DATAMATION 78
AUGUST/3.00 U.S.A.

MINIS AND MICROCOMPUTERS

INVADING THE BUSINESS WORLD

PUTTING THEM INTO PERSPECTIVE

MISUSING THE MINI

MINI & MICROCOMPUTER SURVEY

Now appearing on your favorite network: XL Distributed Processing Systems

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

Presenting XL Distributed Processing Systems from Pertec Computer Corporation. A family of microprocessor-based computer systems — and an approach to distributed processing — that cuts through the buzzword maze to provide state-of-the-art hardware and software solutions.

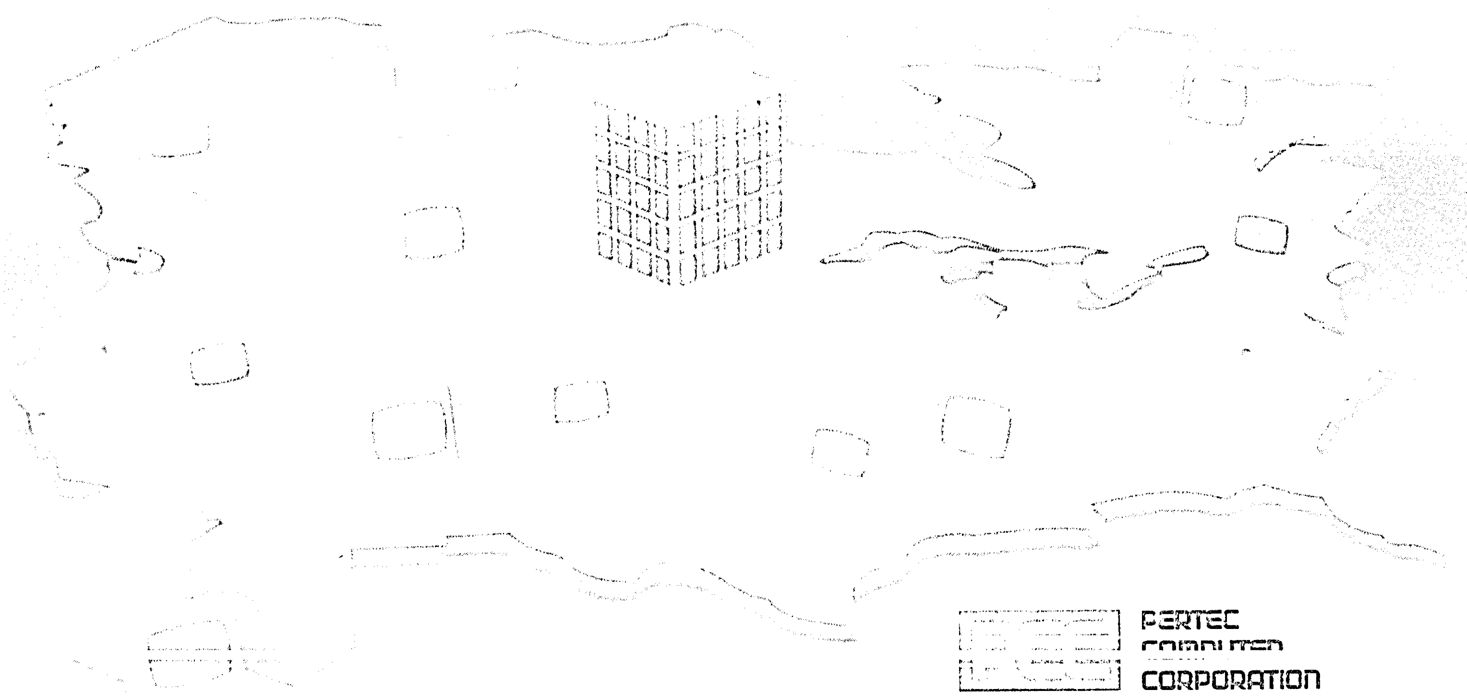
High-power processing
The top-of-the-line XL40 handles up to 16 local and remote terminals. With up to 512K bytes of memory and disk storage expandable to 70 megabytes for local data bases, it can also interactively access your headquarters mainframe via 3270 inquiry mode for non-XL40 residencies. Put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

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

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

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

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



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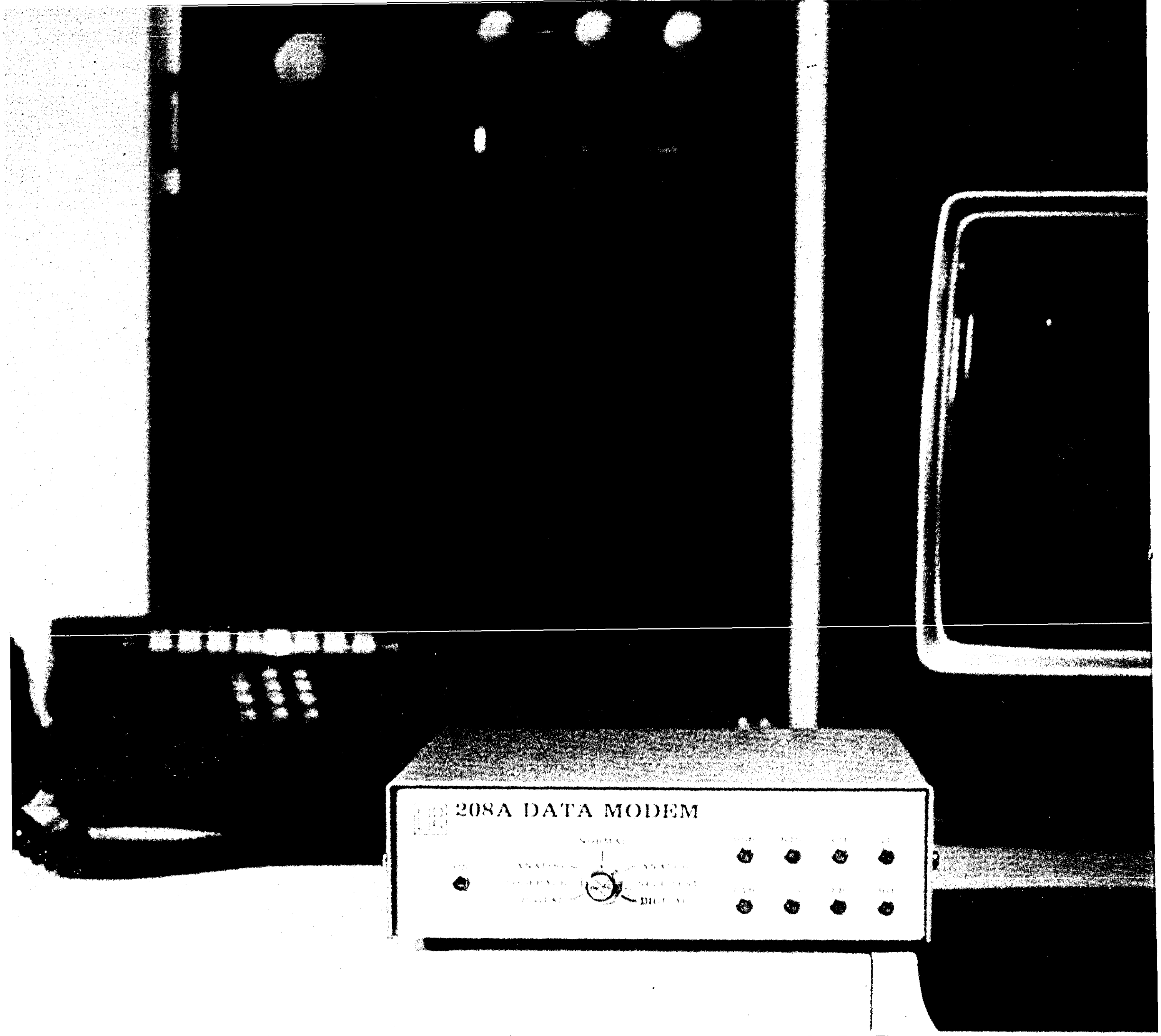

UDS announces a 4800 bps Bell-compatible microprocessor modem.

UDS has leapfrogged current LSI technology with nanosecond microprocessor performance! All components are industry standards — no custom or single-source parts are used.

- **Bell compatibility.** Available in 208A (four-wire) and 208B (two-wire) configurations, one-third Bell's size.
- **Reliability.** A drastic reduction in total number of components results in a longer MTBF.
- **Multi-channel opportunity.** A 7" x 19" rack-mountable enclosure accommodates up to eight single-channel cards.
- **Cost/effectiveness.** Microprocessor power and innovative design make the UDS 208 your best buy for data communications at 4800 bps.

For further details on the UDS 208 or our lower speed modems (103s, 201s, 12 • 12s etc.) contact Universal Data Systems, 4900 Bradford Drive, Huntsville, AL 35805. Phone 205/837-8100; TWX 810-726-2100.

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CIRCLE 9 ON READER CARD

DATAMATION

AUGUST 1978/3.00 U.S.A.
VOLUME 24 NUMBER 8
This issue 135,800 copies

FEATURES

ABOUT THE COVER

Mini and microcomputers, the industry's growth leaders, continue to expand in every way except size (see our survey beginning on p. 112). Will tomorrow's computer center resemble Tim Alt's airbrush painting?

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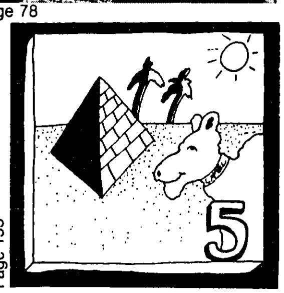

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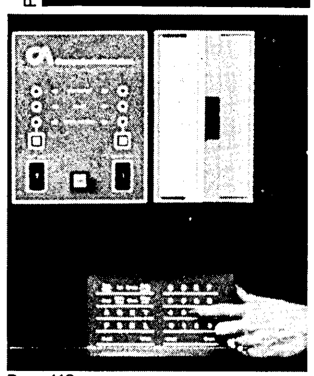

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NEWS IN PERSPECTIVE

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Announcing The 150-cps terminal

It impacts your workload. Not your wallet.

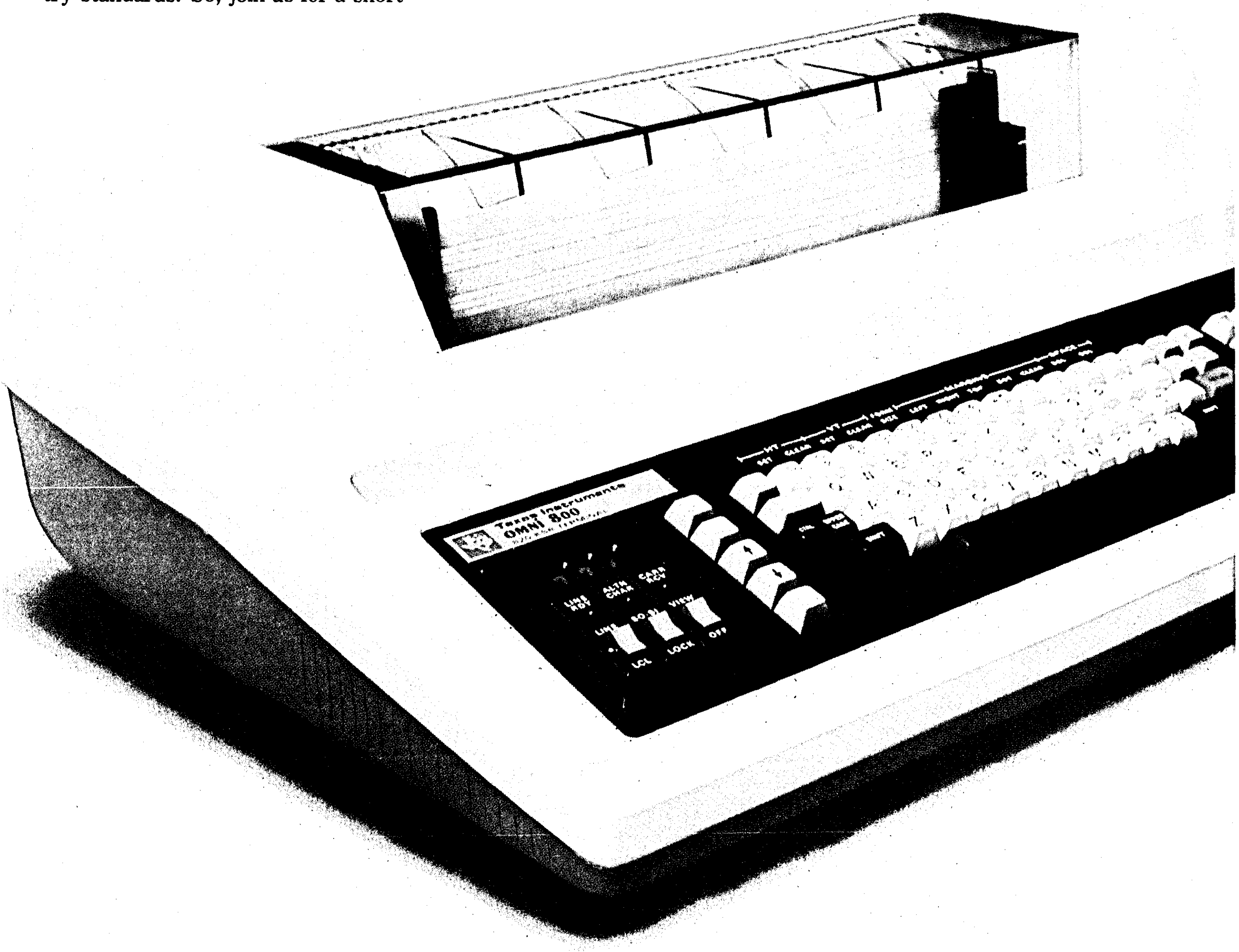
Meet the newest member of our OMNI 800* family: the Model 820 KSR Impact Terminal. It has all the features, functions and options of costly multi-copy terminal printers. But not the price tag.

The 820 comes with standard equipment that's setting new industry standards. So, join us for a short demonstration and we'll show you what we mean.

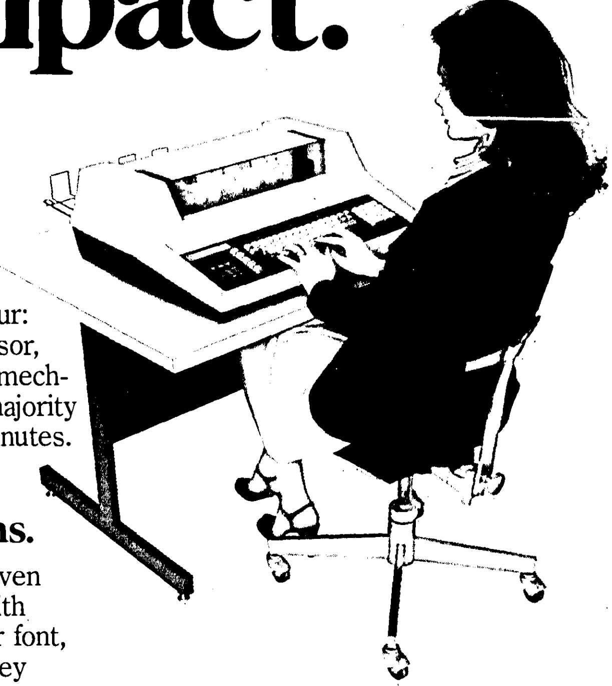
An operator's dream.

First of all, you'll note that the new 820 has an efficient, compact design with a keyboard resembling that of a standard typewriter. So, it can sit on a desk top or stand. And it's easy to use. In operation, you'll see one of the first features: a 9 x 7 dot matrix printhead that prints clear, legible characters. On both the original and up to five copies, too. And a wide carriage that prints forms from 3 to 15 inches in width — up to 132 characters across — at 150-cps speed.

Now, notice the 640-character FIFO buffer. It channels data so

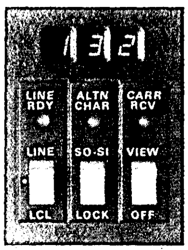


the 820 KSR. with more impact.



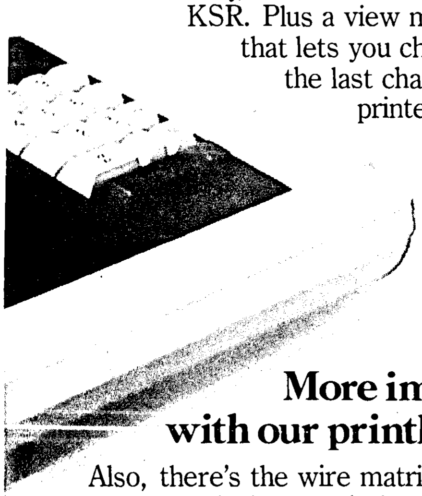
it's printed at maximum efficiency, either uni-directionally or bi-directionally. And the buffer provides overflow protection so you won't lose any input.

Status symbols.



Left of the keyboard you'll notice a three-digit L.E.D. Terminal Status Control panel. But it won't confuse you. It shows you the printer's next position. Or the terminal's status. Or an appropriate code when you have an error condition. It eliminates all the guesswork.

You'll also see Answerback Memory, on our Model 820 KSR. Plus a view mode that lets you check on the last character printed.



More impact with our printhead.

Also, there's the wire matrix assembly-designed printhead. It's specifically designed to increase printing life to 150-million character impressions. And our new extra-length ribbon allows the printhead to make more strikes per ribbon.

Maintenance in minutes.

To simplify maintenance, we've reduced the number of basic components to just four: the motherboard/microprocessor, the keyboard, the print/drive mechanism and the housing. The majority of which can be replaced in minutes.

Making the most of your options.

To increase its performance even further, the 820 is available with optional compressed character font, ASCII/APL keyboard, an 18-key numeric cluster, and a powerful device/forms control package.

Far-reaching support.

Every OMNI 800 Model 820 Impact Terminal comes with TI's over 30 years of experience in the electronics industry. Plus the technical expertise and support 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.

To see how much more impact our new impact terminal can have on your workload, call the TI sales office nearest you, or write Texas Instruments Incorporated, P.O. Box 1444, M/S 784, Houston, Texas 77001, or phone (713) 491-5115, extension 2124.

Yes! I am interested in the Model 820 KSR Impact Terminal.

☐ Please have your representative call me.

☐ Please send me more information.

OMNI 800 electronic data terminals

23-8-DM

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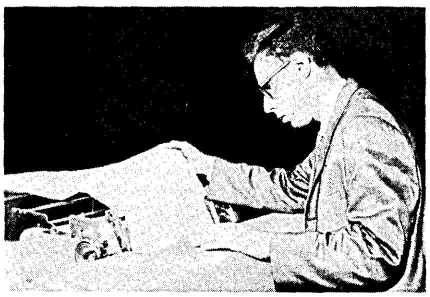
TWENTY YEARS AGO/TEN YEARS AGO

LOOKING BACK



Frank Rosenblatt, circa 1958.

July/August 1958
ARTIFICIAL INTELLIGENCE

Twenty years ago we still had some very simple, mechanistic (and probabilistic) concepts of how the human brain functioned. So simple, in fact, that in an August 1958 article, DATAMATION reported that "... some work which had been performed at Cornell Aeronautical Laboratory indicated that at last a machine operating on the principle of the human brain appeared possible, at least as a laboratory model."

The machine was called a perceptron and it was developed by a research psychologist named Frank Rosenblatt. At an early demonstration Rosenblatt posed the question: Is it possible for a machine to have original ideas? His answer equivocated only slightly: "With regard to the perceptron it appears that we must answer this question concerning original ideas in the affirmative."

An IBM 704 was used to simulate the presentation of various sensory stimuli (e.g., various shapes) to a tv-like camera hooked to the computer system. Instead of recognizing the target shapes by comparing them to a prestored inventory, the perceptron's "recognition is direct and essentially instantaneous, since the association by which a perceived stimulus is identified is derived in the form of new pathways through the system rather than from a coded representation of the original stimulus."

Heady stuff that, back in 1958.

Dr. Rosenblatt went on to say that they would be working on advanced systems and that the perceptron concept was one of the "most important scientific challenges of our time." The perceptron, he stated, was the first brain model to be wholly consistent with whatever is known of the biological nervous system. And further, humanity's very survival might depend on the ability to quickly and accurately deal with complex data. Perceptron applications such as automatic landing systems, automatic pilots, and recognition systems of almost unlimited variety were foreseen, and applications to library research and scientific data gathering were strongly indicated.

What happened to the perceptron's bright promise? Well, as time went on and the world became more complex, the theories supporting the perceptron concept began to unravel. And in 1969 the coup de grace appeared in a book by Marvin Minsky and Seymour Papert, published by MIT Press. The two artificial intelligence experts presented hard proof that the perceptron would mathematically be able to identify only patterns that were, in topological terminology, "simply connected." The perceptron, it turned out, couldn't perceive very much after all.

August 1968
COMPUTER INDUSTRY

The late sixties were euphoric times for the computer industry and DATAMATION's August 1968 issue reflected concerns far removed from debates over the ascendancy of man or machine. Angeline Pantages presented an introduction to third-party leasing firms and talked about Greyhound Computer, Randolph, Data Processing Financial & General, Levin Townsend, Leasco, and others. How many of these, she wondered, would still be in the field by the time the fourth generation of computers came around?

Boom times also meant that computer entrepreneurs were everywhere (some might have said as thick as thieves) and an article on going public was particularly appropriate.

Although these were the industry's salad days, not all was fun and games. Burroughs announced that delivery of their 8500 supercomputer was being delayed because of hybrid circuit troubles and AT&T was smarting under the sting of the June 26 Carterphone decision. Ma Bell mumbled darkly about proposing new tariff provisions that would "protect the telephone system against harmful devices . . ." ✻

FOR AS LITTLE AS $1600 A MONTH YOU CAN ADD FULL TELEPROCESSING CAPABILITIES TO YOUR MAINFRAME.

That's right. The Datapoint Attached Support Processor (DASP)™ can provide your mainframe — a 360, 370 or any other compatible mainframe — with full batch teleprocessing capabilities. And, DASP can do this without requiring costly upgrading of the mainframe and without disturbing the mainframe's existing local processing capacity.

DASP consists of a Datapoint processor, disk storage, interface to the mainframe byte multiplexer channel, and communications equipment. Plus the software needed to make it a complete system.

Here are just a few of the reasons why DASP is the painless, practical and profitable way to add telecommunications to your mainframe.

- Adds no communications overhead to mainframe — spools, queues and schedules data automatically on its own disk. Passes data to mainframe in unit record format.
- Handles up to 4 high-speed telecommunications lines simultaneously, incoming and outgoing.
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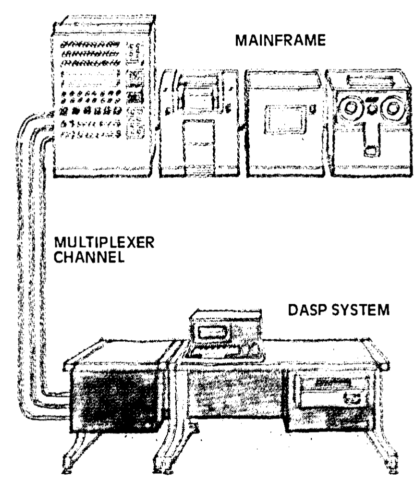
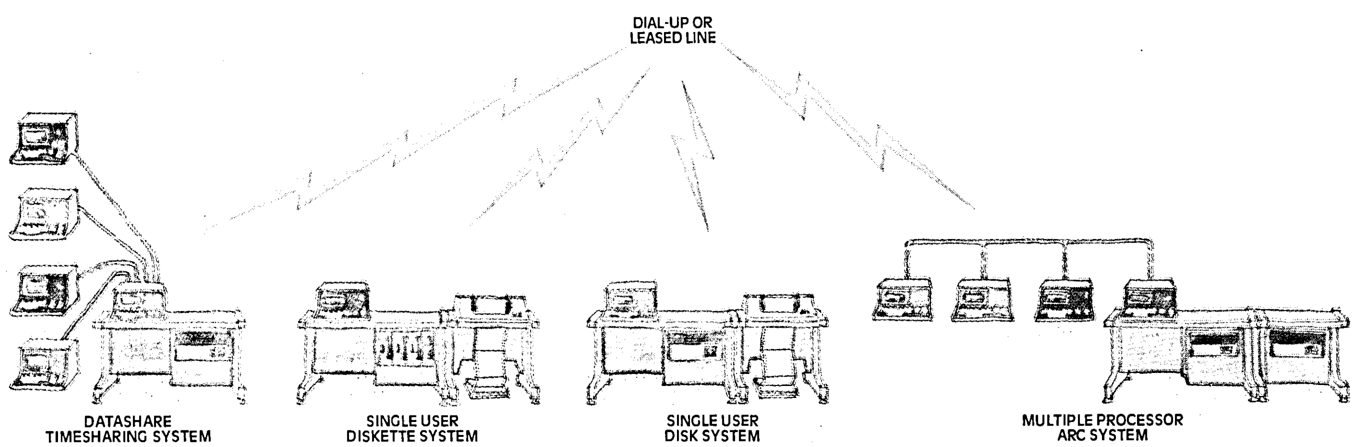
- Compatible with all IBM 360, 370 and compatible systems with byte multiplexer channels.
- Can be utilized when mainframe is down or otherwise engaged.
- Automatic, unattended operation day or night for lowest cost data communications rates.



- Complete system log for billing reports, system analyses, and management reports on network operations.
- Efficient line protocol.
- Utilizes a variety of telecommunications services, including DDD, FX, and WATS.
- Standard automatic calling and answering features.
- Allows timely and cost-effective implementation of a dispersed processing network.
- A variety of remote Datapoint systems can be used — including the 1150, 1170, 5500 and 6600 and their peripherals.
- May be used with DATASHARE multi-terminal systems and ARC multi-processor configurations.

And the prices can't be beat. A one-line DASP system can be leased for $1600 a month; incremental line costs are only $75 per month. If you need to make the move to telecommunications, let DASP make it a painless, practical and profitable transition.

For more information contact the Datapoint sales office nearest you.



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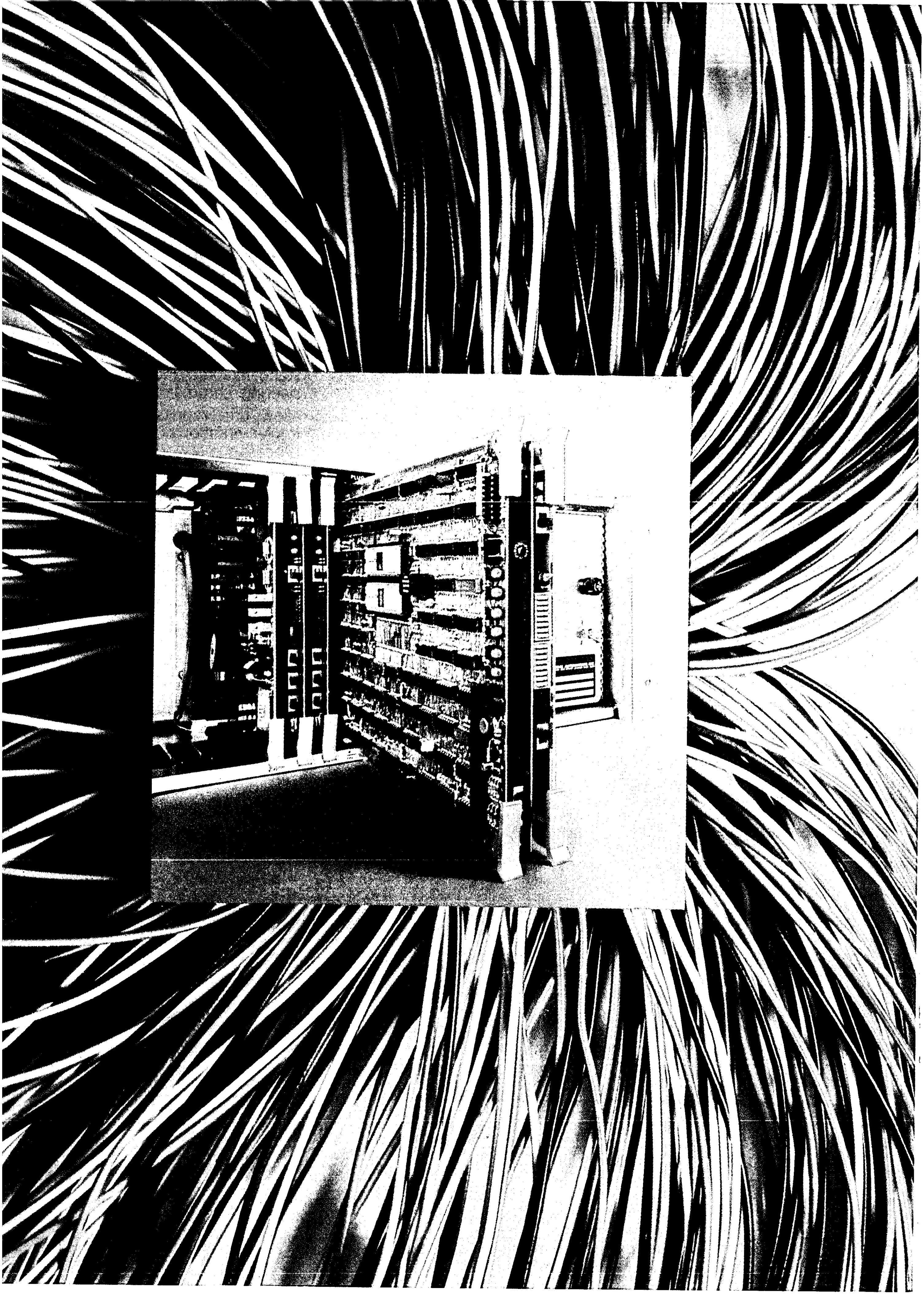
The leader in dispersed data processing™



Count on GA to help carry the load in the most ambitious computer networks.

General Automation: selected by the world's largest corporations, in multi-industries, as a working "partner" in advanced network development.

Financial. Developed with the world's largest bank: a GA network of 60 mini-computers regionally modularized. Handles data on ten-million accounts. Teller response: one second. Up to 345,000 transactions per hour. Through 10,000 terminals in 1200 branches.

Factory testing. The world's largest automotive firm controls quality in their carburetor division with a 129-minicomputer GA network. Conducts 460,000 QC procedures per day: 18-20 tests on 23,000 carburetors daily sharply reduce reject rates.

International banking. GA individually configured over half the 369 member-bank connections into the world's largest interbank network, SWIFT. Nearly 200 sophisticated GA terminal systems: transacting billions of dollars of SWIFT fund-transfers a day.

Broadcasting. For the world's largest television corporation: a complex GA 9-mini-computer network. Controls all TV program/commercial feeds to over 200 affiliated stations. With fail-safe backup systems built in by GA, downtime is nonexistent.

Competing against the world's best-known sources, General Automation was selected by these innovative corporations—*after* exhaustive analysis demonstrated GA's superiority in networking technology.

There's not a minicomputer company today that can touch GA's proven performance in ambitious distributive processing networks. In major industries worldwide. In many highly diverse applications: not only financial, factory testing, international banking, broadcasting, but into telecommunications, energy management, publishing, manufacturing, process control.

GENERAL AUTOMATION

For any type of operation, any volume, any speed—count on GA to help carry your load. And you'll be in good company.

☐ Please send information on GA's capability in distributive processing networks.

☐ Contact us for immediate consultation.
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Name________________________

Title________________________

Clip coupon to business letterhead and return to General Automation, 1055 South East Street, Anaheim, CA 92803.

CIRCLE 39 ON READER CARD

A SMALL ANNOUNCEMENT

Our good news comes in a small package. It's the new Verbatim® Mini Data Cartridge, model TC-150. We've designed it to store data for today's minicomputers. Intelligent calculators and terminals. Word processors. Point-of-sale terminals. Data acquisition instruments. And more. Matter of fact, it plugs right in wherever you're now using 3M's DC-100A or HP's 9162-0061 mini-cartridges. It can be used on HP, TI, Savin, Qantex and 3M drives, among others.

Small wonder!

The TC-150 offers the same rugged packaging, long life and 100% performance testing of all our Verbatim products. And because each Mini Data Cartridge uses quality Verbatim media, you're assured that your data will play back the way you recorded it, bit for bit, byte for byte.

Actual data storage figures depend on your data format, but the recording formats for the Verbatim TC-150 range from single-track 800 bpi up to dual-track 1600 bpi. With room to grow.

Quality mini media. That's our business. At Information Terminals Corp. the whole message is quality.

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WHEN YOUR DATA MUST PLAY

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CIRCLE 22 ON READER CARD

INTRODUCING THE BTI 8000 32-BIT
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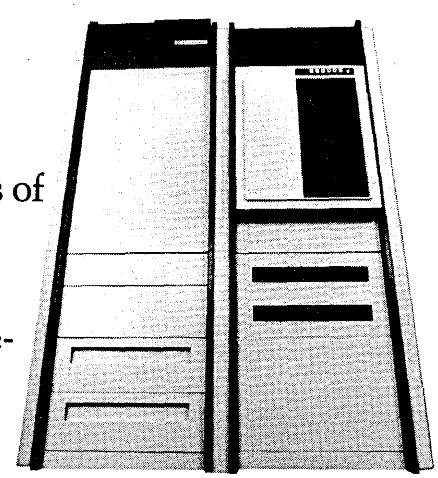
The BTI 8000 uses new hardware and software technology to offer mainframe level performance at an order of magnitude lower cost.

The BTI 8000 can concurrently support hundreds of interactive users and batch tasks.

The BTI 8000 provides multiple languages... PASCAL, FORTRAN, BASIC, RPG II and COBOL, and includes a CODASYL compliant Data Base Management System.

The BTI 8000 is enormously expandable: 1 to 8 CPUs; 256,000 to more than 100 million bytes of core;



BTI, 870 W. Maude Ave., Sunnyvale, CA 94086. Sales Offices: Cherry Hill, NJ (609) 662-1122; Minneapolis, MN (612) 854-1122,

INTRODUCING THE NEW COMPUTER THAT ISN'T.

The biggest problem with buying a new computer is that you have to buy a *new* computer. An untried, unproven computer.

The new Classic 7870, the newest member of the MODCOMP Classic family, solves that problem. Because it has all the performance features of the Classic 7860, which we introduced earlier this year. Except for one thing. It has four times the memory capacity.

With its large solid state memory (up to 2 million bytes) and an effective memory cycle time as low as 125 nanoseconds, it gives you the speed and capacity you need for demanding scientific, engineering and large process control applications.

And because the 7860 has already been tried and proven, the 7870 gives you something that no other new computer can offer you — a track record.

Classic beats DEC, Interdata, Prime and SEL.

In benchmark tests by computer users measuring both computational and I/O performance, the Classic 7860 has outperformed DEC's 11/70 and VAX. Interdata's 8/32. Prime's 400. And SEL's 32/75.

Hard to believe? Not really. Not when you consider some of the features we've built into the Classic.

Both the 7860 and 7870 have our unique multi-word (16-64 bit) architecture. Pipelined instruction processing. Our super fast floating point processor. And hardware instructions that are specifically designed for fast Fortran execution.

You don't have to trade reliability to get Classic's performance.

The best thing about the Classic isn't its performance. It's the fact that its state-of-the-art performance isn't achieved at the expense of reliability.

Since its introduction, the 7860 has been tested exhaustively by computer users in both scientific and process control applications.

They report that the Classic is as reliable as any computer MODCOMP has ever introduced. And that's saying something. Because independent surveys have consistently rated MODCOMP computers as the most reliable real-time systems on the market.

Why buy a new computer when you can buy our new computer?

The Classic is supported by a comprehensive set of operating systems and network extensions that have been used successfully by some of the most demanding computer users in the world. We also provide all the documentation you need to implement it quickly and easily. Plus a worldwide network of service specialists.

In fact, the only thing the new Classic 7870 doesn't give you is something you don't want anyway.

The problems associated with new computers.

For more information, send for our "MODCOMP Classic Family" brochure.

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CIRCLE 73 ON READER CARD

LOOK AHEAD

MORE AND BIGGER FROM HONEYWELL

Honeywell, which ballyhooed its big Model 66/85 in early 1977 only to drop it last spring, never considered it as its ultimate big machine, sources close to the company say. It was to be a "meantime" offering. A really big machine is supposed to be in the offing--like two years away. And CP-6, an operating system under development by Honeywell for its Xerox customer base, is supposed to be the operating system for the new big machine and will become Honeywell's mainstream operating system replacing GCOS.

BEWARE OF 303X LESSORS

Some computer lessees are reportedly being burned by lessors who can't deliver on the 303X systems they promised. The lessee orders a system due in, say, nine months and gets talked into leasing another machine -- a 158, maybe -- in the interim. But the lessor doesn't really own the promised 303X. He's merely acquired a delivery position. Consequently, IBM, which is trying to discourage position purchasing, refuses to install the system with the lessee. Meanwhile the lessor shrugs and walks away claiming there's nothing he can do and the lessee is stuck with the 158 at high monthly rates.

If that's not bad enough, some lessees are also having to shell out whopping premiums for the new IBM machines -- premiums that are often concealed in the lessor's contracts. One California user, for example, just discovered a $250,000 premium buried in a 3032 contract.

SERIES/1 DOING WORK OF 370s

An industry observer suggests that IBM's Series/1 version of the editor for the 370 time-sharing option (TSO) may be another one of those internal developments that users latch on to as a hot product idea. Only this time, it is a General Systems Div. idea and it sells Series/1s to do work that would have been done on a 370. The ease and economy of using a mini that looks to the user just like the popular Structured Programming Facility (SPF) is so compelling that it is unlikely to be confined, claims the source, to IBM minis for very long.

AT&T EYES BRITAIN'S VIEWDATA SERVICE

AT&T, hungry for new marketing opportunities, is rumored to be more than interested in launching a data base service operation in the U.S. similar to the Viewdata service the British Post Office is slated to begin market testing this month (March, p.213). Sources report that Ma Bell already has had tentative talks with the New York-based Insac Group, Ltd., the U.S. subsidiary of the British Insac Data Systems Ltd., which holds exclusive marketing rights to Viewdata. Apparently anxious to acquire licensing rights from Insac, the communications giant is one of a number of U.S. companies taking a serious look at a Viewdata-type venture.

A possible stumbling block to AT&T's Viewdata plunge may be the Congress. Although there currently are no restrictions on the books prohibiting such a move by Bell, Congress, in its deliberations on the newly proposed Communications Act of 1978, may bundle into the bill a cable tv regulation calling for a separations principle. Under such a setup, AT&T could provide the cable facilities but not the data base services. Without such a restriction, telephone companies are expected to swarm into the cable market. "And having done that," worries one industry insider, "it's a short step to them providing not only entertainment programs but any and all data base services."

ICL LOCKS OUT THE COMPETITION

Britain's International Computers Ltd. is being investigated by the European Economic Community (EEC) over alleged "restrictive practices" for locking out third party peripherals manufacturers. The U.K. Office of Fair Trading also is investigating the big mainframer over a complaint from Britain's Systems Reliability Ltd., of Luton, England, an add-on company, that ICL withholds documentation and logic drawings and terminates maintenance warranties from users who go outside ICL for add-on store and memory. SRL is only one of several companies in the add-on business that have asked the EEC's DG 4 Competition Directorate to look into ICL's operations.

ICL also is levying a 20% "software rights" charge on users of third party peripherals and won't allow its software to be used on non-ICL equipment, claiming the add-on companies are "interfering" with its cpu's and trading on its capital investments in machine and systems software. Both the U.K. fair trading office and the EFC decline to comment on "such a confidential matter."

IPL ENTERING IBM 158 FRAY

Watch for competition in the IBM software-compatible mainframe market to heat up again soon with the expected entry of IPL Systems Inc. into the IBM 370/158 marketplace. The machine, to be called the Omega 480 Model III, will also be pitted against Itel's AS/5. One interesting wrinkle to the new equipment is that it will have IBM's ECPS (extended control programming support). IBM offers the microcode enhancement on its 148, but not on the 158, which means IPL Systems will be in the strange situation of offering an IBM feature that IBM can't offer. So far IPL Systems has shipped nearly 60 Omegas to Control Data, which markets them for IPL.

REAL ESTATE THROWN IN

Back when Xerox was still in the general purpose computer business, it sold two Sigma 9s to Dun & Bradstreet before D&B woke up to the fact it didn't have room to house them. "No problem," said XDS' Don McKee, "we'll build you a building." Said building is now fondly known as the Don McKee Memorial Computer Center.

RUMORS AND RAW RANDOM DATA

A minicomputer from XDS? Not quite, but Telefile Computer Products which plans to reintroduce the XDS Sigma 9 late this year or early next (p.55) will follow it up with the Sigma 1, a minicomputer which will run all Xerox software and will be in the price range of an HP 3000...Applications Software, Inc., Torrance, Calif., has landed what may be the largest contract to an independent -- a $5 million order from an undisclosed company for its file management system and its end-user oriented IMS inquiry system, called ASI Inquiry...Cambridge Memories is working on a high density add-on memory for Digital Equipment Corp. PDP-11s.

"When we first looked at MARK IV, we weren't even interested in acquiring software — we were just doing an evaluation of data base management systems. MARK IV sounded so good that we had to take a closer look. Because of the capability and productivity improvements it offered, we decided to go with it immediately.

"We've had such tremendous success with the system that we have made it the standard programming language — the only Cobol work we do now is maintenance of existing systems.

"We're extremely happy with the way MARK IV works with our data base. We installed IMS with DL/1, and that afternoon we were processing off the data base with MARK IV.

"An important part of our success has been in getting MARK IV out to our users. For example, the Director of Budget uses the MARK IV On-Line Query Language for evaluations and projections. Our Registrar people do the same with the MARK IV batch facility. When the user can get his own report out quickly, it creates immense satisfaction and reduced costs for all of us.

"As far as the productivity of my own programmers, I've found that what takes a week-plus in Cobol takes only a day with MARK IV. We're going to use MARK IV to do all the batch work.

"When people ask me what I think of MARK IV. I tell them they can't afford **not** to look at it. I am a firm believer in the results and benefits of MARK IV. It's one of the best pieces of software I've ever used."

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

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Views expressed are those of Mr. Baker and not necessarily those of the University.

CIRCLE 17 ON READER CARD

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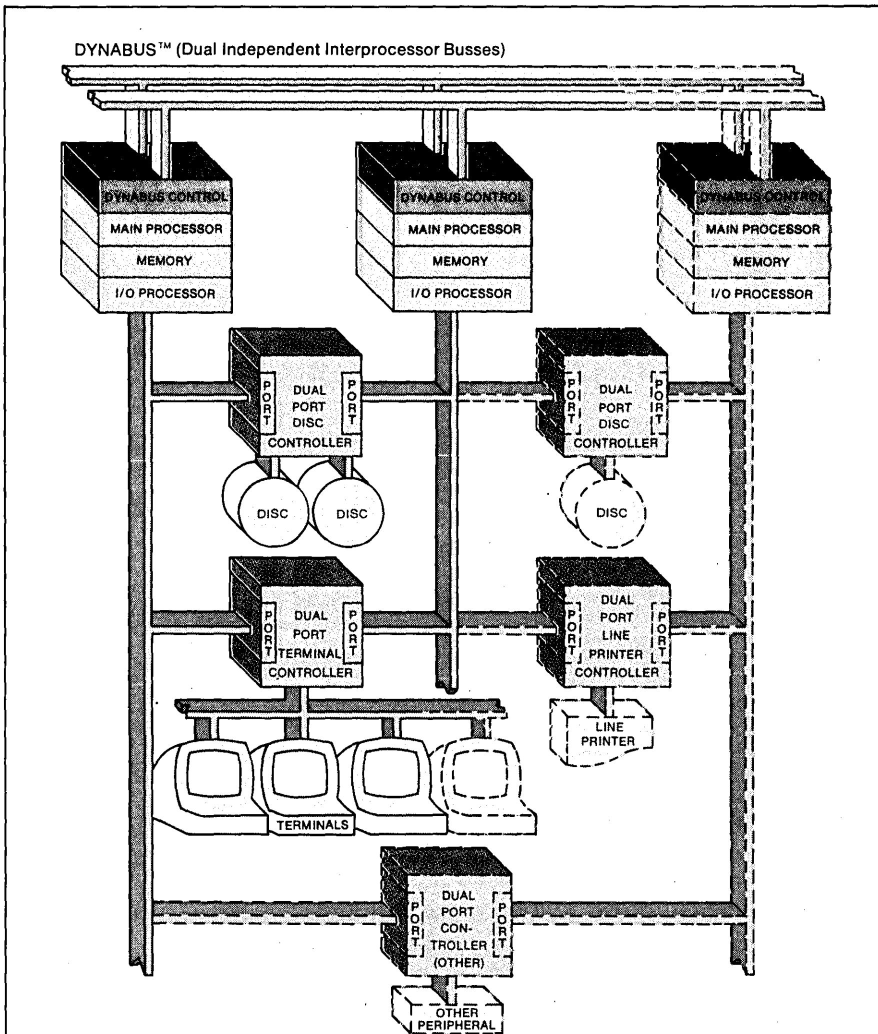
Multiple Processor FORTRAN. Fast.

Tandem FORTRAN runs on the Tandem NonStop™ System, the only multi-processor system designed from scratch for NonStop, transaction-oriented, data base applications. And because Tandem FORTRAN runs under our Guardian Multiple Processor Operating System, no custom software is required. Our FORTRAN utilizes all of our Guardian Operating System features including NonStop operation, re-entrant code, interprocessor communications, virtual memory, and ENSCRIBE data base record management facilities for keyed, relative and sequential access, multi-key data paths, and concurrent record access. Our benchmarks show our FORTRAN to be exceptionally fast, and fully capable of running in a multi-language environment without penalty.

Tandem NonStop FORTRAN conforms to full language specifications of ANSI FORTRAN, X3.9-1977. There's no necessity to deal with subset language specifications. Extended features include RECORD Structures for data base compatibility as well as complete facilities for Interprocess Communications. Firmware support of both extended and standard Floating Point is provided in addition to a host of Extensions which capitalize on Tandem Computers' unique NonStop operation. Six data types are supported, including LOGICAL and CHARACTER. Operators can be arithmetic, character, relational or logical. And Specification Statements include IMPLICIT, PARAMETER, INTRINSIC and SAVE as well as all the usual facilities in each of these categories. Noteworthy among our Control Statements is Block IF. It's FORTRAN as never before.



The Tandem NonStop System is composed of up to 16 multiple, independent processors with dual communications paths between all system modules. The result is not only continuous operation, but throughput unmatched by any other system of comparable cost.

With STARTBACKUP and CHECKPOINT. These functions allow our FORTRAN to utilize the NonStop capabilities of our Guardian Operating System. STARTBACKUP is called once at the beginning of a program to establish the NonStop mode. Thereafter, CHECKPOINT is used to pass critical information to the backup process. Checkpoints will automatically occur upon any OPEN or CLOSE after the backup has been created. With STARTBACKUP and CHECKPOINT, Tandem's Nonstop FORTRAN is freed from the down-time, restart and revalidation which plague the user of any other FORTRAN.

Structures for Record Definition. The constructs RECORD and END RECORD are used to define record structures in Tandem FORTRAN. And Data Definition Language may also be used to transcribe a schema into FORTRAN RECORD structures.

Data Base Record Management. Extensions have been made to the Tandem FORTRAN READ and WRITE statements to permit the full use of our ENSCRIBE Data Base Record Management facilities. This

CALENDAR

SEPT.

COMPCON FALL '78, COMPUTER COMMUNICATIONS NETWORKS, SEPTEMBER 5-8, WASHINGTON, D.C.

A choice is given attendees between three tutorials: a 1978 Revision and Update on Computer Networks, A Practical View of Computer Communications Protocols, or A Survey of Software Validation Methods. The keynote session will feature Henry Geller, Assistant Secretary of Commerce, speaking on "A Government Perspective of the Telecommunications Environment and Related Policy Direction"; Paul Henson, chairman, United Telecommunications Corp., presenting "A Carrier's Perspective of Telecommunications in a Competitive Environment"; and Lewis Branscomb, vice president and chief scientist, IBM, who will address "Computing and Communications: A Perspective of the Evolving Environment." Compcon Fall '78, P.O. Box 639-P, Silver Spring, MD 20901.

WESCON/78, SEPT. 12-14, LOS ANGELES.

Western Electronic Show and Convention, sponsored by the San Francisco Bay Area and Los Angeles Councils of the IEEE and the Northern and Southern California chapters of the Electronics Representatives Assn. Contact Wescon, 999 Sepulveda Blvd., El Segundo, CA 90245 (213) 772-2965.

PERSONAL & BUSINESS SMALL COMPUTER SHOW, SEPTEMBER 15-17, NEW YORK.

20,000 attendees are expected. Featured at the show will be free lectures on small business applications, software, recreational applications, billing, retailing, and introductory topics. Admission is $5 per day. Personal & Business Small Computer Show, 78 East 56 St., New York, NY 10022.

WPOE '78, WEST COAST WORD PROCESSING & OFFICE/BUSINESS EQUIPMENT TRADE SHOW, SEPTEMBER 26-28, SAN JOSE.

The theme will be "The Electronic Office of the Future." Some topics to be covered by the conference are equipment selection, future trends in systems and applications, word/text processing management and personnel considerations, and "emerging information systems." Contact: Cartlidge & Assoc., 491 Macara Ave., Suite 1014, Sunnyvale, CA 94086 (408) 245-6870.

OCT.

THIRD U.S.A.-JAPAN COMPUTER CONFERENCE, OCTOBER 10-12, SAN FRANCISCO.

The keynote speakers will be Dr. Jerome B. Wiesner, president of Massachusetts Institute of Technology, and Dr. Koji Kobayashi, chairman of the board and chief executive officer of Nippon Electric Co. Ltd. The conference, cosponsored by AFIPS and the Information Processsing Society of Japan, will explore technical advances in the U.S. and Japan as well as similar and contrasting ways of using computers to solve problems. Some subjects to be covered by the technical sessions are data bases, data base management systems, very large scale integration, reliability, computing in health care, and transborder data flow. Contact the 3rd U.S.A.-Japan Computer Conference, c/o AFIPS Headquarters, 210 Summit Ave., Montvale NJ 07645, or call the conference general cochairman, John D. Madden, at (408) 245-5807.

INFO 78, OCTOBER 16-19, CHICAGO.

The theme of the 5th International Information Exposition & Conference will be "Strategic Planning in the Information Age." The emphasis of the technical sessions will be on applications rather than on technology. Some sessions to be given are: Merging Trends in Computer Architecture, New Developments for Data Base Long Range Planning, Interactive Graphics for Management Planning and Decision Making, and Front-end Systems to Speed Up and Improve Data Entry. Contact Clapp & Poliak, Inc., 245 Park Ave., New York, NY 10017.

SECOND ANNUAL COMMUNICATIONS MANAGERS ASSN. CONFERENCE AND EXHIBITION, OCT. 17-19, PORT CHESTER, NEW YORK.

The theme is to be "Telecommunications Challenges/Opportunities—1978." Conference participation is open to those with communications responsibility for their company but not those employed by common carriers, equipment suppliers, or communications consultants. Contact Mr. William Perkins, TWA, J.F. Kennedy Int'l Airport, Hangar 12, New York, NY 11430.

CANADIAN CONFERENCE ON COMMUNICATIONS AND POWER, OCT. 18-20, MONTREAL.

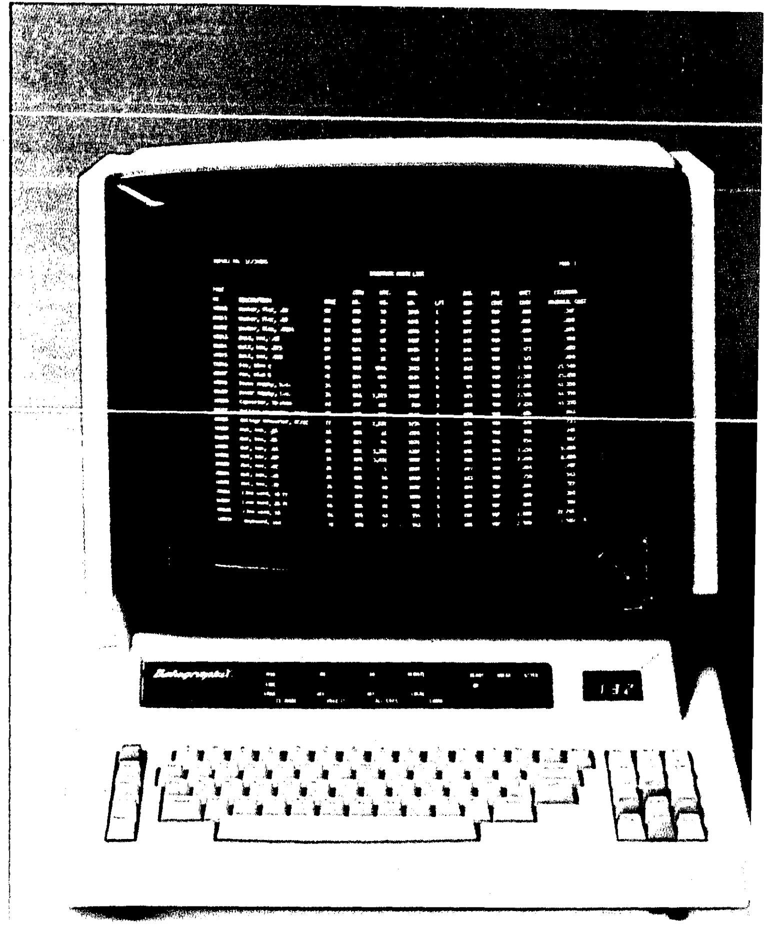
Communications topics to be covered include the design and reliability of systems; design of new techniques of transmission, modulation, coding, and new methods of evaluating external and internal interference. Power topics will include planning of generation facilities, design of transmission facilities, and operation of distribution facilities including automatic operation. CP/PO 757, Succ. "C," Montreal, Quebec, H2L 4L6 Canada (514) 285-1711.

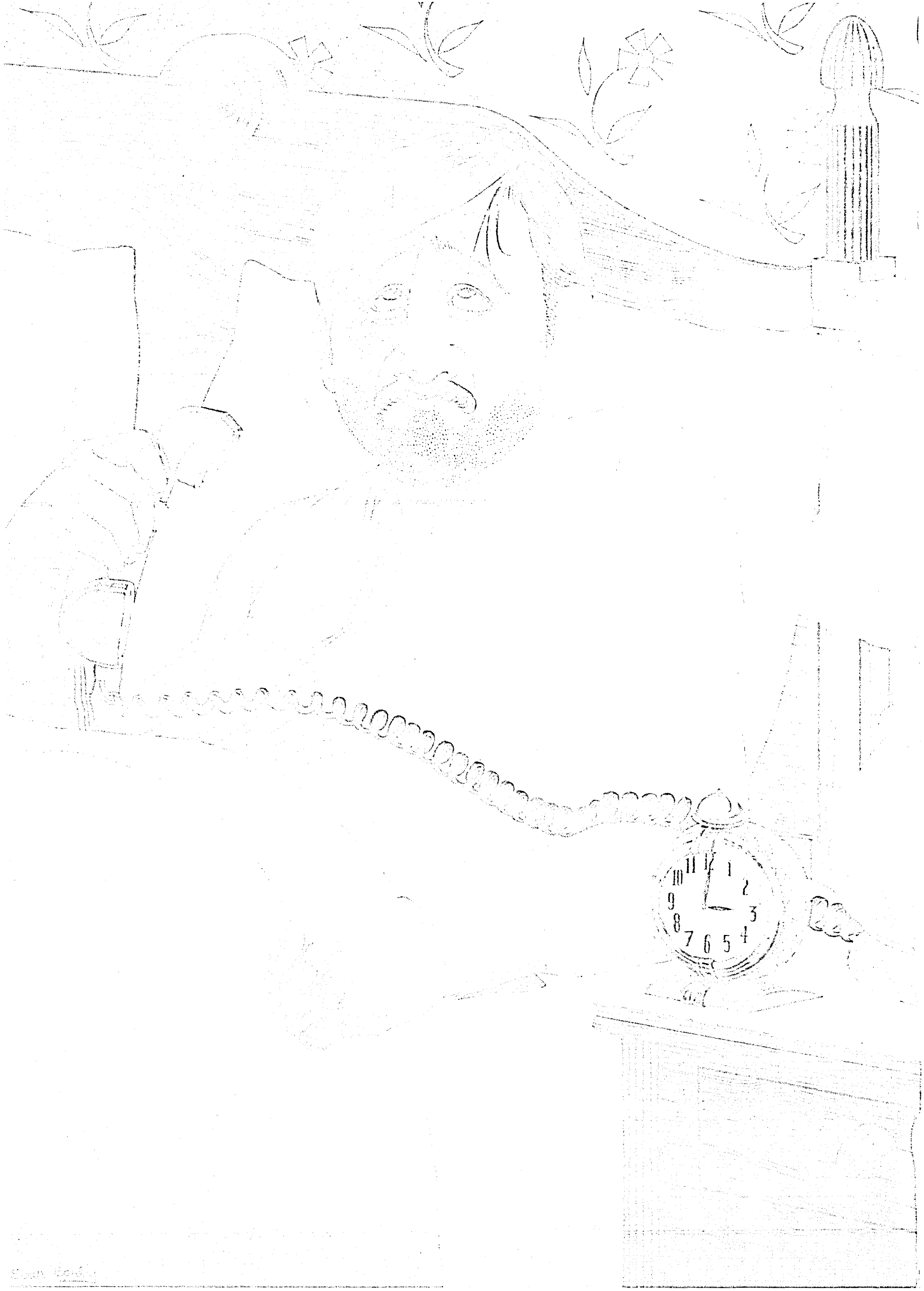
TWELFTH ANNUAL COMPUTER ARCHITECTURE STUDY GROUP/COMPUTER RESOURCES TASK GROUP/DATA AND CONFIGURATION MANAGEMENT CONFERENCE, OCTOBER 23-27, PHILADELPHIA.

Contact: E. J. Nucci, Electronic Industries Assn., 2001 Eye St. N.W., Washington, DC 20006.

FEDERAL MICROGRAPHICS EXPO, OCTOBER 24 AND 25, WASHINGTON, D.C.

There will be no admission charge. Contact Robert E. Harar, National Trade Productions, Inc., 9301 Annapolis Rd., Suite 104, Lanham, MD 20801 (301) 459-1815.





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A DOS Under OS System that uses DOS programs, without reprogramming, as you convert to OS (UCC-2). Circle 92

A Disk Mgmt System that can probably save you the cost of some new disk drives (UCC-3). Circle 93

A PDS Space Mgmt System that eliminates PDS compression (UCC-6). Circle 94

A Data Dictionary/Mgr that really gets IMS under control (UCC-10). Circle 95

A GL/Financial Control System that Accounting has been dreaming of (UCC-FCS). Circle 96

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CALENDAR

COMPUTER PERFORMANCE EVALUATION USERS GROUP MEETING, OCT. 24-27, BOSTON.

The theme of the conference is the role of measurement, evaluation and prediction technology in the major phases of the dp life cycle: planning, acquisition/development, and control. Particular interest is in workload modeling, benchmarking terminal systems, capacity planning, performance standards and installation auditing. Contact Samuel Thompkins, Transportation Computer Center, Department of Transportation, Washington, DC 20590.

DPMA INTERNATIONAL CONFERENCE AND BUSINESS EXPOSITION, OCT. 29-NOV. 1, NEW ORLEANS.

A special management seminar on opportunities for dp managers to reach corporate-level positions will be offered. Contact Carol Harte, DPMA International, 505 Busse Highway, Park Ridge, IL 60068 (312) 825-8124.

SECOND ANNUAL DATA ENTRY MANAGEMENT ASSN. CONFERENCE, OCT. 30-NOV. 1, SAN DIEGO.

The seminars, panel discussions and workshops are to concentrate on the human side of data entry and distributed data entry. Contact Marilyn Bodek at DEMA, 16E Weavers Hill, Greenwich, CT 06830.

ADMINISTRATIVE MANAGEMENT SOCIETY-SAN FRANCISCO CHAPTER 1978 BUSINESS EQUIPMENT SHOW, OCT. 31-NOV. 2, SAN FRANCISCO.

Special emphasis will be on word processing, small and large business computers, microprocessor systems, communications equipment and office systems. Admission to the exhibit area will be free. Contact S.J. "Sandy" Sanford, Jr., Charles B. Slack, Inc., 175 De Haro St., San Francisco, CA 94103 (415) 863-7000.

NATIONAL MICROGRAPHICS ASSOCIATION (NMA) MIDYEAR MEETING, OCT. 31-NOV. 2, SEATTLE.

The theme will be "Micrographics: The Cutting Edge." The conference is designed to emphasize the relationship of micrographics to other related technologies. Contact NMA, Conference Dept., 8728 Colesville Rd., Suite 1101, Silver Springs, MD 20910 (301) 587-8444.

NOV.

CONFERENCE ON COMPUTER GRAPHICS IN CAD/CAM SYSTEMS, NOV. 1-3, CAMBRIDGE.

The objective of the conference is to establish the current state of knowledge in the field and to assess the major problem areas for future applications of computer graphics in CAD/CAM systems. Contact conference chairman Professor David C. Gossard, Dept. of Mechancial Engineering, MIT Room 3-453, 77 Massachusetts Ave., Cambridge, MA 02139 (617) 253-4465.

MINI/MICRO CONFERENCE AND EXPOSITION, NOVEMBER 7-9, HOUSTON.

Contact: Robert D. Rankin, Managing Director, Mini/Micro Conference and Exposition, 5528 E. La Palma Ave., Suite 1, Anaheim, CA 92807.

FEDERAL COMPUTER CONFERENCE AND EXPOSITION, NOV. 7-9, WASHINGTON, D.C.

The exposition will run two days, November 8 and 9. The first conference day will be an introductory program of tutorial seminars on dp basics, procurement, and other subjects of broad interest. The theme of the conference is "Targeting for Improved ADP Performance." Federal Computer Conference and Exposition, P.O. Box 368, Wayland, MA 01778.

COMPSAC 78, NOVEMBER 13-16, CHICAGO.

The IEEE's Second International Computer Software & Applications Conference aims to bring users, researchers, and practitioners together to exchange ideas, experiences and requirements for applications software, management techniques, and software development support, including automated techniques. Contact the general chairman, Wallace A. Depp, executive director, Processor and Computer Software Systems Div., Bell Laboratories, Naperville, IL 60540 (312) 690-2111.

ASIS ANNUAL MEETING, NOVEMBER 13-17, NEW YORK.

The theme of the conference is "The Information Age in Perspective." Technical sessions, an exhibition, and special events are scheduled. The Viewdata Teletext system will be on display, and a nonprofit experimental computer conferencing network will be demonstrated by Murray Turoff, of the New Jersey Institute of Technology, where the system is in use. Non-ASIS members are welcome at the conference. American Society for Information Science, 1155 Sixteenth St. N.W., Washington, DC 20036 (202) 659-3644.

EDUCOM FALL CONFERENCE AND ANNUAL MEETING, NOVEMBER 14-16, WASHINGTON, D.C.

The conference will focus on the future role of computer networking for colleges, universities and nonprofit corporations. Contact Ms. Carol Parysz, EDUCOM, P.O. Box 364, Princeton, NJ 08540 (609) 921-7575.

INTERFACE WEST 78, NOVEMBER 14-16, LOS ANGELES.

10,000 or more attendees are expected. Three conference programs will run concurrently: Small Business Systems, Data Communications, and Microcomputer Design and Application. Interface West, Inc., 160 Speen St., Framingham, MA 01701 (800) 225-4620 (in Massachusetts call (617) 879-4502).

CALIFORNIA EDUCATIONAL DP ASSN. (CEDPA) 1978 CONVENTION AND TRADE SHOW, NOVEMBER 16 AND 17, IRVINE, CALIF.

Teachers, administrators, and dp managers will be present from all levels of California's school system—elementary through university. Contact Sam Price, DPM, U.C. Davis School of Medicine, Davis, CA 95616 (916) 752-3234.

AUTOMATIC TESTING CONFERENCE, NOVEMBER 28-30, SAN DIEGO.

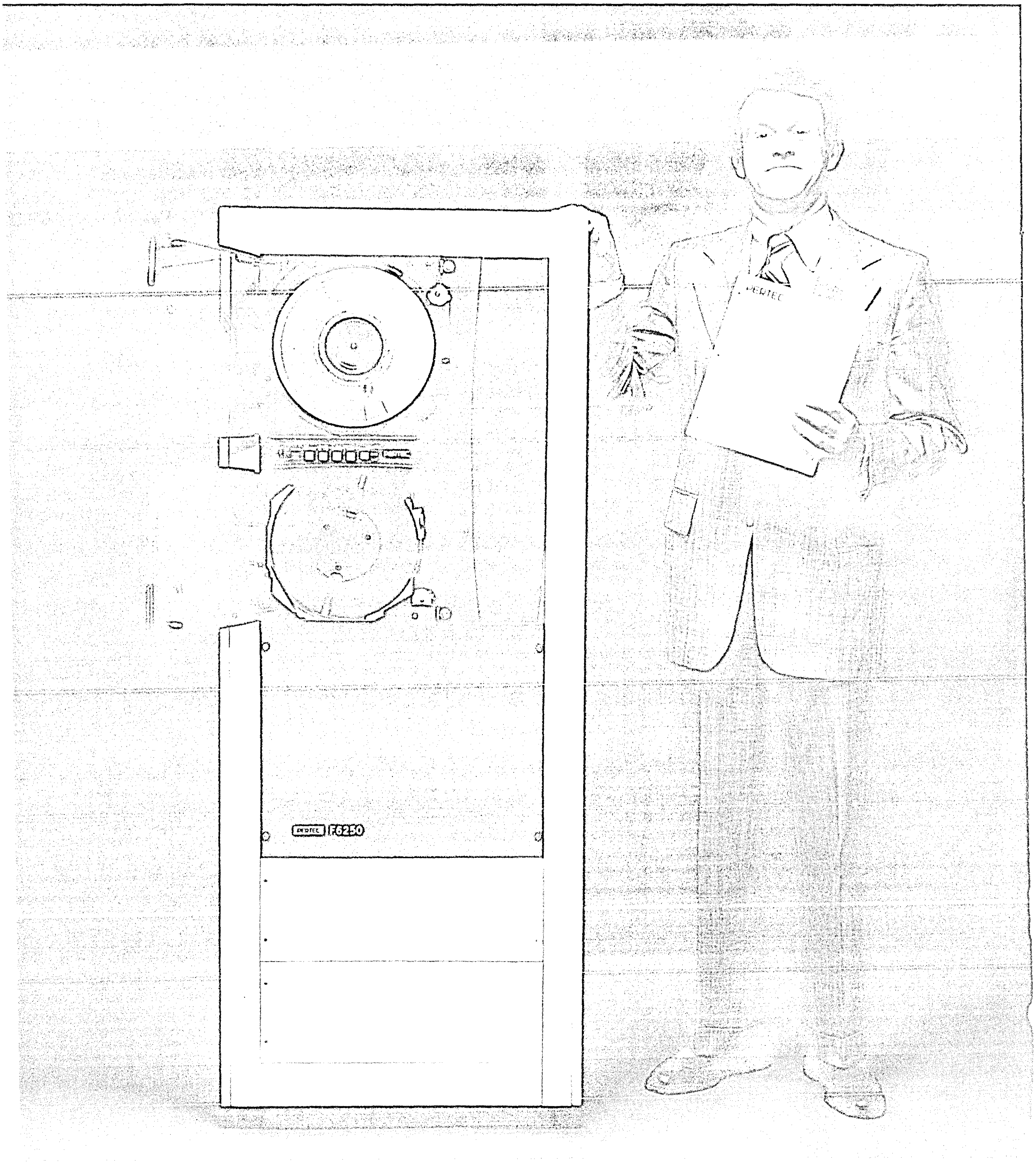
Users and designers will discuss the technology and management of automatic testing. Contact R.W. Aguais, general chairman, General Dynamics Electronics, P.O. Box 81127, MS 7-98, San Diego, CA 92138 (714) 279-7301.

DEC.

INK JET PRINTING, DECEMBER 10-12, CARMEL, CALIF.

Graeme S. Minto, of Cambridge Consultants, Ltd., will chair this small-group conference which will explore in depth trends, progress, applications, and markets for ink jet printing. $475 fee includes room, board, and extras (transportation from the airport, drinks, etc.) Contact: Richard D. Murray, Director of Conferences, Institute for Graphic Communication, Inc., 375 Commonwealth Ave., Boston, MA 02115 (617) 267-9425. ※

ECONOMY-SIZE GIANT:



The little GCR subsystem smart enough to save your end-users time and money.

And the book to save you trouble.

The machine in the picture is one of the most intelligent and most sophisticated data storage units ever developed for minicomputers: The Pertec FT6250, with a recording density of 6250 bpi.

The man in the picture is holding the most comprehensive, authoritative application note in the business. It's a complete "road map" for the GCR interface designer.

Both machine and manual were created by one of the world's leading independent manufacturers of minicomputer peripherals. Pertec.

There's nothing else quite like them anywhere.

We realize these are extraordinary claims. And we make them with confidence, for some excellent reasons.

Self-diagnosis in 3 different modes.

For unsurpassed data reliability, we built a very fast, very powerful, 8085 microprocessor right into our GCR formatter.

It provides three separate troubleshooting systems. And no comparable formatter has it.

First, in the idle mode, a constant alert system continuously polices both the formatter and tape drive for errors.

Second, with the built-in keyboard, the service technician can execute diagnostic programs without tying up the computer...and find precise trouble spots spelled out on the LED readout.

Third, with our exclusive Smart-Bus™ interface, the operator can run full diagnostic routines directly from the computer itself. The formatter logs all errors, so the operator can check the memory system's integrity at any time...without calling in a service engineer.

All this easy self-diagnosis means exceptionally low cost of operation.

Yet the FT6250 costs about the same as other storage units without these features.

Smart-Bus:™ An interface so sophisticated, it's simple.

You may not have heard much about interface requirements from other manufacturers of GCR systems. They don't like to talk about them. Because frankly, the requirements can be very complex.

But *we* don't mind talking about interface.

Because ours is far simpler than anybody's. It's a bus design that allows the parallel transfer of entire 16-bit words directly.

The whole interface has only 28 lines. (Compare that with other GCR interfaces.)

And, as we said before, it enables your computer to interrogate the formatter for errors.

No wonder we call it the Smart-Bus.

Pertec's Application Manual: Important Reference Book.

As one of the leading independent peripheral suppliers we know what minicomputer OEMs are looking for.

That's why systems designers historically have turned to Pertec application notes for the last word on design adaptations.

Our newest manual explains precisely and concisely what GCR is and how to interface.

It's recommended reading for every OEM that wants to offer its customers big computer performance at mini-size and price.

Limited edition, first-printing copies of the notes are available only through your Pertec sales representative.

We'd like to give you a copy. So when your first FT6250's are delivered, you'll be all set to tie in to the biggest little memory subsystem in the business.

Just write, on your company letterhead, to Pertec, 21111 Erwin Street, Woodland Hills, CA 91367. Or call the Pertec regional sales office nearest you: Western area (213) 996-1333. Midwestern area (313) 668-7980. Eastern area (603) 883-2100. England (Reading) 582115.

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CIRCLE 47 ON READER CARD

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LETTERS

SORT SCOOP SETTLED

In February, DATAMATION's "News in Perspective" section contained an item that caused quite a stir: "Sorting 30 Times Faster with DPS" (p. 200). The item described a new sort procedure called "distributive partitioning" as the procedure had been presented in a publication titled *Information Processing Letters* (North-Holland Publishing Co., Amsterdam, Vol. 7, No. 1, Jan. '78, Willem Dijkhuis, ed.)

Our story was written from that description and from information supplied by the newsletter's editor and by Prof. W. M. Turski of the Institute of Informatics, Warsaw Univ. The originator of the method, Wlodzimierz Dobosiewicz, who is a student of Turski's, was not available for comment.

Since DATAMATION's publication of the story, we have received several letters criticizing the claims for DPS, and, four months later, Dobosiewicz himself has come forth to criticize the manner in which his method was presented. What follows is one last letter from a reader, Dobosiewicz's comments, and an analysis of DPS by David Ferguson. David is well known in sorting circles, having developed various sorting techniques through the years and having originated the well known PISORT. We think his comments will close the issue, finally putting it into perspective.

In his letter in the May issue Dr. Sparks explains the theoretical limits of sorting times. I would like to point out the fact that "binary merge sorting" has exactly the theoretical minimum of $m \log_2 m$ comparisons necessary for sorting m elements in the worst case. Clearly, merging two files of m_1 and m_2 elements requires at most $m_1 + m_2 - 1$ and at best $min(m_1,m_2)$ comparisons. For sorting a file of m elements, one may, in the k-th step, merge all pairs of $(2i\text{-}1)$-th and $2i$-th sorted subsequences consisting of 2^k elements each (except for a possibly unpaired and shorter last subsequence). There are at most $(\log_2 m + 1)$ such steps, and in each step there are at most $m/2^k$ pairs of subsequences each requiring at most $(2^k - 1)$ comparisons. This adds up to a total of at most $m \log_2 m$ comparisons.

If no optimizations are added, the best case requires half as many comparisons.

By the way, the distribution of elements as done by Dobosiewicz's DPS requires that arithmetic operations may be performed on the elements to be sorted. Though, normally, these operations are more expensive than comparisons, they nevertheless seem to remove a factor $O(\log_2 m)$ from the sorting time required for uniformly distributed elements.

RAINER ZIMMER
Siemens AG
Munich, Germany

I read with total misbelief the review in DATAMATION of an article which I published in *Information Processing Letters.* The author of the review seemed to be a novice not only in the field of sorting (for example, in claiming that my algorithm uses less memory than other algorithms, which is double nonsense: first, my algorithm requires a lot of extra space; and second, who can use less space than Heapsort, which uses none!), but also generally in computer programming (according to him my method executes less than half an instruction per sorted element). Finally, the author of the review must be a real pessimist as he (she?) was interested mostly in the worst case of the presented algorithm.

Fortunately there was a reference to the original article and I expected that all those who were interested would read my paper. But as this is not the case (DATAMATION published a letter by Dr. Paul R. Sparks and several persons wrote directly to me), I think that it is worthwhile to put things right:

(1) My algorithm is not 30 times faster than Quicksort and I never claimed that. In fact it is not more than three times faster for all practical lengths of the sorted vectors. (It is about twice as fast as Singleton's Quicksort in sorting 30,000 records of random data.)

(2) It requires extra space.

(3) In its worst case my algorithm is several (3 to 4) times slower than Heapsort.

(4) No matter how hard you try, I bet that you will never get an algorithm 200 times faster than Quicksort (in its average case)—and I have never made such claims.

I hope that these comments clarify the real value of my algorithm. I again encourage those readers who are interested in details to read my article in *IPL* (which, as a matter of fact, contains a few errors of secondary importance) or to contact me personally.

Finally, let me reply to two of Dr. P. R. Sparks' comments on DATAMATION's story about my algorithm:

(1) Some sorting algorithms make no comparisons between keys at all; consider LSD radix sort. Therefore, contrary to Dr. Sparks' claim, it is not "obvious that the execution time of a sort routine is directly proportional to the number of comparisons it actually makes while sorting."

(2) The worst case of Quicksort occurs when at each stage of partitioning the smallest (or largest) element is chosen as the pivot for the next stage. Whether the other elements are equal or distinct is of no importance at all.

A final remark: my algorithm is an internal sort algorithm and I do not know whether or not it could be useful in external sorting.

