DATAMATION 70 ®

Bundquist

April

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Your Tally Batch Terminal comes with the works, all tape formatting, parity checking, switching, and tape control functions. As a matter of fact, all you add is the girl.

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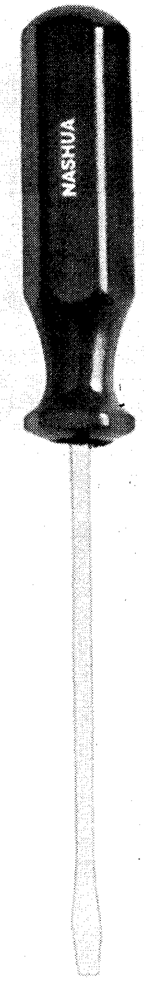

Among Sanders wares, "anyware" is what separates us from so many of our competitors. Particularly when it comes to service. One of our 40 service locations is close enough to put a Sanders field engineer in your office in (at the very worst) just hours. A man who was trained by us and works for us. Who feels the same responsibility toward customers that we feel.

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And that reminds us too much of the competition.

For information, get in touch with our Marketing Manager: Data Systems Div., Sanders Associates, Inc., Daniel Webster Highway South, Nashua, N.H. 03060; Tel. (603) 885-4220.

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See Sanders at SJCC booth 2900

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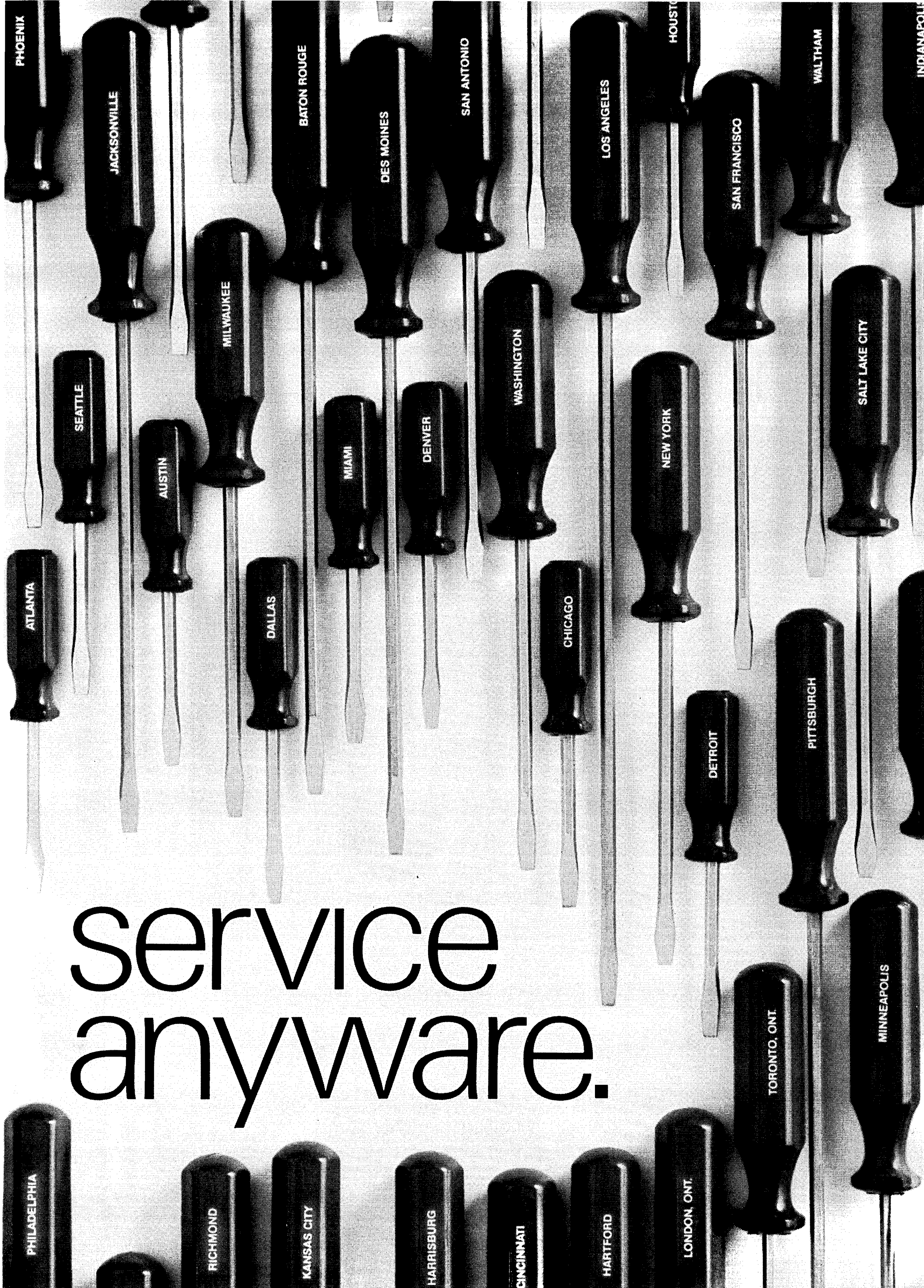
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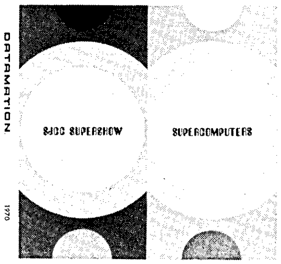

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DATAMATION®

april 1970

volume 16 number 4

datamation departments

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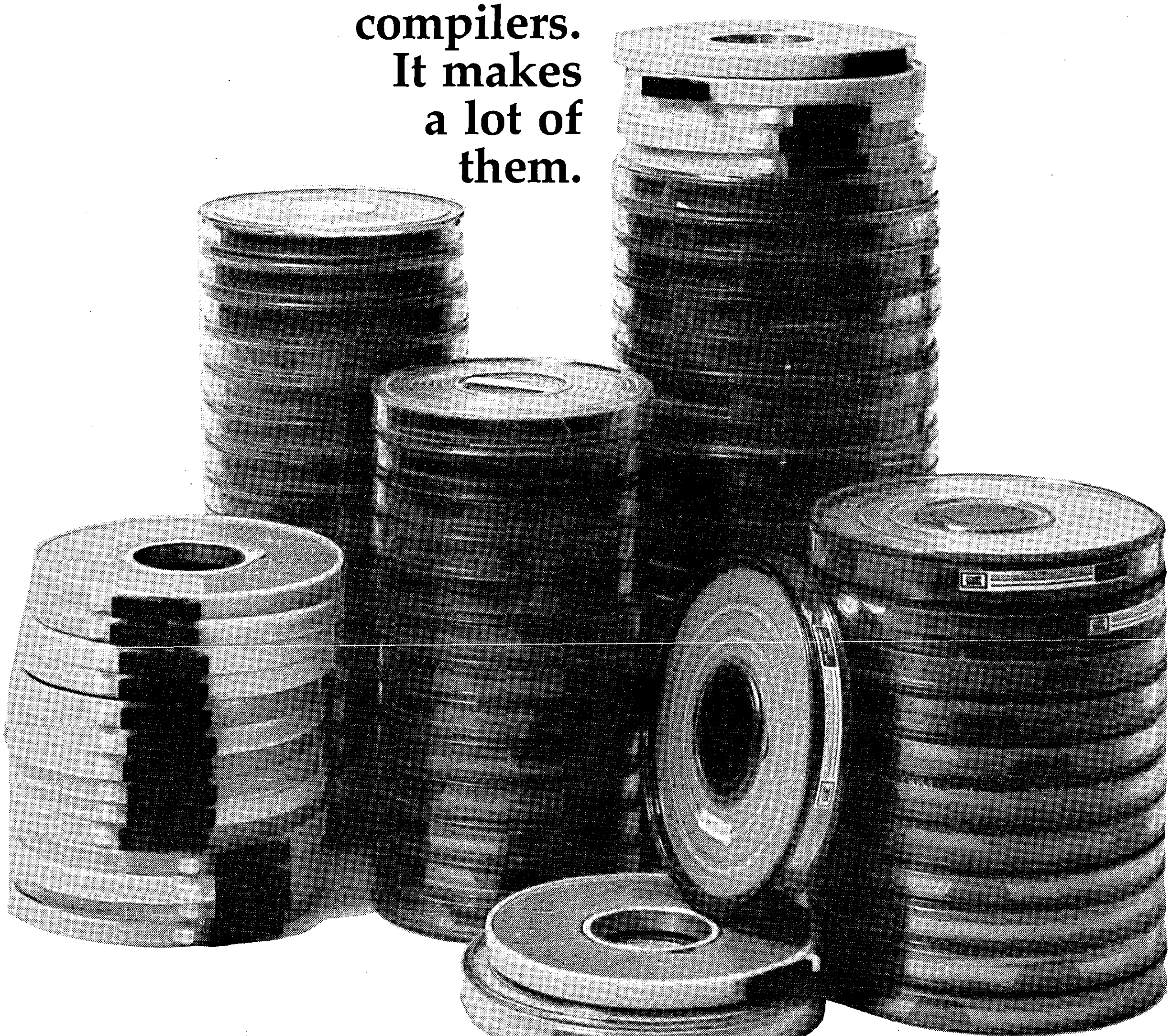

Keypunches are here to stay.

Punch card input is wasting the time of today's computers. Computers capable of processing over 500,000 characters of information every second.

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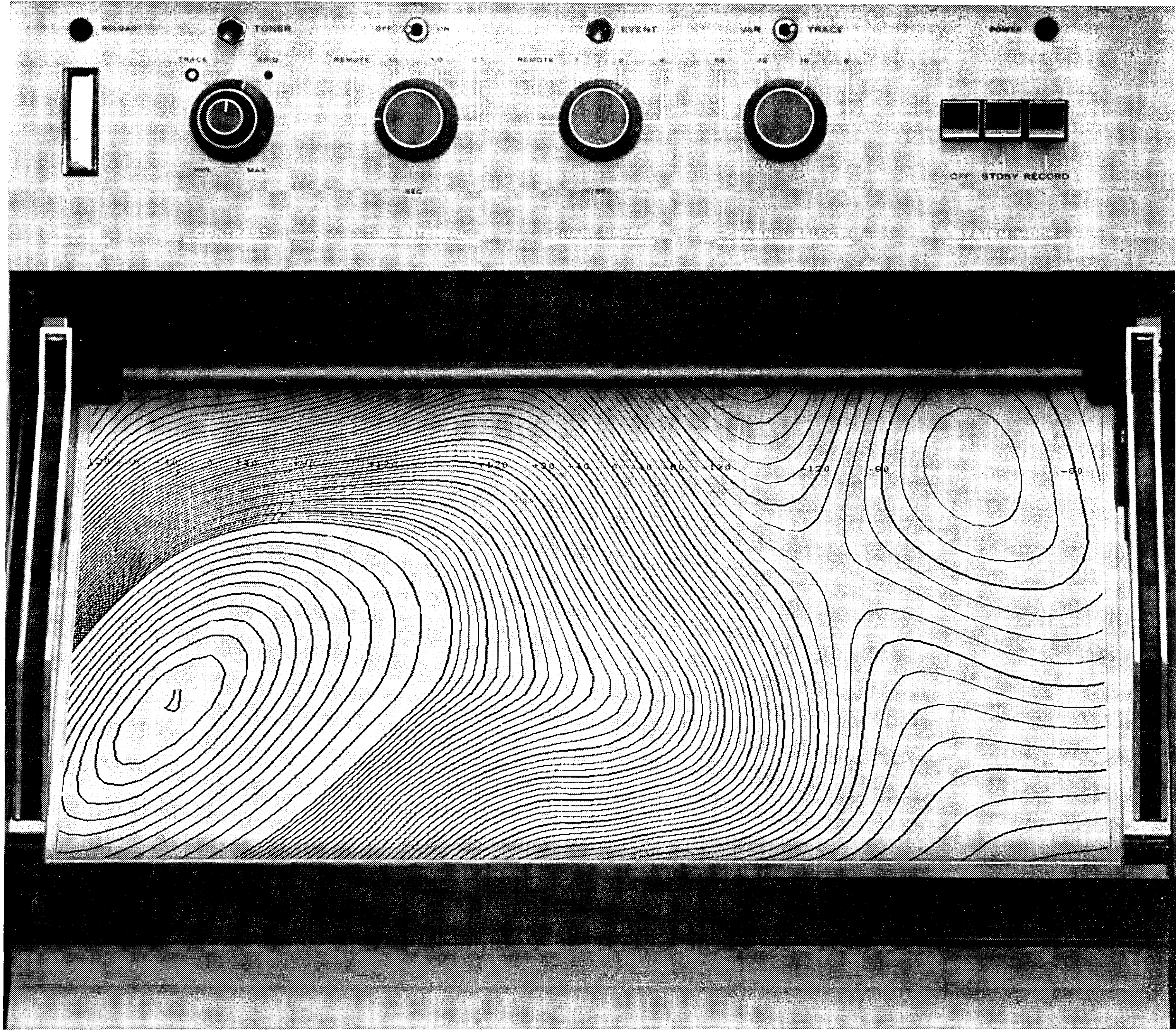
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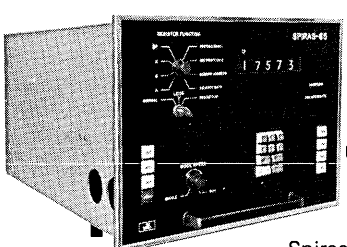

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Visit Spiras Systems at booth 118 at SJCC

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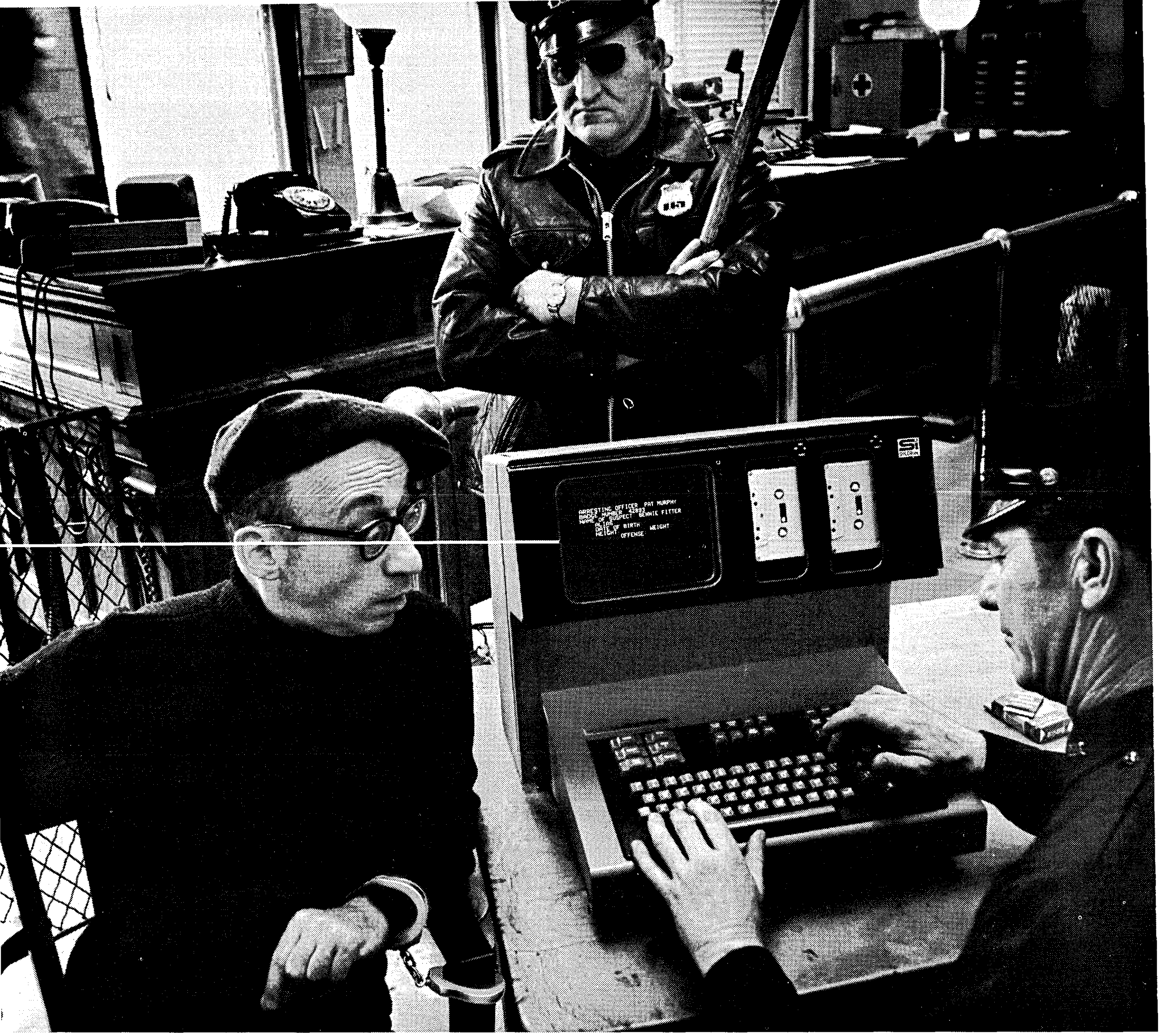
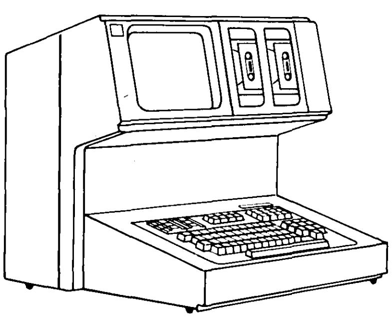
calendar

DATE	TITLE	LOCATION	SPONSOR/CONTACT
April 26-29	Nat'l Automation Conference	San Francisco	Amer. Bankers Assn. Automation Dept. 90 Park Ave., New York, N.Y. 10016
April 28-May 1	Nat'l Microfilm Convention	San Francisco	NMA 250 Prince George St., Annapolis, Md. 21404
May 5-7	Spring Joint Computer Conference	Atlantic City	AFIPS 210 Summit Ave., Montvale, N.J. 07645
May 11-16	Instruments, Electronics, Automation Int'l Fair	London, England	U.S. Commerce Dept. BIC/CAP, Room 6813, Washington, D.C.
May 13-15	Educational Data Systems Convention	Miami Beach	AEDS/Dr. Henry Fox 3525 N.W. 79th St., Miami, Fla. 33128
May 13-15	Electronic Components Conference	Washington, D.C.	EIA 2001 Eye St., N.W., Washington, D.C. 20006
May 17-20	23rd Annual Int'l Systems Meeting	Las Vegas	ASM/R. B. McCaffrey 24587 Bagley Rd., Cleveland, O. 44138
May 26-28	11th Annual Information Display Symp.	New York City	SID/W. M. Hornish Western Union 82 McKee Drive, Mahwah, N.J. 07430
June 1-3	Info Processing & Operations Research Joint Conference	Vancouver, B.C.	IPS, CORS/Session 70 1177 W. Hastings St., Vancouver, B.C., Canada
June 10-12	Computer Simulation Conference	Denver, Colo.	SCi, ACM, IEE/O. Hall Jr. TRW, 1 Space Park, Redondo Beach, Calif. 90278
June 16-18	Computer Group Conference	Washington, D.C.	IEEE/D. L. Doll IBM, 18100 Frederick Pike, Gaithersburg, Md. 20760
June 22-26	11th Joint Automatic Control Conference	Atlanta, Ga.	ISA, ASME 345 E. 47th St., New York, N.Y. 10017
June 22-24	Spring General Meeting	Seattle, Wash.	DPSA P.O. Box 1333, Stamford, Conn. 06904
June 23-26	Annual DP Conference	Seattle, Wash.	DPMA 505 Busse Highway Park Ridge, Ill. 60068
June 18-19	Management & Time-Sharing Conference	Washington, D.C.	ADAPSO 551 Fifth Ave., New York, N.Y. 10017



Now, people who know their job can talk to their computer

See us at the
Spring Joint Computer Conference



Anyone can talk to a computer using our new Key-Cassette terminal. He can call direct for immediate two-way communication. Or he can enter data on tape cassettes for fast, low cost, batch transmission. (Each cassette contains the equivalent of 1/5 of a mile of paper tape or 1400 punch cards.)

No special skills or complicated procedures are necessary. Each Sycor terminal contains a mini-computer that we program to fit the job. It guides the operator step-by-step, checks input and reduces errors. The keyboard is as simple as a typewriter. The video screen displays each step for checking and editing by the operator.

Off-line you can search a cassette file, insert changes, sort information, or copy records. On-line it will transmit or receive data unattended. With an optional printer, multiple copies are provided.

Our terminals are installed worldwide and we deliver within 90 days.

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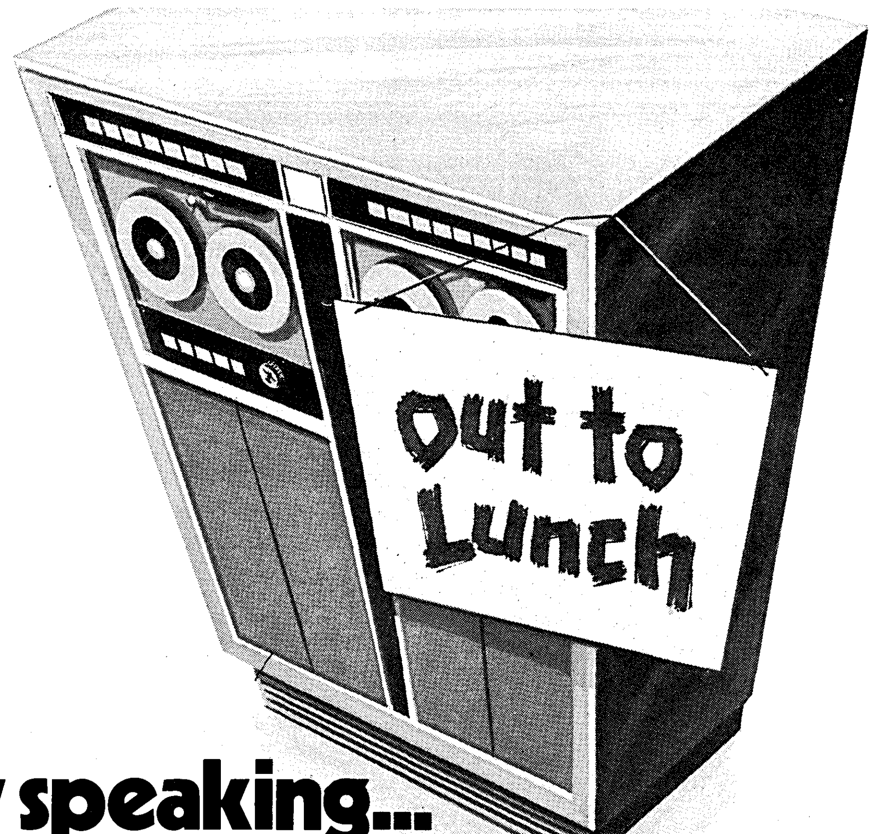


Logically speaking... an error-free data input system keeps your computer from going "out to lunch."

