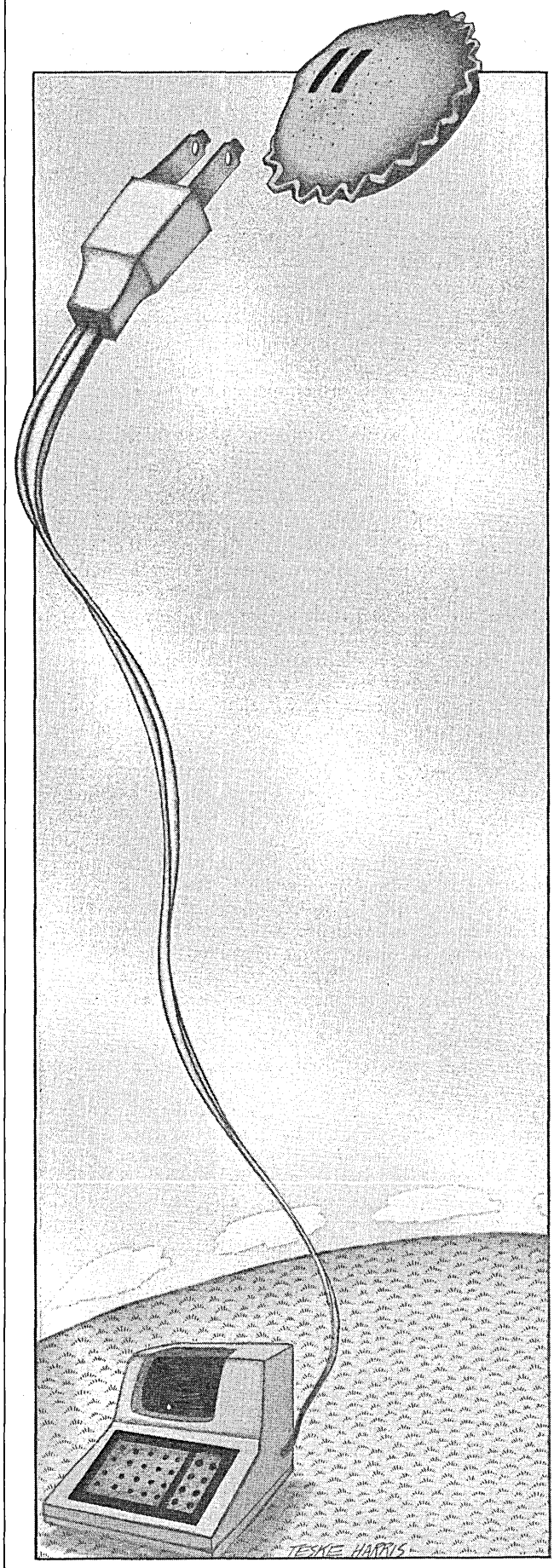
The banking industry in the United States has had to process an increasingly large number of checks. As consumers we enjoy the convenience of cheap (sometimes "free") checking. This wasn't always so. At one time, during our grandparents days, only businessmen and large industry had checking privileges—in part because check handling was slow and expensive. Continued automation has reduced the delay and cost so that we can all enjoy this convenience. Bank personnel and computer processing have been needed for this automation.

In recent years credit cards have become widely available and widely used by consumers. Their development and use requires the development, manufacture and distribution of credit card imprinters and forms. They also use bank personnel and computer time to process credit charges. Again, new organizations and jobs are being created.

In the field of medicine, significant improvements in diagnostic methods have been made due to automation and computer technology. Automated laboratory processing of blood tests has become cheaper, faster and more reliable with computer controlled instrumentation. Quick, painless and sophisticated diagnosis is provided by body scanning devices that rely on computer technology. Society in general has benefited by continued reduction in the costs and wider application of automation.

The banking industry has developed a variety of new and enhanced services to employ inexpensive automation. This creates a need for repairmen to service automatic teller units, bank personnel to physically reload cash dispensers, communications equipment, and technicians to maintain telephone lines. Some new jobs are being created at the banks and some at bank equipment and service suppliers. If the total number of bank customers, number of transactions and other measures of service provided increase, high level white collar jobs also may be created. To some degree, at least, the present low level teller is already familiar with the bank and has a good chance of promotion because of automation.

If we assume that the insurance industry has matured to



the point at which no increase is expected in policies issued, varieties of insurance offered, etc., then productive output will not increase and employment is likely to decline. However, many people in the life insurance industry do not feel that the average person has enough insurance. Are there underlying trends of rising employment in certain areas of insurance (i.e., insurance sales) and in computer manufacture that counterbalance the possibly displaced office worker? We don't know for certain, but the issue is surely not closed.

SO SKILLS BECOME OBSOLETE . . . The assertion in the November article that "Skills have a way of becoming technologically obsolete" is hard to argue. It is not a new phenomenon nor is it necessarily bad. It often reflects a change in productive method that reduces the cost of goods or services to the consumer.