WLODZIMIERZ DOBOSIEWICZ
Institute of Informatics
Warsaw University
PKiN p. 950
00-901 Warsaw, Poland

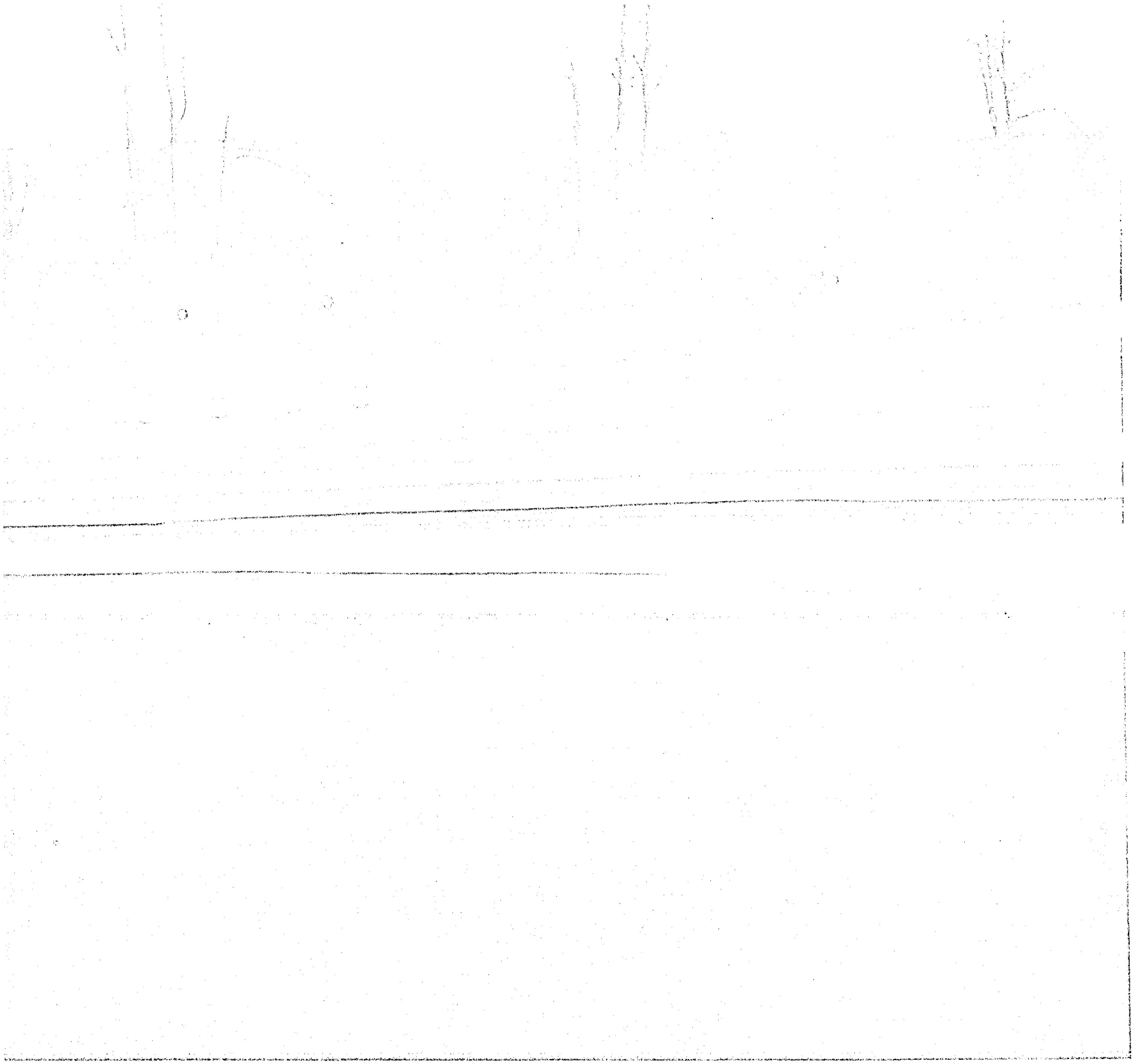
After reading the flamboyant description of Distributed Partitioning Sort, or DPS, and some of the reactions to it, I think it is time for a more sober evaluation of the technique.

This technique uses a "median" algorithm to find the smallest, median, and largest items in the data to be sorted. Then an "address calculation" algorithm is used to attempt to distribute the items into separate groups. If a group has more than one item, that group is distributed in the same manner until, recursively, all of the items are sorted. The "median" algorithm used required $15n$ comparisons for n items. The worst case can happen when $n = 2(2^m - 1)$ items in which case

$$15(n+2)\log_2(n+1) - 30(n+1)$$

MASSIVE UNDERSTATEMENT?

The British are masters of understatement, but International Computers Ltd. (ICL) may think DATAMATION has gone too far. In figuring that company's 1977 earnings (June, p. 86), someone's finger slipped on the calculator keys. In converting pounds sterling to U.S. dollars, we divided instead of multiplying. As a result, we printed ICL's 1977 revenues as $233 million when we should have printed $754 million. When you lose a half $ billion you ought to at least apologize. And we do.



Sperry Univac minis are doing

In Portland, Oregon, Sperry Univac minis help the Police Bureau come to the rescue hundreds of times a day.

Because Boeing Computer Services has computerized all of Portland's emergency services with Sperry Univac Series 77 minis.

Now when a citizen reports a crime, our minis verify the address. Examine the surrounding area for similar calls, hazards, and temporary situations (such as streets under repair). And suggest which units should respond to the call.

This futuristic system coordinates dispatchers and officers and keeps them constantly updated. Much of the paperwork required of field officers is eliminated. And the data base it generates is used for uniform crime reporting and resource allocation.

Boeing Computer Services has found that our minis are cost effective and can handle the job efficiently and with real-time speed.

The Sperry Univac minis used in Portland are just part of our complete family of minis. One and all of them are supported by our powerful software.

If you have a system application, we undoubtedly have a mini that's just right for it. Whether it be business data process-

or about $15nlog_2n$ comparisons must be made. Hence it is what is referred to as an *"nlogn"* sort and as such is better compared to Heapsort than to Quicksort. The trouble with Quicksort is that it is an "n^2" process in the worst case. Therefore when Quicksort took about 0.1 seconds to sort 100 items in the worst case, we could have predicted that it would take about 10 seconds to sort 1,000 items (actual: 9.99) and about 250 seconds to sort 5,000 items (actual: 247).

The number of comparisons is larger than the corresponding number for Heapsort although the author points out that he could have used the method of Schönhage et al. (*Journal of Computer and System Sciences,* 13, 1976) to reduce it by a factor of 5. Nevertheless, times less than half of that reported for Heapsort were quoted. Of course comparison count is not the only factor in determining sort times nor is it clear that the best implementations were made of both methods. Furthermore no times were reported for the worst case for DPS.

The worst case for most comparison type sorts is related to the initial ordering of the data. However DPS has some of the characteristics of comparison type sorts (it uses the median algorithm) and some of the characteristics of radix type sorts (it performs calculations on the keys). The worst case for DPS is a peculiar "logarithmic clustering."

The biggest problem with DPS is that it uses divisions, and lots of them. This would be disastrous on some computers. On the other hand, it may be more efficient than Heapsort in a "paging" environment.

To sum it up, DPS is *definitely* new. It *definitely* has its place. It is *definitely* interesting. And it is *definitely* without merit to claim (as the DATAMATION item did) that it is "30 times faster than existing techniques."

It is disheartening to hear professionals in our industry attempt to discredit a new idea other than their own. And Dr. Sparks evidently did so without even taking the trouble to read the original article. Mr. Tessler states (in July Letters) that it is "nothing more than a clever synthesis of ideas that have been known for some time." This seems like an excellent definition of "invention" to me.

DAVID E. FERGUSON
Topanga, California

RPG II ON MICROS TOO

I read with great interest Robert Wickham's comments in the Personal Computing column of the June issue (p. 273). The pending invasion of microcomputers into the very small business computer market will be a revolution like few we've seen . . . even in our industry.

Mr. Wickham mentions the "vast number of programs in both the proprietary and public domains which could be modified for use on personal computers . . ." Indeed, as a long-time participant in the IBM System/3 and minicomputer world, I have begun to see an impressive amount of mature RPG II software developed for the small-business environment. Once the personal computer makers realize this source for application software, I'll bet we start seeing RPG II implemented on the business micros.

Where will it all end? I, for one, wouldn't be surprised to see "RPG II-on-a-Chip" kits hanging from wire racks at the local computer store someday. That would be a welcome sight to all those people sitting on a lot of RPG II software.

DENNIS A. FLETCHER
Info 3
Woodland Hills, California

RULES OF THE GAME

In your June "Look Ahead" you state that Amdahl lost an order to IBM ". . . in an example of the length IBM is prepared to go to stop competition." Come on, you know better than that.

Competition is the action taken by an individual producer to secure or maintain business with a consumer by offering the most favorable terms vis-a-vis other producers.

IBM in Denmark did whatever it legally could to best the competition. I believe in your business you call it "scooping" the competition, not stopping it.

LARRY A. BECK
Hardware Planning
and Performance Measurement
Manufacturers Hanover
Trust Company
New York, New York

Our Look Ahead editor replies: Sources in Denmark said IBM broke its sequential delivery policy on European 3033 orders; IBM said it didn't. But the company came up with a 3033 15 minutes before the delivery deadline expired. Quite a "scoop."

EMENDATIONS

In the June issue's Display Terminal Vendor Index (p. 217), Computek, Inc.'s old address was listed.

The correct address is: 63 Second Ave., Burlington, MA 01803.

The telephone number listed (617-272-8100) is, however, correct for our present address.

VICTORIA GIBBS
Marketing Dept.
Computek, Inc.
Burlington, Massachusetts

While we enjoyed the article on the Univac II, (June, p. 145) we must advise you that our SDS 910 System has been powered up for 97,925.4 hours and has never been down for as much as eight hours. And, on September 20, the Good Lord willin' and the creek don't rise, the clock will turn 100,000 hours.

While we have discussed replacement, replacement is several years off at 8,640 hours per year of additional clock time.

MARSHALL C. MILLER
Public Utility District of
Grant County
Ephrata, Washington

A BUG-FREE ENVIRONMENT

I thoroughly enjoyed Mr. Dahl's article "The Last of the First" (June, p. 145). I noticed a can of Raid insect repellent in a

cabinet in one of the computer room photos. Now I see how they kept the bugs out of the machine for so long. Now how about user-written routines for application?

ROSS W. ROGERS
Programmer/Analyst
Financial Computer Services, Inc.
Waco, Texas

THE TRUE SPECIALTY OF PROGRAMMERS

Prior to my recent departure from IBM I have spent the last seven years engaged in an intense research project trying to understand the nature of information and information handling activities. My work has brought me to the realization that programmers are really more like manufacturing engineers than they are like logic designers.

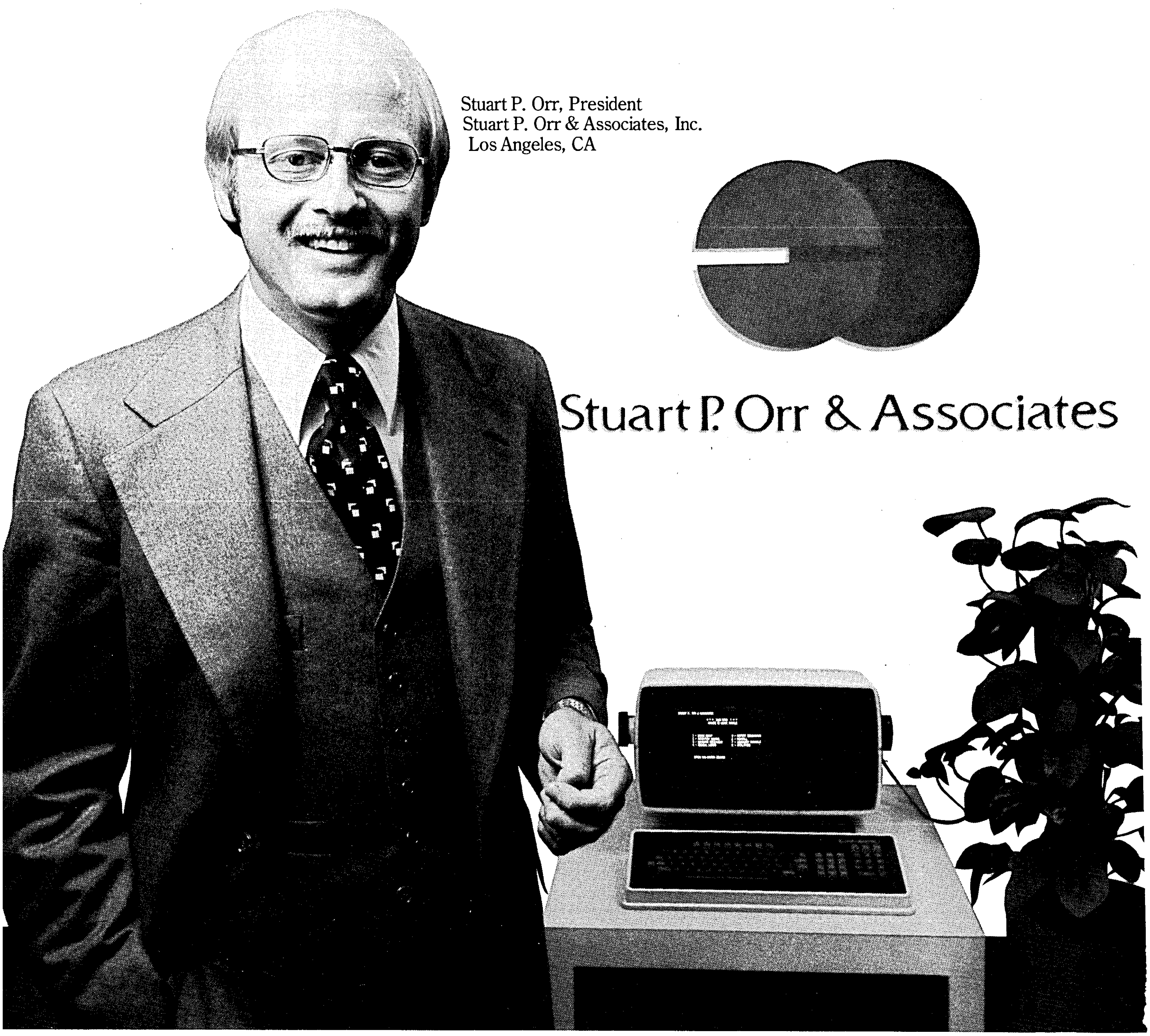
Years ago I was the IBM chairman of the Systems Objectives and Review Committee (SORC), and one of the questions we constantly tried to address was, how do we improve the technical capability of the programmer?

We talked at great length in those days about programmers as engineers and looked for ways of improving productivity, some of which are appearing now in the marketplace. But at no time did we try to make any analogy between the programmer's task and that of engineering disciplines other than logic design.

The programming community faces the

In order to design their own uncomplicated manufacturing management system, Micronics International went to Stuart P. Orr & Associates. "With Orr and Data General's CS/40, we were able to build our own system from the ground up," enthused Larry Resch of Micronics International, a manufacturer of electronic fuzing devices and vehicle security systems. "With 30% annual growth, we need to know where we are in all points of manufacture for every job. We now have the needed information right at our people's fingertips, without flooding the company with paper. And we have visibility into all aspects of our business down to a level impossible with our old manual methods. We'll be able to double

"WHEN A BUSINESSMAN WANTS A COMPUTER SYSTEM, HE WANTS THINGS KEPT SIMPLE."



Stuart P. Orr, President
Stuart P. Orr & Associates, Inc.
Los Angeles, CA

our size without increasing accounting or production clerical staffs."

Stuart Orr sees the CS/40 as "the tool which makes computer solutions to companies' problems a reality—a system to which company presidents can relate. We can provide customized work at packaged software prices. The CS/40 is the most exciting innovation from a systems development viewpoint that has been introduced in the small business computer field. I've already installed five systems and expect to order many more."

Find out how the CS/40 can solve your business problems simply. Call or send the coupon.

The CS/40 makes good business sense. Send me more information. I'm an ☐ end-user, ☐ business system supplier, ☐ I'm too busy to wait for brochures, have salesman contact me.

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Company ____________ Tel. No. ____________

Address ____________

City ____________ State ____________ Zip ____________

Mail to: Data General Corporation, Westboro, MA 01581

Data General Corporation, Westboro, MA 01581, (617) 366-8911. Data General (Canada) Ltd., Ontario. Data General Europe, 61 rue de Courcelles, Paris, France, 766.51.78. Data General Australia, (03) 89-0633. Data General Ltda., Sao Paulo, Brazil, 543-0138. Data General Middle East, Athens, Greece, 952-0557. © Data General Corporation, 1978. DM8

"I'LL BUY THAT."

Larry Resch
Vice President &
General Manager
Micronics
International, Inc.
Anaheim, CA

Data General
We make computers that make sense.

CIRCLE 48 ON READER CARD

problem of being a discipline that is less than 30 years old, whereas the disciplines of engineering and manufacturing are thousands of years old. People attempt to compare programmers to logic designers and engineers in the computer field, when in my opinion they are more like manufacturing engineers or routing specialists, as they work with a predefined set of facilities and move raw materials and subassemblies through those facilities to be processed. Agreed, it's a very large plant they work with—sometimes more than a hundred different kinds of machinery can be used in the process; but a full-sized assembly plant like General Motors is bigger than that, so the job does not seem insurmountable.

I would like very much to get a dialogue started on the question of whether there is something to be learned from manufacturing engineering that would help the dp field get more control, discipline and understanding of what it is we're doing in the world of programming. There are many industrial engineering techniques that have been successfully used in deciding how to build plants, where to put plants, where to put the resources of a physical plant, where the raw materials should be stored and brought from, and how they are to be distributed. I would propose that these questions are fundamental to the activities and processes of handling data as a raw material in a business enterprise. I realize that with the advent of the minicomputer the large centralized system may no longer be the exclusive way to do business, but I also recognize that there is no discipline inherent in how one decides where to put data for remote processes; and it might be useful as we grow into our fourth decade to begin to think about those problems.

D. C. BURNSTINE
Consultant
Petersburg, New York

DISTRIBUTION DISTINCTION

I read with interest the article on the teleprinter terminal survey in your May issue (p. 232).

In that piece you referenced several of our competitors as "manufacturers" when actually they function as distributors, as we do—*for* manufacturers.

RUDOLPH R. MENNA
Sr. Vice President
Group Executive, Equipment Group
Data Dimensions, Inc.
Greenwich, Connecticut

PRIVACY AND NATIONALISM

In your report from the Honeywell Computer Security and Privacy Symposium in Scottsdale in April (May, p. 261) I was quoted as having said: "Nationalism and protectionism are the real European motives (for placing restrictions on transborder data flow)." While you can't report every word of a twenty minute speech, my intention was not made fully clear in your account. What I said was: "The American case was very clearly stated yesterday: The Europeans claim to be concerned with the privacy of the individual. But in fact they are concerned with national sovereignty, national data processing industries, protectionism, danger of cultural dominance, and the operation of multinational corporations. The European case may perhaps be stated thus: The Americans are so eager to secure their business interests and maintain their superiority in data technology that they forget that the legitimate interests of individual European citizens may be at stake."

I then went on to say that there seemed to be a reciprocal suspicion of motives. I admitted that the motives—also on the European side—may be mixed, and that some European industries might prosper if heavy restrictions are laid on transborder data flows. But I ended by urging the parties to come to the negotiation table and try to sort out the real privacy interests involved in TDF.

KNUT S. SELVER
Professor
Oslo University
Oslo, Norway

MORE PLOYS

I was very pleased to read the article in the May issue by Mr. Crabtree and Dr. Kling (DP Sales Ploys and Counterploys, page 194). The authors seem to have done their homework very well. However, with all due respect, I would like to suggest some additional pitfalls which lie ready to ensnare the unwary.

The first is the "kid in the candy store" syndrome. Often when approaching neophyte users, within our own facility, we find that we are asked to provide more hardware/software than the user really requires. In many cases we have a hard time convincing these users that alternative or existing hardware/software is sufficient for their needs. There is a great temptation to oversell services to such customers, pocketing the extra cash flow—armed against future recriminations with the response "we gave you what you wanted" rather than "we gave you what you needed."

The second is the "me too" or the "keeping up with the Joneses" syndrome. To a certain extent this is a derivative of strategies #1 and #4 as suggested by Crabtree and Kling. In this circumstance the user sees his department as "falling behind" similar departments within the same or competitive organizations. This inadequate excuse for upgrading can often be played upon by vendors who claim obsolescence is just around the corner for all but the latest whatever. Indeed they can often "cost justify" the augmented system based on revamped cost of ownership rates versus cost of new system ownership. The pitfall in all schemes of cost advoidance is that the plans never quite unfold as the projections have anticipated. The never-ending cycle of company expansion, method changes and inevitable announcement of even newer whatevers (coupled with unanticipated conversion/downtime costs) conspire to destroy the best cost analyses.

My third pitfall is similar to strategy #8, but is concerned with generalized hardware. This is the situation in which vendors tout their products as "all things to all men"—simultaneously! It often comes as a shock to users that system performance is less than anticipated because of the overhead of the various bells and whistles. Users, therefore, should carefully evaluate which areas of their operations need which type of computer attention (i.e., on-line, interactive, batch, etc.), benchmark various potential machines (if possible), and then make a decision.

The authors avoided the use of the time-worn phrase, but nonetheless their message was blatantly clear: *caveat emptor*. Congratulations on a well-presented story.

NEIL ERRINGTON
Coordinator
Computer Centre
University Hospital
London, Ontario

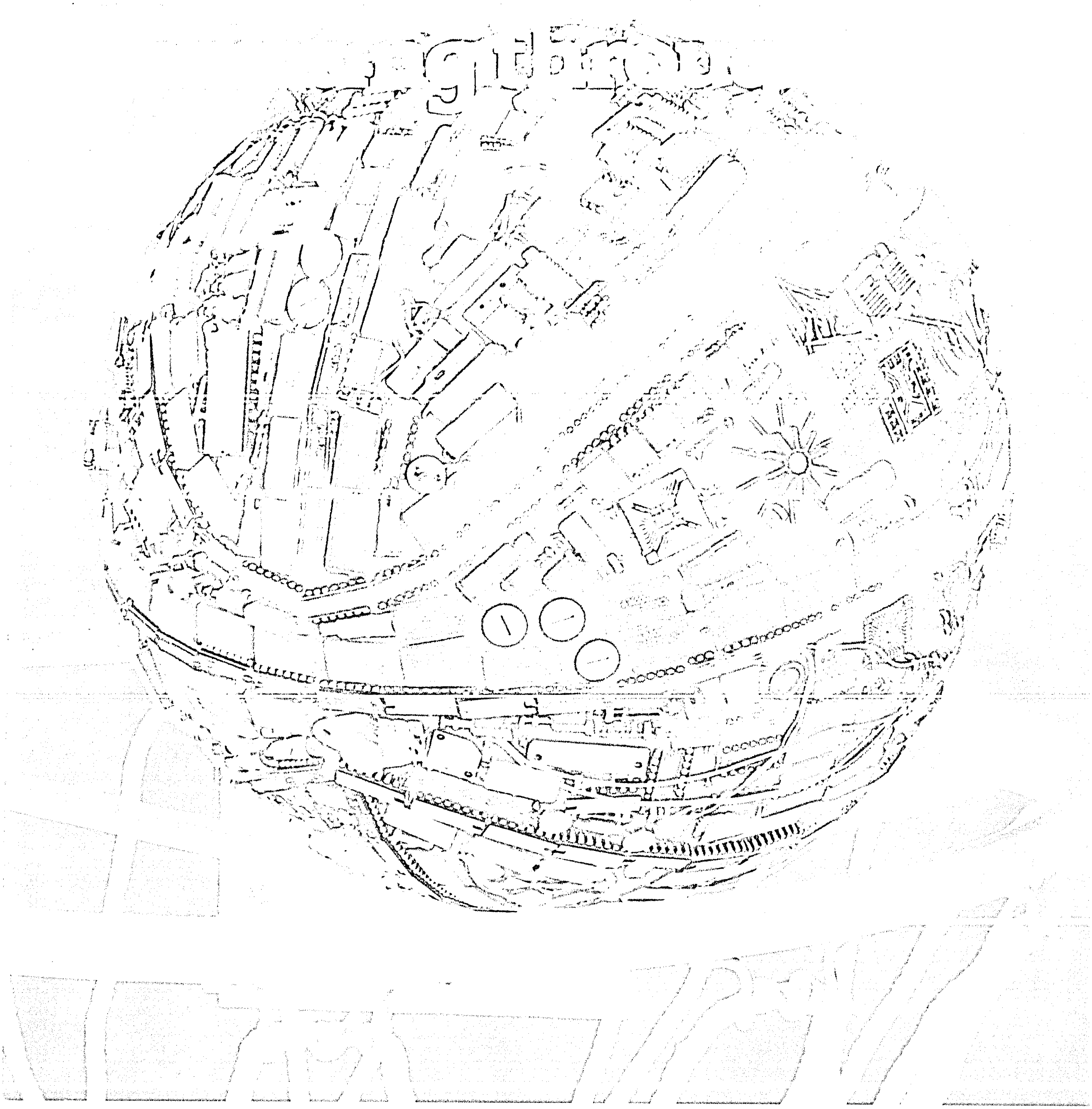
COMPARATIVELY SPEAKING

I found the article "Comparing Programming Language Performance" by Jerome W. Blaylock (April, p. 119) to be disappointing.

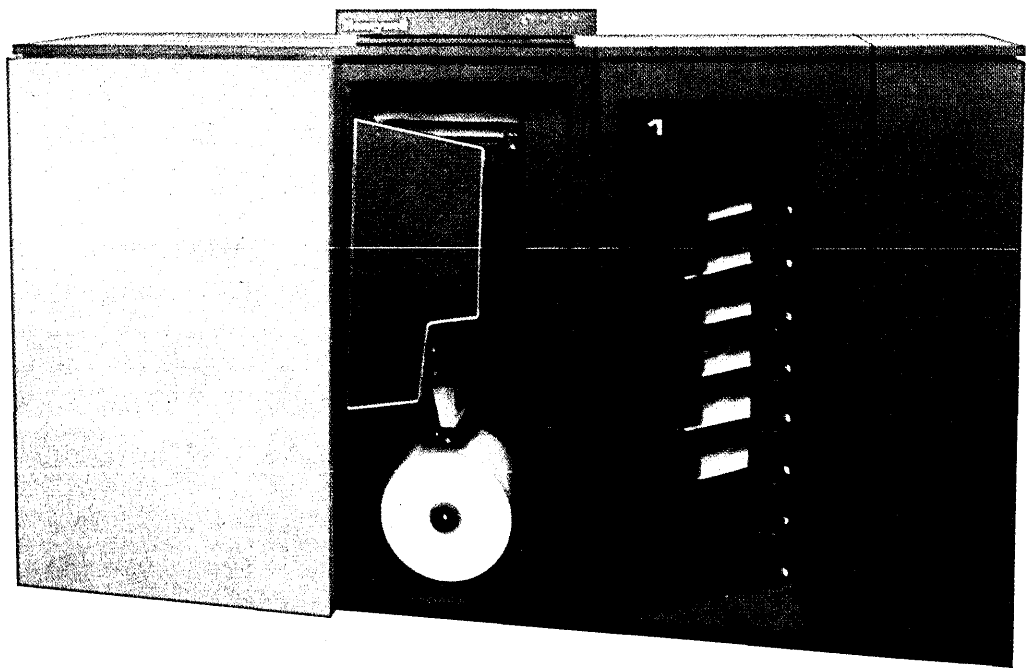
Although originally developed by the Norwegian Univ., NUALGOL is and for some time has been a Univac-supported product, replacing at most installations the older Univac ALGOL compiler. Thus the assertion in the section "FORTRAN VS. ALGOL" that the execution times for the ALGOL compiler were "particularly long" in the random-number generator, grammar analyzer and Tower of Hanoi experiments is not supported by the results in Table 2 for NUALG, which indeed significantly surpassed the optimizing FORTRAN V compiler for the Tower of Hanoi experiment.

Also, the most important factor in any comparison has been overlooked entirely: the efficiency with which the various programs can be understood, maintained and modified. How many one-off programs of more than ten lines remain one-off? Conversely, how many large production programs are built up around hastily written program fragments, preserving like monuments the inappropriate structures imposed by ill-considered use of the wrong language?

I. R. SIMPSON
Computer Center
The Australian National Univ.
Canberra, A.C.T.



The Honeywell Page Printing System.



It can break open your computer printing bottleneck.

It can save money, increase throughput, improve quality, and deliver a better finished product to your end users.

If you're now straining the capacity of two or more impact printers, you have two options: You can add another impact printer, and maybe another. Or you can replace your impact printers with a Honeywell Page Printing System and gain the advantages of total performance:

Economy. At throughput rates as low as 400,000 pages a month, the Honeywell Page Printing System can be very cost-effective. It's already cutting hardware, personnel, and forms inventory costs for a wide range of computer users.

Throughput. While printing variable data at a speed of up to 600 pages per minute, the Page Printing System is also printing the forms and punching, perforating, collating, and stacking the pages. A single PPS system is producing as many as 4,000,000 pages a month for one of our users.

Reliability. Continuous high-speed performance is possible because the Page Printing System uses unique electrostatic technology. More electronic operations. Fewer mechanical ones.

Flexibility. Honeywell's Page Printing System offers an amazing variety of options. There are variable form sizes, a wide range of type fonts (with upper and lower case), hole punching, a choice of colors, selective blanking or suppression, and individual addressing or routing.

Quality. Each printed character is crisp, clean, and sharp. Every line is true and even. Multiple copies, regardless of how many, are all originals. No carbons, no smudging, no degradation.

Efficiency. The Page Printing System is designed to operate off-line at a constant speed. CPU loads are reduced and print speed is not subject to degradation due to higher CPU priorities.

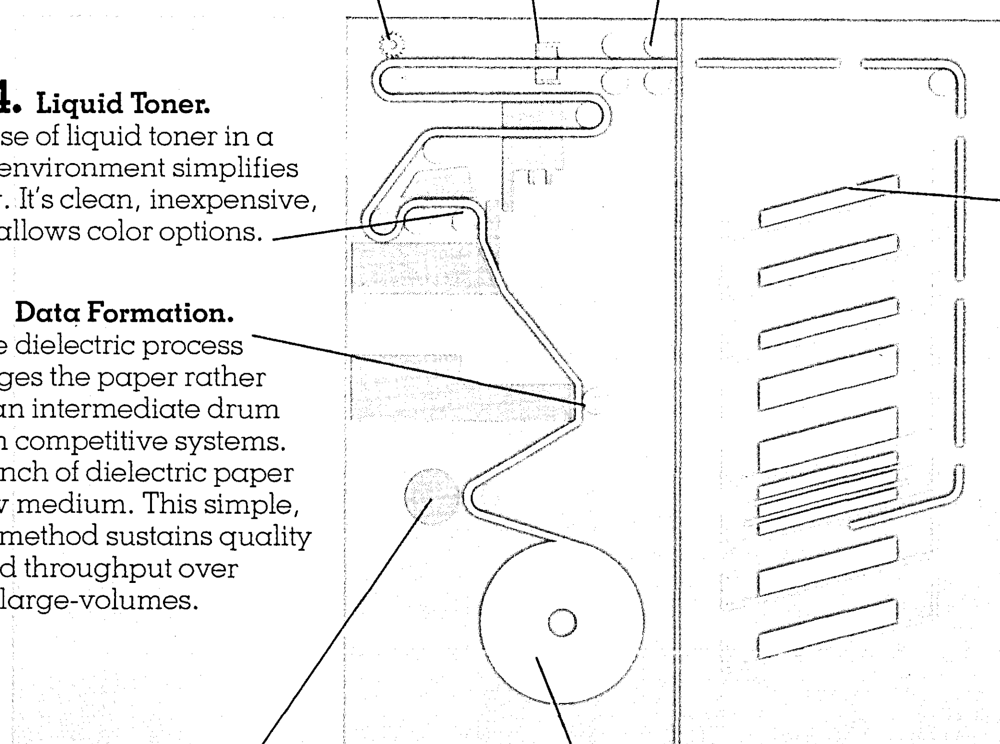
The inside story.

The use of roll-fed dielectric paper leads to a unique combination of features and benefits that insure game-winning performance.

6. Hole Punching.
Two or three holes, top or side.

7. Form Cutting.
Page widths are 8½″ or 11″ and can be cut to any length from 3″ to 14″.

5. Perforation.
Single vertical perforation optional. Operator adjustable.



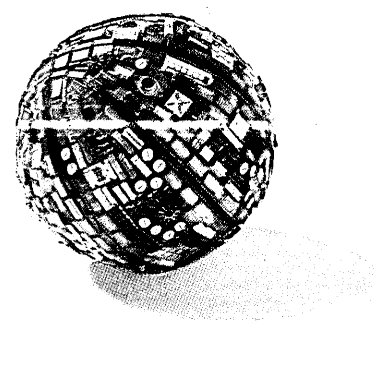
4. Liquid Toner.
The use of liquid toner in a sealed environment simplifies handling. It's clean, inexpensive, and allows color options.

8. Stacking/Collating.
Eight to 32 output pockets allow wide flexibility for automatic assemblies of completed outputs ready for delivery—and eliminate need for supplemental bursters and decollaters, and manual intervention.

3. Data Formation.
The dielectric process charges the paper rather than an intermediate drum as with competitive systems. Every inch of dielectric paper is a new medium. This simple, reliable method sustains quality and throughput over large-volumes.

2. Form Cylinder.
Fixed-data form copy is applied directly to the paper from a metal cylinder, eliminating the need for stock-piling pre-printed forms, insuring accurate registration, and maintaining consistently high print quality.

1. Roll-fed input.
The use of roll-fed paper simplifies the transport mechanism and allows reliable, high-speed printing-press-type operation.



Introducing the HP 1000 model 45.

A powerful number cruncher that won't break your budget.

Most engineers and scientists will find all the power they need in this new leader of the HP 1000 family. A new floating point processor handles big data arrays and cuts lengthy computational problems down to size. And the HP 1000 Model 45 also has the flexibility for complex measurement and control applications, for data base management and distributed networking.

And it isn't hard to get your hands on all this computational power. System prices start at just $46,500.*

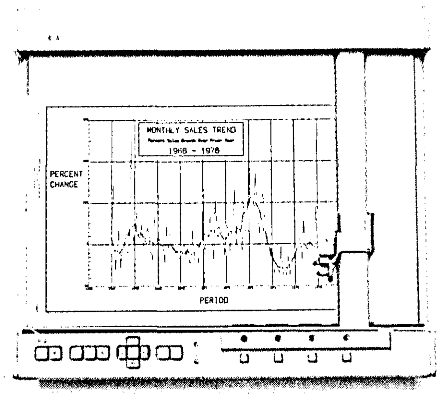
Our new F-Series processor is the hard-working heart of the system. It's extremely fast, completing load and store operations in 900 nanoseconds. The separate hardware processor does floating point calculations at high speeds, too—630 ns for add, 1.8 microseconds for multiply and 3 microseconds for divide.

A special scientific instruction set, standard in the system, also helps to improve execution speed, performing trig and log functions in less than 48 microseconds. And a fast FORTRAN processor, which handles commonly used FORTRAN operations in hardware, also gets things done in a hurry.

Our RTE-IV real-time operating system, the latest in an upward compatible family, lets you manipulate data arrays up to 1.8M bytes, using simple FORTRAN commands. As many as 64 partitions, with a program capacity of 54K bytes, can be resident in memory at the same time.

The HP 1000 Model 45 comes with a fast (25 msec seek time) 20M byte disc drive and an HP 2648A Graphics Terminal, as well as our new Graphics/1000 support software to help you write graphics programs. You can also team it up with other HP products like the HP 9872A four-color plotter and the HP 7245A printer/plotter.

Adding data base management is as simple and economical as adding peripherals. Our IMAGE/1000 software will consolidate your technical information into related and easily accessible files. And you can pool data from other HP 1000 systems (as well as linking to our powerful HP 3000 general purpose computers and IBM) with the help of DS/1000 networking software.



In addition to getting graphic displays on the 2648A terminal, you can get hard copy graphics on our new 9872A programmable four-color plotter, one of many options available with the HP 1000 Model 45. It has a built-in microprocessor and operates up to 360 mm/s (14 inches/s) on each axis. Ideal for vector analysis trace differentiations and window plotting.

So if you've got some big jobs to do, but don't have a big budget to match, the HP 1000 Model 45 can solve your problems fast. To find out all about it, call the HP office listed in the White Pages. Or send us the coupon. We'll prove once again that good things do come in small packages.

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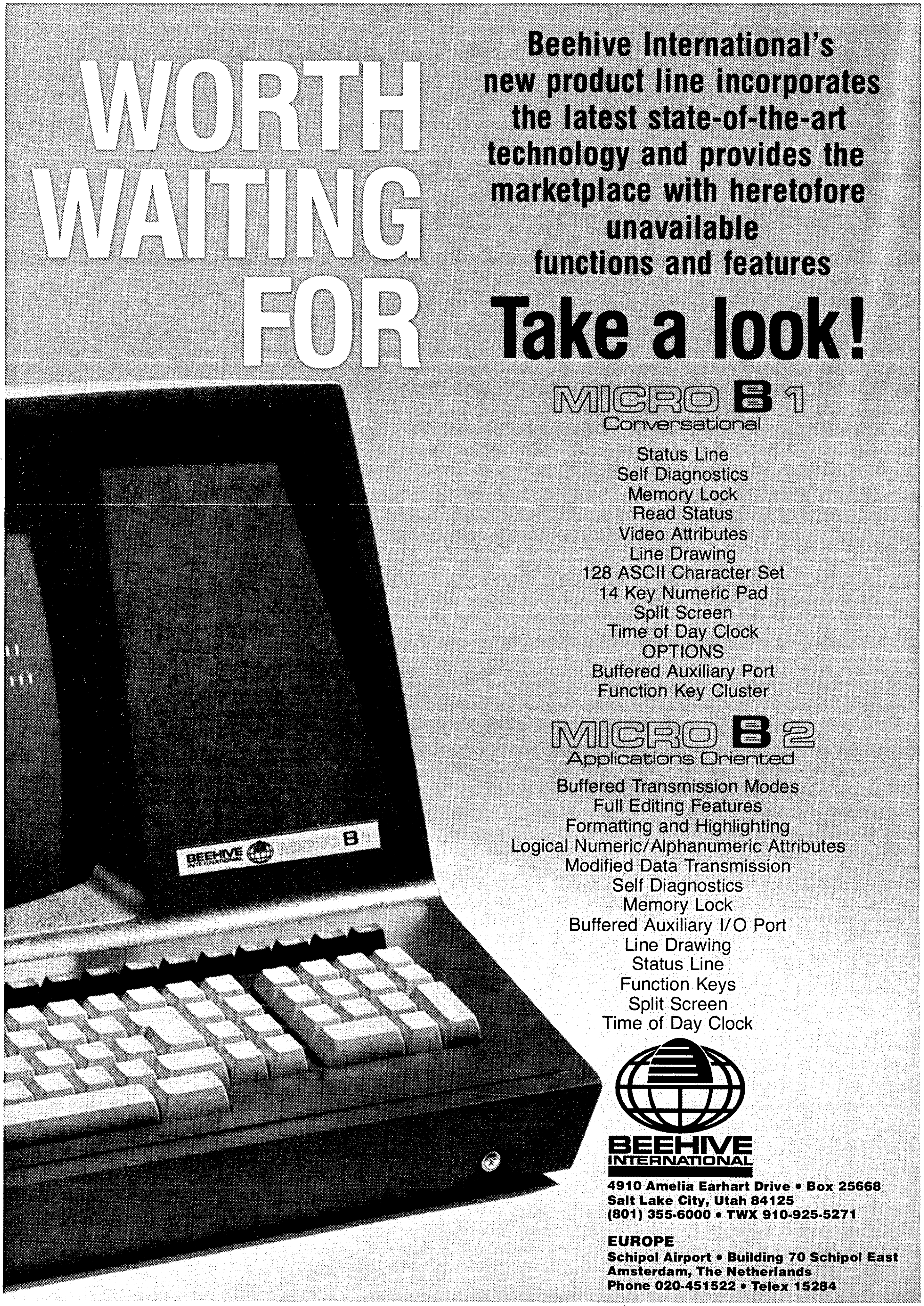
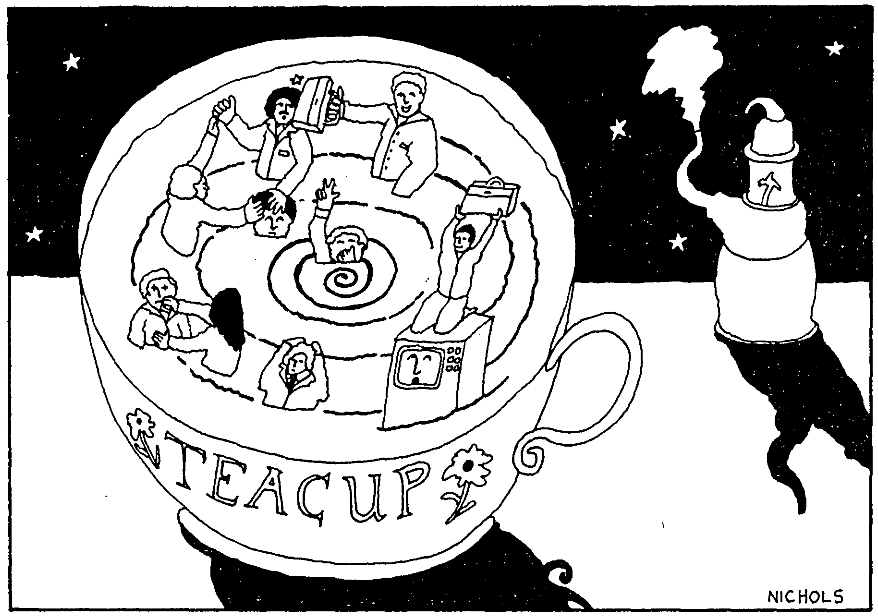


CIRCLE 11 ON READER CARD

EDITOR'S READOUT

A STANDARD FUROR



"A tempest in a teacup" was the way one DATAMATION advisor characterized the current furor over the proposed federal I/O channel interface standard.

Adding a mixed metaphor to his malapropism, he went on to say all the fuss was so much wheel-spinning; after all the standard is based on IBM's 360 channel interface which dates back to the early 1960s. It's a *fait accompli,* a de facto standard that is solidly in place.

But a goodly portion of the computer industry seems to think otherwise. Factions have polarized over the issue and both sides are arguing the pros and cons with increasing vehemence.

The key players are the mainframers on one side, and the government, the plug-compatible manufacturers and the peripheral manufacturers on the other. Each faction has its share of trade associations, user groups, and interested vendors as vociferous supporters. The primary battlefield is Washington, D.C., both in and out of the formal hearing rooms.

On the face of it the government seems to have the upper hand, especially in these cost-conscious, post-Proposition 13 times.

National Bureau of Standards officials claim that the government will save some $55 million in the next five years by being able to procure peripherals on a competitive basis, instead of being forced to use the mainframer's gear.

Responding to mainframer charges that the government is inhibiting technological development by adopting an obsolete architecture, proponents argue that the very latest systems (e.g., the 303X line) use the interface. Furthermore, if adopted, the standard is not immutable. It will be under constant review and in three years can be scrapped or overhauled if some startling breakthrough occurs in the technology. In the meantime, NBS is establishing a program to determine this standard's successor and is calling for industry participation.

If the standard is adopted—and it now appears likely that it will go into effect early next year—there will be repercussions extending beyond federal procurement practices.

It seems likely that state and local governments will demand the same option to choose from the many peripheral manufacturers. And users in the private sector will be looking for the same flexibility. It may be that the federal government—that bastion of reactionary bureaucracy—is fomenting a user minirevolution.

It is amazing that the computer industry has been able to disregard standards in so many areas for so long. The argument has always been that we are a young and growing industry and standardization hinders development.

Well, the industry is no longer in its infancy. We have passed through a rather painful puberty during the early '70s and are now easing gingerly toward maturity. It's time for a little discipline. The dp professional is no longer willing to accept an industry that views compatibility as something to avoid at all costs; it's like asking a homeowner to deal with 15 different wall-socket configurations or light bulbs that fit only one manufacturer's lamp.

That the proposed standard is an IBM design and is, to quote our advisor again, "a pedestrian piece of engineering," is simply a fact of life. Seventy percent of the installed equipment uses the interface and most independent peripheral manufacturers build to it. They'd be foolish to do otherwise.

We think the standard should be adopted.

But we offer that opinion with some apprehension. Like the aftermath of Proposition 13 in California, the adoption of the standard may have repercussions that few can anticipate. That teacup may hold a strong and bitter brew.

A FEW CHANGES

You'll notice some format and graphic changes in the magazine beginning with this issue. They're intended to enhance readability, clearly delineate advertising and editorial material, and, in general, help you, the reader, get the most out of DATAMATION each month.

IBM Series/1 co

IBM's Series/1 is designed to give you the efficiency and flexibility to build the precise system you need to meet your changing data processing requirements. Now IBM Series/1 has added to its range of modular hardware and software to extend the power and versatility of your system.

New hardware

Using cost-efficient 64K storage cards, Series/1 has now doubled its maximum available processor storage to 256KB with a new model of its 4955 processor.

Series/1 has also increased its online file capacity almost five-fold with its new 4963 Disk Subsystem with up to 256 megabytes of online storage per unit in 64 megabyte increments.

To provide either low-cost online access or back-up storage capability, Series/1 offers the new 4966 Diskette Magazine unit.

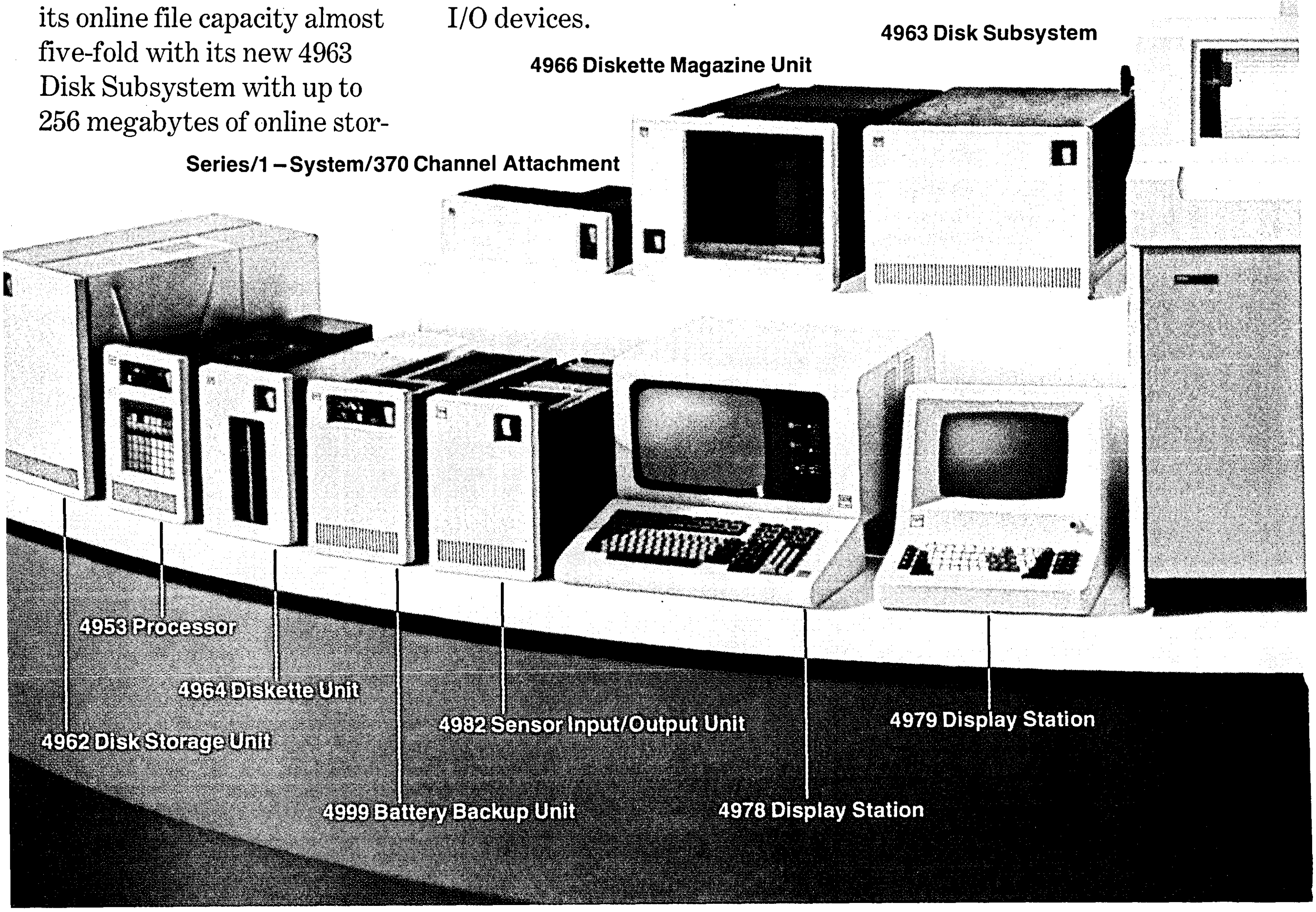
And Series/1 now features a 370 channel attachment device that provides channel-to-channel communication between Series/1 and System/370, including the 3031, 3032 and 3033.

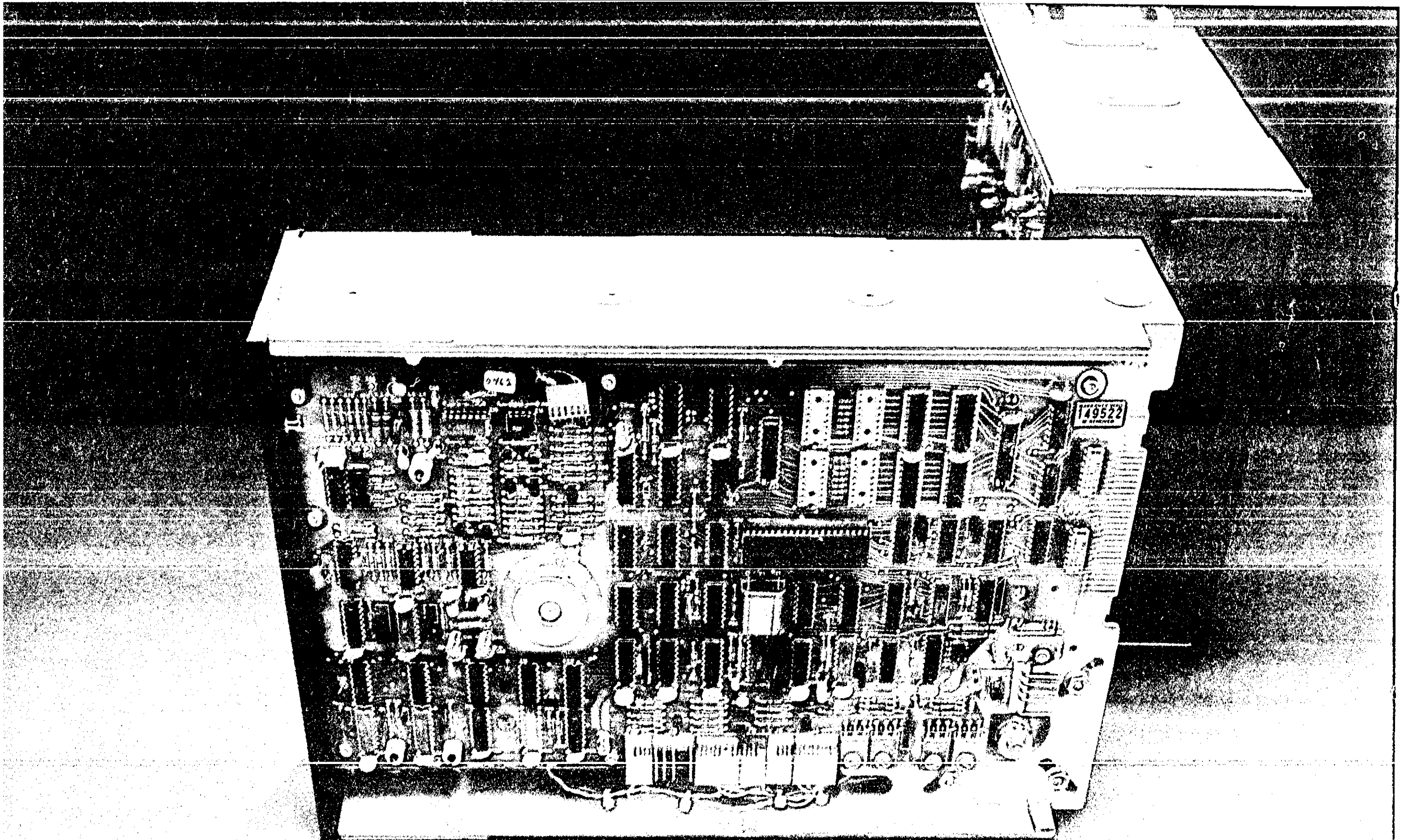
In all, Series/1's extensive hardware menu includes 9 rack-mountable processors, matrix and line printers, standard and customized display stations and a wide variety of I/O devices.

New software

The broad range of Series/1 hardware is supported by a comprehensive set of software. In addition to Fortran IV, PL/I and Assembler, Series/1 now provides COBOL, one of the most widely used commercial application languages.

The Realtime Programming System has been extended to provide dynamic partitions, new I/O support and communications capabilities that enhance the operating system's multi-programming, multi-tasking abilities.





Disk drives or subsystems?

Remex announces two low-cost controller/formatter/drives.

The RFS 1100 and micro-based 1200 are part of the Remex family of disk drive subsystems, complete with built-in controller/formatters.

Now time and money you might otherwise spend developing your own controller/formatter can be concentrated on application software and total systems — where you can make the greatest contribution.

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NEWS IN PERSPECTIVE

COMMUNICATIONS

MA BELL DROPS THE FIRST SHOE

Its ACS will rely heavily on protocol and message code conversion software to make dissimilar systems talk to each other.

AT&T unveiled its long-awaited datacomm network last month. Officially called the "Advanced Communications Service" (ACS), its stated goals are to increase utilization of the customer's existing datacomm hardware and software, and reduce his costs of establishing, operating, expanding, and upgrading a new or existing system. There are also some unstated goals, the chief one being destruction of the regulatory/legal barrier that now keeps AT&T from offering many on-line information services.

ACS will rely heavily on protocol and message code conversion software to make dissimilar systems talk to each other. In its official description of the network, AT&T stressed that this feature will not only promote integration of presently incompatible systems operated by a single organization, but also will enable independent systems, operated by different organizations, to exchange messages with each other—for example shippers, freight carriers and consignees; airlines, car rental firms, hotel and motel companies; and manufacturers and their suppliers.

A large number of I/O functions are integrated into the new network. ACS will allow automatically assigned addresses to be used, for example, or single or multiple address mnemonics can be chosen by the customer; there is also a "last number called" option which gives the customer the capability of originating a new call to the same address as the previous call without having to re-enter the called address.

Besides addressing, there are numerous additional options relating to formatting, validation, transmission, and delivery of store-and-forward messages as well as interactive communications (which AT&T refers to as "calls"). ACS also allows the user to write his own message-handling software, using an AT&T-developed programming language together with a telephone company-provided "network language support center" which will convert his instructions into object code.

The main benefit of this "customer customization compatibility" is to make improved datacomm services available to users who, otherwise, would not be able to afford them. As AT&T explained it: "ACS offers a means of avoiding the high start-up costs normally associated with developing and implementing a data communications system. . . . This low entry threshold will have a positive impact on small users who have been unable to justify the cost of developing their own . . . systems. It also benefits medium-sized and large users who want to begin integrating their current data communications networks, but are reluctant to make a major resources commitment . . . without some opportunity for a trial use."

While specific plans for implementing ACS are still pretty vague, AT&T has stated officially that:

—Packet switching will be the initial transmission method, to be followed by "circuit- or line-switching techniques if conditions warrant."

—It is "expected" that transmission and message storage charges will be priced on a usage-sensitive basis, while optional features—like the alternative message, addressing, formatting, transmission, and delivery schemes mentioned above—will be based on flat rates.

"ACS offers a means of avoiding the high start-up costs normally associated with developing and implementing a data communications system."

—"We have forecast the connection of approximately 137,000 customer terminals and computers to the ACS network by 1983, out of a total of 3.6 million terminals and computers estimated to be then in use."

Last month, DATAMATION reported (July, p. 180) that AT&T plans to have three ACS nodes up and operating by the end of next year. The first one, to be used for system test and development, will be located in Illinois, while the others are to be located on the East and West coasts.

Although ACS incorporates no major technological breakthroughs, it combines, in one service package, all of the well-known methods of promoting system compatibility-with-flexibility. To answer the need for compatibility, as an example, ACS initially will provide interfaces for five types of general-purpose terminals (typically, crt's, teletypewriters, batch and remote job entry terminals, including those using either character or block mode, asynchronous or synchronous transmission, polled or contention-type call setup, and operating at 110-9600bps). In addition, AT&T will provide three ways of interfacing ACS to the user's host computer: through use of emulation, a "character-oriented message-level interface," or a bit-oriented interface "designed to be consistent with CCITT recommendation X.25 but (incorporating) many enhancements . . . to achieve the functionality of the message-level interface."

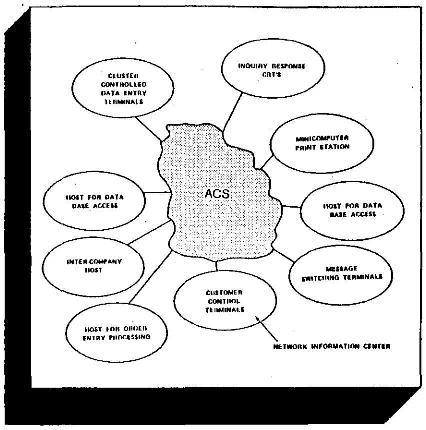
The emulation interface will make ACS appear to the user's host computer as one of the following devices: a start/stop terminal, a bisynch cluster controller, or a bisynch batch terminal. According to an AT&T spokesman, this arrangement will not require any change in the user's system—but he will not be able to obtain the full menu of ACS services.

The spokesman added that in the case of the other two host computer interfaces—both of which will hook up with the user's existing access method (e.g., TCAM, VTAM)—some "accommodation" will be necessary for each installation. The AT&T interface, he explained, will have to be tailored to the user's requirements, and some additional "compatibility code" will have to be written by the user or his supplier, so that the host computer's access method can access all ACS services. The spokesman indicated that if suppliers aren't willing to provide this support, AT&T might do so.

These proposed solutions to the datacomm user's cost/benefit maximization problem—even though not unique—are significant nevertheless. For, given the phone company's universal communications network and vast technical/financial resources, AT&T is capable of bringing the benefits of ACS to a far larger community of customers than vendors of competing services. It is possible, as a result, that within the next decade a majority of all datacomm systems will be supported by software-controlled message formatting, validation, and delivery systems which are much more cost-effective than those in general use today. Probably, there will still be a substantial demand for dumb terminals, but only if the equipment allows the user to access network-provided message-handling software. That means the terminals will have to be compatible with AT&T's interface specs.

The phone company's primary purpose in announcing ACS last month was to justify a request for a "declaratory ruling" from the FCC. AT&T wants the commission to say in effect that Bell had the necessary authority to install and test ACS. Such a declaration would abort most of the opposition to ACS at a very early stage of gestation, making it much easier for the phone company, when it subsequently files an application for operating authority, to get the application approved.

AT&T told the FCC that much of the justification for the new network is based on the commission's prior authorization



A MAJOR purpose of ACS is to provide a "super" interface through which a wide variety of otherwise-incompatible terminal systems, as shown above, can talk to each other. Besides compatibility, ACS is designed to provide many network-resident message handling services, thereby extending the benefits to users who couldn't justify the costs of implementing such services on their own.

of Dataphone Digital Service (DDS), for in that ruling the phone company was allowed to use DDS facilities for "end-to-end digital services . . ." While the FCC failed to define what it meant by this term, such a definition isn't needed, the phone company argued. Reason: the U.S. Circuit Court of Appeals, in its pronouncement last year on MCI's Execunet service, said a carrier is entitled to offer a new service over existing facilities even though the service hadn't been specifically authorized by the commission, so long as the new service hasn't been specifically prohibited. ACS allegedly meets that requirement since the network nodes will be interconnected by DDS circuits.

Ironically, AT&T fought Execunet with every fiber of its corporate being, and went all the way to the U.S. Supreme Court in an attempt to overturn the cited court decision. Bell's legal staff must have had a lot of fun using Execunet as part of the justification of ACS.

Industry reaction to last month's AT&T announcement was predictable, but interesting nevertheless.

"It's clear AT&T intends to become the world's largest time-shared service bureau," commented Jack Biddle, president of the Computer and Communications Industry Association (CCIA). He pointed out that ACS, like a service bureau service, will rent program and data storage to the customer, and will provide a variety of computer-based services on a shared basis.

"AT&T should not be permitted to store customer data," Biddle added, "because once they store it they will process it—actively or passively." He also said that AT&T, based on its statement to the FCC, intends to implement protocols that interface "with the largest portion of the installed base, and that means IBM. So users of Univac, Honeywell, Burroughs, and other non-IBM systems will be left waiting in the wings."

Stuart Mathison, Telenet's vp for business planning, said the hardware and software reportedly chosen by AT&T for ACS—DEC PDP minis and the Unix operating system—"won't support all the service features" promised in the FCC filing. "We were using a similar configuration five years ago. It lacks the capacity and flexibility required by today's applications. What you need are multiple microprocessors controlled by a much more sophisticated operating system, one designed specifically for message handling."

Mathison agreed with Biddle that it will be "very difficult" to write software limited to communications processing since the same instructions can also be used for data processing. The telephone company, somewhat surprisingly, has a basically similar view. Said AT&T data services marketing manager W. A. Whelpley:

"If you ask whether there is some way a data processing function can be detected mechanically in a program designed to perform communications processing, the answer would have to be 'no.' " Whelpley quickly added, however, that if this problem arises, AT&T will be "obliged to take what steps we can to prohibit such use of ACS facilities. But I don't think the network will be a good

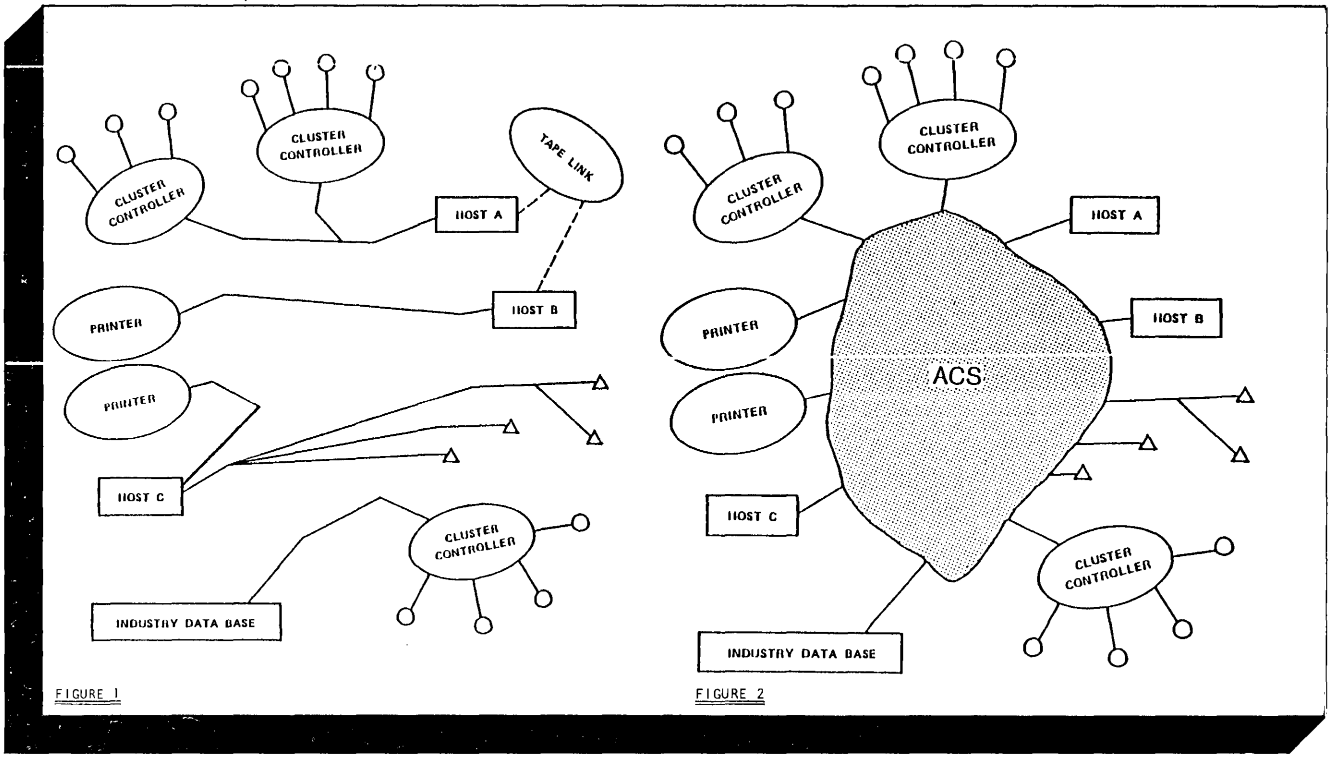
Phone company wanted a "declaratory ruling" from the FCC.

place to do data processing—the facilities will be much more limited, and the costs significantly higher, than if the user employs a dp system."

Asked whether this would be true of a "communications processing" program that included some data processing functions, Whelpley pointed out that the phone company, under current FCC rules, is allowed to perform dp functions "incidental" to communications service.

One interesting question raised by last month's announcement is whether the growing digitization of the voice telephone network may give AT&T some special advantages in marketing ACS.

At the International Communications Association (ICA) conference in Las Vegas last May, Joseph Sciuli—president of Telecommunications Techniques Corp., Rockville, Md., a manufacturer of voice and data communications processing equipment—reported that about 60



"BECAUSE of compatability problems," explains AT&T, communication among the four networks shown in Fig. 1 (those associated with "Host A," "Host B," "Host C," and the "Industry Data Base") is achievable only by manual techniques. Fig. 2 shows how the "compatability provided by ACS allows each of the host computers (and the industry data base) to serve a broader base of terminals without each incurring the burden of additional communications processing time and expense needed to achieve such compatibility." The company's FCC filing stresses that this compatibility will facilitate communication not only among multiple networks operated by a single organization, but also communication among independent, separately operated networks such as those used by airlines, travel agencies, hotel-motel companies, manufacturers and their suppliers.

million channel miles of T-carrier have been built in the United States so far, and this network is growing 33% per year. Several independent manufacturers have sold all-digital switches to independent telephone companies for use in Class 5 central offices, he added, and AT&T is rumored to be developing similar equipment.

Sciuli last month said implementation of digital switching in Class 5 offices is particularly significant because this is the office closest to the subscriber. He also said that the movement of the analog/digital conversion process "closer and closer to the user" is the "major trend in the telephone industry today."

Sciuli was unsure whether it would become cheaper for the user to route his communications through a black box that served as both a PABX and terminal or computer front end, as compared with employing separate units. Telenet's Mathison, when asked essentially the same question, pointed out that the costs of analog/digital/analog conversion are still relatively high, although he and Sciuli both expect them to come down. Mathison added that the Arpanet is already packetizing voice messages, and he predicted that within five years it should be economical to do this at the customer site.

If he's right, and hybrid data/voice communications processors turn out to be significantly cheaper than separate PABX and terminal/computer front-end equipment, ACS could be marketed to a whole new group—those who can't justify a separate datacomm service but *can* make a hybrid system pay off.

The Arpanet already is packetizing voice messages and this should be economical to do at the customer site in five years.

Most users who decided to install such a system would probably obtain it from Ma Bell, rather than a competing supplier, since they're already phone company customers. Thus, Bell's hybrid network would be more extensive than any other and this, in turn, would attract additional users who, because of their application requirements, need a public network.

Even if PABX and terminal/computer front ends aren't combined, however, the development of digital voice transmission, end-to-end, could give AT&T a big competitive edge. For it would then be possible to use the same transmission facilities to carry both types of traffic, split the costs accordingly, and offer each type of service at a lower unit cost.

The existing analog telephone network has been used that way for a long time, of course, but because of such factors as average-rate pricing and the phone company's reluctance to exploit new technology, competitors gained a foothold.

Those factors no longer exist: ACS is a new system, and rate averaging has been supplanted by regulatory policies favoring competitive pricing. Meanwhile, through control of ACS network interfaces and protocols, AT&T is positioning itself to limit the extent to which its facilities are connected to competing networks and terminal systems.

In 1968, DATAMATION devoted a lot of editorial space to the Carterfone dispute, and during the next few years, another big story was the hassle over the efforts of MCI and other specialized carriers to establish themselves. In 1988 or maybe 1998, we'll probably be reporting a repeat of both dramas. But whether the outcome will be the same remains to be seen. In any event, AT&T—at the moment—appears to be heading for the same position in the data communications market that it presently occupies in the telephone market.

—Phil Hirsch

(Mr. Hirsch, formerly DATAMATION's Washington bureau manager, now writes for the magazine on communications-related affairs.)

MICROCOMPUTERS

ON BELL'S COATTAILS

It's an unofficial alignment that could produce huge results for CADO Systems and its microcomputer.

Listening to the late evening news on the ABC radio network, one might be intrigued by a commercial message from tiny CADO Systems Corp. of Torrance, Calif., talking about its computer that is plug compatible with AT&T's Dataspeed 40 crt's and printers.

"We compete against IBM by unofficially aligning ourselves with Bell," says chairman George M. Ryan, a former Pertec Computer Corp. executive who formed the company two years ago. Ryan emphasizes the word "unofficially" because his only agreements with Bell's Teletype subsidiary is to sell CADO the peripherals and have Teletype maintain them.

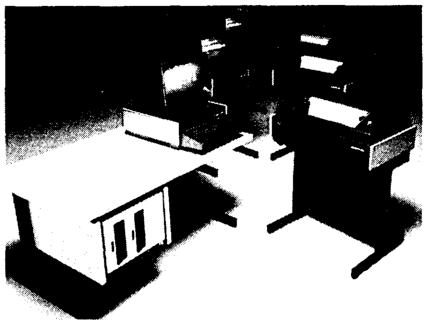
But it's an alignment that eventually could produce huge results for CADO whose customers now are confined to small, first-time users. Ryan envisions Bell leading his distributors by the hand into larger companies where he feels he'd be able to beat out such IBM competing products as the 5110, System 32, and System 34. "After all, 80% of the value of our system is Bell's (peripherals)."

The 46-employee company has shipped about 700 single station systems in two years.

The 46-employee company has shipped about 700 single station microprocessor-based systems in the U. S. and overseas in two years and last month its shipments rate was running at about 1,200 a year. It recently began selling cpu's with Perkin-Elmer crt's and Texas Instrument printers at about 20% less than with the Teletype peripherals, but it also is introducing a multiterminal product that uses Teletype peripherals and not surprisingly is called the CADO System 40/IV. It is advertised in a brochure entitled "You can't beat the system," a reference to Bell's widely advertised slogan, "The System Is the Solution."

The product supports four program partitions with four I/O ports to allow customers to do standalone computing, text editing, message handling, distributed processing, or a mixture of these functions simultaneously. It soon will be enlarged to support eight stations. The company also is examining the addition of a mini Winchester disc drive that would pack 11 million bytes of data on an eight inch fixed medium, but occupy the space of a flexible disc drive which the company now sells with its systems. (It also offers eight applications packages for business offices. "The essence of this business is marketing and software, not hardware," says Ryan.)

The System 40/IV cpu, which sells for about $10,000, can be combined with the Teletype products to enable a user to "create his own office of the future," says



CADO SYSTEM 40/IV—a cpu and Bell peripherals.

Ryan, "since their functions can operate simultaneously in any mixture desired."

The key, he says, is "our extremely efficient operating system," designed by CADO's director of software development, Jim Ferguson, formerly of Northrop Corp.'s Business Data Systems Div. Ryan, who refers to Ferguson as a "one-man development company," says the operating system features dynamic allocation of system resources for multitasking and subtasking, and it's very fast. He said the average access time to any record is only 150 milliseconds.

Ryan drew up CADO's business plan over a year's time while recuperating from back surgery. Its first product was to be a computer aided document originator (CADO), but it never got off the ground because, as Ryan says, "it was a truly distributed processing system and two years ago people were talking about distributed processing, but not buying anything." But the hardware he developed turned out to become the guts of a standalone business computing system.

Except for Ferguson, all are former Pertec executives, Ryan having served as assistant to then president Harold Kurth. John Moser, CADO president, was a cofounder of Computer Machinery Corp., which Pertec acquired, and Robert Thorne, vp of engineering, was a founder of Pertec.

Whether Ryan's aspirations for a closer Bell alignment comes about hinges, of course, on the outcome of the FCC's computer inquiry that will determine how and if Bell can enter the data processing business. Ryan feels that even if Bell were allowed to enter, the way prices for microcomputers are declining while peripherals prices remain way up there, Bell might still prefer to concentrate on peripherals and leave the cpu activity to firms such as CADO. "They're moving that way," says Ryan, "but glacially."

—Tom McCusker

OFFICE AUTOMATION

XEROX AND THE FUTURE

Government examines experimental Xerox office of the future system.

It was a hush-hush operation. Even the Secret Service got in on the act. And that act, one that dp industry vendors may have a hard time following, was orchestrated by Xerox which has been quietly working toward the office of the future. The ostensible beneficiaries of this sophisticated but still experimental effort are the White House, Congress, and the National Bureau of Standards—all of which have recently installed Xerox's innovative office information system in an R&D testing mode.

Wanting to keep the system under wraps for as long as possible, neither the White House, which installed the setup in the new executive office building in May, nor Xerox have released any announcements on it. But last month word leaked out on the secret system evaluations being conducted by Xerox in coordination with dpers in the White House, House Information Systems, and NBS. The White House has since confirmed that the advanced Xerox system is being evaluated in an R&D environment as part of an NBS-honchoed project launched late last year.

Developed at the Xerox Palo Alto Research Center (PARC), Xerox's futuristic R&D think-tank operation, the system has been referred to by the company as its developmental office information system, which it also calls its advanced experimental system. The multifunction setup, which performs word processing, electronic messaging, as well as photocomposition and typesetting chores, is designed to handle printing, filing, and document distribution.

The system is centered around a workstation that PARC researchers have been working on for quite some time. Code named Alto, this workstation with advanced alphanumeric and graphic capabilities includes a keyboard, a high-resolution crt display, a proprietary 16-bit minicomputer, and a disc. Another key system element is the xerographic printer, which essentially is a computer-driven Xerox copier which is fed images from the workstation. Tieing the whole scheme together is an Ethernet-type dis-

Multifunction setup performs printing, filing, and document distribution.

tribution setup which links the workstations to each other and to the printer.

Under the Ethernet distribution technology, a piece of coaxial cable, about one kilometer in length, serves as a passive communications path, allowing up to 256 communicating workstations to be connected on the system. Using this wideband (several megahertz in bandwidth) link, the workstations are able to broadcast brief bursts of information at frequencies of 50KHZ or more.

Electromagnetic emanations from the system proved particularly troublesome to Secret Service representatives who, when informed of the White House's intention to install the system for evaluation, made a quick trip out to the PARC facility with their detection gear to check out the setup. As a result, they nixed the White House dpers' original plans to set up the system in the White House itself and in the nearby old executive office building.

The Xerox system, shooting off emana-

The company has made no commitment to market what it still considers to be an experimental system.

tions in the megahertz frequency range, the Secret Service thought, could tend to camouflage signals from eavesdropping gear, also operating in megahertz frequencies. To solve this problem, it was decided to put the system in the new executive office building.

Operating in this evaluative environment, the Xerox system, which includes two Alto workstations and the xerographic printer, is being used by the White House on an R&D basis for word processing and text editing. It's also being used in interactive graphics experiments, creating such graphical products as statistical tables and charts—including pie and bar charts.

White House dpers, who last year launched their ambitious automation overhaul of the Executive Office of the President, seem impressed with the advanced office automation technology embodied in the Xerox system. While none of this technology is new, what makes it impressive, claim industry insiders, is the way Xerox has bundled the various on-going hardware technologies together and supported them with some very advanced software tools.

The technological direction represented by such systems as Xerox's is being closely monitored by the White House dpers in hopes that it could answer some of the EOP's user requirements. But whether a specific Xerox-developed setup will meet those needs is still a conjecture, partly because the company itself has made no commitment as yet to market what it still considers to be an experimental system.

In addition to the new executive office building installation, the Xerox system is also being used on an evaluative basis at NBS which has approximately four workstations hooked up. The House (HIS) is running a one-workstation system, and the Senate is also about to install the Xerox setup with one workstation.

Xerox's fleet of federal system testers were not the first guinea pigs for the setup. Several large U.S. corporations also reportedly have similar systems operating in an R&D mode. All of which leads one source to wonder when the company will finally chose to officially announce it.

This hesitation, according to another knowledgeable source, may be because the company worried that premature system labels might prejudice whatever marketing schemes it might have. Notoriously low-key, especially concerning its research and development efforts, the cautious company also, he speculates, may not have wrapped up its software R&D work yet. In order to do that, the company may want to get more user experience under its belt to improve the software before taking the marketplace plunge. Xerox, he ventures, may also be wary of its rivals. "It doesn't want competition," he argues, "to see what the hell it's up to."