A computer should eat up data, not expensive time. If we make it sound overly simple, we're just being *logic*al. For we've got an error-free data entry system that keeps computers working without those costly "out-to-lunch" breaks.

It's called the LC-720 KeyDisc Data Input System. It cuts systems time and costs . . . by as much as 50%. It minimizes errors with point-of-entry editing and correction. It optimizes systems throughput. And it keeps your computer working all the time.

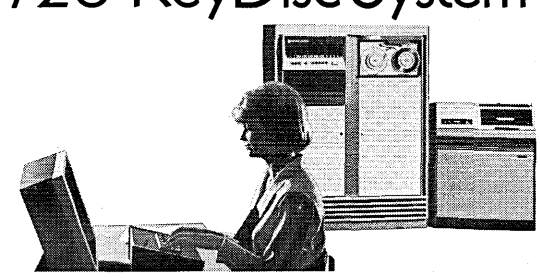
Computer time-shared data from up to 60 key stations . . . all entering or verifying separate jobs and applications . . . is one of the big advantages of the LC-720.

It also offers you total security and high speed random access of data. The LC-720 is the only keydisc system in use that provides a complete IBM/360 compatible disc. Plus a totally compatible 7 or 9 track magnetic tape output.

Logic makes the *Now Generation* of data collection systems. So, if you've got data input problems, Lewis Barr at Logic can more than likely solve them. Give him a call. 609-424-3150.

It's the *logic*al thing to do.

LC-720 KeyDisc System



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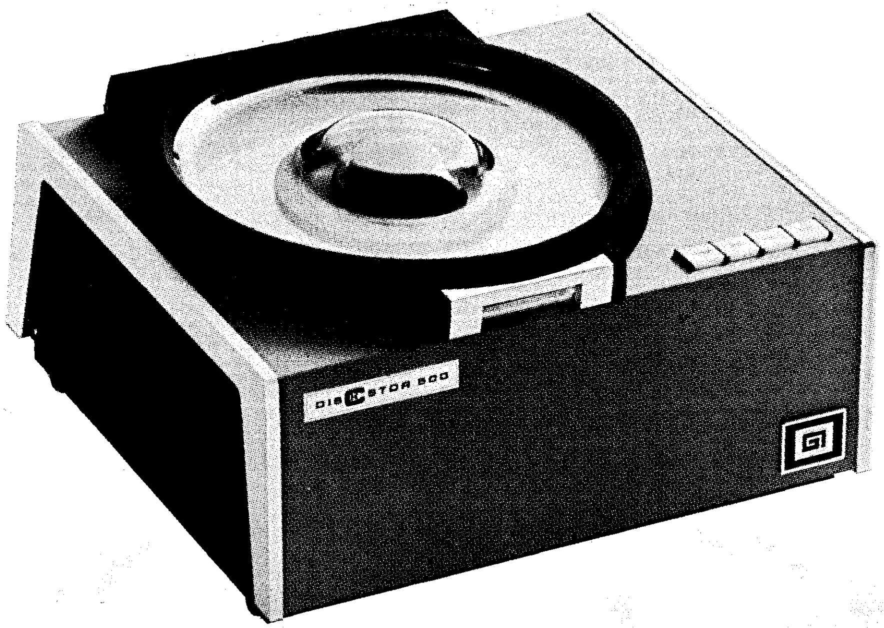

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For complete information, call or write . . . or visit:

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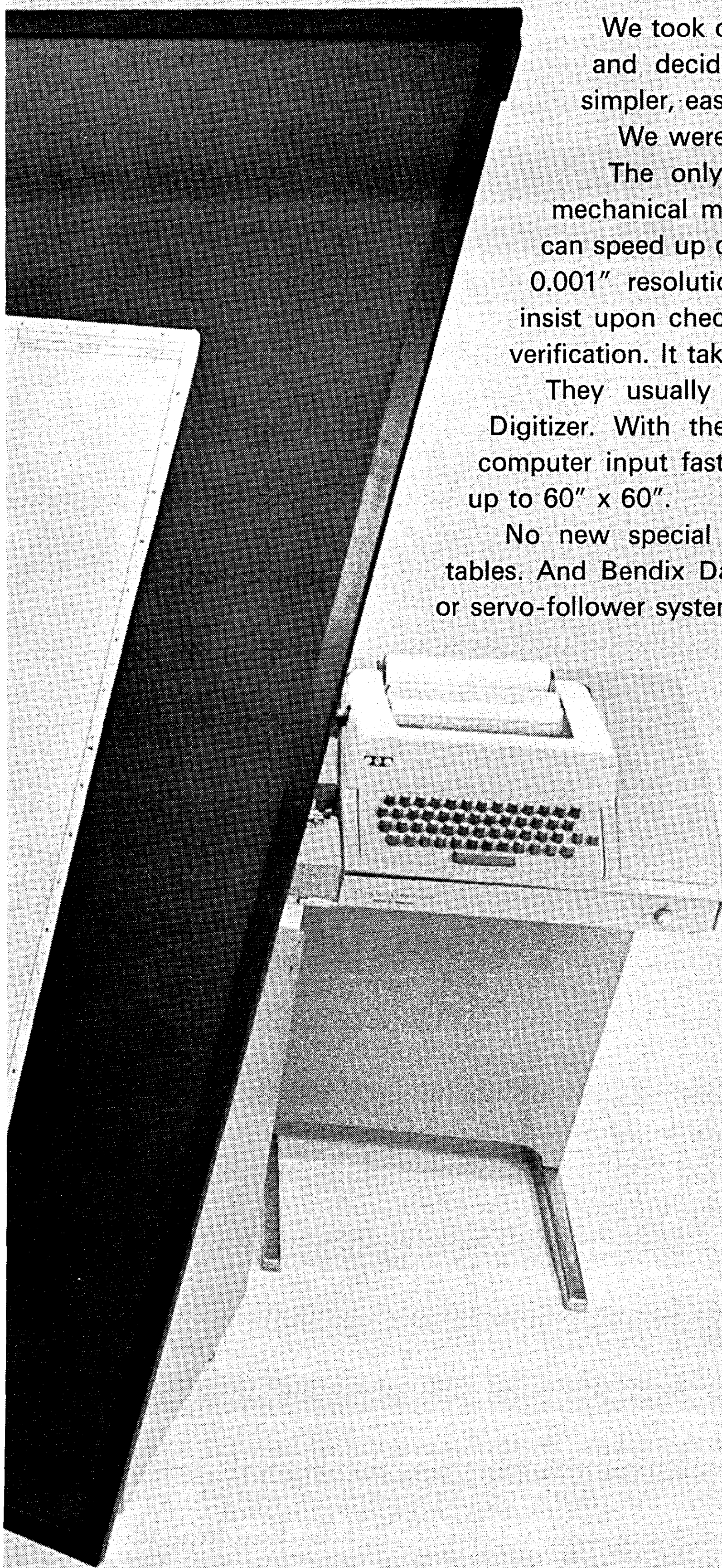
GENERAL INSTRUMENT

CIRCLE 182 ON READER CARD

The digitizer that

doesn't look like it works.



We took one look at those mechanical monster digitizers and decided we could build a digitizer with a faster, simpler, easier to use cursor.

We were right.

The only problem is that people who are using the mechanical monsters can't quite believe anything so simple can speed up computer inputs to 300 inches per second with 0.001″ resolution. Some people, even after we show them, insist upon checking back with their mechanical monsters for verification. It takes a while, but they finally manage it.

They usually end up with our all-electronic Datagrid™ Digitizer. With the free-moving cursor that makes tracing for computer input faster, simpler than ever before, on tracing areas up to 60″ x 60″.

No new special drafting instruments needed. No new work tables. And Bendix Datagrid™ Digitizer has no mechanical linkages or servo-follower systems to wear out.

The Bendix Datagrid™ Digitizer. It doesn't look like it works. But it does. Write for full information. The Bendix Corporation, Advanced Products Division, Bendix Center, Southfield, Michigan 48075. Or call Bendix Automated Graphics Marketing at (313) 352-7661.

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THE EVANS & SUTHERLAND LDS-1 SIMULATES A PERFECT LANDING!

A New "Perspective" in Hardware

Perspective is Essential to Simulation— The Evans & Sutherland LDS-1 quickly and accurately computes and displays *true perspective.* As the pilot of a simulated airplane approaches touch down on a carrier, the picture of the ship and landing deck becomes larger as shown in the actual display photographs at right. Fast and accurate perspective is possible whatever the application such as the simulated docking of space craft. The nearing sister ship will loom larger and larger until it fills the entire screen. The highway in front of a simulated moving automobile will narrow as it trails into the distance. The LDS-1 is uniquely well suited to provide *true perspective* giving the closest representation possible of the picture you would see if you were the pilot, the astronaut or the driver.

Perspective Three-Dimensional Displays Require Division—Unlike analog systems with their inherent problems in performing division, the fully digital LDS-1 processor divides coordinates needed for perspective display with ease and speed. The LDS-1 is fast with 10 microseconds typical for processing each line. A long line requiring considerable processing may take up to 50 microseconds. Accurate too, no analog system can approach our 18, 20 or 24 bit per coordinate accuracy. Using 24 bits, the LDS-1 system will accurately represent one inch in 264 miles. The LDS-1 processes only the visible portions of the pictures. Segments of lines behind the observer or out of his field of vision are automatically clipped before the perspective computation.

Fast and Accurate Hardware Rotation—Simplified Coding—The LDS-1 Matrix Multiplier does three-dimensional rotation and translation in half the time of other systems and with greater digital accuracy. Objects moving with respect to each other such as aircraft in combat or other airport traffic in front of a landing airplane are each positioned by a single four-by-four matrix and the LDS-1 automatically draws them into a composite picture. Compound rotations such as folding landing gear or convertible top linkages are automatically combined by the LDS-1 into the proper single matrix multiplication greatly simplifying required coding.

Easily Displays 2,500 Lines in Real-time— The complexity of possible pictures depends on how the graphic elements are grouped together. Objects with 2,500 lines are simple for the LDS-1 to display in real-time. If any of the lines of the objects are out of view, there can be more lines in the objects because only the lines in the field of view are processed. The right part of a line shows in the right place even when only part of that line is visible.

A New Attitude About Three-Dimensional Display—The LDS-1 represents a new concept of creating perspective with ease in simulations. The user thinks in three dimensions; the LDS-1 computes the correct two-dimensional perspective. It can compute displays for its scope *or for your existing or proposed computer graphic equipment.* LDS-1 data formats are the most flexible in the industry.
The LDS-1 is exactly what you expect from Evans & Sutherland Computer Corporation . . . The Most Sophisticated Name in Computer Graphics.

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Printed from actual display photographs.

See the LDS-1 at the Spring Joint Computer Conference

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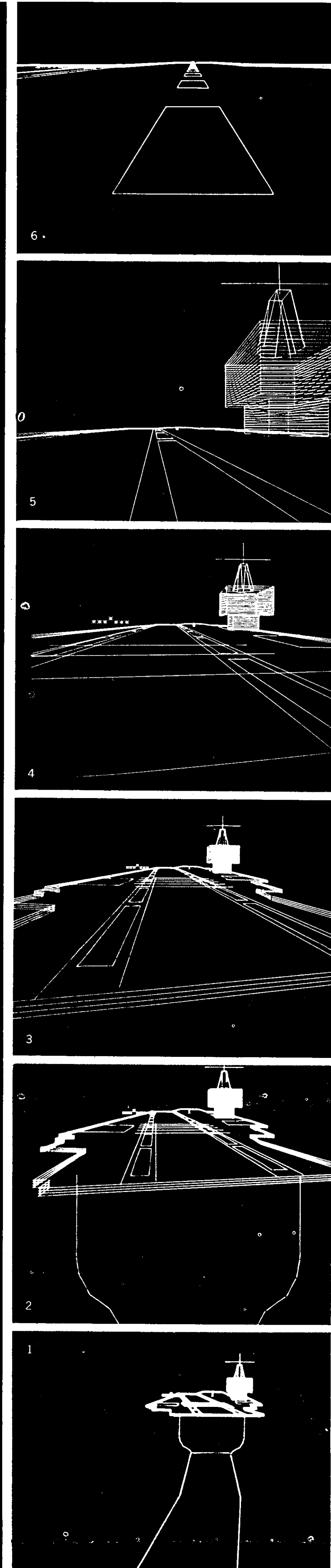

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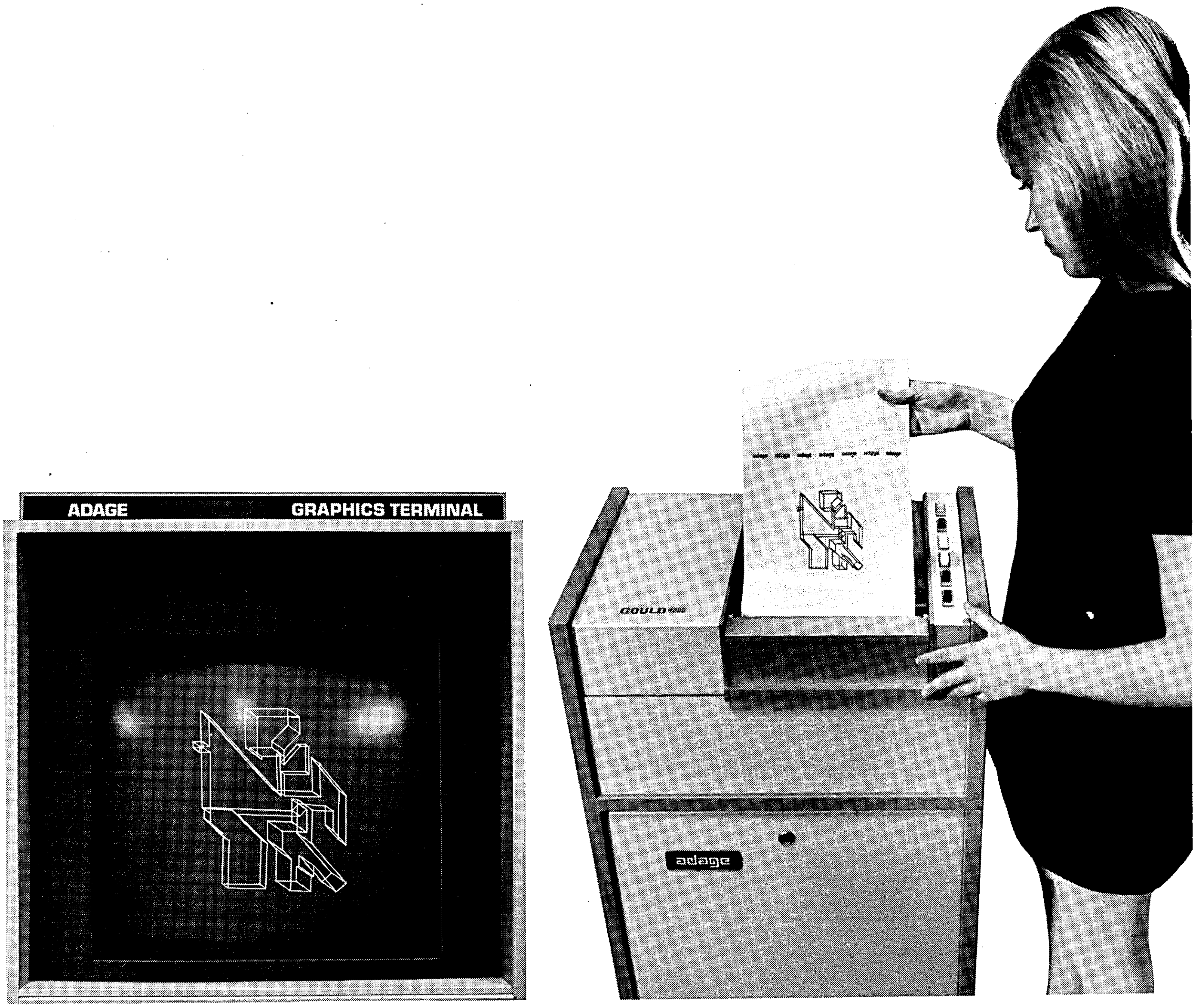

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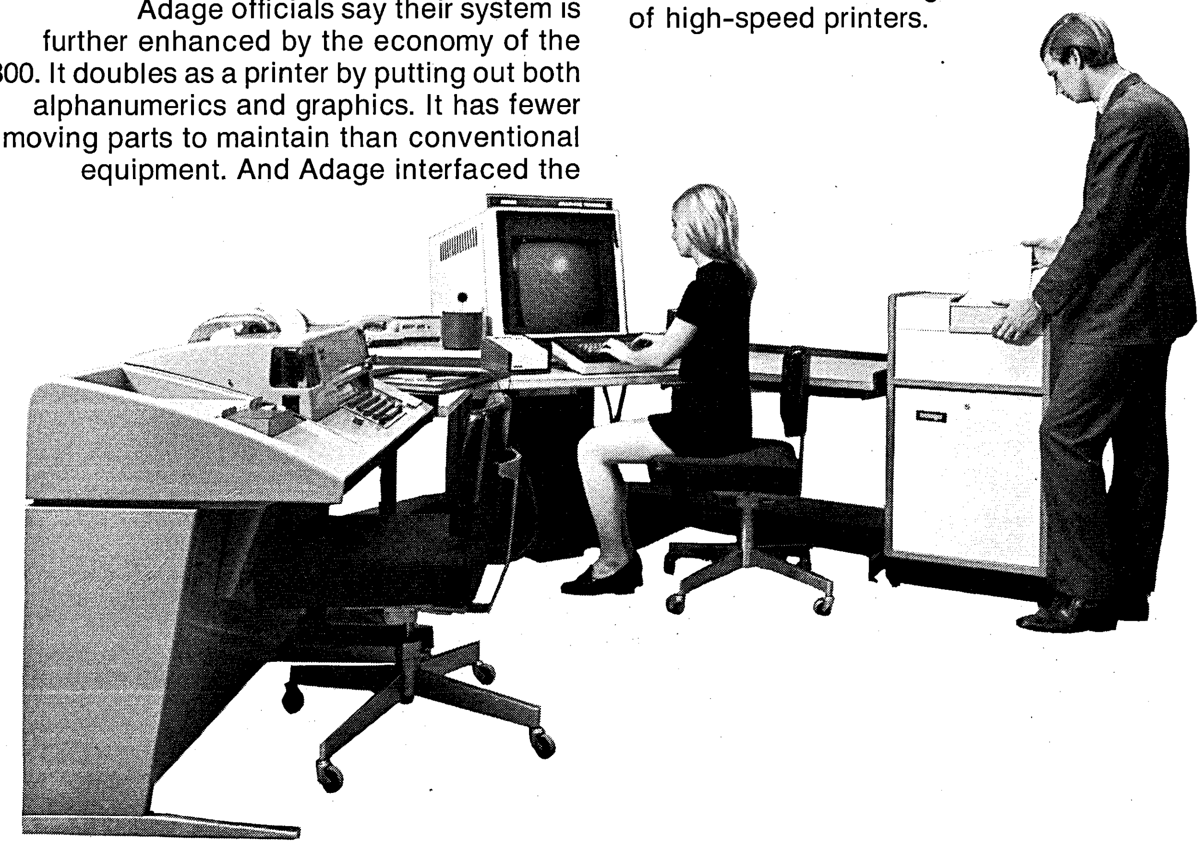
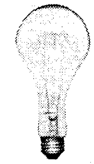


how to recall  any of 1,000,000 pages within 30 seconds

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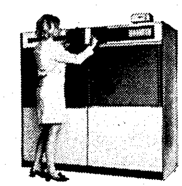

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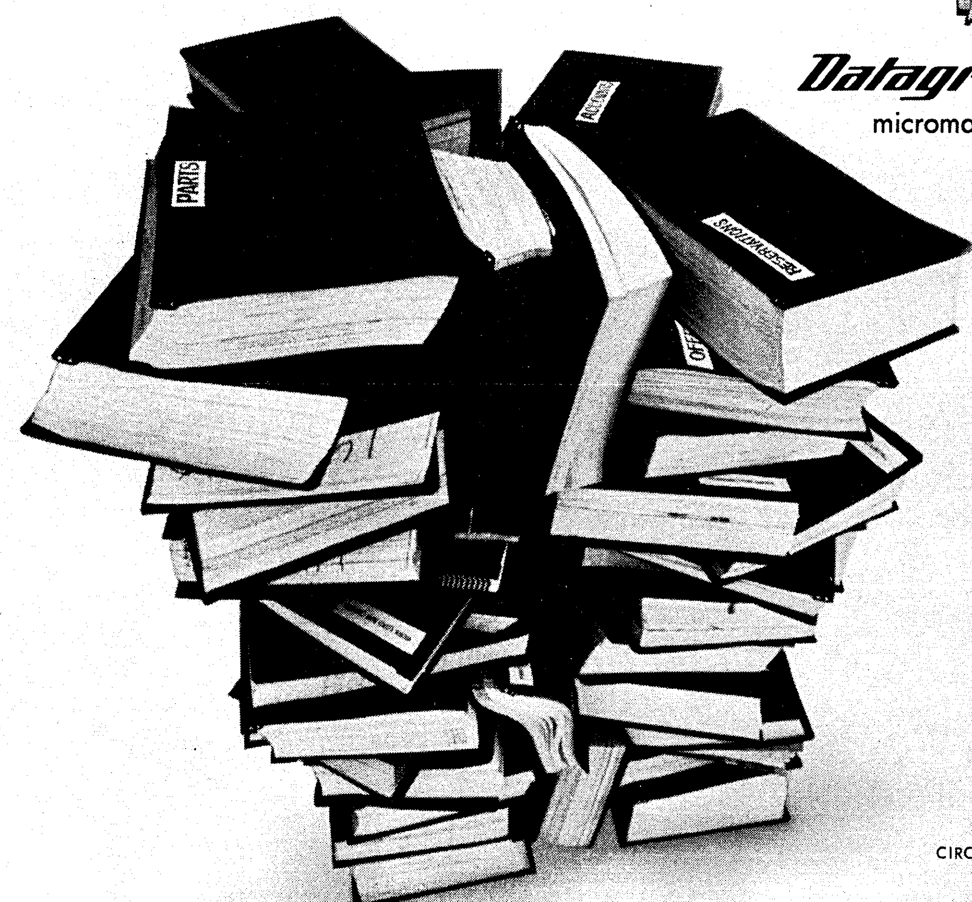