Skills do not necessarily become obsolete overnight, nor do all skills become obsolete at the same moment.

In many instances obsolescence is a long-term phenomenon reflecting the time period needed to introduce effective automated methods. Printing unions have recognized these long-term trends and have taken steps to protect their members by assuring that they get appropriate training and that the employer must continue employment until the individual can either be reassigned in the new automated organization or be retired. In some types of work, skills can be acquired more easily or are largely transferable to automated work. Office workers, such as typists, find immediate employment on word processing equipment. Accounting clerks find less emphasis on fast manual fingering of a calculator keyboard and more interest in their ability to organize their records to insure the results of computer processing meet common sense for totals, balances, etc. Knowledge of the organization and how it works often makes the office worker promotable to a more responsible position in which the tedious clerical work is relegated to machines—a humanizing and welcome aspect of automation.

Skills are always prone to technological obsolescence. The important factor is not to cling to antiquated methods but to retrain and ease the transition of workers into other needed areas.

"Long-term dangers of drastic population bipolarization" seem farfetched. The continual development of less expensive microelectronics and increasingly wide application in automation is not necessarily a calamity. History shows that trends toward automation have often been misunderstood or implemented without regard for the people involved. For example, England, during 1811-1812, suffered riots and rebellions in which workers destroyed new machinery and wrecked factories to protect their jobs. These "Luddite" upheavals were tragic but were, in large part, due to the organization of society at that time. Working conditions of the common man were far different than they are today. The introduction of new machinery was followed by repeated wage reductions and mass firings—not training and reassignment. Employees customarily put in 14 to 17 hours of arduous physical work for starvation wages. Children of five and six spent such hours in mines and were often awakened at 4 a.m. to be closed in a dark, damp mineshaft until 8 or 10 p.m. Workers were subject to despotic laws, as well as numerous fines and disciplinary deductions. The working environment was dangerous, with accident and death common to all. Those who survived were frequently disabled because of exposure to heavy pollution. Employee benefits were generally nonexistent—but this was 160 years ago.

Today's workers have numerous benefits from their employers and from government. The 40-hour week is common; dangerous machinery must have protective guards, rails, and switches; and hazardous environments must be made safer.

Necessarily dangerous physical processing jobs are frequently automated, along with tedious clerical work. Thus automation can contribute to a safer, healthier working environment.

Trends toward increased automation do have many long-

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READERS' FORUM

term impacts. Automation can be, and is, used to reduce costs of production and to allow production that involves dangerous products or processes. At least some, perhaps most, of the impacts of automation are favorable. Rather than condemn computer manufacturers and users as purveyors of disaster, we should take positive steps to encourage their continued growth and development.

I think suggestions of impending doom overstate the case. The forces of automation, when viewed over the last 160 years, have improved the quality of life far more than they have hurt it. Industry is clearly more considerate of its employees now than in 1811. Community, state and federal government have established a variety of plans to minimize the hardships and speed the relocation of those who are technically displaced from factory or office. Certainly every effort should be made to protect workers from forced retirement and unemployment. Major changes in society have curbed many excesses which might be attributed to poor uses of automation. Today, automation is not the road to disaster—it is the road to a good life. It is essential for the data processing industry to make this aspect of automation clear to all.

—Henry H. Petersohn

Dr. Petersohn's 20 years in the dp field include work in management and applications analysis and design. His consulting experience includes work for the federal government and has included industrial concerns, such as North American Rockwell and RCA.

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You won't need an external test box with the D-451. Fault-isolation, and skew verify alignment are among internal microprocessor controlled self-test diagnostics.

An embedded Dual/Density formatter controls up to four tape transports.

Every aspect of the intelligent D-451's design and engineering makes its contribution in superior performance and reliability when reading and writing IBM/ANSI-compatible, ½" magnetic tape. Featured are: 7-or 9-track, NRZI and PE formats; dual format is standard for 9-track. Phase Encoded density is 1600 BPI, while densities of 800, 556 and 200 BPI are available for NRZI.

And Datum's painstaking research provides the D-451 with IBM tape-path geometry, ceramic blade tape cleaners, photoelectric write ring detection, low-inertia capstan drive and digital write deskew control.

Find out more about the reel thing, the tape transport that thinks for itself. Call or write your local Datum representative or Datum Inc., 1363 South State College Boulevard, Anaheim, California 92806. (714) 533-6333.