—Linda Flato

COMPANIES

FROM THE ASHES

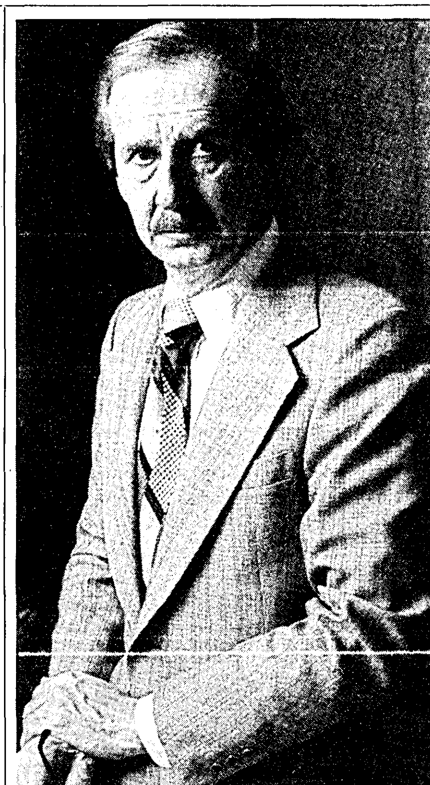
"Telefile is doing what it can to keep CP-V alive and getting better."

When Honeywell first took over the Xerox Data Systems' customer base back in 1976, a top priority was doing something for the users of CP-V, a much-loved Xerox operating system.

Honeywell came up with CP-6, an operating system not yet available which will operate with its level 66 computers. In its conceptual stage, CP-6 came close to being called "project Phoenix," which many Xerox users thought was appropriate. "Rising from the ashes," said Randy Best, then chairman of Exchange, the Xerox user group. "It fits."

Best isn't a user any more. He left Motorola Inc. where he was in charge of computer applications, the computer center and a computer aided design facility, to join Telefile Computer Corp. as director of market planning for Xerox-compatible products. Telefile is doing what it can to keep CP-V alive and getting better at it all the time. Among its efforts is another "Phoenix." Honeywell never used the name but Telefile will for its new Sigma 9-like computer which it hopes to begin delivering late this year.

The Phoenix name eventually will label a whole Sigma-like family—up and down from the 9. It was adopted after a contest which sought entries from users,



TELEFILE'S SAM EDENS: He won the name contest

Telefile employees, and even Honeywell employees. "A couple of Honeywell people did enter," said Henry Haugland, Telefile's national sales manager of Xerox-compatible products and the contest's anchorman. Haugland, like many others involved with Telefile's Xerox operations, is former XDS and Honeywell.

The Phoenix name was selected from more than 20 entries received. Only six came from users. The winner came from Sam Edens, Telefile's president. "From the ashes," isn't its only significance. Telefile last June opened a new facility in Phoenix from which its Xerox-compatible operations will be run. And Honeywell's Xerox operations are headquartered in Phoenix.

"CP-6 is ok for some people," said Haugland, "but there are many who prefer to stay with CP-V and we're going to help them." Telefile hopes to install its first Phoenix, a Sigma 9-like computer, late this year. The company said its computer will outperform Sigma 9s by four to one. Sigma 9 cpu's make an unusually heavy demand on memory bandwidth because of a three-instruction pipeline. Certain instructions can abort the instruction stream, requiring additional memory accesses. Telefile said its Schottky LSI processors eliminate the three-stage instruction pipeline. It is one of the few Sigma 9 features deleted but the result, the firm said, is improved efficiency in multiprocessing environments.

Haugland described the Telefile computer as "a firmware controlled device, close in architecture to the Magnuson computer (June, p. 242). We are taking advantage of Xerox's software investment and that of the users."

Telefile would like to have used the Sigma name but they found that it has been tied up for 10 years by Sigma Instruments, Braintree, Mass. The 32 bit Sigma 9-like Phoenix was called TCP 32 internally prior to the naming contest. It will be followed by other Sigma-compatible processors, larger and smaller.

Haugland said the new machines not only will provide a way to upgrade for users who want to stay with CP-V but will also give some who want to go to CP-6 eventually a longer period of time to get there. He also envisions users using a small CP-V system as a front end for a CP-6 distributed processing system.

"You can't touch it for throughput," said Haugland of CP-V. "When CP-V was under development, every cycle was a precious thing. Memory was expensive. Now cycles and memory are becoming cheap. With CP-6 they (the Honeywell development team, basically the same team that developed CP-V for Xerox) were willing to add function at the expense of cycles and memory."

He said the first Phoenix not only will outperform the Sigma 9, it will be considerably smaller, more reliable, and lower in price.

Telefile is aiming its Phoenix family primarily at small- and medium-sized Sigma users. "The monstrous sites are CP-6 candidates," said Best. He singled out Arizona State Univ. as typical of the kind of user Telefile hopes to serve best. "They have a small Sigma 6 running the whole university. They can't afford it (CP-6 and the attendant level 66 hardware)." He also mentioned as likely candidates for Phoenix computers, sites where most programs are written in assembly language and are tightly coupled to specific aspects of hardware.

Telefile, founded in 1968, has long billed itself as a computer-enhancement company dedicated to prolonging the useful life of older cpu's whose speed and efficiency never were fully tapped before they were effectively obsoleted by their manufacturers in one way or another. It has long manufactured a line of Xerox-compatible peripherals.

When Xerox pulled out of the general purpose computer business in mid-1975, Edens wanted to buy the computer operation. He said Xerox wouldn't talk to him. "I'm going to keep hammering at them," he said at the time. "I can offer Xerox users anything else they might need except the cpu and I'd like to be able to do that." Now, it seems, he can.

Program manager for the Phoenix family is Walter Hollingsworth, a member of the original Sigma design team. Most of the people involved in the Phoenix effort are former XDS exployees.

"If you go back and look at the Xerox strategy (before the pull-out)," said Haugland, "you'll see that we are now where they were headed."

The new Phoenix facility will house more than the Xerox-compatible marketing effort. It also will house certain refurbishing and manufacturing operations and will be home base for the Peripherals General activities. Acquired by Telefile early last year, the Peripherals General operation builds IBM and GE/Honeywell-compatible disc systems.

"We had to expand," said Edens of the opening of the Phoenix facility. "Orange County (the location of Telefile's headquarters in California) presented a problem because of a high cost of living and a low rate of unemployment." So it was Phoenix even before the new family of computers had been named. And almost across the street from a facility set up by Honeywell to accommodate the Xerox user base.

"Rising from the ashes . . . ?"

—Edith Myers

LITIGATION

MEMOREX: SPENDING CONTINUES

Memorex will seek another trial, but a directed verdict for IBM also is a possibility.

As recently as mid-May of this year, Memorex Corp. chairman Robert C. Wilson was saying that one thing seemed certain in his company's billion-dollar antitrust suit against IBM. In the latter half of this year, it then appeared, the case would be resolved and the company would be able to reduce drastically its spending on the litigation. Wilson would not say how much the company was spending, but it has been estimated at somewhere between $1 million and $1.5 million a year. The spending could continue.

After 20 days of deliberation, the 11-member jury in the Memorex case remained deadlocked and a mistrial was declared last month by U.S. District Judge Samuel Conti. At that time, Memorex said it would file for a retrial, again by jury. And IBM filed motions for a directed verdict in its favor, much as was done successfully in the CalComp case against IBM, which CalComp is appealing.

As this was being written, therefore, it was still possible that a directed verdict in favor of IBM would settle the entire case, before a retrial could even be considered.

The hung jury in the Memorex case raises again the question of whether any jury can adequately understand and unanimously agree on the issues in one of these IBM cases. Immediately after the mistrial was declared, IBM chairman Frank Cary said, "We are not surprised that the jury could not reach agreement in a case of this complexity . . ."

But securities analyst Calvert D. Crary of Bache Halsey Stuart Shields Inc., a trained lawyer who follows corporate cases, disagrees. "I've never seen one that was too complex for a jury," he remarks.

Crary views the mistrial as a blessing in disguise for Memorex. He says some passages in the court's instructions to the jury are questionable and could be cause for a reversal on appeal. If, for example, the decision had been in Memorex's favor and IBM had appealed, only to have the verdict overturned, both parties would have to go through the entire procedure of a trial again, just as Memorex was preparing to do. Only it would now be two years and several million dollars later.

What Crary is especially critical of are the instructions regarding predatory pricing. He says anyone who obeyed those instructions would have had to decide the case for Memorex. "I think Memorex the next time around will make sure that that instruction is radically changed."

Assuming that there is a next time around for Memorex, one can see that the company joins six other private parties whose antitrust suits against IBM remain in the balance (see chart). That's not to mention the large federal trial still underway in New York City. And anyone who had the misfortune of having to sit through all of those and earlier proceedings would find that many of the issues are the same, as are many of the witnesses.

The Memorex trial, which many thought would require 10 months or more, came in in less than six months. It produced a trial transcript of more than 18,000 pages and saw the introduction as evidence of thousands of exhibits and more than 80 witnesses. In it, Memorex charged IBM with monopolizing four markets—specifically the markets for general purpose systems or mainframes, for IBM-compatible disc drives, for compatible disc drive controllers, and for compatible communications controllers or front-ends. Of course, each is a market that Memorex is active in or one that it tried to get into.

DEADLOCK—The vote was 9-2 for Memorex

The one market where it no longer is active, that for systems or mainframes, was the long-term goal that the company's founders were working toward, it was said. The company diversified from the manufacture of media (mag tape) to hardware, from disc drives and controllers to front-end processors, all with the idea of eventually developing the capability to make and market its own mainframes. And, it was charged, IBM kept maneuvering to head off any progress toward this objective. What's more, it was further alleged, IBM took measures to discredit the viability of the plug-compatible peripherals business.

In his final arguments to the jury, Memorex's lead attorney John Endicott drew from a reservoir of months of testimony. He flashed graphs and numbers on a large screen, showed a page out of the trial transcript and read a line or paragraph from someone's testimony, and repeatedly said, "if you recall" and "you may remember."

In an effort to show that IBM possessed monopoly power in the relevant market, he displayed a bar chart that contrasted IBM's and Memorex's gross incomes in billions of dollars from 1966 through 1973. One could hardly find the bar that represented Memorex. He also had one that showed the two companies' shares of the IBM plug-compatible disc drive market—in megabytes and as of December '73. It indicated that IBM had almost 80%, Memorex less than 10%.

Finally, there was one showing the installed value in the general purpose computer systems market, IBM being shown having 70% of this market, followed by Univac with less than 10%, and the other dwarfs dutifully following behind.

The Los Angeles attorney also drew upon some documents recovered from IBM's internal files, trying to show how IBM willfully acquired or maintained its alleged monopoly power. He referred to a memo written by IBM's T.J. Watson Jr., dated August 1963, that showed the executive's displeasure at Control Data Corp. taking a leadership position in superscale computers with its announcement of the 6600. IBM's response was said to have been the 360/90.

Memorex's Endicott also referred to an internal memo from a Mr. Kolsky of IBM's San Jose, Calif., lab, one that recommended a development contract with the Atomic Energy Commission. "It should be deliberately done as a competition stopper," Kolsky wrote. "It should get our machines back into our customers' future plans. It should be a deliberate prestige gainer. That is, a project to get IBM back into the position of being the real leader of the computing community. It should be deliberately done as a money loser (or, more tactfully, a shared cost development for the benefit of the government)."

"I submit that this document alone conclusively shows that IBM's purpose was to exclude competition," Endicott said.

The attorney reviewed testimony and exhibits that he said showed IBM tried to eliminate competition not only among mainframe manufacturers, such as RCA and GE, but also to eliminate third-party leasing companies.

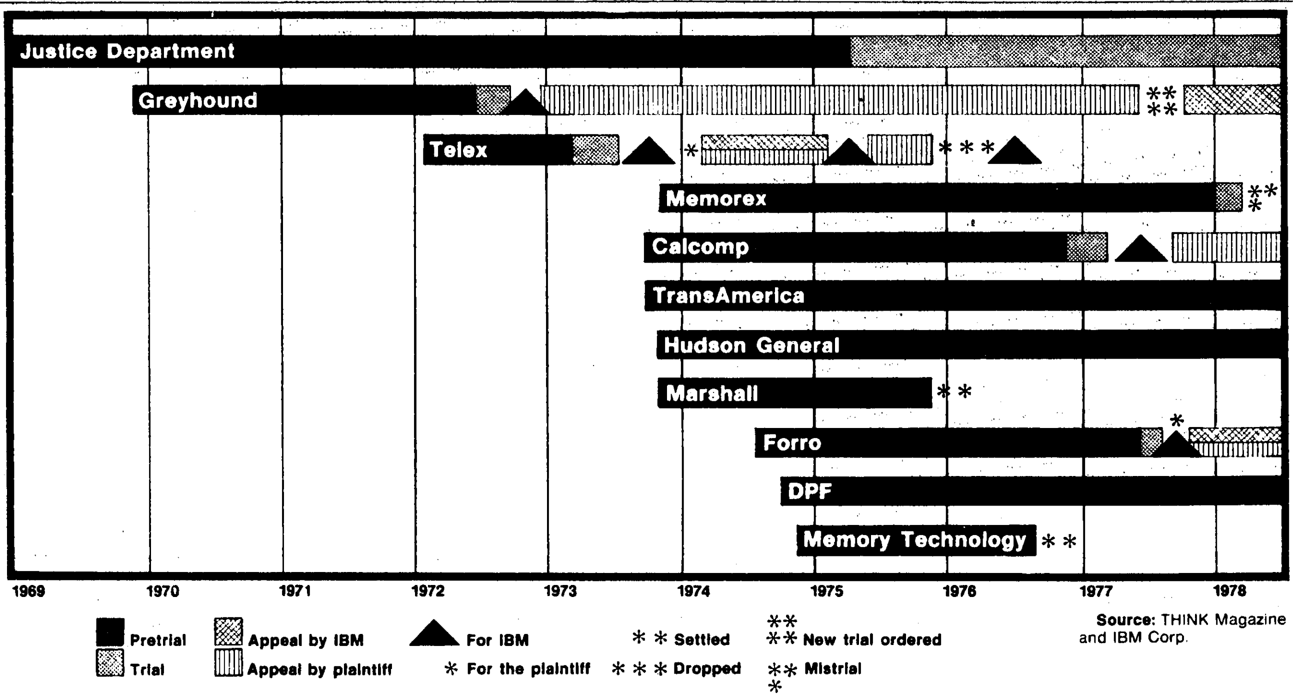
The Memorex attorney was especially critical of the IBM 2319A, the disc drive developed for use with the 370/145 and the 135. Endicott charged that IBM chose not to use the existing 2314 drives with those two mainframes because the 2314 interfaces would allow plug-compatible peripherals suppliers to supplant IBM drives. In its place, he alleged, IBM developed the 2319A, code-named Mallard, which had part of the interface buried in the mainframe, the remainder in the drives. "The effect of that was to exclude competition," he charged, adding that "from the evidence in this case, no PCM ever did attach at that interface."

The trial produced a transcript of more than 18,000 pages and thousands of exhibits and more than 80 witnesses.

Further, he said, IBM lowered the per-spindle price on the 2319As and raised the prices of the 135 and 145s. He termed these moves as examples of selective and discriminatory price cutting, of price balancing, and of predatory pricing.

"It was really the first message by IBM to the financial community that the PCM's might be a dangerous investment," he said, "that it might not be wise to either lend money or invest money in the PCM's because IBM was willing to give up short-term profits in order to get rid of some competition."

Endicott also referenced testimony by the president of Marshall Industries, who said the price cuts on the 2319A "made it impossible for us to get any kind of private or public financing on any reasonable terms." Memorex cofounder and past president Laurence L. Spitters testified to the same effect. And a Wall Street securities analyst was also quoted as having recommended that Memorex share-



ANTITRUST LITIGATION: HOW IBM HAS MADE OUT SO FAR

holders sell their stock because of the newly announced 370/145 and the 2319 "that will complicate life for the independents." The analyst, in his sale recommendation, also cited IBM's price cuts as having serious effects on the PCM's.

The industry giant in the fall of 1970 was said to have made a thorough study of the impact on Memorex's profitability if IBM were to make specific price cuts and introduce certain products. The attorney reviewed testimony that purported to show the preoccupation by IBM'ers with how IBM's product strategies might strain Memorex's relations with institutional lenders.

Said Endicott on a number of occasions during his summation: "Now, I submit you should ask yourself these questions: Are studies of the impact on the cash flow and profitability of a competitor the acts of a company which seeks to compete on the merits of its products and its services and its price? . . . The answer is no."

IBM's attorney Patrick Lynch, in his summation, had an answer for that. He referred to an internal Memorex memorandum that expressed the need to study competitors and to assess their "investment thrust and financial viability" ("Does that lead you to the conclusion that Memorex is a monopolist?" Lynch asked) and competitive strategy, both product and financial ("Does that lead you to conclude that Memorex is a monopolist because Memorex thought it worthwhile to understand the financial strategy of its competitors?").

For his part, Lynch denied any wrongdoing by IBM, attempted to ascribe Memorex's problems to its mismanagement, and asserted that IBM was guilty only of being aggressive in the marketplace—as any company must. "The point is that the law encourages every company to do its best to win if it can," he said. ". . . Basically when you get down to the hard facts, we have two strong companies, two able companies, two aggressive companies competing for the business. Memorex wants some of that business, IBM wants some of that business."

He told the jurors they are in the position to legislate how business is to be conducted in the computer industry. "If you grant Memorex $4 of damages," he said, "you are legislating that IBM was wrong to cut prices. You are legislating that IBM was wrong to meet competition. You are legislating that IBM cannot design new and better products for fear that some competitor may think it shouldn't have been done. You are legislating that IBM cannot announce new products" without first informing competitors of its intentions and asking for their comments.

"What Memorex is attacking is progress," said IBM lawyer.

In defending IBM's new attachment strategy, Lynch said that "what Memorex is attacking is progress. What Memorex is attacking is product improvement. What Memorex is attacking is giving users alternatives."

The damages that Memorex was asking for, before trebling, was $306,580,000. That was comprised of $94.5 million in losses having to do with the Memorex 660 and 3670 disc drive. An additional $27.2 million was tacked on for disc controllers. Then there was $50.7 million for the communications front-end processors. Finally, for the amount written off for the ill-fated systems activity and the profits lost in that endeavor that never quite came off, Memorex asked for damages of $97.8 million.

Endicott, trying to play down the enormity of $306 million, put that amount into perspective in this way. He observed that IBM during fiscal 1977 made $29,000 a minute, or $1.7 million per hour, or almost $14 million per 8-hour day. "At that rate," he said, "it takes something like 22 days—three weeks and a day—to come up with the $306 million. You were selected as jurors on Jan. 16, 1978, as I recall. By Feb. 6th, IBM would have made the $306 million we are asking. Since the trial has started, IBM has made something like $1.8 billion, or six times more than our claim."

But all things said and done, does Memorex have a better chance of winning on any second go-around with IBM? After all, the jury in San Francisco was voting 9 to 2 in Memorex's favor when it became deadlocked. Analyst Crary doesn't believe so. "I don't think you can say that, one way or the other, even though I'm sure some people will," he says. Indeed, he thinks IBM was lucky this time because two of the jurors refused to be swayed by the other nine. And if a retrial were held, the jury next time might have more people like those two.

—Edward K. Yasaki

DP BEHIND BARS

Is it right to teach programming to prison inmates?

" . . . a man with 25 arrests and 14 felony convictions might be better taught to be an auto mechanic or some other worthwhile trade that would not require him to be involved in sensitive financial transactions for the federal government."

Sen. Abraham Ribicoff (D., Conn.), was concerned about the teaching of data processing skills to prison inmates when he said this at the 37th International Conference of the Institute of Internal Auditors in San Francisco last June (see following story).

Sen. Ribicoff, author of a bill which would make it a crime to misuse federal computer systems, also cited a case "in which one prisoner was convicted—while in prison—of having received a $25,000 refund based on bogus returns he filed while incarcerated in the federal penitentiary at Leavenworth, Kansas."

Similar concerns were expressed at an American Bankers Assn. Operations and Automation Conference in Atlanta last May by Paul Havener of the Federal Deposit Insurance Corp. He also cited the Leavenworth case.

At Leavenworth and at the Federal Correctional Institution, Milan, Mich., some 50 convicted felons are learning to be computer programmers in courses run by Federal Prison Industries, Inc. Inmates supplement academic training with experience by developing systems for the Veterans Administration, Department of Labor and other federal agencies. Programming services are sold to agencies at market prices to generate revenue for inmate salaries and other expenses.

In a paper delivered at the National Computer Conference, Willard V. Handley of Federal Prison Industries (FPI) also referred to the Leavenworth case as something that convinced the program's operators that "our operation, and indeed any computer operation susceptible to public opinion, must, like Caesar's wife, not only be above reproach but appear above reproach."

The inmate who defrauded the Internal Revenue Service, he said, "was not connected with our program in any way."

"There was nothing sophisticated in his operation; he was taking advantage of the commonly known fact that IRS does not cross-check, except on a limited scale, the amount a taxpayer's W-2 form shows was withheld with what his employer reports. To his phony tax returns showing money he had not earned, the

SEN. ABRAHAM RIBICOFF— ". . . auto mechanics might be better."

inmate simply attached bogus W-2 forms showing taxes that had never been withheld. IRS processed the returns routinely and sent a refund check to his wife on the outside."

Handley feels it "was perhaps inevitable that it would be assumed our computer was being used in this scheme. Overnight, the story spread and grew by leaps and bounds. In major newspapers, wire service reports, and national television news broadcasts, it was implied and sometimes stated outright, that inmates trained by the prison were using computers to crack the IRS security codes, file hundreds of bogus returns, and embezzle millions of dollars."

The prison program was using Computer Science's Infonet on a time-sharing basis. Infonet, said Handley, was not chosen casually. "It boasted more federal customers than any other network. By

Important in all publicized computer crimes are the numerous privileges and freedoms enjoyed by the perpetrators.

contracting with these agencies, we could develop systems on the same computer as our customers thus eliminating compatibility problems."

He said computer security experts' statements, such as, "No computer system exists that cannot be penetrated," made it difficult for the press "to understand our assertions that our inmates could not penetrate Infonet. No one wanted to hear that, as a practical matter, penetrating a system requires certain resources, such as a prior knowledge of the operating system and unlimited access to a terminal, neither of which our staff had. In the end, we suffered as much adverse publicity as had we been guilty."

Important in all publicized computer crimes, Handley said, "are the numerous privileges and freedoms enjoyed by the perpetrators. But the incarcerated Leavenworth inmate leads a life of almost constant supervision. He is deprived of the usual freedoms, not out of fear he will commit a computer crime, but because his custody is the responsibility of some prison employee at all times. He must have express permission to move from one area of the institution to the other, and must always be in a prescribed place at a prescribed time. At night, he is locked away in a cellblock separated from the computer room by numerous barred doors and gates. During working hours, he has the freedom to be in the computer programming area, but still the requirements of custody apply. His supervisor must be constantly aware that he is present and doing his assigned job. No outside programmers are so closely observed."

The Mitre Corp., in a report following the IRS incident, said of the Leavenworth program's security: "The security procedures in use at this time are probably stronger than those used in most software development shops, and are more than adequate for the types of programs currently being developed and the current development system."

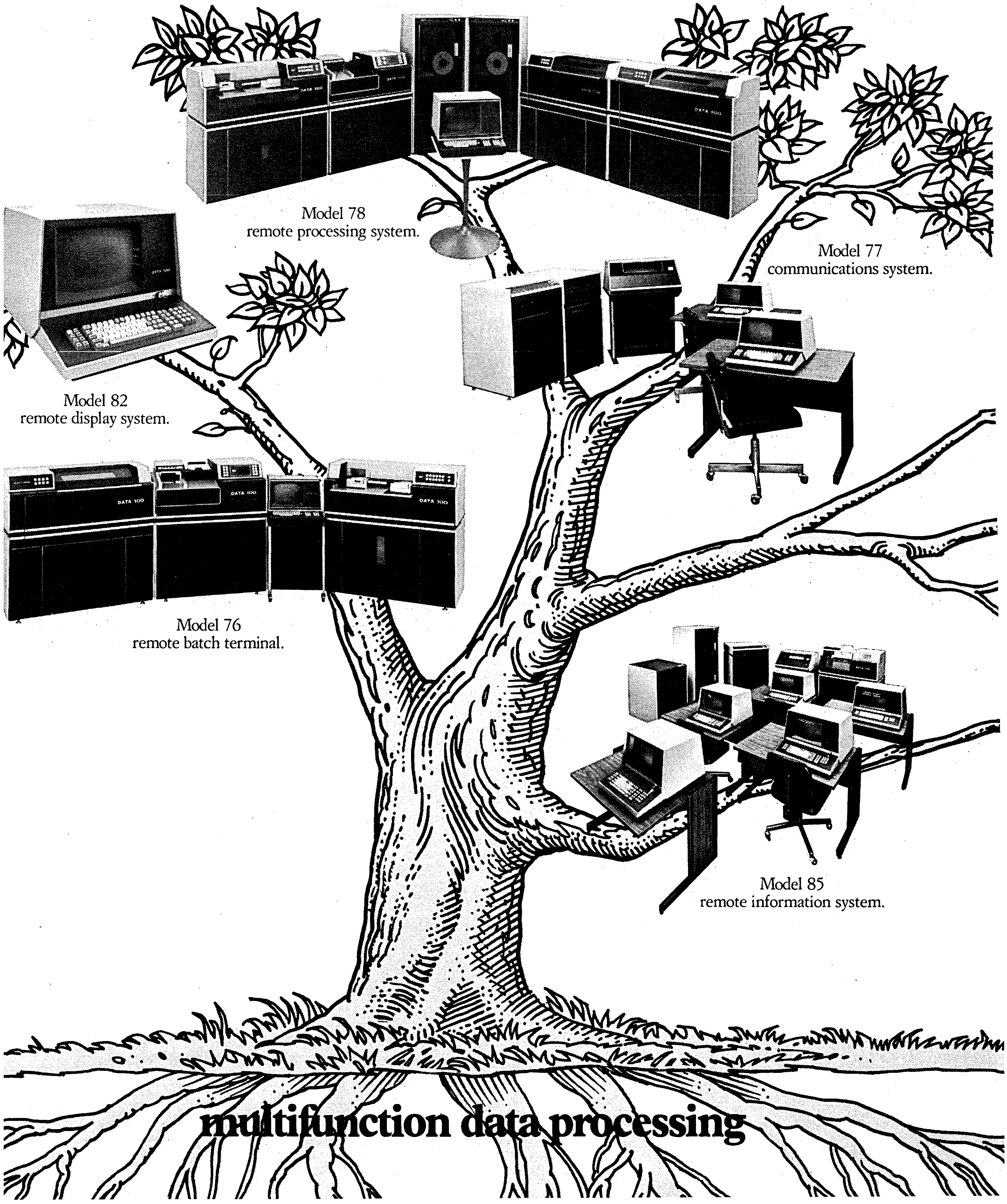
Nevertheless, said Handley, "we realized that this was not enough to prevent a repetition of the incident and its consequence of adverse publicity. An indirect threat existed for which we had no countermeasure: the public outcry against a danger more perceived than real. It could spell the end of our program. A combination of a general belief that with computers anything is possible and the prejudice that everyone who has previously committed a crime will do it again, given an opportunity, meant the issue of computer fraud was sensitive in our situation."

The Leavenworth program has withdrawn from Infonet and now is using its own dedicated machine for system development. The only thing that flows between the development facility and the client system is the program itself, which is moved manually.

Handley said a Congressional committee, in a report following its investigation of the Leavenworth incident, criticized the use of time-sharing and advised against FPI involvement in systems that disburse funds, but approved of the program itself.

"The basic argument against teaching computer programming," he said, "is that it provides criminals with tools to commit more rewarding crimes, with less effort and risk than their previous adventures required. If the saying 'once a criminal, always a criminal' were true, this argument would be unassailable. But it isn't; nearly two-thirds of all federal releases have been shown to be 'successes.' "

The Data 100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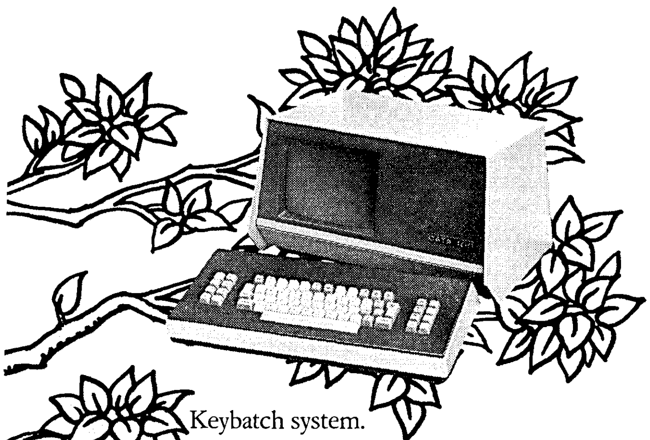

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CIRCLE 37 ON READER CARD

"We know that people who commit crimes have the same basic desires as the rest of us—security, status, and so forth," said Handley. "The main difference seems to be that the criminal is more impatient, wanting his desires met immediately. And they often lack the training to fulfill their desires through legitimate means."

The FPI data processing program, Handley said, "is a long-term, rigorous ordeal. An inmate must apply himself diligently for 12 months of training to avoid being dropped from the course. After completing the course, he has to put in two or three years of further training in live production work, steadily improving his skills, in order to land a job upon release. Many never make it through the first few months of training."

Handley believes the program itself is self-screening. "The attitude of wanting instant, effortless success would not carry a trainee halfway through the first course."

Malcolm Smith of Honeywell started a computer training program for prison inmates in Massachusetts 11 years ago. His experience would seem to back up many things Handley said at the NCC. For one thing, the screening. "We give tests (the same tests as are given in many programmer training schools on the outside) and take anyone who is in the above average group among the people taking the test. For each testing, we usually take a little less than half. Then we loose 50% of these during the first class in fundamentals. Next we get into flow charting and loose a couple more."

Smith said people who have served time in prison have a "different kind of loyalty" from those who have not. "If you give them a chance . . . a job, there's no way they're going to turn around and slap you in the mouth, cause you trouble." Smith believes if there's going to be a problem in a data processing operation it won't come from ex-cons. "The chances of a problem with an ex-prison inmate are much smaller than with somebody just hired off the street. Computer crimes are committed by bright guys who don't need the money and do what they do for the fun of it."

Smith started the Honeywell program as a completely voluntary operation. Some 150 Honeywell people have freely given their time as instructors, teaching at night with no remuneration. It's a self-perpetuating operation in that the basic courses—fundamentals, flow charting and then COBOL—are first taught to inmates by Honeywell people and then are taken over by inmate teachers. Honeywell people continue to teach advanced courses at least one night each week for three hours at six different institutions.

At one, in Framingham, Mass., the inmate-students have gone beyond the classroom. They have started their own service bureau called Conputer Inc. and, according to Smith, "they're doing very well." The money participating prisoners earn is sent to their homes which, Smith says, "keeps their families off of welfare."

RICHARD N. HENDERSON, Honeywell's community services manager and director of its Massachusetts Prison Program, instructs prison inmates in computer programming and operation at the state's minimum security facility in Framingham, Mass. Honeywell volunteers taught their first behind-bars data processing course 11 years ago in the state's maximum security institution in Walpole, Mass.

Smith said he's never had a problem recruiting Honeywell instructors. "All I have to do is get them to go in once and they want to keep going back. There's something about being able to help your fellowman."

"If you give them a chance . . . a job, there's no way they're going to turn around and slap you in the mouth."

Smith, like Handley, has his theories as to why people end up in prison. "I believe 99% of them never honestly had a chance to get into work that interests them and would earn them decent money."

He started the Massachusetts program in the state's maximum security facility in Walpole as a result of a visit to the prison by the Men of Christian Action, a Catholic laymen's group that visits prisons "to talk to the prisoners about religion and other things."

An inmate asked a member of such a group about data processing and the chances of it being taught in prison. That member worked for Sylvania, which didn't make commercial computers. He talked to a Honeywell public relations man who talked to Smith. And so it went.

The program has put some 350 qualified programmers into the job market of whom 250 are actively employed in data processing. "The recidivism rate (rate at which discharged inmates return to prison) is extremely low," said Honeywell's George Field: "3 to 4% as compared to a national average of 70%."

"In my eleven years of experience with prisoners," said Smith, "I've never known any of them to cause a computer fraud problem."

Among the Honeywell success stories is that of Bill, convicted of murder at the age of 19. The death sentence was subsequently commuted, as was its successor sentence to life imprisonment. Bill served 23 years. Today he's a programmer at Honeywell, having progressed from associate programmer through system analyst to a job of responsibility for installation and test of new programs, which keeps him traveling to customer sites all over the country.

Smith emphasizes that he tells inmates participating in the Honeywell program that they can't count on jobs at Honeywell. "We want to build up self-confi-

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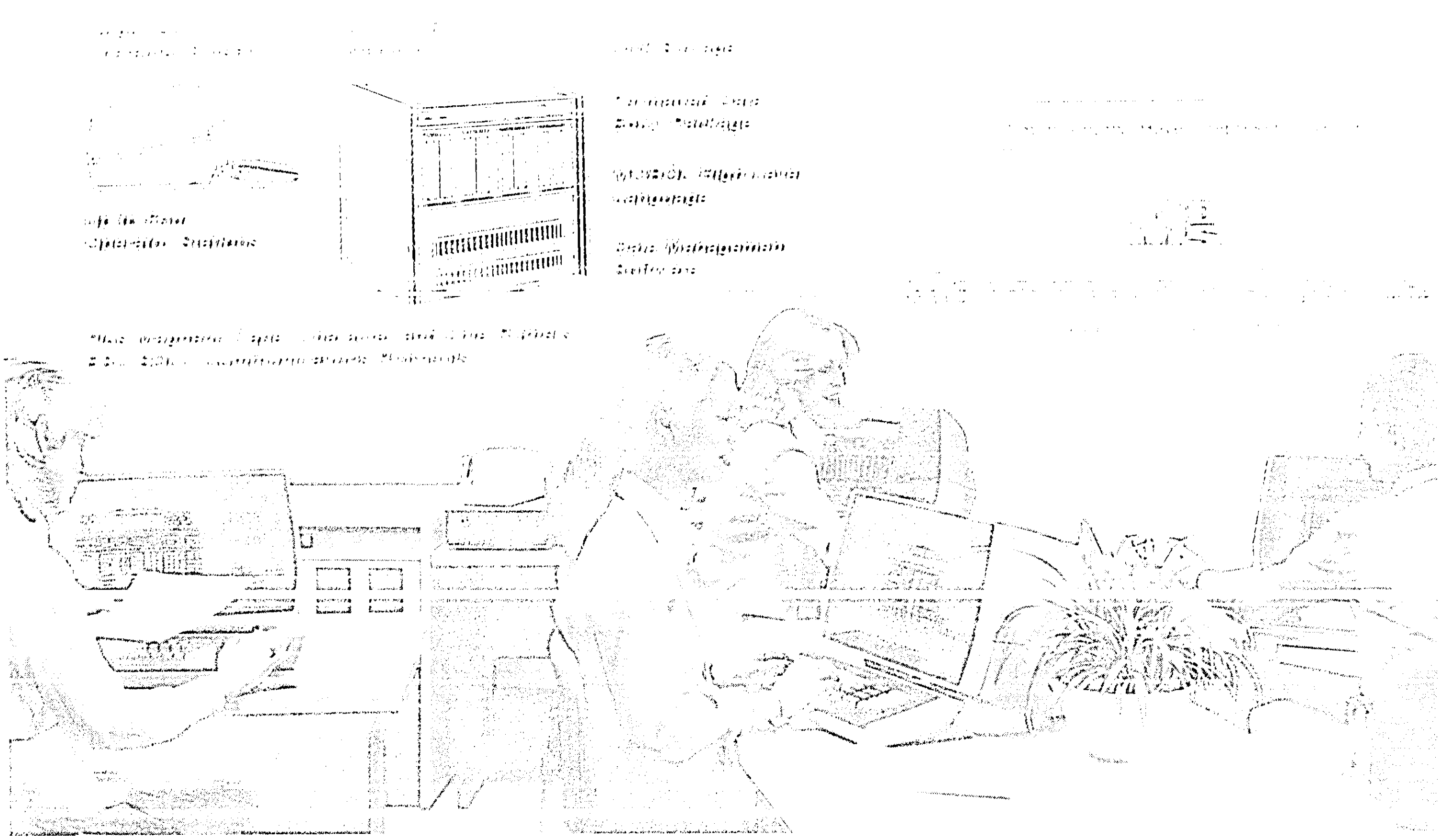

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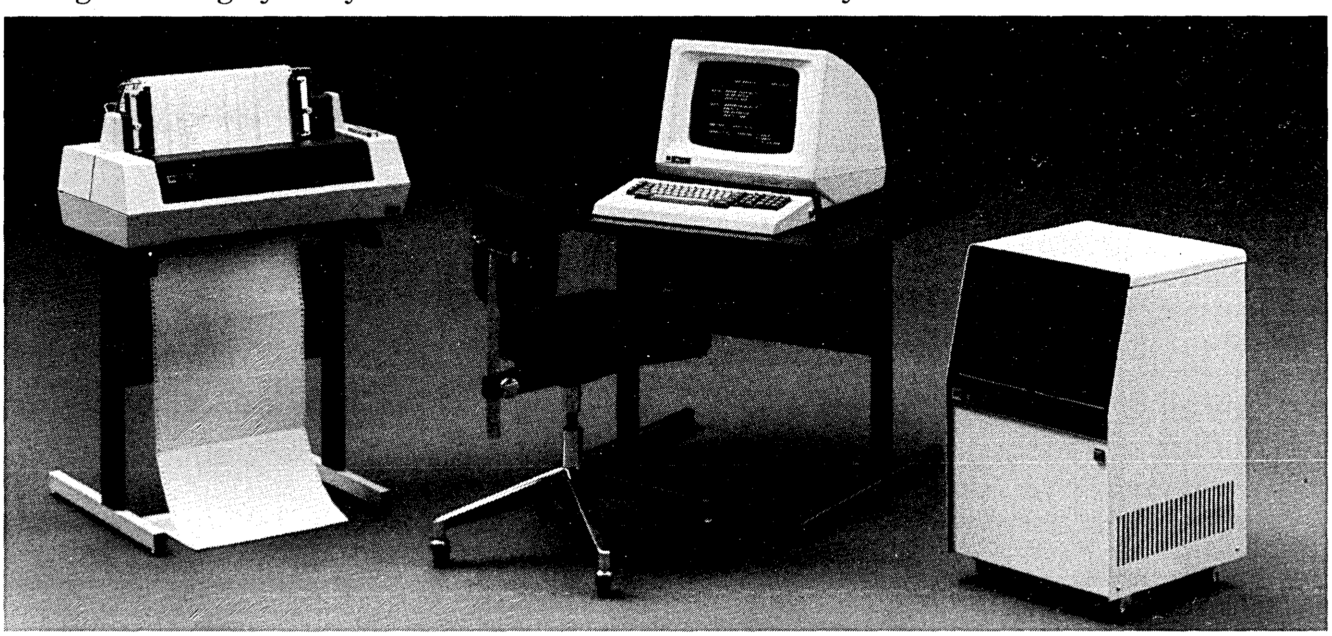

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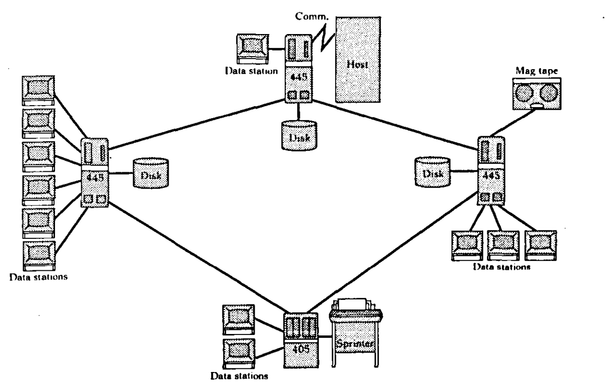

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CIRCLE 60 ON READER CARD

dence, to teach them to believe in themselves and in their ability to go out and get a job for themselves. Honeywell does employ eight of the program's graduates, but all but one, Smith said, had other jobs first. The one exception had his sentence turned around suddenly (conviction reversed) and was eligible for immediate release if a job were immediately available. "We didn't have time to hunt."

John Cool, a principal in Image Resources Inc., a Westlake Village, Calif. firm which tracks the computer hobbyist market, and a former president of Valcomp, a division of Tymshare, and a veteran of Scientific Data Systems, agrees with Smith that teaching data processing to convicts is far more beneficial than it is dangerous.

Cool started and taught a data processing course at Oregon State Penitentiary. He recalls some uncomfortable moments on his first teaching day. "A guy convicted of some pretty heinous murders was sitting in the front row. He was the kind who liked to put his arm around. buddy-up to the teacher." Cool adapted. "Once you're inside prison, you're equal to everybody else. It doesn't matter what you're in for. The opportunities are the same."

He particularly relates to one prisoner, "a safe cracker all of his life, who was assigned to me, when I moved back to Southern California. He lived with me for awhile, married my baby-sitter, and now has an electronics company of his own doing $1 million per year in business. It was the dp training that did it."

—Edith Myers

AUDITING

SUPRISE AUDITS

It's one way to avoid and prevent computer fraud.

"There's no such thing as computer fraud, only people fraud."

It was Warren White's way of shaking up the troops. White, a former manager of dp, systems, and communications for Lockheed Aircraft and who served as a court-appointed assistant trustee in the Equity Funding case, spoke of computer fraud detection and prevention in San Francisco late in June at the 37th international conference of the Institute of Internal Auditors, which featured Sen. Abraham A. Ribicoff as its keynote speaker.

In maintenance programming, there's too much reliance on one person, with no one else knowing what he does or has done.

The Connecticut senator was pushing for the passage of Senate Bill 1766, the Federal Computer Systems Protection Act, which came out of the Governmental Affairs Committee that he chairs. He directed the investigation of computer security in federal programs and learned that "federal computers are not adequately secure. And the government is not properly equipped to prosecute computer fraud."

He said there are some 40 statutes that can be used to combat computer-related crimes. But all 40 were written to combat abuses other than computer crimes. And that makes it difficult for prosecutors who must construct their cases on laws that don't envision the technical aspects of computer crime.

In short, he added, there is no law making computer crime a crime. So prosecutors must make their cases fit previously existing statutes, such as mail fraud or wire fraud. Sometimes this works and convictions are won. But prosecutors also lose cases, not on their merits but from technicalities stemming from the lack of computer crime statutes.

"In some trials, for example," Ribicoff explained, "judges have refused to allow certain exhibits and documents as evidence because the law is unclear as to what constitutes property in the computer field."

His bill, S 1766, specifically defines computer crime and makes more clear what is admissible as evidence.

Lending his support to Ribicoff's bill, consultant White said, "We need this kind of legislation that will make it illegal to go in and purposely change a basic file. That is not illegal today. That's why we have to resort to things like mail fraud."

White went quickly over the three rules of security that apply to computing—as they also apply to accounting—physical security, separation of duties, and independent reviews. And he said people in computing still violate all three.

In maintenance programming, he said, there's too much reliance on one person, with no one else knowing what he does or has done—no separation of duties. There's a problem, too, with the way exception correction and re-entry is being handled, again a lack of separation of duties and independent review.

And then there are program restart procedures. "If you wanted to engage in fraudulent activities—I hope most of you are here to learn how to detect this, not how to do it—a very good way to do it would be to program a stop in the computer." At that time, he explained, the focus of activities is on getting the thing running again. And the person with a preplanned set of restarts could engage in chicanery.

White said that with the way hardware costs are dropping, he looks for the time when we'll have separate equipment for program testing, plus procedures for an independent review of programs before they go into production. He said he doesn't like the idea of testing with live files, although some people still do it.

As for audits of financial records, "I cannot understand doing an audit on anything but a surprise basis," he added. But an internal auditor cannot insist on this without the technical expertise to do it intelligently. And one takes a calculated risk when one doesn't do it because all the dp manager has to do "is push one button and you're going to see what he wants you to see, not what you suspect might be there."

The speaker then explained the procedure of on-line file updating, citing the example of a claims adjuster at an insurance company. She calls up a claim on her crt terminal, studies it, and adjudicates it on-line. How do you audit that? Well, you could provide a terminal to the dp audit staff "and make it known to everyone that they (the audit staff) may be sampling what you're doing at any time." For some people, apparently, it's come to the point where Big Brother is really watching.

White urged his listeners to get their dp people to push for a standard I/O channel interface, something close to being realized at the federal level. He said it would be easier to audit systems if there were such a standard. "If we don't have this," he cautioned, "we may have a tremendous problem auditing a distributed type of system." In that same type of environment, he added, there is a need for very strict corporate standards in the design of distributed data bases.

All the dp manager has to do is push one button and you're going to see what he wants you to see, not what you suspect might be there.

"I look to the day when operating systems will be hardwired," he concluded, saying that if it were hardwired or stored in a ROM it hopefully could not be penetrated by an intruder. "Let's put our control systems in hardware."

—E.K.Y.

[illegible] in Microcomputer Systems

[illegible]

[illegible] first [illegible] microcomputer systems [illegible]

[illegible]

[illegible] by introducing the multifunction microcomputer system, which cost-effectively enhances a wide variety of equipment including word-processing machines, [illegible] [illegible]

[illegible] magnetic bubble memory technology to the [illegible] of the National Aeronautics and Space Administration.

[illegible] for the

[illegible] major advances in microcomputer systems

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CRIME

DENMARK CAPER

Three acquitted of bribery and corruption charges in Denmark's computer industry "Lockheed"

Three men have been acquitted in a two month long bribery and corruption trial in Denmark involving Honeywell's French partner, CII-Honeywell Bull.

The trial was rooted in events that happened four years ago. Behind it lies two years of police investigation, press speculation and innuendo, which have created what the Danes referred to as their "Lockheed."

The case centered around Denmark's telephone company, KTAS—described by one witness as a "mafia"—and a 27 million kroner ($5 million) order placed with CII-Honeywell Bull Denmark in the summer of 1974.

Acquitted of bribery and corruption charges early in July were Ebbe Cordes, former KTAS dp manager; Erik Thomsen, independent consultant and former CII-Honeywell Bull salesman; and CII-Honeywell Bull Denmark's managing director, Leon Philips. All three faced sentences of up to ten years in jail.

Cordes, 41, was accused of taking a bribe from Thomsen when he was dp manager of KTAS to secure the $5 million order for two Series 6000 systems for CII-HB Denmark. Thomsen was brought in by Philips early in 1974 to head his company's sales effort on the KTAS bid—an ambitious and sophisticated telephone network system conceived by Cordes. Both Thomsen and Cordes already were friends, Cordes having once worked for CII-HB in Denmark.

According to prosecution charges, Philips paid Thomsen a fee of 2.5% of the total order, about $140,000, after the Honeywell systems were installed in 1975. This money subsequently was shared with Cordes and salted away in a Swiss bank account. Defense claimed that the money in the Swiss account came about as a result of the sale of property between the two men.

Cordes has said that evidence did exist that could have proved his innocence beyond question, but that unfortunately this had been destroyed. It emerged in court that a country house in Denmark and a flat in Majorca, Spain, were jointly owned by Cordes and Thomsen. Cordes said he sold his share to Thomsen. When asked where the papers of the sale were, Thomsen told the court that he had "panicked" and burned them when the investigation started in earnest.

Though there has been no charge against CII-Honeywell Bull itself, Philips was charged with implication in the alleged bribe. It was from within CII-HB itself that suspicion of something underhanded first arose. At the beginning of 1976, auditors working through CII-HB Denmark's 1975 accounts questioned the payment to Thomsen, and said insufficient explanation was given for it. CII-HB Denmark's chairman became suspicious and refused to sign the accounts, local newspaper reports claimed. It was around this time (February 1976) that the story was leaked and the first Danish press report appeared saying that KTAS and CII-Honeywell Bull were calling for a police investigation.

Sources in Denmark indicate that the auditors leaked the story. But this has never been confirmed, and either CII-HB's chairman, Thomas Federspiel; who resigned in due course, or some other party could have done so.

In his defense, Philips told the court that "commissions" of the order of 2.5% were normal business practice on such deals as the KTAS tender. In addition, he said that both he and Thomsen had originally anticipated that the KTAS order would be half the size it turned out to be.

Cordes says he'll sue KTAS for between $90,000 and $180,000 for "wrongful dismissal" from the company.

Press reports make it clear that Federspiel sensed something underhanded and improper in the payment and may have asked CII-HB to take some course of action that it didn't agree with.

At any rate, CII-HB continued to support its Danish managing director despite the fact that it has squirmed on the end of suspicion and innuendo for two years and had to put its celebrated president, Jean-Pierre Brule, in the witness box to help clear the air.

Meantime, Cordes said he'll sue KTAS for between $90,000 and $180,000 for "wrongful dismissal" from the company. (He was out of work for a year.) He claims his sacking was part of a plot by top KTAS personnel to get rid of him because his new ideas were upsetting the balance of a line management tradition that had existed for 100 years.

Powerful support for some of these charges came in the unlikely form of some KTAS employees themselves. A barrister of 34 years experience with the telephone company, the one who referred to KTAS as a "mafia," said that Cordes had been suspended on a "feeble basis" and that the whole procedure was "unusual." Another witness, this time a project manager, said KTAS had embarked on an "internal policy of slander."

KTAS has said that neither in 1974 nor today has there ever been any doubt that Honeywell was the right choice for the job. In the face of all the intrigue and scandal, everyone seems to have forgotten about the Series 6000 systems. Cordes wanted to use them to display the line layout of the whole Danish telephone system at the push of a button for easy maintenance. But according to sources, the creative urge behind the project went out of the door with Cordes and the system currently is running at only 10% of its capacity.

Now charges of gross inefficiency are likely to be leveled at KTAS. Information circulating among sources close to the company seems to suggest that phone charges could be one-third of what they are at present. Cordes charged after the trial, for instance, that KTAS over a five year period spent $3.6 million more than it should have on a service bureau and consultancy contract with Regnecentralen, a Danish service bureau.

Observers close to the trial feel that KTAS won't appeal and that Cordes' litigation against KTAS will be settled out of court. Cordes, meanwhile, currently is manager of a factory in Denmark manufacturing garden furniture. Thomsen is in California selling covers that lessen the glare from visual display devices. Philips continues with CII-Honeywell Bull.

—Ralph Emmett

TURNAROUNDS

BACK IN THE BLACK

How Cambridge Memories recovered after bank called in $17.2 million in loans two years ago.

In July of 1976, the First National Bank of Boston decided to call in $17.2 million in bank loans that had been made to Cambridge Memories Inc. Within a few days the company terminated its 380 employes and ceased operations. The firm had no working capital.

Several people advised the firm's president, Hungarian-born Joseph F. Kruy, to throw in the towel. Kruy thought about that for a few days, but in the end he decided to try to slug it out. The company resumed operations, but in a sharply curtailed manner with just 52 employes. Cambridge Memories' costly semiconductor operation was closed per-

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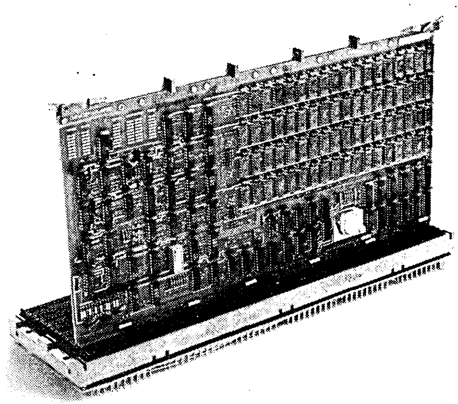

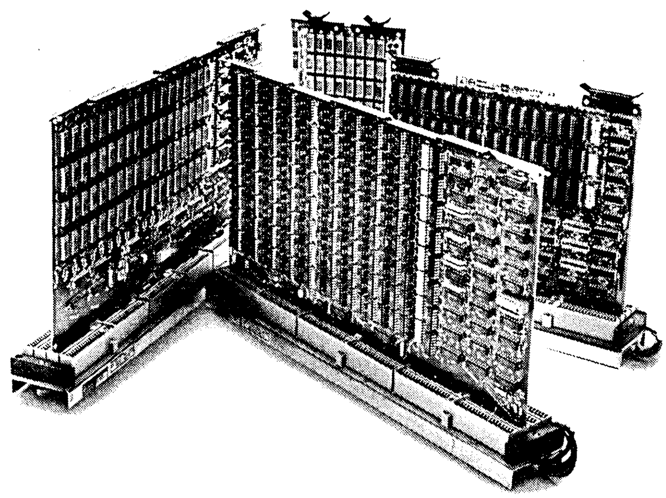

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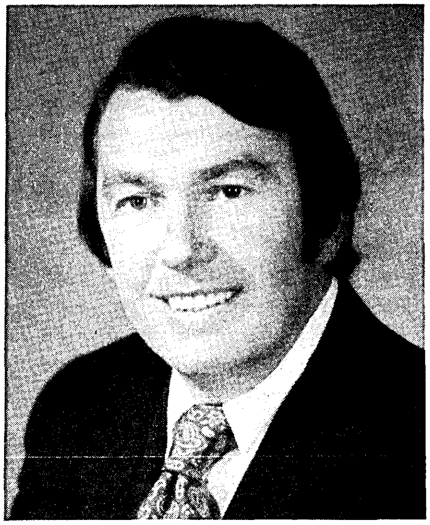


JOSEPH F. KRUY—"We paid our debts off at 100 cents on the dollar."

manently.

Today, two years later, Kruy presides over a healthy, if somwhat smaller company located in new quarters in Waltham, Mass. Cambridge Memories has been profitable for seven financial quarters and, more important, has paid off its $17.2 million in loans primarily by selling off its lease base of add-on memories. The company has been negotiating a new line of bank credit—this time the First National Bank of Boston won't be involved. Revenues are running at an annual rate of $12 million and the company has some 180 employes. In its most recent

Kruy thinks he sees a new opening in the data processing game smack in the middle of the hot distributed data processing market.

quarter ended June 3, the company did $2,938,000, compared with $1,840,000 in the same period a year ago.

"We paid our debts off at 100 cents on the dollar," said Kruy. "That generated goodwill. We had other assets like the goodwill of our customers. And we had a considerable accumulation of talent in the form of our designers of high-speed memories for large data processors."

Now, Cambridge Memories is moving into new product areas, recently announcing an add-on memory for IBM's new 303X line. The firm continues to ship add-on memories for IBM's 370 line and while Kruy expects that market to continue to be a good one, the firm is taking aim at other new markets.

Kruy thinks he sees a new opening in the data processing game smack in the middle of the hot distributed data processing market. Kruy looks for Cambridge Memories to be building IBM software compatible cpu's on the low end of the 370 line. The products should compete not only with IBM machines but with superminis made by the larger minicomputer companies, and that position will put Cambridge somewhere between the proverbial devil and the deep blue sea. And that, says Kruy, is precisely where the action will be.

In recent months, Cambridge has nailed down some prestige accounts—its add-on memories hum away at 158 and 168 installations at MIT and Stanford. They make excellent customer reference sites just as they once did for IBM.

Another asset is the company's affiliate IPL Systems, which designs and manufactures the Omega, an IBM 370 midrange software-compatible cpu. Control Data markets the machine and Cambridge Memories has a 40% ownership in IPL Systems.

Cambridge undoubtedly has some melancholy thoughts about spilt milk—the firm was one of the pioneers in bubble memories and its semiconductor operation produced a landmark 50nsec MOS chip. Those efforts, of course, had to be abandoned in order to pay off the bank loans, and the projects were not dropped without some separation pains.

In an industry where startup companies have become a rarity and turnaround situations have gone the way of the dodo bird, Cambridge Memories is in the unique position of having been through both situations in 10 years. And about that, says Kruy, who has been through it all: "It's much more satisfying to turn around a company than it is to start one. But I'm not going to do it again." ✻

HOME COMPUTING

OUT GO PYGMIES

The way things evolve, there'll be little room for other than the most sophisticated firms in the home computer market.

Technical and financial requirements that eventually will evolve in the home computer market may leave little room for other than the most sophisticated computer firms, says John Morrison of Control Data Corp. In fact, he said in an interview, even formidable entrants such as Tandy Corp. could be absorbed by a large computer firm.

Morrison, CDC's director of long-range planning, says trends for the home computer market are not evolving out of the micros currently offered by the likes of Tandy, Imsai, and Commodore. He said you have to look at the migration of technology from mainframe to mini, distributed processing, and communications.

Two things will happen in the near future. "First in the 1980s you will see significant changes in system architecture, a movement to be led by IBM."

And that, he continued, will interlace with the second development: the marriage of dp and data communications in the emerging distributed processing environment. "As far as I'm concerned, there is no question that IBM is coming back into the service business in the U.S., but they're not coming in through the traditional service bureaus and the like. They'll return to the service business through satellites and communications technology."

The CDC futurist noted that the large mainframe market that has sustained such phenomenal growth over the years is approaching maturity. "Where do we go from here? Obviously, we migrate with the technology down into smaller systems."

In IBM terms, he said, mainframers move down into minis like Series/1 that acknowledge the distributed processing environment and into the office environment with word processing systems like IBM's Office System 6—separating text and number-crunching in separate black boxes for maximum software sales.

"And when we've really moved into the office, we're only one step from the home," Morrison noted. And, he added, it's in the office with the widespread integration of minis in the distributed processing business environment that vendors will meet the home computer users.

He added: "We believe that most of the guys who will buy these things and take them into their homes will be businessmen." They'll be savvy consumers who want a reliable, inexpensive, hopefully money-saving control system for the total home environment. They won't be the hobbyists who learn a programming language for the sheer joy of it.

Morrison, who was scheduled to speak at Boston's Electro/78 this spring on the role of computer giants in the pygmy computer market but couldn't make it because of an airline strike in Chicago, said the market for small computers will evolve as the technology of the industry approaches the user and not as the user becomes a technocrat.

The product that can penetrate the home market will come out of an evolu-

JOHN MORRISON—"When we've really moved into the office, we're only one step from home."

tion in the sophistication of mini networks, said CDC's seer, "particularly the new standards in reliability that will have to develop in order to support distributed processing. . . . For the whole computer industry, the battleground of the 1980s will be in reliability. It's something we're all working on now for distributed processing. And it's only when all the major questions—cost, reliability, and system network architecture—are answered for minis, it's only then that you're ready to go into the home."

The little vendors currently marketing

IBM, CDC, Univac will enter home computer market in the late '80s, squeezing out smaller entrants.

home computers simply can't bring the muscle to bear to address these problems, Morrison contends. Standalone systems are all they can offer. They don't have the sophistication, the money, the experience, or the prestige to bring the computer into the home market.

The communications environment will migrate from the office habitat into the home, leaving discrete standalone systems looking like the early big-wheeled bicycles on a crosstown expressway.

"By 1983, 1985 maybe, I think you'll find microwave antennas on the top of all the office buildings," Morrison said. "And by 1990, I expect you'll find some sort of cheap antenna, perhaps some modification to today's tv antenna, on the roof of virtually every home."

Neat, simple, and efficient controls—probably using something like a Touch-Tone telephone module rather than a typewriter keyboard—may be the rule.

Sophisticated networking will offer the sort of control necessary for remote diagnostics, efficient backup for a system already reliable enough to be trusted with command of the home.

"The computer will be a consumer item, but it won't be like any conventional consumer product. A system tied into the total functionality of the home will not be a novelty item. It will be essential, necessary. And then it can't crap out. It's got to be reliable.

"And that's what will separate the men from the boys."

In that sort of environment, Morrison asked, who else but the large computer companies can be trusted to meet that standard? Radio Shack? The Byte Shops?

"What I think you are likely to see in the near future is an effort by some large computer firms to absorb retail companies like Tandy Corp.," he added. "We won't need the small computer manufacturers. What could they teach us? We don't need the hobbyist manufacturers, but we will need the outlets, the retail connections."

But it will be a natural progression with the pace set by the evolution and migration of technology along paths already visible in the industry, Morrison argued.

First, there will be a reshuffle in the minicomputer market as the large mainframers muscle in and redistribute the market shares. Already most have added their weight to the distributed processing trend, committing themselves to a future of computing through communications in a distributed environment.

"Today, DEC had 37%, Data General 12% in the minicomputer market. Hey! By 1983 those percentages are going to have changed considerably and all the large computer companies are going to be right in there."

And from there, Morrison thinks, the technology naturally will migrate toward the home. And as that market matures, when it's ready, we'll all be in home computing too—the IBM's, the CDC's, the Univacs and the DEC's. It will be an evolution rather than a revolution. Home computing is for the future, but the revolution started yesterday.

—Vin McLellan

JUSTICE

THE SOVIET DISSIDENTS

Says ACM head, "We care how our colleagues are treated in Russia."

In July, when the Soviet courts handed down stiff prison sentences for dissidents Anatoly Shcharansky, Aleksandr Ginzburg and Yuri Orlov, another round of efforts began in an effort to pressure the Russians into releasing them and easing restrictions on emigration.

Using trade restrictions is earning the U.S. the reputation of being unreliable suppliers.

What Russian courts had seen as espionage (in Shcharansky's case) and anti-Soviet propagandizing, the West viewed as gross mistreatment of three human-rights activists, whose only crimes were the exercise of free speech and desire to emigrate.

Secret negotiations were underway to trade some of the dissidents for Russians arrested in the U.S. on espionage charges. President Carter in a highly symbolic gesture withdrew an application for an export license to ship a Univac 1110 system to the news agency Tass and halted critical oil technology exports.

The Association for Computing Machinery kept its promise to halt all cooperative ventures—meetings and formal exchange of visits—with its Russian colleagues. At a conference of university computer science department chairmen, 27 attendees sent a telegram to the Soviet Academy of Sciences noting that in view of the treatment of Shcharansky, a computer scientist himself, it will be "increasingly difficult to welcome Soviet scientists to our laboratories and universities" because situations like this tend to "poison the atmosphere."

ACM's president Daniel McCracken said his organization's move means simply, "We care about how our colleagues are treated in Russia." He admitted the exchange of visits and joint meetings has not been heavy in the past, and currently no specific meetings are in the works.

"Our action was more symbolic in that sense," said McCracken, but the feeling is strong. Sources say that ACM professionals who, as individuals, participate in such exchanges are being pressured to take a stand.

Although no other computer orders are slated for the same fate as Univac, the Carter action was believed directed at the harassment of U.S. journalists in the Soviet Union and the fact that Shcharansky is a computer scientist. The fact that Tass is in a hurry for this multiterminal, $6.8 million system because it will be used for the 1980 Olympic games is considered a bone thrown to those who are pressuring for a U.S. boycott of the Olympics in Moscow.

Univac cancellation was meant to appease those pressuring for U.S. boycott of Moscow Olympic games.

Oil technology cancellations are considered more severe, since it is harder to come by outside of the U.S. and the Soviets are anxious to develop oil exports and obtain more hard currency.

Some strong human-rights activists in the U.S. were incensed by what they call the "tokenism" of the computer move, however. "This is insignificant," complained one, "meant only to satisfy Congressional outrage."

He suggested Carter should have picked on equipment yet to be delivered to the big industrial Kama River project, or to the Aeroflot system, already two years into development.

An east-west expert at a computer company added an economic perspective to American human-rights actions. "What good this will all do in Shcharansky's case, we don't know. Perhaps once everyone is through with these gestures . . . perhaps the negotiations to exchange arrested Russians here for imprisoned dissidents will proceed quietly in earnest."

But he added: "The U.S. is using trade restrictions over the human-rights issue in Russia, Argentina, South Africa and elsewhere, and that is earning us the reputation of being unreliable suppliers. Siemens has gone back into South Africa to sell computers because of this. Datsun is even guaranteeing in their auto advertising that they are there to stay."

What Russian courts had seen as espionage, the West viewed as gross mistreatment of human-rights activists.

He questioned whether our human-rights stand—trying to tell other countries how to behave—was "gaining anything for the individuals."

"Or is it merely costing us economic opportunities and political alliances? I don't know. I sympathize with the individuals involved, the Shcharanskys, the Orlovs."

Whether computer technology will be involved in any negotiations for the release of Shcharansky, Orlov, and Ginzburg has yet to be seen. When it all started, more than a year ago, a supporter said, "Trade a computer for Shcharansky and he'll be out of there tomorrow."

—Angeline Pantages

UK'S PUSH IN MICROS

Britain's National Enterprise Board will sink $100 million into a new manufacturing plant.

Britain is going on a multimillion dollar spending spree to buy itself a future in microelectronics.

A government-backed program that will swing into operation during the year includes:

- setting up a manufacturing operation in the north of England (or possibly Scotland) to manufacture micros,
- acquisitions and joint ventures in the U.S.,
- buying the services of top U.S. electronics experts,
- and luring back British expatriates from California's Silicon Valley.

In addition to these state-backed measures, Britain's private sector is looking to follow a recent $1 billion takeover buying spree of U.S. banks and industrial companies with further purchases, as well as joint ventures, in the microelectronics sector.

Britain's National Enterprise Board (NEB), which acts as an umbrella for state holdings in industry and seeks new investment opportunities, is to sink around $100 million into a new manufacturing operation for microcircuit memories. The plant will be built somewhere in the north of England (though as yet a site hasn't been announced), and initially will concentrate on the mass volume production of 64K RAM devices. Some 4,000 jobs are expected to be created during the next three to four years.

The British government already has a $100 million micro development budget (Advanced Research Projects) and is expected to announce a $120 million research program into specialist microprocessor applications later this summer. In addition, the government's new $110 million Aid to Industry scheme has a high microelectronic content—particularly in the education area.

Petritz and company stand to become very rich—but this time it will be the British taxpayer coughing up the risk capital.

The kingpin in the NEB initiative is an American, Dick Petritz. The former head of semiconductor research at Texas Instruments and founder of Mostek will head a team of six. Another U.S. cofounder is Dr. Paul Schroeder, from Bell Labs and Mostek, who played a major role in new standard 4K and 16K memories. Though unavailable for comment since the NEB plans emerged, Petritz is believed to be recruiting five expatriate British microelectronic engineers from California.

According to reports, one of these is Colin Crook who is quitting his job as Motorola's Micro Products head, though the NEB link is yet to be confirmed.

At the same time that the manufacturing operation is launched in the U.S., a separate company will be formed in the U.S. by the NEB to handle a future assault on this market. An eventual workforce of 1,000 currently is envisioned in the U.S. It's not known at this stage which of these two options provides the main focus for the team's investment.

Like the six or so leading lights that became millionaires at Intel, Petritz & company stand to become very rich—but this time it will be the British taxpayer coughing up the risk capital.

The NEB plan to back entrepreneurial high risk investment is a fresh approach in the U.K.—and in Europe. According to sources close to the British Department of Industry (DOI) the NEB move will "smash" the recent European Economic Community (EEC) four year plan for the Euro computer industry. This $80 million package of proposals was heavily influenced by a French lobby to support its minicomputer (Perinformatique) industry on a pan-European scale. Only an initial $10 million was budgeted for microcomputer developments. The British government has since privately told the EEC that its $22 million share of the budget is too high considering the proposals as they stand. It said more stress should be laid on the microcomputer and services industry and certain high-speed peripherals and mass storage systems.

The $80 million proposal was considered a "joke" by many European experts for one other reason—its size. This amount over four years is not even one-half a percent of what the U.S. government spends each year on its computer industry. One expert described the $10 million budgeted for micros as "just enough to buy about four test systems at about $2.5 million each!" Since the proposals were announced at the end of 1976, at least one EEC official formerly with its telecommunications office has been trying to raise a $1 billion program for VLSI—"nearer the more realistic figure for a European scale involvement," he said.

Another plan being considered by the EEC is the formulation of a pan-European semiconductor operation "drawing together entrepreneurs from the electrical monoliths" into one company. But like a similar British plan, this has so far floundered on jealousy, mutual distrust, and entrenched interests—"the European disease."

The NEB, aiming for 20% of the European market for its devices, has cut across all these plans. The multinationals like ITT (aiming for a 10% of Europe and going into 16K RAM production at the end of the year) and Philips are smarting. Philips has already spent about $1 billion to achieve a tiny share of the European market.

Britain's GEC is "frustrated" because it must compete with the NEB for Britain's scarce semiconductor workforce.

The giant British GEC, already the leader in charge-coupled devices in Europe, is "frustrated" because both the NEB and itself will be competing for Britain's scarce semiconductor workforce. GEC, with an enormous cash mountain (London analysts put it at $1.4 billion to $2 billion), has ambitious microelectronic plans of its own. The company is trying to forge a major alliance with U.S. interests. After some three years of discussion, GEC and Fairchild are believed to be putting the final touches to a joint venture program to manufacture advanced semiconductor circuits in Britain.

One source rumor has it that GEC is interested in buying Fairchild for a market capitalization value of around $200 million. Ex-ICL boss Geoffrey Cross, backed by upwards of $1 billion worth of GEC's "mountain" and the promise of a sack full of shares in his future purchase, has been looking for suitable acquisitions in the U.S. Rumor has already linked him with an attempt to buy Zilog from Exxon, and to buy Intel from its "millionaires" for about $500 million.

So far Cross and GEC boss Arnold Weinstock are remaining tight-lipped about their intentions, but one recent report said that they both might be "cooling" on the Fairchild joint venture.

The NEB micro plan also runs parallel to the INSAC software and services consortium it is pumping some $60 million into to put British skills in touch with the vast U.S. market. This program also includes acquisitions and joint ventures in the U.S. The first of these—the takeover of Monchik-Weber, a New York-based specialist in banking software and services—is believed to be going through at present.

INSAC managing director John Pearce is believed to be buying a 60% to 80%

stake in the U.S. outfit for about $2.5 million. But neither side had confirmed the move in July. The INSAC boss is looking at another half dozen companies on the East Coast for similar stakes.

—Ralph Emmett

COMMUNICATIONS HEADACHE

Communications always has been a headache in South Africa. Quality is poor and leased lines are expensive. Until two years ago, no permission was available for users to share leased lines.

This tended to militate against on-line computing, except for the larger organizations such as banks and building industries. But that situation is changing rapidly.

The South African Post Office announced last year that its Saponet network, originally designed for internal requirements, would be made available for public use.

Two banks, Barclays and Standard, are joining forces to establish a shared data communications network which should be available by 1980. Both, meantime, are upgrading current installations, presumably to the joy of Britain's ICL and IBM. Standard placed a firm order for two IBM 370/138 machines and is expected to upgrade its computers at regional centers—Cape Town, Durban and Port Elizabeth.

Barclays, which began ordering ICL's 2970 systems, is expected to spend some $2.3 million on hardware over the next five years.

Another intriguing project is Anglo American's three year HURIS project (Human Resources Information System), which will cost $4.4 million. It's a comprehensive computer-based management information system for Anglo's Gold and Uranium Div.

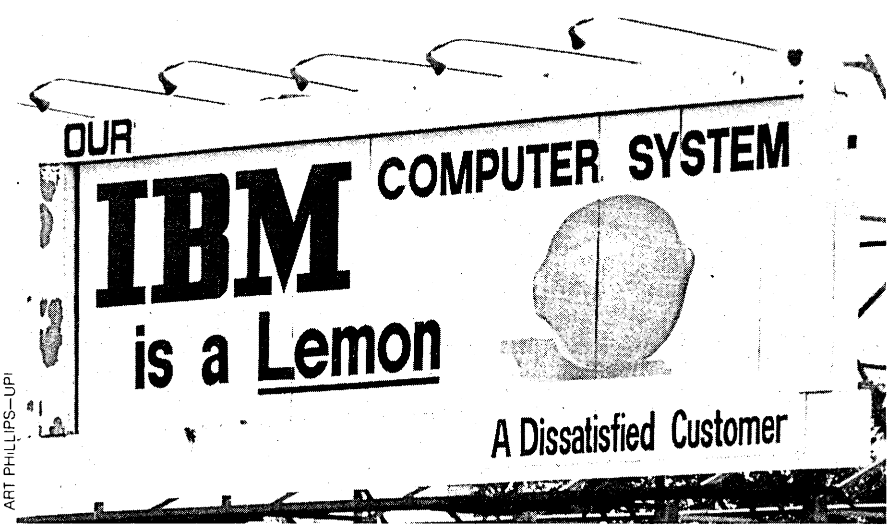
Anglo, which is South Africa's largest

Barclays and Standard will share a datacomm network.

computer owner next to the government, will base the system on two IBM 370/158 installations on a data communications network of more than 300 on-line terminals. It estimates it could save about $4.4 million a year in reduced working costs as a result of better use of labor. ❊

MERGER PLAN: In its nine years of making batch terminals, and later data entry devices and finally multifunction devices for the distributed processing market, Data 100 of Minneapolis has been phenomenally successful, having installed more than 7,000 terminals worldwide. But last month, after years of having to raise money to finance its leases, the company's directors decided to accept an offer from Canada's Northern Telecom, Ltd., to acquire all of Data 100's stock for $20 a share or about $125 million. It already had acquired about 31% of the company's stock in an agreement in which Northern Telecom also sunk $5 million into the cash-hungry company's R&D budget. After Data 100 stockholders approve the merger in late August or early September, Data 100 would be merged with Sycor, the Ann Arbor, Mich., terminals manufacturer which Northern Telecom acquired in May, into a U.S. company to be called Northern Telecom Computers, Inc. Data 100 and Sycor would be the principal subsidiaries. The acquisition agreement left McDonnell Douglas Corp., the aerospace firm, out in the cold. Data 100 had courted the company until Northern Telecom upped the ante by $2.50 a share.

REORGANIZATION AT IBM: Is IBM becoming too massive to be run efficiently with its present centralized top management setup? Many believe that is the reason why the company is studying the possibility of establishing its General Business Group as a wholly owned subsidiary on a worldwide basis. IBM said it will take several months to complete the study. Chairman Frank T. Cary said the goal is to "make the company more responsive to our customers and to take advantage of the opportunities for growth." The General Business Group's biggest operations are the General Systems and Office Products divisions. Others are the Information Records Div., General Technology Div., and the General Business Group/International Div. They have about 100,000 employees. Last year's estimated revenues of $5 billion represented 28% of IBM's $18.1 billion corporate revenues. Initial reaction to the announcement in early July was that IBM could be run more efficiently through the formation of semiautonomous subsidiaries along the lines of AT&T and General Motors. GBC, as a subsidiary, probably would have its own board of directors. Some felt the reorganization would be the basis for a Consent Decree in the long antitrust litigation with the government in which the Justice Dept. wants IBM to be split up. But many others felt that wouldn't be a solution because it creates more competition—or as one put it, many hungry sharks instead of a single hungry whale.



ART PHILLIPS—UPI

FORCEFUL PROTEST—An IBM General Systems Div. customer in St. Louis finally got action when he rented billboard space to voice his dissatisfaction. IBM in Atlanta said in early July the company was negotiating with the customer but refused to identify him. The owner of the vacant building, Charles Hudson of Hudson Chemical Co., knows the identity of the soured customer but wouldn't disclose his name either. "We're a good customer of IBM," said Hudson.

NO SPECULATION: Harris Corp. acquired 19% of the outstanding shares of Quotron Systems, Inc., of Los Angeles, a manufacturer of System 800, which displays information for stockbrokers and other financial firms. Harris, which makes data communications and information processing systems, paid about $4.5 million to Dun & Bradstreet which acquired the stock by converting a Quotron subordinated note. Harris president and chief executive officer Joseph A. Boyd declined to speculate on future relationships between Harris and Quotron. But the company in recent years has been acquiring electronics companies and is not known to hold minority positions for long. Quotron was founded as Scantlin Electronics in 1959 and became profitable in 1975 after many years of losses.

CHANGE OF NAME: Management Assistance, Inc. said it is changing the name of its subsidiary Genesis One Computer Corp., to Wordstream Corp. The company last year acquired Wordstream, a manufacturer of shared logic word processing systems. Genesis One sells information display terminals.

ANOTHER LINE: TRW Datacom International, an international distribution firm formed primarily to market Datapoint Corp. terminals, has added portable data entry terminals to the products it distributes. It announced an agreement with Azurdata, Inc., which incorporates solid state memory and charge-couple devices in its terminals. TRW Datacom also distributes internationally the products of Computer Entry Systems Corp., TRW Communications Systems & Services, and Centronics printers.

MILESTONE: Data General delivered its 50,000th computer system this summer, an Eclipse C/330 to TRW Communication Systems and Services. The system will be interfaced with six Data General Nova computers, 24 on-line terminals, and will be used in conjunction with 24 additional Novas for development purposes. It will support a software development staff of some 90 programmers in TRW's three data centers.

MAINTENANCE EDGE: Third-party maintenance firms reply and repair faster and at lower prices than do equipment suppliers, says a four-volume study on the subject by Alltech Publishing Co., Pennsauken, N.J. Its study shows third parties provide reply and repair services 67% faster and charge about 18% less than equipment suppliers. But the study also cautions that about 25% of the third party firms also act as sales agents for other vendors, suggesting possible conflict of interest. It also notes that the skill level of third party maintenance personnel sometimes is below that of the equipment manufacturers.