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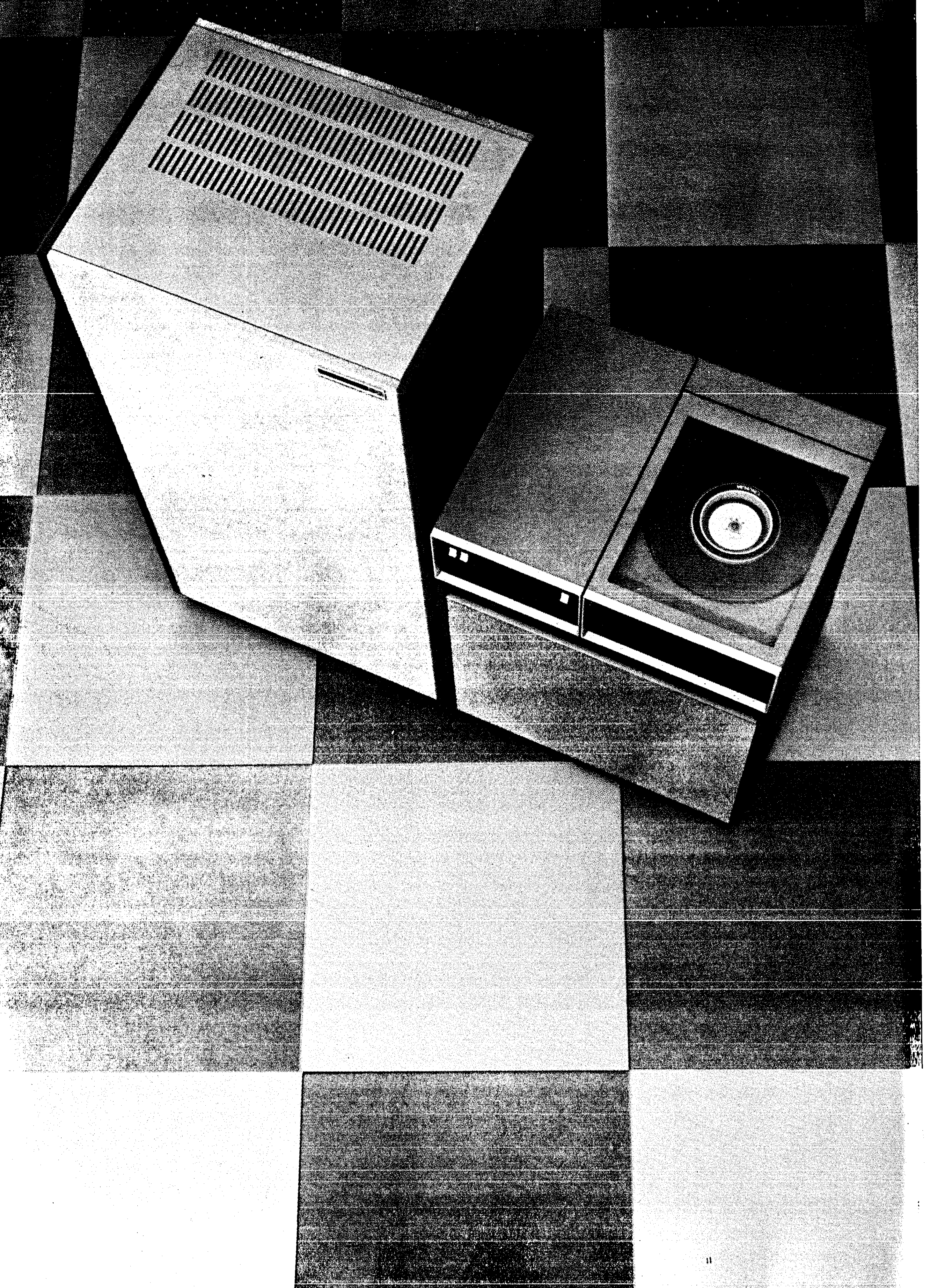
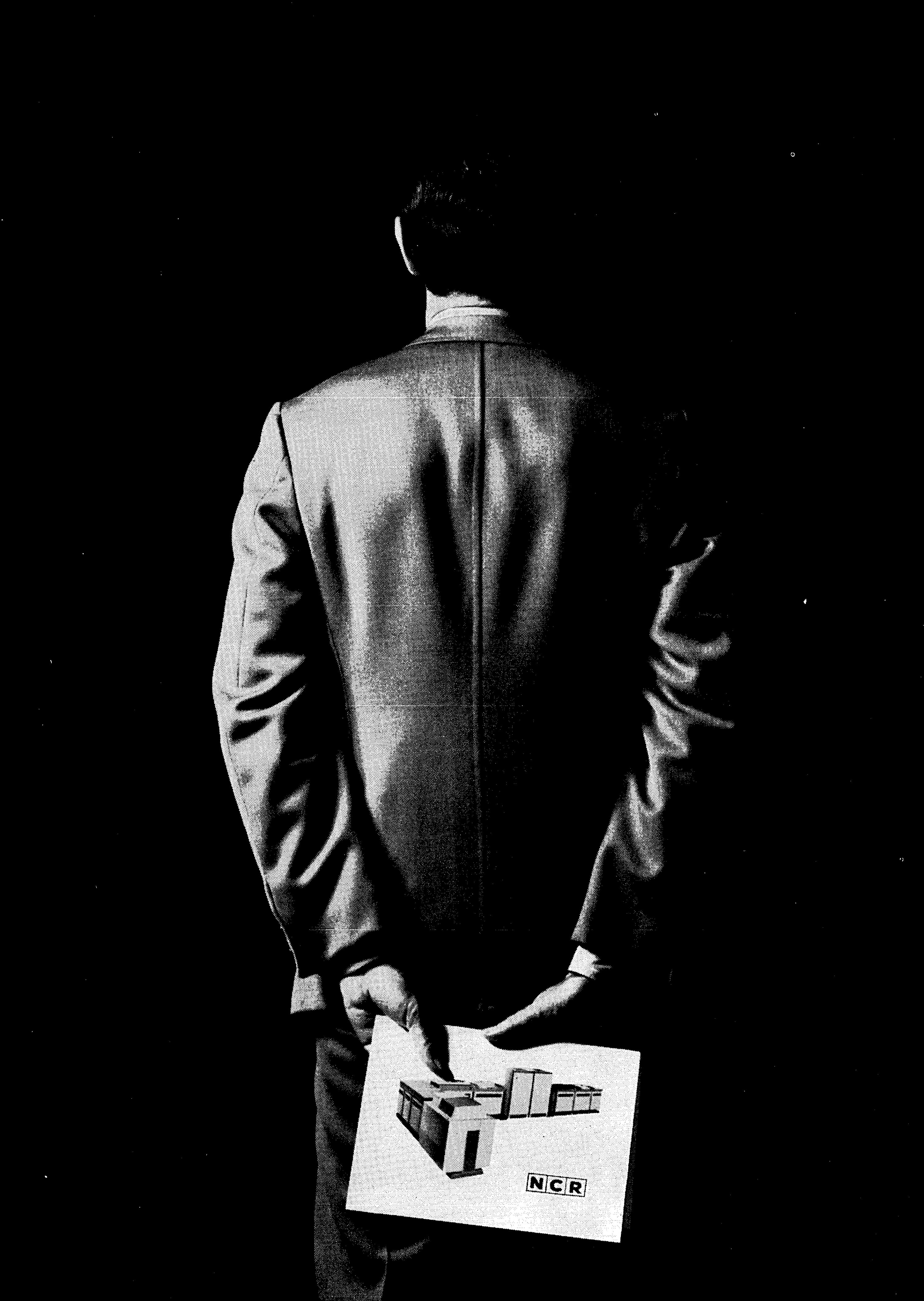
CIRCLE 85 ON READER CARD




NCR

Do you have the courage to recommend the NCR Century?

It's 30-50% more productive than the IBM 360 at 30% lower cost.

We have to admit it.

The average person would probably feel more comfortable recommending IBM's system to his management.

Although IBM costs more, it's easier to explain if the results don't turn out as expected. After all, how could anything go wrong dealing with the world's biggest supplier?

A lot of people in this business think that's the way management thinks. Trouble is, they're dead wrong.

Sure, your front office wants to buy from reputable vendors. But they won't knowingly pay for more than they get.

That's why more and more computer professionals are looking at the promise of the NCR Century. The promise and the performance. Because there are now enough NCR Century systems in operation to prove our promises. NCR Century users who have replaced or investigated IBM computers support the price/performance comparisons.

Computers so advanced they make others old-fashioned

We've delivered a computer with a new memory concept . . . new monolithic integrated circuitry . . . a new disc concept . . . and new standardization. A computer that lets you process data faster. For less money.

You can rent an NCR Century 100 with 16K of internal memory for $1,910 a month. Or a 32K NCR Century 200 for $3355. Use that as your first benchmark.

Three-way simultaneity is standard on the 100. So you can read and print at the same time program steps are being performed internally. The 200 offers five- or nine-way simultaneity.

What's more, our memory is thin film short rod memory. Ultra-fast, with speed in the 800 nanosecond range. Far faster than core memory, at lower cost. (An extra 16,000 bytes rents for only $375 a month.)

Circuitry is integrated monolithic throughout. With more power and reliability than the hybrids, at a fraction of their size and cost.

Our dual spindle disc unit, standard on every NCR Century, stores and makes instantly available over 8.3 million characters of business information at an average access speed of 44 ms.

Input is by cards or tape. You can go on-line, too. Printing speeds range from 450 to 3,000 LPM. The top speed is standard for the NCR Century 200; optional for the 100.

Expandability is built in

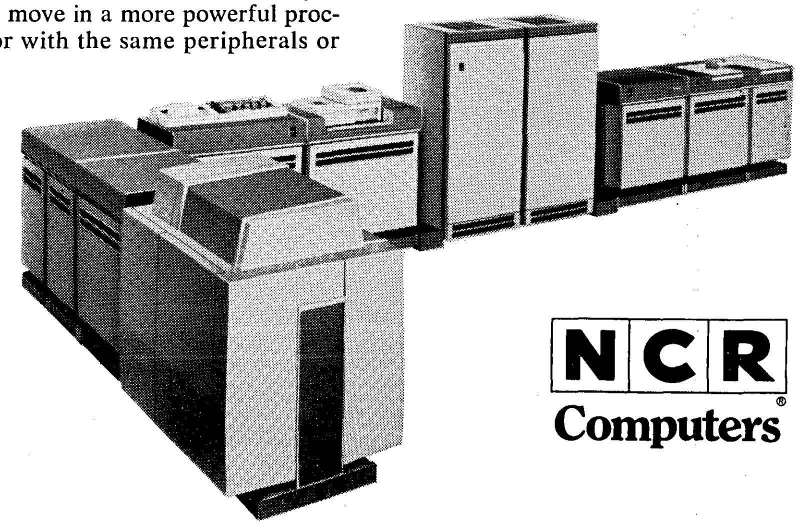
The NCR Century Series is completely upward compatible.

No reprogramming or recompiling as you grow from the NCR Century 100 to the 200 and larger. Just move in a more powerful processor with the same peripherals or increase throughput with higher speed magnetic tape drives, paper tape or punch card readers and punches, CRAM (Card Random Access Memory) units and remote on-line devices. Go all the way to nine-way simultaneity and multiprogramming. At far less cost than our competition.

Our software is the same new breed, too. Compilers, operating systems, applied programs and utility routines. All written, tested, in use. And all the languages, too: COBOL, FORTRAN, our own NEAT/3.

We'll be glad to give you the names of NCR Century users who say it's the buy of the century.

Also ask for the comprehensive report on the NCR Century prepared by the industry's leading independent consulting firm. It will open your eyes and let you uncross your fingers when you make your computer recommendation. Write EDP Products Marketing, NCR, Dayton, Ohio 45409.



NCR Computers®

letters

mortal locke

Sir:

Dr. Locke (Feb. p. 69) thinks "anybody who talks about storing any number of books, even off-line, is off his head." I don't think Dr. Locke is off his head, but I expect he will be doing quite a bit of talking soon on this subject. If your advertisers' are to be believed (Nov. p. 291), 10^{12} bits of on-line, but read-only, storage costs a megabuck, or 10¢ per megabit year when capitalized at 10%, or one third of 30¢ per megabit year Dr. Locke allocates now to card catalog storage. A $2K crt terminal costs about 25¢ an hour, which is cheaper even than graduate students. Land and building costs are rising rapidly . . .

NEVILLE A. BLACK
Computer Sciences International
Brussels, Belgium

pooh

Sir:

"Pathetic . . . That's what it is. Pathetic." (1)

Thus spake the neglected Eeyore on his birthday, and thus might well speak the almost as neglected PL/I compiler writers, as PL/I F-level passes its third birthday of usability (I take as datum the release of Version 2).

For here we are, most of us, still trying to persuade compiler writers to add, to COBOL and FORTRAN, features which have long been implemented and working in PL/I.

For example:

FORTRAN:

Dynamic storage allocation (3)
Multiprogramming facilities (3)

Run time error handling package End of file on READ	added recently by IBM
Character handling Free form I/O Mixed type expressions (2) Expressions as subscripts and in DO statements (2)	available in some compilers

The above have been working in PL/I for a considerable time.

COBOL:

I/O editing data representation
Mathematical functions
Default options
Free form COBOL
Abbreviations
Expressions as subscripts
Global Common
Variable length data items

All these "subjects for future exploration" in "A Short Guide to The Wonderful World of Cobol" (4) (who are you trying to convince, buddy?) have been giving delight (mostly) to PL/I users for over three years. "Impenetrability, that's what I say!" (5)

(1) Milne, Winnie the Pooh.
(2) Healy, Computer Journal, Vol. 11, pp. 169-172.
(3) Samet & Hendry, Computer Journal, Vol 12, pp. 218-220.
(4) Edelman, DATAMATION (Dec. '69, p. 161).
(5) Carroll, Alice Through the Looking Glass.

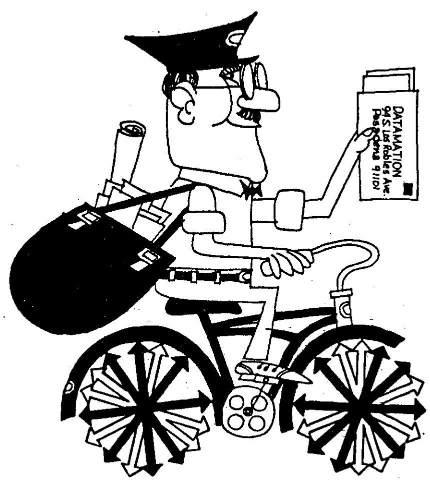
J. M. SYKES
Cheshire, England

speak up

Sir:

We are in need of volunteers to read articles from DATAMATION for our blind men and women in the computing field.

A knowledge of computers, a clear voice, and a tape recorder are all that is necessary.



Any person who can give a couple of hours a month should contact:

MRS. DONALD A. DUNCAN, JR.
Science for the Blind
221 Rock Hill Rd.
Bala-Cynwyd, Pennsylvania

also sprach marchant

Sir:

I read the first installment of "Also Sprach Von Neumann" in your January issue. As a wet-eared, callow kid who is Systems Director for SCM Corporation, I feel constrained to offer a few words in behalf of my associates in the Smith-Corona Marchant Division, makers of what our hero defined as a "now extinct, sickly green, electromechanical desk calculator."

The Marchant rotary calculator burst on an unsuspecting world at the Panama-Pacific International Exposition in 1915 and was at that time widely regarded as the first major improvement on the abacus. Marchant added the novelty of electricity in 1917 and planetary dial gears in 1933. Last year, Marchant became the first American manufacturer to produce a desk calculator using MOS/LSI circuits, something the rickety competition is just getting around to.

Anyway, it is just possible that someone, around the time of which Von Neumann sprach, had a room full of Marchant calculators all of which were painted green. But even if they were models of the 1930's, they weren't "rickety," and they sure as hell weren't then and aren't even now "extinct." You can still buy a rotary calculator from us, and you'd be surprised how many do. You can also buy the newest Marchant, and whether this or any other model ever becomes "extinct," we expect the Marchant name to be on calculators for a long time.

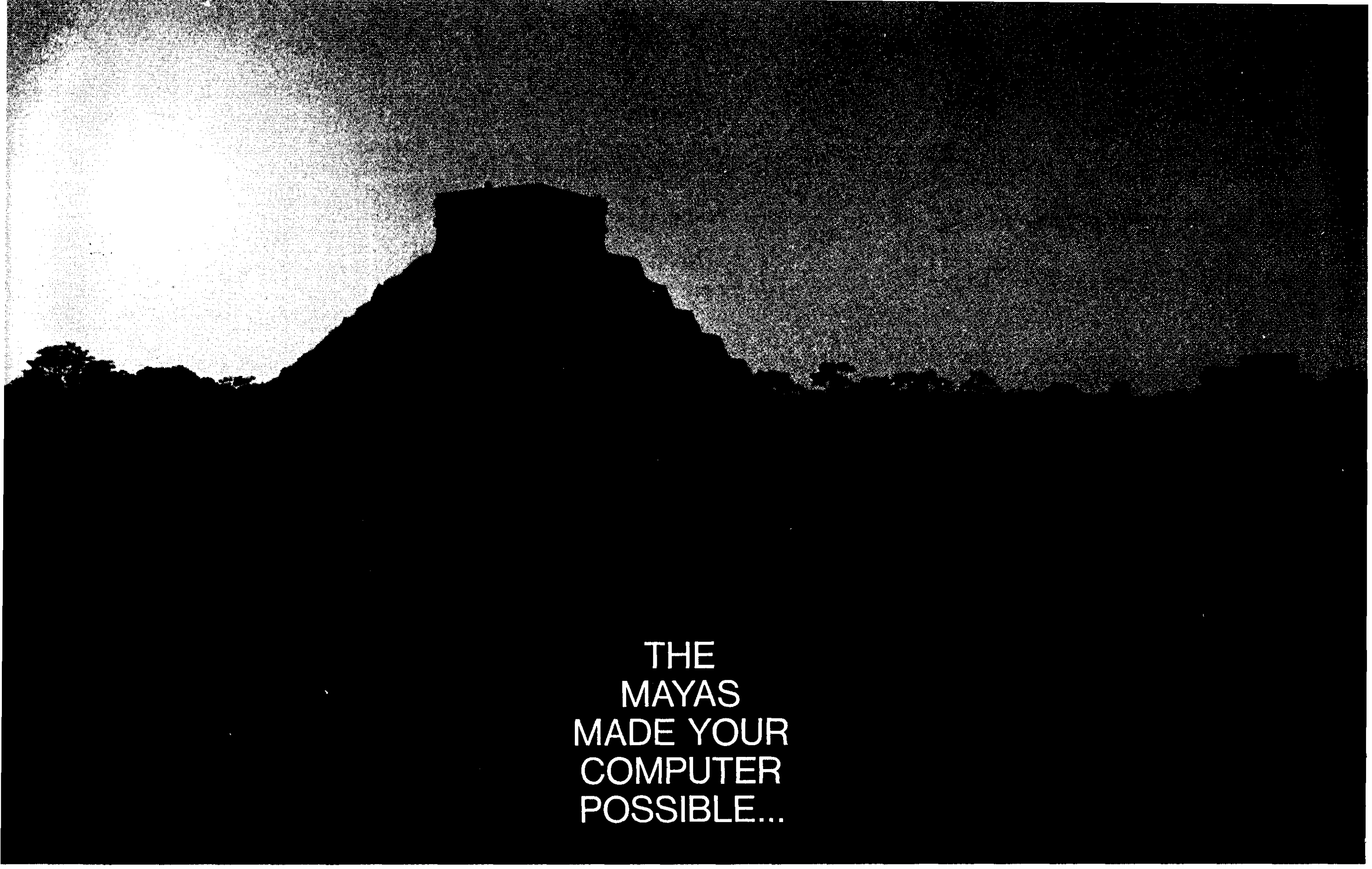
D. R. HOLLIS
SCM Corporation
New York, New York

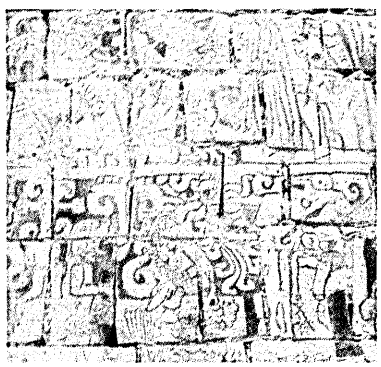
getting loaded

Sir:

In "Architectural Questions of the Seventies" (Jan. p. 66), Mr. Amdahl states that a user "will find he has considerably less than twice the performance in dual processor configurations." Here at the University of Michigan, we have been running MTS (the Michigan Terminal System) on our dual processor IBM 360/67 for 17 months (10,000 hours of operation) and our experience has been that under heavy loads such as we normally experience during the day, we are certainly able to obtain more than twice the throughput obtainable by running the same system on one processor and half as much core. Of course, if the load is light, adding the second CPU and more storage will not increase performance significantly. Likewise, if the single processor system is CPU limited and not core limited (i.e., no paging is required) with a certain job mix, then adding the second CPU with or without increasing core can, at best, double the performance.