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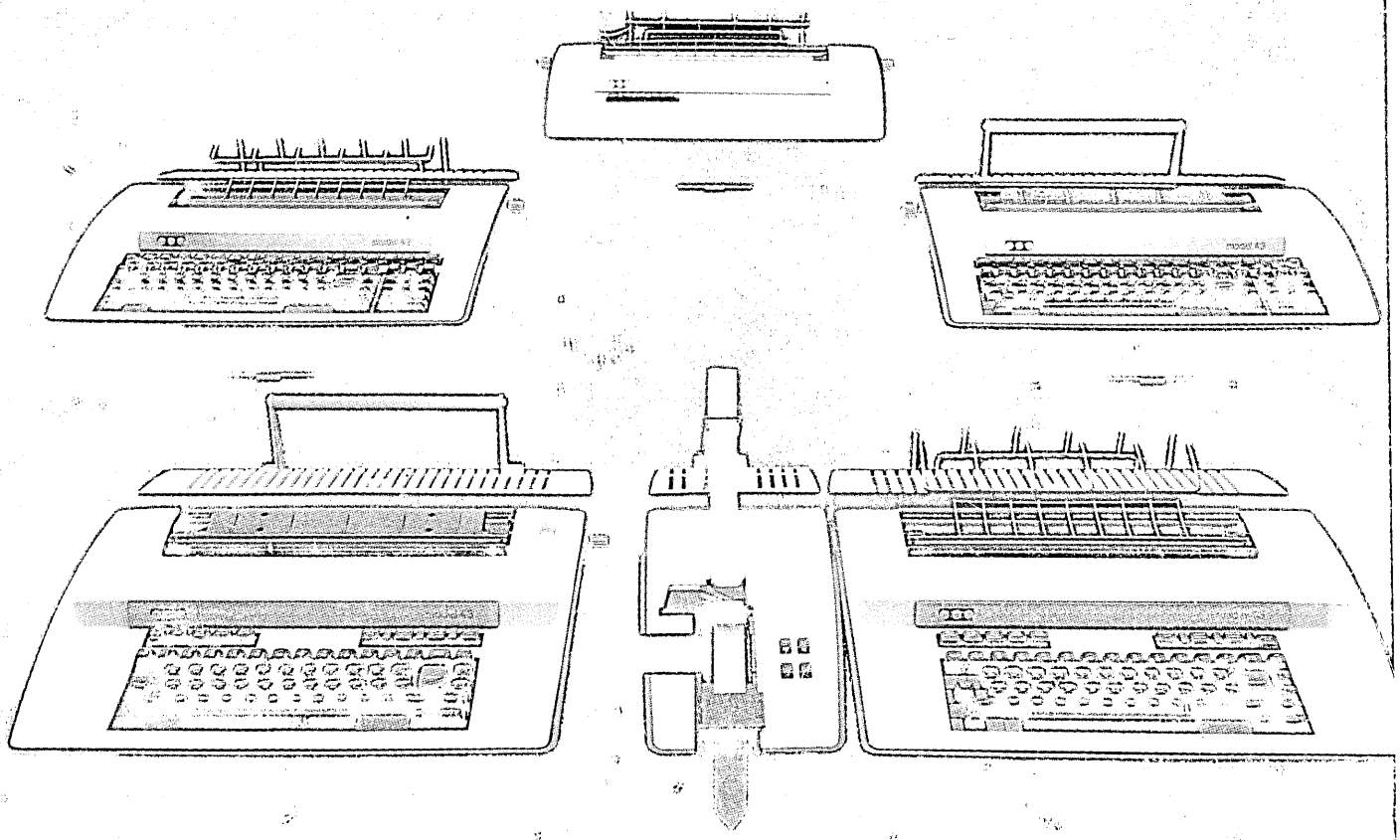
PPD 105

CIRCLE 2 ON READER CARD



OUR MODEL 43 TELEPRINTER FAMILY IS THE BEGINNING OF A NEW LEGEND.

When we introduced it just a year ago, the basic idea behind the Teletype® model 43 proved so sound and flexible that today it's grown into a comprehensive terminal family with extensive capabilities for message communications.

Model 43's come in a variety of configurations with either 80 column friction-feed or 132 column pin-feed printers. Some units are designed for use on the switched network, others for point-to-point private-line systems. (There's also a new generation of 5-level buffered teleprinters for Telex applications.)

The basic model 43 series operates on-line at 10 or 30 cps in either the half- or full-duplex mode and prints multiple copies using the 96 character ASCII code set. A wide choice of interfaces, including EIA RS232C and DC 20-60ma, are available for easy system integration.

With the automatic send-receive configuration, messages can be prepared off-line via the paper tape punch, edited, combined with a master tape, then sent at maximum terminal speed—automatically and unattended—when line rates are lowest.

Buffered 43's operate on-line at speeds ranging from 10 to 180 cps and provide up to 20,000 characters of storage for sending, receiving and editing. These terminals send and receive automatically via the buffer while messages are simultaneously being prepared for future transmission. They also include full forms control, the automatic answer capability and answer back.

Just like its predecessor, the legendary model 33, our model 43 family is designed for extreme reliability. The reason is simple: simplicity. Our model 43's use only five major pluggable components (six, counting the paper tape module on the ASR), along with extensive use of LSI circuitry.

So when you think of our model 43 family, think of it as the beginning of a new legend.

THE TELETYPE® MODEL 43 FAMILY.

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CIRCLE 62 ON READER CARD