TOO HIGH AND TOO LOW: The Teale Center Five Years Later (June, p. 221) was both too high and too low—low on the amount of money the center is saving the state and high on its storage. The center has saved the state $10 million in hard cash and $10 million in cost avoidance (as opposed to thousands). The center is looking to increase its storage capacity, but its disc packs to date total 200, not 40,000. ❋

LOS ALAMOS–CRADLE OF COMPUTING

It needs computers two orders of magnitude faster than it now has.

by W. David Gardner

In the 1940s and 1950s, the Los Alamos Scientific Laboratory pointed the way in computing. Its accomplishments were legion: The first program run on the ENIAC, the first electronic digital computer, was a Los Alamos program; the MANIAC, one of the great pioneer computers, was designed and built at Los Alamos; the facility's designers served as coarchitects of IBM's STRETCH computer.

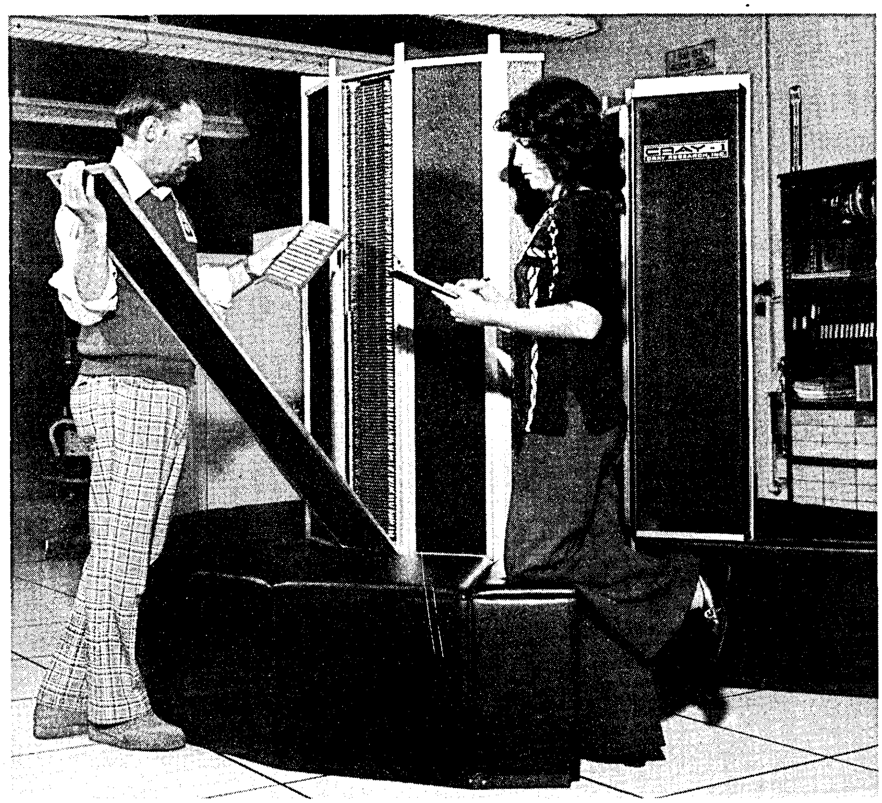
It's no wonder then that Los Alamos has become a place of interest for computer history buffs, a sort of Grant's Tomb of computing.

And if Los Alamos hasn't been heard from so much in recent years, it isn't as if nothing significant has been happening there—it's largely because the design of computers has long since passed completely into the hands of commercial equipment manufacturers. But there still are things of computing interest happening high up in the rugged Jemez mountain range in New Mexico at LASL, as the Los Alamos Scientific Laboratory is called in acronym shorthand.

"We got the first Cray-1," notes Jack Worlton, associate division leader of LASL's Computer Science and Service Division. "Our orientation here is to large-scale scientific computing, but we try to keep track of all new technology developments."

Worlton, at the LASL for more than 20 years and a former member of the STRETCH design team, is in a good position to follow the technology. At his fingertips is a dream configuration—in addition to the Cray-1, there are four Control Data 7600s, two CDC 6600s, two CDC Cyber 73s, an IBM 370/148-3850 Mass Storage System, and all kinds and sizes of Digital Equipment Corp. minicomputers. There also are a wide variety of other minis, terminals, and peripheral devices too numerous to list. An idea of the scope of the configuration is illustrated by the fact that a CDC 7600—a stand-alone supercomputer in its own right—is used to create programs for high-speed execution on the Cray machine.

Yet Jack Worlton can be unhappy. His brow wrinkles when he describes the user demands on his system. "We have 2,000 users here," he says, "and we are technology-limited. We need computers that are two orders of magnitude faster than we have now. Why just the other day I was using the time-sharing system and I waited until lunch hour when the response time is always better. I found I still was competing with 17 other users."



JACK J. WORLTON with latest acquisition, a Cray-1.

Indeed, Los Alamos' Five-Year Computer Plan makes the same point. "Fiscal year 1978," the plan states, "will clearly be a year of computational drought at LASL, with a 28% of deficiency in installed capacity . . . Although the CCF (Central Computing Facility at Los Alamos) is one of the most powerful computer centers in the world, it is still a limited resource. The realization that the CCF is extremely low on computational capacity is especially frustrating for the user community."

Sound familiar? It is the plaintive cry heard at computer installations the world over and that is precisely why LASL's future plans are pertinent to many computer users. What is Worlton doing to remedy his situation?

Worlton has a scenario he's pieced together from current technology developments that he believes will continue into the foreseeable future—probably over the next five years. It concerns the relationship among memory, logic, and communications costs. He expects memory costs to continue to drop at the rate of 32% a year; logic costs at 23%; and communications costs at 11%.

The rapid drop in memory costs means that although prices of supercomputers could drop by a factor of four in five years, Worlton will expect to pay the price he now pays for a Cray-1, but get four times the performance in five years. "And the drop in memory will make the use of 32-bit minis much more widespread," says Worlton, "I think that 32-bit minis will increasingly eat into mainframe functions."

Since there is less payoff potential in the communications sector, Worlton believes this will spur the drive into distributed processing—with ever-increasing computing power (e.g., memory and logic) being placed at the outer extensions of networks. Distributed computing, Worlton points out, minimizes communications costs and, further, there are obvious security advantages in permitting users to have computing capabilities off-line from a central network.

The LASL's networking and data communications activities center around the Laboratory's Integrated Computer Network (ICN) which connects the facility's computing equipment.

"In networking," says Worlton, "we still have to do much of our own work. Although our policy here has always been to buy what we can, we still maintain a strong hardware and software capability of our own. For instance, we may have to build a unique communications link between the Cray-1 and another computer. But we are seeing networking companies coming along and they'll eventually do more work for us."

The Los Alamos technical people note that the design of computer communication networks is more advanced than distributed processing designs because heavy emphasis has been placed on making the network quickly operational. With networks a reality now, they believe new work will emphasize other facets of networking, like security and resource-sharing technology.

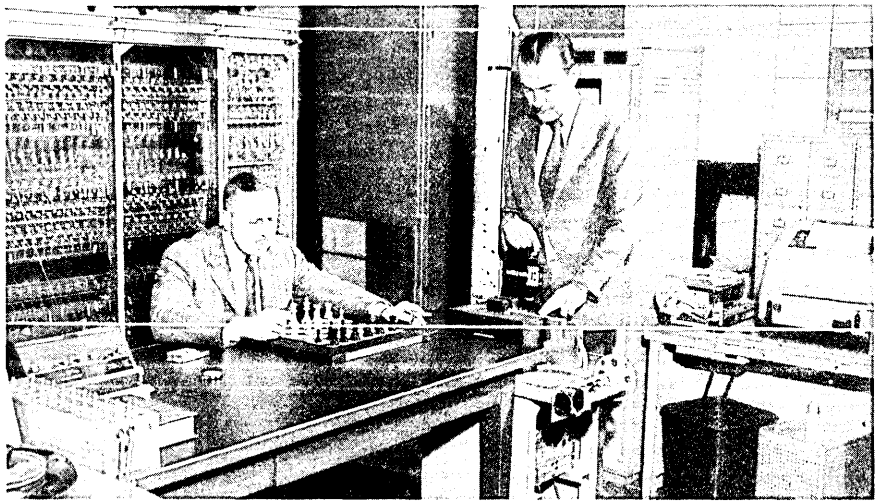
"The basic reason for networking is to share resources," states the Los Alamos Five-Year Plan. "... the purchase price of new systems will not have to include all of the supporting peripherals (tape units, printers, etc.) because these will be available through the network. In fact a major advantage of resource sharing will be the wide range of user capabilities to access network resources."

Los Alamos' ICN network consists of four major subsystems—all linked through a central structure that provides switching and buffering. The network management subsystem provides overall network management functions, while the network access subsystem handles user access. The worker computers subsystem contains the computers that execute user codes and, finally, the file storage subsystem provides a common mass storage for files.

As might be expected of a facility that specializes in weapons research, security is a prime concern at Los Alamos. Moreover, the LASL has found that its users are divided into two groups—those performing classified work and those performing unclassified work. The laboratory has looked at the possibility of building two separate networks to accommodate each class of user, but a decision has been made to stay with a single network and design better security measures into it.

About security, the LASL Five-Year Plan states: "The cornerstone of a good security system is its verification that the user at a terminal is who he says he is. The classical approach to the authentication problem has been the typed alphanumeric password. Research into more sophisticated password schemes, including physiological measures of the user, hold some promise to remedy current authentication deficiencies."

When asked to name an important development at LASL that could have ramifications for other users, Worlton answers quickly: "graphics."



FIRST sophisticated chess game was played on the MANIAC. Paul R. Stein, with chessboard, and Nicholas C. Metropolis, still work at Los Alamos in the theoretical division.

At Los Alamos, he says, the problem is underscored by a user who has been running, say, an eight-hour program on the Cray-1. "The designer himself may actually get into the calculation itself," says Worlton. "Easy-to-use graphics systems make his job easier. Our system uses graphics but it isn't a graphics system."

In short, Los Alamos is experimenting with and developing more sophisticated graphics systems that will ease a user's grueling chore of working with computers. Los Alamos is experimenting with a variety of advanced new graphics technologies including color, filters, and lasers.

"The future graphics terminal," says the LASL report, "will probably consist of a crt (or plasma panel) with refresh and storage display capability, a microprocessor, a data tablet, and function keys. Future plotting devices will be fast and their use will be great. This will necessitate the use of online operation and scheduling of these devices. This implies that the machine-to-machine transfer of data at a high rate (several megabits per second) will be necessary to support future graphics devices."

Because of its work with the ENIAC and the MANIAC, Los Alamos will always represent something of a cradle of computing and Worlton, as one of the STRETCH computer's designers and as one of those involved in hardware design at Los Alamos for more than 20 years, will be looked upon by some as one of the industry's midwives. ("I still believe the STRETCH was the best computer ever designed," he says adamantly. "Its problem was that it wasn't compatible with earlier IBM computers.")

And where does Worlton think computer architecture is going?

He believes the design advancements traceable to componentry improvements have about run their course—although he looks for component prices to continue to drop—and that the new architecture improvements will come from a move toward vector processing and away from scalar processing. He says his thoughts on the subject are colored by his experience with Los Alamos' Cray-1 computer, which is a vector processor. Los Alamos now attempts to encourage manufacturers to build vector processors, or array processors, as they are sometimes called.

"Over the next 10 years, the industry is going to have to face up to this," he says. "We'll be moving away from John von Neumann's old approach of single instruction-single data streams toward multi instruction-multi data streams."

It would appear that the boom in personal computing has touched Los Alamos, too. The laboratory expects its users eventually will perform much of their work on their own personal computers—as soon as the computers come with large high-speed disc storage. The Los Alamos technicians look for a personal computer with the capability of a CDC 6400 to appear on the market in a few years.

"In order to interconnect small machines and personal computing systems together in a useful fashion, a great deal more work will be required in high-speed networks," the Los Alamos report states. "A network connection between two small machines must be able to compete in data transmission speeds with a user walking from one building to another with a small disc pack under his arm. The current capability of terminals to communicate at 1,000 characters per second will be much too slow for terminals with computers and high-speed discs in them. One hundred thousand to one million characters per second would be much more suitable."

And one day, the Los Alamos technicians and scientists expect many small machines interconnected into a multiprocessing system will be executing "a substantial fraction" of the laboratory's computing load. ✲

The MANIAC: a great big toy

No one needs convincing today that computers are remarkable instruments and indeed the world at large often ascribes supernatural powers to them. But it wasn't always so.

Nicholas C. Metropolis, staff member of the Los Alamos Scientific Laboratory, a man who was deeply involved in the early days of computing, recalls that it took some doing to convince some of the world's great scientists at Los Alamos that there was something special about the computer. Los Alamos had one of the first computers built—the MANIAC.

"We wanted to get the problem originators at Los Alamos interested in computing," recalls Metropolis. "At first we had trouble getting Edward Teller interested, but after he saw Enrico Fermi use it, Teller did become interested. I remember one Sunday when we turned on the machine that Teller went in and ran some problems on it. I knew then that computing had come of age."

Metropolis, a physicist, was director of the Institute for Computer Research at the Univ. of Chicago and he headed the efforts to design the MANIAC I and II computers. Metropolis was also a member of the Los Alamos team that ran the first program on the ENIAC.

The scientists who brushed up against the computing facility at Los Alamos represented a veritable Who's Who of scientists—John von Neumann, Stanislaus Ulam, John Pasta, Hans Bethe, George Gamow, J. Robert Oppenheimer and Anthony Turkevich. In those early days at Los Alamos, the laboratory also served as a training ground for others like John Kemeny who later developed the Dartmouth time-sharing program and the BASIC software language before becoming president of Dartmouth.

"I remember that to Teller the MANIAC was a great big toy," says Metropolis. "A marvelous toy. The physicists tended to shy away from data processing, but when the war intensified, they needed programs for their work and they became interested. Data processing became very fancy engineering."

One thing that won the hearts and minds of the scientists then was chess—it still does today. As far as is known, the first sophisticated computer chess game was developed on the MANIAC I. The computer couldn't handle eight by eight squares so it was programmed to operate six by six squares by removing the bishops. Thus, the computer chess game was called "anticlerical chess." It took 25 minutes for the machine to calculate its next move. Ulam, recalls Metropolis, was the best chess player at Los Alamos, and most of the human chess players could beat the machine.

Metropolis was at Los Alamos from its start in 1943 and he remembers that the laboratory's scientists had a great need always to solve nonlinear, partial-differential equations. That meant Los Alamos needed more and more raw computing power. The first solution was to acquire bigger and bigger calculating machines—usually from IBM. Later, the laboratory decided to build its own computer, the MANIAC. In between, the Los Alamos scientists used the ENIAC.

"It was decided that the Los Alamos

NICHOLAS C. METROPOLIS—It took some doing to convince some of world's great scientists that there was something special about the MANIAC.

team would take the ENIAC through its shakedown period," Metropolis recalls. "Our problem would tax the full machine. We had an uphill battle to get it debugged. There were bad tubes and cold solder joints, for instance. But it all was terribly exciting."

It turned out that "the Los Alamos problem" was a program that would calculate whether it was feasible to build a hydrogen bomb. The test was successful—it was indeed feasible to build the bomb.

Metropolis tells the following story about the development of the so-called stored-program concept. Usually, John von Neumann is given entire credit for the concept, but Metropolis feels that Richard Clippinger of the Ballistics Research Laboratory (and later Honeywell) also played an important role in the development of the stored-program concept.

"On one of his many visits to Los Alamos," says Metropolis, "Von Neumann described a suggestion of Richard Clippinger . . . that the ENIAC might be converted into a limited stored-program mode of operation instead of its gigantic plugboard mode distributed over the entire machine.

"The idea was that the so-called 'function tables,' normally used to store 300 12-decimal digit numbers set by manual switches, could be used to store up to 1,800 2-decimal digits that would be interrogated sequentially including loops, each pair corresponding to an instruction. Thus one could go from one problem to another much more efficiently."

In 1948, after a short period at the University of Chicago, Metropolis returned to Los Alamos where he directed the Los Alamos effort to design a computer. A design that drew heavily from Von Neumann's Institute for Advanced Study (AIS) computer was developed, although the Los Alamos team came up with several important design innovations of its own.

"We decided," recalls Metropolis, "to pursue an independent course for memory, using a 2-inch tube rather than the 5-inch tube considered by Princeton. We then went on to plan an independent control system and vocabulary, a quite distinct input–output including photoelectric paper tape reader-punch, quarter-inch magnetic tape, typewriter, 10,000-word magnetic drum and a line printer (Analex Model 1).

"The inclusion of electromechanical devices led to the oracular pronouncement: whenever electromechanics can be replaced by electronics, do so!

"Debugging and testing were completed in early March 1952, and the first scientific computations were started. The exhilaration and satisfaction derived from watching the neon lights flickering their way through the calculation more than compensated for the frustrations, delays, and long hours on the way."

It was on that first Los Alamos computer that so many scientists cut their data processing teeth. The machine remained in service at Los Alamos until the late 1950s and then another six or seven years at the Univ. of New Mexico. Its successor was MANIAC II, which was started in 1955 and remained in service until less than a year ago. MANIAC III was a machine started at the Univ. of Chicago in 1957. There is an interesting tale behind the acronym MANIAC (for Mathematical Analyzer Numerical Integrator And Computer). Metropolis, interested in ending once and for all the fad of calling computers by acronym, suggested to Von Neumann that the AIS computer be called MANIAC. Von Neumann was appalled at the levity of the idea, but when Metropolis had his chance, he called his computer the MANIAC. Ever since, computers have tended to bear numerical designations rather than acronym designations.

Metropolis currently has a variety of projects underway at Los Alamos with several collaborators. Some of his work has medical overtones but he remains deeply involved in computing. He still indulges in blue sky thinking on future computer generations. ✻

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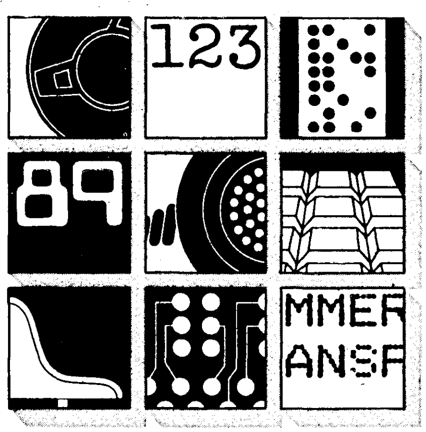
Time Is Running Out

The Deadline for TIME's Special Section on New Office Technologies is Coming Up Fast

THE OFFICE:
PEOPLE, PROBLEMS AND PROFITS



On September 25, TIME B will be closing its 1978 special advertising section on new office technologies —*The Office: People, Problems and Profits.* This year's section promises to be bigger and better than ever. Here are some of the features it will include:

• How-to advice from top experts: Dr. Vincent Giuliano of *Arthur D. Little, Inc.*, Randy J. Goldfield of *Booz, Allen and Hamilton,* John Pile of *Pratt Institute* and Gerald S. Korb of *Bankers Trust.*

• Specific case histories to show you how to increase efficiency and cut costs as you move confidently into the future.

• Illustrations, charts and diagrams, plus a specially prepared lexicon of basic terms every businessman needs to know.

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TIME B's special section will provide more than just the right environment—it also will produce results. You'll receive valuable new leads through our inserted postpaid reader service card. Plus a demographic and geographic analysis of all respondents to the section. And, a confidential market analysis of all responses to your individual ad, including results of a follow-up questionnaire.

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TIME

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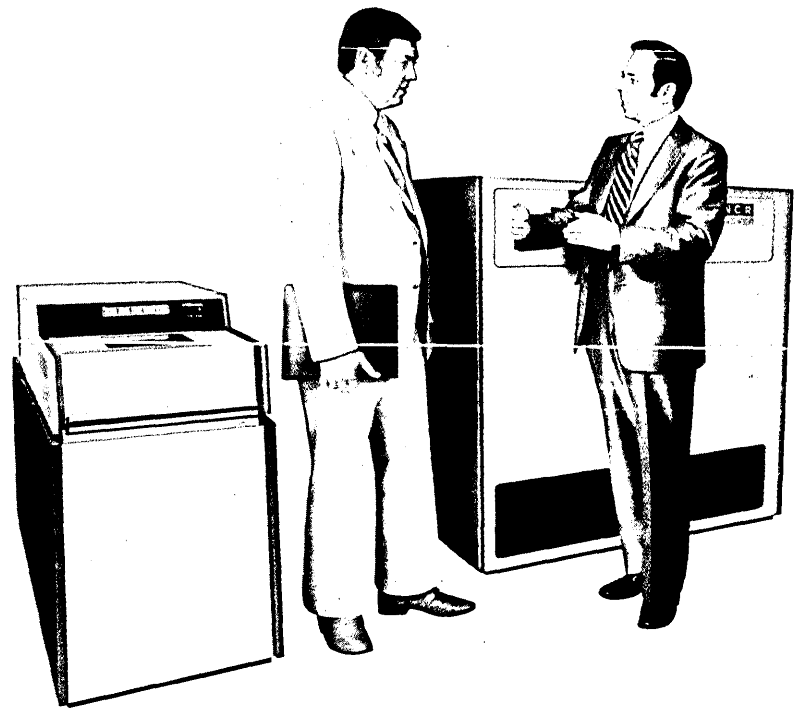

"The only noticeable change was a 30% improvement in thru-put," says Jay Chapin of Taylor Rental.

CHAPIN: At first, we had some reservations about going to a computer mainframe with the latest circuitry and new architecture. But we needn't have worried. Downtime on our NCR Criterion has been less than negligible.

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CHAPIN: All but 18 hours a week. But that will improve because we are installing NCR's VRX (Virtual Resource Executive) right now.

SCHENK: With virtual memory, you will be able to run more jobs simultaneously. Up to 35 jobs at once. VRX also dynamically allocates memory and resources. It takes care of virtual memory swapping. It constantly monitors the job mix for memory thrashing and program loops and, when it finds a problem, adjusts the mix automatically to compensate.

CHAPIN: And it will smooth our work flow in the computer room. In a multishift operation like ours, scheduling can be a headache, particularly when the operators change. The new operator doesn't know what the last operator has left undone. But from now on, VRX will do all the scheduling automatically.

"We have the best data processing system in our industry at 70% of the cost."

SCHENK: And the transition to VRX will be effortless.

CHAPIN: We expect that. Easy transition is NCR's long suit. We went to our Criterion 8550 from our NCR Century 201 over a weekend. On Monday, the only noticeable change was a 30 percent improvement in thru-put.

SCHENK: You ran the same COBOL programs on both systems.

CHAPIN: That's right. And it runs some programs written in NEAT/3, too. These programs are over six years old and were written for our first system, a Century 50. We're still using them.

SCHENK: You can now run programs written in NEAT/3, RPG, FORTRAN, COBOL 68 and COBOL 74, all at the same time.

CHAPIN: Taylor Rental is really two businesses. We franchise Rental Centers and we are a hardware wholesaler. Our EDP load is split evenly between the two. Statistics for the industry tell me that hardware wholesalers spend 1.3 percent of sales for data processing on the average. We spend 0.9 percent. And I'll match our system against any in the industry. That tells me we have the best data processing system in our industry at 70 percent of the cost.

Jay Chapin (left) is President of **Taylor Rental Corporation,** Springfield, Massachusetts. Ed Schenk is NCR District Manager.

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Compare performance data for a 3770 Disc Cache Subsystem to a current 200MB Disc Storage Subsystem. For example, on the average, the time to access a full track of 13030 bytes from the 3770 is:

Track seek time:
0.1ms vs. 10ms,
rotational delay:
2.0ms vs. 8.3ms,
and data transfer time:
10.9ms vs. 16.7.

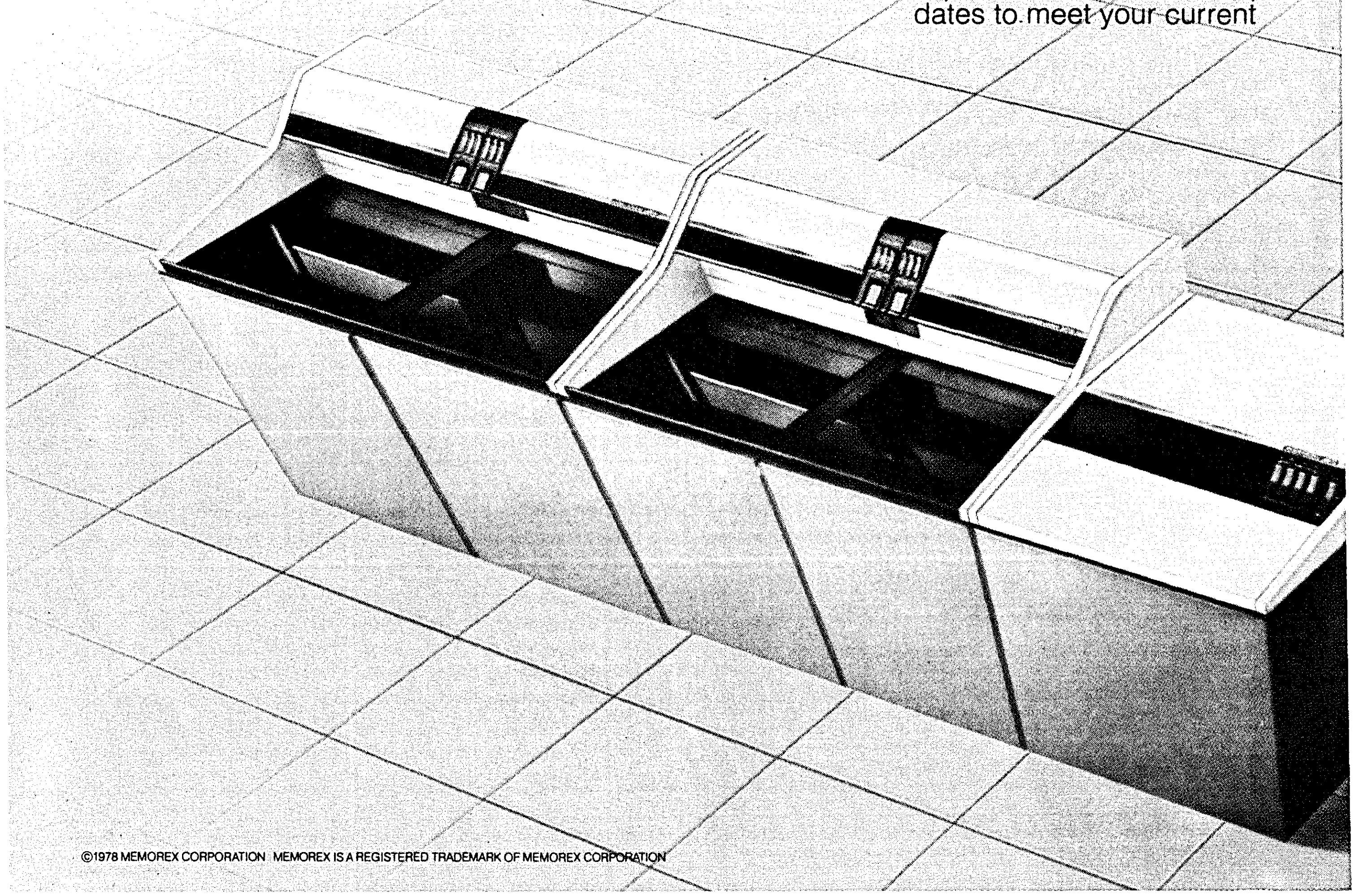
Thus, for data in the 3770 Disc Cache, significant increases in throughput at the channel level can be achieved. In fact, a 50% improvement in your data transfer rate is guaranteed when the Memorex® 3674 control unit is used.

Potential benefits from proper application of the 3770 can be less CPU wait time, less task switching, improved channel efficiency, reduced arm contention, automatic space management, and better time sharing response.

And putting a 3770 to work for you is easy, because full software compatibility is maintained.

The Memorex 3770 Disc Cache works with IBM 370/135 and above, Amdahl 470 V/5 to V/7, Itel AS-4 to 6, and other compatible CPUs. In short, any CPU with a Memorex 3670/75 Disc Storage Subsystem.

The key to ultimate performance of your disc subsystem is Memorex's unique 3770 architecture and caching algorithm. These algorithms will be continually improved via microcode updates to meet your current



CIRCLE 40 ON READER CARD

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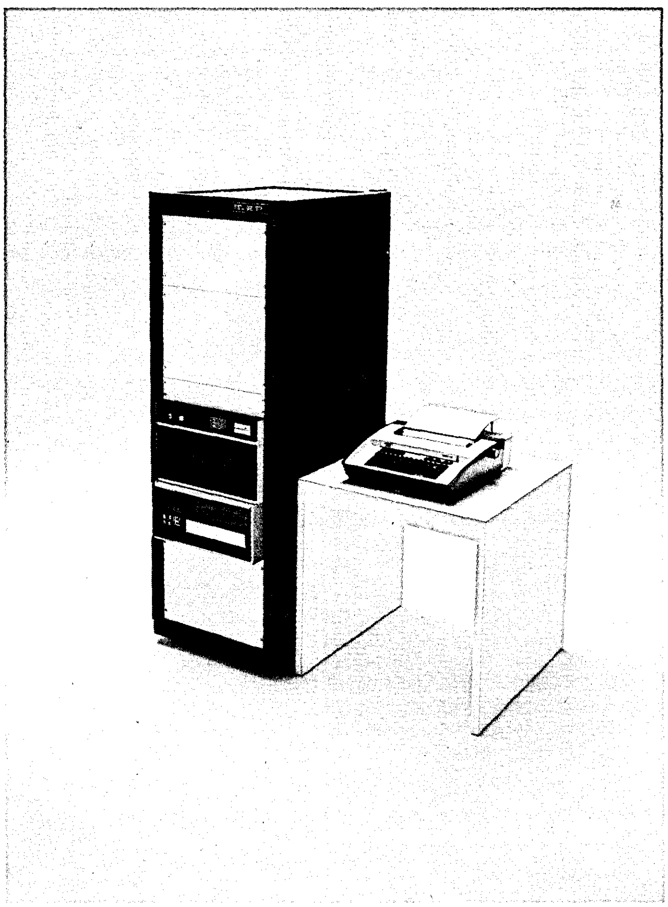

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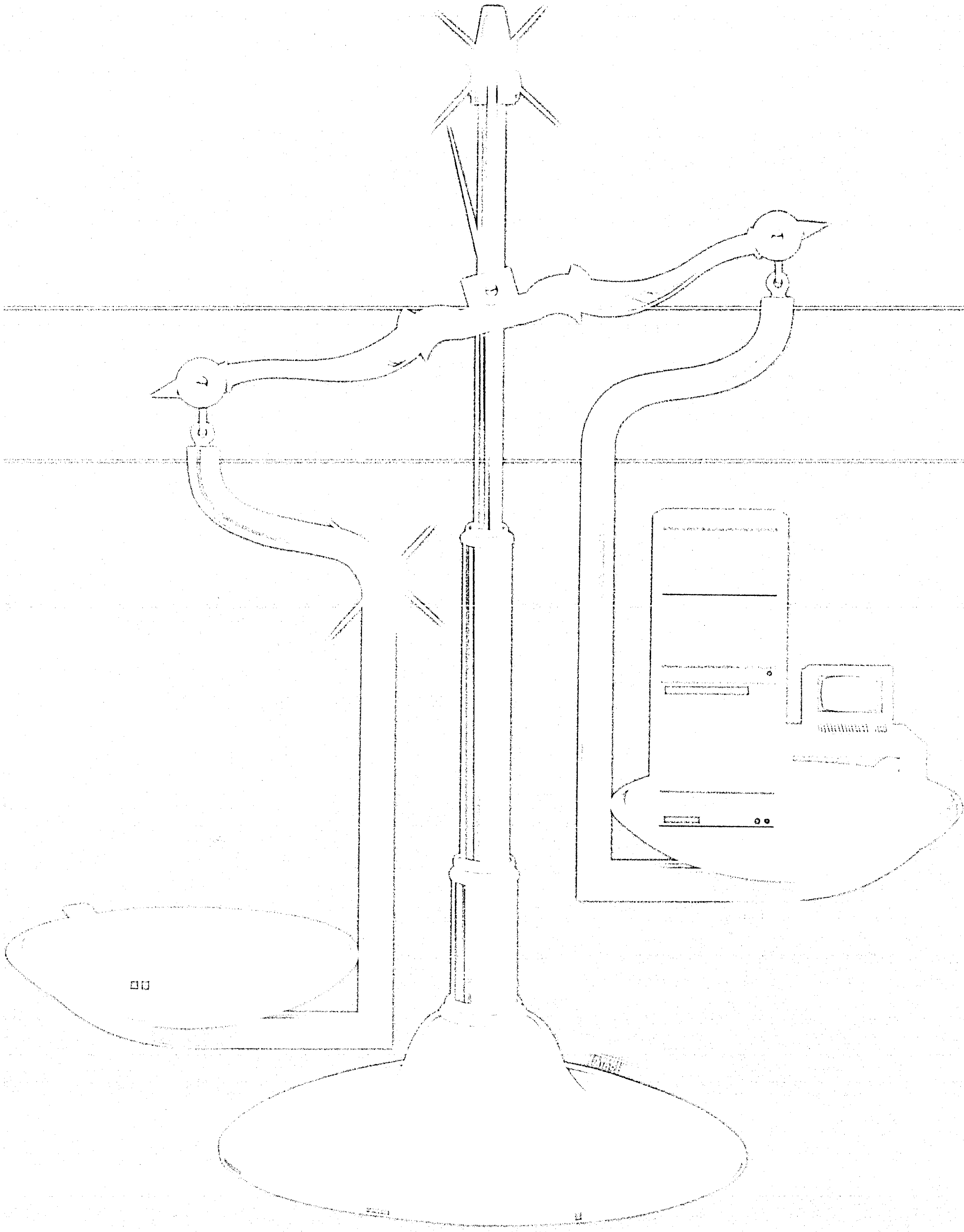

The stream of minis going into business environments will become a flood of micros.

MICROS INVADE THE BUSINESS WORLD

by Richard G. Canning and Barbara McNurlin

During the past few years minicomputers have moved into business data processing, being used by small businesses or by small units of large organizations for distributed processing. These small computers are bringing a radical change in the whole data processing function—system development, programming, data entry, and computer operations—are shifting in the direction of the end user. And now we are beginning to see the same phenomenon happening with microcomputers. In fact, the use of microcomputers in business may soon reach deluge proportions.

Now that the tools of data processing have been put in the hands of the end users, the department managers of the organizations control the resources for getting their data processing done. And they are performing their data processing in a new fashion. They do not have and do not want an inhouse programming capability. So they use previously developed application systems or have the programming done on a contract basis.

Many data processing executives have been very concerned about the proliferation of minicomputers. They see the "mess of the 1401 days" being repeated, when every site went its own way, programs could not be exchanged, data could not be exchanged, staffs built up unreasonably, and so on.

These executives have sought to impose controls over the acquisition of minis to avoid such difficulties. But this control is difficult to maintain, because computer technology can sneak in so many ways. The office administration people are bringing in word processing systems, and some of these have data processing capabilities. The communications people are bringing in computer-based switches. Engineers are bringing in microcomputer control systems and monitors. But none of these types of systems really have fixed boundaries or limits. They can be expanded into what can be considered data processing areas.

The message of the day is: *you ain't seen nuthin' yet*. If minis have proliferated, micros will explode. Control will become more and more difficult. Microcomputers are beginning to offer "big system" capabilities, the prices are right, and the hardware and software suppliers are beginning to concentrate on this market. Micros have too many good points for their use to be effectively resisted.

So now is a good time for organizations to think through their attitudes and policies on the use of micro systems, based on their experiences with mini systems. Although micros do not seem to be displacing installed minis in business, and may not in the near term, the shift toward the end user is definitely accelerating with the use of micro systems.

The types of microcomputer systems which will have greatest impact on business organizations are those that come as fully assembled systems with sufficient sets of peripheral devices for serving business applications. Further, such systems will come from organizations that are willing and capable of providing the many types of support and services that a business organization needs. These include programming support, documentation of the system, training, hardware and software maintenance, and so on.

We are not discussing the hobbyist approach, where circuit boards are purchased and assembled for the fun and experience of assembling the system components. Nor are we discussing the case where a small business buys a fully assembled microcomputer and then hires a hobbyist to do the system design and programming.

This feature contains excerpts from three previously published issues of the *EDP Analyzer:* "Personal computers for business" (June 1978), "Computer services for small sites" (May 1977), and "Distributed systems and the end user" (October 1976). The complete reports may be ordered for $6 ($7 overseas) each from Canning Publications, Inc., 925 Anza Avenue, Vista, CA 92803.

THE HARDWARE PICTURE

Currently, the microcomputer hardware picture is about as follows. A $600 system (with crt, keyboard and cassette recorder) has a very limited application for business. Even a system with 16K of memory and a floppy disc, priced at about $1,500, would be more useful as a terminal. But when a 10 to 15cps printing mechanism is added, for printing reports, invoices, etc., driving the price to between $2,000 and $3,000, the resulting system is beginning to get into the useful size range for performing the data processing functions for a small organization.

The current "upper limit" of micros for business use seems to be as follows. Generally, internal memory currently is limited to about 64KB, of which 20KB to 25KB might be used for the operating system and a BASIC interpreter (although some micros are storing these in read-only memory, leaving most of main memory available for user programs). Later this year, internal memories of over 100K are expected to appear.

Mass storage is provided by floppy disc units. With four regular floppies, over one million characters of on-line storage is now provided. With dual side, double density floppy discs, this will be raised to over four million characters. Printing can be done by a 30cps typewriter type printer, or a 150cps matrix printer; the price of each is about $3,000. The typewriter printer is preferred for correspondence printing, while the matrix printer is suitable for reports, invoices, and so on.

Current upper limit systems might handle applications with the following characteristics. A typical master file (customer, inventory, or whatever) might be in the order of 200,000 characters, stored on one regular diskette. The maximum size of an application program that can be stored in memory at one time might be in the order of 30,000 characters (which is a few hundred BASIC source statements, due to the relative inefficiencies of BASIC). This is generally a program of only moderate complexity and small business organizations can easily require programs of greater size.

The total price of such an upper limit system might be in the order of $7,000 for the hardware and, say, $3,000 to $6,000 for the software.

As an indication of the progress in the field, in early 1977, one of the lowest priced *mini*computer systems had a 16KB memory, one keyboard and crt, three regular floppy disc drives, and a 200cps matrix printer. That system was priced at about $18,000 for the hardware alone. Today's micros offer *much* more for less money.

As a further indication of current progress, we have seen three fully-formed character (not dot matrix character) line printers, operating at 300 lpm, priced in the $4,000 to $5,000 range. And a new 14MB hard disc storage system is priced in the same range. These are end-user prices; the oem prices in quantities of, say, 100, are under $2,000.

THE SOFTWARE PICTURE

Because of the low cost of the micro computers, it is not particularly expensive for an individual consultant or a small software company to set up business for supplying packaged software or custom programming. So we would expect to see a very rapid growth in the overall software picture for micros.

At present, the system software for the micros is fairly limited, as compared with regular computers or even with minis. Utilities, sorts, report program generators, data base management systems, and programming languages are either very restricted or nonexistent.

Application packages are beginning to appear in some volume. As far as we can tell, these often have the same history as the early application packages for big computers. That is, an application is developed for one user. It works well, so someone decides to sell it to other users. The package is not generalized and turns out not to fit any other user particularly well.

Frequently, financial application packages for small businesses can be purchased for $300 to $400 each. On the other hand, we have seen one advertisement for a set of business application packages priced at $1,000 to $2,000 for each package or $14,000 for the whole set. So the price of packages can vary widely.

At the other extreme, micro software may be distributed in books that include source program listings for general applications such as payroll and general ledger. Each book will give the documentation and source code for the application. These programs can be converted to any microcomputer so as to fit the documentation, and presto, you have a documented application system. Our guess is, though, that small businesses (or small units of large organizations) had better plan on spending at least $3,000 to $6,000 for programming services for the first applications they want to put on microcomputers.

Until recently the limited memory size of most micros has argued against the use of compiler languages for bringing up those applications. Instead, languages that can be used interpretively, such as BASIC or assembly languages, have been the ones commonly used. Things have changed however, and PASCAL, COBOL, FORTRAN, and even APL are offered.

No one argues for the use of assembly language for programming business applications; but assembly languages were helpful for solving some of the interface problems so common in the early days of the micros.

BASIC is a relatively easy programming language to learn. But there is so far no "standard" BASIC; most suppliers have made their own variations and extensions. For business use, the fact that only one- or two-character data names can be used is very inconvenient. For this and similar reasons, it is hard for a nonprogrammer business user (who does not have a programmer around) to be able to look at a BASIC program and grasp what it is doing.

COBOL programs potentially can be more readily reviewed by the nonprogrammer business user, and several COBOLs are now available. One of the first was Micro-Cobol from Computer Analysts and Programmers, in the U.K., which was developed for use on the Intel 8080 and Motorola 6800 micros.

PASCAL, also more readily understood by nonprogrammers, may be the language of the future for the micros. But PASCAL needs improvements and extensions, so there is a chance that it will go off in all directions as has BASIC. To help guard against this, Kenneth Bowles of the Univ. of California at San Diego held a working conference this summer to seek agreements on desired extensions to PASCAL. Also, the U.S. Department of Defense is close to adopting a standard systems programming language that is based on PASCAL. So, we will be hearing a lot more about this language.

AND SUPPORT

Business users want and need rapid service and available spare parts when office equipment goes down. This is the type of service that they have come to expect with typewriters, photocopiers, and so on. The same will be true of mini and micro business systems; users will want to be able to call somebody local to come and fix the hardware or software.

Of course, hardware maintenance contracts can be signed with computer maintenance firms. On the other hand, the components of some of the micro systems are proving to be very reliable, so the hardware maintenance problem may not be a severe one.

The software support picture is currently worse than the hardware picture, some say. For one thing, there is the lack of utilities, sorts, etc. mentioned earlier. And if the user modifies an application package so as to better meet his needs, whom does he turn to when the system crashes? Further, the small business user might tend to hire a computer hobbyist to develop an application, and this could be a very bad choice. The hobbyist is more interested in the computer than in the business application, and probably does not understand the business. The resulting application systems may be a disaster, as far as the user is concerned.

And of course there are other types of support to be considered: system and program documentation, user training, and software maintenance for both fixing bugs and making enhancements.

We are not implying that all of these services are being adequately provided for all users of minicomputers or even big computers. But such services for those machines are far ahead of what is currently available for the micros. With all of the attention being given to the micro market, it is possible that such services will develop rather quickly, but this is an area that users must recognize as a potential problem.

GETTING READY

In order to deal with the problems that the wide use of minis and micros in business organizations might bring, we see the data processing department drawing up an internal document for use by all department heads. This should describe the growing use of small computers and some of the problems that can arise. And it should list some company policies and good practices for department heads to follow when considering and using these computers for their departments. This set of policies would seek to allow the company the benefits of the machines while at the same time avoiding their undisciplined use.

As mentioned earlier, some data processing executives might resist this approach. Instead, they may try to prohibit end users in their organizations from acquiring micros or at least from acquiring a local programming capability. With the rapid growth of the micros, such a policy is doomed to failure. It is better to assume that micros, and the ability to get them programmed, will spread throughout organizations.

Here are the most frequent problems we have heard mentioned and some corporate policies and good practices for dealing with them:

Jumping too quickly. People who become interested in microcomputers tend to be almost hypnotized by the relatively low price of the hardware. So they might buy inadequate hardware and application packages before they understand their own needs.

The data processing department can provide a real service to other parts of the organization by supplying up-to-date information on mini and microhardware and software. And representatives can visit user departments to get a better idea of their needs and advise them on the selection and use of the computers.

Wasting time. Microcomputers and some of their application packages may be inexpensive, but they represent a large potential waste of time. Almost all purchased software packages need some modification to fit a particular user's needs. The user may spend a lot of time trying to fix up these packages, and may end up only making matters worse.

Standards and good practice policies may very well be the key to successful use of these small machines. Programming and data definition standards should be imposed. And standard methods for developing and documenting application systems should be created. Also the data processing department should worry not only about getting the applications to fit users' needs, but also ensuring their usability on other equipment. So standards should be set for cassette and floppy discs (and possibly even for programming languages).

Then, too, the computer is a challenging new toy. People will want to play with it during working hours, learning programming, trying out new programming ideas, and so on. A policy is probably needed that clearly states that these small computers are not to be used for either playing computer games or for a person's own uses, such as playing the stock market. The evidence we have seen indicates that the lure of the computer is just too great, so these things should be expected to occur. Without specific corporate policies, these computers represent a potentially large waste of employee working hours.

(Accidental) violation of policies. The new privacy laws have caused many companies to search out all of their personal data files. Many have found that first-line supervisors are keeping "desk drawer" files on their subordinates, against company policy, which are being used in ways that top management does not approve. With micros, this situation is likely to get worse, not better, unless adequate policies are set up, publicized, and enforced.

One company policy might deal with the types of data that must not be stored in micro systems, unless approved for specific purposes. These types of data could include personal and company proprietary data. Further, the policy should state that the data is owned by the company and is not to be removed from company premises except under stated conditions.

Designing poorly. Inadequate design practices may occur for both system design and program design, and for both purchased application packages and custom programmed applications. Inadequate backup and recovery procedures may make operations difficult, and inadequate or nonexistent data security may lead to serious disclosure problems.

To avoid these problems, company practices should involve the data processing department and the audit department in the selection and development of applications software. The audit department should maintain a list of the company micro systems and should be given authority to perform surprise audits to detect violations of corporate policies.

As far as the use of micro and minicomputers is concerned, it would seem sensible to adopt a limited set of preventive policies and standards, aimed at avoiding the most serious problems, and drawing up a "good practices" document for use by department heads.

THE FLOOD IS COMING

A number of things are changing the conventional data processing environment. First, the economics are changing. It is becoming feasible to give each manager the responsibility and the resources for his own data processing operations. Minicomputers started this shift, and microcomputers will accelerate it.

Second, the users want more control. They want to control when their work is done and how it is done—not only data entry and data processing production but also system development, and programming of production and special programs. They want to call in the data processing specialists only when needed.

Third, some aspects of programming are getting easier. At least for some minis, it is now quite feasible for end users to perform data retrieval and reporting using new end user languages. We would expect to see such languages for micros appear in the not-distant future. Application systems for departmental minis and micros will tend to be smaller and may well be easier to set up and easier to change, compared to systems set up for central computers.

And finally, computer operating needs are changing. The data entry function has moved toward the end user. With departmental minis and micros, the operations function will also shift toward the end user.

As we see it, the use of microcomputers in business will soon reach deluge proportions, and the shifts to the end user started by minicomputers will be accelerated. So now is a good time for organizations to think through their attitudes and policies on the use of these small systems in order to be ready for the deluge when it starts. ✲

RICHARD G. CANNING

Mr. Canning has been editor and publisher of *EDP Analyzer* since 1963. He has worked in the computer field since the 1940s—as an electronics engineer with IBM, as a researcher at UCLA, and as a consultant in Canning, Sission & Associates.

He has been an AFIPS officer and director, U.S. representative to IFIP/IAG, ACM Council member, and a candidate for the ACM presidency. In 1976, he received the ACM Distinguished Service Award.

BARBARA MCNURLIN

Mrs. McNurlin has been a member of the editorial staff of *EDP Analyzer* since 1968. Prior to that time, she was a member of the economics department at the Rand Corp. She has been editor of the Los Angeles ACM Chapter newsletter, *Data-Link*, for the past three years, and was lead editor of the 1977 annual conference proceedings of the Society for Management Information System.

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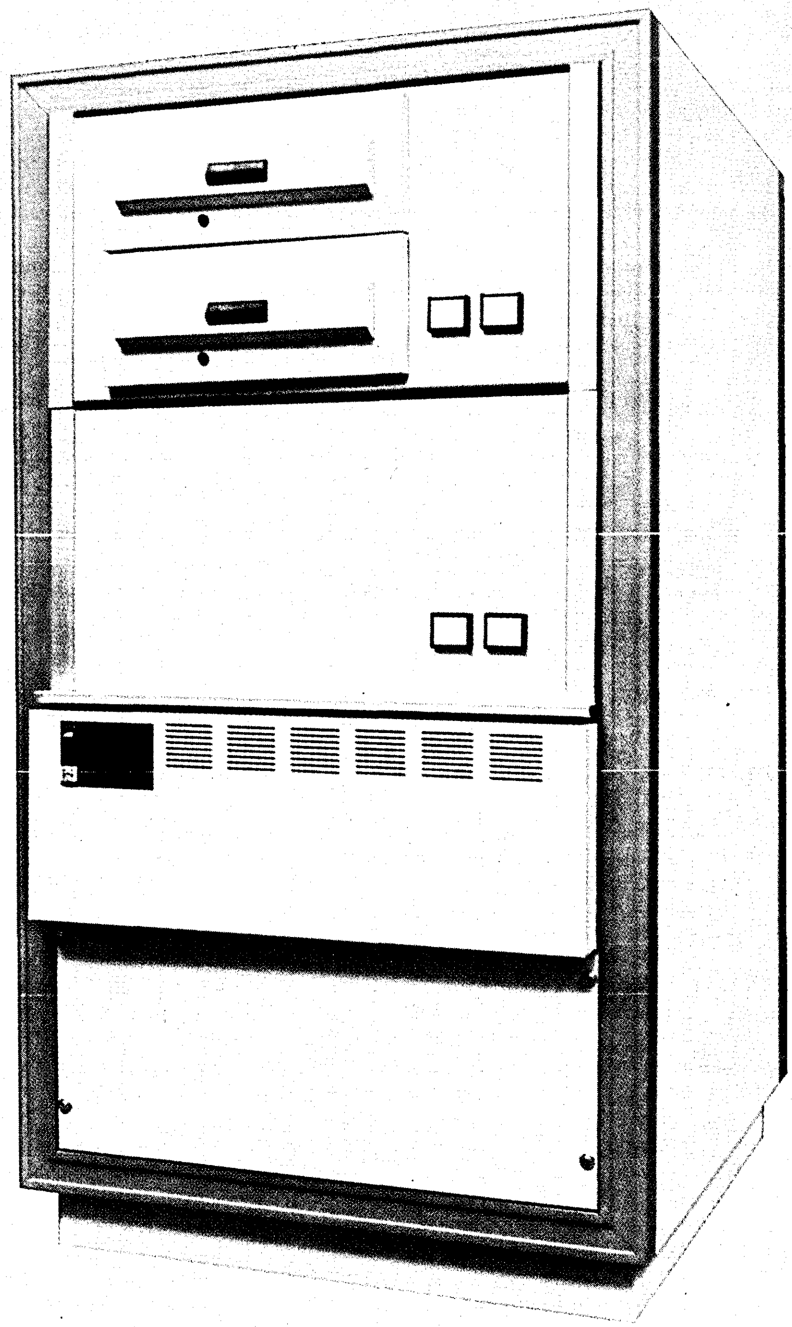

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CIRCLE 108 ON READER CARD

Not long ago, in a city not far away, the real fourth generation was born. What makes it different?

PUTTING THE MICRO INTO PERSPECTIVE

by Douglas A. Cassell

The influence of microcomputers is spreading rapidly. The devices are being used in applications that range from sophisticated electronic weapons systems to home entertainment centers. Microprocessors represent a major product of the growing semiconductor industry and have contributed to the growth of ancillary industries such as systems houses, consultants, educators, trade magazines, and so on. They have resulted in the creation and improvement of many products that otherwise would have been impossible or impractical.

ORIGINS OF THE CLASSES

The first microcomputer was developed for use in a new, small desk calculator that Intel Corp. designed for a Japanese company in the early 1970s. The motivating idea behind its development was roughly as follows: Although it was possible to build the calculator from custom LSI (large scale integration) circuits, the circuits would be costly and would serve only that function. Being complex devices, it was probable that there would be errors in design that might not be detected until many had been built. Correcting these errors would be costly. If the circuits could be simpler and somewhat general and *programmable* in a relatively easy way, most of these potential problems could be prevented or minimized. The resulting approach was to create a small general purpose computer component (the Intel 4004) that could become a special purpose device through programming.

The next microprocessor product was the Intel 8008, an 8-bit device (the 4004 was a 4-bit device). The 8008 was the first generally and widely used microprocessor and Control Logic, Inc., was the first company to package and sell it along with memories, input/output circuits, and other hardware for general purpose use.

To clarify some terms, a *microprocessor* is the basic central processor semiconductor integrated circuit, without any of the supporting circuitry and devices required to make it fully operational. A *microcomputer* is the combination of microprocessor, support circuitry (clock and control circuits), memories, and circuits. It is a true computer that has been built around a microprocessor I/O.

Microprocessors may be classified by two methods: (1) according to the type of semiconductor technology used in their manufacture, and (2) according to the word size and architecture of their internal registers that handle data.

With respect to semiconductor technology, there are two major classes, and several subclasses. The relative advantages of each have to do generally with processor speed, ease of manufacture (which influences cost of purchase) and ease of use (which influences cost of application and conversion into microcomputers). The two major classes are MOS (Metal Oxide Semiconductor) and bipolar. Generally, MOS microprocessors are less costly than bipolar because they are easier to make, and use less power. The fundamental elements of an MOS device are also smaller, so that it is easier to integrate a large number of them into a microprocessor. As a result, most of today's popular microprocessors are made using MOS semiconductor processes. On the other hand, MOS microprocessors are not as fast as bipolar devices. Thus the most powerful microprocessors are based upon bipolar technology. Because they are less amenable to large scale integration, bipolar microprocessors are usually formulated as microprogrammable bit-slice devices.

The most prominent subclasses of MOS devices are PMOS (p-channel MOS), NMOS (n-channel MOS) and CMOS (Complementary MOS). PMOS was the most popular early microprocessor technology, but has been largely supplanted by NMOS in modern devices. There are minor variations on each subclass and each variation has its advantages and disadvantages, its advocates and critics. Without pursuing all the details or considering the possible special requirements of a given application, it is safe to say that NMOS devices are generally the best compromise in terms of the most generally considered factors (cost, speed, ease of use, reliability, computing power, and so on).

Internally, conventional MOS designs do battle with bit-slice bipolar architectures.

REPRESENTATIVE MICROPROCESSORS

word size

4-bit	Intel 4040 (PMOS)
	Rockwell PPS-4 (PMOS)
8-bit	Fairchild F8 (NMOS)
	Intel 8080A (NMOS)
	Motorola 6800 (NMOS)
	Zilog Z-80 (NMOS)
12-bit	Intersil 6100 (CMOS
16-bit	Data General microNOVA (NMOS)
	General Instruments CP-1600 (NMOS)
	National Semiconductor PACE (PMOS)
	Texas Instruments TMS-9900 (NMOS)

bit-slice

2-bit	Intel 3000 (Schottky TTL)
4-bit	AMD 2900 (Low-power Schottky TTL)
	Motorola 10800 (ECL)
	Texas Instruments SBP0400A (I^2L).

Generally, MOS circuit components are smaller and thus easier to integrate into a microprocessor. Easier to make, they also use less power and are therefore quite common in microprocessors.

On the other hand, bipolar devices are faster. Because bipolar components are more difficult to integrate, bipolar microprocessors are usually constructed using microprogrammable bit-slice architectures.

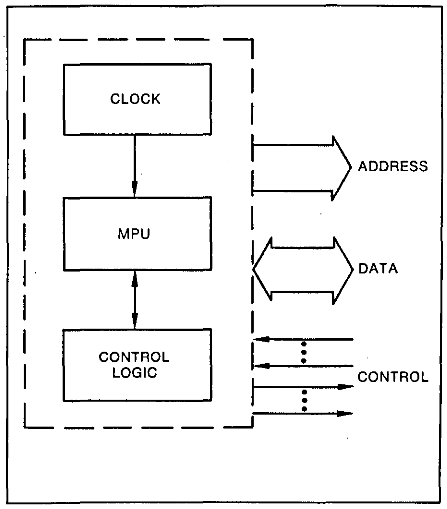

Fig 1. These are the main components of the central processor in a microcomputer. The clock steps the logic from one state to another and synchronizes data transfers. Control logic manages data transfers. In some cases, interrupt logic is also included.

The most prominent subclasses of bipolar devices are Schottky TTL (transistor/transistor logic), low power Schottky TTL, ECL (Emitter-Coupled Logic), and I^2L (Integrated Injection Logic). The advantages and disadvantages of various bipolar technologies can also be argued.

With respect to word size, there are five common types: 4-bit, 8-bit, 12-bit, 16-bit, and bit slice (of which there are two subtypes: 2-bit and 4-bit). Word size refers to the number of bits in the processor's *working registers*—the registers that it uses to perform arithmetic and logical combinations of data elements.

The *4-bit* types are used mainly for small controllers and calculators. They are principally equipped for decimal arithmetic, handling 4-bit BCD (Binary Coded Decimal) numbers one digit at a time. They are very limited in processing power and speed, but not very much less expensive because they still require a moderate amount of support circuitry. Further, they are more difficult to program.

The *8-bit* types are the most popular microprocessors. Most characters used in communications applications fit with an 8-bit format. The 8-bit microprocessors therefore handle communications functions very well. With single-precision arithmetic, they can resolve one part in 256; and with an 8-bit instruction code, they can be equipped with a large number of powerful program instructions. With multiple-precision arithmetic, they can perform operations of greater resolution (one part in 65,536 with double-precision) at moderate cost. Since they can also be manufactured economically and are relatively easy to use, they represent the best compromise for most applications.

The *12-bit* types are typified by the Intersil 6100 which has an architecture like the popular PDP-8 minicomputer manufactured by Digital Equipment Corp. Although this device provides more arithmetic resolution than an 8-bit processor, its design is based on a one instruction per 12-bit word format. Since this instruction word must also include address information, the instruction set and addressing capability of this processor is somewhat limited compared to typical 8-bit devices and can therefore be considered less powerful. It does have the ability to draw from the large library of software developed for the PDP-8, but this advantage is being eroded by new software libraries currently being developed for 8-bit microprocessors.

Bit-slice microprocessors are usually microprogrammed, equipped to execute certain primitive operations (microinstructions) very rapidly. More complex and powerful instructions are executed by carrying out equivalent combinations of the microinstructions. Sets of microinstructions are combined to form *microprograms*—essentially one microprogram for each of the more complex instructions which are called *macro*instructions). These microprograms are kept in a read-only memory associated with the microprocessor. The processor operates by retrieving macroinstructions from the system's main memory, determining the type of macroinstruction retrieved, and executing the appropriate microprogram routines that perform the function implied by the macroinstruction.

Sets of bit-slice microprocessor components can be arranged to form a processor whose word size is any integral multiple of the bit-slice size (8-bit, 16-bit, 24-bit, and so on). Because these devices can be tailored by changing their microprograms, they are very flexible and can be set up with instruction sets that are very appropriate to their intended application. They can even be programmed to emulate other processors. In fact, some minicomputers are built this way.

THE CLASSICAL LINES

Most of the microcomputers available today are organized along classical lines having three main parts: memory, cpu, and I/O.

The central processor unit operates by retrieving instructions from the memory. Normally, instructions are retrieved and

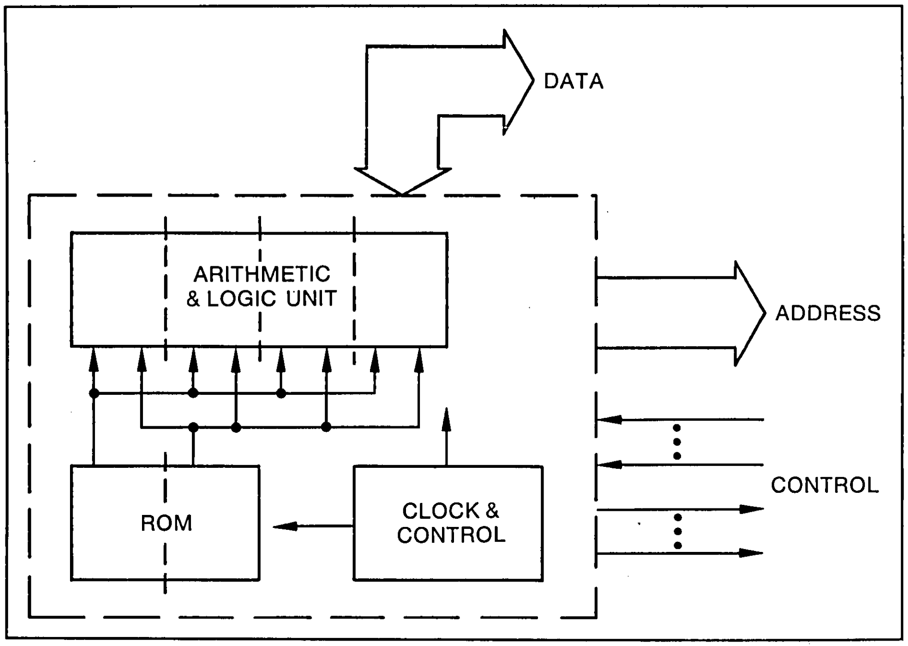

Fig. 2. The microprocessor in a bit-slice microcomputer, as with any other central processor, must have arithmetic and holding registers, the program counter, instruction decoding logic, and sequencing logic. But it also must have a ROM associated with it to store the microprograms used for executing its instructions.

executed in sequential order from memory, the address of the instruction in memory being specified by a cpu register called the *program counter.* (As with any true computer, certain instructions may be used by the programmer to alter the sequence. For example, an instruction might test the contents of an arithmetic register in the cpu and specify that the next instruction be retrieved from a particular address if certain conditions are met.)

The main components of the cpu in a microcomputer are illustrated in Fig. 1. The *clock* is used to step the logic from one state to the next and assure synchronization of data transfers and operations on the data. The *control circuits* direct the general operation and direction of data transfers into and out of the cpu. Their nature depends upon the form of the actual microprocessor, but they might typically include various gates and latches that represent the state of the microprocessor and the type of operation being performed. In some cases, *interrupt* circuits may be included. These permit external devices to interrupt the normal sequence of instruction execution under special circumstances.

The microprocessor (mpu) includes arithmetic and holding registers, the program counter, instruction decoding logic and sequencing logic. Fig. 2 illustrates how these components might be organized in a microcomputer made from bit-slice microprocessor components.

Microcomputer memories come in a variety of forms. Random access memories are used to store both programs and data. However, the contents of RAM memories are lost when power is turned off and they can be accidentally altered by transients and other electrical "incidents." If permanent program storage is required, or if it is inconvenient to reload memory after power outages, either a battery backup is used or the program is stored in read-only memory. ROM's do not lose their contents when power is removed and they are less susceptible to accidental alteration than RAM's.

There are two main classes of RAM: static and dynamic. *Dynamic* RAM's require special control circuitry to "refresh" their contents during operation. However, they can be more highly integrated than static RAM's and they use less power and are therefore less expensive for large memories. *Static* RAM's do not require refresh circuitry, and thus are less expensive for small memories.

There are three main classes of ROM: masked, programmable, and erasable/reprogrammable. The contents of *masked* ROM's are determined by the masks used in their manufacture. Masked ROM's are economical only when used in large quantities. Because their "tooling" is relatively costly, they are not recommended for use in small or prototype quantities. However, for some types of masked ROM, there are equivalent devices that can be programmed or erased (generally by exposure to intense ultraviolet light) and reprogrammed using special electronic equipment. *Programmable* ROM's are used for small quantity situations and situations where there may be a need to change the contents of the memory from time to time. Although more expensive than masked ROM's on a per-piece basis, they are cheaper than masked ROM's for this kind of project, since there are no tooling costs and tooling delays. In the literature, the types are abbreviated variously. For example, "PROM" is used for both programmable and erasable, reprogrammable types. "EPROM" or "e/PROM" are also used for reprogrammable types.

Fig. 3 illustrates how a typical microcomputer memory subsystem might be organized. Address inputs are decoded and used to select particular elements of the memory array and to transfer data into and out of the selected elements. This data is read from or written to the microcomputer system's data bus. The control logic might include refresh circuitry if the memory is a dynamic RAM, latches for holding input or output data, and so on.

I/O for most microcomputers is organized by *ports,* small groups of I/O lines that are read or written in parallel between the cpu and I/O logic. The number of lines or bits in a port is usually the same as in the word size of the microcomputer. Most microcomputers can be equipped with plug-in subsystems that contain the logic for several such input/output ports. Fig. 4 illustrates how such an I/O subsystem might be organized. Addresses are decoded to select specific ports. For inputs, the ports are usually sets of logic gates that route input signals to the system's data bus. For outputs, the ports are usually sets of latches into which signals from the data bus are stored. Generally, these subsystems handle low-level electrical signals that are compatible with TTL semiconductor devices. If the transfer of electrically noisy or high voltage/current signals is required, some form of signal level conversion and isolation hardware is used. This might include optical or transformer isolation devices, relays, triacs, power transistors, and so on.

Other integrated semiconductor devices are also commonly used with microcomputers. Perhaps the most interesting of these are Universal Asynchronous Receiver/

Transmitters (UARTS). These devices convert parallel data (received through a port) to serial form for transmission and convert serial received data to parallel form for input to the microcomputer (through a port). Serial data is usually transmitted and received using either of two major electrical methods: current loops or EIA RS232. Current loops involve switching small currents to represent the bits in a serialized message. EIA RS232 is an Electronic Industries Association specification that involves switching small voltages to represent the message.

In modern microcomputer architectures, the central processor, memories, and input/output subsystems are logically connected by a set of *busses*. (See Fig. 5.) There are four major sections in each bus structure: address, data, control, and power. Each section consists of a number of lines. Physically, they may be circuit wires etched on a printed circuit board, wrapped or soldered wires between connectors into which circuit board modules and subsystems are plugged, or ribbon cable of various types. The *address bus* is used to specify the memory location or I/O port at which data is being read or written. The data being handled is transferred from one subsystem to another on the *data bus*. Signals used to control these addressing and data transfer functions are carried on the *control bus*. Various signals are included in this group to specify such conditions as "address present," "read from memory," "write to memory," "data present," and so on. The *power bus* is used to distribute power from the system power supply to the various subsystems of the microcomputer. In a typical system, several dc voltages are required (such as +5V, +12V,-5V, etc.)

Microcomputer components are physically packaged on one or more printed circuit boards. The number and type of functions supplied on a board vary with the manufacturer and the type of system. The most complete single board systems include the mpu, 4KB of PROM, 2KB of RAM, 6 I/O ports, and a serial interface. These boards are fairly large (12″ x 6.75″).

Other systems are built from smaller boards that include various subsystems and can be interconnected to assemble microcomputers of various sizes. For example, each board might separately contain a cpu, a certain amount of PROM, a certain amount of RAM, a certain number of ports, and so on. The microcomputer manufacturer usually offers card frames into which these modular boards may be inserted. The card frame provides for holding the subsystem cards and for electrical interconnection. Finally, enclosures are used to hold the card frames and system power supplies.

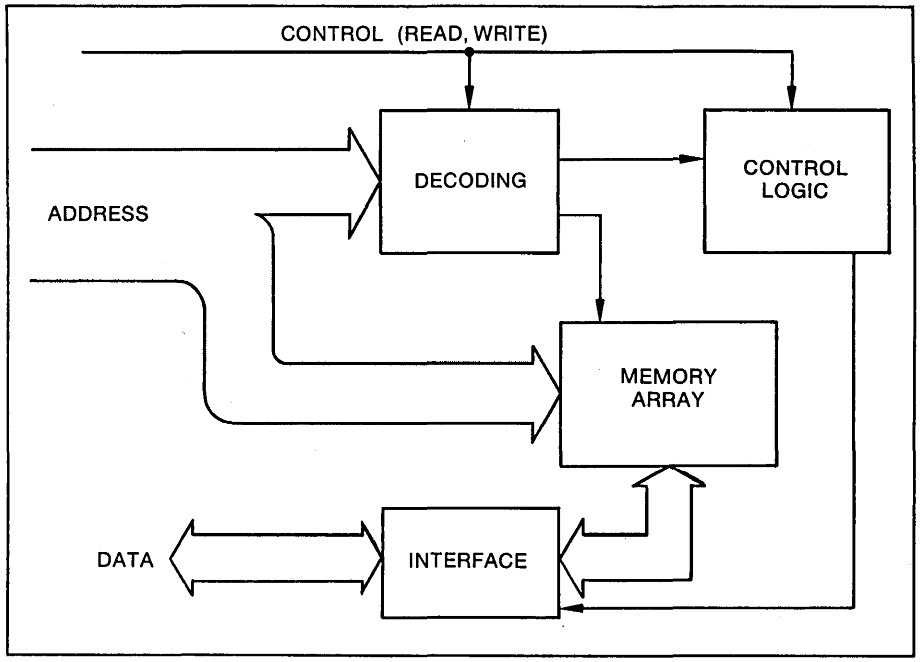

Fig. 3. This illustrates how a typical microcomputer memory system might be organized. Certain bits of the address field are decoded to select elements of the memory array while lower-order bits select words within those elements. Data is read out to or written into those places from the data bus. The control logic might include latches for holding input or output data, refresh circuitry if the memory is dynamic, and so on.

The most active areas of new development for microprocessors and microcomputers are increased integration and system architecture. New products of the semiconductor companies include single-chip computers that combine the mpu, control circuits, some memory and I/O in a single integrated circuit package. Microcomputer manufacturers are also investigating ways to connect several microcomputers to make very powerful and flexible multiprocessor systems.

MICROS VS. MINIS

Trade press commentary during the early days of microprocessor introductions tended to disclaim any significant competition between minicomputers and microcomputers. History has proved otherwise. Early comments said microcomputers would be applied on the low end of the "complexity spectrum" and would tend not to intrude on the more complex applications that were the domain of the mini. The first part is true. Microcomputers have made many things possible that would have been (and still would be) "beneath" the minicomputer. But the second part of the comment is not true. Microcomputers are encroaching upon minicomputer territory. In the case of many relatively complex applications, microcomputers are sometimes the better solution.

To clarify this and put the "mini/micro" competition into some perspective, compare some of the relative advantages and disadvantages of each:

Technology: Microcomputers are more densely integrated than minicomputers. This implies many things that will be amplified in the points of comparison that follow. Because most minicomputers are based on computer architectural concepts that date back to the late 1960s, they may not be taking fullest advantage of the latest concepts—concepts that strongly influence microcomputer development. Microcomputers are very popular now—they are where the action is. As a result, people want to work with them. Trade magazine coverage of microcomputer applications is very intensive. The use of microcomputers by hobbyists is very active and is resulting in the contribution of new ideas. Therefore, though it is difficult to quantify as an advantage, microcomputers have an edge in this area simply because they represent the latest technologies.

Word size: Minicomputer word sizes range from 12-bit types through 16-bit types (available from most manufacturers) to 18-bit, 24-bit, and even 32-bit types (available,

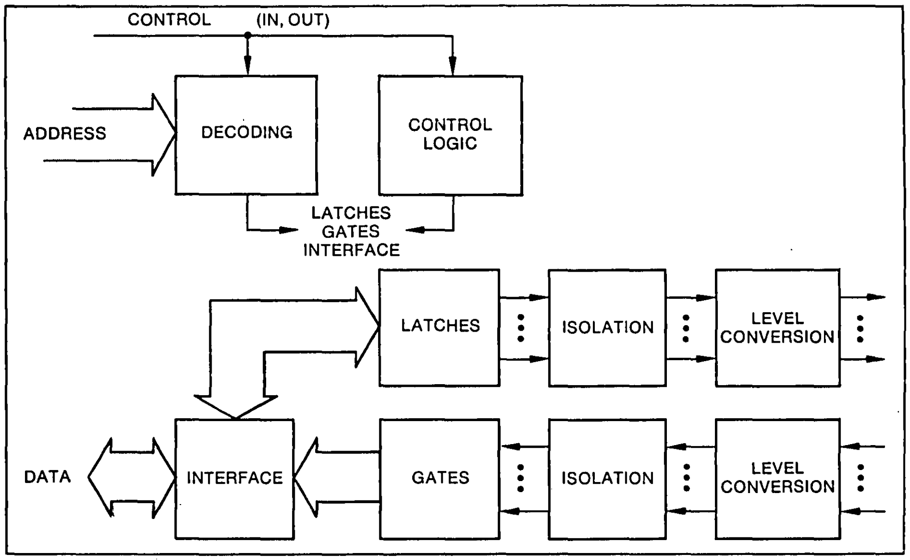

Fig. 4. This illustrates how an I/O subsystem might be organized. Addresses are decoded to select specific ports—which will be sets of logic gates for outputs to the data bus or sets of latches for inputs to the memory.

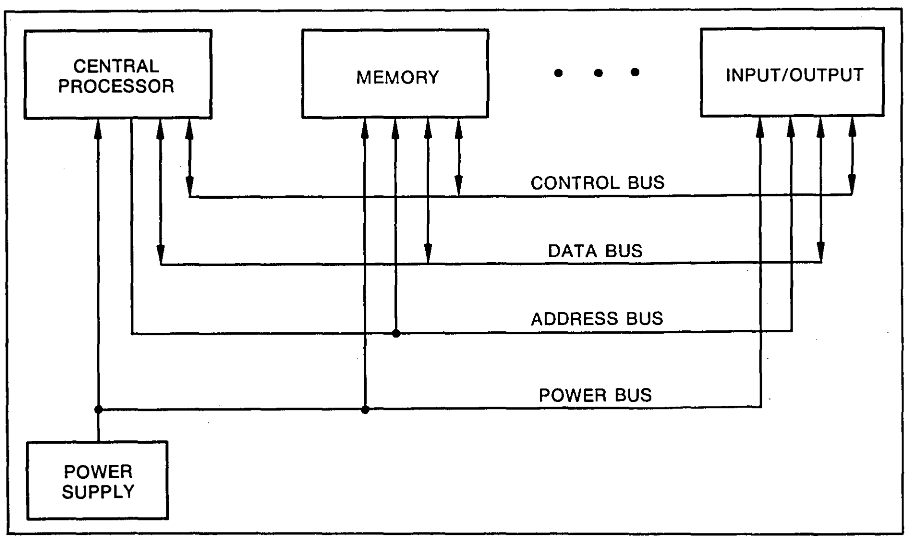

Fig. 5. In modern microcomputers, the cpu, memory, and I/O subsystems are connected by busses for control signals, data, addresses, and power.

but not particularly numerous). Microcomputers are also available in these sizes or can be built using bit-slice microprocessors. In terms of the most popular types, it is fair to say that most minicomputers are 16-bit types and most microcomputers are 8-bit types. Here, the edge depends upon the application. For operations that require lots of calculations, 16-bits is generally the best choice—a choice that is available from both minicomputers and microcomputers. For other kinds of operations, 8-bits may be quite suitable and less expensive. Some 8-bit microprocessors are equipped with instructions that perform a limited number of operations on 16-bit quantities. Thus, up to 16 bits the word size competition between minicomputers and microcomputers is pretty much a "draw."

Instruction sets & registers: Here again, both classes are comparable. Some microcomputers have better instruction sets and more registers than some of the "middle-aged" minicomputers. For example, most programmers would agree that the 8080 is better than the PDP-8 in this regard. Microcomputers such as the 8080 have stack control instructions that help their programmers to maintain lists of data and addresses on a first-in, first-out basis. This feature is very useful in writing many kinds of control and data processing programs, yet is absent in many minicomputers. On the other hand, some minicomputer instruction and register sets (including that of the PDP-11) are demonstrably better than those of many microcomputers. There are also some cases of microcomputers exactly matching minicomputers (for example, the Intersil 6100 matches the PDP-8 and the Data General microNOVA matches NOVA minicomputers). Again, the situation is pretty much a draw overall; as with word size, it often depends upon the application.

Memory: The amount of main memory directly addressable by a computer is determined by the number of bits allocated to the address fields of its instructions and the size of its address bus. Typically, 16 bits are used in most popular minicomputers and microcomputers, giving both the ability to address up to 65,536 words. Minicomputer memories are most commonly core or semiconductor RAM. PROM memory, although offered by some manufacturers, is not a common type of minicomputer memory and is relatively expensive when it is available. As noted earlier, microcomputer memories are most commonly a combination of PROM and RAM. Very advanced minicomputers can be had with sophisticated and extremely fast cache memories and with virtual memory support. These types of memories are not yet available with microcomputers. The speeds of microcomputer memories are comparable to conventional minicomputer memories (in the range of access times of 500nsec). Faster memories are available for use with the faster microprocessors. Generally, however, minicomputer memories contain more program and data than microcomputer memories, due to the former's 16-bit word size.