However, with a load of half a dozen batch jobs (some usually from remote batch stations) and 40 to 50 terminal users (some of whom are sometimes using more than a million bytes of storage), we are able to more than double our "half-system" performance—not to mention the increased





MAYA PHOTOGRAPHS BY RENE PERON

Katun can make it work.

The Ancient Mayas invented the concept of zero over 2000 years ago. In so doing they created for the first time in the Western World the mathematical principle that would some day make electronic computers possible. Now, the problem is to make the computers work (as effectively and as productively as you were promised). ◻ KATUN Computer Management will do just that. ◻ KATUN is a company of up-to-date business and computer experts drawn from all fields of the computer sciences: hardware, software, programming, installation, education, management, operations, and quality control. Together, the people of KATUN offer you a *total resource* of professionals in the effective management of all your data processing needs. And because they are *professionals* they can make your computer work better, more effectively and at greater capacity than you can. The result? You gain a *competitive edge* over other businesses whose management must run their computer instead of their business. ◻ If you'd like proof, write for details to KATUN, 680 Beach Street, San Francisco, California. ◻ We'll manage your computer so that it helps you manage your business. ◻ *Photos above: The Ancient Mayas were the most advanced computational experts of their time. In ceremonial centers such as this at Chichén Itzá in Yucatan, Mexico, they used a time counting system—from which the name KATUN derives—that was more accurate even than the calendar we follow today.*

KATUN
CORPORATION

CIRCLE 196 ON READER CARD

system reliability and flexibility obtainable with a duplex machine.
W. SCOTT GERSTENBERGER
Ann Arbor, Michigan

the turnoff

Sir:

May I draw your attention to inaccuracies in your December World Report, page 266, on the subject of "ESRO Turns On with Info Retrieval System."

In paragraph one, it is incorrect to say that we have been unable to link up a terminal at Frascati in Italy "because the Italian communications authorities would not provide guarantees on data link quality." In actual fact we have as yet made no approaches to the Italian authorities, since we have not yet decided to install this terminal.

In paragraph two, you say that "the operating system for the 360/65 occupies a 180K slab of memory." This is misleading since if you are talking of the information retrieval programmes, the correct figure is 120K.

In paragraph three, you talk of "a scheme for Eurodoc etc. . . . " This has no foundation in fact. There is no such scheme as far as ESRO is concerned, and even if there were, it would be unlikely that Eurodoc would be sponsoring it, since it would almost certainly be on an intergovernmental basis.
N.E.C. ISOTTA
European Space Research Organization
Neuilly-Sur-Seine, France

hearing it for ibm

Sir:

In regards to the News Scene (p. 158) concerning IBM's unbundling in your February issue, I would like to present the following comments:

Being a former employee of IBM, having participated somewhat in the unbundling world of IBM, and being in a competitive situation with them at this time, I feel you may be interested.

In regards to System Engineer agreements and SE estimates, I found the following guidelines to be in effect. The SE agreements simply mean that if you want service you can obtain it. If no service is ever requested, there will be no charges. As far as the SE estimates are concerned, they are just what the name implies—estimates. It happens that management policy states that all estimates must be reviewed when 60% of the estimate has been used. In either case, only the services used are actually billed.

As far as your comment on the user footing the bill for a replacement's learning process on a given project, it is rare indeed that a project of any consequence would have only one SE involved, mostly for just the reason you claim is a weakness—the avoidance of a replacement's "learning process."

Also, a comment on the fear of getting a nonqualified person to work on your contract—IBM makes every effort to place the most qualified person on any given job. Why? IBM is a service oriented company and certainly wishes to maintain its reputation.

Worried about IBM stealing ideas? Look at IBM's past policy—customers are *asked* if their programs may be packaged, and anyway, who develops most of these programs? IBM SE's maybe?

Worried about the change of rates clause? Look at the contract you sign before you buy an automobile: "Price may change up to and including day of delivery." How about that, sports fans? Should we all quit buying autos because of it?

In summary and conclusion, I submit to you that having had a very enjoyable relationship with IBM, that the IBM Corporation is a very people-oriented and people-sensitive organization and will continue to be one, for these are the foundations IBM was built on.
THOMAS J. BUDZYNSKI
Farmington, Michigan

getting sassy

Sir:

It was most interesting reading C. I. Keelan's comments on the use of timesharing at Johns-Manville (Feb. p. 137). Incidentally, he might be surprised to know that as early as December, 1968, the Johns-Manville plant in Waterville, Ohio, was using timesharing for the very purpose he identifies.

How do I know? I developed and wrote most of the programs!
C. J. SASS, JR.
Maumee, Ohio

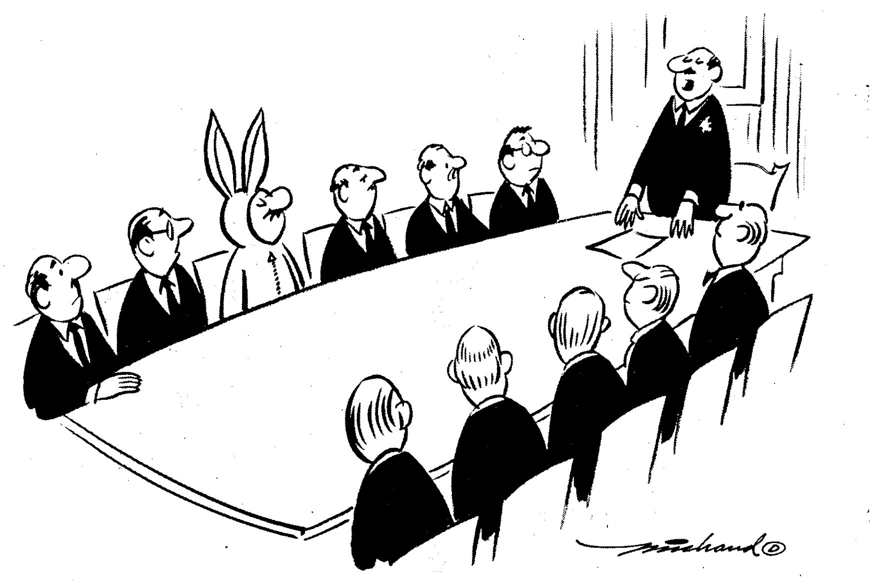
ibm a bit better

Sir:

Having spent some time in Canberra, Australia recently, November 1969—January 1970, I thought to comment on your mention of the Australian computer market which appeared on page 179 of the February issue.

IBM is doing quite a bit better in Canberra than your article implies. By mid-1969, they had received two substantial orders from the commonwealth government that I know about. The Health Department has placed an order for a dual 360/65 installation which will service a nationwide data collection network. Also, the Repatriation Department (equivalent to Veterans Administration) was reported to have ordered a similar configuration.

Univac is doing well, also, in government circles, although not in Canberra. An 1108 order was recently announced which will service the betting shops business (TAB) in the Sydney area. Also, the Australian Post Office has selected the 418-III equipment to implement the Common User Data Network (CUDN), an implementation similar to Western Union's Infocom service.
EDWIN B. HEINLEIN
Computer Sciences Corp.
San Francisco, California



"About my little talk last week on individuality . . ."

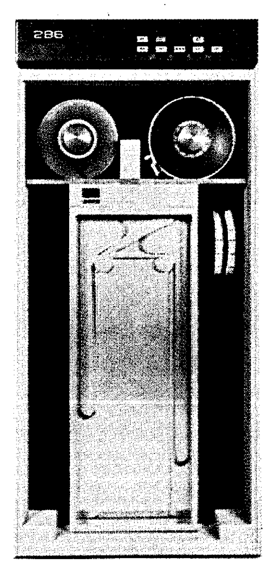
benchmark

Storage Technology Corporation announces a line of high performance tape drives plug-to-plug compatible to the IBM 2420 series tape drives. These drives are available to the IBM 360 user as well as OEM. For more information, write:

Storage Technology Corporation
P. O. Box 3524
Boulder, Colorado 80303
Phone (303) 449-1096

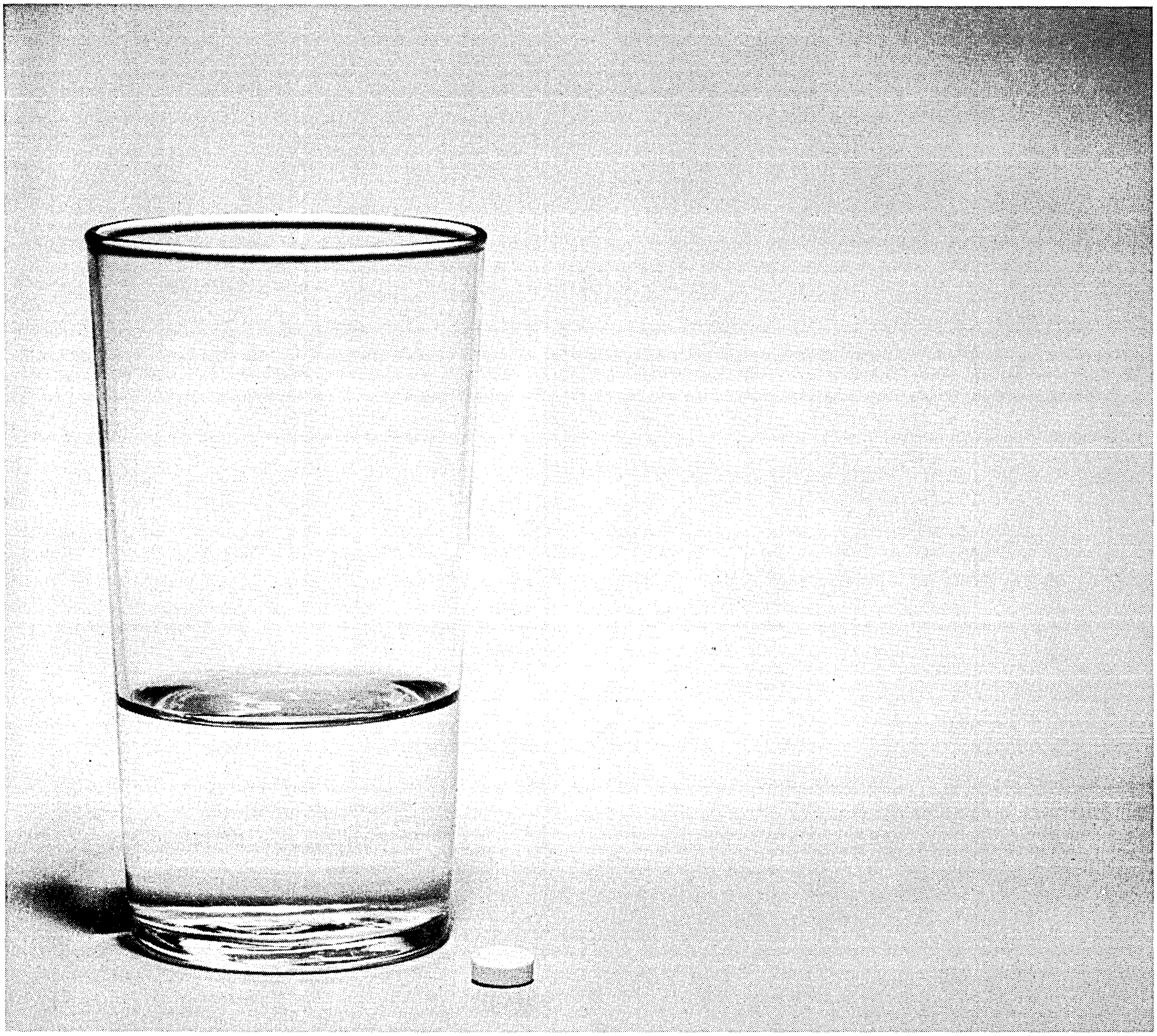
In addition to automatic threading, cartridge loading, single capstan, in-column rewind, and 1600 bpi phase-encoding, STC tape drives feature:

- o DAC-Dynamic Amplitude Control
- o Automatic Reel Hub
- o NRZI Model
- o SIMS/DUAL Density Options
- o Analog Capstan Control
- o Modular Construction
- o Integrated Circuits
- o Fail Safe File Protect



On display at SJCC/Booth 10009/Convention Hall

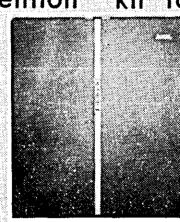
CIRCLE 139 ON READER CARD



The Pill.

LIKE THE PILL, **EDPAC** PREVENTS TROUBLE, (IN COMPUTER ROOMS).

Please send me the "EDPAC-ounce-of-prevention" kit for computer room air conditioning.



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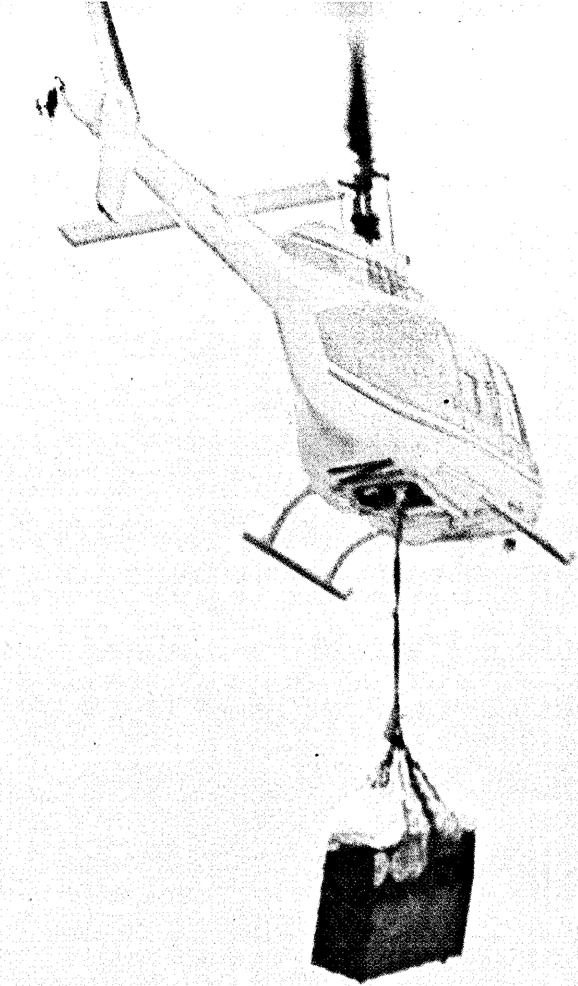

Honeywell delivers Keytape.* No excuses.

We know how eager people can be to get their new Honeywell Keytape equipment.

It's the kind of enthusiasm we expect. After all, consider the advantages that Keytape data preparation has over keypunching.

Benefits like faster, more accurate data transcription. Faster data input to the computer. Reduced operating expense. Simple error correction. Improved storage and handling. Lower noise level. Happier operators.

You can also do a lot of things with Keytape that you could never do with keypunch. Things like communicating from remote locations, printing out hard copy, converting cards or paper tape, pooling data from multiple units, validating check digits, adding and listing. Altogether we have 52 different models in both seven-channel and nine-channel configurations.

So if you're in a hurry to get your Keytape equipment, we understand. That's why we deliver. Fast.

Even if it means a little extra effort on our part.

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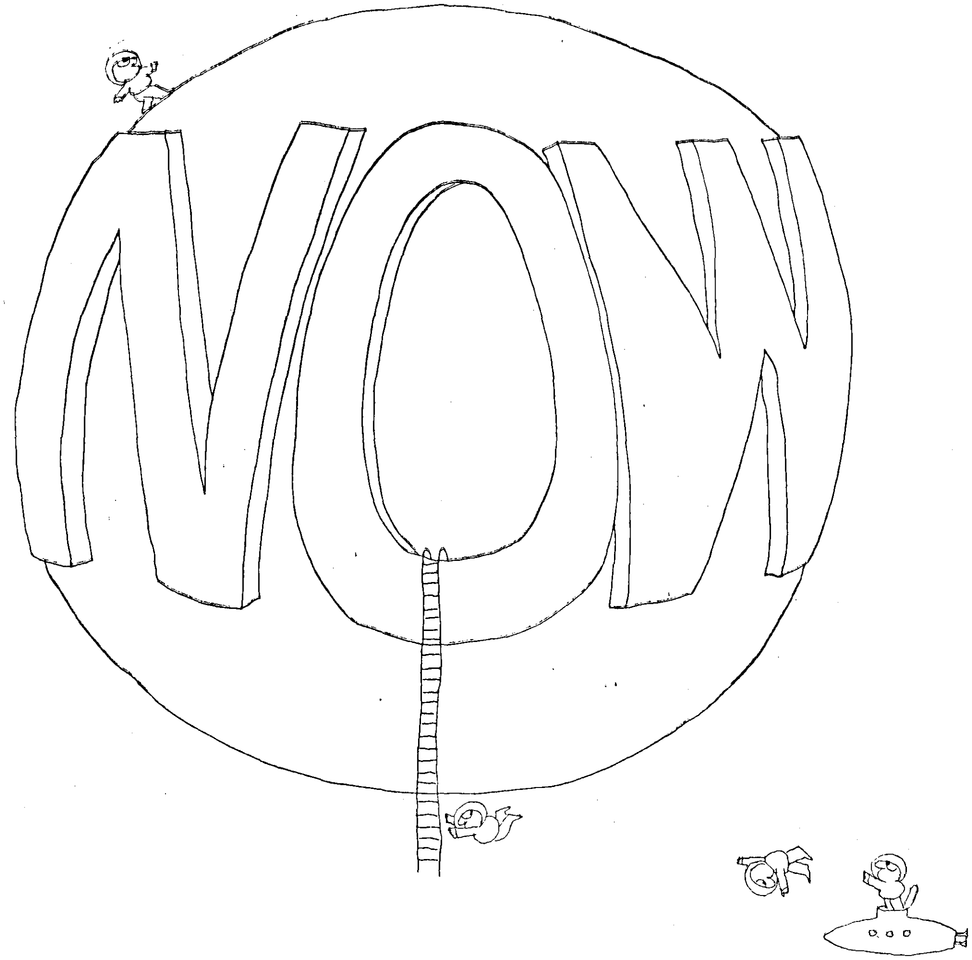
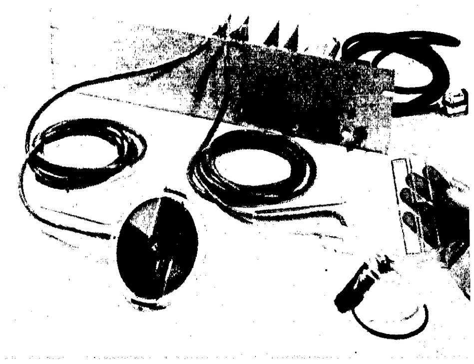
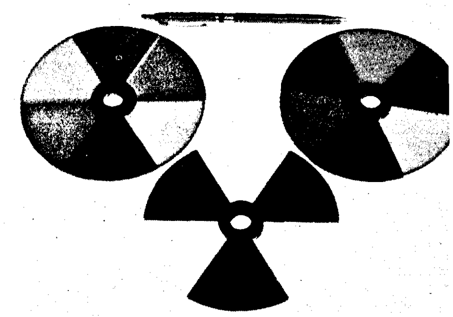

NOW





AND NOW, COLOR AND STEREO IN COMPUTER DISPLAYS FOR LESS THAN $1,000!

The LORGNETTE, another new product by Evans & Sutherland Computer Corporation

Increased capabilities — The Lorgnette (pronounced Lornyet), a uniquely engineered device by Evans & Sutherland Computer Corporation, gives color and/or stereo capabilities to your computer display system.

Color displays — The Lorgnette is a lightweight, hand-held viewer which with associated equipment permits computer display users to see programmed color. Displays can be color-coded as an aid to understanding complex situations.

Three-dimensional viewing — The Lorgnette can also separate right and left eye images for viewing of three-dimensional information in stereo. The complete structure of such an object as a three-dimensional molecule becomes more easily understood.

Color and stereo — The Lorgnette rotates a filter disk at a speed synchronous with your display. Three interchangeable disks are provided with the unit. The first gives a color presentation, the second consists of clear and opaque sections providing black and white three-dimensional displays. The third disk combines colored, clear and opaque sections to give color and stereo presentations.

Basic Lorgnette system — The basic Lorgnette system includes a power supply unit, synchronous circuitry, clocking circuits and level converters mounted on a standard 19" x 5¼" panel. Each system can drive up to 10 Lorgnette viewing units.

Reasonably priced — The basic Lorgnette system including two viewing units with three interchangeable disks each is available at $995, F.O.B., Salt Lake City. Additional viewing units: $245 each.

For further information, write or call:
Evans & Sutherland Computer Corporation, 3 Research Road, Salt Lake City, Utah 84112
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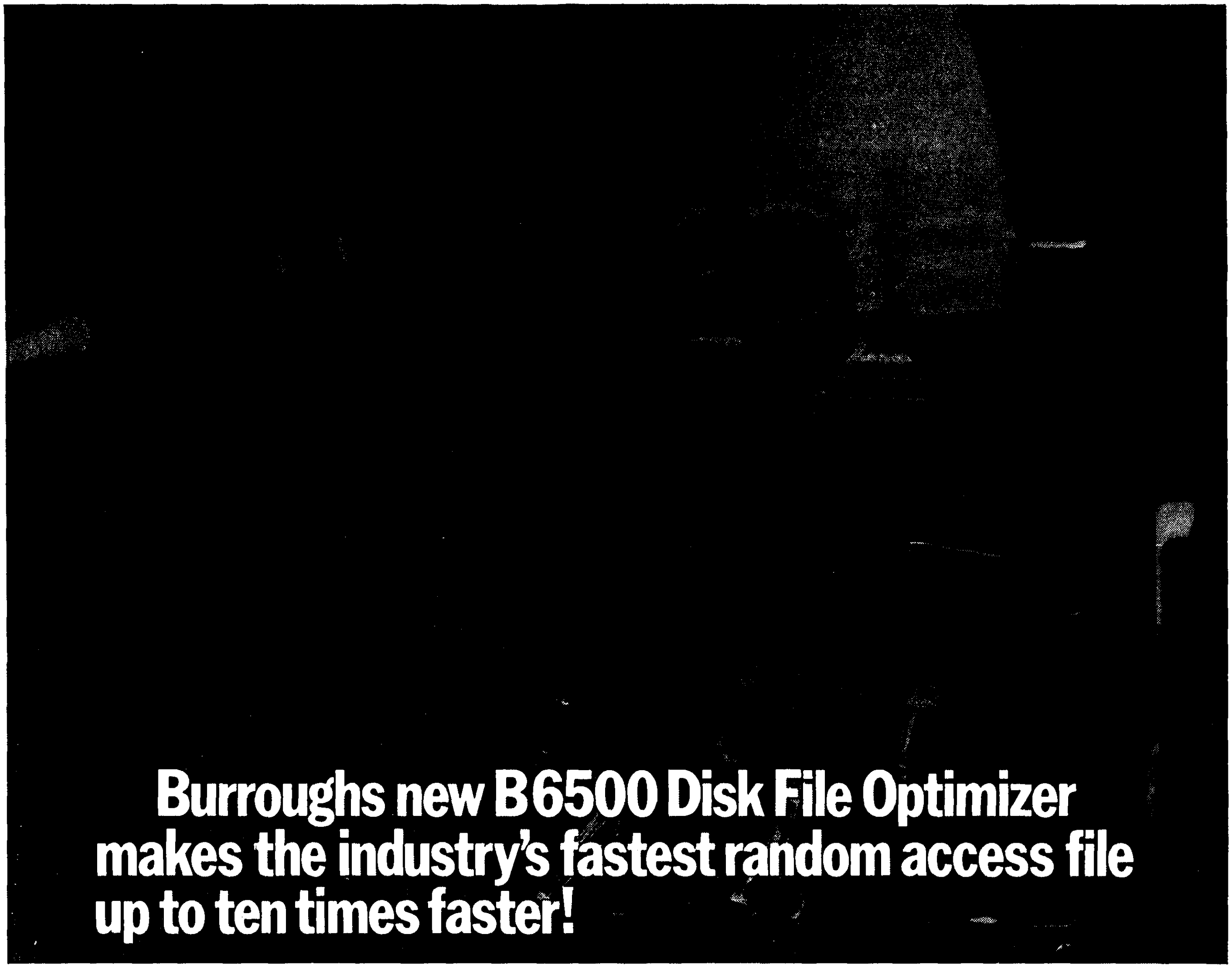
CIRCLE 81 ON READER CARD



Burroughs head-per-track disk file systems are fast to begin with. Fast enough to make any data segment in the file available in an average of 20 ms, regardless of file size.

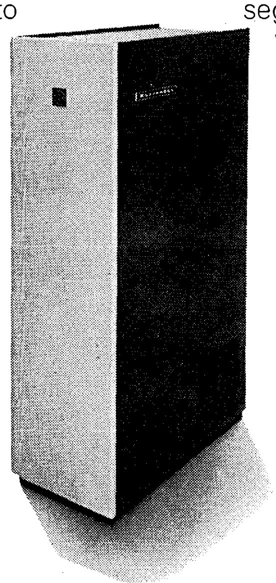
Now, consider what happens when you add Burroughs new Disk File Optimizer to your B 6500 system. Depending on the access request pattern, your 20 ms file may deliver average access times of 2 ms, or even better.

The Disk File Optimizer doesn't make the file work harder, just smarter. It takes note of file access requests, checks to see how far away each requested data segment is from its read/write head, then tells the computer what order to follow in servicing the requests.

In this way, many requests can be sandwiched into the same few milliseconds that a single access would otherwise take. The heavier the access request load, the more efficient the file becomes. Without reprograming!

Ask your Burroughs man for the impressive details.

Burroughs



look ahead

BURROUGHS UNBUNDLING BALLOONS FLOAT QUIETLY BY

Burroughs has been leaving a trail of clues (or are they trial balloons) re its future unbundling stance by splitting out some software on bits and pieces of its product line outside the main B-500 line. The latest is on the DC-1000 computer-based terminal series, two models of which at writing are being marketed but have not been publicly announced--typical Big B move.

The DC-1100 and 1200 (Varian mini-based) come complete with a system representative agreement and the promise of for-fee licensed Program Products which might include operating systems. The way it works is that the user will receive 15 free days of system rep time, which can include training by SE's. Beyond that he pays $28/hour (three-hour minimum) and signs an agreement that is fairly simple but absolves B of responsibility for keeping the user's dp secrets.

Burroughs has done a "slight" variation on the IBM software scheme. System Software Products come for free and include things like the line controller, assembler, communication handler. No Program Products were announced, but, says a company missive to salesmen, they "may include system software (operating systems, compilers, etc.) and/or application software."

Whether any of or all of this will spill over into the B-500 series Systems will probably depend on user reaction. Some are surprised that the 6500 hasn't been unbundled.

SHARE INTEGRATES, GUIDE SEPARATES

"Third-class membership" is what some people are calling the new Product Organization affiliation that SHARE is offering those awful, sweaty non-IBM vendors. The affiliate status will be offered to certain kinds of product and service firms--not mainframe manufacturers. Doubts are being raised on whether the big user group can legally sustain the restrictions it imposes. SHARE lawyers though, have no doubts as long the group's rules and procedures are clearly defined.

Regardless, this issue probably has dashed forever merger chances for SHARE and GUIDE, its business system counterpart. GUIDE wants no outsiders in its midst--the reason we are told that it has dissolved all joint projects (about 10) with SHARE. The last such joint efforts will take place at the May GUIDE meeting in Minneapolis.

According to a GUIDE letter to membership, the respective executive boards have pursued "different objectives" since the Jan. '69 defeat of the merger proposal, and unbundling has intensified the differences. "As a result, what worked well when the organizations considered merger is rapidly becoming a liability in effective project works by both organizations."

By avoiding SHARE and staying "IBM-Only," GUIDE expects to be more influential with IBM. Some

(Continued on page 51)

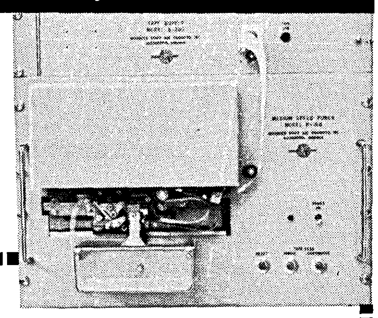
punch
Mylar at 150 cps

punch
Paper at 150 cps

punch
within EIA standard tolerances

punch
up to 1 billion operations (oiled paper tape)

punch
up to 500 million operations (Mylar in 3.7—4 MILS)



Only one punch guarantees this kind of performance at a competitive price, the new P-150 from Advanced Space Age Products, Inc. It's the latest in a long line of punches, translators and related equipment. For all the facts about the amazing P-150, put this coupon in the mail today. P-150 is $2,250; with long-life block, $2,705. Prices include electronics. Delivery 60 days ARO.

ASAP

Mr. Morris Bowles
Advanced Space Age Products, Inc.
4308 Wheeler Avenue
Alexandria, Virginia 22304 Tel: (703) 751-3320

Tell me more about the P-150 and while you're at it, send me information about the other ASAP products I have checked.

_____P-240 _____Model 180 Master Translator
_____P-300 _____Model 181 Static Translator

Name____________________Title__________

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observers agree, feeling that GUIDE's users are more IBM-reliant than the scientific SHARE members, and may win points by using the "appropriate pressure tactics" (no competitive threats) on IBM. On the other hand others, including SHARE, feel that mixed systems are a fixture now and a user group will only be effective if it can keep IBM on its toes and its members informed of other offerings. Too, they say the GUIDE move was "nose-cutting, face-spiting."

XEROX ENTERS ROUGH T-S BIZ

Formation of a time-sharing accounting service by Xerox is seen by some as a sort of end-run attack on IBM. Late last month, the Big X announced its formation of Xerox Computer Services to provide an interactive accounting system to small businesses. Primarily, this will be directed at distributors and manufacturers currently without computers, but this is also the market for System/3.

To pursue this market, XCS will start with a Sigma 7 in Los Angeles. We hear they'll have 10-17 centers in the next four years. Significantly, the software package they'll be using, acquired from BMA Data Processing in Salt Lake City, is described by an outsider as the only one of its kind (as far as he knows)that really works. The integrated small-business package includes payroll, accounts receivable and payable, inventory control...the whole works. And, according to XCS head James S. Campbell, the input of receipts, for example, updates all pertinent files.

Campbell, ex-president of Greyhound Computer Corp., sees the average user paying $2500-3500 per month within a year after his start of conversion to the system. With three or four terminals, the cost might get up to $5-6K. This service can compete with the System/3, he admits, as well as the 1401s. With a recent acquisition, there are also packages that can be marketed to municipalities, a utility billing system among them.

SOME SDC PEOPLE GET OPTIONS, SOME LAID OFF

1,031 of the nearly 3,000 employees at System Development Corp. were offered the opportunity to buy stock under the firm's plan to go public (March, p. 132). Some are happy with it, some are not (one technical higher-up termed his allotment an "insult") but a company spokesman said it was extremely equitable. Meanwhile, the company is laying off people in an effort to trim to commercial fighting weight, has let around 225 go in the last few months. Resignations are minimal, insisted the spokesman, and the company receives 70-80 unsolicited resumes a day as a result of the aerospace layoffs in the Southern California area.

TWO MINIMAKERS READY NEW MAINFRAMES

Varian Data Machines, seeking to escape the cutprice/throat atmosphere choking today's minicomputer business, is ready to announce a new mini, the 620/f (for fast). A 750-nsec 16-bitter with read-only memory, the unit will be software-compatible with its two-year-old brother, the 620/i, and in the same $10K ballpark. The 620-man Irvine, Calif., firm has a healthy backlog, expects shipments this year to be 30-35% over last year, and is building data concentrators and remote batch terminal interfaces for a major manufacturer. Around the bend: special hardware/software systems aimed at yet-to-be (carefully) selected vertical end-users. Backed by a solid parent company with a good cash flow situation, VDM should emerge as one of the major mini makers.

Another, Interdata, will announce two new computer

(Continued on page 371)

How to lose an $8000 bet

Sykes cassette-loaded COMPU/CORDER™ 100. A high-speed, direct access magnetic tape transport system for mini-computers.

Confessions of a disk pack reject

"I'm good. I know I'm good. Almost everybody says so. And I was sure I could make it as an RCA Disk Pack.

"The 6-high RCA 506. Some of my best friends are 506s. And some are 11-high RCA 511s. For disk packs, either is a goal worth striving toward.

"Anyway, I thought I had it made when I started my final physical at RCA. They checked my sense of balance. Went over my tracks. Examined the quality of my coating. Gave me the toughest mechanical and electrical tests in the industry.

"Those people don't miss a thing. I didn't even get to the final test, a chance to prove myself on a computer. Seems I had a slight case of the run-outs.

"What's a disk pack to do? I'm good enough to be somebody else's disk pack. But all I want to be is an RCA 506. And if I were 11-high, I'd want to be a 511."

Nobody needs a reject. Write RCA Magnetic Products, 201 East 50th Street, New York 10022.

Our disk packs make it.

RCA Disk Packs

Announcing a new lease meter plan for the Kodak KOM-90 microfilmer.

You only pay for the time you use it.

If you're using a computer output microfilmer, or thinking about it, Kodak has important news: Our new KOM-90 microfilmer lease meter plan starts with a monthly base rate as low as $2,200 on a 5-year lease. Slightly higher base rates are available on shorter term leases.

You pay nothing more for under 20 hours of usage. Additional hours are economically priced at a declining hourly rate.

This means that now many more computer users, rather than waiting until they grow larger, can immediately take advantage of the KOM-90 microfilmer and associated COM benefits.

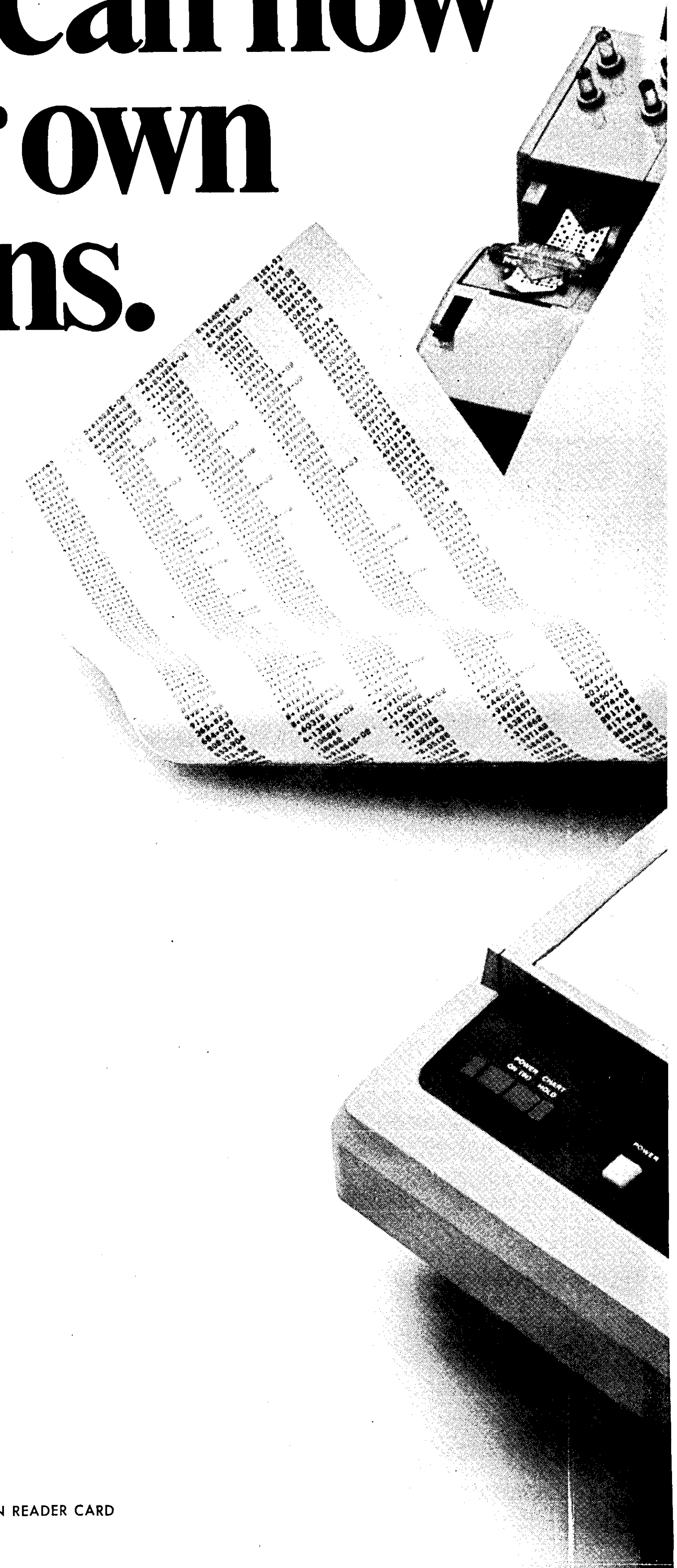
For the new low cost there is no sacrifice in our big-machine speed, big-machine capability, and COMplete Kodak support.

There's a lot more to the story. So get in touch with your Kodak microfilm systems representative. Or write Eastman Kodak Company, Business Systems Markets Division, Dept. DP651, Rochester, N. Y. 14650.

Kodak Microfilm Systems

CIRCLE 90 ON READER CARD

Time-share terminals can now draw their own conclusions.



Now you can get instant graphics. From the new Hewlett-Packard Graphic Terminal, the most functional advance in time-share capability since the Teletypewriter itself.

Feed standard EIA ASCII inputs to the Graphic Terminal and as the data arrives from the computer, it can be plotted right along with the Teletypewriter printing. When data transmission is finished, so is the graph. Plugged into the Teletypewriter, the Graphic Terminal will plot from keyboard inputs, or you can plot with the Teletypewriter silenced by a switch. No more waiting. No more wading through a swarm of digits. Clear, sharp graphs help you get the picture every time—on the spot. And give you faster, more direct comprehension of computer solutions.

The HP terminal is simple to operate but provides sophisticated results. No special programming knowledge is needed. Numbers become points, curves, circles, lines, ellipses, contours. Or business graphs like bar or pie charts. Check out trends, study the behavior of input functions, compare one result with another. Design graphically with figures from computer-resolved data.

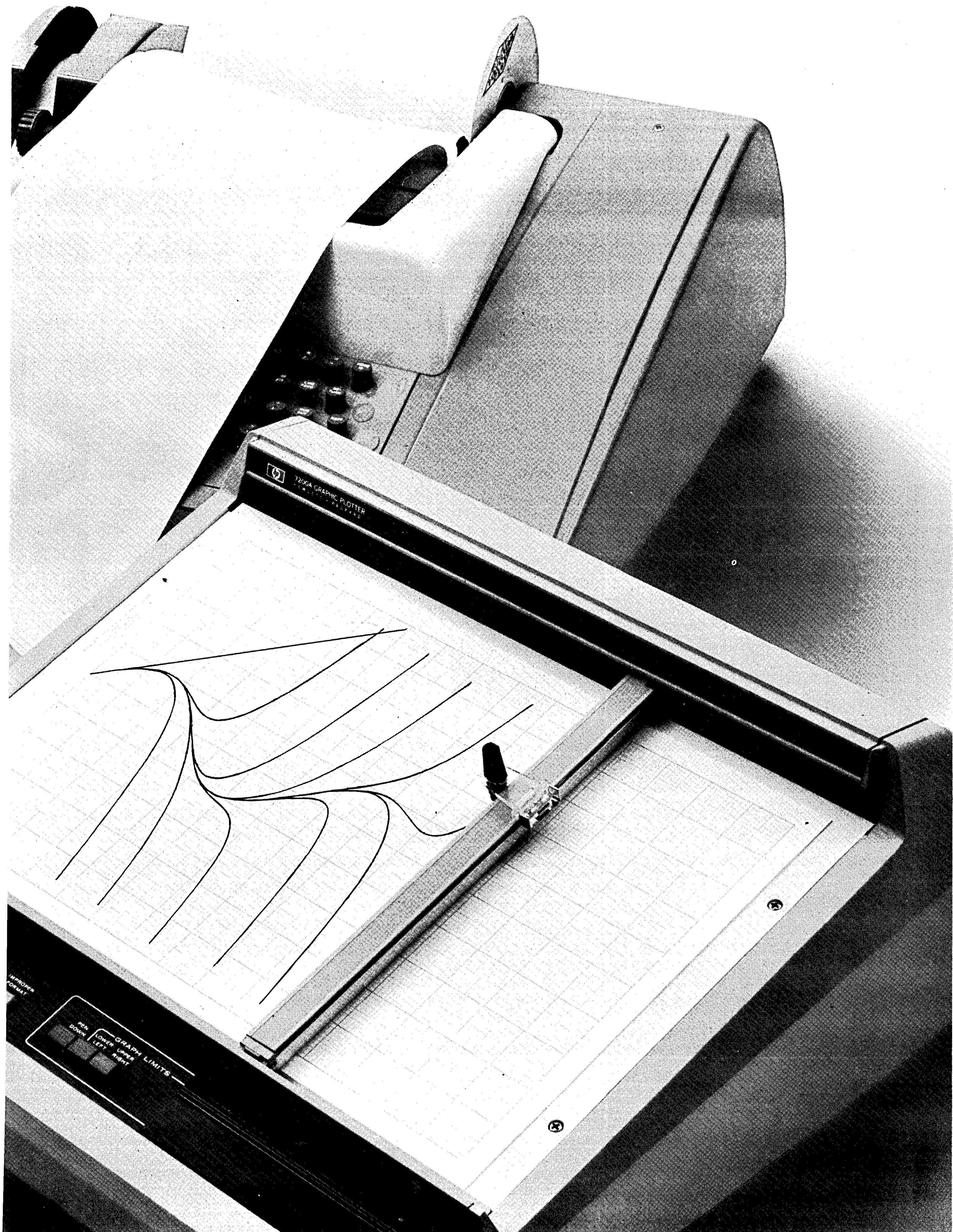
Add a new dimension to your in-house capability. Put a Hewlett-Packard 7200A Graphic Plotter next to your Teletypewriter and draw a more functional picture of the cold hard data. Your time-share service has the facts. If they don't yet offer the 7200A, have them get in touch with us.

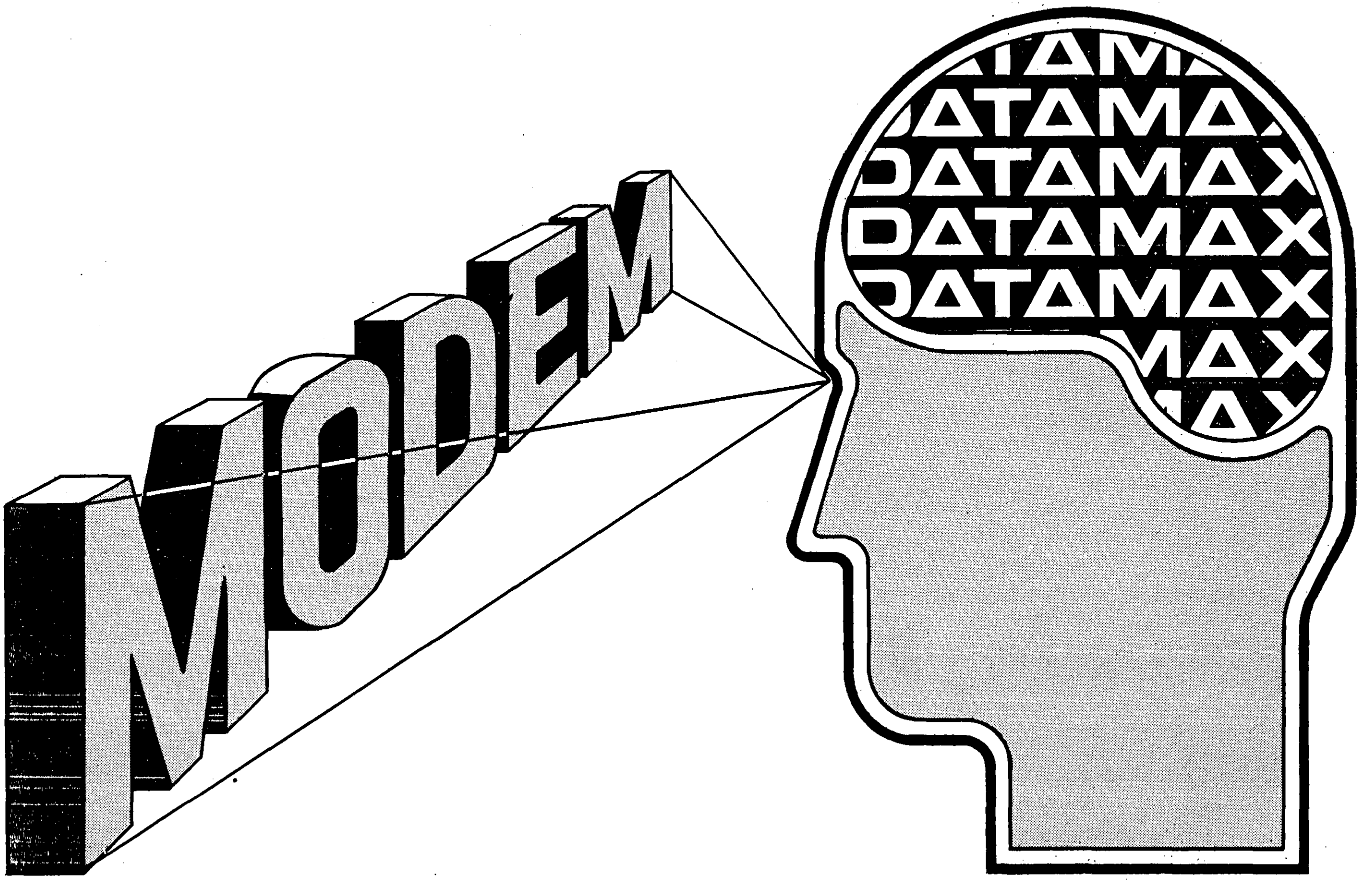
HEWLETT **hp** *PACKARD*

GRAPHIC RECORDERS

11909

CIRCLE 138 ON READER CARD


7200A GRAPHIC PLOTTER
IMPROPER FORMAT
PEN DOWN
GRAPH LIMITS
LOWER LEFT
UPPER RIGHT



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editor's readout

SLOWING PAINS

Most of us in the computer industry are not old enough to remember the depression of the 30's, with its bread lines, men selling apples, going to the state store for powdered milk and all them fun and games.