Input/Output: The design of conventional minicomputer I/O is strongly tied to the design of the central processor. Special instructions and control signals are provided for testing the status of peripheral devices and for transferring data to and from these devices. Most micros use the port concept explained earlier. They tend to provide one "read" signal and one "write" signal with an instruction for each (IN and OUT on the 8080). Both data and device status are transferred using these and the program determines the status of the addressed peripheral device by examining bits transferred over a "status port." In terms of microcomputer hardware, distinctions between data and status become unnecessary. Both minicomputers and microcomputers often use interrupts in dealing with peripheral devices.

Direct memory access (DMA) arrangements are commonly used with mini-

The functional equivalent of hardware which once filled a room can now be held in the palm of the hand.

computers when transferring data to and from high speed peripheral devices such as magnetic tapes and discs. DMA arrangements permit peripheral interface logic to suspend the operation of the cpu temporarily while data is transferred directly into or out of the memory. Although almost all of the most popular microcomputers can be equipped with DMA, they are often equipped with buffered peripheral devices from which data can be transferred at a more leisurely rate. In general, it is easier to interface a simple peripheral device to a microcomputer (less interface hardware is required), but the situation with more complex devices is about even. Data transfer rates are somewhat slower with microcomputers, but they can perform the same kinds of I/O as minicomputers.

Packaging: Minicomputers are available in standalone or rack-mountable enclosures of various sizes and styles. Microcomputers come in many styles ranging from single unmounted printed circuit boards, to card racks that can be mounted in several ways, to rack-mountable types that are usually indistinguishable from minicomputers.

Environmental aspects: Environmental considerations could be treated as extensions of I/O and packaging. Semiconductor elements, printed circuit boards, wiring, and power supplies in microcomputers are made from essentially the same materials as are used in minicomputers and are assembled in the same way. As a result, the nominal outside limits of ambient temperature around the circuits are 0°C to 70°C. In the case of some microcomputers and some minicomputers, ranges of -55°C to +125°C are possible where military grade integrated circuits can be used in the manufacture of the computer. The nominal outside ambient temperature range for an enclosed system without special temperature control provisions is about 0°C to 40° or 50° C. However, in most cases where operation in severe temperatures is necessary, the temperature of the enclosure must be controlled. Thus, minicomputers and microcomputers can be made to operate in the same kinds of severe environments. By installation in enclosures of various NEMA industrial classes, they also can be made to operate in oily, dusty, or corrosive atmospheres. Microcomputers are usually more amenable to such special packaging because they are smaller and use less power than minicomputers.

In the case of electrically noisy environments, microcomputers and minicomputers are on somewhat equal footing. The integrity of power and grounding systems is important to both. The same electrical isolation techniques (relay, transfer, and optical) are available for use with microcomputers and minicomputers to protect them from transients.

Programming: When programming with assembly languages, microcomputers and minicomputers are about equal. The difficulty of assembly language programming becomes mainly a function of the instruction set of the microprocessor and the utility software that is available with it for creating programs. The small 4-bit microcomputers are somewhat difficult to program because of their limited instruction sets and utility software. The 8-bit microcomputers are about as easy to program as minicomputers. They are now equipped with very sophisticated editors and assemblers and have excellent instruction sets.

When programming with high level languages, minicomputers generally have the edge. More languages are available for minicomputers and their compilers are more sophisticated and efficient. However, this gap is closing. Microcomputer compilers are being improved.

Reliability & maintenance: With respect to reliability and maintenance, the microcomputer has a slight edge over the minicomputer. Because micros use fewer components and less power, they are subject to less stress and lower failure rates. Microcomputers are often easier and less expensive to maintain as well. There being fewer components and boards in a typical microcomputer system, it is generally easier to isolate a fault to the replacement module level and less costly to maintain an on-site inventory of spare modules.

Peripheral devices: Minicomputers already can be equipped with a wider variety of conventional computer peripheral devices, such as discs and magnetic tapes, but microcomputers are catching up rapidly. Many peripheral equipment manufacturers are making or designing buffered devices and interfaces that are very easy to attach to microcomputers, although in some cases they may be slightly more expensive and a bit slower than devices available for minicomputers.

Software & training: Minicomputers, by virtue of their longer history, have larger libraries of prepared software, and more programmers trained in their use. Again, however, because of the great current interest in microcomputers, the gap is being closed. Training in the use of microcomputers is available from their manufacturers and from many independent companies that specialize in this activity and in consulting for microcomputer applications.

SUMMARY As we can see from the above comparisons, the boundary between minicomputers and microcomputers is getting hazy. Microcomputers today do compete for applications that used to be the exclusive domain of minicomputers. And, as microcomputers intrude upon minicomputer territory, we also find minicomputers becoming more powerful and intruding on the territory of larger computers.

Many of us, especially those who are old enough to have experienced the Paleolithic Age of computing, marvel that the functional equivalent of hardware which once filled a room can now be held in the palm of the hand. Where will it all lead? It is clear that growth in the capabilities of microcomputers and minicomputers is still rapid and will certainly continue for a while. We are all affected by it, both in our professional and in our private lives. The technology is both solving old problems and posing new challenges that will hold our interest for some time. ✲

DOUGLAS A. CASSELL

Mr. Cassell is presently the vice president–engineering at Control Logic, Inc., in Natick, Mass. In that post he is responsible for the engineering of general purpose microcomputer products and microcomputer-based systems, especially for material control applications. Prior to joining Control Logic, he was with Sylvania Electronic Systems.

His feature has been developed from a presentation he recently made at the 1978 Mini/Micro Conference in Philadelphia.

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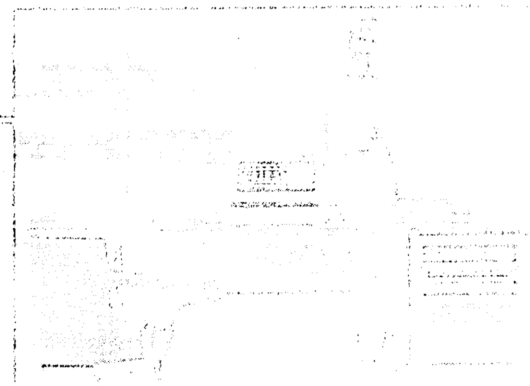

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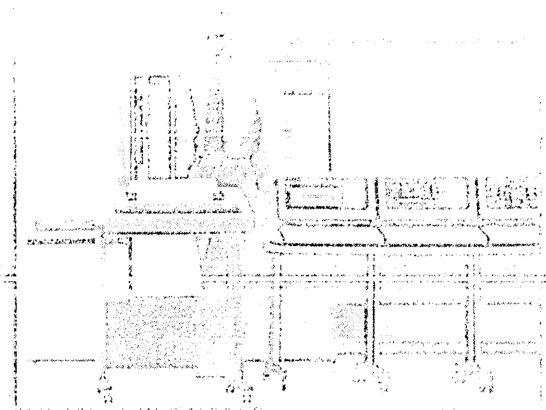

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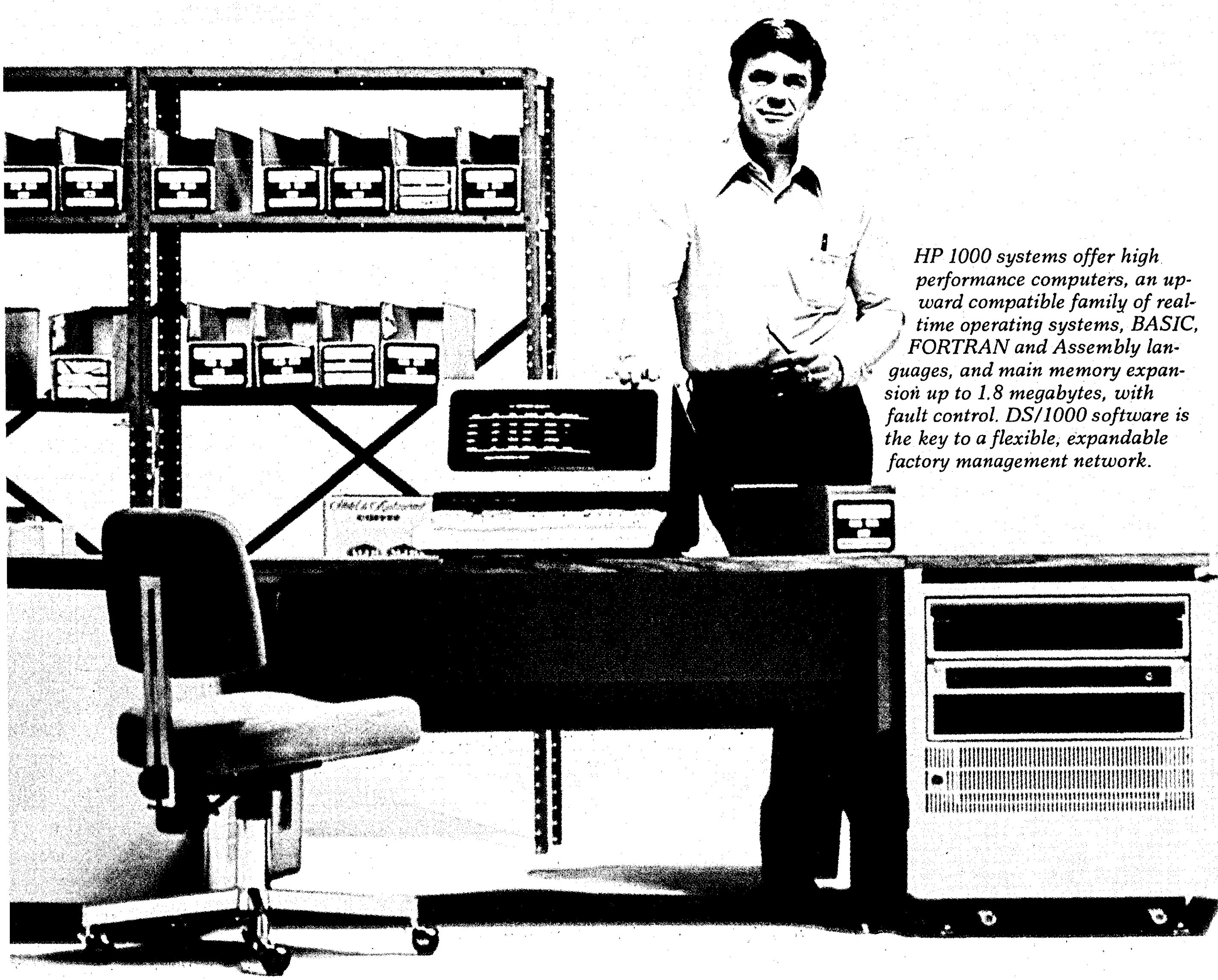

HP 1000 systems offer high performance computers, an upward compatible family of real-time operating systems, BASIC, FORTRAN and Assembly languages, and main memory expansion up to 1.8 megabytes, with fault control. DS/1000 software is the key to a flexible, expandable factory management network.

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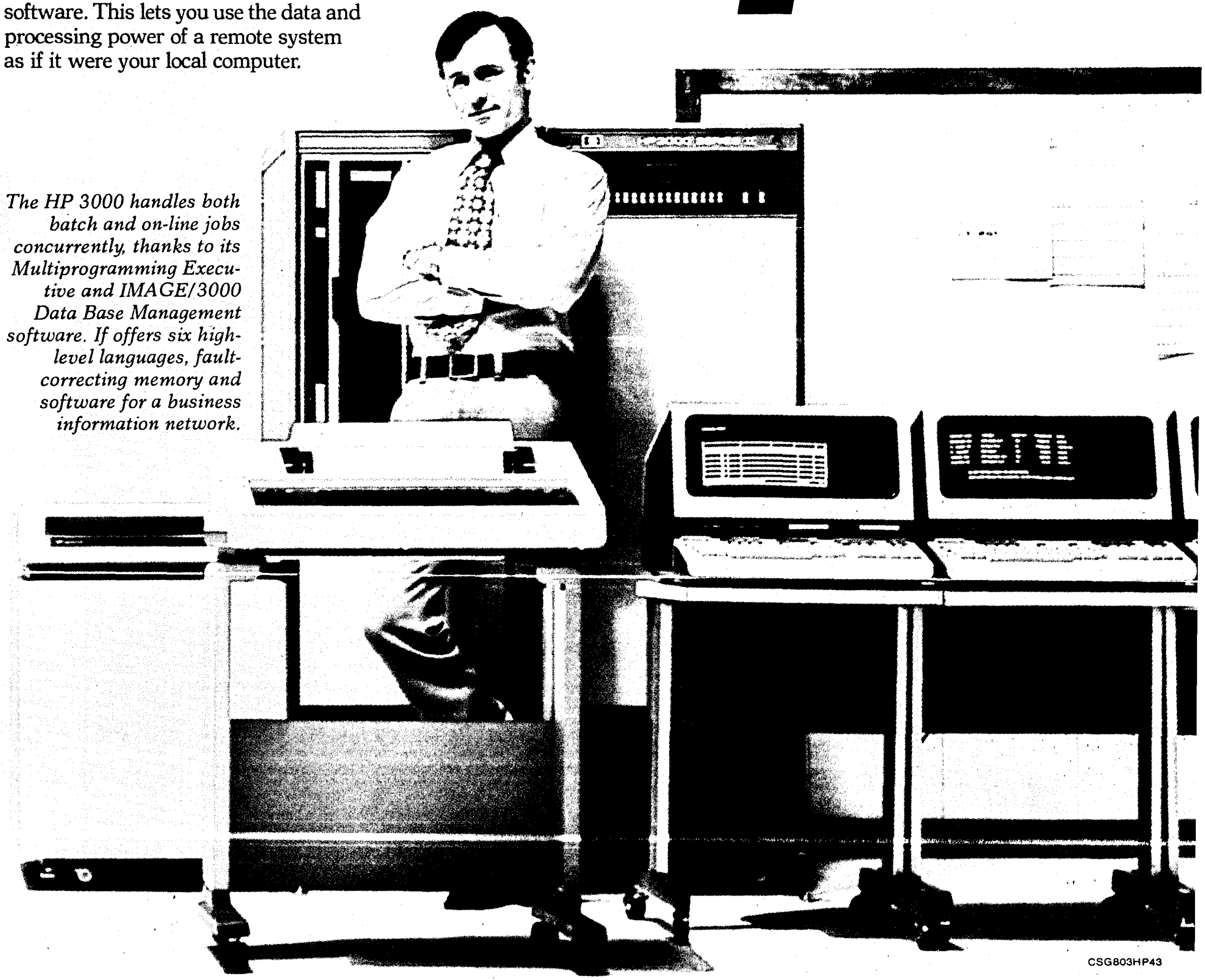

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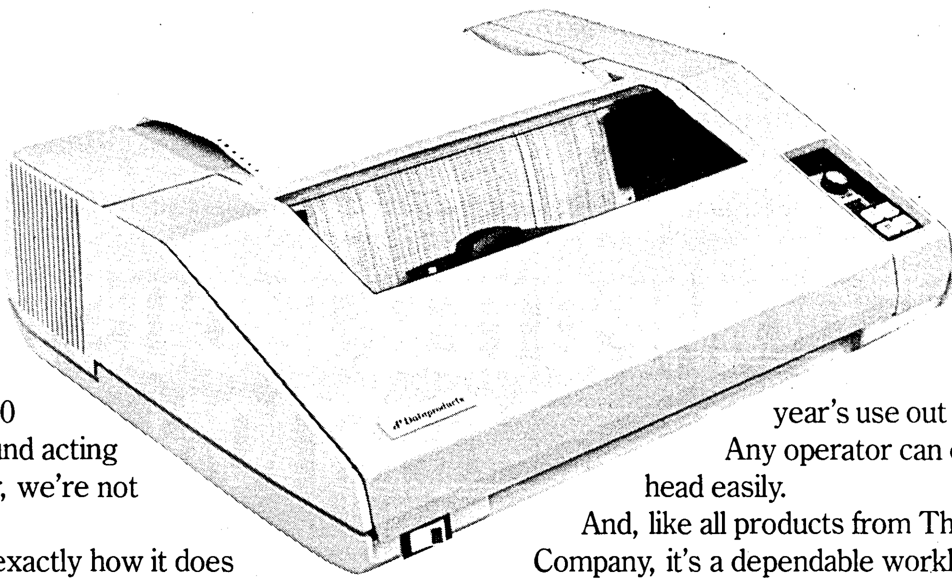

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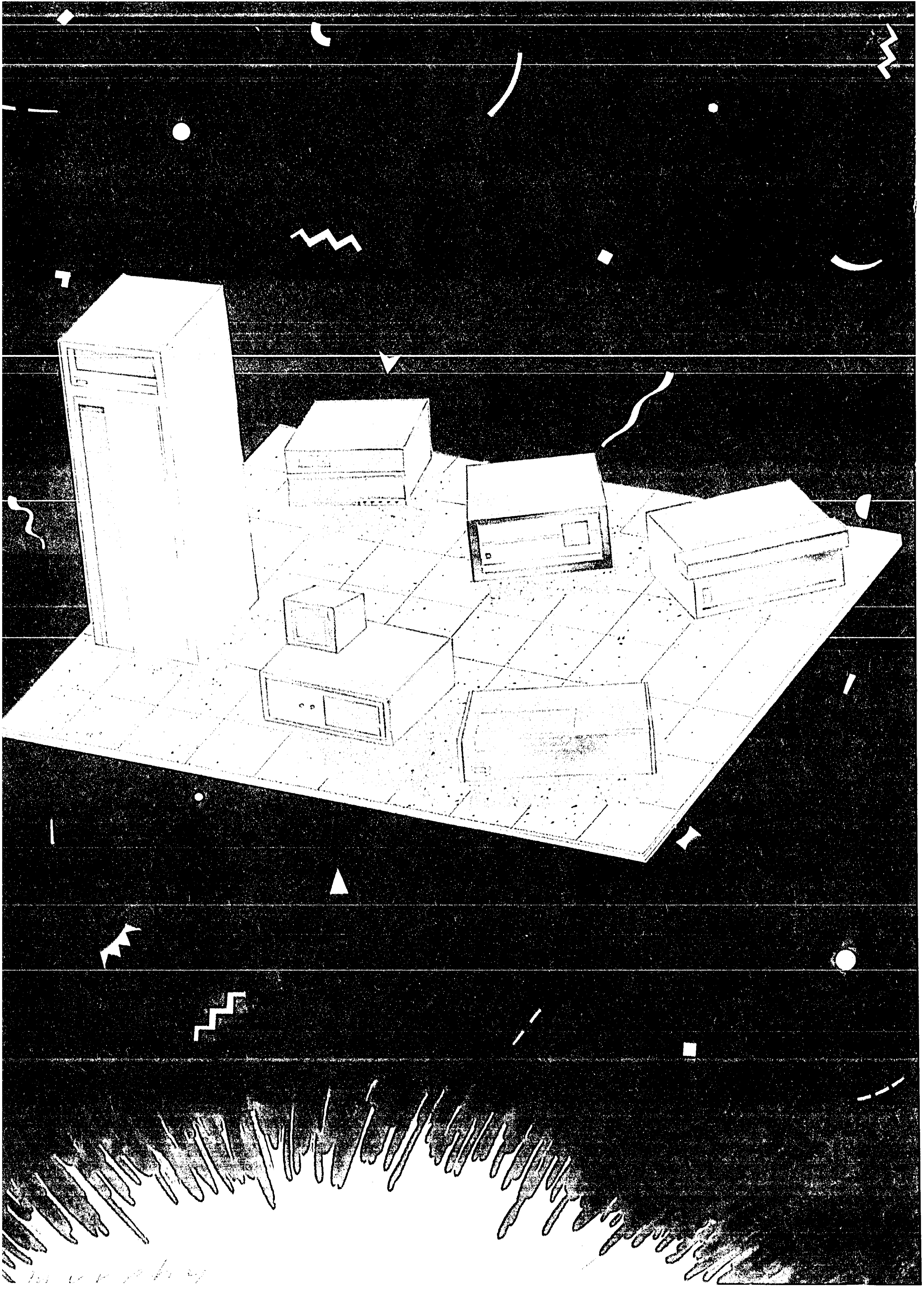


The dividing lines between classes of computers are fading and may soon disappear.

MINI AND MICROCOMPUTER SURVEY

by Nancy Knottek, Assistant Editor

A decade or so ago, minicomputer applications tended to be primarily in instrumentation, test, and control systems. Originally distinguished from general-purpose mainframes by their size, price, function specialization, and absence of a solid software base, minicomputers were often sold as control components of other (usually specialized) systems.

Then, in the early '70s, the microcomputer was born. At first many of us dismissed the possibility that the chip computers could become a threat to the minicomputer market. However we did foresee that microprocessors would be used to implement minicomputers in some cases in lieu of random logic, and therefore would tend to place a lower limit on the price and capability of what we normally consider a minicomputer. But we didn't expect them to impact the minicomputer market in any significant way.

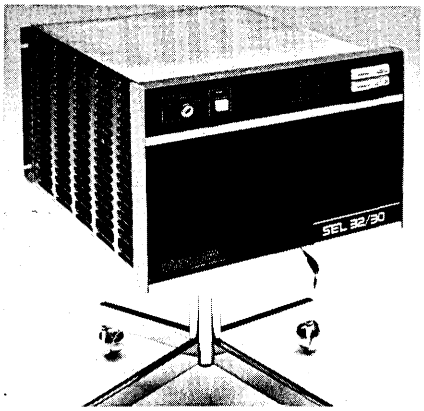
Much has happened since then and the results of DATAMATION's present survey indicate several industry changes. First, it is almost impossible to define a "minicomputer" anymore. LSI circuit technology has allowed minicomputers to increase performance to where today their capabilities are almost boundless. Their software has grown and improved; what seems like thousands of packages are now available from software houses as well as manufacturers.

Minis are still being used in dedicated applications, but to a far lesser degree. To sustain profits as component costs were reduced and prices fell, many minicomputer manufacturers began packaging their hardware into complete systems, including peripherals and software in most cases. The packaged system concept has also been popular with users who don't have the staff or the technical expertise to configure their own systems properly.

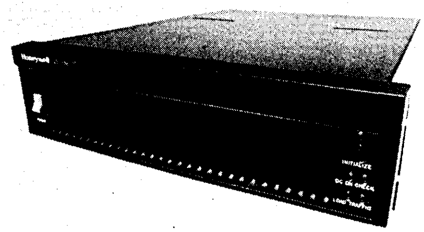
These mini-based systems, usually dubbed "small business" or "distributed systems," are the current market rage and, as more and more manufacturers turn to system packaging, they are deserting the original market they created. This is where microcomputers are making their biggest market penetration and repeating the history of minicomputers.

At first distinguished from minicomputers also by their size, price, and lack of software, microcomputers gained popularity as components in word processors, data entry terminals, and data communications equipment. But now they are gaining respectability and proving their versatility and standalone capability. And just as minicomputers impacted the low-end mainframe market, microcomputers are challenging the low-end minicomputer market.

The System 8813, part of PolyMorphic's System 88 line, features BASIC and disc operating system, and exemplifies the microcomputer systems' approach to business applications.



The SEL 32/30 Maxibox is a new 32-bit minicomputer designed primarily for oem applications. The quantity oem base price is approximately $20,000, including 256K bytes of memory.



Just announced in February, the new entry-level member of the Honeywell Level 6 family, the Model 23, is designed for end user applications. Shown here in rack-mountable form, it is also available in prepackaged "minimount" and workstation crt versions.

Computer Automation's Naked Mini 4 illustrates how broad the range of minisystem packages can be. Available in stripped form (with 4K of memory, power supply, chassis, and console) for $995, it also can be delivered in configurations like the one above (with hard disc, soft disc, crt, extended memory, etc.). In fact, "typical" systems can run 10 to 15 times as much.

Software is another area of improvement. BASIC, FORTRAN, and COBOL and other higher level languages are showing up on a large number of microcomputers. And while micros are taking over in dedicated applications, they are also going head-to-head with minis as systems. Manufacturers are beginning to provide applications software, and microcomputer software houses, like MicroSoft and Digital Research, are springing up.

Function has become the main selection criterion for most users. They want a piece of hardware to fit a specific application for the right price, no matter what it's called or how it's implemented. And the options are many. A "black box" 8-bit microcomputer offering limited function can be bought by an end user in single unit quantity for as little as $950, while at the high end a powerful minicomputer system, like the Prime 500, can sell for close to $½ million when fully configured!

Differences that remain between minis and microcomputers are basically a function of performance. Most microcomputers presently have much less I/O capacity, which limits their use in systems to small configurations. They also are being offered with limited memories—64KB or less. But in number of channels available and processor speeds, micros overlap with their bigger rivals. Word size is another factor. Microcomputers generally use 8- and 16-bit words. And although 8- and 16-bit words are still used in most minicomputers, a growing number are going to 32 bits.

TRENDS

Microcomputers will continue to make advances in low-end markets, as components and systems, while minis concentrate on pushing performance into the large-scale machine class. Both moves will further cloud already confused computer distinctions. In fact, several S/370-compatible "minicomputers" have recently been introduced. Although referred to as minis by their manufacturers because of their size, their performance clearly qualifies them for full-size computer status.

Further, several minicomputer manufacturers have already acknowledged a place in the industry for microcomputers by adding them to their equipment line. One manufacturer, General Automation, seems to have caught on to the trend early. Its 16 Series begins with the 16/220 micro, includes the 16/460 16-bit mini, and peaks with the 32-bit (maxi-mini?) 16/550 model.

More minicomputer manufacturers undoubtedly will introduce microcomputers either of their own design or acquired, as Pertec picked up MITS and its Altair 8800. And the scramble which started a couple of years ago for terminal and peripheral company acquisitions will be repeated with microcomputer companies as the industry strives to satisfy the user's demand for total system suppliers.

READING THE TABLES

Because of the difficulty in accurately defining minicomputers today, the equipment category surveyed for the following presentation was defined without regard to the generic terms "mini" or "micro." What appears are general-purpose cpu's available in minimal operating form (with control panel, power supply, and *at least* 4K of internal memory) at a single-unit end user price of $40,000 or less. Packaged or specialized systems (such as small business systems) were excluded. Manufacturers were asked to include only those units they would sell in this naked form. Although the survey lists *most* common minicomputers, only representative microcomputers were included—since it is impossible to uncover all those that are available at any given minute.

A few of the items on the charts require some explanation. For instance, the cycle time listed is the memory cycle. Also, the entries listed for registers are the number of *hardware* registers. And maintenance charges quoted presume prime shift on-call service and scheduled maintenance.

The charts are intended as a guide to the range of equipment available. For detailed information on any model or series, please contact the manufacturer directly, either using the address listed in the Vendor Index, or by circling the appropriate number on the reader service card bound into this issue.

Manufacturer	Altos	Applied Data	Applied Systems	Century Computer	Computer Automation
Model Highlights	ACS8000	Event 1000 & 2000	ASC/80	200 Series	Naked Mini 4
Classification	Microcomputer	Microcomputer (8080)	Microcomputer (8080/8085/Z80)	Minicomputer	Minicomputer
1st shipped/# shipped	08/77 150 shipped	05/75 150 shipped	1975 # shipped not given	10/69 2, 300 shipped	05/77 # shipped not given
Word size/cycle time	8-bit word/0.9usec cycle	8-bit word/750usec cycle	8-bit word 0.8 cycle	8-bit word/1-2usec cycle	16-bit word/550-1200nsec
Maj. applications		General business	Communications; control; business	Business	General purpose
Processor					
Address/instruction	16-bit add./8-24 bits	16-bit add.:/8-bit instr.	16-bit add./8-bit instr.	8-bit add./10 bit instr.	16-bit add./16-32 bits instr.
Multiprecision word	32 or 64 bits multiprec.	24 bits multiprecision	16 bits multiprecision	8 bits multiprecision	32 bits multiprecision
Registers	2 index/16 gen. purpose	1 index/7 gen. purpose	3 index/7 gen. purpose	6 index/16 gen. purpose	2 index/4 gen. purpose
Register-register add	3usec add time	1.5usec add time	0.8usec add time	1.6usec add time	1-3usec add time
Other features	Floating-pt. hardware; real-time clock; opt. decimal arith.	Decimal arith.; real-time clock; power fail restart	Decimal arith.; power fail restart; opt. reloadable control store, floating-pt. & real-time clock	Microprogrammable; real-time clock; power fail restart	Microprogrammable; real-time clock; power fail restart; opt. decimal arith. & floating-pt.
Memory	16KB-64KB RAM; 1KB EPROM	48KB-61KB RAM; 1KB-4KB PROM	1KB-64KB RAM; 1KB-64KB ROM; 1KB-64KB PROM	32KB-512KB ROM	2KB-512KB RAM; 0.5-16KB ROM; 0.5KB-16KB PROM
Addressing	64K words direct address	64K words direct address	64K words direct address; Opt. indirect address	512K words direct address; indirect paging	64K words direct address; multilevel indirect
Other features		Bit/byte addressing	Opt. parity, error correction, memory protect & bit/byte address	Memory protect; error correction	Error correction; bit/byte addressing; opt. parity & memory protect; battery backup available
I/O & Communications	Bisync; SDLC; HDLC		Bisync; tty protocol		SDLC; Bisync protocol
Max. # of channels	256 channels max.	17 channels max.	# of channels not given	256 port multiplexor	64 channels max.
Max. I/O rate/comm. rate	I/O: 100KB; comm. 550Kbps	I/O: 500 KB; comm: 38.4Kbps	I/O: 250KB; comm: 50Kbps	I/O: NG; comm: 3.6Kbps	I/O: 115KB; comm: 19.2Kbps
I/O path width	I/O path width 8 bits	I/O path width 8 bits	I/O path width 8 bits	I/O path width NG	I/O path width 16 bits
Direct memory access	1MB/sec DMA	200KB/sec DMA	1MB/sec DMA	512KB/sec DMA	1.8MB/sec DMA
Software					
Operating systems	CP/M & DOS	Micro/DOS & Micro Exec	Disc & PROM Executive	CEN/OS	OS 4; RTX 4
Assemblers	Macroassembler	Micro Exec	Macroassembler	1-pass assembler	Macro-4 2-pass assembler
Interpreters	Basic	Business BASIC	BASIC	No interpreter	BASIC; PASCAL
Compilers	FORTRAN; COBOL; PASCAL	No compiler	FORTRAN & PL/M	—	FORTRAN; PASCAL
Applications software	Business & scientific	Business; word processing; text-editing; games	DBMS; data acquisition; communications & controls; business; statistical	DBMS & general business software	No applications software
Pricing	Sales primarily oem	Sales primarily end user	Sales primarily end user	Sales 70% oem	Sales primarily oem
Base price (single unit)	$3,840 (maint. $50/month)	$10,300 (maint. not given)	$950 (maint. $40/month)	$16,500 (maint. $200/month)	$995 (maint. not given)
Base price (quantity 100)	$2,535	—	30% discount	—	—
Typical system range	$3,840-$4,840	$10,300-$27,400	$1,000-$3,000	$23,500-$40,000	$10,000-$15,000
Lower price includes:	32K cpu, dual discs, power supply, cabinet, dual serial I/O	Dual floppy, teleprinter 48K RAM, 1K PROM, work station	4KB cpu, controls & power supply, I/O adapter, dual discs	Disc, printer, crt, 32KB memory, multiplexor	CPU, memory, chassis, power supply, floppy, console
Comments	Z80 bus; true single board computer; integrated discs	10MB single or dual floppy available	Multiprocessor options	Base price includes 32K.	Maxibus architecture

Manufacturer	Computer Hardware	Computer Talk	Control Logic	Cromemco	Data General
Model Highlights	CHI 4210	400 Series	M & MML Series	System Three	Eclipse S/130
Classification	Microcomputer (TI TMS 990)	Minicomputer	Microcomputer (8008/8080/Z80)	Microcomputer (Z80A)	Minicomputer
1st shipped/# shipped	Date & # shipped not given	05/75 6 shipped	1972 over 1,000	1978 new product	06/77 # shipped not given
Word size/cycle time	16-bit word/0.73usec cycle	16-bit word/0.5usec cycle	8-bit word/0.45-0.65usec cycle	8-bit word/1usec cycle	16-bit word/500 or 700nsec
Maj. applications	CHI CLOK system	Automation; engineering	Industrial control	Oem applications	General purpose
Processor			Varies with chip used		
Address/instruction	15-bit add./16-bit instr.	8, 16, 24 bits/16, 32, 48 bits		16-bit add./8-32 bits	16-bit add./16, 32 bits
Multiprecision word	32 bits multiprecision	32, 48, 64 bits multiprec		60 bits multiprecision	32 bits multiprecision
Registers	15 index/16 gen. purpose	2 index/12 or 16 gen. purp.		2 index/16 gen. purpose	2 index/4 gen. purpose
Register-register add	4.67usec add time	1usec add time		2usec add time	600nsec add time
Other features	Real-time clock; opt. power fail restart	Microprogrammable; floating-pt. hardware; real-time clock; power fail restart; opt. decimal arith. & reloadable control store	Floating-pt. hardware; real-time clock; power fail restart	Reloadable control store; decimal arith.	Reloadable control store; power fail restart; opt. microprogrammable, floating-pt. hardware & real-time clock
Memory	4KB RAM; 1KB PROM	4KB-512KB RAM; 0.7KB-4KB ROM; 0.7KB-4KB PROM	1KB-64KB RAM; 0.5KB-64KB PROM	32KB-512KB RAM; 1KB ROM	32KB-64KB MOS; 32KB core
Addressing	32K words direct address	512K words direct address; relative, page, index, indir.	64K words direct address	64K words direct address; 512K bank select indirect	32K words direct address; multilevel indirect
Other features	Parity; memory protect; bit/byte addressing	Memory protect; bit/byte addressing; opt. parity	Bit/byte addressing	Memory protect; opt. parity	Memory protect; bit/byte/block addressing; error correction w/MOS memory
I/O & Communications	IBM 3780 & 3270 protocols				Bisync; tty; SDLC
Max. # of channels	1 channel max.	256 channels max.	256 channels max.	256 channels max.	64 channels max.
Max. I/O rate/comm. rate	I/O: 187.5KB; comm: 9600bps	I/O: 2MB; comm: 9600 bps	I/O: NG; comm: 50Kbps	I/O: 76.8KB; comm: 76.8KB	I/O: 2.5MB; comm: 56KB
I/O path width	I/O path width not given	I/O path width 16 bits	I/O path width 8 bits	I/O path width 8 bits	I/O path width 16 bits
Direct memory access	2.25MB/sec DMA	2MB/sec DMA	No direct memory access	1MB/sec DMA	2.5MB/sec DMA
Software					
Operating systems	Multitasking single user	Operating system NG	DOS & papertape	Floppy DOS	RDOS; RTOS; AOS
Assemblers	2-pass assembler	2-pass & 2-pass micro	Absolute & relocatable	Macro/conditional assembler	2-pass macroassembler
Interpreters	BASIC	Extended BASIC; FORTRAN IV	BASIC	BASIC	BASIC; business BASIC
Compilers	FORTRAN IV	BASIC; FORTRAN IV	FORTRAN IV	FORTRAN; COBOL	FORTRAN IV & V; ALGOL
Applications software	Time & attendance; labor distribution	DBMS; interactive graphics; digitizing; word processing	Industrial control; real-time operating system for Z80	DBMS; inventory; word processing	INFOS file system; no applications software
Pricing	Sold primarily thru distributors	Sales primarily end user	Sales primarily end user	Sales primarily oem	Sales primarily end user
Base price (single unit)	$8,950 (maint. $130/month)	$24,950 (maint. $120/month)	$2,000 (maint. not given)	$5,990 (maint. N/A)	$11,000 (maint. $145/month)
Base price (quantity 100)	—	—	$1,600	$3,893	38% discount
Typical system range	$15,300-$19,500	$24,950-$174,000	$1,500-$4,000	$5,990-$12,000	$20,000-$100,000
Lower price includes:	32KB memory, 2 diskettes, printer, cassette reader	4K, crt modem & light pen, battery backup	3K memory, power supply & basic I/O	32K cpu; dual floppy discs, RS232 & printer interface	16K cpu, cabinet, crt & diskette
Comments	Uses 16-bit data bus; compatible with TI 990/A	Multiprocessing virtual memory	Bus-oriented with memory mapped I/O	S-100 bus; IBM format floppy; compatible with Cromemco System Two	Base price includes 32K core. Microprogrammed; Nova & compatible microNova

Manufacturer	Data General	Data General	Datapoint	Datapoint	Digital Equipment
Model Highlights	microNova	Nova/3	Diskette 1100	1500	PDP-8/A
Classification	Microcomputer (DG MN601)	Minicomputer	Minicomputer	Minicomputer	Minicomputer
1st shipped/# shipped	12/76 # shipped not given	01/76 # shipped not given	Date & # shipped not given	12/77 1,000 shipped	1975 12,000 shipped
Word size/cycle time	16-bit word/0.96usec cycle	16-bit word/700nsec cycle	8-bit word/1.6usec cycle	9-bit word/0.8usec cycle	12-bit word/1.2usec cycle
Maj. applications	—	General purpose	Data entry	Data entry; communications	General purpose
Processor					
Address/instruction	15-bit add/16-bit instr.	15-bit add./16-bit instr.	16-bit address/8-bit instr.	16-bit address/8-bit instr.	8–17 bit add./12-bit instr.
Multiprecision word	—	16 bits multiprecision	8 bits multiprecision	No multiprecision word	—
Registers	2 index/4 gen. purpose	2 index/4 gen. purpose	14 gen. purpose	2 index/12 gen. purpose	8 index/2 gen. purpose
Register-register add	2.4usec add time	700nsec add time	3.2usec add time	1.6usec add time	3–4.5usec add time
Other features	Real-time clock; power fail restart	Power fail restart; opt. floating-pt. hardware & real-time clock	Decimal arith.; power fail restart	Decimal arith.; real-time clock; power fail restart	Floating-pt. hardware; real-time clock; power fail restart
Memory	2KB–64KB RAM; 0.5KB–64KB ROM; 0.5KB–64KB PROM	8KB–64KB MOS; 16KB–32KB core	16KB RAM; 2KB ROM	32KB RAM; 4KB PROM	2KB–64KB RAM; 2KB–8KB ROM; 0–2KB PROM
Addressing	32K words dir. addressing; multilevel indirect	32K words direct address; multilevel indirect	16K words direct addressing	36KB direct addressing	256K words direct address; 128K words 1-level indir.
Other features	—	Memory protect; bit/byte addressing; opt. parity	Byte addressing	Parity; byte addressing	
I/O & Communications	Bisync protocol	Bisync; tty; SDLC	Async; sync; bisync	Sync; async; bisync	DECnet 8 protocol
Max. # of channels	61 channels max.	64 channels max.	1 channel	1 parallel, 2 serial	—
Max. I/O rate/comm. rate	I/O rate NG; comm: 19.2Kbps	I/O: 2.5MB; comm: 56KB	I/O 40KB; comm: 9600bps	I/O 1MB; comm: 9600bps	I/O: 50KB; comm: 9600bps
I/O path width	—	I/O path width 16 bits	I/O path width 8 bits	I/O path width 8 bits	I/O path width 12 bits
Direct memory access	340K–2MB/sec DMA	2.5MB/sec DMA	No DMA	No DMA	Not applicable
Software					
Operating systems	DOS; RTOS	RDOS; DOS; RTOS	DOS C Series	DOS H	OS/8; RTS8
Assemblers	2-pass macroassembler	2-pass macroassembler	2-pass assembler	Restricted	3-pass assembler
Interpreters	BASIC; Business BASIC	BASIC; business BASIC	BASIC; Databus; Dataform	Databus; Dataform	FOCAL
Compilers	FORTRAN IV	FORTRAN IV & V; ALGOL	No compilers	Databus; Dataform	BASIC; FORTRAN IV
Applications software	No applications software	INFOS file system; no applications software	No applications software	No applications software	Word processing; typeset; COS 310
Pricing	Sales primarily oem	Sales primarily oem	Sales primarily end user	Sales primarily end user	Sales primarily oem
Base price (single unit)	$1,995 (maint. $140/month)	$2,600 (maint. $38/month)	$12,880 (maint. $47/month)	$5,950 (maint. not given)	$3,900–$6,050 (maint. $55/month)
Base price (quantity 100)	$1,236	38% discount	—	—	35% discount
Typical system range	Up to $10,000	$5,000–$70,000	$15,000–$19,000	$5,950	$10,000
Lower price includes:	16K words RAM, dual diskette, crt terminal, cabinet	16K cpu, cabinet, crt & diskette	16K processor, console, 2 diskettes	32K RAM; crt; 2 diskettes, commo. interface, software	8K cpu, terminal, floppy or hard disc
Comments	Compatible with Nova 3 & Nova	Multiple register architecture; compatible with microNova & Eclipse family	Compatible w/Datapoint 2200/5500/6600	Dual sync/async communications; floppy disc	OMNIBUS architecture; maximum memory 128K in 4K fields

Manufacturer	Digital Equipment	Digital Equipment	Digital Equipment	Digital Scientific	General Automation
Model Highlights	PDP-11/03	PDP-11/04	PDP-11/34	Mesa 4	GA-16/220
Classification	Microcomputer (LSI-11)	Minicomputer	Minicomputer	Minicomputer	Microcomputer (proprietory)
1st shipped/# shipped	1976 3,500 shipped	1975 10,000 shipped	1976 10,000 shipped	1970 over 200 shipped	1975 3,000 shipped
Word size/cycle time	16-bit word/0.75 cycle	16-bit word/0.7usec cycle	16-bit word/1usec cycle	16-bit word/500nsec cycle	16-bit word/0.7usec cycle
Maj. applications	Low-end general purpose	General purpose	General purpose	Market research; education; engineering; service bureau	Industrial, banking, networks
Processor					
Address/instruction	16-bit add./16-bit instr.	18-bit add./16 or 32 bits	16-bit add./16-bit instr.	16-bit add./16 or 32 bits	16-bit add./16-bit instr.
Multiprecision word	—	32 bits multiprecision	64 bits multiprecision	64 bits multiprecision	Multiprecision via software
Registers	8 general purpose	2 index/8 gen. purpose	8 general purpose	3 index/2 gen. purpose	8 index/16 gen. purpose
Register-register add	3.5usec add time	3usec add time	1.5usec add time	1.37usec add time	2.1usec add time
Other features	Floating-pt. firmware; real-time clock; power fail restart; opt. microprogrammable & reloadable control store	Power fail restart; opt. real-time clock	Real-time clock; power fail restart; opt. floating-pt. hardware	Opt. floating-pt. hardware & real-time clock	Real-time clock; power fail restart; opt. floating-pt. hardware
Memory	8KB–64KB RAM; 1KB–32KB ROM; 1KB–32KB PROM	16KB–56KB RAM	16KB–64KB RAM	16KB–128KB RAM	4KB–128KB RAM; 6KB–32KB PROM
Addressing	32K words direct address	32K words direct address	32K words direct address: 128K words indirect	65K words direct address; 1-level preindexed indir.	64K words direct address; 1-level indirect
Other features	Byte addressing	Byte addressing; opt. parity	Parity; memory protect; byte & word addressing	Parity; memory protect; extended power sequencing & sys. parameter monitoring	Byte parity; memory protect; error correction; byte addressing
I/O & Communications	DDCMP; Bisync protocol	DECnet, bisync protocols	DDCMP; BSC; SDLC; HDLC	Bisync protocol	Bisync; SDLC; HDLC
Max. # of channels	16 channels max.	Infinite # of channels	Unlimited # of channels	256 channels max.	128 channels max.
Max. I/O rate/comm. rate	I/O: 180KB; comm: 38.4Kbps	I/O: 5MB; comm: 1Mbps	I/O: NG; comm: 1Mbps	I/O: 4MB; comm: 19.2Kbps	I/O: 1.6MB; comm. 2Mbps (SDLC)
I/O path width	I/O path width 16 bits	I/O path width 16 bits	I/O path width 18 bits	I/O path width 16 bits	I/O path width 16 bits
Direct memory access	500KB/sec DMA	2.8MB/sec DMA	2.5MB/sec DMA	4MB/sec DMA	1.6MB/sec DMA
Software					
Operating systems	RT-11; RSX-11S	RT-11; RSX-11M & 11S	RSX-11; IAS; RT11; RSTS/E	DM-2; CYTOS; TSO	Control I, II, III
Assemblers	2-pass papertape & macro	2-pass macroassembler	Macroassembler	1-/2-pass & macroassembler	1-pass macroassembler
Interpreters	BASIC; APL	BASIC; APL; FOCAL	BASIC Plus; APL; FOCAL	APL	BASIC
Compilers	FORTRAN IV	FORTRAN IV	FORTRAN IV; COBOL; RPG II	FORTRAN IV-G; COBOL; RPG II	FORTRAN; COBOL; Comfort
Applications software	No applications software	No applications software	RMS 11 DBMS; no applications software	DRS; IBM 1130 software	DBMS
Pricing	Sales primarily oem	Sales primarily oem	Sales primarily oem	Sales primarily end user	Sales 50% end user; 50% oem
Base price (single unit)	$1,995 (maint. $37/month)	$4,000 (maint. $120/month)	$10,310 (maint. $91/month)	$21,250 (maint. not given)	$3,285 (maint. not given)
Base price (quantity 100)	$1,297	$2,600	$6,702	—	$2,037
Typical system range	$1,995–$6,870	$15,000–$25,000	$10,310–$101,340	$50,000–$60,000	$1,800–$12,000
Lower price includes:	8KB memory (MOS); power supply, control panel	64KB memory, dual floppy, terminal, cabinet & software	Power supply, control panel, 16K words memory	—	Cpu, chassis, power supply, serial I/O port
Comments	Q-bus architecture; compatible with PDP-11 family	UNIBUS architecture; integral DMA; stacks; compatible with PDP-11 family	UNIBUS architecture; MOS/core memory; integral memory management; auto bootstrap loader; EIS; self-test	Compatible with IBM 1130 & 1800; CHI 2130; GA 18/30	Base price includes 16KB. Minicomputer architecture implemented in LSI

Manufacturer	General Automation	General Automation	General Robotics	GRI	Hewlett-Packard
Model Highlights	GA-16/460	GA-16/550	/X3 Series	9950	HP 1000 M, E & F series
Classification	Minicomputer	Minicomputer	Microcomputer (LSI-11)	Minicomputer	Minicomputer
1st shipped/# shipped	1975 1,500 shipped	1977 10 shipped	10/76 1,000 shipped	1976 150 shipped	Date & # shipped not given
Word size/cycle time	16-bit word/0.78usec cycle	32-bit word/0.2usec cycle	16-bit word/4.5usec cycle	16-bit word/1.76usec cycle	16-bit word/0.35usec cycle
Maj. applications	Industrial; banking; networks	Industrial, banking, networks	Business; industrial; laboratory	Control & business systems	Scientific; engineering
Processor					
Address/instruction	16-bit add./16-bit instr.	16-bit add./16-bit instr.	Not given	16-bit add./16, 32, 64 bits	15-bit add./16-bit instr.
Multiprecision word	Multiprec. via software	Multiprecision via software	Not given	32 bits multiprecision	48 bits multiprecision
Registers	8 index/16 gen. purpose	8 index/16 gen. purpose	16 gen. purpose	1 index/8 gen. purpose	2 index/2 accumulators
Register-register add	0.78usec add time	0.48usec add time	3.5usec add time	1.76usec add time	0.9usec add time
Other features	Microprogrammable; real-time clock; power fail restart; opt. decimal arith. & floating-pt. hardware	Microprogrammable; real-time clock; power fail restart; opt. decimal arith. & floating-pt. hardware	Microprogrammable; reloadable control store; floating-pt. hardware; real-time clock; power fail restart	Microprogrammable; reloadable control store; power fail restart; opt. real-time clock	Microprogrammable; opt. reloadable control store, real-time clock & power fail restart; sci. instructions
Memory	64KB-2MB RAM	128KB-2MB RAM: 1KB cache	0-60KB RAM, ROM, PROM, or core	16KB-64KB RAM	64KB-2MB RAM; control memory: 16K words RAM or ROM
Addressing	64K words direct address; 2MB indirect	64K words direct address; 2MB memory address- 4 maps	30K words direct address	32K words direct address; indirect	32K words direct address; 2MB hardware-firmware mgmt.
Other features	Byte parity; memory protect; 22-bit error correction; byte addressing	Byte parity; memory protect; 22-bit error correction; bit/byte addressing	Bit/byte addressing	Opt. parity	Parity; memory protect; bit/byte addressing; opt. error correction
I/O & Communications	Bisync; SDLC; HDLC	Bisync; SDLC; HDLC	Bisync; SDLC; HDLC	Bisync protocol	Bisync protocol
Max. # of channels	128 channels max.	128 channels max.	2 channels max.	144 channels max.	43 channels max.
Max. I/O rate/comm. rate	I/O: 2.2MB; comm: 2MB (SDLC)	I/O: 8MB; comm: 2MB (SDLC)	I/O: 500KB; comm: 50Kbps	I/O: 568KB; comm: 9600bps	I/O: 2MB; comm: 2.5Mbps
I/O path width	I/O path width 16 bits	I/O path width 16 bits	I/O path width 16 bits	I/O path width 16 bits	I/O path width 16 bits
Direct memory access	2.2MB/sec DMA	2MB/sec DMA	500KB/sec DMA	1.1MB/sec DMA	2MB/sec DMA
Software					
Operating systems	Control I, II, III, IV	Control I, II, III, IV	DEC's RT-11 or TSX	Multiuser OS-99; DOS; RTX	RTE; RTE-M, II & IV
Assemblers	1-pass macroassembler	1-pass macroassembler	Macroassembler	2-pass assembler	Microassembler
Interpreters	BASIC	BASIC	BASIC; APL	Floating-pt. interpreter	BASIC
Compilers	FORTRAN; COBOL; Comfort	FORTRAN IV; COBOL; Comfort	FORTRAN; PASCAL; ALGOL	RPG II	FORTRAN
Applications software	DBMS	DBMS	DBMS; commercial; laboratory; word processing	No applications software	RJE/1000; graphics; distributed proc.
Pricing	Sales primarily end user	Sales primarily end user	Sales 90% oem	Sales primarily oem	Sales 50% oem; 50% end user
Base price (single unit)	$11,000 (maint. $140/mo.)	$43,000 (maint. not given)	$4,250 (maint. not given)	$6,410 (maint. $257/month)	$7,425–$12,250 (Maint. $126/mo.)
Base price (quantity 100)	$6,820	$26,660	$2,760	—	$4,825–$7,960
Typical system range	$6,600–$50,000	$25,800–$200,000	$2,760–$35,000	From $32,600	$22,000–$80,000
Lower price includes:	64KB memory, chassis, power supply, console	256KB cpu w/ECC, 1K cache, chassis, console, power supply	60KB memory, serial async interface, real-time clock, bus terminator, bootstrap	16K word memory, disc, cabinet, terminal & printer	64KB cpu, RTE-M, console with dual minicartridge
Comments	Base price includes 64KB. Hypak memory technology	Base price includes 256KB. Multiprocessor architecture; Hypak memory technology	Q-bus architecture; 100% DEC 11/03 compatible; 6 models available	Base price includes 8K words. Dual bus architecture; compatible with GRI 909 & 99	Fully microprogrammable; separate memory & I/O busses; memory mgmt. floating-pt. processor on F

Manufacturer	Honeywell	Honeywell	Honeywell	IBM	ICL
Model Highlights	Level 6 Model 23	Level 6 Models 33 & 34	Level 6 Models 4X & 5X	Series/I	1501 Transaction System
Classification	Minicomputer	Minicomputer	Minicomputers	Minicomputer	Minicomputer
1st shipped/# shipped	02/78 new product	10/75 # shipped not given	10/76 # shipped not given	Date & # shipped not given	Date & # shipped not given
Word size/cycle time	16-bit word/1usec cycle	16-bit word/0.65usec cycle	16-or 32-bit word/0.55usec	16-bit word/800 or 660nsec	8-bit word/0.3usec cycle
Maj. applications	General purpose	General purpose	General purpose	Facilities control/power mgt.; data entry	
Processor					
Address/instruction	16-bit add./16, 32, 48 bits	16-bit add./16, 32, 48 bits	20 bits add./16, 32, 48 bits	16, 24 bits/16, 32, 48 bits	8-bit add./16-bit instr.
Multiprecision word	32 bit multiprecision	32 bits multiprecision	32 or 64 bits multiprec.	64 bits multiprecision	—
Registers	3 index/7gen. purp./7 add.	3 index/7 gen. purp./7 add.	3 index/7 gen. purp./7 add.	32 gen. purpose registers	7 index/1 accumulator
Register-register add	3usec add time	1.9usec add time	0.7-1usec add time	4.2usec or 1.1usec add	8usec add time
Other features	Opt. real-time clock & power fail restart	Opt. real-time clock & power fail restart	Opt. microprogrammable; control store; decimal arith.; floating-pt. hard.; real-time clock & restart	Two processors offered: 4953 & 4955; power fail restart; opt. floating-pt. hardware & real-time clock	Programmable power fail restart; opt. real-time clock
Memory	16KB-128KB RAM	16KB-128KB RAM	16KB-2MB RAM; 0-8KB cache	16KB-256KB RAM	8KB-32KB RAM; 2.5KB ROM
Addressing	32K words direct address	32K or 64K words dir; 19 address modes	1M words direct address; 19 address modes	32K words direct address; 16MB 1-level indirect	256K words direct address; indexed indirect
Other features	Parity; bit/byte addressing; opt. error correction	Parity; bit/byte addressing; opt. error correction	Parity; bit/byte addressing; opt. error correction & memory protect	Parity; memory protect; bit-byte addressing	Parity; bit/byte addressing
I/O & Communications				Bisync; SDLC; X.25	Bisync protocol
Max. # of channels	1,024 channels max.	1,024 channels max.	1,024 channels max.	1 channel	1 channel (up to 63 periphs)
Max. I/O rate/comm. rate	I/O: 1.8MB; comm: 9600bps	I/O: 6MB; comm: 72KB/chan.	I/O: 6MB; comm: 72KB/chan.	I/O: see DMA; comm: 56KB	I/O: 60KB; comm: 9600bps
I/O path width	I/O path width 8 or 16 bits	I/O path width 8 or 16 bits	I/O path width 8 or 16 bits	I/O path width 16 bits	I/O path width 8 bits
Direct memory access	1.8MB/sec DMA	6MB/sec DMA	6MB/sec DMA	1.33MB or 1.8MB DMA	250KB/sec DMA
Software					
Operating systems	GCOS; MOD 200 & 400	GCOS; MOD 200 or 400	GCOS; MOD 200, 400 or 600	Real-Time, Event-Driven	No operating system
Assemblers	2-pass assember	2-pass macroassembler	2-pass assembler	Macroassembler	2-pass assembler
Interpreters	—	—	—	Event-Driven Exec appli. lang.	—
Compilers	COBOL; FORTRAN; RPG	COBOL; FORTRAN; RPG	COBOL; FORTRAN; RPG	FORTRAN; PL/1; COBOL; S/370 cross-comp	COBOL; BTL; CDE
Applications software	Data entry; remote batch; file transfer	Data entry; remote batch; file transfer	Data entry; remote batch; file transfer	Facilities control/power mgmt.; data entry; RJE	DBM-2
Pricing	Sales primarily oem	Model 33 end user; 34 oem	Sales primarily end user	Sales primarily end user	Sales primarily end user
Base price (single unit)	$4,000 (maint. $52/month)	$4,450 (maint. $60/month)	$10,500 (maint. $114/month)	$4,360 (maint. $133/month)	$5,200 (maint. $45/month)
Base price (quantity 100)	$2,440	$3,900 (33) & $2,715 (34)	$6,405	same as above	$4,420
Typical system range	$14,000–$30,000	Model 33 single-unit price	$10,405–$47,150	$12,500–$100,000	$5,000–$15,000
Lower price includes:	16K memory	$6,400 (maint. $67/month)		32KB cpu, console, cabinet, crt, diskette	Crt, dual cartridges, 8K cpu
Comments	Base price includes 16K words. Single bus architecture; multiple registers	Base price includes 8K words. Single bus architecture; multiple registers.	Base price includes 16K words. Single bus architecture; multiple registers.	Basic single unit price for 4955 processor is $6,165 Base price includes 16KB.	Facilities for processor-to-processor communications using SQUIC

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Manufacturer	IMSAI	Intel	Lockheed Electronics	Modular Computer	National Semiconductor
Model Highlights	8080	Series II	SUE 1110, 11 & 12	Classic 7860 series	RMC 80/10
Classification	Microcomputer (8080A)	Microcomputer (8080)	Minicomputer	Minicomputer	Microcomputer (8080A)
1st shipped/# shipped	06/76 # shipped not given	03/78 # shipped not given	10/72 2,600 shipped	Date & # shipped not given	Date & # shipped not given
Word size/cycle time	8-bit word/500nsec cycle	8-bit word/450nsec cycle	16-bit word/0.6usec cycle	16-bit word/500nsec cycle	8-bit word/450nsec cycle
Maj. applications	Hobbyist; small business	Microprocessor development	COM; ATM; small business	Measurement & control	Oem applications
Processor					
Address/instruction	16-bit add./8-bit instr.	16-bit add./8, 16, 24 bits	18-bit add./16-bit instr.	21-bit add/16-bit instr.	16-bit add/8,16,24 bits
Multiprecision word	16 bits multiprecision	16 bits multiprecision	32 bits multiprecision	64 bits multiprecision	16 bits multiprecision
Registers	7 gen. purpose	8 gen. purpose	7 index/8 gen. purpose	240 gen. purpose	9 gen. purpose
Register-register add	1usec add time	2usec add time	2.85usec add time	200usec add time	3usec add time
Other features	Decimal arith.; opt. real-time clock	Decimal arith.; real-time clock; opt. floating-pt. hardware	Microprogrammable; decimal arith.; real-time clock; power fail restart	Microprogrammable; reloadable control store; decimal arith.; floating-pt; hardware; real-time clock; power fail restart	
Memory	4KB-64KB RAM; 4KB ROM or PROM available	32KB-64KB RAM; 4KB-24KB ROM	32KB-256KB RAM; 8KB-32KB core	128KB-4.0MB RAM	1KB RAM; 4KB ROM; 4KB PROM
Addressing	65,536 words direct address	64K words direct address	32K words direct address; 128K words indirect	128KB direct address; indexed, nonindexed indir.	5KB direct address; double register pair indirect
Other features	Bit/byte addressing		Byte/word addressing; opt. parity	Parity; memory protect; error correction; bit/byte addressing	
I/O & Communications			Bisync protocol	SDLC; HDLC protocols	
Max. # of channels	256 channels max.	512 channels max.	2,048 channels max.	4 channels in each bus	512 channels max.
Max. I/O rate/comm. rate	I/O rate: 100KB; comm: 56Kbps	I/O: 500KB; comm: NG	I/O: 1.1MB; comm: 9600bps	I/O: 8MB; comm: 50Kbps	I/O 200KB; comm: 38.4Kbps (sync)
I/O path width	I/O path width 8 bits	I/O path width 8 bits	I/O path width 16 bits	I/O path width 16 bits	I/O path width 8 bits
Direct memory access	1MB/sec DMA	500KB/sec DMA	2.5MB/sec DMA	8MB/sec DMA	No DMA
Software					
Operating systems	IMDOS (multidisc OS)	ISIS-II	Multitasking	MAX II & III; MAXNET III & IV	No operating system
Assemblers	8080/8085 & relocatable	Macroassembler	1-pass assembler	M5A macroassembler	No assembler
Interpreters	2 levels of extended BASIC	—	—	BASIC	BASIC
Compilers	BASIC; FORTRAN IV	PLM; FORTRAN ANS 1977	RPG-II; COBOL; FORTRAN	FORTRAN; COBOL	UES hosted on PACE DOS
Applications software	No applications software	No applications software	File management	File management; TOTAL DBMS	No applications software
Pricing	Sales primarily end user	Sales primarily end user	Sales primarily oem	Sales primarily end user	Sales primarily oem
Base price (single unit)	$1,120 (maint. not given)	$3,600 (maint. not given)	$10,780 (maint. not given)	$37,000 (maint. $240/month)	$1,345 (maint. not given)
Base price (quantity 100)	—	—	—	—	—
Typical system range	$1,000–$2,000	Other models $8,490 & $13,950	$5,000–$10,000	$50,000–$100,000	—
Lower price includes:	16K RAM & M I/O board	Integrated crt, card cage, floppy disc in single chassis	32KB memory, power supply, parallel & serial I/O controllers, autoload	128K memory, power supply, control, floating-pt. hardware, 15 gp registers, memory mapping	—
Comments	Table top or rack mount; offered as kit or assembled	Intel multibus architecture	Infibus structure, multiprocessor, separate bus controller	Base price includes 128KB. Concurrent memory pass & pipeline execution; compatible with MODCOMP II & IV	Multibus architecture; compatible with Intel System 80

Manufacturer	National Semiconductor	National Semiconductor	Perkin-Elmer	Perkin-Elmer	Perkin-Elmer
Model Highlights	RMC 80/14	RMC 80/204	Interdata 5/16	Interdata 6/16	Interdata 7/32
Classification	Microcomputer (8080A)	Microcomputer (chip not given)	Minicomputer	Minicomputer	Minicomputer
1st shipped/# shipped	Date & # shipped not given	Date & # shipped not given	04/77 # shipped not given	04/76 # shipped not given	07/74 # shipped not given
Word size/cycle time	8-bit word/450nsec cycle	8-bit word/450nsec cycle	16-bit word/0.6usec cycle	16-bit word/0.1usec (core)	32-bit word/.750usec
Maj. applications	Oem applications	Oem applications	Industrial automation	Industrial automation	Scientific, commercial
Processor					
Address/instruction	16-bit add./8,16,24 bits	16-bit add./8,16,24 bits	16-bit address/16,32 bits	16-bit address/16,32 bits	32-bit address/16,32,48 bits
Multiprecision word	16 bits multiprecision	16 bits multiprecision	32,64 bits multiprecision	32,64 bits multiprecision	64 bits multiprecision
Registers	9 gen. purpose	9 gen. purpose	15 index/16 gen. purpose	15 index/16 gen purpose	30 index/32 gen. purpose
Register-register add	3usec add time	2.7usec add time	1.2usec add time	0.1usec core; 0.9usec MOS	1usec add time
Other features			Opt. real-time clock	Microprogrammable; opt. real-time clock & power fail restart	Opt. floating-pt. hardware, real-time clock, & power fail restart
Memory	4KB RAM; 4KB ROM; 4KB or 8KB PROM	4KB RAM; 8KB ROM; 8KB PROM	8KB–64KB RAM; 2KB–48KB ROM	8KB–64KB core; 8KB–64KB MOS	64KB–1MB core
Addressing	5KB direct address; double register pairs indirect	12KB direct address; register pair indirect	32K words dir. address. indexed reg. & short-format	32K words dir. addressing; indexed & short-format	256K words direct addressing
Other features			Bit/byte addressing	Bit/byte addressing; opt. parity	Parity; memory protect; bit/byte addressing; shared memory
I/O & Communications			Bisync protocol	Bisync protocol	SDLC; bisync; HDLC
Max. # of channels	512 channels max.	512 channels max.	255 channels max.	255 channels max.	7 channels max.
Max. I/O rate/comm. rate	I/O: NG; comm: 38.4Kbps (sync)	I/O: 300KB; comm: 38.4Kbps (sync)	I/O: 59.5KB; comm: 9600bps	I/O: 83.3K (core); comm: 50.2Kbps	I/O: 360KB; comm: 9600bps
I/O path width	I/O path width 8 bits	I/O path width 8 bits	I/O path width 8 or 16 bits	I/O path width 8 or 16 bits	I/O path width 16 bits
Direct memory access	No DMA	No DMA	256KB/sec DMA	2MB/sec DMA	2MB/sec DMA
Software					
Operating systems	No operating system	No operating system	OS/16MT2	OS/16MT2	Dynamic OS/32MT; OS/32MTM
Assemblers	No assembler	No assembler	1-pass & macro preprocessor	1-pass & macro preprocessor	1-pass & macro preprocessor
Interpreters	BASIC	BASIC	BASIC II	BASIC II	BASIC II
Compilers	Compiler hosted on PACE DOS	Compiler hosted on PACE DOS	Extended FORTRAN IV	Extended FORTRAN IV	FORTRAN VI; FORTRAN VII
Applications software	No applications software	No applications software	No applications software	No applications software	ISAM DBMS; no applications software
Pricing	Sales primarily oem	Sales primarily oem	Sales primarily oem	Sales primarily oem	Sales primarily end user
Base price (single unit)	$1,495 (maint. not given)	$1,645 (maint. not given)	$2,100 (maint. not given)	$2,400 (maint. not given)	$11,659 (maint. not given)
Base price (quantity 100)	—	—	38% discount	38% discount	38% discount
Typical system range	—	—	$3,000–$5,000	$5,000–$12,000	$25,000–$75,000
Lower price includes:	—	—	Add'l. memory, serial I/O port, bootstrap loader	Add'l. memory, serial I/O port, bootstrap loader	Add'l, memory, crt, card reader, disc
Comments	Multibus architecture	Multibus architecture	IBM-like instruction set; dual I/O bus structure; compatible with other Interdata 16-bit machines.	Dual I/O busses; 4 DMA channels; IBM-like instruction set; compatible with other Interdata 16-bit machines	32-bit structure; shared memory; compatible with Interdata 8/32

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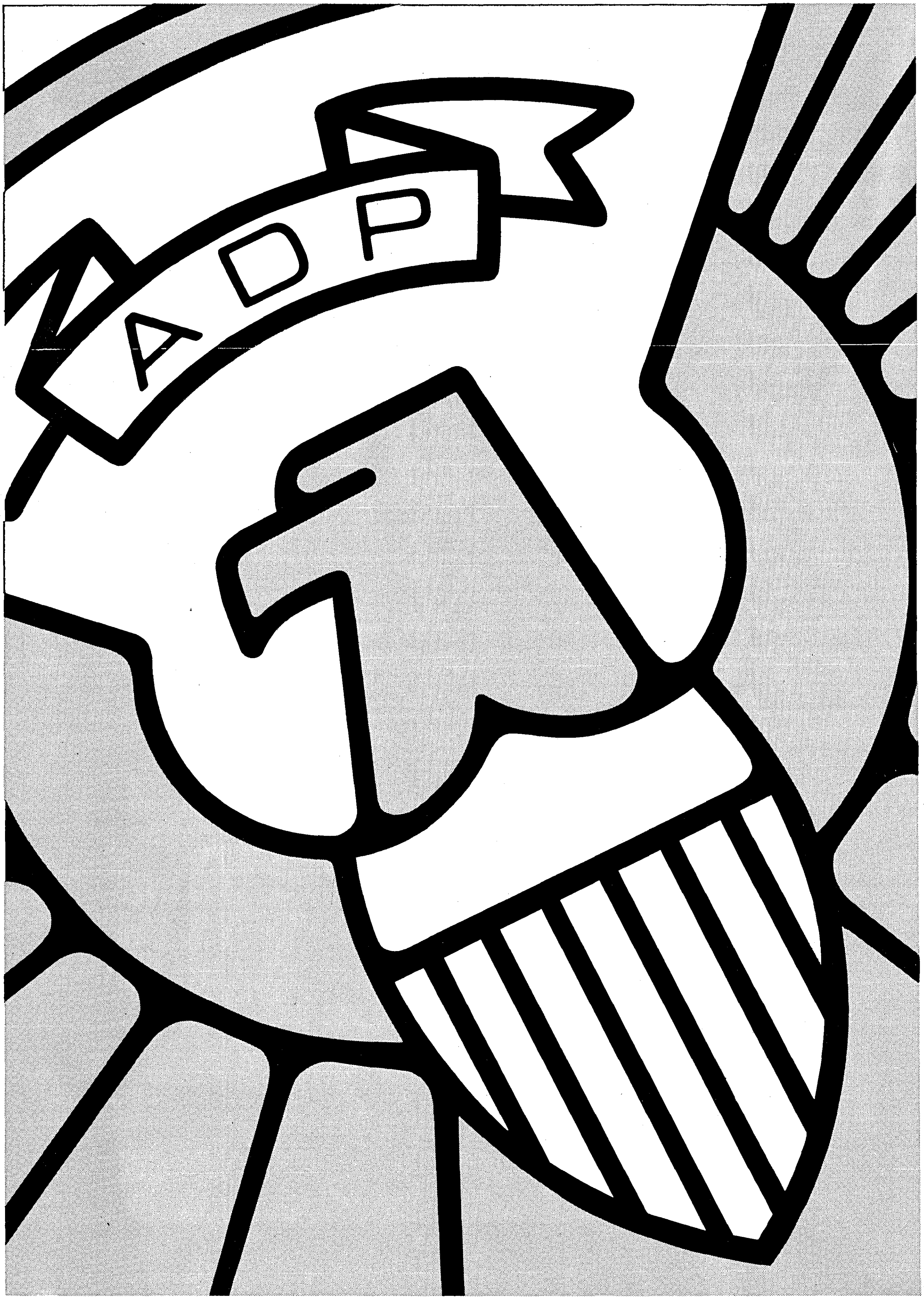
Manufacturer	Perkin-Elmer	Pertec Microsystems Div.	Plessey Peripheral Systems	Plessey	Polymorphic Systems
Model Highlights	Interdata 8/16E	MITS/Altair 8800	Micro-1	PM-1150/5RP	System 8813/8810
Classification	Minicomputer	Microcomputer (8080A)	Microcomputer (LSI-11)	Minicomputer	Microcomputer (8080A)
1st shipped/# shipped	11/77 # shipped not given	1975 # shipped not given	06/77 200 shipped	16-bit word/0.55usec cycle	09/77 500 shipped
Word size/cycle time	16-bit word/.750usec cycle	8-bit word/450nsec cycle	16-bit word/500nsec cycle	12/76 100 shipped	8-bit word/350nsec cycle
Maj. applications	Scientific, industrial automation, business	Small business; personal computing	Small business; data base; industrial control	Ruggedized environment	—
Processor					
Address/instruction	16-bit address/16,32 bits	8, 16, 24 bits/16 bits instr.	16-bit add./16 bit instr.	18-bit add./16-bit instr.	16-bit address/8-bit instr.
Multiprecision word	32, 64 bits multiprecision	64 bits multiprecision	—	—	16 bits multiprecision
Registers	15 index/16 gen. purpose	9 gen. purpose registers	8 gen. purpose	8 gen. purpose	8 gen. purpose registers
Register-register add	0.75usec add time	2usec add time	3.5usec add time	0.3usec add time	Add time not given
Other features	Microprogrammable; power fail restart; opt. floating-pt. hardware & real-time clock	Real-time clock	Real-time clock; power fail restart; opt. microprogrammable & reloadable control store	Floating-pt. hardware; power fail restart; opt. real-time clock	Decimal arith.; floating-pt. hardware; real-time clock
Memory	32KB-256KB core	16KB-64KB RAM; 2KB PROM available	8KB-64KB RAM	32KB-256KB RAM	16KB-64KB RAM
Addressing	32K words dir. addressing; indir. thru memory mgmt.	64K words direct address	32K words direct address; auto, reg. & indexed indir.	128K words direct address; reg., auto, index deferred indir.	—
Other features	Integral memory management; 256KB memory expansion	Byte addressing	Byte addressing; I/O page address (29K, 30K or 31K words)	Bit/byte addressing; opt. parity	—
I/O & Communications	Bisync protocol				
Max. # of channels	255 channels max.	256 channels max.	4,096 channels max.	4,096 channels max.	# of channels not given
Max. I/O rate/comm. rate	I/O: 90.9KB; comm: 50.2Kbps	I/O: NG; comm: 9600	I/O: 33KB; comm: 19.2Kbps	I/O: NG; comm: 9600bps	I/O rate NG; 19,200bps
I/O path width	I/O path width 16 bits	I/O path width 8 bits	I/O path width 16 bits	I/O path width 16 bits	I/O path width 8 bits
Direct memory access	2.67MB/sec DMA	No DMA	833KB/sec DMA	—	—
Software					
Operating systems	OS/16MT2	—	DEC RT-11; RSX-11; DBL/TSX	RT-11; RXS-11; RSTS-E	System 88 DOS
Assemblers	1-pass & macro preprocessor	1-pass assembler	Macroassembler	Macroassembler	2-pass assembler
Interpreters	BASIC II	BASIC	DEC BASIC	DEC BASIC	BASIC
Compilers	Extended FORTRAN IV	FORTRAN IV	DEC FORTRAN	DEC FORTRAN; RPG; COBOL	—
Applications software	No applications software	General business & word processing packages	DBMS	DBMS	System 88 DIO; text editing
Pricing	Sales primarily oem	Sales primarily thru dealers	Sales primarily oem	Sales primarily oem	Sales primarily thru dealers
Base price (single unit)	$9,300 (maint. not given)	$1,990 (maint. not given)	$4,665 (maint. $60/month)	$22,400 (maint. $200/month)	$2,795 (maint. not given)
Base price (quantity 100)	38% discount	—	$3,125	$14,560	$1,872.65 (quantity 50)
Typical system range	$20,000-$40,000	—	—	—	$3,900-$5,000
Lower price includes:	Add'l. memory, crt, 2 discs	power supply, control panel, & 16 KB RAM	—	32KB core in 10.5 inch chassis	32K system with two drives
Comments	Base price includes 16K words. List processing instructions; dual I/O busses; IBM-like instructions	S-100 bus architecture	Base price includes 64KB. Hardware EIS/FIS; vectored interrupts; compatible with DEC PDP-11/40	Stack processing; 4-line multilevel priority interrupt & vector interrupts; compatible with DEC PDP-11/34	

Manufacturer	Prime Computer	Prime Computer	Raytheon	SEL	Sperry Univac
Model Highlights	Prime 300	Prime 350	RDS-5000 & Apollo	32 Series	V77-200
Classification	Minicomputer	Minicomputer	Minicomputer	Minicomputer	Minicomputer
1st shipped/# shipped	1973 # shipped not given	1978 new product	1974 new product	1978 new product	01/77 550 shipped
Word size/cycle time	16-bit word/760nsec cycle	16-bit word/760nsec cycle	16-bit word/0.7usec cycle	32-bit word/0.9usec cycle	16-bit word/0.66usec cycle
Maj. applications	Time-sharing; business	Time-sharing; business	Communications & scientific	—	Dp satellites & controller
Processor					
Address/instruction	16-bit add./16-bit instr.	16, 28 bits/16, 32, 48 bits	12, 16 bits add./16 bits	19, 24 bits add./16, 32 bits	15-bit add./16, 32 bits
Multiprecision word	32 bits multiprecision	64 bits multiprecision	32 bits multiprecision	64 bits multiprecision	32 bits multiprecision
Registers	1 index register	2 index registers	8 gen. purpose registers	3 index/8 gen. purpose	7 index/8 gen. purpose
Register-register add	Not applicable	—	1.4usec add time	0.9 usec add time	0.825usec add time
Other features	Real-time clock; power fail restart; opt. microprogrammable, reloadable control store & floating-pt. hardware	Floating-pt. hardware; real-time clock; power fail restart; opt. microprogrammable & reloadable control store	Microprogrammable; reloadable control store; floating-pt. hardware; opt. real-time clock & power fail restart	Floating-pt. hardware; power fail restart; opt. microprogrammable & real-time clock	Real-time clock; opt. power fail restart
Memory	64KB-512KB RAM; 3KB-6KB PROM	64KB-512KB RAM; 128KB PROM; 2KB cache	32KB-1MB RAM; 6KB PROM	128KB-16MB MOS; 16KB-32KB writable control store	16KB-64KB RAM
Addressing	Virtual memory via paging to 128KB	Virtual memory via paging to 2MB per user	32K words direct address	512KB dir. addressing; multilevel indir.	32K words direct address; 32K words indirect
Other features	Parity; memory protect; bit/byte addressing	Parity; memory protect; bit/byte addressing	Parity; memory, protect; error correction; bit/byte addressing; array processing	Error check & correct; memory protect; halfword/word/doubleword addressing	Byte addressing; opt. parity
I/O & Communications	Bisync; ASCII protocols	Bisync; ASCII protocols	Handles all protocols		Bisync; SDLC; UDLC
Max. # of channels	8 DMA channels	8 DMA channels	2 channels max.	16 channels max.	32 channels max.
Max. I/O rate/comm. rate	I/O: 2.5MB; comm: 56Kbps	I/O: 2.5MB; comm: 56Kbps	I/O: NG; comm: 3.2Mbps	I/O: 26.6MB; comm: 40Kbps	I/O: 600KB; comm: 20Kbps
I/O path width	I/O path width 16 bits	I/O path width 16 bits	I/O path width 16 bits	I/O path width 32 bits	I/O path width 16 bits
Direct memory access	2.5MB/sec DMA	2.5MB/sec DMA	4MB/sec DMA	4.44MB/sec DMA	600KB/sec DMA
Software					
Operating systems	PRIMOS III, multiuser	PRIMOS IV multiuser	Multiprog.; multiproc.; comm	Mod. Real-Time Monitor	VORTEX I
Assemblers	Macro & microassembler	Macro & microassembler	2-pass macroassembler	Macro assembler	DASMR; macroassembler
Interpreters	BASIC	BASIC	—	BASIC	RPG-II
Compilers	BASIC/VM; FORTRAN; COBOL;	BASIC/VM; FORTRAN; COBOL	FORTRAN	COBOL; FORTRAN IV	FORTRAN IV
Applications software	MIDAS (ISAM); DBMS; emulation packages	DBMS; MIDAS (ISAM); emulation packages	Communications	No applications software	No applications software
Pricing	Sales primarily end user	Sales primiarily end user	Sales primarily end user	Sales primiarily oem	Sales primarily oem
Base price (single unit)	$21,500 (maint. $214/month)	$35,000 (maint. $265/month)	$15,000 (maint. $250/month)	$27,300 (maint. $240/month)	$5,350 (maint. $100/month)
Base price (quantity 100)	—	—	$9,000	$20,475	$3,477
Typical system range	$50,000-$100,000	$100,000-$150,000	$30,00-$250,000	$43,300-$104,700	$10,000-$20,000
Lower price includes:	128KB cpu, cartridge, console, AMLC, OS, FORTRAN & BASIC	192KB cpu, disc, tape, AMLC, printer, FORTRAN & BASIC	Cpu, disc, terminal	128KB cpu, disc, hardcopy console, RTM, macro assembler	32KB cpu, 8 lines & VORTEX I
Comments	Base price includes 64KB. Virtual memory; hardware memory mgmt.; multiuser; multiprogramming.	Base price includes 64KB. Large virtual memory system; reentrant & sharable procedures; hardware memory mgmt.	Multiprocessing system	Base price includes 256KB. Central bus structure with overlapped memory synch. on 150usec clock	Single-board cpu; multiplexor I/O bus lines; compatible with V77-400 & V77-600


ADP

Manufacturer	**Sperry Univac**	**Sperry Univac**	**Texas Instruments**	**Texas Instruments**	**Texas Instruments**
Model Highlights	V77-400	V77-600	960B	980B	990/4
Classification	Minicomputer	Minicomputer	Minicomputer	Minicomputer	Microcomputer (TMS 9900)
1st shipped/# shipped	12/76 450 shipped	03/77 500 shipped	05/74 # shipped not given	05/74 # shipped not given	03/76 # shipped not given
Word size/cycle time	16-bit word/0.66usec cycle	16-bit word/0.66usec cycle	16-bit word/0.75usec cycle	16-bit word/0.75usec cycle	16-bit word/0.67usec cycle
Maj. applications	Communications & dp	Commercial dp; communications & scientific applications			
Processor					
Address/instruction	15-bit add./16, 32 bits	15-bit add./16, 32 bits	16-bit add./32-bit instr.	16-bit add./16, 32, 48 bits	15-bit add./16, 32, 48 bits
Multiprecision word	32 bits multiprecision	32 bits multiprecision	32 bits multiprecision	32 bits multiprecision	—
Registers	7 index/8 gen. purpose	7 index/8 gen. purpose	8 index/8 gen. purpose	1 index register	16 gen. purpose
Registers-register add	1.1usec add time	0.43usec add time	3.6usec add time	1.75usec add time	4.7usec add time
Other features	Real-time clock; power fail restart; opt. microprogrammable & reloadable control store	Real-time clock; power fail restart; opt. microprogrammable, reloadable control store & floating-pt. hardware	Power fail restart; opt. real-time clock	Power fail restart; opt. real-time clock	Real-time clock
Memory	32KB–2MB RAM	32KB–2MB RAM; 2KB cache	16KB–128KB RAM	16KB–128KB RAM	8KB–64KB RAM; 0.5KB–1KB ROM; 0.5KB–31.5KB PROM
Addressing	32K words direct address; indir. via mega map to 1M word	32K words direct address; 1M words indir. via mega map	64K words direct address; indirect	64K words direct address; 1-level indirect	32K words direct address
Other features	Memory protect; byte addressing; opt. parity	Memory protect; byte addressing; opt. parity	Memory protect; error correction; bit/byte addressing	Memory protect; error correction; bit/byte addressing	Bit addressing; opt. parity & memory protect
I/O & Communications	Bisync; SDLC; UDLC	Bisync; SDLC; UDLC			Bisync protocol
Max. # of channels	32 channels max.	32 channels max.	8 channels max.	8 channels max.	256 channels max.
Max. I/O rate/comm. rate	I/O: 3MB; comm: 20Kbps	I/O: 6MB; comm: 20Kbps	I/O: 2MB; comm: 9600bps	I/O: 2MB; comm: 9600bps	I/O: NG; comm: 9600bps
I/O path width	I/O path width 16 bits	I/O path width 16 bits	I/O path width 16 bits	I/O path width 16 bits	I/O path width 16 bits
Direct memory access	600KB/sec DMA	3KB/sec DMA	2MB/sec DMA	2MB/sec DMA	3MB/sec DMA
Software					
Operating systems	VORTEX I	VORTEX II	PAM; PAM/D (disc OS)	DX980; Basic OS; Disc OS	TXDS
Assemblers	DASMR; macroassembler	DASMR; macroassembler	2-pass assembler	2-pass assembler	2-pass assembler
Interpreters	RPG-II; BASIC; COBOL	RPG-II; BASIC; COBOL	No interpreters	BASIC	—
Compilers	FORTRAN IV	FORTRAN IV	Transaction language; COBOL via DXS	FORTRAN	FORTRAN
Applications software	TOTAL DBMS; no applications software	TOTAL DBMS; no applications software	DXS	No applications software	—
Pricing	Sales primarily oem	Sales primarily end user	Sales primarily oem	Sales primarily oem	Sales primarily oem
Base price (single unit)	$7,850 (maint. $350/month)	$9,050 (maint. $800/month)	$4,500 (maint. $75/month)	$5,150 (maint. $95/month)	$1,925 (maint. $41/month)
Base price (quantity 100)	$5,102	$6,516	$3,600	$4,120	$1,193.50
Typical system range	$40,000–$80,000	$80,000–$150,000	—	—	—
Lower price includes:	32K word cpu, disc, 8 lines, mag tape & crt	64K word cpu, disc, printer, crt, 8 lines, mag tape	Power supply, control panel, 16KB memory & max. discount	Power supply, control panel, 16KB memory & max. discount	Power supply, control panel, 4K memory & max. discount
Comments	Base price includes 16KB. 3MB bus & shared memory modules; compatible with V77-200 & V77-600	Base price includes 32KB. Dual-ported memory; multiplexor I/O bus lines; shared memory.	Two operating modes; parallel operation; pre- & post-indexing; compatible with TI 960 & 960/A	Parallel operation; compatible with TI 980A	Processor controlled CRU (bit addressable); compatible with TI 890/10

Manufacturer	**Texas Instruments**	**Westinghouse Electric**
Model Highlights	990/10	W-2500
Classification	Minicomputer	Minicomputer
1st shipped/# shipped	03/76 # shipped not given	1972 over 1,000 shipped
Word size/cycle time	16-bit word/0.65usec cycle	16-bit word/850nsec cycle
Maj. applications		Utilities; metals; process control
Processor		
Address/instruction	Add. NG/16, 32, 48 bits	8-bit add./5-bit instr.
Multiprecision word	—	32 bits multiprecision
Registers	16 gen. purpose	2 index/13 gen. purpose
Register-register add	3.6usec add time	1.8usec add time
Other features	Real-time clock; power fail restart	Floating-pt. hardware; opt. real-time clock & power fail restart
Memory	16KB–2MB RAM; 0.5KB–1KB ROM; 2KB–2MB PROM	16KB–2MB RAM
Addressing	32K words direct address; mapping regs. to 1M words	256K words direct address; relative, base rel. indir.
Other features	Parity; bit/byte addressing; opt. error correction	Parity; opt. memory protect
I/O & Communications	Bisync protocol	
Max. # of channels	256 channels max.	125 channels max.
Max. I/O rate/comm. rate	I/O: NG; comm: 9600bps	I/O: 1.6MB; comm: 9600bps
I/O path width	I/O path width 16 bits	I/O path width 16 bits
Direct memory access	—	1.6MB/sec DMA
Software		
Operating systems	DX10	RTX-6
Assemblers	Macroassembler	2-pass & macroassembler
Interpreters	—	BASIC
Compilers	FORTRAN; COBOL; PASCAL	FORTRAN; RPG
Applications software	—	File management; energy; numerical control
Pricing	Sales primarily oem	Sales primarily end user
Base price (single unit)	$3,400 (maint. $57/month)	$8,500 (maint. $140/month)
Base price (quantity 100)	$2,108	—
Typical system range	—	$20,000–$100,000
Lower price includes:	Power supply, control panel, 8KB memory & max. discount	32KB cpu, ASR 33, card reader, process I/O
Comments	Processor controlled CRU (bit addressable) & high-speed TILINE for memory & peripherals; compatible with TI 990/4	Base price includes 8K.