Even the recessions of the 50's didn't hit the computer industry—what there was of it—very hard. Computers were still sailing under the beautiful banner of cost savings, and the relatively small number of computer specialists around were too busy trying to get such mundane applications as payroll and inventory control working to get to the bank to cash their plump paychecks.

And while economic theorists debate whether we're facing a recession, a slowdown or a minirecession, it's fairly clear that in certain segments of the industry, at least, the computer bandwagon is slowing perceptibly.

The defense biz is a puny shadow of what it used to be, and there are startling cutbacks at aerospace companies. There are even experienced programmers available . . . at reasonable rates. Even in rather stable, healthy user industries, management is taking another look at the voracious appetites of its edp entities. Expansion has become a dirty word.

So for the first time, a large number of edp managers throughout the industry are facing the rigorous realities of life. They're being asked to tighten the belt a notch. It's not easy for folks used to riding the crest of an expansion wave . . . ordering the latest hot-button feature, staffing up for a continually ascending workload, installing the latest version of an os without worrying about the resulting reprogramming shock waves. Let's face it: most edp bosses are not used to tightly managing their resources.

But it can be done.

How many of those consoles scattered around the company are luxury terminals, used maybe an hour or two a day? Do you *really* need 16 tapes? Or would 14 maybe do? A single tall-pack disc might do the job of several six-packs. There are now plug-plug-compatible peripherals available for many of the major manufacturers' mainframes . . . at significant savings. Even "foreign" auxiliary core can be found . . . and a company that will install it for you. There are hardware and software monitors that will help you analyze, tune and scrub down your configuration. Even without them, you may find a lot of data coming out of your computer about its own performance . . . data nobody's reading right now. Another thought: some computer families are downward-compatible . . . if you have good internal documentation and standards, and are willing to alter programs.

It's about time somebody in your shop paid attention to measuring and evaluating people performance, too. It might not hurt to look over the travel budget, see exactly which shows are worthwhile . . . to how many people. Maybe you send two guys instead of eight, and make sure they report back to the others what they learned.

We don't have any wise words that will help you in that painful moment of letting someone go. But before trimming your staff, try a little manpower planning, matching skills, experience and headcount to match your commitments. Then prune to the plan.

The toughest trick might be that of holding on to those bright people interested in innovative work, a precious resource likely to drift off at the first sign of cutbacks in advanced projects. Hopefully, you can husband enough funds to keep at least one development activity going.

The edp manager who can survive the current slowdown, keep vigor in an organization that isn't expanding any more, will win important brownie points with management . . . and pave the way for future advancement and success.

Growing up isn't all bad.

—R.B.F.

AN INTRODUCTION TO THE ILLIAC IV COMPUTER

by David E. McIntyre

This introduction to ILLIAC IV is written for a computer user who has only an acquaintance with the hardware involved in a conventional digital computer. For a more complete description consult references 1, 2 and 3.

A stereotype computer can be functionally characterized as shown in Fig. 1a. It is composed of: (1) a memory that holds operands and instructions; (2) a control unit that fetches instructions from the memory, decodes them, and issues control signals (microsequence pulses) that operate, or drive; and (3) an arithmetic unit that performs the computation operations (addition, logical operations and multiplication) on operands that have been supplied from memory, and returns the result to the memory. In effect, the control unit monitors and controls the flow of information between the memory and the arithmetic unit and operates the arithmetic unit.

A typical sequence of events that takes place during operation is:

1. An instruction is fetched from memory to the control unit.
2. When it arrives in the control unit, it is decoded.
3. If the instruction involves operands in memory, the operands are fetched to the arithmetic unit.
4. When the operands arrive in the arithmetic unit, the computation (for instance, subtraction) is initiated and monitored by the control unit until complete.
5. After completion, the result is stored in memory.

There are several ways one can modify this stereotype design to achieve an increase in computing speed. One way would be to add additional control units and arithmetic units. This is the multiprocessor configuration. Another way (Fig. 1b) would be to divide the arithmetic unit into a group of functionally independent subunits, each of which could be operated independently by the control unit. As the control unit decodes instructions, it will determine when two or more consecutive instructions use separate functional subunits and are independent of each other. If this is the case, the separate instructions are allowed to proceed concurrently in the separate functional units rather than sequentially, as was the case with the stereotype machine. This is the approach employed in the CDC 6600, IBM 360/9X series and other current generation computers. If the number of

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1. Slotnick, D. L., et al. "The ILLIAC IV Computer," *IEEE Transactions on Computers*, V. C-17, No. 8, August 1968, pp. 746-757.
2. Kuck, D. J., "ILLIAC IV Software and Application Programming," *IEEE Transactions on Computers*, V. C-17, No. 8, August 1968, pp. 758-770.
3. Davis, R. L., "The ILLIAC IV Processing Element," *IEEE Transactions on Computers*, V. C-18, No. 9, September 1969, pp. 800-816.

The innovations of new large-scale computers often show what design characteristics will become standard in medium-sized machines for the commercial market a few years later. Thus, to give you a look at new ideas that may help shape the future, we have gathered together in this issue some examples of very large systems. There are descriptions of the IBM 360/195 and CDC 7600, with emphasis on the latter's software, plus an introduction to one of the supercomputers—the ILLIAC IV. In addition, Dr. Graham of RAND discusses the advantages and drawbacks of parallel versus pipeline design, using ILLIAC IV and CDC's forthcoming STAR as examples of these contrasting approaches.

operands that can be processed by the arithmetic unit is increased, the speed with which the arithmetic unit can obtain and store operands from the memory must also be increased to avoid a bottleneck. This can be achieved by partitioning the memory into several sets of memory banks. A memory operation can then take place simultaneously in separate memory banks.

Fig. 2 (p. 62) shows how the stereotype design has been modified in the design of ILLIAC IV. This figure describes one quadrant, or one-fourth of the ILLIAC IV array. The control unit operates in very much the same manner as the control unit in the stereotype computer. Instructions are fetched from the memories to the control unit where they are decoded and microsequence signals are produced. The microsequence signals are duplicated 64 times, and each set of microsequence signals is passed to a separate arithmetic unit. The same set of signals operates 64 different arithmetic units and increases the number of arithmetic operations that can be performed by a factor of 64. An arithmetic unit is referred to as a "processing element" (PE). Each of the 64 PE's has one memory bank and can fetch or store operands only to or from its own unique memory bank. The control unit, however, can fetch instructions from any of the 64 memory banks. The restriction that each arithmetic unit perform memory operations only with its unique memory solves some problems and poses some others.

If the memory banks of ILLIAC IV were arranged with a large crossbar switch so that any PE could access data from any memory bank, there would be delays imposed because of the distance that the signals would have to travel. Furthermore, if two different PE's required a datum that was stored in a third PE's memory bank, one of the two PE's would be forced to wait a complete memory cycle before it could receive its operand because only a single memory operation can take place using the same memory bank at one time. These delays are referred to as bank conflicts and are encountered even in concurrent computers. Therefore, by assigning each processing element its unique memory near the PE, signal line delays can be minimized and the possibility of bank conflict will be eliminated because only one PE will be making demands on a given memory bank.

Programs run most efficiently if all the operands used by PEi can be stored in memory i. This is a restrictive condition

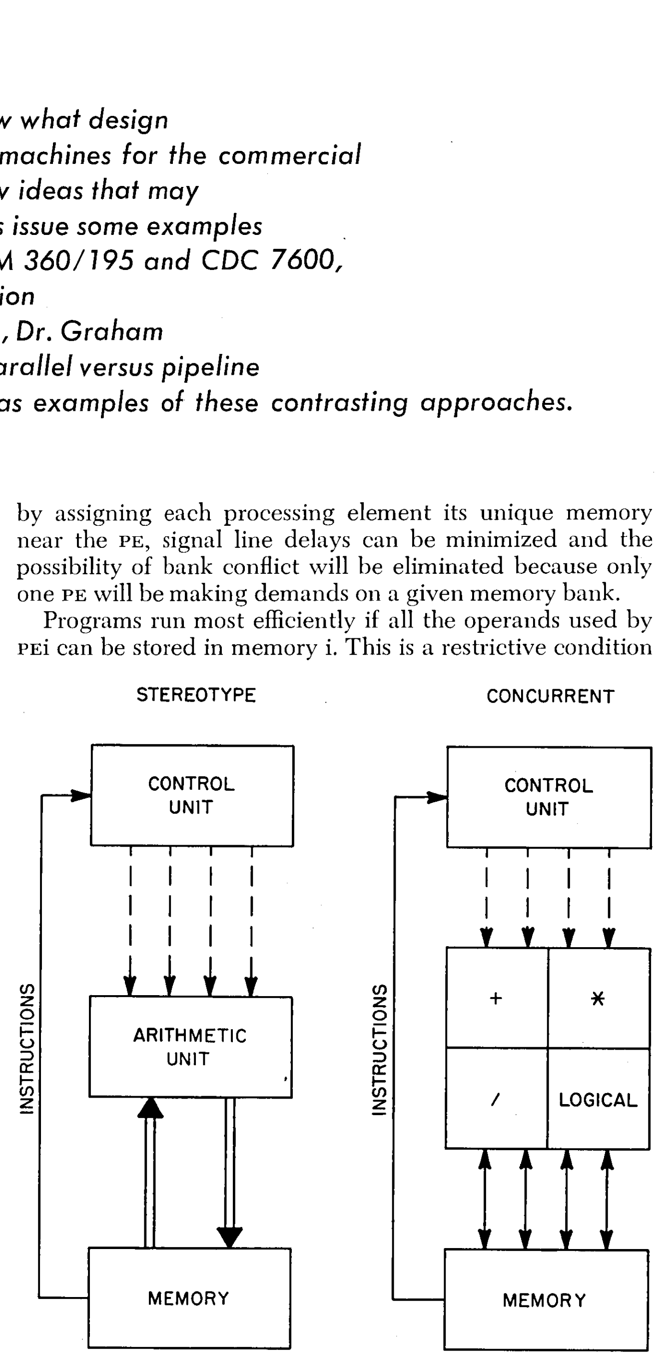

Fig. 1a (left). Functional block diagram for a stereotype computer.

Fig. 1b (right). Functional block diagram for a concurrent computer.

and is not always possible. Occasionally PEi needs to use an operand that is stored in PEj's memory. When this is the case, the operand in PEj's memory can be transmitted to a register in PEj and then again transmitted to the corresponding register in PEi. PEi can then store the operand in its memory. This process is called routing and will be explained in more detail in the programming section of this article.

The processing element (Fig. 3) in the ILLIAC IV is basically a four-register arithmetic unit. There is an A register and a B register used to hold the operands for arithmetic and logical operations. Operands for arithmetic operations are placed one in the A register and one in the B register when the operation is performed and the result is left in the A register. The S register is provided as temporary storage to avoid making repeated accesses to memory to fetch or store intermediate results. The R register is used to transfer information among the PE's in the routing operation. Each of these registers is 64 bits long.

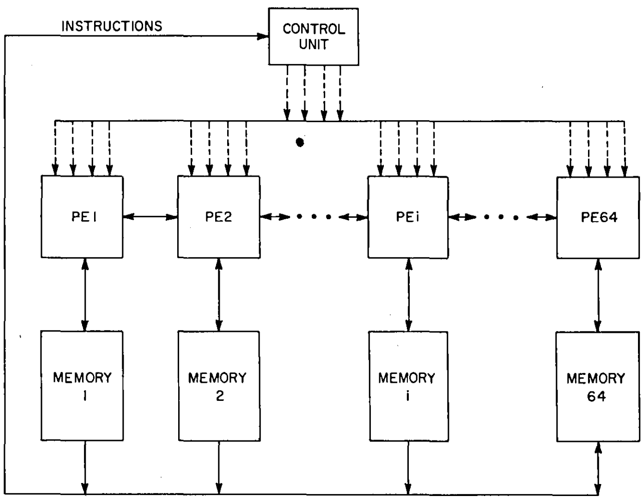

Fig. 2. ILLIAC IV quadrant.

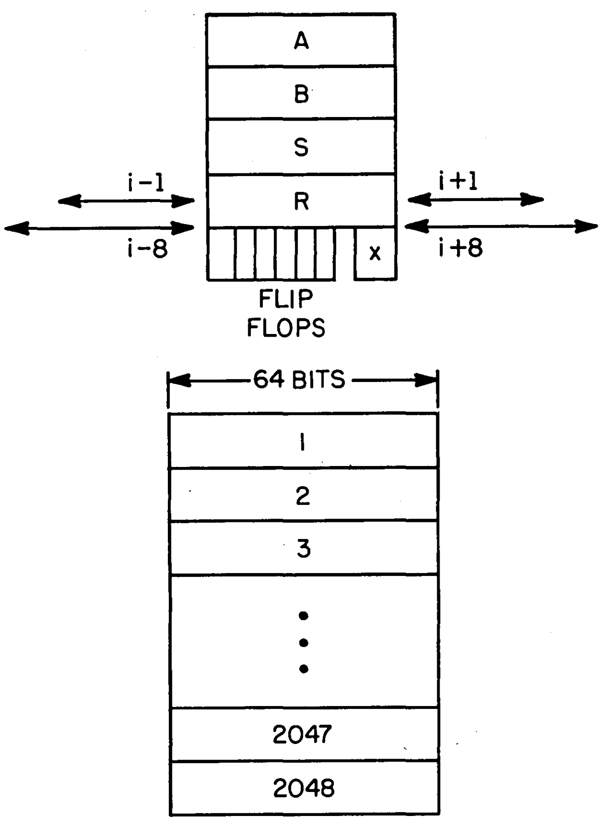

Fig. 3. ILLIAC IV processing element and associated processing element memory.

The R register of every PE is wired directly to the R registers of four other PE's. PEi is connected to PEi+1, PEi−1, PEi+8, and PEi−8 via the R register. The routing operation uses the R registers and can be visualized by considering the 64 R registers as a large 4096-bit register. Upon executing the command "route 1 to the right," this long register is shifted end around 64 bits to the right. (See Fig. 4.) Routes can be performed toward the right (in the direction of increasing PE number) or left. A distance 8

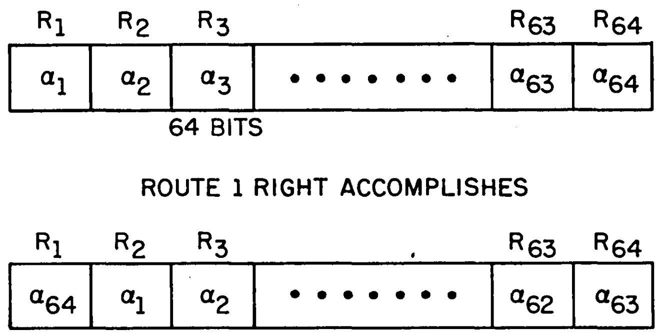

Fig. 4. Route instruction.

route (shift of 512 bits) is provided so that information can be rapidly sent between PE's with greatly different numbers. Displacements of ±1 and ±8 require about 100 nsec. Arbitrary distance routes are decomposed by the hardware into several consecutive routes of distances 8 or 1.

There is also an 18-bit index register (x register), which is used mainly to increment a basic memory address. Finally, there are eight 1-bit flip-flops that can be used to store the results (true or false) of tests, logical operations, etc. Each PE memory is composed of 2048 64-bit words. It is a semiconductor memory with a cycle time of roughly 200 nsec.

It should be stressed that the microsequence stream controlling PEi is exactly the same stream that controls PEj, and the PE's are constrained to execute exactly the same instructions at exactly the same time. When PE1 is performing an addition, PE5 can not perform a multiplication. There are two degrees of local autonomy provided for a PE. The first degree of autonomy involves "turning off" or disabling a PE. A disabled PE can perform no operations. A PE can be disabled either on command from the control unit or as a result of some conditional test. For instance, at the end of an arithmetic operation, the control unit can issue a command that is interpreted as "any PE that has computed a negative result, turn yourself off." Once a PE is turned off, it can no longer turn itself back on and must be enabled on command from the control unit. The other degree of independence available is that each PE may use a different memory location for a memory operation. This can be done by incrementing a base address by the contents of the index register in each PE. Suppose PE17 is to store the contents of its A register in memory location 35, while PE18 is to store the contents of its A register in memory location 45. The index register in PE17 would be set to zero, the index register in PE18 would be set to 10, and the control unit would issue the instruction "store to location 35 incremented by the index register." In PE17 the memory address would be incremented by zero, and the store would be to location 35. In PE18, the address 35 would be incremented by 10, and the store would be performed into location 45. These two degrees of freedom associated with each PE actually provide a great deal of flexibility in programming ILLIAC IV.

PE's can be operated either in 64-bit mode or in 32-bit mode. In the 32-bit mode, each 64-bit word is considered as two 32-bit words and two 32-bit floating point operations can be performed in roughly the time required to perform one 64-bit operation. In 64-bit mode, floating point numbers have 48-bit mantissas, leaving 16 bits for exponent and sign. In 32-bit mode, mantissas are only 24 bits long.

Table 1 compares the execution times for common operations between a single processing element and a CDC 6600. In all fairness, it should be pointed out that there is often a great deal of concurrency obtained using the CDC 6600. That is, several separate floating point operations can be going on at one time. There is also a limited amount of concurrency in ILLIAC IV. If two consecutive instructions to be sent to the PE's are independent and do not require the same components in the PE, they may be executed concurrently. Acknowledging that this is rather a rough comparison, it is fairly reasonable to equate in floating point computing power a single PE and one or two CDC 6600's. If all 64 PE's are enabled and doing useful work, they can produce floating point operations at a rate comparable to between 64 and 128 CDC 6600's.

	PE nsec	6600 nsec
Memory to Operating Register (fetch)	350	800
Floating Add	350	600
Floating Multiply	450	1000
Floating Divide	2750	3000
Register-Register Transfer	50	300
Operating Register to Memory (store)	300	1000

Table 1. Comparison between PE and CDC 6600 of execution times for some common operations

control unit

Fig. 5 gives a functional representation of the major components in the control unit (CU). There is a local data memory composed of 64 words. This local memory can be filled from any location in any PE memory and also stored to any location in any PE's memory. There is a block of 64 words called the Program Look Ahead (PLA). This block of words provides an instruction queue and its operation will be explained in a later paragraph. The arithmetic unit in the control unit is a very simple unit and is restricted to performing logical operations and fixed-point addition and subtraction, obtaining operands and storing results only within the local data memory.

The instruction decoding logic decodes instructions provided from the program look ahead (PLA). If the instruction is of the type to be executed by the array of processing elements, the decoded instruction is fed into the microsequence generator where the microsequence pulses are generated and sent down control lines to drive the processing elements. If the instruction is one to be executed in the control unit, the decoded instruction is issued to the simple arithmetic unit. Most of the instructions executed by the control unit involve housekeeping operations associated with loops or indices. These housekeeping instructions can be executed concurrently with arithmetic instructions fed to the PE's. (This concurrency is not related to the concurrency in PE instructions, which was mentioned previously.)

An ILLIAC IV machine language instruction is composed of 32 bits. The 64 words (each word is 64 bits) in the PLA provide a queue of 128 instructions. Loops containing up to 128 instructions can be executed without any reference to PE memory. The 64 words are divided into 8 sections of 8 words each. When the control unit is executing the instruction contained in the fifth word of the 8-word section of instructions, it checks to see if the next 8 words of instructions are already contained in the PLA. If the next 8 words are not contained in the PLA, it will issue commands to bring them to the PLA and destroy the oldest subsection of 8 words. This effectively eliminates many of the delays imposed by instruction fetching, except for the case in which a jump is made to a section of the program that is not contained in the PLA. For a large range of programs that have been simulated, it has been found that the control unit is delayed waiting for instructions to be fetched from memory much less than 1% of the time.