FOR RENT NOW...

Hewlett-Packard's new, easy-to-use 1640A Serial Data Analyzer that simplifies analysis of your computer network by identifying and locating failures all the way down to the component level.

You don't have to be a programmer to use the new HP 1640A, nor learn instruction sets, nor write and debug programs. All you have to be is someone who wants to monitor a RS232C (V24) interface, measure time intervals, or simulate a network component.

The new Serial Data Analyzer is very easy-to-use, even for a semi-skilled operator. It comes with mylar overlays—pre-labeled for your application—which cut down on the time required to set-up and minimize the chance of errors. Your operator will enjoy the menu set-up concept with its keyboard parameter entry, pre-programmed measurement execution and transparent "wake-up" mode. The operator can quickly identify and isolate problems to the network component level, and flexible triggering allows the trapping of data errors, time-interval violations or invalid protocol sequences. Most problems may be located in a non-intrusive "monitor" mode, but the amazing new 1640A also simulates the CPU, terminal or modem to handle subtle problems or conduct loop-back tests. Plus, the new instrument can be operated with any combination of transmission modes—Simplex, Half Duplex or Full Duplex; 2-wire or 4-wire links; synchronous or asynchronous operation; and up to 9600 bps (19200 HDX) data rates.

Whether you're integrating a minicomputer with a few terminals or analyzing a complex, centralized CPU-based communication network, the low-cost 1640A will solve your problem while reducing system debugging time.

You can use the 1640A to locate problematical problems in your computer network before they cause a network failure. And you'll enjoy the real-time display of FDX data in ASCII, EBCDIC or Hex. Trigger specifications are continuously displayed, and measurement results are clearly displayed as well. Up to 480 characters may be displayed on the large screen. It's very easy to see exactly what's happening in your system. 1640A memory includes 2048 characters of monitor buffer and 1024 characters of transmit message buffer. Error checking is provided at odd, even or no parity. The lightweight (25 pound) 1640A Serial Data Analyzer from HP is on-the-shelf at Rental Electronics now. It's For Rent . . . for you.

More than 12,871 state-of-the-art instruments . . . off-the-shelf, throughout North America.

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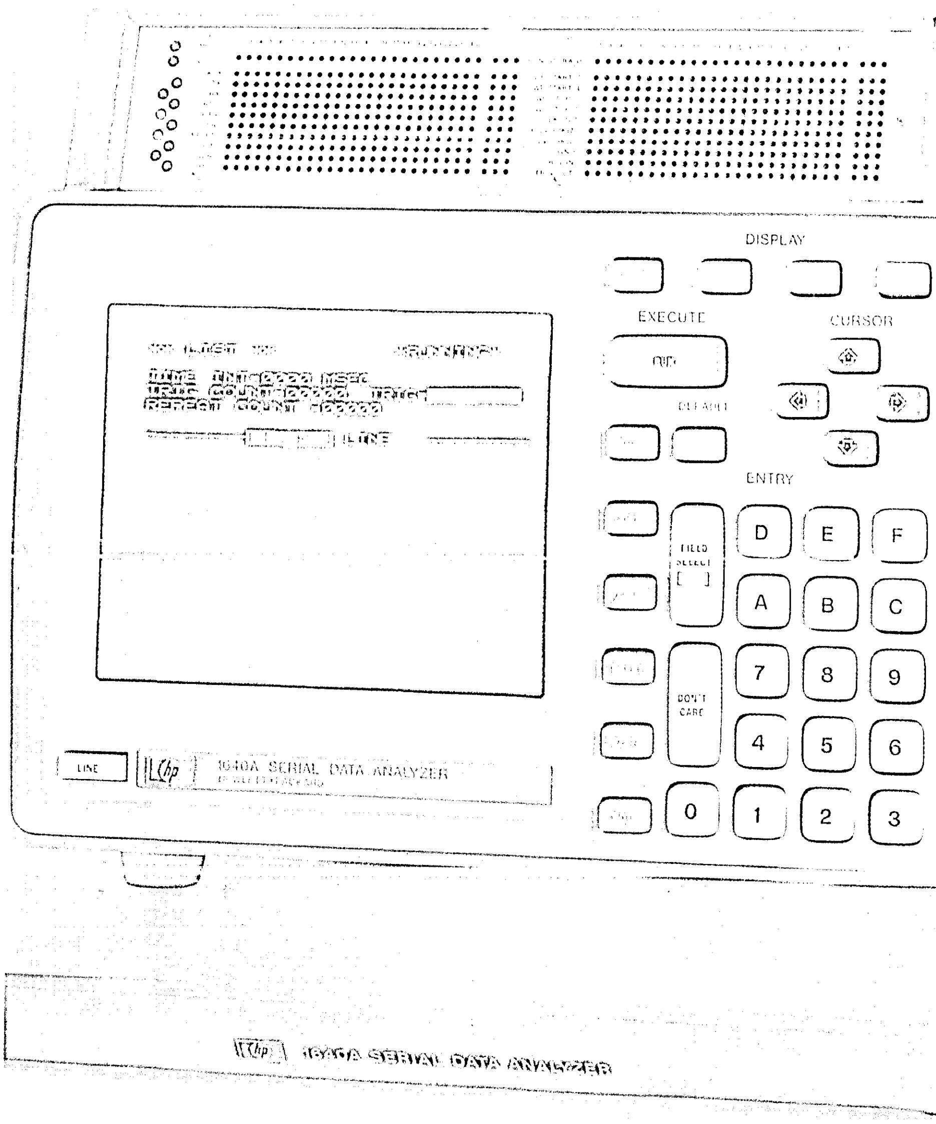

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Oakland, NJ (201) 337-3757
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Houston, TX (713) 780-7218
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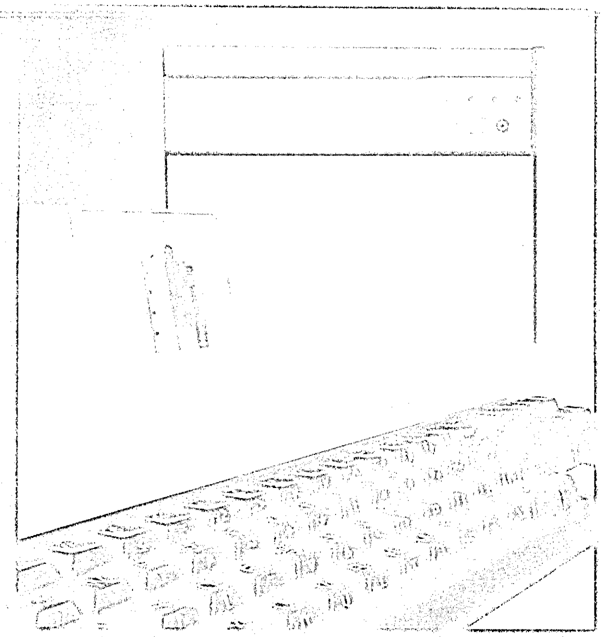
CIRCLE 82 ON READER CARD

Introducing DECSYSTEM-2020 full-function APL.



In the world's lowest cost mainframe APL system.

It took the world's lowest cost mainframe to configure the world's lowest cost full-function APL package.

The new DECSYSTEM-2020 APL System.

Just $199,500.

Based on a five year system life, that works out to less than half the cost of outside APL services.

And compared with other systems offering a similar level of APL functionality, the new DECSYSTEM-2020 package comes in, incredibly, at about *one-fourth* their cost.

For $199,500, here's what you get:

- DECSYSTEM-2020 Mainframe CPU;
- 4 APL Terminals with Full APL Character Set;
- Complete APL Software;
- TOPS-20 Virtual Memory Operating System;
- One Megabyte of Main Memory;
- 67 Megabyte Disk Drive;
- High Speed Tape Drive.

With the DECSYSTEM-2020, you really do get full-function APL. The same APL that runs on our largest DECSYSTEM-2060 mainframe, recognized as being among the best in the industry. It comes complete with features like an extended file system, divide-quad functions, error analysis and recovery, and dyadic format function.

You also get all the features and benefits that are making the DECSYSTEM-2020 one of the hottest mainframes to hit the market in years.

All Digital mainframe systems are now available to qualified OEMs.

Things like surprising ease of use, thanks to its fully developed interactive mainframe software, comprehensive system utilities, and specially designed architecture. And unmatched ease of upgrading that allows you to move up through the entire DECSYSTEM-20 family of mainframes without ever giving up your investment in software.

The new DECSYSTEM-2020 APL System.

For DP Managers, the world's lowest cost.

For APL users, everything they want, in their very own mainframe.

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A-8-8

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Telephone ______

Send to: Digital Equipment Corporation, MR1/M-49, 200 Forest St., Marlboro, MA 01752. Tel. 617-481-9511, ext. 6885.

MINI AND MICROCOMPUTER VENDOR INDEX

For additional information regarding the products listed in this survey, please contact the vendors directly, either at the addresses shown or by circling the appropriate number on the reader service card bound into this issue.

Altos Computer Systems, Inc.
2378B Walsh Ave., Santa Clara, CA 95050
Established 1977; 15 employees
Gross sales $1 million
Dr. Roger Vass, vp mktg. (408)244-5766
CIRCLE 455 ON READER CARD

Applied Data Communications
1509 E. McFadden Ave., Santa Ana, CA 92705
Date est. not given; 23 employees
Gross sales $1.5 million
P. Marc Covert, vp mktg. (714)547-6954
CIRCLE 456 ON READER CARD

Applied Systems Corp.
26401 Harper Ave., St. Clair Shores, MI 48081
Established 1967; # of employees not given
Gross sales not given
Marty Wyrod, manager (313)779-8700
CIRCLE 457 ON READER CARD

Century Computer Corp.
4410 Spring Valley Rd., Dallas, TX 75240
Established 1969; 52 employees
Gross sales $3–$5 million
Raymond Kramer, president (214) 233-3238
CIRCLE 458 ON READER CARD

Computer Automation, Inc.
18651 Von Karman, Irvine, CA 92713
Established 1967; 1,000 employees
Gross sales $43 million
Sel Handler, mgr. mktg. comm. (714)833-8830
CIRCLE 459 ON READER CARD

Computer Hardware, Inc.
4111 N. Freeway Blvd., Sacramento, CA 95834
Subsidiary of Jackson Drop Forge
Established 1969; 100 employees
Gross sales $5 million
Hugh R. Getty, dir. of mktg. (916)929-2020
CIRCLE 460 ON READER CARD

Computer Talk, Inc.
P.O. Box 100, Idledale, CO 80453
Established 1972; # of employees not given
Gross sales not given
W. M. Barnes, president (303)697-4315
CIRCLE 461 ON READER CARD

Control Logic, Inc.
9 Tech Circle, Natick, MA 01760
Subsidiary of Harnischfeger
Established 1961; 75 employees
Gross sales $3 million
Hiram French, dir. sales & mktg. (617)655-1170
CIRCLE 462 ON READER CARD

Cromemco
280 Bernardo Ave., Mountain View, CA 94040
Established 1975; 100 employees
Gross sales not given
Brian Job, sales mgr. (415)964-7400
CIRCLE 463 ON READER CARD

Data General Corp.
15 Turnpike Rd., Westboro, MA 01581
Established 1968; 10,000 employees
Gross sales $270 million
Dick Pleau, sr. mktg. specialist (617)366-8911
CIRCLE 464 ON READER CARD

Datapoint Corp.
9725 Datapoint Dr., San Antonio, TX 78284
Established 1968; 3,500 employees
Gross sales $103 million
Gerry Cullen, dir. mktg. comm. (512)699-7059
CIRCLE 465 ON READER CARD

Digital Equipment Corp.
146 Main St., Maynard, MA 01754
Established 1957; 38,000 employees
Gross sales $1 billion
Communications services (617)897-5111
CIRCLE 466 ON READER

Digital Scientific Corp.
11425 Sorrento Valley Rd., San Diego, CA 92121
Established 1967; 150 employees
Gross sales $6 million
D. L. Kittel, dir. of mktg. (714)453-6050
CIRCLE 467 ON READER CARD

General Automation, Inc.
1055 South East St., Anaheim, CA 92805
Established 1967; 3,000 employees
Gross sales $100 million
Headquarters representative (714)778-4800
CIRCLE 468 ON READER CARD

General Robotics Corp.
57 N. Main St., Hartford, WI 53027
Established 1974; 50 employees
Gross sales $2.5 million
David Stubbs, vp mktg. (414)673-6800
CIRCLE 469 ON READER CARD

GRI Computer Corp.
320 Needham St., Newton, MA 02164
Established 1967; 50 employees
Gross sales $3.3 million
Joyce Dinman, mktg. services (617)969-0800
CIRCLE 470 ON READER CARD

Hewlett-Packard Data Systems Div.
11000 Wolfe Rd., Cupertino, CA 95014
Established 1969; 1,600 employees
Gross sales not given
Tom Freed, mktg. comm. mgr. (408)257-7000
CIRCLE 471 ON READER CARD

Honeywell Information Systems
200 Smith St., Waltham, MA 02154
Division of Honeywell, Inc.
Established 1970; 75,840 employees
Gross sales $1,037 million
Bill Boone, marketing (617)667-3442
CIRCLE 472 ON READER CARD

ICL, Inc.
1 Turnpike Plaza, 197 Highway 18, East Brunswick, NJ 08816
Subsidiary of International Computers, Ltd.
Established 1977; 800 employees
Gross sales $25 million
Peter Pollizzano, U.S. mktg. mgr. (201)246-3400
CIRCLE 473 ON READER CARD

IMSAI Manufacturing Corp.
14860 Wicks Blvd., San Leandro, CA 94577
Established 1972; 150 employees
Gross sales not given
Sales dept. (415)483-2093
CIRCLE 474 ON READER CARD

Intel Corp.
3065 Bowers Ave., Santa Clara, CA 95051
Established 1968; 8,000 employees
Gross sales $290 million
Leonard Bertain, U.S. dev. mgr. (408)987-7243
CIRCLE 475 ON READER CARD

International Business Machines General Systems Division
Box 2068 Atlanta, GA 30301
Established 1924; 310,155 employees
Gross sales $18,133 million
GSD headquarters (404)231-3000
CIRCLE 476 ON READER CARD

Lockheed Electronics Co.
Highway 22, Plainfield, NJ 07061
Subsidiary of Lockheed Corp.
Established 1916; 35,000 employees
Gross sales $3 billion
Donald Brown, prod. mgr. (201)575-1600 x2673
CIRCLE 477 ON READER CARD

Modular Computer Systems, Inc.
1650 W. McNab Rd., Ft. Lauderdale, FL 33309
Established 1970; 1,200 employees
Gross sales $54 million
Dave Kintler, dir. of sales (305)974-1380
CIRCLE 478 ON READER CARD

National Semiconductor Corp.
2900 Semiconductor Dr., Santa Clara, CA 95051
Established 1967; 26,000 employees
Gross sales $387 million
William Sweet, dir. of mktg. (408)737-6590
CIRCLE 479 ON READER CARD

Perkin-Elmer Interdata Div.
2 Crescent Pl., Oceanport, NJ 07757
Established 1966; 1,500 employees
Gross sales $423 million (all of P-E)
Christopher Hoppin, mgr. mktg. comm. (201)229-4040
CIRCLE 480 ON READER CARD

Pertec Microsystems Div.
206303 Nordhoff St., Chatsworth, CA 91311
Division of Pertec Computer Corp.
Established 1967, # of employees not given
Gross sales $132 million
Steve Elsner, nat. sales mgr. (714)998-1800
CIRCLE 481 ON READER CARD

Plessey Peripheral Systems
17466 Daimler Ave., Irvine, CA 92714
No company information given
G. Mottier (714)540-9945
CIRCLE 482 ON READER CARD

Polymorphic Systems, Inc.
460 Ward Dr., Santa Barbara, CA 93111
Established 1975; 60 employees
Gross sales not given
Toby Bradley, dir. of mktg. (805)967-0468
CIRCLE 483 ON READER CARD

Prime Computer, Inc.
40 Walnut St., Wellesley Hills, MA 02181
Established 1972; 1,070 employees
Gross sales $50 million
Edgar Geithner, mgr. sales promo. (617)237-6990
CIRCLE 484 ON READER CARD

Raytheon Data Systems
1415 Boston-Providence Tnpk., Norwood, MA 02062
Subsidiary of Raytheon Co.
Established 1928; 40,000 employees
Gross sales $2.9 billion
Marketing dept. (617)762-6700
CIRCLE 485 ON READER CARD

Sperry Univac Minicomputer Operations
(Formerly Varian Data Machines) 2722 Michelson Dr., Irvine, CA 92713
Subsidiary of Sperry Rand Corp.
Established 1964; 1,500 employees
Gross sales $50 million
Michael Timmons, prod. mgr. (714)833-2400
CIRCLE 486 ON READER CARD

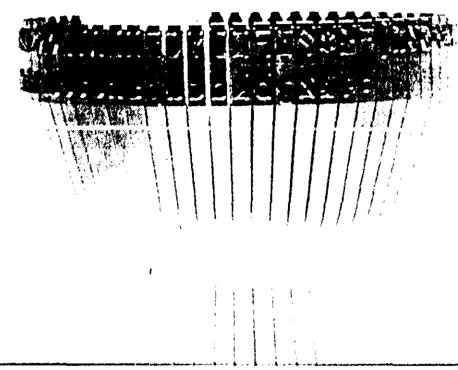
Systems Engineering Laboratories, Inc.
6901 W. Sunrise Blvd., Ft. Lauderdale, FL 33313
Established 1961; 1,200 employees
Gross sales $50 million
Paul Haller, dir. corp. comm. (305)587-2900
CIRCLE 487 ON READER CARD

Texas Instruments Digital Systems Div.
P.O. Box 1444, M/S 784, Houston, TX 77001
Subsidiary of Texas Instruments, Inc.
Established 1939; 68,670 employees
Gross sales $2 billion
(512)258-7305
CIRCLE 488 ON READER CARD

Westinghouse Electric Corp.
1200 W. Colonial Dr., Orlando, FL 32804
Established 1970; # of employees not given
Gross sales not given
Manager of customer services (305)843-7030
CIRCLE 489 ON READER CARD

TO BUILD A BETTER CHARACTER PRINTER, YOU NEED A BETTER PRINT ELEMENT.

WE HAVE ONE.



THE NEC SPINWRITER "THIMBLE"

NEC built the Spinwriter family of bidirectional character printers to be better than today's best. That required a high quality print element able to outperform "daisy wheels," and we have one.

Our unique "thimble" print element lasts up to three times longer, prints faster, offers greater applications flexibility, and costs less than daisy wheel elements.

Spinwriter thimbles are made from plastic specially reinforced with fiberglass – and specially molded – to provide normal element life of more than 30 million impressions. Thimbles are smaller in diameter and lighter in weight than daisy wheels. They have less mass, which means they can reach the next character faster and, therefore, print at a faster effective rate.

Spinwriter thimble elements can print up to 128 characters compared with 94 printable on daisy wheels. One thimble can hold two type fonts, and output those fonts with OCR quality. That means a Spinwriter can be used even in those applications normally requiring metal wheels or other modifications which slow printers down.

Spinwriter thimbles are available in a wide variety of type fonts, and are priced approximately 30 percent less than daisy wheel elements. Like Spinwriter ribbons, thimble elements are easily accessible, and can be replaced in seconds by operators using one hand.

Spinwriter thimbles are noticeably quieter than either plastic or metal daisy wheels, which means that Spinwriter printers fit well in office environments. A Diablo-compatible interface is available for Spinwriters, making direct replacement easy for original equipment manufacturers (OEMs) and end users.

The thimble is only part of what makes Spinwriters better than today's best character printers. Consider our much longer lasting print hammer assembly: it has fewer moving parts than those on competing printers, and the voice coil actuated print hammer is strengthened with special alloys.

And consider the way highly reliable Spinwriters meet your printer needs: the Spinwriter family includes microprocessor-controlled receive-only and keyboard send/receive models, and basic mechanisms for those wishing to add their own power supply and housings.

Spinwriters feature Mean-Time-Between-Failure rates of better than 2,000 hours, and are serviced by one of the largest, most competent organizations serving the computer industry. Spinwriters are priced approximately 10 percent below competition, and we can deliver in OEM quantities in 60 days or less.

Tell me more about the Spinwriter family.
☐ Please have a sales representative call.
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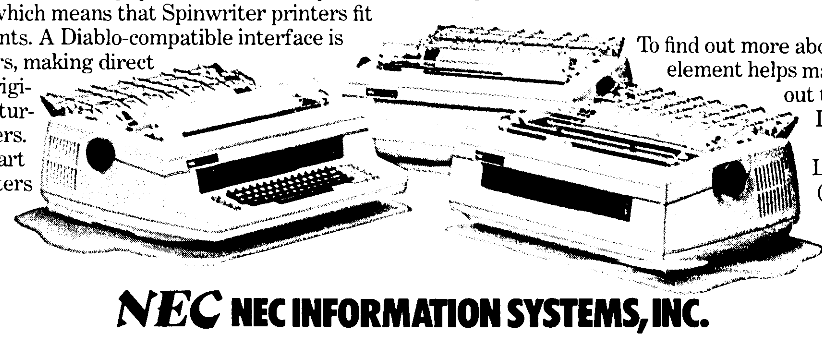

To find out more about how a better print element helps make a better printer, fill out the coupon, or call NEC Information Systems, Five Militia Drive, Lexington, Mass. 02173 (617) 862-3120.

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Eastern Office: NEC Information Systems, Inc., Mr. Richard G. Gilbert, 5 Militia Drive, Lexington, Massachusetts 02173
Central Office: NEC Information Systems, Inc., Mr. Stephen A. Kadash, 3400 South Dixie Drive, Suite 105, Dayton, Ohio 45459
West Coast Office: NEC Information Systems, Inc., Mr. Marty Rubin, 8939 S. Sepulveda Blvd., Suite 330, Los Angeles, California 90045

CIRCLE 83 ON READER CARD

Four short stories that won't be found in any computer vendor's brochures.

THE OTHER SIDE OF THE SMALL COMPUTER PICTURE

by Robert L. Patrick, Contributing Editor

Those who are well read in the field have seen about a million words touting mini and microcomputers, and describing how little systems offer freedom not only from bureaucracies, but also from the lines waiting at the central computer complex, and from those irritating monthly bills the computer center sends. But we seldom see any reference to the problems, delays, and costs encountered in coming to the promised land.

On the other hand, the practicing consultant sees a different, but perhaps equally distorted view. He or she is called in either to help the very healthy trying to do better or, more often, the very sick trying to survive. The consultant usually appears only *after* the problems do, and then—to his frustration—is kept around only until the problems are *almost* fixed. Thus the consultant's view is almost the opposite of that seen in the manufacturers' brochures. Consider the following true but somewhat disguised cases:

CASE I The consultant is introduced to the controller of Makeshift Enterprises Inc., a machine shop which produces large quantities of custom products. The controller has read all the right magazine articles, listened to the salesmen, attended the seminars at his trade's annual conferences, and concluded he needs a minicomputer for job costing. He has chosen the minicomputer vendor, almost chosen the software house to do the programming, and—at the last minute—has gotten cold feet.

Enter the consultant. He finds the specifications for the new computer system in the form of a three-page statement which looks like it was taken out of some Management By Objectives textbook. No enumeration of the exact hardware configuration exists, and it takes *two* visits from the salesman even to get fact sheets on each device being acquired.

Since the client is his firm's controller, financial things are well underway. He has contacted a leasing company, and that company has checked his credit and drafted a four-year full payout lease. Thus the controller has all the fine print concerning down payment, transfer of title, and insurance on the system—but he doesn't yet know what he's going to do with the system when it is delivered.

To top things off, the controller has made promises to Makeshift's president, and the whole project is taking on an unwanted momentum. We're already deep in the "commit" phase when the president of the software firm brings in his analyst and we learn that neither of the pair has done a job-costing system before nor has had any contact with the machining business.

Two months later the software house produces its first output, an inch of paper containing a few words, some screen formats, and a set of sample reports. True to the now-classic plot, the screen formats are not consistent (sure to provoke operator problems), we suspect some reports are missing (some data goes in, isn't used anywhere, and never comes out), and the system specification says nothing about training, troubleshooting, installation, transition, or any of the practical things that make the world go 'round.

What was once only suspected is now abundantly clear: the analyst is incompetent, the software house is the wrong choice, and the controller went too far too fast (in fact, he's learned that he needs a $3,000 extension to his $9,000 contract to put in missing pieces).

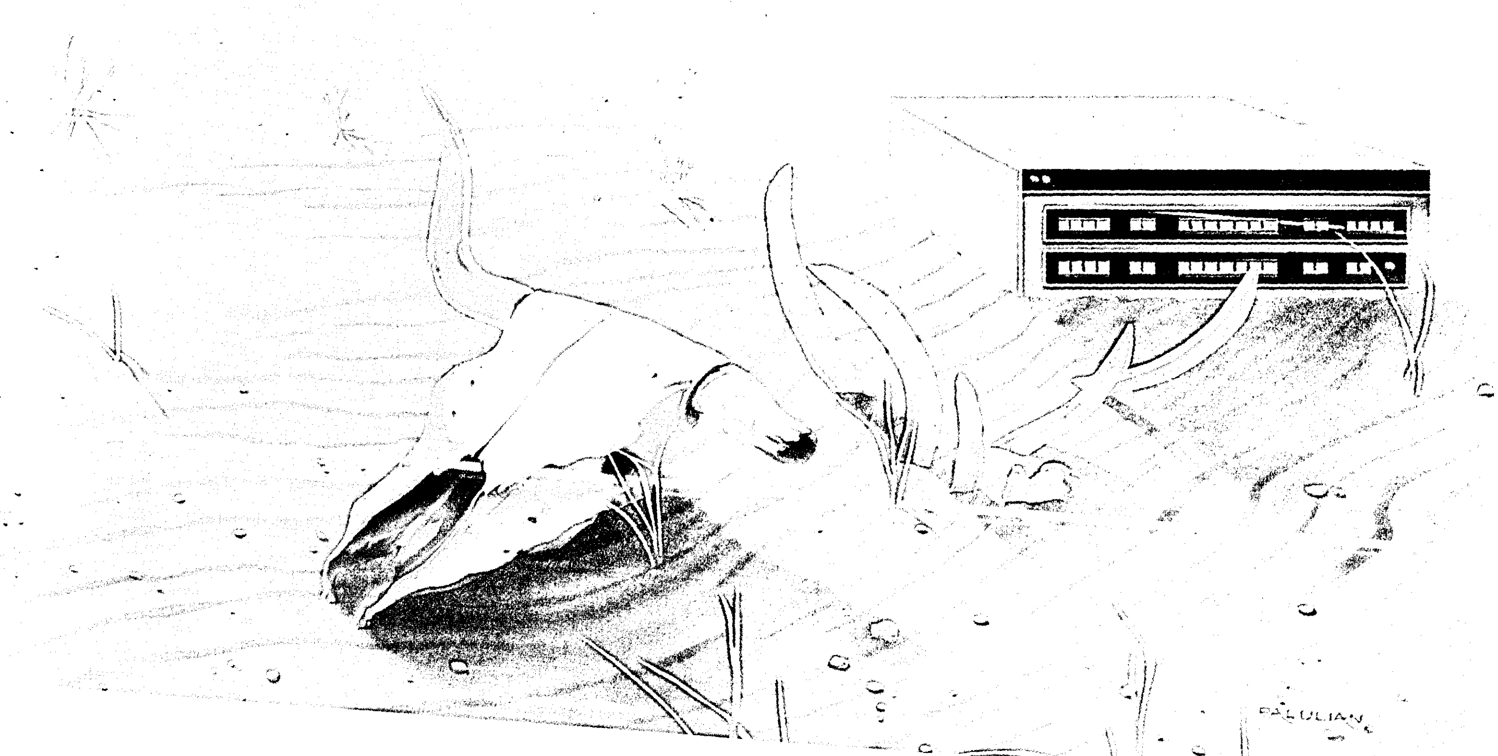
CASE 1 CHAPTER TWO However, Makeshift still needs its job-costing system. A new project leader is installed and the option to buy is exercised. As implementation starts, problems continue. The new project leader finds more flaws in the specifications. The little software house has a hard time managing the project and meeting its dates.

Those are only the *outside* problems. Inside problems turn up when the new set of input forms are delivered from the software house (the old ones are clearly unsatisfactory for use as computer input and thus the new forms are requested as some of the first items delivered). When the controller takes them to the operating departments, he runs into a brick wall.

The new job-costing system is going to give better labor, material, and expense distribution data, more precise tracking of profit and loss, and a series of performance reports on the sales force and operating departments. As it turns out, not every manager welcomes that kind of visibility. In fact, it's a hard sell. The controller suffers a breakdown. Those who pick up the project in his absence find statements from him conflict with those from the software house and statements from the software house conflict with those from the hardware company, the leasing company, and the managers within Makeshift Enterprises. Also, the first increment of software is late and it is now clear that this program won't be installed before the end of the fiscal year—which means unanticipated midyear data conversions.

Later the hardware, working software, and somewhat meaningful documentation are all brought together. By then, the "simple" system has taken 2½ years to build and install. It has cost about $6,000 more than anticipated, plus an outside consultant's help, and one breakdown.

CASE II A military agency sponsored the development of a classified-document control system based on a minicomputer. The agency was so pleased with the prototype system that it wanted to use it in a production environment. As might be expected, the prototype system proves unreliable for production work. Troubleshooting is difficult, no provision has been made for migration from one software release to the next, and while documentation was adequate for a system run by the designers in a development environment, it leaves quite a bit to be desired when 24-hour seven-day operations were to be performed by real live operators.



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CIRCLE 29 ON READER CARD

On top of that, the hardware fails periodically and the operating system has an unhealthy habit of deleting files on restart. The hardware problems are severely aggravated by unstable electrical power and by air conditioning which can best be described as "intermittent."

Then there is a minor technical difficulty. The intelligent terminals contain a customized ROM, and while the terminal and the ROM and the communication line and the minicomputer all passed their tests with flying colors, in real live operation the terminals sometimes get temperamental, leading to the saturation of the communications link with error messages, interrupts, and retransmissions. The usual diagnostic tools are missing. Nowhere in the development shop is there a hardware monitor, the terminal ROM program has no error logging, and the host computer software has no hooks to log communications errors at the line, protocol, and message levels.

All the makings of a disaster are there, and this time the software vendor stands to lose—even though the vendor had done a fine job of developing the prototype system for which it had contracted.

CASE III

Another branch of the government had doled out a bundle of money to a nonprofit institution, based on a proposal put together by a principal investigator of that institution. Unfortunately, the investigator had strong political connections but weak computer experience.

The investigator acquired a development team, and the team acquired equipment from a manufacturer which was well known for its high quality hardware, and low quality software. The team used the vendor's known failing as an excuse for developing its own supervisor and data management package.

By the time management called for an outside review, the project had received two supplemental grants for a total of $700,000 in taxpayers' money. What had the money gone for? Well, the hardware had been installed for two years; the operating system had been completed for about a year; and the data base management package was well on the way. But the original grant had called for data *bases*, for applications programs, and for demonstration facilities—none of which have even been started.

The computer room turns out to be a little, windowless office in the middle of an everyday ordinary office building. A few listings are scattered around on tables and other flat surfaces; the printouts have dates up to a year old. There are parts left over from some hardware repair, and a thick layer of dust lies on the tap heads, tops of cabinets, and on infrequently used console keys.

The same general level of housekeeping carries over into the hardware maintenance cabinets, where there are descriptions of engineering changes that have (or have not) been made, another random sprinkling of small parts, a vacuum cleaner that has not seen recent use, and a collection of punched cards, instruction sheets for hardware diagnostics, and similar necessities. (The agency had happily reported that it was seeing better maintenance service, however, since the same serviceman had been seen on consecutive calls.)

Further, the agency has purchased some terminals from an independent supplier, found it could not maintain them, and has stocked a spare (which, when not in service due to a failure of one of the primary units, is in a crate on the way to the vendor's shop due to its own failure).

Security of the taxpayers' mounting investment has apparently been considered, because there are backup tape copies for the listings in the tub file in the middle of the room; but those backup tapes are in racks in another part of the *same* room. There is also a red "emergency power off" button on one wall, though fire extinguishers and sprinklers are absent.

CASE IV

Next consider the auto manufacturer which had 50 minicomputer systems on the way for an order entry application. Its central computer workforce was very sophisticated, having grown up through 3½ generations of large equipment and about 25 major software releases. They had read all the literature and carefully selected a minicomputer with what they thought was sufficient capacity to support two primary applications in distributed parts warehouses. The cost savings would be substantial if they could get the two applications to run satisfactorily.

Here the situation was quite different because the two applications were already automated. One, a data capture application, was running on a dedicated mini. The other, an order status system, was running on the central machine from input provided through a network of dumb terminals. All in all, it looked like a classic distributed processing application, already half converted to a mini.

Things had appeared to be going very well. The first application program to be completed was rich in function, though a bit fat. The users take delivery of a few machines, install the first application in three pilot sites, and are met with their first surprise. The general purpose software and deluxe applications code cannot meet the performance of the previously-installed dedicated minicomputers even before the second application is brought up. Then another problem is discovered. Both programs perform their functions satisfactorily while operating solo, but seriously intefere with each other's performance. The interference impacts keyboard response, which in turn slows down data entry, which in turn induces a new class of interesting operator errors.

It is apparent that the two applications aren't going to run on the chosen (and already on-order) configuration unless radical surgery is performed. This will require: merging the experience of the on-site workforce and the consultant, establishing a set of programming standards which recognize the limitations of the minis, developing programming approaches which are appropriate to the smaller machines, assembling a performance measurement team, acquiring a hardware monitor, teaching the minicomputer maker about performance analysis and tuning, and revising both "finished" applications programs. All this to merge two straightforward applications, one of which already was running on a mini.

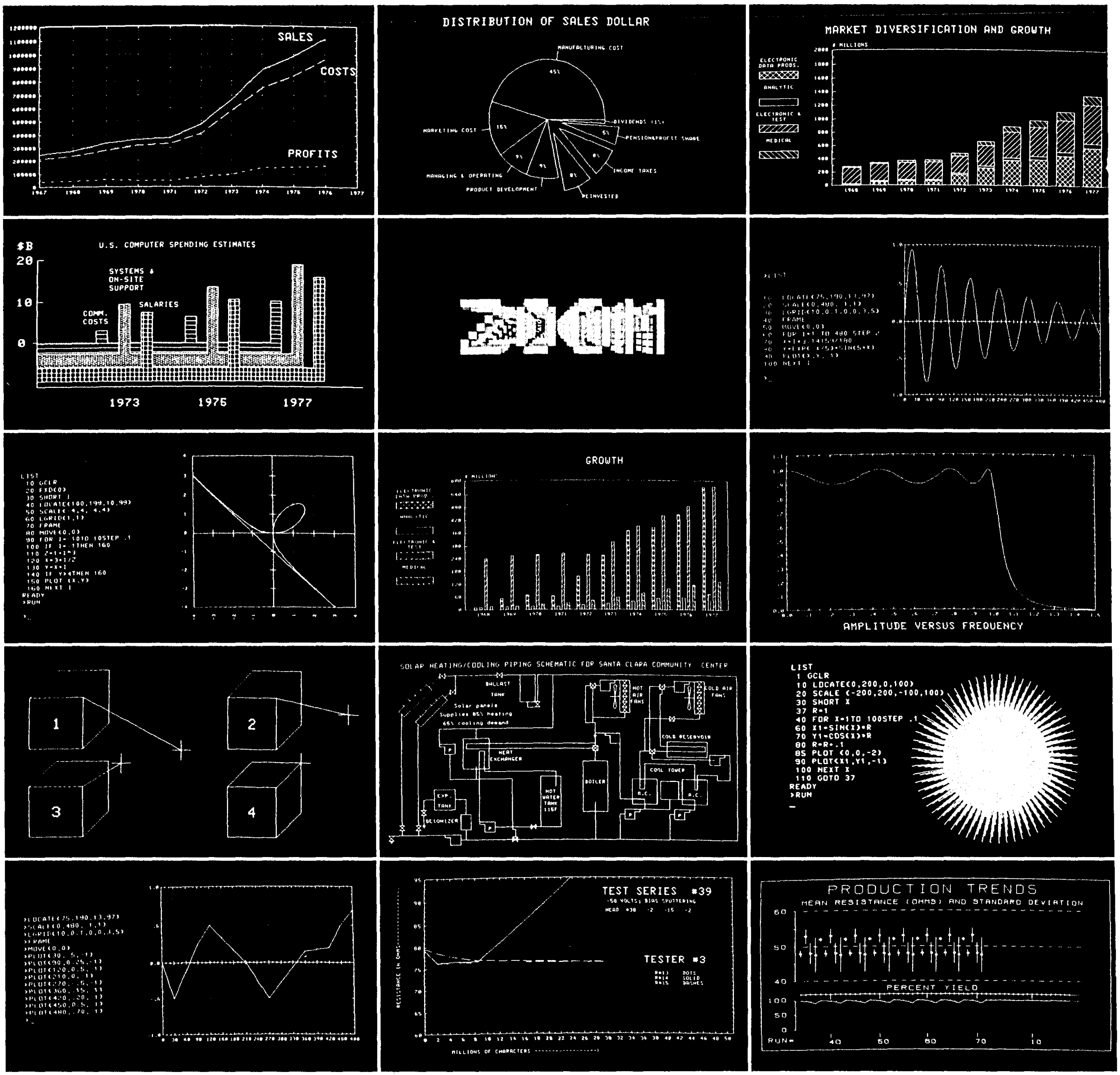
MICRO, MINI, OR MAXI

Thus it looks like minis and micros are fine for dedicated applications. In addition, there have been many successful turnkey installations of small systems where the customer's requirements and the application's specifications matched (and the programs were mature). However, the installation of any computer in a complex environment is tough because the environment is tough. Complex software is difficult to produce in any environment. Further, if the computer is to be used as an instrument of change, delays and trouble will occur. It makes no difference whether the computer is a micro, mini, or maxi. ※

ROBERT L. PATRICK

Mr. Patrick has been an independent data processing consultant since 1959. His assignments usually involve system design, computer center management, or audits of computer center operations. His clients have included aerospace companies, computer manufacturers, and technical publishers among others, both in the U.S. and internationally.

Graphics. Without



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You just lost your last excuse for sticking with alphanumerics. Because with HP's new 2647A Intelligent Graphics Terminal, you get graphics without digging into your CPU's software.

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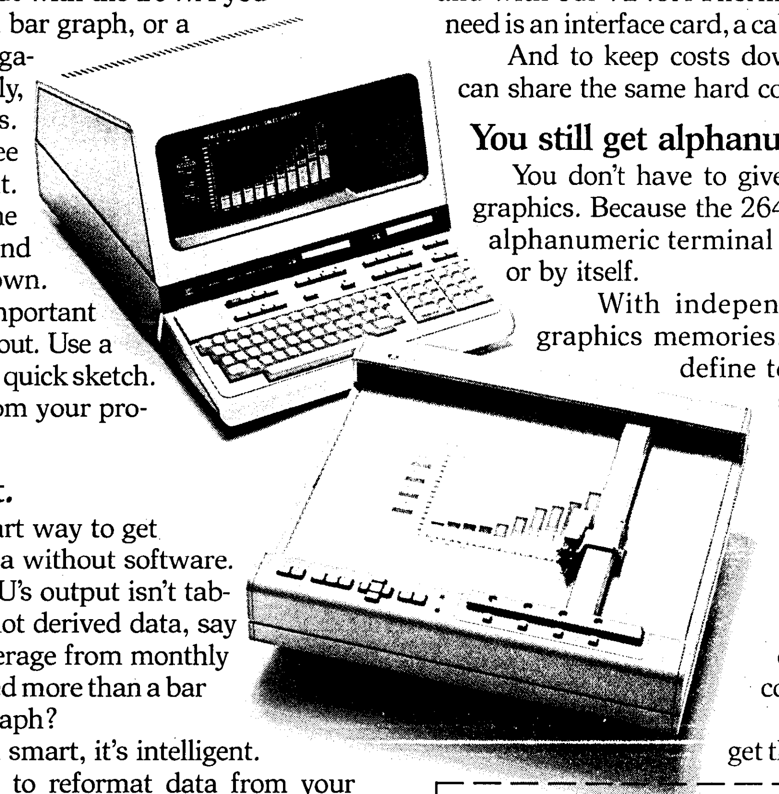
Without any help from your programming department.



It's more than smart.

The 2647A's the smart way to get graphics from tabular data without software.

But what if your CPU's output isn't tabular? Or if you'd like to plot derived data, say a three-month moving average from monthly sales figures? Or if you need more than a bar graph, pie chart or line graph?

The 2647A's not just smart, it's intelligent.

You can program it to reformat data from your CPU, or to compute more data, in easy-to-write BASIC. And you can program it in AGL, our high-level graphics language extension of BASIC. Its powerful commands, such as FRAME, AXES, LABEL, LOCATE and PLOT, put sophisticated graphics at your fingertips.

Either way, your program runs on the 2647A without any help from your CPU.

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The 2647A makes graphics as portable as alphanumerics. It interfaces easily with our 9872A Four-Color Plotter (which can even make overhead transparencies), and with our 7245A Thermal Plotter-Printer. All you need is an interface card, a cable and the peripheral itself.

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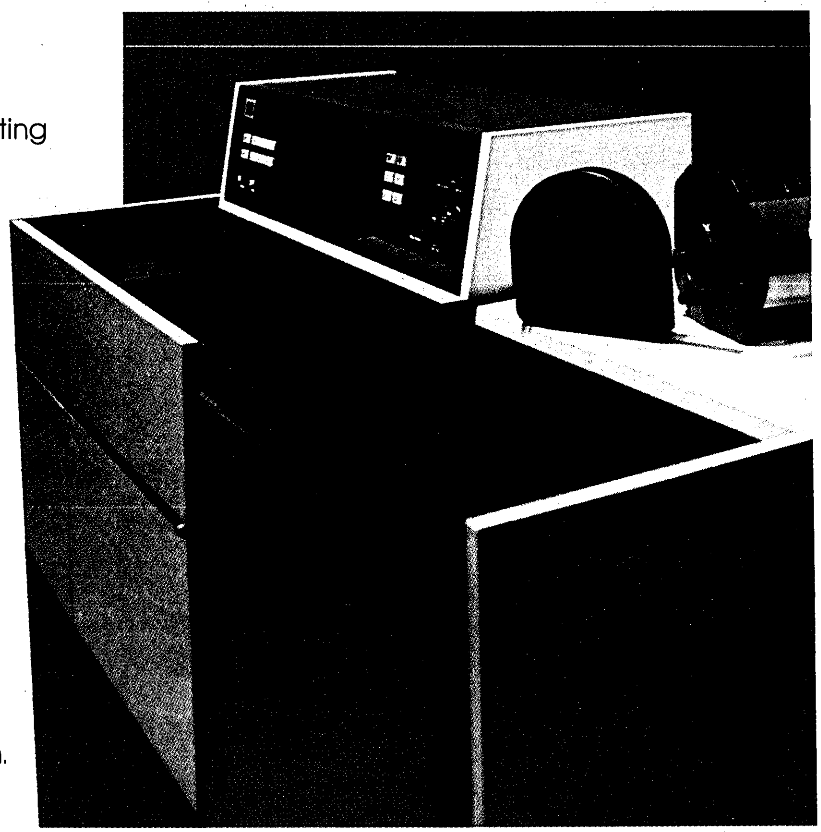

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Consider, for example, the cost of generating a 1000-page, 3-copy report.

Three-part stock paper costs about $22.30* per 1000 pages. But you can put the same report on microfiche for around $1.50.

So, from the standpoint of materials alone, paper is about 15 times more expensive than microfilm.

Time and labor costs are important factors, too. Especially in a DP department. Which is why you should know that it would take almost 50 minutes to decollate, burst, bind and package a 1000-page report. It would take only 9 minutes to print, duplicate and package the same report on just 4 microfiche.

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87% cheaper.

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When you step over the line into show biz from technology, a different set of angels takes over.

EXCUSE ME, WHAT WAS THAT?

by Nels Winkless

Personal computing is still newsworthy, and attracts excited comment from reporters who don't know a byte from a warthog. Therein lies both opportunity and danger. "Personal" refers here to computer performance in which the system seems to care what happens. Thousands of plain folks are buying small systems these days, determined to wring this sort of performance out of the indifferent hardware.

When you have some technology that really seems to be interested in its user, you're a cinch for good national publicity, true? Yes. In this case, reality is as good as the pipe dream.

The problem is to remember where the line is between technology and show biz. When you step into the limelight, a different set of angels takes over your affairs. The show angels smoke cigars, and laugh a lot, unlike the technical angels, who look worried all the time, and speak exclusively in formulae.

Two of my clients were drawn into the limelight with products that get personal. One is John Peers, whose ADAM computer system (manufactured by Logical Machine Corp.) can be instructed by a naive user in comparatively relaxed English. The other is George Glaser (escaped president of AFIPS), whose product, MIKE, accepts spoken commands, and responds aloud. (Mr. Glaser is now president of Centrigram Corp.) When Mr. Peers' computer is equipped with Mr. Glaser's product, a naive user can speak to the system aloud and cause it to operate. Very personal. Intoxicating power.

And so it came to pass that a wise producer of NBC's "Today" show decided that it would be interesting to have somebody with a ready tongue say a few stimulating things about the future of computing early one morning. (What's that laughter? Who's smoking a cigar?)

Doreen Chu, of the "Today" show, was saddled with the task of drawing a computerist into the limelight, and she was steered to John Peers in California. Ms. Chu dangled the bait of six minutes on national television. Mr. Peers did not step delicately across the line from technology to show biz; he *leapt* across.

First, Mr. Peers called me in Albuquerque, that center of advanced technology, show biz, and green chili, where I hunch daily over my typewriter, withdrawn from reality. "Do something appropriate," said Peers, "whatever is necessary. We can tape it here in Sunnyvale, or maybe in Los Angeles, not necessarily in New York. Whatever they want. I'll be traveling in England or on the Continent if you need me. Ta ta." And off he went.

So, I called Ms. Chu. Six minutes or so would indeed be scheduled, four minutes of jolly conversation in which the future would be revealed in detail, and a couple of minutes of demonstration of current miraculous machine capability. Excellent.

One hooker.

"Taped? Oh no, not taped—live. In New York."

Live, alive-o.

"Mr. Peers said that he has a machine that listens to its operator, then talks back. Is that right?"

"Yes. What would the 'Today' show like the conversation between Peers and Machine to be about?"

"You know more about it than we do. Make some specific suggestions."

"Well," said I, warming to the old show biz call, "how about introducing Gene Shallit to MIKE and having the machine say something witty, like 'What a moustache!' MIKE could say 'pretty lady' at the mention of Jane Pauley."

No, this should be serious, demonstrating something important about the future.

Nondialing telephones? Just tell the phone who it is you want to call?

No, they were tired of telephone talk. Something else.

Okay, I'd write a couple of little routines to consider. Did they really want the whole computer system or just the speech-recognition-and-response black box?

It wasn't really necessary to drag 700 lb. ADAM to New York. MIKE was sufficiently charming alone. Super. I knew we could send at least two working MIKE's. My theory is that the guardian angels like to spice up show biz demonstrations of working hardware by casting a spell so that 53% of the demonstrations fail at the critical moment, increasing the entertainment value of the events.

So, with MIKE's enough to handle the angels, I put together a couple of routines. One was a security system.

"Knock, knock," says Peers.

"Who's there?" says MIKE.

"John Peers," says Peers.

"What company?" says MIKE.

"Logical Machine Corporation."

"Phone number?"

... and so on ... the notion being that MIKE asks questions at random that only the real John Peers would be able to answer promptly. MIKE might have 50 such questions in memory, with a checklist of answers. If the guy at the door answers correctly in John's voice, MIKE accepts him as the genuine article.

"What's the password?" says MIKE.

"Swordfish."

"Why, John Peers, is that you?"

"Yes, indeed."

"Come in."

... and MIKE unlocks the door. Corny routine, but swift and clear in its purpose.

The other routine did involve both MIKE and ADAM. It was an inventory-taking procedure in which a storekeeper calls out information aloud in response to prompting from MIKE. Very businesslike, in spite of MIKE's wisecracks.

"Today" show hated the routines. "We need something the housewife can understand," said Ms. Chu.

Any other hints?

No. I should make more specific suggestions.

How about a routine on automatic shopping. You tell the system what you need from the store; it tells you the cost and what's in stock, then orders from the store's computer automatically.

That might be nice, but it shouldn't be frivolous. Practical, useful, informative. Those were the keys.

Righto.

"By the way," said Ms. Chu, "they want to know if the computer can sing."

"Sing?"

"Yes."

"Um . . . not very well," I said, wondering what had suddenly become of practical, useful, and informative.

"That's what I thought," said Ms. Chu with relief in her voice. "We now have the appearance set for Tuesday, the 9th of May. Will that do?"

It would do. The wandering Mr. Peers could get back from Europe for the occasion.

I ground out a couple of minutes of uplifting shopping dialogue between John and MIKE. Panic was manifest in Sunnyvale, since customers were demanding delivery of all the MIKE's that could be made, but . . .

On Saturday, April 29, Mr. Peers called from London to find out how things were going. He decided that MIKE/ADAM should be on the show, not just MIKE. "Tell them in Sunnyvale that we need both. Keep me informed. My secretary will be reaching me in Amsterdam. Ta ta." Something must have twanged the cable we were using, or bumped the satellite. I thought I heard laughter from afar.

The MIKE/ADAM routine was technically practical, and I had seen people control ADAM by speaking to MIKE, but there were still a few bugs. One knew it would all work perfectly, but when?

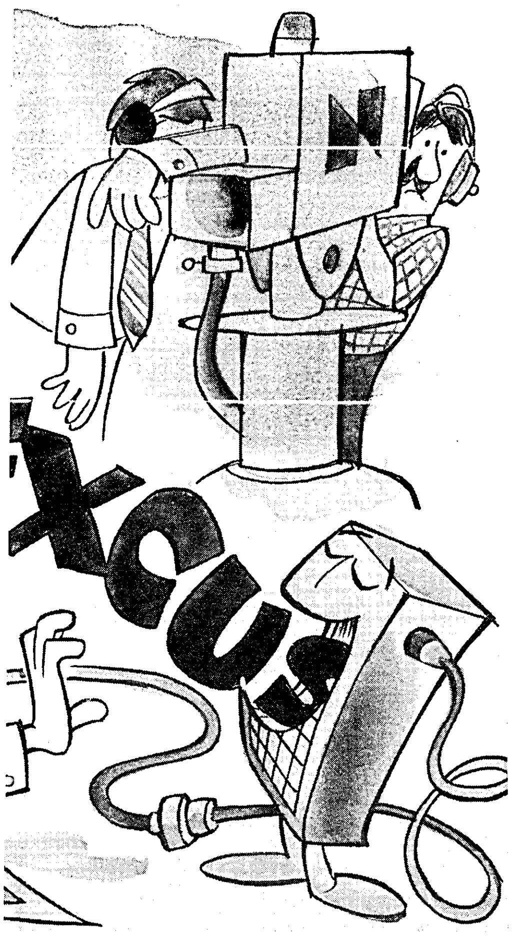
At least 20 people were involved by now, and several of them were calling NBC independently to ask critical questions. ("When can we get in to set up? Not until you sweep John Chancellor and the remnants of the 'Evening News' out of that studio about eight the evening before? If the equipment arrives on Monday morning, does it have to sit out on Fifth Avenue until Mr. Chancellor is through? You mean we can't rehearse with the 'Today' people until six in the morning? We draw under 20 amps of 110 and we wish we had a clean line. You can give us a thousand amps? Wow!")

Mr. Peers was scheduled to stop in at Ms. Chu's office on Friday, the 5th, to discuss the script of the demo. John had never seen the script, of course. He phoned me at Albuquerque sunrise that day to say: "I'm at the Plaza Hotel, and there's no bloody script here. Read it to me."

I crawled out of bed, found my glasses, hunted for the script, fell asleep briefly at my desk, crawled back to the phone, and fumbled through a recitation.

Mr. Peers loved it, loved it.

It *is* only a paper moon in show biz, because the real thing probably won't work when the curtain rises.



"Good Lord," he said, "can the system really do all that?"

"Theoretically, yes. We won't know in practice until it's too late."

"Marvelous," said the adventure-loving Monty Python of the Computer Industry, and went off to do his thing.

MIKE/ADAM worked perfectly for the first time on Saturday. Peers rehearsed a few times over the weekend in California, then sent people and equipment to New York in a swarm. Secure in the knowledge that "Today" would settle for MIKE alone in case the Mafia hijacked ADAM at the airport, and we couldn't raise the ransom in time, George Glaser headed east with two MIKE's under his arms.

The fellows galloped into the studio on Chancellor's heels, and had the system operating before midnight. MIKE/ADAM worked like a champ. "The system was working so well," reports Glaser, "that it was a great distraction for the crew. They kept playing with it. There were a few small hitches, of course. After we had the 700 lb. machine working, the director discovered that he couldn't cover it in that position, and we tore it down to move ten feet." (Laughter and smoke rings.)

The reporters and guests came in about six. Mr. Peers (who was a professional piano player at one time) sat at ADAM's keyboard to render a few routines for Sammy Cahn and Alan Jay Lerner. The distinguished songwriters were there in celebration of Irving Berlin's 90th birthday. (Is *that* why Ms. Chu asked about singing?)

Just before airtime, Peers retaught MIKE the commands he wanted the machine to recognize, a three- or four-minute task. If the operator's voice changes significantly, the machine may not identify him. Peers had slept about three hours in the last 50, was still waiting for the jet lag to catch him, and was about to perform for the biggest audience of his life. He wanted MIKE to know about any stress in his voice.

The recognition vocabulary is stored in MIKE's random access memory.

Volatile RAM.

The phrases MIKE speaks aloud are also recorded in RAM.

Tom Brokaw wondered if the system could respond to him. Yes, there were three recognition and response slots open, so they quickly worked out a routine in which Peers introduced Brokaw to MIKE/ADAM, and the two exchanged pleasantries for a few seconds.

All set.

"Hey," said somebody in the control booth. "That machine must be putting funny signals on our lines. The automatic switcher doesn't work when the computer's on. You'll have to turn it off during the first part of the show." And he reached for a switch.

Peers, Glaser, and their crew flung themselves on the man and the machines. Switchoff meant that ADAM and MIKE would forget everything they knew, with no time for retraining. STOP!

Miraculously, he stopped. The stuff in RAM was saved. On with the show.

The little introductory discussion went well when the time came, and Peers turned confidently to ADAM.

"Good morning, ADAM," said Peers.

"Good morning, John," said MIKE/ADAM in George Glaser's voice, since it was George who had recorded the responses.

"I want to buy some groceries," said Peers. "Take a shopping list for me."

"What items?" said MIKE/ADAM.

"Fresh butter."

"Fresh butter," said MIKE/ADAM, and displayed "Butter . . . $1.45" on ADAM's screen.

"Is it that much?" said Peers, expecting MIKE/ADAM to reply with: "It's gone up."

Instead, the machine said: "Excuse me, what was that?" That's what MIKE/ADAM is supposed to say when it doesn't understand a command clearly.

"Is it that much?" said Peers with dignity.

"Excuse me, what was that?"

"Is it that much?"

"Excuse me, what was that?"

"ADAM doesn't seem to like the hot lights," said Peers thoughtfully.

"Excuse me, what was that?"

"Be quiet, ADAM," said Mr. Peers.

"Excuse me, what was that?"

"Well, let's talk about some other things," said Mr. Brokaw, and he asked a question.

"Excuse me, what was that?" said MIKE/ADAM.

Peers launched into a discussion of Mr. Brokaw's question. Poor old MIKE/ADAM was by now firmly stuck in a loop. Every few seconds, George Glaser's voice would pipe up "Excuse me, what was that?" in a pathetic, demented cycle. After about three minutes of this torment, Mr. Glaser himself was on his hands and knees, creeping behind Peers and Brokaw, behind MIKE/ ADAM, heading for the loudspeaker on the floor. He was planning to rip out its little wires. You don't get to be a consultant, a corporation president, and leader of the American Federation of Information Processing Societies by wallowing in indecision. George was bent on murder.

Peers, meanwhile, had no operating control of the system from the keyboard, that being one of the refinements overlooked in the previous week's frenzy. Rigid self-discipline also prevented him from turning off the master switch on ADAM, since this scrambles the innards in unhandy ways. Brokaw had no such inhibition.

"Maybe we should switch this off," he said, and did it.

"Excuse me," said MIKE/ADAM, and fainted.

Mr. Glaser did not creep into national view. Mr. Peers did not cry on camera, but spoke winningly of better things to come. A smell of cigar smoke and a sound of giggling filled the air.

After the commercial break, Peers and Brokaw chatted on for an unscheduled five

In Albuquerque they opted for local news.

minutes in a segment that is not seen everywhere around the country. In Albuquerque they opted for local news, and I chewed my rug in ignorance of the relaxed exchange.

When MIKE/ADAM got home, the system worked flawlessly once more. Was it the lights? Were signals from the automatic switcher leaking in? The scientists are working on that. Overall, of course, it was the move from technology to show biz that caused the system to lose its marbles at the critical time.

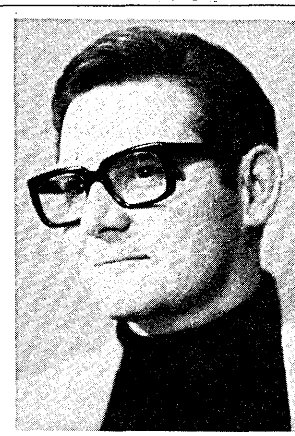
It *is* only a paper moon in show biz, not only because the producers are too cheap to use the real thing, but because the real thing probably won't work when the curtain rises.

Indeed, the panic of MIKE/ADAM was so genuine, and so appealing in human terms, that Peers, Glaser, et al. have been awash in sympathy. No mocking laughter, except from above. The "Today" show folks were almost as disappointed as Peers, and have extended an invitation to come back when MIKE/ADAM are feeling better. Not as good an effect as we hoped, but better by far than we feared. Trouper Peers came through in style.

Certainly our convictions were reconfirmed. Personal computing *is* newsworthy.

"Excuse me, what was that?" ✻

NELS WINKLESS



Mr. Winkless is a writer ("of articles, books, films, labels, reports, lame excuses," he says, and a consultant. He claims he accidentally became the editor of *Personal Computing* magazine for its first year of publication, but is now off working as he most enjoys, as a "professional outsider." Presently the director of the U.S. Robotics Society, and vice president of a small research foundation, the versatile Winkless also holds a patent in the field of optics.

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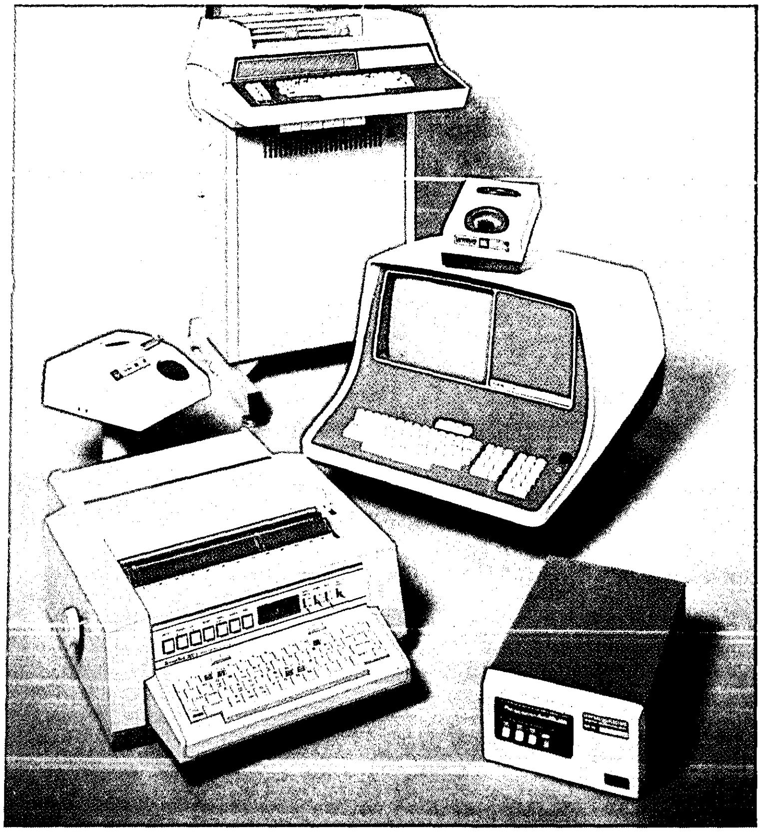

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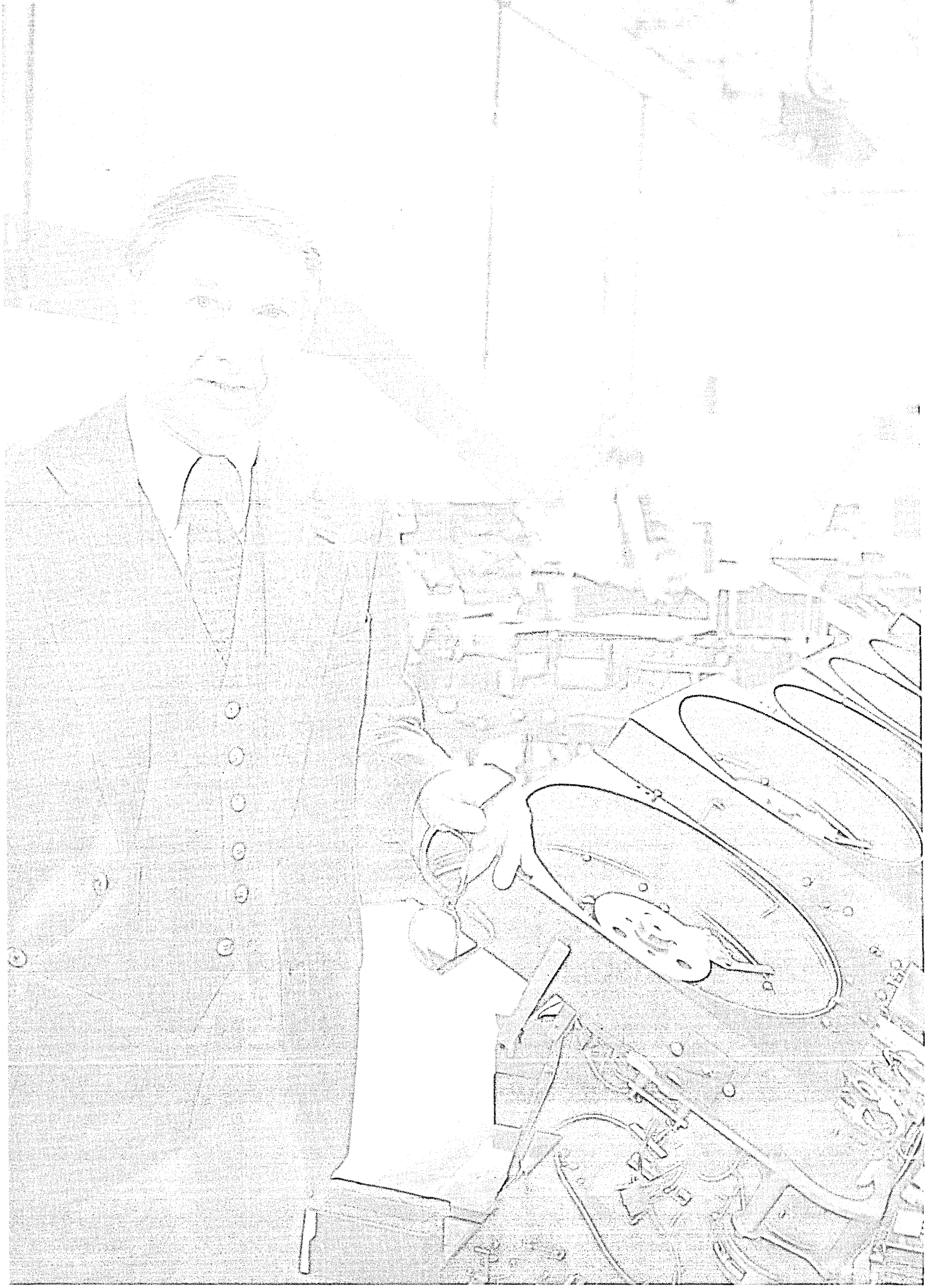

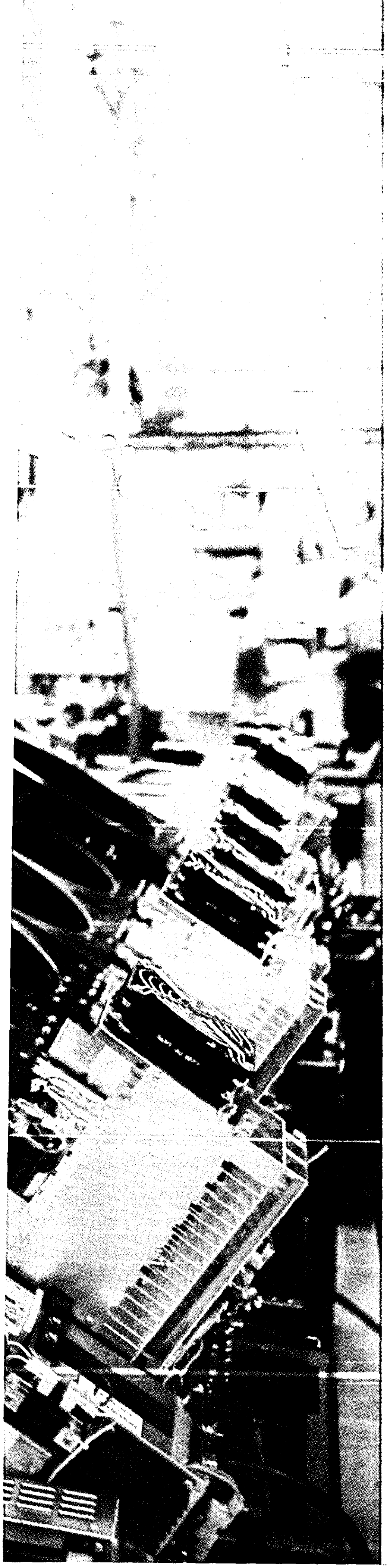

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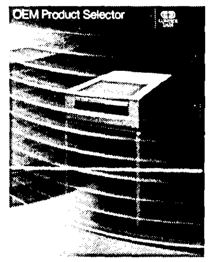

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How the data base is built is crucial. It cannot be handled as a file conversion.

DESIGNING THE DATA BASE

by D. C. Tsichritzis and F. H. Lochovsky

A Data Base Management System can be an effective data management tool, provide invaluable help in coping with data organization and access problems, and improve the quality of information available for management decision making. Or it can be an inflexible and costly addition to the dp budget, providing management with more headaches than help. The difference is often determined by how the data bases are generated.

Data base generation, the process of determining the data organization and processing requirements of an enterprise, generating a suitable description of these in terms of a schema, and converting existing files and programs according to the schema, is the critical first step in adopting the DBMS approach. However, data base generation is often treated as merely a file conversion problem. Data are converted with little or no analysis of the appropriateness of their organization. The result is that the DBMS is fitted to the *existing* processing environment and is used as a glorified access method.

Data base generation should not be regarded as a conversion problem, but as an opportunity to plan the organization, use, and management of the data. The emphasis should be on analyzing the data requirements of a business or other enterprise, and on the accurate reflection of these requirements in the schemas.

Most DBMS vendors recognize the critical role of data base generation, and provide utilities to help the data base administrator generate the data base appropriately. However, these utilities are not universal; each is strictly geared to a particular data model and to the data base management system of a particular vendor. In addition, most available utilities are concerned with efficient physical data storage and access. They don't address themselves to the problem of generating an appropriate, complete, accurate, and long lasting schema. In this respect, the data base administrator is left to fend for himself.

Under these circumstances, the successful generation and implementation of a data base calls for a carefully organized plan. The basic steps in such a plan are to:

1. identify the data *organization* requirements of the enterprise
2. identify the data *processing* requirements of the enterprise
3. generate the schema(s)
4. convert the data organization and processing operations to the DBMS environment.

INSURANCE COMPANY EXAMPLE

An insurance company is a good example to use in describing these steps because the organization of such an enterprise is quite complex, consisting of many departments concerned with both internal and external operations. To keep the size and complexity of the example within manageable bounds, we shall consider only that part of the enterprise concerned with handling data directly related to the processing of individual life insurance policies. In our example, this function is performed by three departments: (1) Underwriting and Issue, (2) Agency, and (3) Insurance Administration. As their names suggest, the Underwriting and Issue department handles data related to the issuance of policies, the Agency department keeps data on the company's insurance agents, and the Insurance Administration department looks after the financial and policyholder service aspects of insurance policies.

1. IDENTIFY THE DATA ORGANIZATION

The first and most important step in data base generation is to determine the data organization requirements of the different components of the enterprise. An enterprise's data is one of its most important resources. Its effective organization and use should be of foremost concern. Unfortunately, this step has been largely ignored or given only cursory attention. Data base design has often proceeded by considering only the operations on the data, putting the cart before the horse.

Data organization requirements are best identified by conducting a series of interviews within the various user departments. These may be conducted informally, or through questionnaires. Either way, several interviews may be required in each department to clarify needs and resolve apparent conflicts. The result of the process is a list of all the entities of interest to each department, and the relationships between the entities.

An entity in this context is a concept or an object of interest to the enterprise, something facts are gathered about and kept. For example, insurance policies, clients, and agents are all entities in our example. They are objects of interest to the insurance company about which facts, such as policy number, client name, etc., are kept. To identify them, the important questions to ask are:

1. What are the objects (entities) of interest to each department?
2. What is the appropriate name(s) for each entity?
3. What facts (attributes) are of interest for each entity?
4. What is the appropriate name(s) for each attribute?
5. What is the domain of values for each attribute? For example, is commission rate a percentage between 0 and 100?
6. What are the known dependencies between attributes of each entity, e.g., does "type of coverage" determine "premium rate"?
7. What are the unique identifiers (if any) for each entity? For example, is policy number a unique identifier?

The result of this series of questions is a list of entities and their attributes for each department. Merging the lists for the different departments generates the first iteration toward establishing a data dictionary of all data base names and their meaning.

Only after the data entities and their relations are established can the enterprise description be done.

While merging the lists we need to resolve name conflicts, isolate candidate keys (unique identifiers), and check for functional dependency properties. After merging the lists, the aggregate list is shown to the various departments for their approval. For our insurance company example, this analysis results in the entities and attributes shown in Table 1.

A relationship here is a known correspondence between two entities. It is a fact or condition which links one entity to another entity. For example, policies and clients are related since it is known that every policy is held by a client. Similarly, agents and policies are related since policies are sold by agents. Relationships between entities are identified by asking:

1. What are the known correspondences (relationships) between entities?
2. What is the appropriate name(s) for each relationship?
3. What is the mapping property of each relationship—1:1, 1:N, or N:M?
4. Is the relationship expressible in closed form using the attributes of the entities? Is policyholder "true" when Social Security number in client equals Social Security number in policy?
5. What is the meaning of each relationship, expressed either formally or informally in English?
6. What are the possible relationships which are not used, but are still meaningful?
7. What combinations of relationships make sense as separate, identifiable relationships, like client's beneficiaries?

The relationships obtained from this process for our insurance company example are shown in Table 2. The mapping property of each relationship—one to one (1:1), one to many (1:N), or many to many (N:M)—as well as the direction of the mapping is indicated beside each.

From the list of entities and the relationships between them, we now produce an enterprise description. The enterprise description is a synthesis of the data requirements of each department with redundancy eliminated. Diagrammatically it is a network, as can be seen from the enterprise description for our insurance company (Fig. 1.)

We can now document the enterprise description. Documentation involves a suitable summation of the data obtained from the interviews. It also includes retention of the interdepartmental universe of discourse of each entity and relationship. The documentation and schematic of the enterprise description is then presented to each department for its approval—which may well necessitate some negotiation.

It is important to identify the data organization requirements of an enterprise as the *users* perceive them or would like them to be. Often, existing data files do not accurately reflect an enterprise's data organization requirements. In most cases, existing data files emerged on an *ad hoc* basis, are highly dependent upon specific applications (no matter how transient), and contain redundant and/or improperly defined data item names. Because of their *ad hoc* nature, integration of data and evolution of the files to meet changing needs is difficult, if not impossible. Merely converting existing files to a DBMS without any analysis of current needs often defeats the whole purpose of the DBMS approach and can result in even more costly and less effective operation than experienced prior to conversion.

ENTITIES AND ATTRIBUTES OF INSURANCE COMPANY EXAMPLE

Underwriting and Issue	
Policy	policy number, last activity, last activity date, next activity, next activity date
Coverage	coverage type, coverage amount, premium rate, issue date
Client	Social Security number, name, address, birthdate
Prior Coverage	policy number, type, amount, rating
Beneficiary	Social Security number, name, address
Termination	termination date, reinstatement date, termination reason
Agency	
Agent	agent number, name, address, area
Policy	policy number, coverage type, coverage amount, issue date
Client	Social Security number, name, address, birthdate
Commission	type, rate
Insurance Administration	
Policy	policy number, last activity, last activity date, next activity, next activity date
Client	Social Security number, name, address, birthdate
Billing	mode, amount, next premium date, name, address
Loans	principal, balance, interest rate, interest due date
Commission	type, rate

Table 1. The first step in data base generation is to discover what data entities are used by which department in the organization, and to collect the information necessary to define them, as has been done for the hypothetical insurance company in the example.

RELATIONSHIPS BETWEEN ENTITIES OF INSURANCE COMPANY EXAMPLE

Policy Coverage	1:1 between Policy and Coverage
Policy Billing	1:1 between Policy and Billing
Prior Policy Coverage	1:N from Policy to Prior Coverage
Policy Beneficiary	1:N from Policy to Beneficiary
Policy Loans	1:N from Policy to Loans
Policy Termination	1:N from Policy to Termination
Policy Holder	1:N from Client to Policy
Policy Commission	N:M between Policy and Commission
Agent Commission	N:M between Agent and Commission
Client Agent	N:M between Client and Agent.

Table 2. After the entities are defined, the relationships between the data entities, and how each maps into others, are determined.

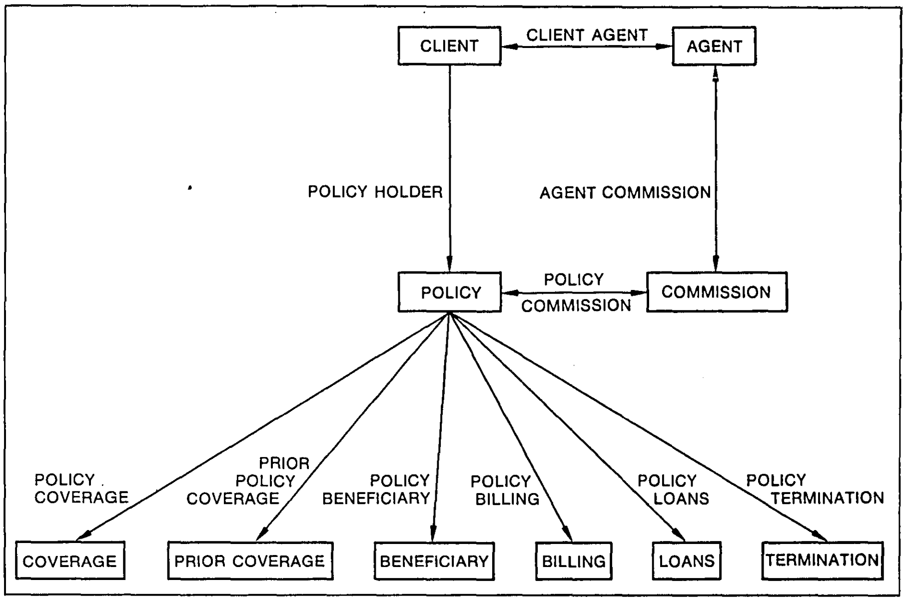

Fig. 1. The enterprise description is produced from the list of data entities and the relationships between them.

SOME SAMPLE TRANSACTIONS FOR THE INSURANCE COMPANY EXAMPLE

Transaction: List the policies held by a client.
Entities: Client, Policy.
Relationships: Policyholder.
Description
1. Retrieve the Client entity.
2. Retrieve the Policy entities related to the Client entity via the Policyholder relationship.

Transaction: Perform today's policy processing activities.
Entities: Policy, Billing, Loans.
Relationships: Policy Billing, Policy Loans.
Description
1. For each policy where next activity date is today, do the activity indicated by Next activity.
2. Update Last activity and Last activity date in Policy.
3. Determine the Next activity by finding the minimum of Next premium date in Billing or Interest due date in Loans.
4. Update Next Activity and Next activity date in Policy.

Transaction: List a client's beneficiaries by policy.
Entities: Client, Policy, Beneficiary.
Relationships: Policyholder, Policy Beneficiary.
Description
1. Retrieve the Client entity.
2. Retrieve all Policy entities related to the Client entity via the Policyholder relationship.
3. For each Policy entity retrieved, retrieve all the Beneficiary entities related to the Policy entity via the Policy Beneficiary relationship.

Table 3. Using the enterprise description in Fig. 1, it is possible to develop a list of all the transactions involving data entities.

2. IDENTIFY DP REQUIREMENTS

The second step of data base generation is to identify the data processing requirements of the enterprise. All current and projected transactions on the data base are included. A transaction in this context is an action, or set of actions, that requires access to the data stored in the data base. For example, on-line access, report generation, and data entry are all transactions. For each it is necessary to identify its nature (retrieval, update), its frequency, its origin (department), and its purpose together with the part(s) of the data base it affects. The enterprise description of the previous step is used as a basis for describing the transactions.

Some relevant questions to ask are:

1. What transactions are required by each department?
2. What kind of access is required by each transaction—retrieval, update?
3. What is the frequency of each transaction—daily, weekly?
4. What entities, attributes, and relationships are involved in each transaction?
5. What is the processing priority of each transaction?
6. What kind of on-line transactions are going to be supported?
7. What is the frequency of each type of on-line transaction?
8. What is the need for concurrent update activity?
9. What kind of pattern of data base usage do we expect—what mix of transactions, when performed, etc.?
10. What reports are needed?
11. What is the format of each report?
12. What is the acceptable time frame for producing each report?
13. What security requirements are important?
14. What integrity constraints are to be placed on the data?
15. How is input going to be performed?
16. What parts of the data base are *essential* for the operation of the enterprise?

The result of this step is a list of all transactions and their characteristics. Current as well as anticipated future needs are included. For each transaction we identify the data base entities and relationships it will involve, plus a sketchy outline of the data access. This outline is in terms of the enterprise description and English statements of the processing or a problem specification language formulation of the processing. Table 3 contains some transactions required in our insurance company example. The list of transactions is shown to the different depart-

The DBMS usually "decides" the choice of data model, but the reverse can occur as well.

ments and an agreement on a final list is reached together with some priorities for implementation.

3. GENERATE THE SCHEMA The enterprise description is next expressed as a data model schema, a graphical description of the proposed schema according to the data model of the DBMS under consideration. (It is not necessary to write programs that will generate the schema at this stage if a DBMS has not already been selected. In such a case, a data model schema for each DBMS under consideration should be outlined.)

Existing commercial DBMS's can be grouped into three main categories: hierarchical, network, or relational.

For a hierarchical system, such as IBM's IMS, or MRI's System 2000, the enterprise description is transformed into a set of spanning trees of the network. Care should be taken to abide by the restrictions of the hierarchical approach and of the particular system being used. Entities usually will be mapped into segment types (for IMS) or repeating groups (for System 2000) and entity relationships into parent-child (1:N) relationships. (For example, each of the items from "Coverage" to "Termination" in Fig. 1 would be a child to the parent "Policy.")

The transformation of the enterprise description to a hierarchical schema is by no means algorithmic or unique. The nature and type of the data base transactions will often influence the particular hierarchy chosen. For example, in some systems access to root segment types (those with no parent segment) is usually faster and more efficient than access to dependent segment types. Therefore, frequently accessed segment types will tend to be placed at or near the root (top) segment type of a hierarchy. Also, the exact placement of segment types within the hierarchy (right or left of each other) may also be dictated by the type of transactions required.

After much thought, discussion, and trial and error, a data model schema consisting of a set of hierarchical definition trees is produced. Each data base transaction should be reflected as a navigation through these trees.

For a network system, such as Honeywell's IDS, Software AG's ADABAS, Cullinane's IDMS or Cincom's TOTAL, the enterprise description must be transformed into a data structure diagram. A data structure diagram for the insurance company example would look much like the enterprise diagram of Fig. 1, but without any N:M relationships. Entities are usually mapped into record types, and entity relationships into Codasyl Data Base Task Group relationships into

RELATIONAL SCHEMA FOR INSURANCE COMPANY EXAMPLE

Policy (Policy number, Last activity, Last activity date, Next activity, Next activity date)

Coverage (Policy number, Coverage type, Coverage amount, Premium rate, Issue date)

Client (Social Security number, Name, Address, Birthdate)

Policyholder (Social Security number, Agent number)

Beneficiary (Policy number, Social Security number, Name, Address)

Prior Coverage (Social Security number, Current policy number, Prior policy number, Type, Amount, Rating)

Billing (Policy number, Mode, Amount, Next premium date, Name, Address)

Loans (Policy number, Principal, Balance, Interest rate, Interest due date)

Termination (Policy number, Termination date, Reinstatement date, Termination reason)

Agent (Agent number, Name, Address, Area)

Client Agent (Social Security number, Agent number)

Commission (Policy number, Agent number, Type, Rate)

Table 4. To produce derived relations in a relational data base, it may be necessary to include additional attributes. Here, for example, Policy Number has been added to the schema for Coverage, Beneficiary, Billing, Loans, Termination, and Commission.

DBTG sets (1:N relationships). The data base areas correspond to a natural division of the data structure diagram into disjoint parts (one or more). Each data base transaction is mapped into a navigation through the data structure diagram.

The nature of the DBTG sets—manual (user constructed) or automatic (system constructed) optional or mandatory—reflect the semantic properties of each entity relationship. Any restrictions imposed on DBTG sets must be observed and may require a transformation of the enterprise description before the mapping to DBTG sets is performed.

Consider, for example, the functional (1:N) restriction on DBTG sets. Any entity relationship that is not functional must first be transformed into a (set of) functional relationship(s). This transformation can be accomplished in two ways: duplication, or the introduction of an intermediate record type. In Fig. 1, duplication of "Commission" records would be used to transform the N:M relationships "Policy Commission" and "Agent Commission" into two 1:N relationships. The introduction of an intermediate record type "Client Agent" between "Client" and "Agent" could be used to transform the N:M relationship "Client Agent" into two 1:N relationships. The "Client Agent" record type can be empty (containing only linkage data) or it can contain attributes common to both the "Client" and "Agent" entities.

For a relational system, such as IBM's System R or INGRES (developed at the Univ. of California at Berkeley), we transform the enterprise description into a relational schema. Entities are mapped into base relations (relations which are permanently stored in the data base). Entity relationships are mapped into base relations if they can't be obtained from joining other data base relations (such as Policyholder and Client Agent in Table 4). Otherwise they are mapped into derived relations which are constructed through "joins" (relations which are implicit in base relations), such as Policy and Coverage being related by Policy Number.

If derived relations are used very frequently, they can be mapped into permanent joins if the system permits, such as links in System R. Note that to be able to produce derived relations it may be necessary to include additional attributes in an entity, as in Table 4. Data base transactions are mapped into relational operations on the base relations.

The result of transforming the enterprise description into a data model schema according to a particular DBMS approach represents a documentation of the data base structure. In addition, we have a navigational sketch of each transaction to be performed. The schema(s) and navigational sketch(es) should again be discussed with the different departments in order to obtain their approval. The final choice of a particular approach, DBMS, and schema may hinge on several factors. Three possibilities arise:

First, a DBMS may have been already selected on the basis of hardware, economic, political, or other considerations. In this case, no choice is possible and the data model schema generation effort is directed toward generating a schema for the particular DBMS.

Second, after completion of the data model generation for each approach, the results may point to an obvious choice. Or the departments may agree that one of the approaches best meets their requirements. In this case, the choice is now among one of the DBMS's within a particular approach. If there are several candidates, then other criteria, such as economics, hardware, and/or user performance, need to be considered.

Third, there may be no obvious best choice for a data model schema. Again, criteria such as economics, hardware, and/or user performance may be used to make a choice.

After a choice has been made, the data model schema and outline of transactions are used for the actual conversion process.

4. CONVERT THE DATA

Data base conversion is the process of transforming existing files and procedures into a format that can be used by a DBMS. Unfortunately, most enterprises begin with this step, bypassing everything discussed so far. Plans to convert existing files to a particular DBMS are made without any analysis of current or future needs, or any determination as to whether the existing files represent the real needs of the enterprise. The end result is that DBMS's are used merely as glorified access methods, rather than for integrating data and improving data utilization, which are the real advantages of the approach.

The physical generation of the data base consists of a phased plan which involves:

1. Relating existing data to the data model schema;
2. Writing the data definition language (DDL) programs which will implement the DBMS schema;
3. Loading the data according to the schema as described by the DDL programs, either from existing files or from newly generated data;
4. Implementing each application using the data manipulation language (DML) of the DBMS according to the outline of the data base transactions;
5. Testing and running each application.

The relationship between the existing files and the data model schema is established by mapping each file field to an entity attribute and then to a data item in a data model schema. Any discrepancies should be pointed out clearly to the appropriate departments. If a field does not have a corresponding data item, then it is either an oversight or the field outlived its usefulness and is no longer required. If a data item has no corresponding file field, then a data entry process is implied unless the data item can be computed from existing file fields. (Discrepancies are resolved in a revised data model schema, which must be shown to each department for final approval and certification.)

The DDL programs which will implement the schema can now be produced. If several possible candidates for a schema exist, as opposed to DBMS approaches as discussed earlier, some analysis or simulation for efficiency requirements may be helpful in making a choice. Discussions and negotiations with different departments regarding trade-offs may also be necessary. To generate the data files for the data base, some knowledge of the physical characteristics of the data is required, such as:

1. What is the probability of occurrence of each entity?
2. What are the average and maximum number of expected occurrences of each entity?
3. What is the average number of additions and deletions of each entity over a given period of time?
4. What is the probability of a non-null value for each attribute?
5. What is the size (length) of each attribute?
6. What is the role(s) of each attribute—primary key, sort key, security?
7. What is the probability of occurrence ("connectivity") of each relationship?
8. What is the average number of additions and deletions of each relationship for a given period?

After the data files have been generated, loading them from the existing files may begin. The conversion is a very costly process. In fact, it may be the major cost in any data base generation project. Data existing prior to conversion usually come in many formats and structures. Thus several programs usually must be written for every data base file. (In one effort the authors know of, 100 COBOL programs were required to restructure 29 files.) These programs are tedious to write, and nontrivial because they involve accessing many files and extracting and converting data. Errors that occur in this process usually have a broad effect on the resulting data base files. Also these conversion programs are commonly used only once and then discarded; hence their high cost. (Some work has been done on automating the conversion process, but as yet no commercial packages are available.)

ANOTHER HARD PART

When each DDL program is documented in relation to the enterprise description, it is passed to the appropriate departments for use in application programming. Each application program is written according to its description as a data base transaction using the DML of the DBMS.

General guidelines for these final steps are beyond the scope of this article. However, a phased plan for conversion is necessary. The plan should provide for parallel operations of the current and proposed systems, and for checkpoints. It should also list the conversion utilities needed, indicating whether they will be provided by the vendor or produced in-house. Good planning and analysis in the previous steps should help eliminate major problems and surprises here.

The process of data base generation has been presented as a series of manual procedures. It's obvious that the right automated tools could be very helpful in this process. Such tools should be forthcoming as DBMS's evolve, but right now schema changes are rather difficult and very expensive. Therefore, the aim of the data base generation process should be to produce a good schema, as is the goal of the steps outlined here. ❊

D. C. TSICHRITZIS

Dr. Tsichritzis is a professor of Computer Science at the Univ. of Toronto. In addition to the book he has written with Dr. Lochovsky, he is also coauthor (with P. A. Bernstein) of *Operating Systems* (Academic Press, 1974). Prior to joining the university, he had worked as a consultant at Arthur D. Little, Inc., Cambridge, Mass.

F. H. LOCHOVSKY

Dr. Lochovsky is an assistant professor in the computer science department of the Univ. of Toronto. His doctorate is in computer science with a specialization in data base management systems, and he is the coauthor (with Dr. Tsichritzis) of *Data Base Management Systems* (Academic Press, 1977).


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CIRCLE 107 ON READER CARD

A tutorial on successful data processing performance management.

THE NINEFOLD WAY

by David F. Stevens

Contrary to popular belief, a successful computer installation performance management program rests less upon the technical competence of management than upon its administrative excellence.

What, then, constitutes success? A computer installation may be considered as an organism; like any other organism, if it is not in a state of growth it is dying. Success thus consists of growth, and growth in a computer installation has two aspects: amount of installed computing power, and number of people employed. Faithful adherence to the nine principles outlined here will guarantee a satisfactory rate of growth in both categories *even in the absence of real growth in the institution supported by your computing system.*

1 *First Principle:* Seek the advice and assistance of your mainframe vendor.

It is important to realize at the outset that your vendor desires your success as much as you do, for it is in your success that his opportunities arise. His advice on all matters is motivated by his sincere desire to assist you to augment your computing power: his configuration recommendations, choice of operating systems (and even their design), tools for measurement, suggestions on what to measure, are all directed at ensuring that your requirements for computing equipment continue to grow. His company has man-millenia of experience in the utilization of huge numbers of people to create monolithic systems with insatiable hardware demands. Use the manufacturer's systems, do things the manufacturer's way, follow the manufacturer's recommended procedures, and your success is guaranteed.

If so, why the other eight principles? For two reasons. First, it is better to be the master of your own fate than to be totally dependent upon the beneficence of another, however well-disposed. Second, it is frequently the case that you cannot rely wholly upon any one manufacturer to supply all of your needs. It is thus always desirable and frequently necessary either to do some of the work in-house, or to coordinate a number of external efforts. It is in those situations, as well as in developing a deeper appreciation for the many contributions of your mainframe vendor, that you need to develop your skill in the application of Principles 2-9.

(As near as I can discern, the First Principle is the only one not applicable to general management situations. Principles 2-9 should thus be somewhat familiar from other contexts. But it is precisely the function of tutorials such as this to show you how to apply these general principles in the specific arena of computer installation performance management.)

2 *Second Principle:* Increase management activity.

An active manager is one who gets deeply involved in the tasks under her supervision. Such involvement includes fact finding, goal setting, dialogue with subordinates, and other praiseworthy activities. These activities all take time. Under a passive manager they may occupy 0% to 10% of the total activity of the work force; under an active manager, especially a *creative* active manager, they may occasionally take even more than 100% of the total activity of the work force. (Suitable redefinition of goals, alone, can ensure that.)

In applying this principle to a computer installation, you must remember that not all of the important managers are human: all schedule-creation and other resource-management modules are managers in this sense, and the more active they are, the better for you. The most fruitful areas of overmanagement in current systems are those involving storage: virtual storage systems and garbage collection (even in single-level systems) are especially recommended as areas of involvement.

A more subtle form of overmanagement, but one which requires advance planning (for these gambits can rarely be introduced into a running system), is the use of fully managed, general-purpose, slow-but-sure procedures in place of specific, efficient, special cases. Two examples of this behavior which I have encountered are:

1. backspace implemented as rewind + read

2. execution-time calculation of offset in such FORTRAN statements as A(1,1,1) = B(2,3).

Active human management can be invoked in all of the usual ways; anyone with extensive experience in the military or any other large organization is familiar with the possibilities here, so I will content myself with discussing a single tactic which is particularly useful in the computing milieu: the scheduled interrupt. The more interruptions you can schedule, the smaller the duty cycle of the installed equipment, the more equipment you need. Some of you, of course, are fortunate enough to have vendors whose products provide enough *un*scheduled interruptions to satisfy your needs.

If you need some additional interruptions, but are already overworking the two basic justifications (preventive maintenance and system development), here are three less familiar possibilities:

1. reconfiguration

2. system cleanup (some systems help you out here by failing to reclaim released space in various situations)

3. preservation of order and accountability across shift changes.

3 *Third Principle:* Complexify.

In some sense this is the essence of overmanagement, but it is sufficiently well-defined to merit individual consideration. The more complex a procedure, the less productive the unit which uses that procedure, and hence the more units—people or machines—that are necessary. That is, of course, the area in which vendor software is unsurpassed. Vendor success is largely a consequence of the Law of Large Numbers (see the Fourth Principle), but there are a number of opportunities open to you, even with your more limited resources. Among the devices which have achieved success in many installations are:

1. suggestively incomplete documentation, in which the reader is invited to draw an "obvious" conclusion . . . which turns out to be false;

2. subtly incompatible contiguous systems, whether contiguous in time or in space (i.e., whether as successive variants running on one machine, or as simultaneous slightly specialized variants running on several);

3. error-intensive syntax, especially for job control:

a. positional parameters instead of keywords (e.g., RUN,,,,,,,,A.)

b. multiple (contradictory) meanings for a single keyword (e.g., R = Read, Ring, Rewind, no-Rewind)

c. multiple keywords for the same meaning in different places (e.g., SL, E, R all meaning "tape label exists")

d. letter-number confusion (e.g., O = 0)

e. long, non-mnemonic, nearly identical names (e.g., BXQZ1A, BXO2IA).

With respect to procedures in such human areas as work submission, I once again bow to the real world: you can do no better here than to emulate your government (whichever one it might be).

4 *Fourth Principle:* Iterate as necessary: "Two heads are better than one."

This is based upon the Law of Large Numbers as it applies to the process of system design:

$$0 \alpha N^2$$

i.e., overhead is proportional to the square of the number of members on the software development team. (This is, by the way, a conservative statement of the Law; some observers claim that the exponent should be $2 \alpha \sqrt{M}$ or even 2M where M is the number of managers, instead of a simple 2.)

I believe that everyone is so familiar with the operation of this Principle that further exegetical remarks are unnecessary.

5 *Fifth Principle:* Design for the ages.

This may appear to be somewhat off the subject of performance management, but in fact it is not. Design is a significant element of the performance of any system, and full performance management involves management of design. This is too large a subject to do more than touch upon, and it has been the subject of intensive discussion recently. This is another area where you have much to learn from your vendors, for the surest way to develop systems with all of the attributes which contribute to success as I have defined it is the classical vendor approach:

1. smother all problems with numbers of bodies;

2. insulate your designers from all distracting influences (users are distracting influences);

3. insulate your implementers from all distracting influences (designers are distracting influences);

4. insulate your maintenance personnel from all distracting influences (implementers are distracting influences);

5. design every conceivable thing into the system;

6. fix the (complete) design before implementation starts (and allow no redesign as a result of actual experience).

Others are more competent than I to address this aspect of performance management; suffice it to say that if you embrace monolithic, fixed design and eschew incremental design, then your systems *will* promote installation growth.

6 *Sixth Principle:* Direct your system evaluation effort.

Do not adopt performance evaluation techniques indiscriminately. Systems (and people) respond to the measures used for their evaluation. Thus, if you wish to have a fully utilized system, multiply your system manager's base salary by the percentage of system utilization. Complexity is usually related to size; you can guarantee a suitable level of complexity by evaluating your programmers on the basis of lines of code. Choose your measures carefully, and performance will automatically adapt along your selected lines.

7 *Seventh Principle:* Name your measures carefully.

We have now moved out of the province of the management of performance *per se* into that of the management of the measurement of performance. The management of performance alone is not sufficient to guarantee success. Not only is it desirable that you achieve your performance goals, but you must also provide objective proof of superlative performance. That is the function of the management of performance measurement. Some practitioners go so far as to say that management of performance is unnecessary in an installation which truly understands the management of performance measurement.

The Seventh Principle will be seen to be a subset of the Eighth, but it was practiced long before the other forms of obfuscation came into use, and is therefore considered separately.

The importance of a measure in terms of the weight it is accorded by the outside world is often a function of its name more than of its content. People will rarely (if, indeed, ever) question the definition of a measure, especially if it has a reasonable and comfortable sounding name. Some of the prime examples of this phenomenon are:

1. "availability," which measures scheduled uptime instead of availability to the end user;

2. "MTBI" (mean time between interruptions), which measures average scheduled uptime between unscheduled interruptions instead of the mean service interval;

3. "percent saturation," which measures percent of "capacity," under some static, and hence unrealistic, definition of capacity (for capacity is dependent upon workload and scheduling considerations), and which in fact ignores the presence or absence of saturation;

4. "degree of multiprogramming," which counts the number of initiators and not the degree of concurrency.

It makes little difference what you measure so long as its name reflects your purpose.

8

Eighth Principle: Obfuscate.

Obfuscation is the casting of shadow instead of light. If you are to achieve success, you must demonstrate that your overloaded equipment is used efficiently and effectively. The easiest way to approach the problem is to ensure that high measurements have positive names, e.g., "CP efficiency" for "CP utilization." But that is only one element of the obfuscator's arsenal:

1. measure the wrong things: utilization instead of throughput, MTBI instead of service interval;

2. measure the right things in the wrong way: *existence* of overlap instead of *depth*, *means* instead of *medians* and *distributions;*

3. measure things of no significance: average response time.

A general rule to follow is that the easier a measure is to obtain, the more likely it is to be obfuscatory. So take those measures which come readily to hand (which include nearly all averages and percentages), give them jazzy names, and you're on your way to success!

This Principle, of course, is based upon the fact that while figures maybe don't lie, the truths they tell may be irrelevant, immaterial, insufficient: obfuscatory.

9

Ninth Principle: Numbers are an acceptable substitute for judgment.

This Principle underlies the success of the previous two. Upper management would rather be swayed by numbers than exercise judgment, for numbers are reassuringly unarguable; you can adopt the same philosophy. Thus, for instance, you need not attempt the difficult task of evaluating the quality of a programmer's work when you can merely count the lines of code he produces, nor attempt to assess the satisfaction of your users when you can point to 99.5% cpu utilization.

Remember your goal is growth, and growth is measured with numbers.

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DAVID F. STEVENS

Mr. Stevens began his computing career at the Lawrence Berkeley Laboratory in 1960, and is still there. He has held various technical and managerial positions in LBL's computer center, of which he is now the head.

His involvement in performance management began in 1967 with the development of what he believes is the first rational preemptive dispatching algorithm, and with the first of a number of programs using the CDC 6600 peripheral processing unit as a programmable hardware monitor. He claims that his interest in performance management continues undiminished, but has become more philosophical with increasing distance from the technical front lines.

OFF-LINE

Even the proverbial rat race lends itself to automation. Witness the Amazing Micro Mouse Maze Contest, sponsored by the IEEE. About 6,000 engineers, worldwide, have entered the contest to build an electronic rodent capable of traversing a maze. The mouse must be entirely autonomous; it can't be remotely controlled. Even though 6,000 entries are in, don't expect to see thousands of automated cheese-grabbers crawl out of the woodwork. At the first time trial, held at the NCC, only six of an expected 54 mice showed up. The next time trial will be held at Personal Computing '78 in Philadelphia the 25th through 27th of this month.

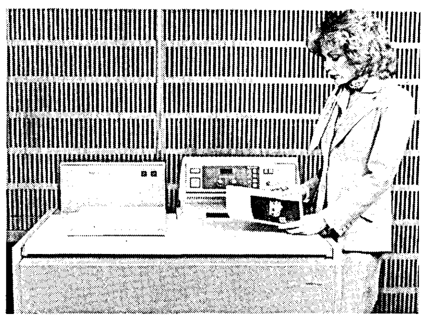
First, Star Wars made a mint. Then, Close Encounters opened with special effects said to go a step beyond Star Wars'. Now Universal Studios and ABC are banking on a television movie/series called Battlestar Galactica. And Tektronix has provided roughly $400,000 worth of instrumentation to keep the Galactica's captain and crew on top of it all. In addition to scopes, multimeters, counters, and function and pulse generators, the Galactica's instrument complement includes ten 4051 desk-top graphic computers. The commander-in-chief, played by Lorne Green, will have an interactive graphics terminal for tactical command and display, real-time fighter simulation, and graphical library printout. Stay tuned this fall to see how big screen special effects, prepared by two Star Wars alumni, translate to your home television screen.

Texas Instruments introduced a talking learning aid, the Speak & Spell, at the consumer electronics show in June. The $50 device, designed for children seven and older, uses a single MOS IC to translate digital speech (in ROMs) into outputs for a D/A converter driving the unit's speaker.

COLOR OUTPUT

If you've ever looked at graphics terminals, chances are the vendor has also pointed out a companion hard-copy unit capable of reproducing the screen with a mere push of a button or a simple software request. But it wasn't until the NCC that we saw what is almost certainly the first such hard-copy unit for color graphics.

Much of the Xerox 6500 color graphics printer has been around since 1973. That's because the machine happens to be based on a modified Xerox color copier that's been on the market since 1973. It's been modified with the addition of a digital (DTL or TTL compatible) interface and laser imaging. It takes about 20 seconds for the color graphics printer to produce a full

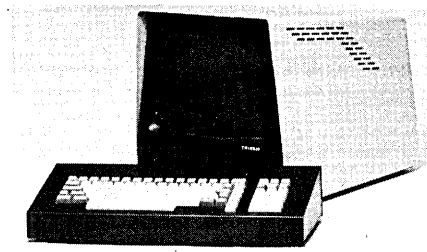


color image—composed of three primary colors—on plain paper. Composite copies are possible using platen (that's the glass window on the copier) or 35mm slide input; the unit can also be used simply as a color copier.

Xerox says it doesn't want to get into the business of building interfaces between the 6500's digital interface and specific terminals. The firm indicates that several color graphics terminal makers have expressed interest in building such interfaces. On the NCC floor the Xerox demo used a Ramtek terminal; we're told building its interface cost around $1,000. The 6500 color graphics printer sells for $25,000. Leases are not offered. Deliveries are slated to begin this month. XEROX CORP., El Segundo, Calif.
FOR DATA CIRCLE 505 ON READER CARD

CRT TERMINAL

The 1061 has the features one would want in a low-cost crt terminal, and a maintenance feature that should really appeal to users in far-flung (and not so far-flung) locations: the unit can be disassembled to assembly-level units in less than two minutes, without any tools. A user can call the factory service number, describe his malfunction, and get instructions as to which subassembly to return to the factory. If he stocks his own spares, he can be up and running in a matter of minutes; if not, he'll

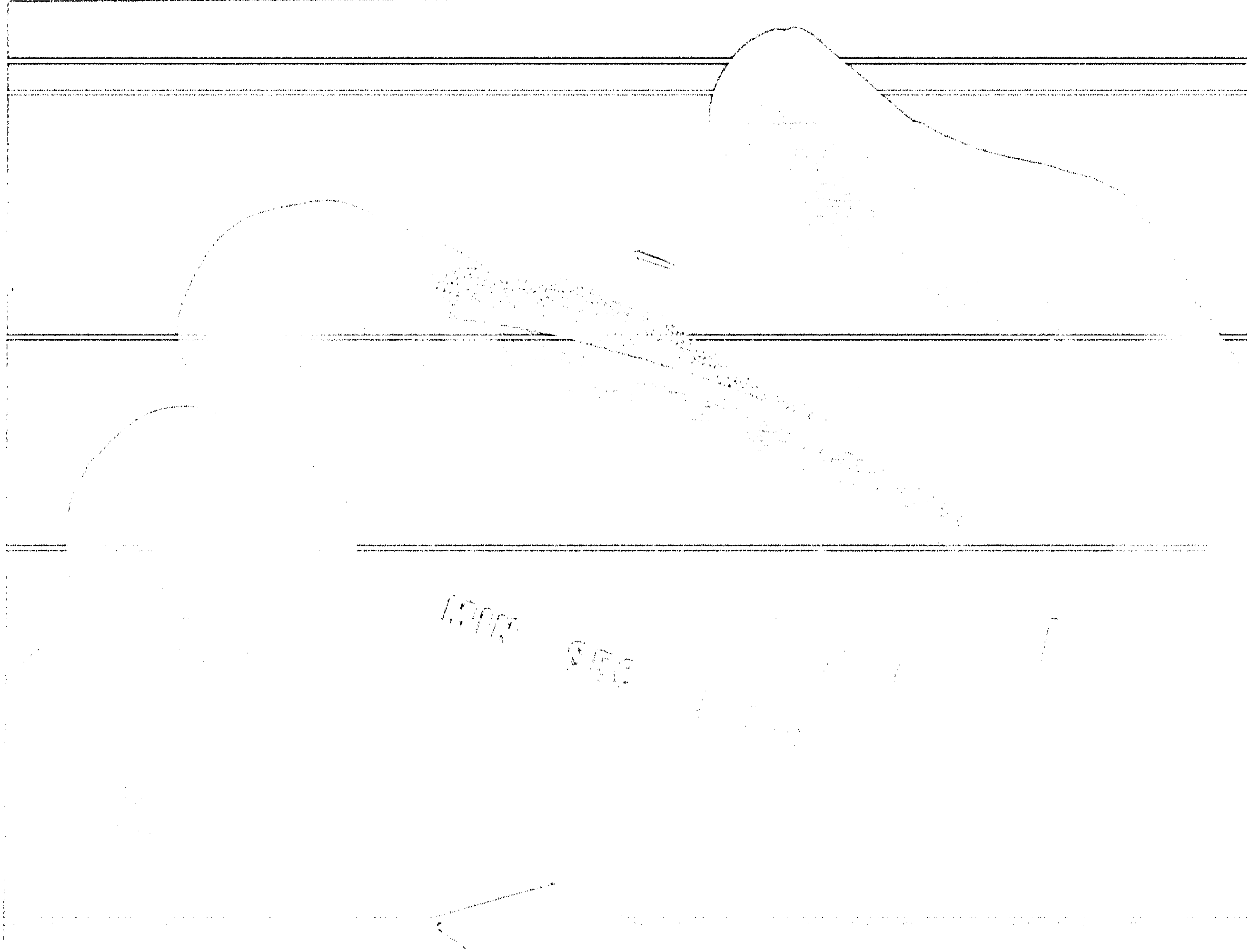


have to wait a day or two for a spare to arrive from the factory. On-site maintenance also is available within a 50 mile radius of any of the vendor's 65 regional service centers. The microprocessor-based terminal displays 24 lines of 80 characters (an escape sequence can put the terminal in a wide character mode with 40 characters per line). The unit can operate in block or character transmission modes, with data rates ranging from 50bps to 9600bps. Editing functions, cursor positioning and sensing, and screen formats with protected fields are all supported. The upper and lower case ASCII terminal comes with an RS232 interface; a 20mA current loop interface is offered as an option. A single model 1061 sells for $1,090; in lots of 100 the price drops to $785. Deliveries are quoted at 14 weeks. RESEARCH INC., Teleray Div., Minneapolis, Min..
FOR DATA CIRCLE 506 ON READER CARD

TIME-SHARING SYSTEM

"The most powerful computing system ever developed by the Naked Mini Div. of Computer Automation . . ." It's an end-user system, indicating the vendor is widening the markets for equipment from this traditionally oem-only division. Perhaps that's why they call the system PROTOS (Greek, meaning "first").

We don't doubt that the PROTOS processor is the most capable, fastest unit ever to emerge from the Naked Mini Div. In fact, we hear the processor, at various times, has been called the LSI-4/95 and the LSI-4/90X, indicating it's a cut above the division's current oem top-of-the-line, the



An E-sized drawing in 13.5 seconds.

Gould's 5400 printer/plotter will produce an E-sized drawing in 13.5 seconds. That's faster than any competing electrostatic printer/plotter. With a paper width of 36" and a speed of 3.25"/second, the 5400 generates over 48 square feet of hardcopy per minute.

Designed for applications where fast turn-around and high throughput rates are important, the 5400 is ideal for computer-aided-design, seismic data plotting, and business graphic applications such as PERT/CPM, Gantt, and others.

Gould's [illegible] closed loop toning system ensures high contrast dry hardcopy even at the maximum plotting speed of the 5400. Print resolution is 100 dots per inch, horizontal and vertical. In addition, a staggered image head produces overlapping dots for high contrast images. A user-oriented control panel features a unique LED system for continuously monitoring paper supply.

For additional information on Gould 5400 printer/plotter capabilities, software, interfaces and special application packages contact your Gould representative. Or write Gould Inc., Instruments Division, 3631 Perkins Avenue, Cleveland, Ohio 44114 (216) 361-3315. For brochure call toll free: (800) 325-6400. In Missouri (800) 324-6600.

GOULD

CIRCLE 30 ON READER CARD

LSI-4/90. We've also been told the processor finally used in the PROTOS system isn't even a member of the LSI-4 family, and it won't be offered as an oem processor. More on this later.

The big story is PROTOS software (that's how the vendor justifies its pricing). The virtual memory operating system looks *tres elegante:* capable, intelligible, and powerful. Supporting concurrent processes, the operating system provides interprocess control and communication facilities. The file system allows hierarchical directories, shared file access, transparent or edited I/O. An Automap feature lets user-specified program regions contain sections of files.

Under this "automatic address space access," users can access data within the file as if they were local variables. No synchronization or I/O is required of user programs making use of this feature. Write into the specified region and the file gets updated.

Unfortunately, the choice of programming languages pales before the operating system. You either write code in a macro-assembler language, or you write in Alamo, a proprietary systems programming language. No industry standard languages—at least not immediately. FORTRAN, BASIC, COBOL, and PASCAL are said to be on the way; but today, it's assembler or Alamo.

The only drawback we see in Alamo is its lack of compatibility—with machines from other vendors, or with other machines in this vendor's product lines. Alamo, said to be philosophically similar to C and BLISS, is a block-structured systems language that allows total machine access, bit, byte, word, double, and real data types, recursion, and address arithmetic. But, it's a new language for programmers to learn, there aren't (to the best of our knowledge) any available applications programs written in it, and it certainly won't migrate to any existing larger machines.

Back to the 16-bit PROTOS processor. It steps above the LSI-4 family by offering cache memory (which reportedly pushes the processing rate to over 1 million operations/sec), and a memory-mapping module that maps each user's 16-bit address (64K word address space) into a 22-bit real address (that's up to 4M words).

A small PROTOS configuration including a 256KB (128K word) processor, eight asynchronous I/O ports, upper/lower case hard-copy terminal, 300 lpm printer, 80MB disc, two floppies, and *all* software (including utilities such as sort/merge and an editor) sells for $100,000. For $200,000 you can get a 512KB system with 16 ports, hard-copy terminal, 600 lpm printer, two 300MB discs, dual floppies, and three crt's, not to mention all the software. Deliveries begin in the first quarter of next year. COMPUTER AUTOMATION, INC., Naked Mini Div., Irvine, Calif.

FOR DATA CIRCLE 507 ON READER CARD

PORTABLE COMPUTER

The Miniterm PRO model 1206 was one of the most interesting products to debut at the NCC. It looks like other portable terminals in this vendor's product line, but it offers one important capability that sets it apart from the crowd: its M6800 microprocessor is accessable to users, allowing the PRO (Programmable Remote Operation) to process programs written in BASIC or assembly language. For the single unit price of $5,485, users get a 17-pound package including 32KB of RAM, a minicassette tape transport (68KB per cassette), 80 character thermal printer, RS232 interface, and software supporting both language processors, editing, and ASR operations. Integral acoustic couplers are optional. The 1206 prints at 50cps, has a 1KB line buffer, and can operate at 1200bps transmission rates between tape, memory, keyboard, or line. COMPUTER DEVICES, INC., Burlington, Mass.

FOR DATA CIRCLE 508 ON READER CARD

TERMINAL

The tabletop model 820 KSR terminal can print at 150cps, while its buffering allows it to send and receive at asynchronous rates ranging from 110bps to 9600bps. The 132-column impact printer can form 95 printing ASCII characters. Characters are formed on a 9 x 7 dot matrix. Features of the terminal include adjustable tractors for forms 3-inches to 14⅞-inches wide, 128 character keyboard, 640 character buffer, answer-back memory, keyboard selectable data rates, and RS232 interfacing. The microprocessor-based unit has self test capabilities and programmable forms control. Options include a compressed character font, international character sets, numeric cluster, full ASCII/APL key-

HARDWARE SPOTLIGHT

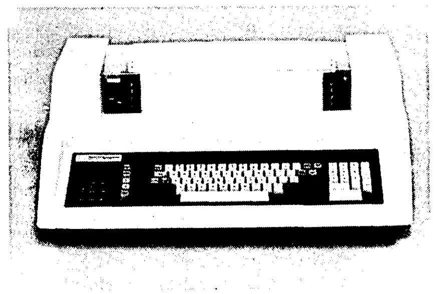
INK-JET PRINTER

It took nearly ten years for the two inventors of this ink-spitting printer to bring it to market. In those years, the "drop-on-demand" printing technology of Ed Kyser and Steve Sears led to the formation of a printer company as a subsidiary of System Industries. A Japanese firm, Konishiroku Photo Industry Co., Ltd., provided about $5-million in capital, receiving, in turn, 49% of the printer company and exclusive rights to the technology in Southeast Asia. A six-year effort, including appeals before the U.S. Patent Office and the Federal Court of Customs and Patent Appeals, brought the company a "broad" patent on its drop-on-demand technology.

The Quietype looks well worth the 10-year development cycle. As its name implies, it's *quiet.* An upper/lower case ASCII printer, the Quietype can print 180cps in its normal 80-column mode, and 210cps in a compressed, 132-column mode. It works with common teletypewriter roll paper and its ink supply comes in disposable cartridges good for six-million characters (about 3,000 pages). With an RS232 interface, a single, buffered, bidirectional mi-

croprocessor-controlled Quietype sells for $2,495. For the time being, the vendor will focus on oem's capable of providing field support. With this in light, it offers the Quietype, unpackaged and without electronics. Ink ($17.50 a can), mechanisms, and packaged printers all get discounted in quantity purchases. SILONICS, INC., Sunnyvale, Calif.

FOR DATA CIRCLE 504 ON READER CARD



board, and device/forms control. A single model 820 sells for $2,395, with quantity discounts available. TEXAS INSTRUMENTS INC., Digital Systems Div., Houston, Texas.
FOR DATA CIRCLE 509 ON READER CARD

TERMINAL CLUSTERS

Teletype Corp. used the occasion of the NCC to introduce "evidence of a change from Teletype Corp.'s traditional product orientation to a user-application orientation," in the words of executive v.p. J. Roger Moody, who also happens to be the firm's chief marketing officer. The Teletype 4500 data system's family of clustered and stand-alone terminals is tangible evidence of the change.

Targeted at the entire spectrum of dp terminal users—interactive, batch, and data entry—the 4500 family will include units compatible with IBM-host communications packages. Initial offerings will in-

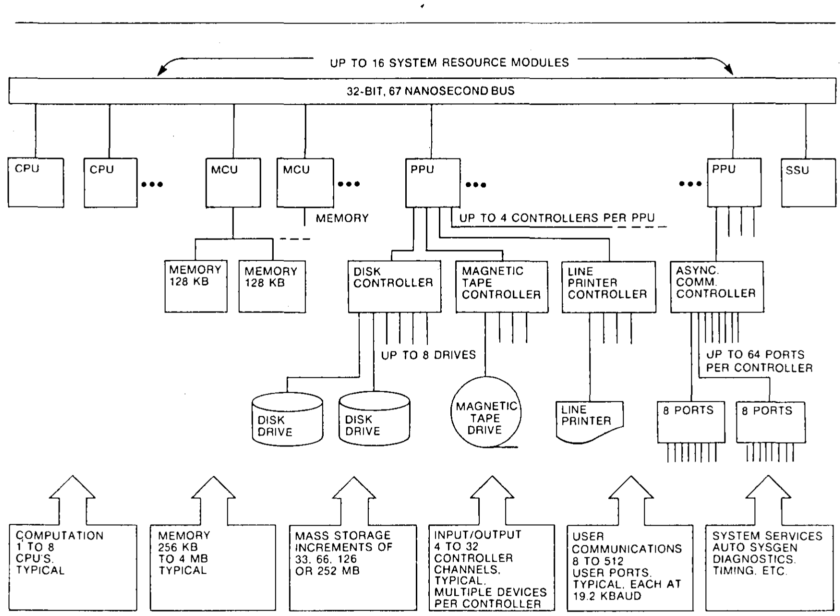
32-BIT INTERACTIVE SYSTEM

The NCC saw this vendor's introduction of its first 32-bit system, the model 8000. The virtual memory system, capable of supporting multiple processors, boasts several interesting twists. Software design preceded that of the hardware. The vendor says this led to the inclusion of instructions for manipulating the data structures commonly used by compiled code; addressing modes were created to facilitate the manipulation of stacks, queues, arrays, and linked lists, with arbitrary-sized data elements. Then there's the system software itself, written in an extended version of PASCAL. And the entire system, which can contain as many as eight processing units, is treated as a pool of resources which can be dynamically allocated by the operating system.

On the hardware side, a model 8000 system consists of up to 16 resource modules connected by a 32-bit, 67nsec bus. A minimal system requires one of each of the four types of resource modules: computational processing units, memory control units, peripheral processing units, and system services units. Additional computational, memory, and peripheral units can be added to fit specific applications. The system's services unit automatically inventories the installed modules at start-up time and sysgens to make use of all modules. It also allows fail-soft reconfiguration around failed modules.

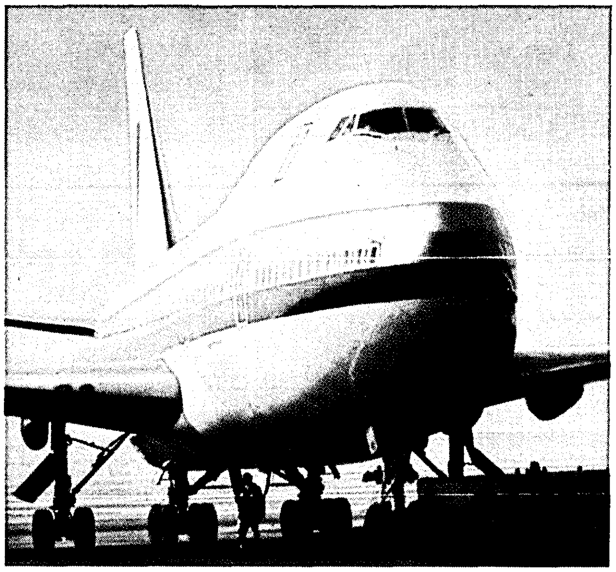
A minimal system, consisting of one processor, 256KB of memory, 33MB of disc, cartridge mag tape (for backup), eight asynchronous ports (up to 19.2Kbps), operating system, utilities, and PASCAL-X compiler, sells for $86,950. The vendor expects typical system configurations to fall in the $100,000 to $500,000 range. Unbundled software offerings include FORTRAN IV, COBOL, RPG II, BASIC-X, and a CODASYL-compliant DBMS. Initial deliveries are slated to begin before year's end. BTI COMPUTER SYSTEMS, Sunnyvale, Calif.
FOR DATA CIRCLE 510 ON READER CARD

BTI 8000 Multiprocessor System



SYSTEM RESOURCE MODULES—FOR COMPUTATION, MEMORY AND I/O—ARE AUTOMATICALLY POOLED FOR EFFICIENT SUPPORT OF INTERACTIVE USERS AND MULTI-STREAM BATCH

At United Airlines, customer service and growth mean the same thing:



INCOTERM®.

United Airlines maintains an average of 1.3 million reservations; every day, they add 90,000 new ones, change 30,000 already in the files, price and print 30,000 tickets, reserves 2,000 cars. And more.

Every hour, United personnel answer more than a quarter of a million separate requests from travelers . . . at 11 reservation centers, 115 airports, 30 ticket offices.

These are just some of the reasons United Airlines relies on over 3,000 INCOTERM Intelligent Terminals.

INCOTERM Terminals are the medium through which United personnel "talk" to the APOLLO computer system. APOLLO responds within two seconds, in simple English, in any location on the system from New York to Honolulu.

APOLLO aids in itinerary planning, flight service scheduling, ground transportation and hotel arrangements, calculates fares from a data base of 325,000 fare items, validates credit cards and prints tickets. And, APOLLO also automatically supports operations, maintenance, ground crews, accounting and administration.

Through APOLLO—and in other major computer systems at United—reliance on INCOTERM Intelligent Terminals keeps growing. United Airlines keeps growing too. APOLLO is one of many reservations-based applications by INCOTERM. Whether a transaction lives for days, as with reservations, or for hours as in banking, or for years as in insurance, the solutions have a lot in common. Write or call for more information.

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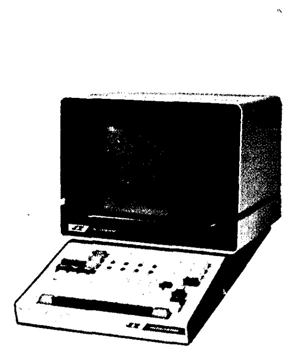

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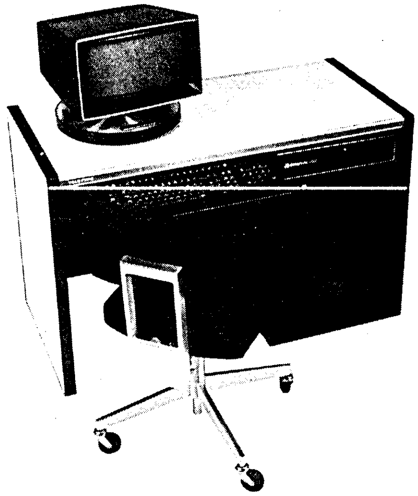
CIRCLE 21 ON READER CARD

clude data entry and typewriter style keyboard modules (with optional numeric keypads, operator badge readers, and keyboard locks), displays for 24 or 32 lines of 80 characters, 132-column printers (a dot matrix unit capable of 47.5cps, and a line printer rated at 300 lpm), and a microprocessor-based controller. The system's modularity should provide user flexibility and, at the same time, allow the firm to respond to future developments as they occur.

The family's initial member is the 4540-

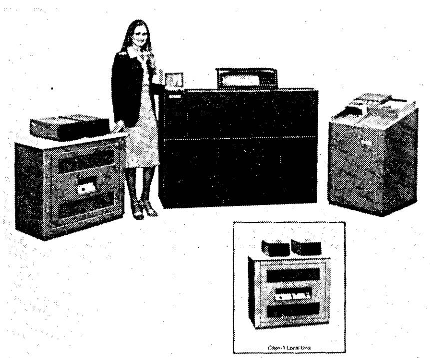


series. These interactive terminals are (surprise!) compatible with the vendor's 40/4 terminal. Available in ASCII or EBCDIC versions, the terminals operate at 2400bps up to 9600bps. Available in single display and clustered (up to 32 devices to a cluster) versions, the 4540 family uses bisync communications and offers compatibility with software developed for 3270s. A clustered system with six keyboards and displays will sell for $17,000. Deliveries begin in the first half of next year. TELETYPE CORP., Skokie, Ill.

FOR DATE CIRCLE 511 ON READER CARD

REMOTE COMPUTING

CAPRI-1, a card and printer remote interface, and RJE stations capable of emulating 2780, 3780, and HASP systems, have joined



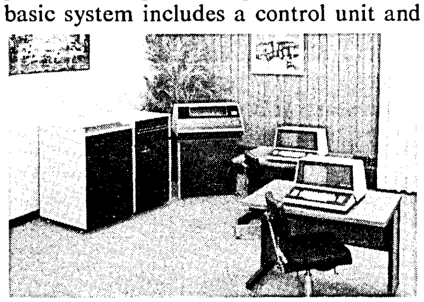
this peripheral-maker's product line. The CAPRI is said to eliminate the need for teleprocessing software such as TCAM, BTAM, QTAM, and VTAM. A local CAPRI unit attaches to a 360, 370, or 303X selector or multiplexor channel; the local unit communicates with a remote CAPRI interface via one or two high-speed lines. The remote unit supports a 1,000cpm reader, and a line printer chosen from the vendor's offerings in the 1,000 lpm to 2,000 lpm range. Built-in diagnostics allow exercising the system off line. A CAPRI-1 remote unit for attachment to a 1,000 lpm printer sells for $51,620; for attachment to a 2,000 lpm printer, a CAPRI-1 sells for $76,620.

The RJE hardware can support printing at up to 2,000 lpm. It consists of a 64KB processor, integrated communications chassis, 10MB disc or floppy disc, line printer (1,000 lpm or 2,000 lpm), 600cpm reader, and crt console. Options include mag tape and an interpreting card punch. The 2780/3780 compatible system uses bisync protocol with data rates of 9600bps or 19.2Kbps. Data can be directed to disc, tape, or printer, and the unit supports compression with multiple-record send and receive. The HASP system offers tapes and/or disc support, data overrun protection, HASP control traffic logging, and HASP/ASP command compability. RJE system pricing ranges from $49,000 to $101,000. DOCUMATION INC., Melbourne, Fla.

FOR DATA CIRCLE 512 ON READER CARD

DATA ENTRY SYSTEM

Users wanting to move their data entry operations closer to the source of the data may find this remote data entry system fits the bill. Capable of supporting one or two crt keystations, the model 77-107 can communicate synchronously, in a variety of protocols, at speeds of up to 9600bps. The basic system includes a control unit and



2.5MB of disc. Eight printers, with speeds ranging from 62 lpm to 1,250 lpm, card readers, with speeds of up to 100cpm, and 9-track 800bpi or 1600bpi tape drivers are offered as options. The 77-107's standard data entry software provides operator statistics, output reformatting, and compare and branch functions. Concurrent IBM 2780, 3780, and HASP communications are optional, and a stand-alone 3780 emulator can support auto-answer for unattended operation. A single station 77-107, with communications, 2.5MB of disc, 62 lpm printer, and communications, leases for $679 per month, including maintenance, on a one-year lease. The same system sells for $23,286. DATA 100 CORP., Minneapolis, Minn.

FOR DATA CIRCLE 513 ON READER CARD

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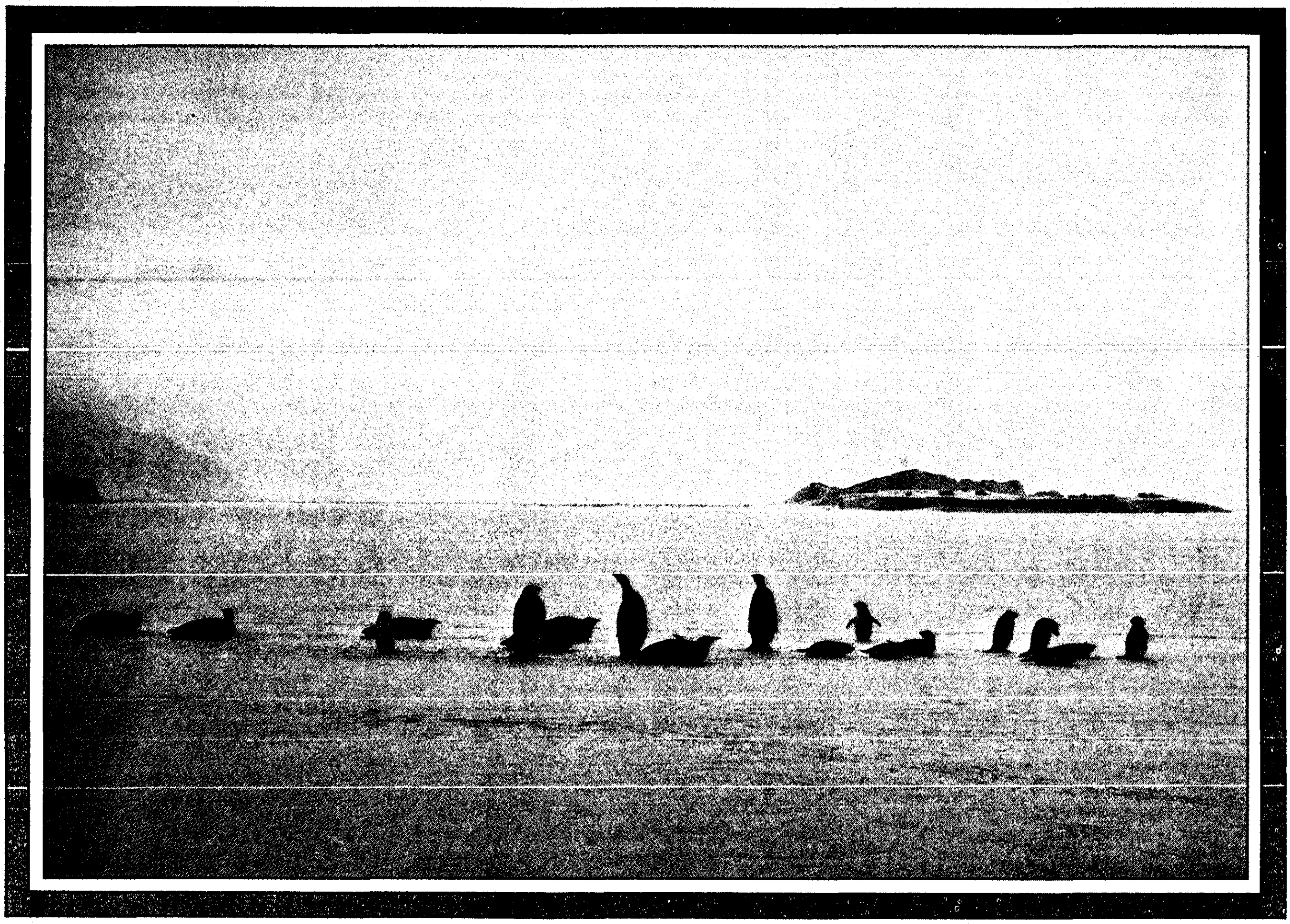

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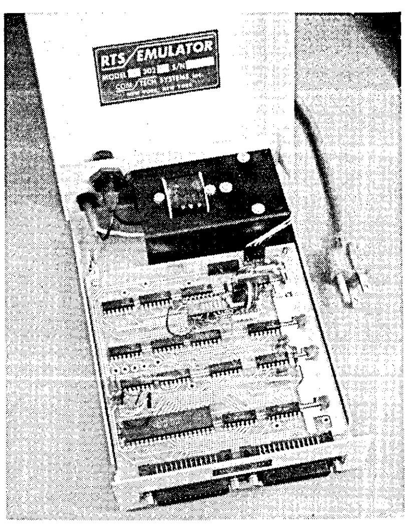
CIRCLE 44 ON READER CARD

ON-LINE SYSTEM/3

Super 3, a combination of hardware and software, will let System/3 model 8, 10 or 12 users go on-line, while retaining full batch capabilities. The package comprises a Local Display Controller (LDC) and an Information Display System (IDS). The software supports file definition and screen format design. System generation, program conversion, and recompilations are not required. The package supports on-line file inquiry, file update, and data entry, concurrent with batch processing. Use of Super 3 requires from 10KB to 16KB of memory. As many as 32 local crt's can be accommodated. Month to month rental on the LDC is $125, on a three-year lease it's $70 per month; purchase price is $3,000. The IDS software goes for $100 per month on a three-year plan. The software became available last month (it can be used with an LCA/3271); the hardware will be available by the end of the third quarter. MEMOREX CORP., Business Systems Div., Santa Ana, Calif.
FOR DATA CIRCLE 514 ON READER CARD

FULL-TO-HALF DUPLEX

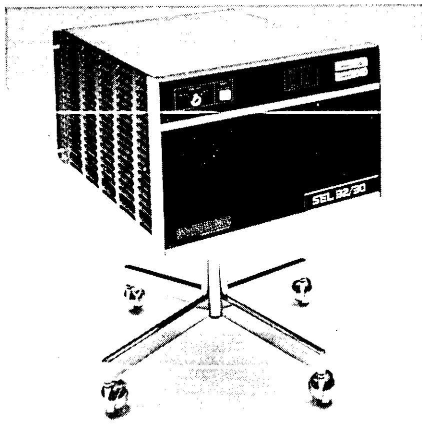
If switching to half duplex communications at higher speeds makes sense for a given application currently limited to full duplex by existing hardware, the RTS/Emulator can make the conversion. While providing full-to-half-duplex conversion, the emulator provides RTS and CTS handshaking. Buffering protects against data loss during the RTS/CTS delay. The RS232-interfaced



converter also can handle data rate conversion and asynchronous-to-synchronous conversion. The RTS/Emulator is offered in several versions with data rates of up to 19.2Kbps. Characters may be 5- to 8-bits in length, and one or two stop bits may be selected. A break signaling option is offered for use with modems having reverse channels. Prices range from $350 to $485. COM/TECH SYSTEMS INC., New York, N.Y.
FOR DATA CIRCLE 515 ON READER CARD

32-BIT MINI SYSTEMS

This well-established vendor of 32-bit machines has added MOS memory versions to its packaged systems product line. Additionally, a 32-bit processor with MOS memory, the MaxiBox, is offered to oem's. And,



just to complete the package, its largest machines got a new operating system.

The MaxiBox, also known as the model 32/30, is intended for the oem and systems-house markets. The 32/30 processor includes floating point arithmetic in firmware, 256KB of error-correcting MOS memory, and a turnkey front panel, all packaged for standard 19-inch rack mounting. The 900nsec MOS memory can be expanded to 1MB in 256KB increments. The basic MaxiBox sells for $27,300.

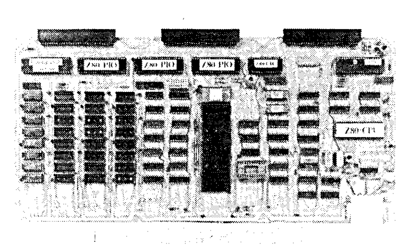
The 32/57 packaged systems series comprises four models. MOS-memory based, these four are said to offer new peripherals and improvements in packaging. Common to all four are floating point instructions, and MOS memory expansion to 1.8MB. The smallest member of the line, the 32/5720, includes processor with 128KB of error-correcting MOS memory, 10MB of cartridge disc, and a 20cps printer/console; this system sells for $43,300. The largest member of the family, the 32/5750, consists of a 256KB processor, 10MB of disc, 300cpm card reader, 45ips 9-track tape, 300 lpm printer, and console crt. The 32/5750 sells for $70,500. The higher performance 32/77 family consists of three members. Direct descendents of the vendor's existing core-base 32/75 family, the new systems have error-correcting MOS memories, and sport a real-time multiprogramming executive and macroassembler as standard equipment. Options include high-speed floating point arithmetic and memory expansion to 16MB. The 32/7720, at the low end, includes 256KB of memory, 10MB of disc, and a 30cps printer/console. It sells for $54,300. The top-end 32/7750 comes with 512KB of memory, 24MB fixed disc, 45ips 9-track tape, 300cpm card reader, 300 lpm printer, and console crt. The 32/7750 sells for $89,100.

The 32/77 and existing core-based 32/75 family can use the new MPX-32 operating system, a real-time mapped program-

ming executive. MPX-32 handles memory management, optimized I/O control, intertask communications, file management and security, interactive terminals, and multiprogrammed batch processing. MPX-32 is available to users at no additional charge. Deliveries on these systems and software are scheduled to begin before the end of the year. SYSTEMS ENGINEERING LABORATORIES, INC., Fort Lauderdale, Fla.
FOR DATA CIRCLE 516 ON READER CARD

MICROCOMPUTER

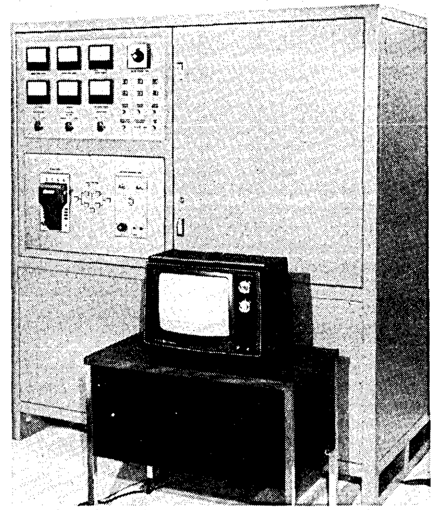
Intended for oem applications, the 90MPS is a single board Z80-based microcomputer



sporting 4KB of dynamic RAM and a 1KB, PROM-resident monitor. The board also contains 1KB of static RAM for a monitor scratchpad, Z80 counter/timer chip, UART with RS232 and teletypewriter serial I/O, two Z80 parallel I/O chips, a PROM programmer, and sockets for six EPROMS (2708 or 2716). The 90MPS sells for $695. A second version, the 90F/MPS, adds a floppy disc controller, capable of supporting up to four single density drives, bringing the price to $995. Quantity discounts are offered; delivery takes between 30 and 60 days. QUAY CORP., Freehold, N.J.
FOR DATA CIRCLE 517 ON READER CARD

UNINTERRUPTABLE POWER SYSTEM

Aside from proprietary improvements inside the box, the largest selling point of the IPM-FA is its front access. During assembly, everything goes in from the front, allowing all maintenance to be done from the front. This means the 415Hz UPS can sit with its back to the wall in large IBM (3032, 3033,



370/168) and Amdahl shops, reducing the amount of floor space required by the UPS. A 75KVA UPS, sporting 15 minutes of battery power, sells for roughly $40,000; delivery takes about four months. Options include a video status display, and a remote status panel. INTERNATIONAL POWER MACHINES CORP., Mesquite, Texas.
FOR DATA CIRCLE 518 ON READER CARD

DRUM PLOTTER

The microprocessor-based model 1012 drum plotter was designed specifically for time-sharing and remote computing applications. Using fanfolded 11-inch paper, the 1012 can plot at speeds of up to 10ips, with a resolution of 0.05mm. The unit's integral controller sports an RS232C interface. Switch-selectable data rates (from 110bps to 9600bps) and a 256 byte input buffer are standard equipment. The four-pen plotter includes a character generator capable of forming 96 characters in specified sizes and orientations. An internal line generator and self-test capabilities are also included. The 1012 sells for $6,500 in single quantities and deliveries are scheduled forJanuary 1979. CALIFORNIA COMPUTER PRODUCTS, INC., Anaheim, Calif.
FOR DATA CIRCLE 448 ON READER CARD

SOFTWARE

UPDATES

The Minority Contractors Assistance Project, Inc., provides small minority contractors with computer services allowing them to compete with larger contractors. The nonprofit Washington-based corporation lends financial and technical assistance to contractors in a number of U.S. cities. The Project's System/32 "makes minority contractors more viable," according to Dickie S. Carter, president and executive director. He says the computer helps minorities "become more competitive through better management."

PROSE, a high-level, calculus-based programming language, has been around since the early 1970s. This past June, a group of users representing major manufacturers in a variety of industries and universities joined together to form a users group. The group intends to promote the use of PROSE, encourage meetings and communications between users, and to encourage major hardware makers to offer PROSE. Currently, versions exist for machines from Control Data, Univac and IBM. The group contact is Frank W. Pfeiffer, Bechtel Power Corp., 12400 E. Imperial Highway, Norwalk, CA 90650.

ANSI currently has three CODASYL specifications advanced as candidates for standardization before the X3 Committee on Computers and Information Processing. Of these, the Journal of Development of the Data Description Language Committee has just been updated to reflect changes in the Schema Data Definition Language adopted as of January of this year. Copies of the Journal of Development are available for $6.50 from the Receiver General for Canada, Materiel Data Management Center, Supply and Services, Canada, 4th Floor, Core B1, Place du Portage, Phase III, 11 Laurier Street, Hull, Quebec, Canada, K1A 0S5.

COBOL

When Data General announced its monster mini, the M/600, we asked "Where's COBOL?" "It's coming," the mini-maker said. Now, it's come, with RPG riding on its coattails. And, to round things out, the vendor announced its Interactive Data Entry/Access (IDEA) applications development tool, INFOS file management system, and a sort/merge utility at the same time. All for Eclipse M/600s and C/330s running AOS.

COBOL represents an implementation of the 1974 ANSI standard. Said to conform to the standard "at its highest levels," COBOL should allow applications developed for larger processors to migrate to the M/600 and C/330. An interactive debugging module is included to speed program development.

The INFOS file management system lets users create, maintain, and access data bases in multiterminal, batch processing, and communications environments. The data base-oriented software is said to minimize data redundancy while increasing throughput.

IDEA provides interactive data entry and inquiry/response. Working with the INFOS file system manager, IDEA allows validation against files at data entry time, and dynamic updating of the data base from interactive terminals.

The AOS implementation of RPG II is said to go a step beyond those available on IBM's System/3, and the DOS versions offered on 360s and 370s. An editor, program analyzer, and interactive debugger aid program development. The implementation also has an interface to the INFOS file management system. Again, the vendor stresses the migration path from mainframe to mini provided by its implementation of an industry-standard language.

Both INFOS and standard AOS files can be sorted, merged, copied, or split by the sort/merge utility. The utility's record selection and reformatting options are said to obviate the need for custom programs, in many instances.

The five software products run on machines having at least 256KB of memory. COBOL and IDEA are priced at $4,000 apiece; INFOS is $2,500; RPG II comes in at $1,500; sort/merge carries a $750 price tag. These are all one-time charges. DATA GENERAL CORP., Westboro, Mass.

FOR DATA CIRCLE 491 ON READER CARD

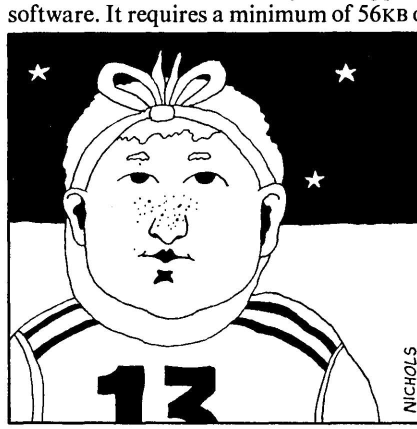
META CROSS-ASSEMBLER

To be general, this cross-assembler had to be a meta-assembler. That's because its target machine is the Advanced Micro Devices 2900-series bit slice microprocessor, a machine that allows the system designer to define his own instruction set. A meta-compiler allows the user to define the object code instruction set, and then assemble programs using that instruction set. This meta-compiler also includes conditional assembly, complex expression evaluation, and cross-reference listings. A separate program in the package prepares object code for loading into ROM's or PROM's. The meta cross-assembler itself is written in ANS FORTRAN IV and will compile and run on any machine with a word length of 16 or more bits. The meta-assembler package carries a price tag of $1,200. MICROTEC, Sunnyvale, Calif.

FOR DATA CIRCLE 492 ON READER CARD

SERIES/1 MIIS/MUMPS

MIIS, a dialect of the recently standardized MUMPS language, is now offered for the IBM Series/1 minicomputer. The real-time, interactive on-line, data base-oriented system provides its own operating environment without the need for any IBM supplied software. It requires a minimum of 56KB of



memory, and can support eight to 16 users (constrained currently by hardware). While MUMPS was developed for hospitals, it finds use in other areas. The vendor tells us that law enforcement agencies in New York use an earlier version of MIIS, written for another mini.

To make the system easy to learn, it comes with a computer assisted instruction module to teach MIIS. Programmers, it is

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CIRCLE 77 ON READER CARD

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CIRCLE 24 ON READER CARD

*100 piece U.S. domestic price

said, can learn MIIS in one to three weeks using this module.