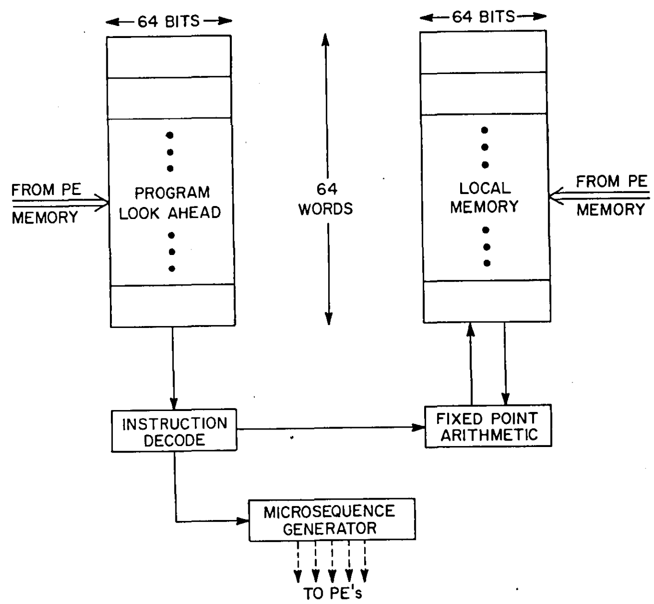

Fig. 5. Control unit.

cu-pe communication

Operands and control information can be transferred between the control unit and the PE's in several possible ways:

1. The control unit can broadcast a 64-bit word to all PE's simultaneously. The word originates in the CU local memory, or the arithmetic unit in the CU, and the destination can be any of the 64-bit operating registers in the PE.

2. The control unit can broadcast a 64-bit word with one bit going to each PE. That is, bit one would go to PE1, bit two to PE2, . . . , bit 64 to PE64. The destination of the bit going into a PE can be any of eight 1-bit registers in each PE. This is a method by which PE's are enabled and disabled. For instance, if it is desired to enable all even-numbered PE's and to disable all odd-numbered PE's, the control unit (using its arithmetic unit and logical operations) constructs a 64-bit word which has alternating ones and zeros. This word is then passed to the microsequence generator where one bit is sent to each PE, disabling all PE's

that receive a zero, and enabling all PE's that receive a one. The 1-bit register that specifies whether a PE is enabled or disabled is called the mode register.

3. The control unit receives information from the processing element in the reverse of the method previously described. That is, a bit is sampled from a 1-bit register in each processing element and assembled into a 64-bit word in the control unit. The control unit can use this facility to determine which PE's are enabled by assembling a 64-bit word from the single bit mode registers in 64 different PE's.

4. The control unit can fetch words from the memory of any PE into the local data memory or into the PLA. The fetch can consist of a transfer of one 64-bit word or a transfer of 8 contiguous 64-bit words. The fetch of 8 contiguous words requires only slightly longer than the fetch of one word, and thus is a high-speed method of getting large amounts of data into the control unit from the PE memory. All of the fetching to the PLA is automatic, as was previously pointed out.

the illiac iv system

Fig. 6 shows the ILLIAC IV system organization. It is composed of four identical control units, each control unit driving 64 PE's with 64 PE memories. The CU's are con-

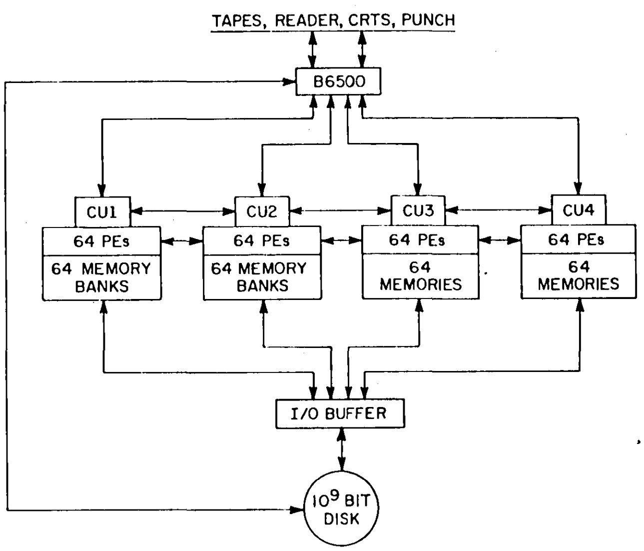

Fig. 6. ILLIAC IV system.

nected by lines that allow all to execute exactly the same instruction stream. In this "united" mode of operation, routing is provided across quadrants and end around from PE256 to PE1.

ILLIAC IV can be operated in several configurations. For example, all control units can be executing the same instruction stream, or each could be executing a different instruction stream; also, two control units could be executing one instruction stream and two executing another. It is possible to change the configuration during the execution of a program, but it is felt that this is not an extremely practical facility and does require certain careful programming considerations.

ILLIAC IV performs its input/output (I/O) through the Burroughs B6500 computer. The B6500 is very similar to the B5500, but is about five times faster. The data base for programs that are not core contained resides on a 10^9 bit head-per-track disc. This disc has two controllers, and each controller is capable of transferring into or out of the ILLIAC IV memory at the rate of 500×10^6 bits per second. If input and output were being carried on simultaneously by using both controllers, the effective transfer rate can be 10^9 bits per second. This disc has a revolution time of 40 msec, giving an average access time of 20 msec.

The average effective access time can be decreased considerably below 20 msec when several I/O requests can be accumulated in the I/O controller. There is a mechanism in the I/O controller that compares the beginning disc address of all I/O operations in a queue of requests with the address of the section of the disc that is passing under the read-write heads. As soon as a match is found, an I/O operation is initiated. For example, suppose two I/O descriptors reside in the descriptor queue with the lowest (oldest) descriptor, descriptor a, referencing a disc address that is located 270 degrees away from the disc address that is passing under the read-write heads, and the second I/O descriptor, descriptor b, referencing a disc address that is located only 90 degrees away from the disc address under the read-write head. (See Fig. 7.) The logic in the I/O controller would initiate the I/O operation b first, requiring only a disc rotation of 90 degrees, or a latency of only 10 msec, instead

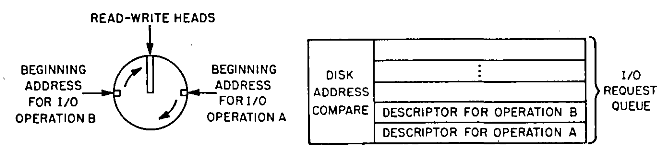

Fig. 7. I/O descriptor queue.

of initiating the I/O operation a, which would require a disc rotation of 270 degrees, or 30 msec latency time. The queue in the I/O controller can contain 24 I/O descriptors.

The B6500 exercises control over the CU's and all of the interactions between the disc and the computing array. The control units request I/O of the B6500, and it coordinates all I/O requests and initiates all I/O transfers between the disc and the array. At the end of an I/O transfer, it signals the control unit that the transfer is complete. In addition to performing in this supervisory capacity it also does all of the compiling for programs to be executed on ILLIAC IV. All external data used by the ILLIAC IV array goes first to the ILLIAC IV disc. For instance, if an executing ILLIAC IV program needs to read a tape unit, it makes the request of the B6500. The B6500 then reads one of its tape units, writes the result onto the ILLIAC IV disc and initiates the operation to bring the record from the ILLIAC IV disc into the ILLIAC IV memory.

programming illiac iv

It was mentioned previously that the separate memories assigned to each processing element do provide operands at a very high rate to each processing element, but they also cause a complication when programming ILLIAC IV. The programmer must arrange a storage allocation scheme so that when PEi needs a datum of information, it is "easily" accessible to PEi. This does not necessarily mean that the information must be stored in PEi's memory, since the route instruction makes it possible to obtain operands from memories other than that associated with PEi. However, it does mean that the transfer of operands from one memory to another by using the routing instruction must be done in some regular fashion.

Suppose PE7 needs a datum of information that is stored in PE2's memory at the same time that PE12 requires a datum of information that is stored in PE7's memory. This requires a parallel operation because both PE2 and PE7 can fetch operands from their memory and simultaneously route a distance 5 to the right (by performing a route 8 to the right and 3 consecutive routes of 1 to the left), making operands available to PE7 and PE12. However, if PE7 needed the information from PE2, and PE12 needed the information from PE19, this transfer of information would be impossible to implement in parallel because one involves a route to the right while the other involves a route to the left.

Programming ILLIAC IV involves a rather alien situation for the programmer who is accustomed to the conventional machine. He must not only think of some way to implement his mathematical algorithm, but he must also think of a memory allocation scheme for storing data which allows the algorithm to be implemented in a parallel fashion. However, memory allocation problems are not totally new to the FORTRAN programmer. An experienced FORTRAN programmer can use the DIMENSION, COMMON and EQUIVALENCE statements to force the FORTRAN compiler to allocate data storage as the programmer chooses. It is often a common programming trick to reference a doubly dimensioned variable as a singly dimensioned variable. For instance, if A were dimensioned 10 × 10, a programmer will sometimes reference A(27) knowing that he is actually referring to A(7,3). Occasionally it is expedient to write a subprogram with arguments that are singly dimensioned arrays but to call, or enter, that subprogram using a doubly dimensioned argument.

In order to effectively use the EQUIVALENCE and COMMON statements and employ some simple programming practices, the programmer must know how arrays are stored or distributed in memory. When using ILLIAC IV, the programmer must consider the memory allocation while he is composing the program rather than simply regarding it as a casual "after-the-fact" problem.

Perhaps it is worthwhile to illustrate the problem of memory allocation and also to demonstrate how parallelism can be achieved by specifying the steps that are programmed to perform a matrix multiply. For this example, ILLIAC IV will be constrained to use 3 PE's. The first step is to arrange to store the elements of the 3 × 3 matrices, X, Y, and the product matrix Z (we will compute $X * Y = Z$) in the memories as is shown in Fig. 8. This form of storage is commonly used for doubly dimensioned variables and is referred to as "straight storage." X_{12} is stored in location 10 in PE2's memory, Y_{33} is stored in location 27 in PE3's memory, etc.

Step 1: Copy the first row of X to the CU local data memory (the contents of memory location 10 in the first three PE's).

Step 2: Simultaneously fetch the first row of Y to the B registers. Each PE fetches from location 25.

Step 3: Broadcast X_{11} from the CU to the A registers of all PE's. The contents of the registers are shown in Fig. 9a.

Step 4: Multiply (the contents of A times the contents of B replace what was in A), and store contents of A in the S register.

Step 5: Fetch the second row of Y to the B registers. Each PE fetches from location 26.

Step 6: Broadcast X_{12} to all A registers. Contents of A, B, and S registers are shown in Fig. 9b.

Step 7: Multiply ($X_{12} * Y_{21}$ is formed in PE1's A register, while $X_{12} * Y_{23}$ is formed in PE3's A register).

Step 8: Add contents of S to contents of A and store results in S.

Step 9: Fetch third row of Y to B registers. Each PE fetches from location 27.

	PE1	PE2	PE3
loc 1			
	o	o	o
	o	o	o
	o	o	o
loc 10	X_{11}	X_{12}	X_{13}
loc 11	X_{21}	X_{22}	X_{23}
loc 12	X_{31}	X_{32}	X_{33}
	o	o	o
	o	o	o
	o	o	o
loc 25	Y_{11}	Y_{12}	Y_{13}
loc 26	Y_{21}	Y_{22}	Y_{23}
loc 27	Y_{31}	Y_{32}	Y_{33}
	o	o	o
	o	o	o
	o	o	o
loc 102	Z_{11}	Z_{12}	Z_{13}
loc 103	Z_{21}	Z_{22}	Z_{23}
loc 104	Z_{31}	Z_{32}	Z_{33}
	o	o	o
	o	o	o
	o	o	o
loc 2048			

Fig. 8. Straight storage.

CU LOCAL MEMORY

X_{11}	X_{12}	X_{13}

	PE1	PE2	PE3
A reg	X_{11}	X_{11}	X_{11}
B reg	Y_{11}	Y_{12}	Y_{13}

Fig. 9a. Contents of A and B registers after Step 3 of matrix multiply.

	PE1	PE2	PE3
A reg	X_{12}	X_{12}	X_{12}
B reg	Y_{21}	Y_{22}	Y_{23}
S reg	$X_{11} * Y_{11}$	$X_{11} * Y_{12}$	$X_{11} * Y_{13}$

Fig. 9b. Contents of A, B, and S registers after Step 6 of matrix multiply.

Step 10: Broadcast X_{13} to all A registers. (See Fig. 9c, p. 66.)

Step 11: Multiply

Step 12: Add contents of A to contents of S. Fig. 10 (p. 66) shows contents of A registers after addition. Note that the first row of the product matrix has been formed, Z_{11} in PE1, Z_{13} in PE3.

Step 13: Store contents of A registers to first row of Z. All PE's store to location 102.

Now, in order to compute the second row of the product matrix, the second row of X is fetched to the local data memory in the CU, and the process is repeated.

In fact, what we have demonstrated through the description of a matrix multiply is that ILLIAC IV can do elementary row operations "in parallel." However, there will be many applications in which it is desirable to perform column operations in parallel, as well as row operations. In particular, matrix inversion and numerical solution of partial differential equations require this facility. An alternate method of memory allocation, called "skewed storage," permits row and column operations to be performed in parallel.

	PE1	PE2	PE3
A reg	X_{13}	X_{13}	X_{13}
B reg	Y_{31}	Y_{32}	Y_{33}
S reg	$X_{11} * Y_{11} + X_{12} * Y_{21}$	$X_{11} * Y_{12} + X_{12} * Y_{22}$	$X_{11} * Y_{13} + X_{12} * Y_{23}$

Fig. 9c. Contents of A, B, and S registers after Step 10 of matrix multiply.

	PE1	PE2	PE3
A reg	$X_{11} * Y_{11} + X_{12} * Y_{21} + X_{13} * Y_{31}$	$X_{11} * Y_{12} + X_{12} * Y_{22} + X_{12} * Y_{32}$	$X_{11} * Y_{13} + X_{12} * Y_{23} + X_{13} * Y_{33}$

Fig. 10. Contents of A register after Step 12 of matrix multiply.

Fig. 11b shows the skewed storage technique for a 4×4 matrix A. As in straight storage, the first row is stored across the PE's at some location ζ in the PE memory. The second is then "skewed" or rotated once to the right, so that a_{21} is stored in PE2 (instead of PE1 as would have been the case with straight storage). The third and fourth rows are skewed two and three PE's to the right, respectively.

Now in order to perform row operations involving the third row, the contents of memory location $\zeta + 2$ is simultaneously copied to the PE operating registers. To perform a column operation involving the first column, the index registers are loaded as shown in Fig. 11a. The index register in PE1 is loaded with 0; the index register in PE3 is loaded with 2. Then, on the command "fetch from location ζ incremented by the index register," the first column (circled elements in Fig. 11b) is simultaneously copied to the PE operating registers. In order to fetch the second column, the contents of the index registers are simply rotated one PE to the right (dotted portion of Fig. 11a), "fetch from location ζ incremented by index register" is executed, and the second column (triangles) is obtained.

the higher level language

Because the architecture of ILLIAC IV is so different from that of a conventional machine, and because there is so much potential computing power available with ILLIAC IV, it is quite a challenge to construct a higher level language that will allow the user to easily and effectively use the machine. Such a language, called TRANQUIL, is being developed at the University of Illinois. It is very similar to ALGOL and is, in fact, a superset containing ALGOL. It differs from ALGOL in several areas, principally in the use of index "sets" for loop control and by permitting two types of loops: a sequential loop and a loop that is executed simultaneously (in separate PE's).

Instead of attempting to detail the language and compiler, some illustrations of TRANQUIL source code will be given and the method of implementation by the compiler will be explained.

```
FOR(I,J) SEQ([1, 2, . . ., 10], [5, 10, . . ., 50]) DO
    A[I] ← B[I+1] + C[J]
```

The FOR statement is the loop statement like DO in FORTRAN. This is interpreted as: for I sequentially taking on

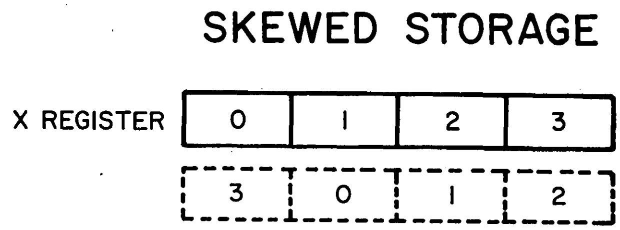

Fig. 11a. X register rotation scheme for skewed storage.

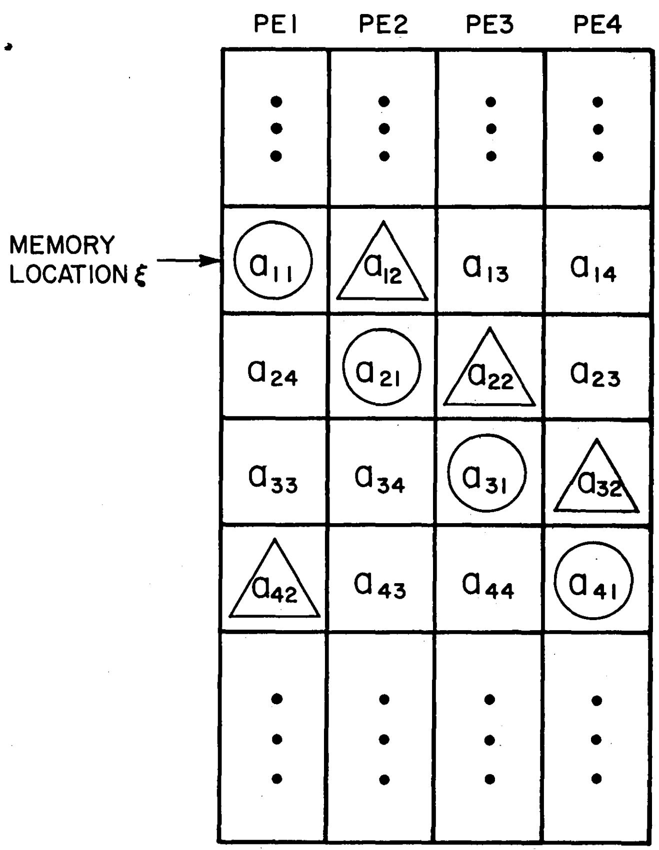

Fig. 11b. Skewed storage of matrix elements in PE memory.

the values 1, 2, etc. up to 10; and J sequentially taking on the values 5, 10, etc. up to 50; replace A(I) with the sum of B(I+1) and C(J). The object code would first locate B(2) and C(5) in the PE memories (according to some memory allocation scheme that had been previously specified to the compiler by the programmer), copy them to some PE, perform the sum and store the result in the location assigned to A(1). This process would then be repeated with B(3), C(10) and A(2). After a total of 10 repetitions, A(10) would contain the sum of B(11) and C(50). Total operations involved in this loop, neglecting set-up time, is 20 locate-fetches, 10 adds and 10 stores.

```
FOR (I,J) SIM ([1, 2, ..., 10], [5, 10, ..., 50] DO
        A[I] ← B[I+1] + C[J]
```

This construction will implement the loop simultaneously. B(2), B(3), . . . , B(11) will be located and fetched to PE operating registers simultaneously, as will C(5), C(10) . . . , C(50). The sums will be computed in separate PE's at the same time, and the results stored to A. Total operations involved for this loop are 2 locate-fetches, one add and one store. If some naive programmer had assigned the arrays B, C, and A all to PE5, this simultaneous implementation would not be possible, and the statement would necessarily be executed sequentially. The compiler can only implement parallelism that has been enhanced by the programmer (through judicious choice of memory allocation schemes and index sets); it cannot impose parallel or simultaneous operations in all circumstances. Some future version of TRANQUIL may be able to distinguish the implicit parallelism in an instruction string, but certainly for the first few months the user must be explicit in his definition of what portions of the program can be implemented in parallel. A sample TRANQUIL program is shown in Fig. 12.

```
Line
Number      SAMPLE TRANQUIL PROGRAM

 1    REAL SKEWED ARRAY A, B[0:100, 0-100];
 2    INCSET JJ
 3    MONOSET II(1) [27:6], KK(1) [100:60];
 4    INTEGER I, J, K, L;
 5    II ← [2, 10, 13, 21, 24];
 6    JJ ← [2, 4, . . ., 98];
 7    FOR (I) SEQ (II) DO
 8    BEGIN FOR (J) SIM (JJ) DO
 9         KK ← SET (J:A [I, J] < B [I, J]);
10         FOR (K) SIM KK) DO
11         A [I, K] ← A[I+1, K] + B[I, K+1];
12    END
```

Fig. 12. Sample TRANQUIL program.

Some of the features of this TRANQUIL program will be described. Lines 1 through 4 are declaration statements. Lines 5 and 6 define sets. Lines 7 through 11 are the "executable" portions.

Line 1: Informs the compiler that arrays A and B are type real and should be stored in skewed storage fashion. The programmer can then do row or column operations with equal facility (although line 11 involves only a row operation). Limits the range of the two subscripts to between 0 and 100.

Line 2: Specifies that JJ is to be considered an "increment" set, a set whose succeeding elements differ by a constant increment.

Line 3: Specifies that II and KK are sets of monotone "one-tuples". II has no more than six elements (max element no more than 27) and KK has no more than 60 elements (max element no more than 100).

Line 4: Types I, J, K, L as integer.

Line 5: Defines the set II to be the set (2, 10, 13, 21, 24).

Line 6: Defines the set JJ to be the set (2, 4, 6, 8, 10, . . . , 96, 98).

Line 7: The start of a loop which extends through line 11 (the commands contained between the BEGIN of line 8 and the END of line 12). This loop will be performed first with I = 2, then with I = 10, then I = 13, I = 21, and finally I = 24.

Line 8: The start of a simultaneous loop with J taking on values 2, 4, 6, . . . , 98.

Line 9: Defines a new set KK. KK is the set of even J, such that A[I, J] is less than B[I, J]. Observe that KK will, in general, be a different set each time I, the index on the outer loop, changes.

Line 10: The start of a simultaneous loop in which the index K takes on the values of the new set KK that has just been generated.

Line 11: This arithmetic and replacement is done simultaneously in several PEs (provided KK has more than one element.

Line 12: Ends the inner loop.