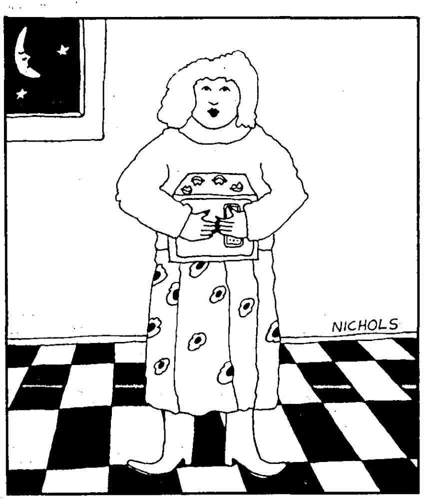
MIIS carries a price of $15,000 for the first copies, with discounts for multiple copies. It will be available for installation next month. MEDICAL INFORMATION TECHNOLOGY, INC., Boston, Mass.
FOR DATA CIRCLE 493 ON READER CARD

MVS/SE ASSIST

There used to be concern that this IBM-compatible mainframe of relatively long standing would find difficulty in coping with IBM's move to microcoded enhancements. Well, the MVS/SE Assist is a software response to IBM's firmware system extension for MVS. And it's said to improve 470 system performance by as much as 12% depending on the customer's environment and system workload. MVS/SE Assist carries a monthly license fee of $250, and will allow 470V/5, V/6, V/6-II, and V7 users to run IBM's MVS/SE software product. AMDAHL CORP., Sunnyvale, Calif.
FOR DATA CIRCLE 494 ON READER CARD

INDEXED FILE SYSTEM

The Keyed Indexed Sequential Search (KISS) system provides 8080/8085 and Z80-based microcomputers with multi-keyed access to disc files. Key and data lengths are user selectable. Coded in assembler, KISS includes an Indexed Sequential File Manager (ISFM) and a Direct Access File Manager (DAFM). It is said that at most three disc accesses are required for KISS to retrieve a given record. Distributed



as a relocatable object module on a formatted floppy disc, KISS is currently available for ISIS-II and IMSAI DOS-A systems. It has programming language interfaces for FORTRAN, assembler, PL/M, and extended BASIC. KISS, including an illustrated user guide, carries a price of $485. The user guide alone sells for $22.50 (plus $2.50 handling and postage). MORROW COMPUTER AND ELECTRONIC DESIGN, INC., Nashville, Tenn.
FOR DATA CIRCLE 495 ON READER CARD

MVS MONITOR

SYSMON IV is intended to aid MVS shops in locating performance problems and bottlenecks. The monitor provides information on paging rates, channel and device activity levels, transaction rates (such as response times for on-line jobs), and page delay time by page data set. Its reports can be accessed via TSO or through batch jobs. Queue lengths, device activity, and I/O count data also are made available. SYSMON provides a picture of what's happening in the system *now,* leaving work-flow analysis to existing SMF reporting packages. The package requires no operating system hooks, and it works with uniprocessor, multiprocessor, and attached processor configurations. It's licensed for $289 per quarter, with a 30-day free trial period. Additional cpu's at the same site can use the package for 50% of the license fee. PERFORMANCE SYSTEMS, Indianapolis, Ind.
FOR DATA CIRCLE 496 ON READER CARD

PHONE COST ALLOCATION

Cost Allocation for Electronic Tandem Switching (CADETS) provides reporting functions to users of Dimension ETS (Feature Package 8). CADETS provides three major reports. The Manager is a detailed long distance usage report. The Accountant provides consolidated statements (by cost center) of telephone expenses. And the Miser compares the cost of using Dimension ETS versus long distance dialing.

On a calendar month basis, the Manager lists calls and charges by cost center. Under each cost center, each call and its originator are listed. The Manager can analyze both Dimension Station Message Detail Recording (SMDR) and local phone company Long Distance (LD) tapes. The Manager can be given lists of phone numbers to be absorbed as system overhead or specific nonbusiness numbers to be noted on reports.

The Accountant summarizes, by group division and department, the Manager reports. Long distance and local phone expenses are itemized.

Finally, the Miser, by providing comparison reports, allows users to structure their telecommunications system in the most economical manner.

CADETS, written in ANS COBOL, carries a one-time fee of $20,000. Its first installation is scheduled for completion on Sept. 1. COMMERCIAL SOFTWARE, INC., New York, N.Y.
FOR DATA CIRCLE 497 ON READER CARD

ARRAY PROCESSOR FORTRAN

This manufacturer, which claims to be the world's largest vendor of array processors, has been in the hardware business since 1970. Its current line of array processors was first put in service in 1975. Since the beginning, its customers have been provided with a math library for conventional processing problems, but have been forced to code main routines in assembly language. That's over now with the introduction of AP FORTRAN, a compiler handling an abbreviated form of FORTRAN IV for use on these array processors.

Since the attached processors handle only part of the overall processing, leaving much of the nonscientific work to the host mainframe, the compiler does the same. Missing from its repertoire are such things as EQUIVALENCE and BLOCK DATA statements, Hollerith character types, and anything to do with I/O. (Double-precision is also missing, but only because the vendor's attached processors already work with 38-bit floating-point numbers.)

The compiler itself is written in FORTRAN, and is therefore easily converted for use on a wide variety of hosts. It's priced at $9,500 ($8,500 if purchased with an array processor). FLOATING POINT SYSTEMS, INC. Beaverton, OR 97005.
FOR DATA CIRCLE 498 ON READER CARD

SOFTWARE SPOTLIGHT

PROGRAMMING TOOLS

After many contract programming jobs, this vendor found itself with a number of handy, commonly used subroutines on hand. So, packaging 30-some-odd subroutines in the Compiler Language Utility Extension (CLUE), the vendor has set out to market these useful tools to 360 and 370 users running under OS. Written in assembler, each subroutine's calling sequence (from COBOL, PL/I, and assembler) is given in the manual, along with full descriptions of each parameter.

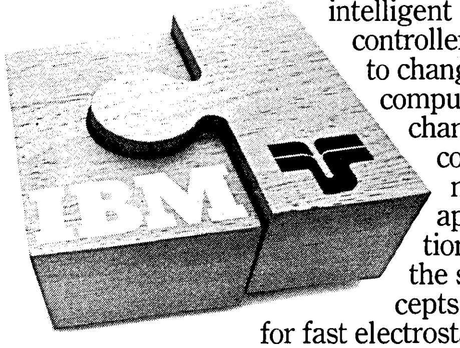
CLUE programs fall into two main categories: system functions, and general functions, useful time and time again in programming. System functions include allocating, scratching, cataloging, uncataloging and renaming data sets; attaching and detaching subtasks; reading the directory of a partitioned data set; reading and writing members of a PDS; and all I/O functions for on-line terminals under TSO. General utility functions include character manipulation (right- and left-justification, centering a line, condensing multiple spaces into single spaces or removing spaces entirely; hashing; and calendar date processing on Gregorian or Julian dates.

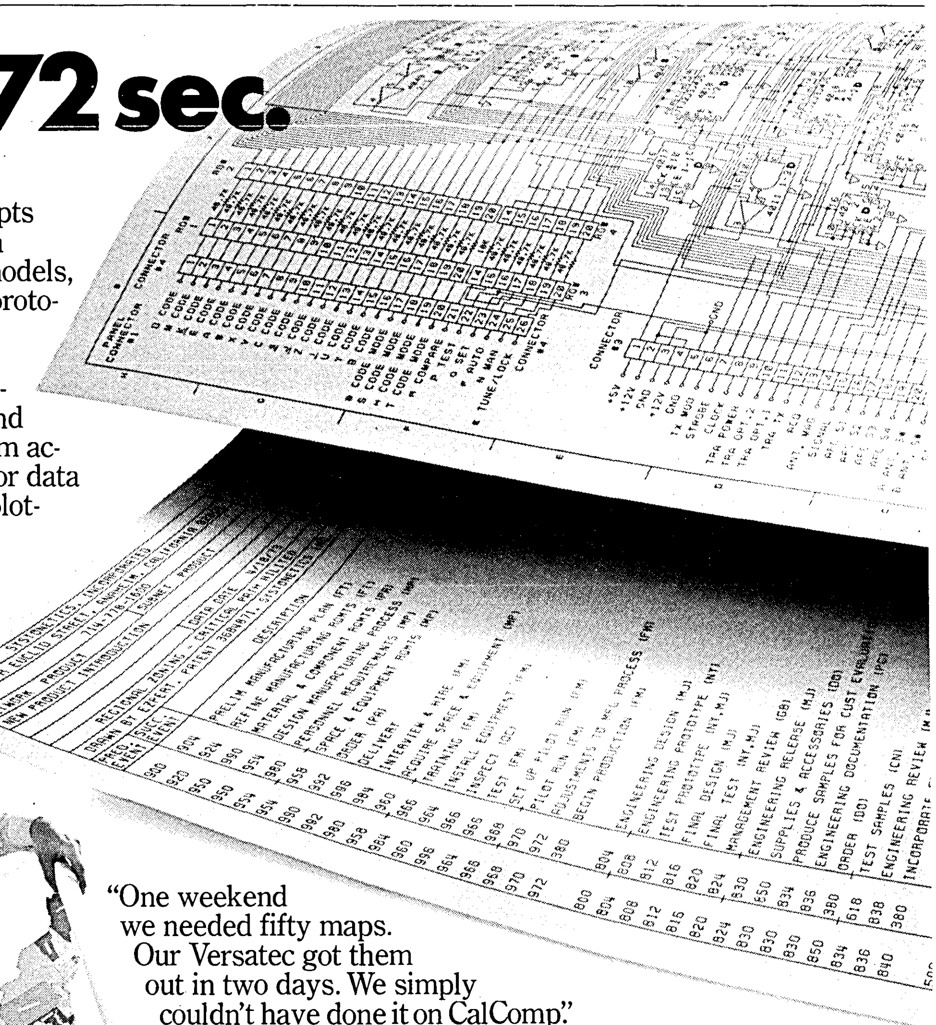
Realizing it can't anticipate the needs of all programmers, the vendor solicits user requests for specific functions. Those deemed sufficiently useful will be added to the CLUE package as quickly as possible. Purchase of the package entitles users to all modules added during the first year. Subsequent maintenance and update service will be priced at 10% of the current CLUE selling price. UNITED STATES ROBOTS, INC., Bethesda, Md.
FOR DATA CIRCLE 490 ON READER CARD

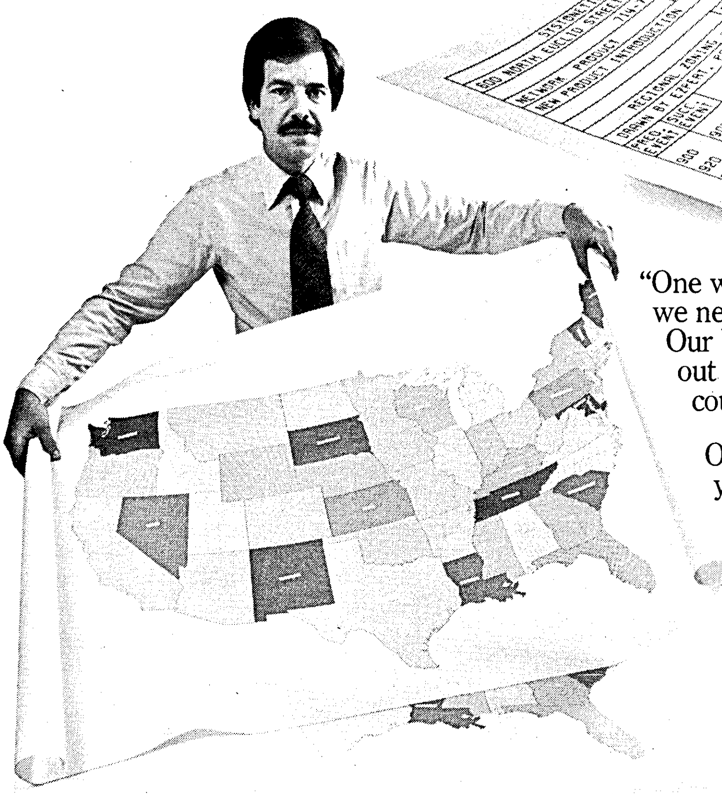
The complete IBM 360/370. Onl

72 sec.

On-line systems emulate IBM 3211/3811 or 1403/2821 printer controllers. No changes are required in IBM hardware, operating system or application software. The intelligent controller adapts to changes in computer models, channel protocols or new applications. And the system accepts vector data for fast electrostatic plotting without excessive CPU or I/O overhead.







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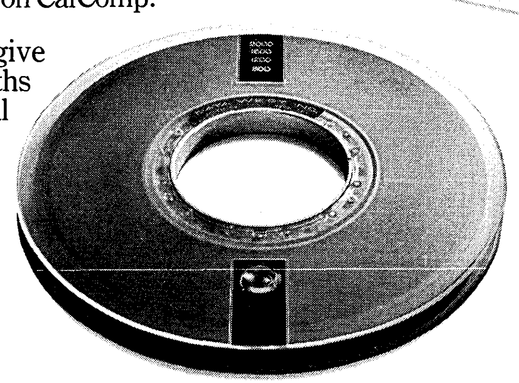

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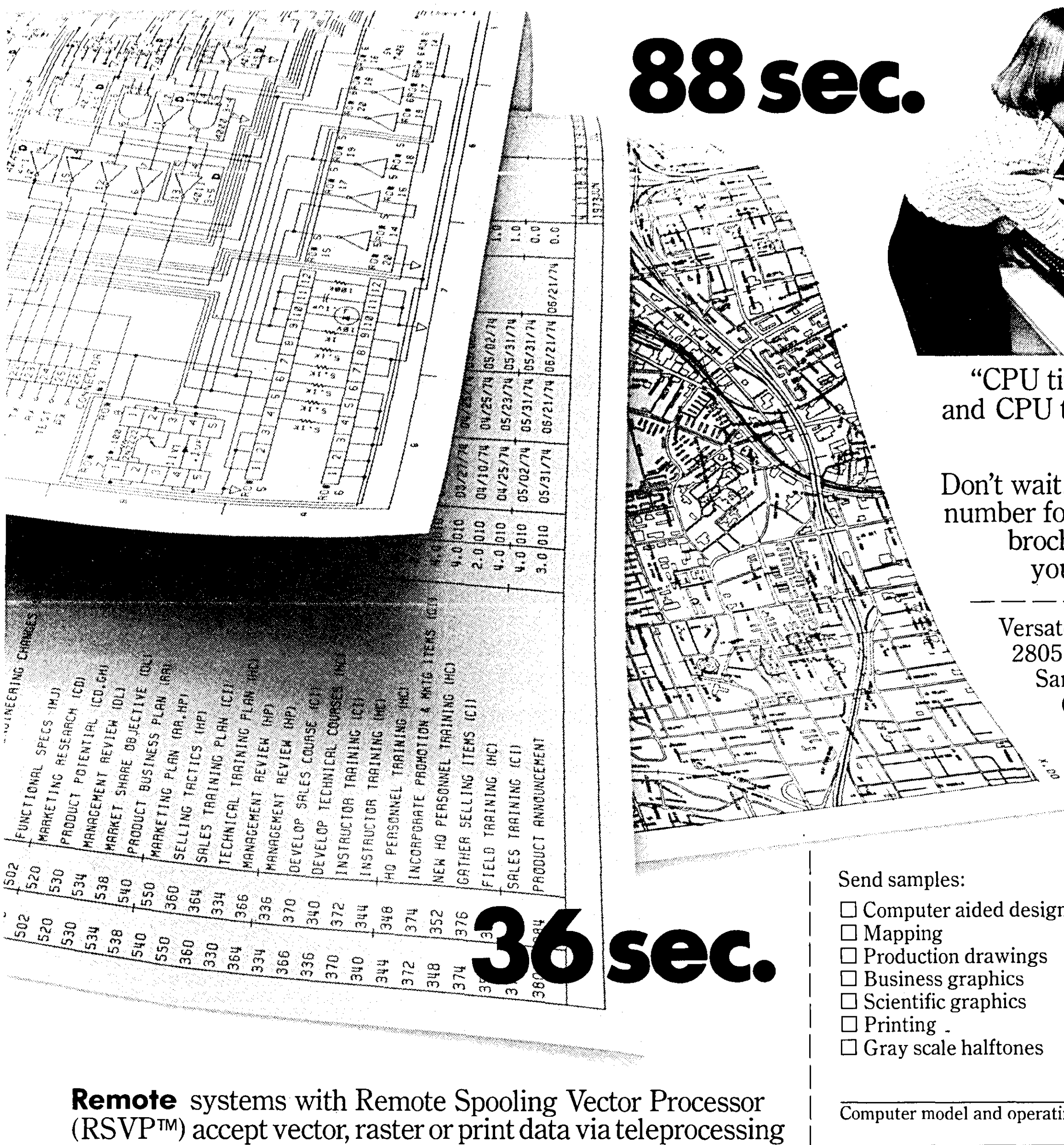

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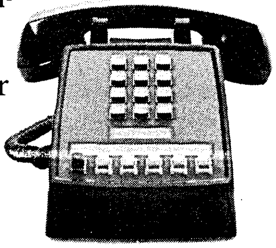

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PERSONAL COMPUTING

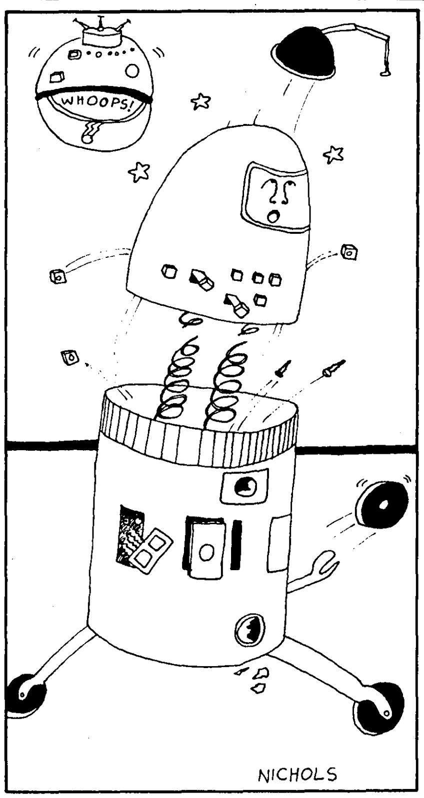
KEEPING THEM UP AND RUNNING

Admittedly there are horror stories about the reliability of personal computers. Such stories can often be traced to problems in configuring, assembling, or testing the system. For example, there is a story that it was necessary for the first purchaser of an Altair computer to park his van on the MITS parking lot in order to get the help he needed. That was an assembly problem, not reliability. Many horror stories can be traced to improperly assembled kits. Other stories can be traced to system configurations of components that were not quite compatible by people who were not knowledgeable about the hidden glitches. Still other problems can be traced to infant mortality of chips that would be found during a proper burn-in period.

The following discussion is of the reliability of properly configured, assembled, and tested personal computer systems.

HOW RELIABLE ARE PERSONAL COMPUTERS?

In looking for the answer I found no published studies on the reliability of personal computers. The case studies given here were acquired by identifying the first 30 customers of The Micro Store in Richardson, Texas, who purchased systems including discs. We assumed that most systems involving discs would be used for business applications. Of those 30 customers, we were able to reach 15 who could and would answer our questions about their experiences in the reliability and maintenance area. The other 15 were not identifiable as individuals because a large company's purchasing department bought the computer, the computer had been purchased for someone else, the customer was unreachable in our time frame, or the customer simply didn't want to answer questions.



Of the 15 cases, only one gave a definite negative assessment of the personal computer, and that case may be caused by software problems. Two cases were neutral, since in one case the disc was never used and in the other the computer system was sold. Twelve cases had positive comments about the reliability of their personal computers. Some of the more interesting cases, both positive and negative, are shown below:

Nickey Naumovich owns two IMSAI computers with two iCOM disc drives, a Model 40 Teletype, and a Diablo terminal. He uses them for solar energy studies. His system has never failed, although there are some problems with static electricity. *(Purchase date: 11/12/76)*

Denny Chadbourne, of Otis Engineering, has installed an IMSAI to handle building security and control 2,000 telephone lines. It is linked to three machines (370 Mod 168, 370 Mod 155, and a 360 Mod 50). It has been in use 24 hours a day, 7 days a week with *no* down time. The cover has never been off. It is often referred to as "old faithful." *(Purchase date: 11/5/76)*

A second system, a SOL-20 with dual iCOM Frugal Floppies, has considerable problems. They have been burning out a floppy per month due to ventilation problems. The Micro Store is presently installing fans.

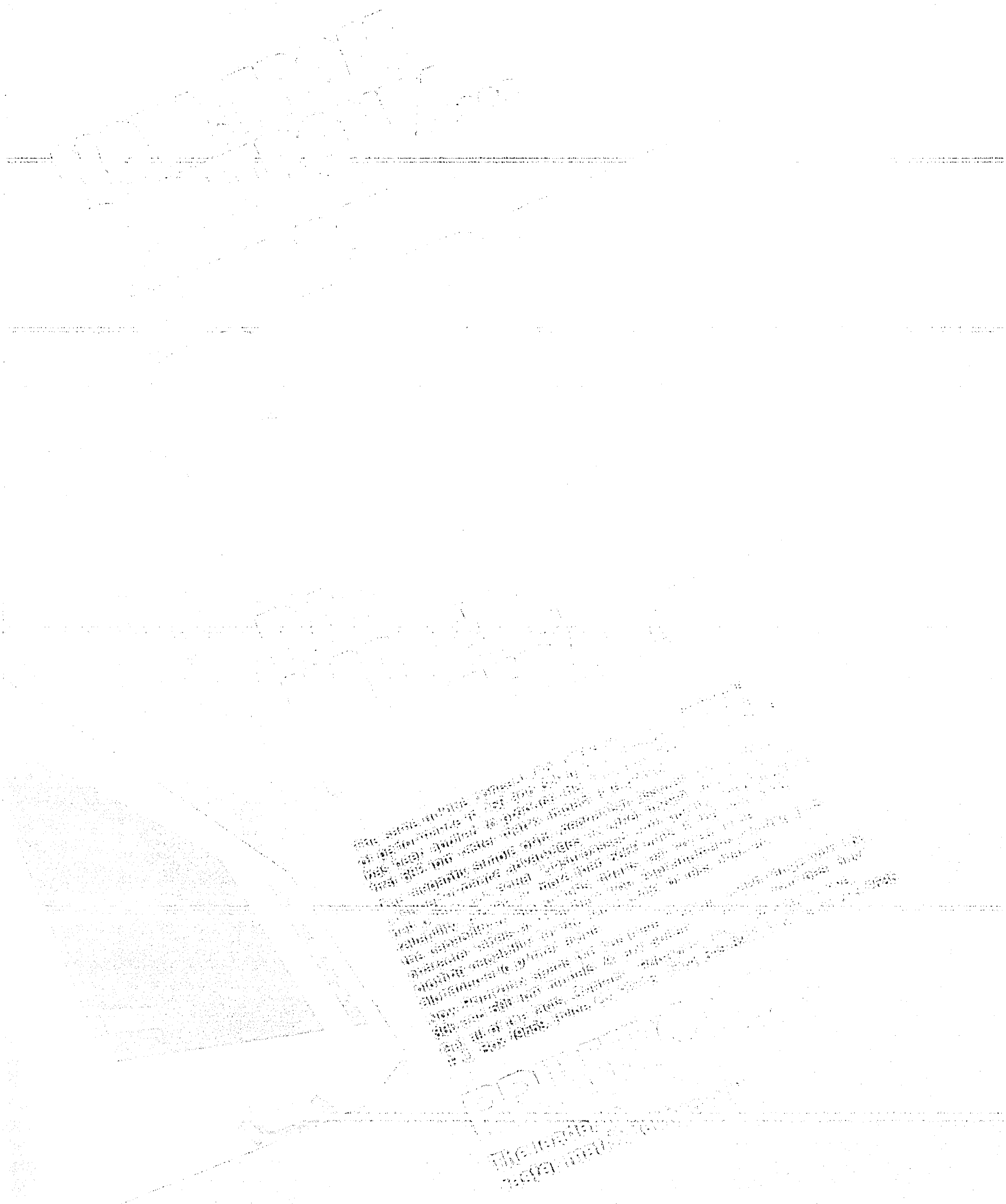
Otis Engineering's confidence in personal computers is evidenced by the fact they have on order 180 systems for use in numerically controlled drilling machines.

Harley Peter, of Crown Communications, Inc., reports that they have had no hardware problems and consider the equipment very reliable. *(Purchase date: 2/9/77)*

Russell Smith, of ON-INC. has an IMSAI with iCOM FF 36-1 discs, a Vector Graphics computer, and TEI computer for use in developing business applications. He reports the Pertec disc failed about eight months ago. The disc was returned to Pertec for exchange repair at a cost of $160. *(Purchase date: 12/29/76)*

A Dallas CPA who uses his system for accounting reports the one maintenance problem in a year was a faulty I/O board, which was exchanged at The Micro Store for a small fee. He considers the system highly reliable. *(Purchase date 2/22/77)*

Mike Graham, of Petroleum Instruments,



uses a Cromemco Z-1 with 64K bytes of main memory and iCOM disc. He reports that since December 1976 the system has been down four times for short periods. The last failure was for 30 minutes. The first failure they thought was the disc controller. It was sent back to iCOM which could find no problem. Later, the problem was found in the multiplexor board and they fixed it themselves. The last three failures were memory chips that changed a bit so that the program would not run. With the on-board memory test programs, they found the bad chip and replaced it themselves.

Mike Graham, who has had considerable experience with large systems, thinks the reliability of micros is superior. *(Purchase date: 11/22/76)*

Captain Edward P. Grant, USAF, has a TDL Z-80 and iCOM floppy discs that he uses for games, piloting information, and electrical engineering. He had one out-of-warranty floppy repaired for $125 after four or five months of use. *(Purchase date: 4/30/77)*

Louis Bone, of Cable Vision, has two identical IMSAI computer systems with dual iCOM floppies which he uses for business applications. He reports that one floppy failed in late 1976, but was replaced under warranty. He is trying to convince a friend to buy a similar system for inventory control in five retail stores. *(Purchase date 5/2/77.)*

One person reports that he is very unhappy with his system because it forgets to add, even though it prints out, and forgets to carry into year-to-date. He knows it is not a software problem because his son-in-law writes the software. He knows the software is good because that's his son-in-law's business. *(Purchase date: 4/15/77)*

COMPUTER STORES SPEAK

These specific user experiences present one side of the picture, that seen by the users of a variety of equipment from a number of different vendors. For a wider view, a number of retail computer stores told us of types of service they offer. They give an indication of the cost of maintenance and of the sorts of service most appropriate to this market.

Dick Heiser, the proprietor of the first computer store, reports that The Computer Store (Santa Monica, Calif.) will provide service either in the store or, for equipment under maintenance contract, at the customer's site. The Computer Store will service only equipment that they originally sold, since their good service is a major reason for buying from them rather than another store.

The Computer Store sells maintenance contracts on a 12-month basis. Under such a contract, the customer's system is either repaired in 24 hours or loaner equipment is provided. The usual charge for such a contract is $25/month for a 32K computer, $30/month for a dual disc, and $10/month for a crt. The Computer Store will arrange a maintenance contract on a printer with a printer service company. An entire business system is, therefore, covered for about $100/month.

Dick reports that, in his opinion, the typical expenditure of a business user of a personal computer system purchased from his store is about $200/year if the system is not under a maintenance contract. The Computer Store has priced in-the-store maintenance on a by-the-board basis and on an hourly basis. Typical board repair costs on the by-the-board basis are $30 to repair a cpu board, $10 to repair an 8K memory board, and $25 to repair a serial I/O board. They are now considering a return to hourly pricing. Their hourly rate will be $20.

The Computer Store warrants assembled systems for 90 days. Warranty service is done only in the store. They are considering a surcharge for field warranty service with a 24-hour response guaranteed.

Larry Stein reports that The Computer Mart (Iselin, N.J.) will provide service either in the store or, for an additional charge, at the customer's location. Service is charged at $20/hour in the store and $30/hour at the customer's location.

Business systems are commonly sold with a maintenance contract. Maintenance contracts are priced at about 15% of the system purchase price per year. (That's $1,200 a year for an $8,000 system.) The maintenance contract provides no guaranteed response time, although references provide a history of response in less than 24 hours, with most systems operational in less than 48 hours. If the business will agree to stock their own spares, the cost of the maintenance contract is less.

Larry estimates that the actual cost of maintenance for a business system sold by his store is $300/year. He says that as computer stores move more into the end-user market, maintenance contracts will become common. By next year, he thinks, 90% of all systems sold by computer stores will include a maintenance contract.

According to Forrest Hurst, Microcomputer Systems (Tampa, Fla.) does maintenance in the store at $20/hour and at the customer's location at $30/hour. Maintenance contracts are written for approximately 1% of the total system price per month. Under a maintenance contract, 24-hour response is guaranteed. The actual time to repair is commonly a half day and

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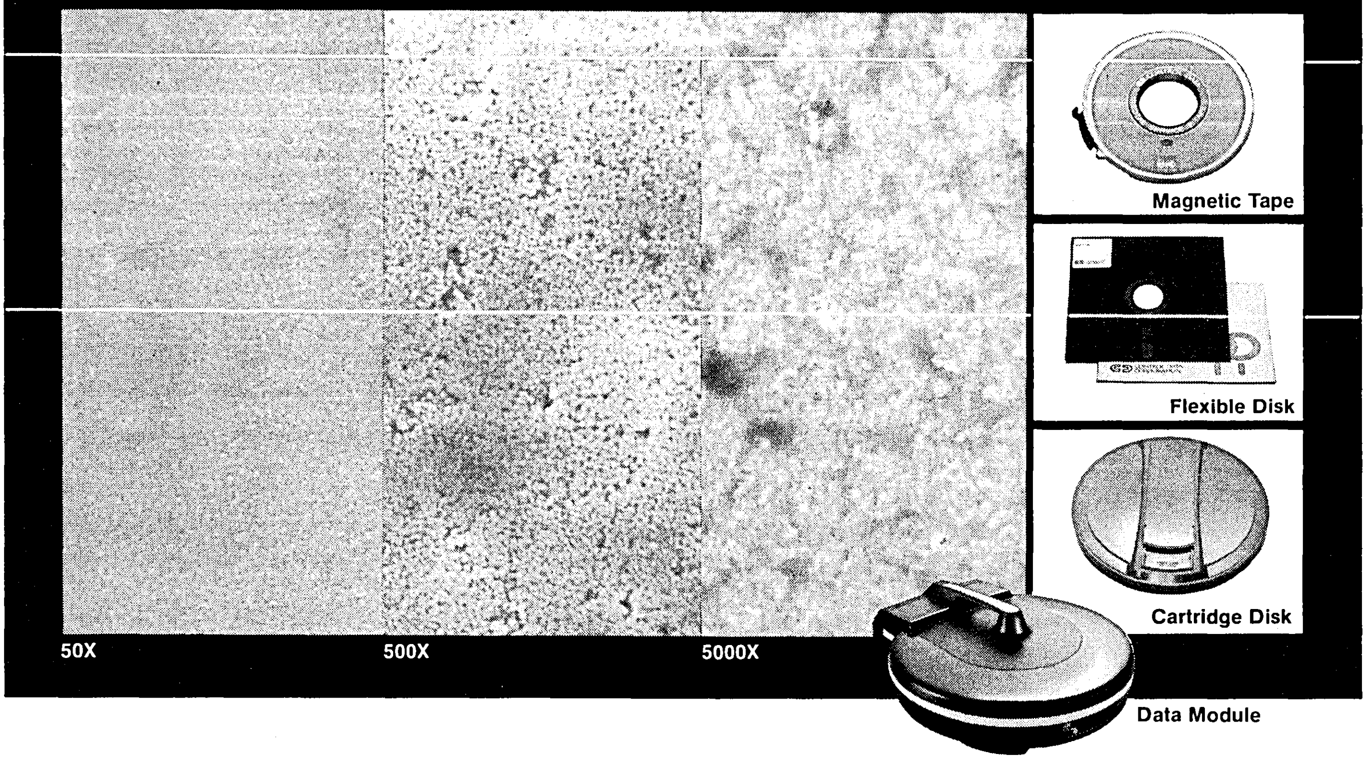

A close look at a section of disk through a scanning electron microscope taken at 50X, 500X and 5000X shows the magnetic oxide coating of the surface. The quality of the surface is of the utmost concern, because of the increasing requirement for higher densities.

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CONTROL DATA CORPORATION

More than a computer company

CIRCLE 35 ON READER CARD

usually within three days. Microcomputer Systems will provide rental equipment for a customer whose system is down or for evaluation purpose. The rental terms are arranged so that the value of the equipment is recovered in one year.

Forrest estimates that the actual cost of maintaining a system not under a maintenance contract is about $100/year. Microcomputer Systems encourages their customers to become self-sufficient in maintenance. A course is offered on microcomputer hardware which provides much of the information needed.

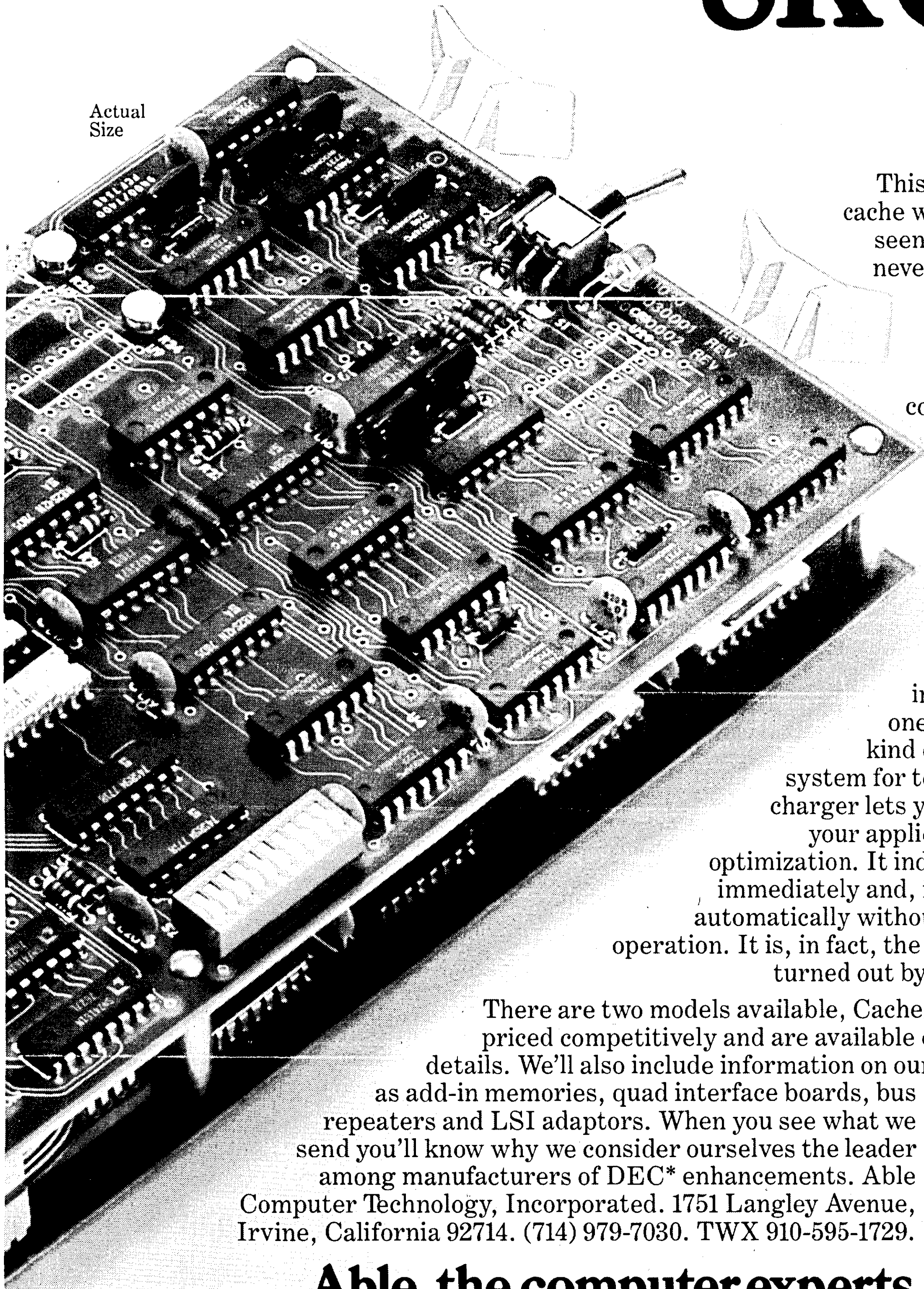
Gene Murrow's stores offer an interesting approach to maintenance based on their experience with 200 business systems in the field. Their records show that a business user spends on the average only $90/year on service. Because of this, the maintenance contract which they offer has been dropped by their customers. Computer Power and Light (Studio City, Calif.) charges $30/hour in the store for service. At the customer's location, most service calls require less than one-half hour, which is included in the mileage charges of $30 for up to 15 miles, $50 for up to 30 miles, and $70 for up to 45 miles. The cost of loaner equipment, if needed, is covered in the service charge. Gene believes that because of the high reliability of personal computers, we may see subscription maintenance coverage offered by stores in the future instead of maintenance contracts. The subscription services would entitle a customer to a discount on service.

Preston Love's computer store not only provides service in the store but also at the customer's location. The typical hourly charge is $20. Datamart, Inc. (Atlanta, Ga.) will sell a maintenance contract for an annual fee of 10% of the total system selling price; however, it is not recommended to the customer because of the expectation that the customer's actual cost for service will be much lower. According to Preston, the service provided by computer stores could be improved if the manufacturer's would offer service classes and better manuals. Another problem faced by computer stores is when trying to make a sale to a company that has offices where it wants to place computers all over the United States. This problem could be solved by manufacturer's service networks, an independent service firm, or cooperating computer stores.

Dave Kominick reports that Quantum Computer Works (Hammond, Ind.) usually charges about $25 per board for repair, unless the board is unusually difficult. In this case, the hourly rate of $25 is used. In the future they may change to fixed fees for different boards. Quantum Computer Works does not offer a maintenance contract. ✲

The Incredible 8K Cache

Actual Size



This is the ultimate version, the 8K cache with everything. You have never seen one like it before, and you may never see another. Designed for the 11/34, 11/35 and 11/40, it has byte and address parity, upper/lower limit switches, on-line/off-line manual switch control, activity indicator lights, 8K bytes of memory (4K words) providing a capacity four times that of competitive units and an interconnect board design which consumes no extra space in the computer.

That's why there is always room in your computer for this incredible cache. You should put one there, especially if you are the kind of guy who likes to optimize his system for top performance. Our 8K super-charger lets you tailor performance to match your application and to establish hit-ratio optimization. It indicates hit rate and parity error immediately and, if errors are detected, shuts off automatically without ever interfering with system operation. It is, in fact, the only intelligent buffer memory turned out by an independent manufacturer.

There are two models available, Cache/434™ and Cache/440™. Both are priced competitively and are available off-the-shelf as usual. Write for details. We'll also include information on our other buffer memories as well as add-in memories, quad interface boards, bus repeaters and LSI adaptors. When you see what we send you'll know why we consider ourselves the leader among manufacturers of DEC* enhancements. Able Computer Technology, Incorporated. 1751 Langley Avenue, Irvine, California 92714. (714) 979-7030. TWX 910-595-1729.

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CIRCLE 45 ON READER CARD

SOURCE DATA

BOOKS

ARE YOUR LIGHTS ON? by Don Gause and Jerry Weinberg

This book is sneaky. It's slim, entertaining, and easy to read. That may fool some people into thinking that it is trivial—that it has nothing serious to say about problem solving, which it is about.

But the authors are serious people with solid credentials. Weinberg is the author of over 10 books, including the popular and influential *The Psychology of Computer Programming.* His teammate at Ethnotech, Don Gause, has taught creative problem solving at the Jung Institute in Zurich, Switzerland. So much for credentials. The book should—and can—stand on its own.

The book is a series of light and lively essays on approaches to problem definition and solving, built on anecdotes (they're too much fun to be called case studies) describing a wide range of types of problems. The problems start with the classic example of poor elevator service used by Edward De Bono to illustrate "lateral" thinking, with a few twists added, indicating there are few tidy problems . . . and that this is not an ordinary book on solving problems.

Most of the problems are not highly technical, and only two could be said to involve computers. And in both cases the problem is solved (to some degree) without the use of one of those magical machines.

But the principles extracted from the examples can be easily applied to highly technical problems as well as to social and even personal puzzles.

As with many truths, the maxims sound all too simple. But as the examples indicate, they are not easily arrived at or practiced. "Don't mistake a solution method for a problem definition—especially if it's your own solution method," is one instance.

There's plenty of practical advice in the book, including easy, sensible techniques for helping you get your mind in gear to tackle a problem, then to define it before trying to solve it. These include how to discover the source of the problem, and whose problem it is.

There are semantic games that can help to make sure that everyone involved understands the problem, and that a proposed solution takes into account the different people's perceptions of the problem.

One example deals with a design problem and shows how what appears to be a simple solution can start a chain of follow-on problems that the "solution" did not anticipate. And there are samples of how to turn "ridiculous" ideas into useful ones.

A couple of the authors' personal pet peeves—smoking and college administrations—sneak into the book. And there is a discussion of moral issues that is too brief to be likely to elicit serious thought by the reader.

You'll either like the casual writing, the drawings, and the comic-book character names, or you won't. If you're looking for a solemn, turgid textbook on solving problems in your information processing work, you will be disappointed.

If you want some new insights into creative ways to approach all sorts of problems, you'll want to read it more than once. It is also a book that you could take home to your spouse and/or high-school-age children. Ethnotech, Inc. (1977), Route 2, Lincoln, NB 68505 (157 pp., paperback, $9.00).

—Bob Forest

BOOK BRIEF

JOB CONTROL LANGUAGE: A SELF-TEACHING GUIDE by Ruth Ashley and Judi N. Fernandez

This clearly written book seems to live up to its title; it is filled with examples and exercises, begins at the beginning, and takes the reader through the steps of learning to code in JCL. The chapters are: Basic JCL Concepts, Elementary JCL, Data Sets on Tape, Multi-Step JCL, Disk Data Sets, Additional Parameters for JCL Statements, JCL in the Real World, and JCL in the Library. John Wiley & Sons, Inc. (1978), One Wiley Drive, Somerset, NJ 08873 (156 pp., $4.95).

COMPUTER METHODS IN OPERATIONS RESEARCH by Arne Thesen

In the preface the author states that the book is designed to fill the widening gap between operations research applications and the limited methods usually taught the engineering student which are not generally applicable to large-scale, real-world problems. The author does a good job in bridging this divergence and has selected topics which are becoming of particular interest to the industrial engineer. In such a short book, depth or breadth must be sacrificed and in this case, the former suffers. Subjects treated are: list processing, sorting and searching, networks, critical path methods, resource-constrained scheduling, linear programming, branch and bound methodology, random number generators, and discrete event simulation. Good, current bibliographies complete each chapter as well as a small set of representative problems.

All-in-all, a pleasant little book to whet your appetite and much easier to read than the several standard texts generally available. Academic Press (1978), 111 Fifth Ave., New York, NY 10003 (268 pp., $19.50).

DATABASE DESIGN by Gio Wiederhold

Books on data base subjects are now plentiful, yet new ones seem to be published regularly. This one covers a broad spec-

trum of data base topics, with emphasis on physical aspects of file organizations and data base structures. The treatment is generally in-depth, and special attention is given to techniques such as simulation and queuing. Reference is made to data base software systems as examples of particular implementation techniques. The book includes a comprehensive bibliography and index, and is suitable as an intermediate level college text. McGraw-Hill (1977), 1221 Avenue of the Americas, New York, NY 10020 (658 pp., $21.50).

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CIRCLE 46 ON READER CARD

FACILITIES MANAGEMENT

Brandon is offering, free of charge, a "Facilities Management Contract Checklist" for users embarking on such an agreement. Contained are some 180 different clauses deemed necessary by the Brandon Consulting Group, Inc.

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PERSONNEL MANAGEMENT

The growing cost of personnel record keeping and compliance with federal regulations are two main subjects that were explored at Information Science Inc.'s 8th National Conference on Human Resource Systems. InSci president Dale Learn, in his remarks at the conference, said he believes "that we are using computers to track people as individuals so that they may increasingly realize their potential," and that "the computer is truly being used as a tool to repersonalize our companies in society instead of the other way around."

Other speakers at the conference included Senator Abraham Ribicoff, who addressed the privacy issue as it relates to employment; Warren B. Buhler, director of the Commission on Federal Paperwork; and Senator Harrison A. Williams, Jr., who spoke on employment trends and legislation. The text of these talks and summaries of the many workshops presented, such as "The Think Tank Approach and the Human Resource System," and "New On-Line Capacity with Your Batch HRS," are available in the Conference Proceedings. $37.50. Information Science Inc., 95 Chestnut Ridge Rd, Montvale, NJ 07645.

HEADHUNTER GUIDE

The ninth edition of the Directory of Executive Recruiters lists 1,400 employment agencies in the U.S., Canada, and Mexico. Contingency-based organizations are listed separately (but agencies that charge the individual are not included at all). Listings are cross-indexed by function, by industry, and by geography. The directory includes sections on writing resumes and on the importance of professional affiliations for recruiters. Also available is an International Directory of Executive Recruiters (alphabetical only). Each $10 (prepaid). CONSULTANTS NEWS, 17 Templeton Road, Fitzwilliam, NH 03447.

PROBING AT&T

Probe Research, Inc. has released two reports on current AT&T situations. In "Terminal Equipment (Interconnect): The Government's Case Against AT&T," Probe concludes that some large issues and potential solutions are being overlooked. The government's strategy and case preparation are discussed, and the government's evidence in the following areas is analyzed: interface devices, equipment registration, AT&T tariffs, inside wiring, new AT&T PBX, key and ancillary equipment, alleged monitoring and harassment by AT&T. The 43-page report sells for $80. A 33-page report entitled "AT&T's License Contract Comes Under Attack," includes analysis and additions to the results of California's PUC staff study in which 70% of AT&T's R&D license contract charges were questioned. $60. Both from PROBE RESEARCH INC., P.O. Box 251, Millburn, NJ 07041, (201) 376-7730.

FORMS MARKET

The total volume of paper used by minicomputer sites is projected to increase 65% over the next five years in a study recently conducted jointly by International Data Corp. and International Business Forms Industries. The report) "The U.S. Market for Computer Output Forms," covers continuous forms output at general-purpose and small business as well as minicomputer sites, including computer site statistics, forms consumption characteristics, and forms data mix—stock/custom, single/multipart, and page size.

The report also predicts a continuing decrease in page size, growing use of one-part forms, and form usage shifting away from large and medium sites—for an estimated 50% drop in market share. $750. IDC, 214 Third Ave., Waltham, MA 02154 (617) 890-3700.

IEEE PUBLICATIONS

A 1978 catalog of recent publications from the IEEE Computer Society is now available. The following subjects are covered: applications and systems; communications and signal processing; COMPCON/COMPSAC; computer architecture; arithmetic, and logic; design automation and fault-tolerant computing; education; microcomputers; pattern recognition and optical computing; software; and switching and automata theory. Write to IEEE, 5855 Naples Plaza, Suite 301, Long Beach, CA 90803.

TELEPRINTER TERMINALS

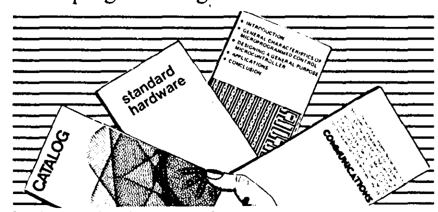
Datapro has issued a new report entitled "All About Teleprinter Terminals," in which users rate DEC and Xerox terminals the highest. Included in the report are specifications of 149 teleprinter-type terminals (from 53 vendors), comparisons between characteristics of various terminals, and an overview of the industry including predictions for the future. $12. DATAPRO RESEARCH CORP., 1805 Underwood Blvd., Delran, NJ 08075; (609) 764-0100.

DATACOMM PRIMER

MIC offers a beginning guide to datacommunications concepts, terminology, and systems, entitled "Datacomm for the Businessman." The report covers the main ingredients and basic configuration of a datacomm system, and brief explanations of common carriers, legislation, communications satellite facilities, and packet-switched communications. $25. MANAGEMENT INFORMATION CORP., 140 Barclay Center, Cherry Hill, NJ 08034; (609) 428-1020.

IMPROVED MAINTENANCE TECHNIQUES

This report gives two approaches for using improved programming technologies to maintain and enhance existing ordinary systems and programs. With the "direct maintenance" approach, for immediate problems, chief programmer teams and a librarian use HIPO and top-down and structured programming methods. The "retrofit" method, for long-term benefits, includes extensions to development support libraries (standard media definitions) and library management systems), HIPO, program classification by function, reformatting and restructuring programs, team operations to develop functional documentation, and the librarian is a programmer technician. The report is based on research, experience, and interviews with the professionals, and also includes capsule descriptions of selected software packages that aid maintenance. Price $6 prepaid ($7 outside U.S. and Canada). SHETAL ENTERPRISES Dept. DNPR, 1787 B West Touhy, Chicago, IL 60626.



DP TRAINING SURVEY

Ninety-eight organizations' responses to a nine-page questionnaire are compiled and interpreted in this report. Comparisons are made between in-house and public dp training; the main reason cited for not sending people to public vendor training courses is budget constraints. The nature of the dp training director's job is also featured, as is budget information. The *Annual DP Training Survey* can be obtained free of charge from BSI (BRANDON SYSTEMS INSTITUTES, INC.), 4720 Montgomery Lane, Bethesda, MD 20014 (301) 986-8611.

ARCHITECTURE RETROSPECTIVE

A special issue of *Communications of the ACM* reveals architectural details of the IBM System/370, Sperry Univac 110, and DEC System 10; the CRAY-1 supercompter, and the Manchester Mark I, Atlas, and and mu-5 systems. Featured are discussions of each computer's development, influence, product climate, and some future direction. Single copy is $5.00 (for non-members of ACM), available prepaid from ACM, P.O. Box 12105, Church Street Station, New York, NY 10007.

TEXT FILE MANAGEMENT SYSTEM

A very colorful, six-page brochure describes this vendor's TEXT-19 FMS (File Management System) which can range from a single station providing word processing capabilities, up to a 14-station system with ocr input and phototypesetter output. The system's 132-column video display terminals are described, along with other available input and output devices. A discussion of software covers text editing, composition, and sorting capabilities. Text and diagrams explain how the TEXT-19/FMS can function as a front-end device for a phototypesetting system. ALPHANUMERIC PUBLICATION SYSTEMS, Div. of Volt Technical Corp., Los Angeles, Calif.

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EDUCATIONAL APPLICATIONS

Teachers and school administrators can refer to this booklet to select among 270 software packages for PDP-8 and PDP-11 minicomputer systems. Titled "IDEAS (Index and Description of Educational Application Software)," the book describes packages developed by users, third parties, and the hardware vendor. IDEAS includes applications covering administration, social and physical sciences, computer science, mathematics and statistics, computer assisted instruction, business, and games. DIGITAL EQUIPMENT CORP., Maynard, Mass.

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MICROPROCESSOR DIAGNOSTIC AID

A six-page, illustrated data sheet describes this vendor's MicroSystem Analyzer. Written for those involved in the design, production test, and field service of microprocessor-based products, the data sheet describes the MicroSystem Analyzer's in-circuit emulation, and signature analysis capabilities. The portable unit's capabilities in time-domain measurement also are explained. An illustration identifies the device's operating displays and push-button controls. MILLENNIUM SYSTEMS, INC., Cupertino, Calif.

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MICROPROCESSOR-BASED MODEMS

The MPS family of 9600bps, 7200bps, and 4800bps microprocessor-based modems are described in a 12-page, four-color brochure. Diagrams illustrate the many possible ways the modems can be installed, including single port, multiport, and multiport with modem sharing. For each of the three operating speeds offered, the basic modem and its optional capabilities are described in text, photographs, and diagrams. A table summarizes the characteristics of the modems in their many possible configurations. Another table summarizes the technical data which characterizes each modem. RACAL-MILGO INFORMATION SYSTEMS, INC., Miami, Fla.

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BUSINESS SYSTEMS

Two brochures, one addressing the word processing capabilities of this vendor's systems, the other a generalized "Computer Shopping List," have been published by this small-business-system vendor.

The vendor's "Common Sense Approach to Word Processing" begins with a brief definition of terminology and an overview of the three basic elements of its word processing software—the test editor, correspondence typing module, and the text printing module. Section headings include operating simplicity, systems capabilities, hardware specifications, and printer specifications.

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Ten questions that potential small business system users should ask before placing a hardware order are presented in a six-page, four-color flier. The questions cover

installation, programming, communications, ease of operation, and expandability. A postage-paid postcard is included for requesting more information from this vendor. QANTEL CORP., Hayward, Calif.
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MICROCOMPUTER SYSTEMS

Although this vendor's Summer 1978 catalog of microcomputer systems carries a $1 cover price, one of the vendor's marketing men manning the firm's booth at the NCC said they'd be more than happy to send complimentary copies to any of our readers expressing interest. The 36-page, illustrated catalog covers microcomputer systems, cpu's, memory, I/O, disc software, resident software, and peripherals and accessories. Illustrated with photographs and diagrams, the catalog includes descriptions and technical specifications as well as pricing information. The last two pages of the catalog are devoted to listing the 150-plus local dealers selling this vendor's equipment. CROMEMCO, INC., Mountain View, Calif.
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SUPPLIES

Supplies for mini and microcomputer users are listed in this mail-order catalog. The catalog includes templates for programmers and engineers, paper tape winders, media—papers, paper tape, data cartridges, and cassettes, and floppy diskettes—and "storage stuff . . . and accessories for cleaning, repairing, and labeling." The catalog gives prices and includes order forms. ALPHA SUPPLY CO., Northridge, Calif.
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TURNKEY CHECKLIST

A "Checklist for a Turnkey Systems Contract" includes over 150 items commonly included in a systems contract. With equipment prices dropping as capabilities increase, more and more potential first-time users will look at turnkey systems. This checklist is intended to point out the "traps in buying such a turnkey system," along with what to know and what to avoid in turnkey systems contracts. Some of the topics include reliability protection, acceptance tests, scope definition, charges and requirements for added cost items, and software maintenance responsibility. BRANDON CONSULTING GROUP, INC., New York, N.Y.
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DIGITAL CASSETTE RECORDERS

Incremental cassette writers, this vendor's ICT series, are the topic of a 12-page, illustrated brochure. Illustrated with photographs, block diagrams, and timing diagrams, the brochure also provides detailed specifications and pricing information. DATEL SYSTEMS, INC., Canton, Mass.
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OEM MINICOMPUTERS

The Naked Mini LSI/4 family of oem minicomputers is described in a 20-page, four-color brochure. Each of the three processors in the family is described, along with the "Intelligent Cable" interfacing common to the three. Memories, peripherals and software get their due, as does support. COMPUTER AUTOMATION, INC., Irvine, Calif.
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WORD PROCESSING OCR

Illustrated with both photographs and sample input, this 12-page brochure describes this vendor's offerings of optical character recognition equipment for word processing applications. The booklet starts with an overview of how ocr fits into a word processing operation, then gives a brief history of the firm and its initial entry into the ocr market via the publishing business. The main part of the booklet then centers on the vendor's line of ocr page readers and supporting software. Hardware and software options also are discussed. The booklet in-

cludes samples of the type fonts recognized by this vendor's equipment. ECRM, INC., Bedford, Mass.
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MAGNETIC TAPE

"Low Cost Digital Tape Transport Systems," a six-page, illustrated brochure, describes this vendor's miniature closed-loop cartridge tape media and transport. Actual-size photographs show the tape cartridge, bare transport, and transport with read/write electronics. The brochure also includes specs for the media, transport, and read/write electronics. MICRO COMMUNICATIONS CORP., Waltham, Mass.
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INDUSTRIAL CONTROL

The IP300 industrial control microcomputer system is described in this pamphlet. The vendor presents its case in terms of operational advantages, hardware features and system software for the LSI-11-based system. A configuration summary listing standard systems, options, and both digital and analog I/O modules is included. DIGITAL EQUIPMENT CORP., Northboro, Mass.
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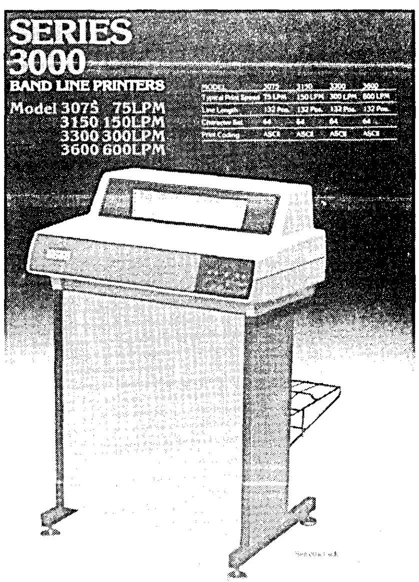
LINE PRINTERS

A four-page, illustrated data sheet describes this vendor's Series 3000 band line printers. The data sheet includes specs,



standard features, and options. A brief company profile is included. DATA PRINTER CORP., Cambridge, Mass.
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DISKETTE DRIVES

Four IMB-compatible floppy diskette drives, marketed primarily to oem's, are described in this eight-page illustrated booklet. Interface descriptions explain input control lines, output status lines, and data lines. Each of the models is pictured and its standard features are enumerated; optional features also are listed. A table provides information on media, recording parameters, power requirements, performance, and physical and environmental specifications. PERTEC COMPUTER CORP., Pertec Div., Chatsworth, Calif.

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DISTRIBUTED PROCESSING

"Distributed Datasystems with DICAM" explains how this vendor's Datasystem 300 series of small business systems operate within distributed processing configurations. The pamphlet discusses communications between both Datasystems and host systems from other manufacturers. Examples are drawn from a variety of applications, including inventory control and credit checking. File utilities, forms handling, and other software tools are described. DIGITAL EQUIPMENT CORP., Commercial Products Group, Merrimack, N.H.

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POLICE INFORMATION NETWORK

An illustrated, 12-page application note describes the New York State Police Information Network (NYSPIN). Although the booklet's graphic design, production, and distribution are provided by the network's terminal vendor, the text, prepared by the New York State Police, presents a description of an actual system, without any sales pitches for the various vendors involved. The booklet explains NYSPIN'S interactions with other computer-based crime information systems, including the National Crime Information Center (NCIC), and the National Law Enforcement Telecommunications Systems (NLETS).

The NYSPIN can be considered to be two subsystems: a message switching system and an inquiry system. The inquiry system prioritizes requests, it is explained, ensuring faster responses for more serious inquiries. This means an inquiry about a wanted individual takes priority over an inquiry about suspected stolen securities. The booklet also gives an overview of the various data bases accessible through NYSPIN. RACAL-MILGO, INC., Miami, Fla.

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TAPE FILING

"If You've Ever Misfiled a Tape," a four-color, four-page brochure describes this vendor's CompuColor Tape ID System. Photographs show how the system works, and how a misfiled tape sticks out like a sore thumb due to the color-coded tape ID numbers. TAB PRODUCTS CO, Palo Alto, Calif.

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MAGNETIC MEDIA

Two brochures describe this vendor's line of quarter-inch tape cartridges and flexible diskettes. The four-page diskette brochure includes a table describing six diskettes; entries include format, recording density, capacity, expected media life, diskette coating, and environmental data. A compatibility chart cross-reference IBM part numbers with this vendor's numbering system.

FOR COPY CIRCLE 539 ON READER CARD

A six-page folder covers two tape cartridges manufactured under nonexclusive license from the 3M Co. A prose description and list of features is given for both cartridges, and a table of technical data. INFORMATION TERMINALS CORP, Sunnyvale, Calif.

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SOFTWARE

A capabilities brochure describes a number of software products which should appeal to a broad spectrum of dp shops. The firm, its personnel, and customer base also are profiled. Product descriptions lead off with the vendor's best-known product, the Mark IV family, including its various relations, Mark IV/Auditor, Mark IV/Reporter, and

Mark IV/EEO. Then there's the Monitor IV line of teleprocessing monitors: Minicomm, Betacomm, and Intercomm. Firms looking into packaged accounting systems may be interested in the modular Accounting IV package, which consists of general ledger and financial planning, accounts receivable, accounts payable, and standard product cost modules. Score, a data management and COBOL program generating package, and Shrink, a generalized data compression and encryption system, round out the product line described in this 12-page booklet. INFORMATICS INC., Canoga Park, Calif.

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370 DATACOMM

Memorex offers a course on basic data communications for users of System/370 and compatible systems. Aimed at systems analysts, programmers, and others with responsibility for planning, installing, and maintaining data communications systems, the course will cover cost and efficiency trade-offs, front-end processing and test equipment, and the identification of functional elements of a datacomm system. The course is offered in a one- or three-day format. The three-day course will include operations and design topics, such as EIA interface operation, coding schemes, line protocols, transmission modes, and exercises in network cost analysis and performance. Three days: $420. One day: $245. To be held at various U.S. locations. Contact MEMOREX CUSTOMER EDUCATION DEPT., 1125 Memorex Drive, MS/0064, Santa Clara, CA 95052 (408)987-2272.

DP AND PROJECT MANAGEMENT

"Data Processing Management," Sept. 18–20 in Chicago, will focus on performance measurement, impact of current technologies, personnel, and organization. "Project Management Workshop," Sept. 20–22 in Chicago, will feature class exercises for learning management techniques for completing projects on time and within budget. The workshop only is offered again Sept. 25–27 in Detroit and Oct. 4–6 in Cleveland. Fee for either the seminar or the workshop is $395, $195 for teams. For the combination (in Chicago) $595, teams $385. Contact: Dept. DTM, AIIE Seminars, P.O. Box 3727, Santa Monica, CA 90403 (213)450-0500.

DATA ENTRY MANAGEMENT

The practical side of data entry is the subject of this course. Discussions are promised with instructors and with other participants for an "interactive" approach. Topics to be covered include: organization of the data entry department, data entry control techniques, personnel communications and motivation, keying standards, productivity, and operator training. The course will be held in Cherry Hill, N.J., September 11–13, November 13–15, and January 22–24. $425 (includes lunch, materials, and a cocktail hour). Contact MANAGEMENT INFORMATION CORP., 140 Barclay Center, Cherry Hill, NJ 08034 (609)428-1020.

CRYPTOGRAPHY

The course objective is to provide each participant with a working knowledge of the use of cryptography in computer applications. Emphasis will be on the needs of commercial users of cryptography. Special requirements for public cryptography and innovative approaches to meeting those requirements will be discussed, and the group will seek to extend the list of requirements based on the input of the participants. $405. September 18–20 and January 15–17 (1979), at The George Washington Univ., Washington, D.C. Contact: Martha Augustin, Continuing Engineering Education, George Washington Univ., Washington, DC 20052 (202)676-6106 or (800)424-9773.

AMA COURSE CATALOG

The American Management Associations'

catalog of course offerings is available to non-AMA members for $3.75. Courses are listed by subject and by region. Information about on-site training is included. AMA, 135 West 50th St., New York, NY 10020.

AUDITING ON-LINE SYSTEMS

Participants will be provided with appropriate practical descriptions and case study analyses for the design and evaluation of systems with multiple security/privacy levels and rigid failure recovery requirements. $475 (includes lunch and course materials). Sept. 20–22 in Denver, Oct. 4–6 in New York, and Nov. 27–29 in Arlington, Va. THE INSTITUTE FOR PROFESSIONAL EDUCATION, Suite 601, 1901 North Fort Meyer Dr., Arlington, VA 22209 (703)527-8700.

LONG-RANGE PLANNING

This five day workshop will present a set of procedures for projecting future user requirements, mediating between competing user priorities, and estimating hardware, software, and personnel needs. Also covered will be the role of system development project controls. $595 (includes lunch). To be held Sept. 11–15 in Jackson Hole, Wyo.; Oct. 16–20 in Washington, D.C.; Oct. 23–27 in San Francisco, and Dec. 4–8 in Miami Beach. In-house sessions are also available. Contact KESTON ASSOCIATES, 11317 Old Club Rd., Rockville, MD 20852 (301)881-7666.

FALL CDC SEMINARS

Control Data's education branch, the Institute for Advanced Technology, offers courses in major cities around the country on the following subjects: computer auditing and control, data base technology, data communications, distributed processing, forecasting techniques, minicomputers, operations and planning, software, and systems design. Fees are $320 for two-day courses, $460 for three-day courses. Contact IAT, Control Data Education Co., 6003 Executive Blvd., Rockville, MD 20852 (301)468-8576. *

A DREAM

(from *Reflections of an Aging Data Processing Manager*)

I dreamed I had a giant brain
That I needn't program, only train.
It could read users' minds, and meet their needs
Heuristically, learning from data feeds.
Stalwart guardian of the data resource,
Gracious partner in terminal discourse.
Self-adaptive to management whimsies,
Self-diagnosing when it got the mimsies.
This dream was a nightmare, because, you see,
The giant brain had no need of me.

CREDO

(from *Reflections of an Aging Data Processing Manager*)

I believe that some day software tasks,
However large, ambitious and complex,
Will yield to techniques structured, top-down, new
And always be on budget, time and specs.

I believe that some day microcodes,
Multilinguists of agility,
Will bring my systems to my cherished goal,
Transparent compatibility.

I believe that some day user needs
Will be defined and understood so clearly,
That I can offer systems robust, stable,
Friendly, graceful: all will love them dearly.

I believe that some day I'll be close
To managers' ideas and plans a-borning.
I'll be a full-fledged member of the team,
And of new needs obtain an early warning.

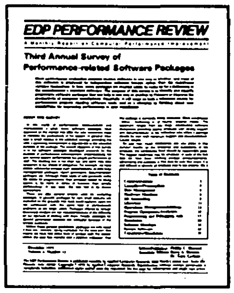
And the sun will rise in the west some morning.

—Ted Withington

The Marketplace...

advertisers' index

EDP PERFORMANCE REVIEW



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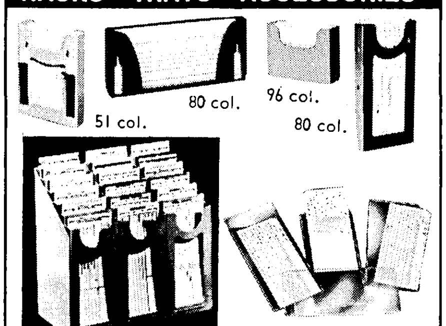

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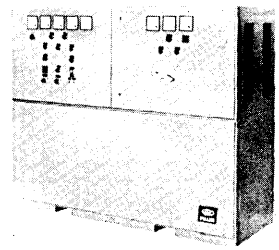

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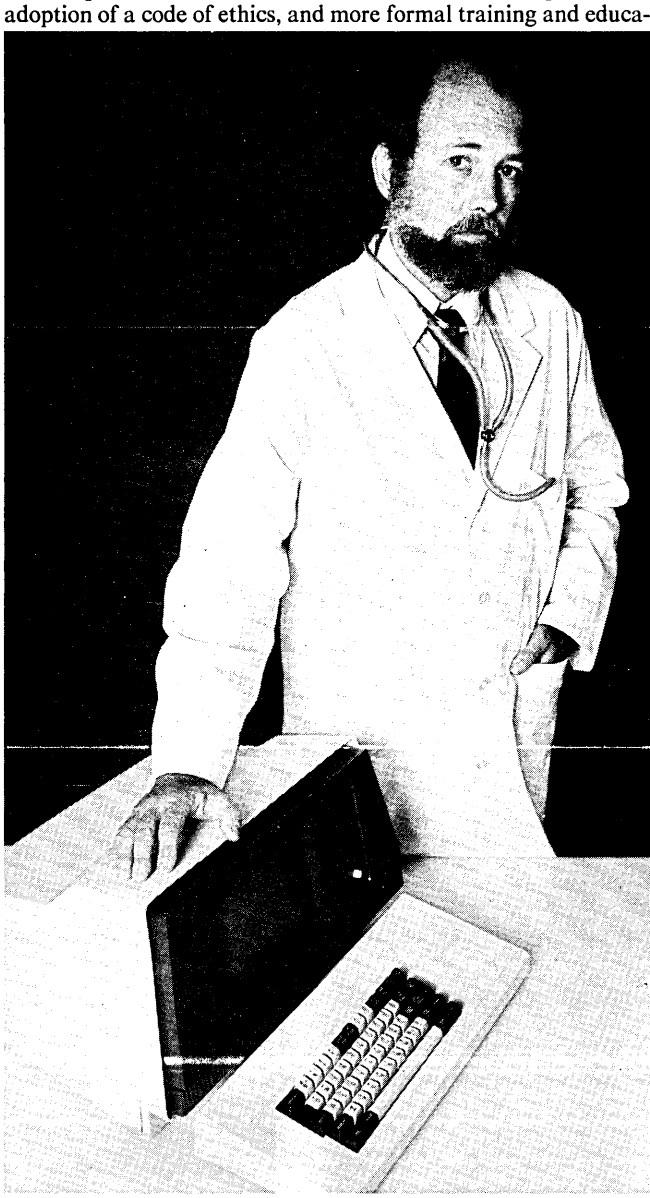
FORUM

PROGRAMMERS AND ANALYSTS ARE NOT PROFESSIONALS

If recent articles and letters to editors of data processing magazines are valid indicators, there is increasing interest among dp workers in the professionalization of dp occupations. The techniques most frequently suggested by the supporters of this trend toward professionalism include the certification of dp workers, adoption of a code of ethics, and more formal training and education programs. Data processing is not unique in this regard. The same trend has been observed among secretaries, craftsmen, and workers in a wide variety of other occupations.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There are several factors behind this interest in professionalization. One is the desire for increased prestige. High-prestige occupations are predominantly professional. A second factor is that professional occupations tend to be high-paying. Finally, they offer their practitioners a great deal of autonomy and personal independence in the course of their work. So the trend toward professionalization may be based on the belief that making an occupation "professional" will result in increased prestige, salary, and autonomy for that occupation.

But the word "professional" has many meanings. An athlete is considered professional because he is paid for performing. A salesman might be called professional because he has a serious attitude toward his job. The professional occupation, however, has been well defined on the basis of studies of traditional professions including physicians, attorneys, ministers, scientists and CPA's. These studies indicate that the adoption of some of the characteristics of the professional model is no guarantee that an occupation will become a "profession."

Let's examine the occupations of programmer and analyst in light of this professional role model, and attempt to assess the likelihood that these jobs are now, or will become, professional. This issue involves more than the proper classification of these occupations. It is important because the role model that dp careerists adopt will carry with it obligations and constraints as well as benefits; and it will affect the way dp'ers view themselves, the way they are viewed by others, and the conditions in which they work.

Social scientists have identified a number of characteristics which can be used to distinguish professional occupations from others. While there is not universal consensus on all these attributes, every definition of the "professional" occupation contains three common elements.

The first of these is the emphasis on the body of knowledge on which a profession rests. A professional body of knowledge is large, complex, and theoretical in the sense that it can be expressed in terms of laws or principles. The practice of the profession may involve either the further development of this body of knowledge, as in the case of the research scientist, or its concrete application, as practiced by the civil engineer.

Further examples of these bodies of knowledge are the medical knowledge of the physician, the legal knowledge of the attorney and the religious knowledge of the minister. This body of knowledge is typically so large that it can only be acquired through a long period of intensive, formal education, and it is therefore not generally available to the public in its entirety. While a nonmember may acquire some professional knowledge, it is only through the long period of training that this knowledge may be fully acquired.

The second common aspect of the definition of a profession is an emphasis on the "service ethic." The profession supplies a service that is vital to society. The professional must recognize the need for his services, and is expected to provide them without costs should the need arise. Despite the cynical comments often made concerning the altruism of physicians and attorneys, both of these professions have established formal mechanisms for providing their services to the indigent.

The third and final area in which most definitions of a profession agree is in the area of the social organization of professions. A professional occupation enjoys a relationship with the rest of society unlike that found in other occupations. Because members of a profession are the sole possessors of their special knowledge,

society grants them the exclusive right to employ that body of knowledge, and recognizes their right to control its use and dissemination. It requires professionals to control their colleagues' behavior, and is generally reluctant to interfere with them in the performance of their professional duties. Also, the possession of this body of knowledge gives the professional a degree of authority over nonprofessionals in his area of competence. The attorney takes charge and determines the course of action in legal matters. The physician has the last word in matters of health and safety (even to the extent that his authority can override that of other legitimate authorities).

The professions are also different from other occupations in terms of their internal organization. Because professions have control over their body of knowledge, they control entry into the profession, either through the establishment of training programs, the institution of entrance exams, or both. Also, because they are expected to control the behavior of fellow professionals, a formal code of ethical behavior tends to develop. Formal professional organizations are established to administer these functions. These organizations promote interaction among professionals, resulting in attitudinal consensus and the tendency to identify with one's colleagues. Professionals become deeply and personally involved in their occupations, and are unlikely to change to another occupation.

While other specific attributes of professionalism are contained in some definitions, the characteristics described above are the most commonly accepted ones. These attributes of the professional role are presented in the summary table, along with a brief description of their applicability to dp jobs. Compare each category of professional characteristics—the body of knowledge, the service ethic, and social organization—to dp occupations.

There is no question that the occupations of programmer and analyst/designer are organized around a substantial body of knowledge. With the emphasis on Improved Programming Technologies, this knowledge is becoming increasingly well defined and codified. The theoretical aspects of system design and coding are receiving added attention.

However, other features of the professional body of knowledge do not seem particularly appropriate to dp jobs. Many, if not most, data processing careerists were educated not in a long, formal, training program, but through a wide variety of less-structured means such as self-instruction programs, in-house training, and individual courses in school. This knowledge is then usually developed further through experience. These same methods of gaining dp knowledge continue to be available to the public, and with the advent of personal computing, they will probably be increasingly utilized. The body of knowledge on which data processing is based, then, is not restricted.

Nor do dp occupations exhibit the "service ethic" found in traditional professions. While dp careerists have demonstrated their commitment to their work time and time again to restore service after fires, floods, or other disasters, this work has not been considered as vital to society as medicine, law, or religion. There is no Florence Nightingale figure in data processing's history.

Dp occupations do not seem consistent with the social organization of the professional role model, either. Dp careers are not being granted the same independence from outside influences found in traditional professions. Instead, outside influences are noticed more and more in the dp field. Privacy legislation, the training of FBI personnel to investigate computer crime, the growth of dp auditing; all of these point to the limiting of the dp careerist's influence within his sphere of competence. Nor do dp careerists have the same degree of authority over nonprofessionals that is found in traditional professions. Quite often, dp personnel are working on projects requested by, and from specifications developed by, non-dp sources. While there are exceptions to this, in most cases the dp careerist does not determine the nature of his own work.

Dp careerists also do not adhere to the professional model in their relationships with one another. They do not control the entry of new careerists in the dp field. While there has been some activity in the area of certification of dp careerists, this certification is in no way required for participation or advancement in data processing. Nor is there a code of dp ethics which programmers and analysts are required to follow. The questions of occupational culture, identification with colleagues, and attitudinal consensus within the data processing field cannot be definitely answered. On one hand, the growth of dp oriented publications and increasing membership in data processing societies may result in the formation of increasing formal and informal social interaction among dp'ers. On the other, the large number of new entrants to the field may increase the heterogeneity among them, and lead to internal divisions and conflicts. At this point, the results cannot be predicted.

Finally, it was mentioned that professionals are unlikely to change occupations. Programmers and analysts, by contrast, are often promoted to new occupations. This is inconsistent with the professional model, as there is no promotion within a profession.

In summary, it would appear that the characteristics of data processing occupations such as programmer and analyst differ considerably from the professional model. And as increasing numbers of people enter the field of data processing, both as careerists and hobbyists, the control that dp careerists have over their body of knowledge can be expected to erode even further. For these reasons, professionalization of dp occupations in the future seems unlikely.

At present, data processing occupations do not conform to the definition of a profession, and the prospects for professionalization in the future do not seem promising. What does this mean for dp careerists? First, it does not relegate dp occupations to inferior status. Many high prestige occupations are nonprofessional, including business executives, government officials, political personalities. Second, it frees dp careerists from certain obligations inherent in the professional role, and may allow them to develop their careers in ways which would not be possible for a professional in the dp setting. For instance, the professional model emphasizes control and limitation of access to the body of knowledge. If dp careerists emphasize the dissemination of their knowledge, and recognize its increasing use by members of the public, they will be better prepared to assume leadership roles in this growth, and to make available to the public the lessons they have learned through experience. In this way, dp careerists can become increasingly valuable to the home computer market.

Also, the professional model emphasizes identification with colleagues as a source of satisfaction, and limits the individual's career orientation to progress within the profession as his ultimate occupation. Rejection of this model would allow the dp careerist to orient his work more to commercial or institutional goals, to use his dp background as a means of entry into other areas of endeavor, such as management, planning, etc. This transition is not readily available or acceptable to the professional. By focusing his attention on institutional rather than professional goals, the dp careerist will be increasing, not limiting, his opportunities within an organization.

Finally, the recognition that dp occupations are not professional frees dp careerists from the obligation to participate in certification programs and "professional" societies; and it can reduce their liability to malpractice suits filed by dissatisfied users.

The occupations of programmer and analyst are fundamentally different from the professional model, so a change to one or two of the characteristics of these jobs will not result in professional status. This leaves the programmer or analyst who wants to become a professional with only one real choice: get out of programming and into one of the established professions.

—Daniel J. Hiltz

Mr. Hiltz apparently has examined the professionalism issue from two sides: He is a programmer/analyst at Western-Southern Life Insurance Co. in Cincinnati, and expects to receive his Ph.D. in sociology from Notre Dame this summer.

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