TRANQUIL probably will not be used as the primary language to compose ILLIAC IV programs. Since descriptions of the language are available in the open literature (references 2, 4, 5) it was referred to here to illustrate the type of language extensions that are necessary to reflect the features of ILLIAC IV.

illiac iv operation

Because of economic considerations, only one quadrant of the four-quadrant system is currently under construction. This quadrant will be delivered to the University of Illinois, where it will be available for continued language and software development, and for use by the supercomputer users in the weather community, Department of Defense and AEC. At the university a 10^{12} bit mass storage device will be integrated with the system.

summary

ILLIAC IV, in order to achieve a cost-effective solution to the speed problem, has decentralized the central processing unit into four control units (each capable of executing independent instruction streams) each of which drive 64 processing elements—a total of 256 processing elements. Each processing element acts as an arithmetic and logic unit and has its own 2048-word (64 bits per word) memory capable of communicating with all of the other processing elements.

Distributing the arithmetic and logic functions over 256 processing elements allows the ILLIAC IV to perform operations simultaneously on many types of data structures. In addition to this parallelism, the processing elements are extremely fast computers in their own right: memory cycle time is less than 300 nsec; a 64-bit floating point add takes 250 nsec; a floating point multiply of two 64-bit numbers takes 450 nsec.

At the present time, however, ILLIAC IV is not "transparent" to the programmer; that is, he can not merely write his program in some high level language and remain unaware of the "insides" of the machine. He must have some knowledge of the computer at a machine language level in order to fully exploit the parallelism of ILLIAC IV. Of course, work continues in the development of a high-level language for ILLIAC IV so that it will be easier for the novice programmer to use. ■

4. Northcote, Robert S., "Software Development for the Array Computer ILLIAC IV," University of Illinois at Urbana-Champaign, Department of Computer Science, Urbana, Illinois, Document No. 214, March, 1969.

5. Abel, N. E., et al. "TRANQUIL: A Language for an Array Processing Computer," Proceedings AFIPS Spring Joint Computer Conference, 1969, pp. 57-75.

THE PARALLEL AND THE PIPELINE COMPUTERS

by William R. Graham

Within the next year, two extraordinary computers will become operational. Both of these machines will transcend the usual limits of computer design, and operate at speeds a factor of 10 faster than today's most powerful machines. However, it would be a serious mistake to think that presently existing problem formulations and programs can easily be adapted to these supercomputers. In fact, it is not yet certain that the new machines will ever be useful for other than limited, special applications. The computers are the parallel ILLIAC IV and the pipeline Control Data STAR; the equally formidable strengths and weaknesses of their generic designs are the subject of this article.

the parallel computer

The parallel computer, such as the University of Illinois' ILLIAC IV described in another article in this issue, is based on the notion that two conventional computing machines can work at twice the rate of one machine. The major deficiency in this approach is that two machines also *cost* twice as much as one machine. To overcome so fundamental a drawback, the parallel design has many identical copies of the conventional computer's arithmetic unit driven with only one control unit. The control unit is responsible for obtaining, decoding, and issuing instructions, and generally assuring that the machine will do what it is supposed to do. Since the control unit is rather sophisticated and expensive, a considerable amount of money is saved by having only a single control unit in charge of W identical arithmetic units. (W is called the "width" of the parallel processor.) The price paid for getting by with only a single control unit is that each of the arithmetic units must do the same thing at the same time or else be inhibited and do nothing, a condition which somewhat limits the flexibility of the computer.

The parallel processor must be organized so that it is impossible for two or more arithmetic units to attempt to change the same number in memory at the same time. This is achieved most simply by allocating to each arithmetic unit an exclusive block of memory, not directly accessible to any other arithmetic unit. The result is that if arithmetic unit J needs a number stored in the memory of arithmetic unit K, the control unit must have K recall the number and then transmit it, over specially provided channels, to J. The number of channels that would be required to interconnect directly all of the arithmetic units is W^2-W.

If the designer wishes to sacrifice transmittal time, a smaller number of channels may be used. For example, in the ILLIAC IV, if one imagines the arithmetic units strung on a circle, then only the two nearest units and the two seven units away are in direct communication. Another way to visualize the interties is to arrange the arithmetic units on a toroid as shown in Fig. 1. Then only the four nearest neighbors (two on the circles shown and two along the toroid) can communicate directly. In this arrangement, eight transmissions are required for communications between the most distant arithmetic units.

the pipeline processor

A quite different approach underlies the design of the pipeline processor, such as the STAR which is under development at the Control Data Corp. In the conventional computer, the time required to retrieve operands from the memory, execute the operation, and return the result to memory must be greater than a time equal to the distance

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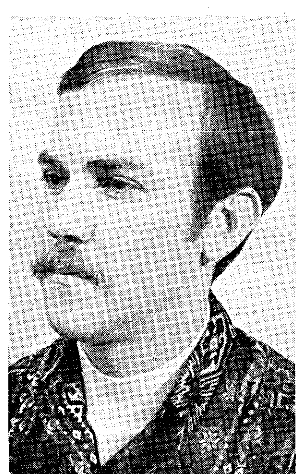

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traveled by the information divided by the speed of light, and several other less inevitable factors. The pipeline processor, shown schematically in Fig. 2, gains its advantage by starting the retrieval of a second set of operands, each located in memory adjacent to the first, before the first result has been returned to the memory. Thus, a pipeline begins to fill, and the round-trip distance divided by the speed of light no longer limits the apparent cycle time.

So that the arithmetic unit will not be an obstruction to the flow, it too is built as a pipeline. It can receive and start working on a second set of operands before finishing the calculation for the first set. The hardware required to make the arithmetic and memory units work as a pipeline is elaborate and expensive, so that if the pipeline processor is to be economical, the pipe must be kept full a substantial part of the time.

To complete the memory-to-memory pipeline, the arithmetic unit must deliver the results back into memory at the same time and rate that it is receiving new pairs of operands from the memory. It is sometimes desirable to skip an operation on certain operands in the pipeline. This is done through the use of a control vector which contains one bit that is associated with each operand set in the pipeline. Depending on whether the associated control-vector bit is one or zero, the operation is either performed or skipped. If no operation is performed, the memory location for the result does not have its previous content changed.

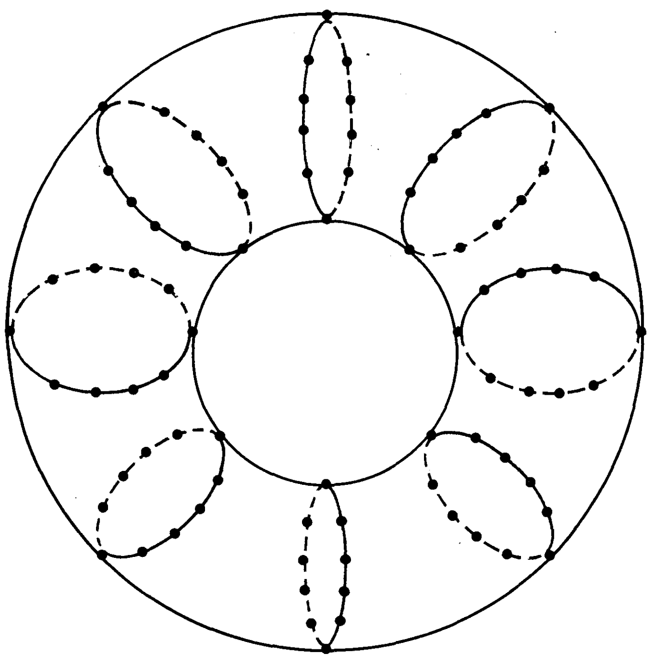

Fig. 1. ILLIAC IV memory interconnection.

The logical control processes that must take place for the number stream in the pipeline to flow smoothly are collectively referred to as a Boolean Orgy, and are sufficiently difficult that the foreseeable pipeline machines will permit only one type of arithmetic operation per stream (e.g., add or multiply or divide) and only one stream at a time. (A rather amazing exception to this is the vector inner-product operation, which may be implemented on the STAR.) Furthermore, the pipeline memory retrieval and storage locations for each operand string are constrained to lie on a consecutive linear sweep through the memory. As with the parallel processor, both the maximum computing rate and the opportunities for inefficient operation are greatly increased by this design.

To compare the two types of machines, it is first necessary to have a clear idea of what computation can proceed in parallel and what in pipeline.

The hierarchy of computer activities starts with the basic *step:* the retrieval of a set of operands from memory, the operation, and the return of the results to memory. At the next level is the parallel or pipeline *stage*. The stage is the collection of all of the program steps which could be done in parallel or in the same pipeline stream without creating a dilemma in the logic of the program execution. A stage is a property of the logic of the problem, but not of the computer width or pipeline capacity. Finally, all of the stages connected in the proper order constitute a computer *program.*

The following conditions result from the constraints of logical simplicity being imposed in present computer designs. N computing steps, S_1, S_2, . . . S_N, form a parallel stage if (1) no step depends upon the result of any other in the stage, (2) all steps require the same operation to be performed, and (3) the operands are properly distributed among the arithmetic unit memories.

N computing steps form a pipeline stage if (1) no step depends upon the result of any other in the stage, (2) all steps require the same operation to be performed, and (3) the members of each operand string are packed in successive memory locations. Comparing these two sets of conditions, one sees that (1) and (2) are the same; only (3), memory location assignment, is different for the parallel and pipeline machines.

A world of trouble is hidden in these three conditions. The first condition means, for example, that the usual two-pass algorithm for solving the Crank-Nicholson equation will reduce pipeline and parallel computers to conventional one-step-per-stage operation, with a corresponding long execution time and low machine efficiency. The third condition, proper storage allocation, makes performing such a simple operation as multiplying a matrix by itself a substantial problem in parallel or pipeline operation. The parallel computer requires that the operands for a stage be distributed throughout its arithmetic units' memories in a two-dimensional arrangement, while the pipeline computer requires that the same operands be packed together tightly in the one-dimensional memory. This difference in memory allocation, and the ability of the parallel arithmetic units to communicate with each other, are the dominant differences that the user sees between the two types of computers.

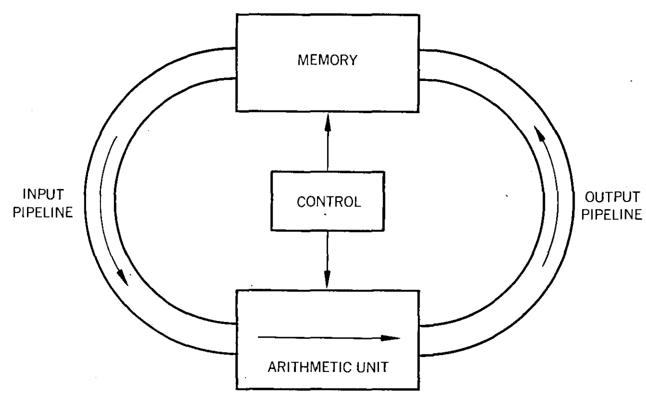

Fig. 2. The pipeline processor.

Assuming that the three conditions have been met (a nontrivial assumption), one may then proceed to compare the machines on the basis of execution time and the efficiency with which resources are used. One overriding fact to keep in mind through the following discussion is that one-step-at-a-time sequential operations will greatly diminish the computer's performance. If half of the operations executed are so well matched to the machine that they take essentially no time to execute, but the other half must be done one step at a time, then the total program execution time is at best an unimpressive factor of two less than that for a conventional machine. As a first approximation, the ratio of the parallel or pipeline program execution time to the conventional computer's time is the ratio of the number of steps that must be performed sequentially, one at a time, to the total number of steps. To make efficient use of the parallel or pipeline computer's resources, it is not sufficient that a few steps of the program be suited to the machine; the majority of the program steps must be part of large stages—ones which each contain many steps.

parallel vs. pipeline: execution time

In a parallel processor, the three parts of a computing step—the memory retrieval, the operation, and the memory storage—are shown in Fig. 3.

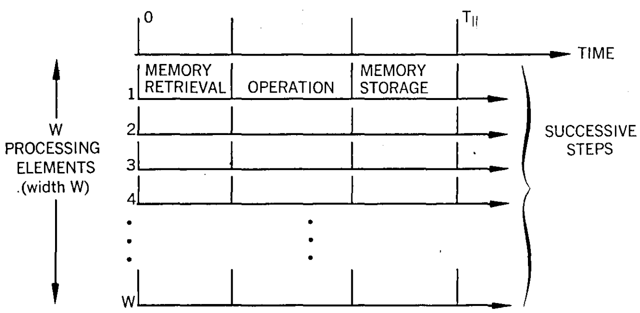

Fig. 3. Parallel processor—sequence of activities.

Here, the step time $T_{||}$ depends upon the specific operation being performed. For a stage of N steps, the time required for execution by a parallel machine is $T_{||}$ times the integer part of $(N-1+W)/W$, usually written $T_{||} \bullet [(N-1+W)/W]$.

The operation of the pipeline machine is shown in Fig. 4.

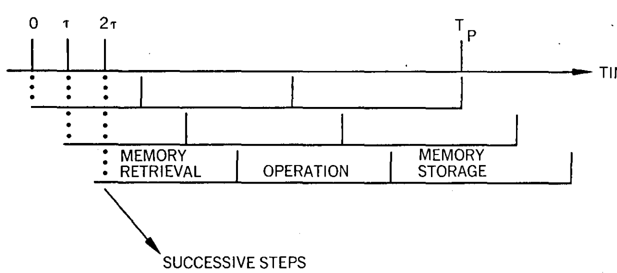

Fig 4. Pipeline processor—sequence of activities.

The time required for the pipeline computer to execute a stage of N steps is $T_p + \tau\,(N-1)$. Knowing the parameters $T_{||}$, T_P, W, and τ of two machines, these times may be calculated as a function of N. For example, when N=1, the parallel-machine time is just $T_{||}$ and the pipeline-machine time is T_p. At the other extreme, as N tends to infinity, the parallel-machine time per step tends to $T_{||}/W$, and the pipeline-machine time per step tends to τ.

With a parallel machine, the execution of a stage of N steps takes a time that is always less than or equal to $T_{||} \bullet (N+W-1)/W$. Thus, if $T_{||}/W$ is less than τ and $T_{||}$ is less than T_p, then the parallel machine will execute any stage, of whatever size N, more rapidly than will the pipeline machine.

For a stage of N steps, the parallel machine will always take a time greater than or equal to the larger of the times $T_{||}$ and $T_{||} \bullet N/W$. If $T_{||}$ is greater than $T_P + (W-1)\tau$, then the pipeline machine will execute any stage faster than the parallel machine. In general, the results can be more mixed, and it is quite possible for the advantage to shift back and forth between the two machines as N increases.

Using the preliminary information in Table 1, one may deduce that the STAR and an ILLIAC IV quadrant have comparable speeds for performing addition, with the ILLIAC having the edge when only a few sums are to be formed. In multiplication, the ILLIAC IV is always faster than the STAR, while in division, the STAR is about twice as fast as the ILLIAC in finding a single quotient, but the ILLIAC is about 1.4 times as fast as the STAR in calculating a long sequence of quotients. Of course, accurate determinations of the hardware speeds must await the final stages of machine development.

OPERATION	CDC STAR T_p	τ	$T_{\|\|}$	ILLIAC IV W (one quadrant)
Addition	1.76 μsec	20 ns.	1.28 μsec	64
Multiplication	1.76 μsec	40 ns.	1.45 μsec	64
Division	1.80 μsec	80 ns.	3.76 μsec	64

(These figures are preliminary and for illustrative purposes only.)

Table 1. 64-bit precision characteristic parameters for the CDC STAR and the ILLIAC IV

Computing rates are also shown in Table 2 for the IBM 360/75, the CDC 7600, and the IBM 360/195.

OPERATION	Steps per Stage	IBM 360/75	IBM 360/195	CDC 7600	CDC STAR	ILLIAC IV (one quadrant)
Addition	N=∞	.24	4.6	5.2	50	50
	N=1	.24	.55	1.6	.57	.78
Multiplication	N=∞	.14	4.6	5.2	25	44
	N=1	.14	.53	1.5	.57	.69
Division	N=∞	.096	1.7	2.0	12.5	17
	N=1	.096	.43	.93	.56	.27

(For the ILLIAC IV and the STAR, the figures are preliminary and for illustrative purposes only.)

Table 2. 64-bit precision computation speeds (memory to memory) in millions of operations per second

Although the 7600 and 195 are much faster than the familiar 360/75, they are obviously not in the same league as the STAR and the ILLIAC IV when it comes to performing long sequences of identical calculations. However, except for problems well suited to parallel or pipeline manipulation, the 7600 and 195 are as fast or even faster than the STAR and ILLIAC IV.

The cost of executing a stage is more closely related to the efficiency with which each computer's resources are used than it is to the execution time. For the parallel computer, maximum computing rate is reached when all processors are used. At the maximum $W/T_{||}$ steps per second are executed. For the pipeline machine, the maximum computing rate is reached when the pipeline is filled; then the rate is $1/\tau$ steps per second.

Efficiency for a stage may be defined as the ratio of the actual computing rate, in steps per unit time, to the maximum computing rate; this efficiency always lies between zero and one. For a stage of one step, the efficiency of the parallel machine is $1/W$ and that of the pipeline machine is τ/T_p. For a stage of N steps, the efficiency of the parallel machine is $N/(W \bullet [(N-1+W)/W])$ and the efficiency of the pipelines machine is $N/(T_p/\tau + N-1)$.

It is useful to remember, when formulating a problem, that the efficiency of the parallel computer reaches unity whenever N is an integer times W but is not monotonic in N; whereas the efficiency of the pipeline processor increases monotonically with N but approaches unity only asymptotically as N tends to infinity. The ILLIAC IV has a quadrant width W of 64, so it would execute a stage of 64 steps with unit efficiency. The STAR would execute a stage of this size with an efficiency lying between .42 (for addition) and .75 (for division). For a stage of 65 steps, the STAR efficiency would increase slightly, while the ILLIAC IV efficiency would drop to about .5.

To see what the efficiencies are in the worst case, note from Table 1 that the one-step efficiency for the STAR is between 1% and 4½%, depending on the operation, and for the ILLIAC IV is always about 1½%. The license for inefficient use of computer resources which the parallel and pipeline designs give to the programmer and to the compiler far exceeds any habitual excess yet seen in the computing world.

The efficiency with which a complete program is executed is the average of the efficiency E_i of each stage, weighted by the total time T_i required to complete that stage:

Program Efficiency $= \Sigma_i T_i E_i / \Sigma_i T_i$.

Stated most simply, the program efficiency is the ratio of the time required to execute a program, if the computer is operating at unit efficiency as defined above, to the actual execution time. For a program which has half of its operations executed at unit parallel or pipeline efficiency, and the other half executed one step per stage, memory to memory, the over-all program efficiency would lie between 2% and 9% for the STAR and be 3% for the ILLIAC IV.

conclusion

The parallel and pipeline designs will produce computers that, when used to their maximum, unquestionably will be faster than more conventional computers. However, formulating problems and writing programs which will use the new machines to anything approaching their maximum capabilities will prove a severe and, perhaps on occasion, an overwhelming challenge to the creativity of all concerned. Whether these huge machines will become the workhorses of computing hardware or go the way of the dinosaurs has yet to be seen. Their future hinges upon the skill of the users. ■

in a world of mixed jobstreams

THE IBM 360/195

by Jesse O. Murphey and Robert M. Wade

Some time ago it became clear to IBM that a new top-of-the-line member of System/360 would be needed for delivery to customers by 1971—one that would be faster than other IBM computers, including the Models 91 and 95 built for a limited scientific market. First of all, many potential users had jobs whose requirements for computer processing speeds and capabilities were growing explosively. In addition, during the preceding year or two, many large system users had discovered that the very large main storage capacities available to them from IBM often allowed the combination of several related jobs into a single job, the elimination of memory overlays in problem programs, and the specification of much larger main storage buffer areas for I/O operations, resulting in reductions in I/O times that were sometimes enormous.

Similar results also became attainable through user experience with Operating System/360 (for example, finding it possible to make more OS modules continuously resident), or by reason of new OS components (such as 88KB or 128KB linkage editors in place of 44KB linkage editor). Finally, faster I/O devices, such as the Model 2314 direct-access storage facility (with a 312KB per second transfer rate) and Model 2301 Drum Storage (1200KB per second), had found general use on IBM large systems, although even now only a fraction of the performance gains they make possible has been realized. Together, these and other trends have had the long-term effect of steadily increasing the ratio of compute time to net I/O time for most jobs.

One vital aspect of the market requirements for the new system must be emphasized. In general, the milieu of the supercomputer is well described as a data processing world of "mixed" jobstreams, a fact that has important implications for system characteristics affecting both internal performance and throughput. We are speaking of a computer system for general use, of course, not a customized system with limited capabilities. As used here, the term mixed jobstream has several connotations, one or more of which should be applicable to just about every large computer that will be installed for some years to come.

In a sense, mixed jobstream means that monthly workloads contain more than one type of work to be executed, with each type implying at least certain instruction mix characteristics. Perhaps there is variety only in job run types and identity of operating system components executed (Compile-Link-Go, Link and Go, Assemble only, Compile only, Load and Go, Sort or Merge, Utility or RPG operation—with different versions of OS components used). There also may be variety in type of problem program (Go Step) executed. Some may be FORTRAN generated, while others are COBOL or PL/I generated. Some may exhibit a high frequency of floating-point or decimal arithmetic, although others do not.

In another sense, mixed jobstream means that the constituent jobs differ in their organization or use of system resources. Programs may differ greatly in operand addressing patterns, in structuring for memory overlays, in I/O buffering requirements, in total main storage requirement, in compute time vs. channel or I/O time relationships, or in types and numbers of supporting I/O devices required.

In still another sense, mixed jobstream means that jobs and job steps composing it differ widely in total amounts of cpu time, channel time, or total system time required for their execution. Or, the term means that some "large" job has total command of the entire system, part of the time, while jobs are run in a multiprogrammed mode at other times (in batched and/or some teleprocessing operating environment).

The new computer would have to be able to process efficiently and economically mixed jobstreams in any or all of these ways. With respect to internal performance, then, all machine instructions would have to be executed faster than in any previous IBM system. Hardware algorithms for both floating-point and decimal arithmetic would have to be especially well suited for execution speed, because those types of operation, in terms of both instruction execution complexity and frequency of occurrence in user workloads, impose the severest processing demands on large computers.

When the new large-scale system was announced, the observer might have mused aloud: "This article says that the Model 195 with a 54-nsec. cpu cycle time has twice the compute power of the Model 85, with its 80-nsec. cycle. How can that be? Wouldn't the 195's cycle time have to be 40 nsec. for it to be that fast?"

No, it does not. Yet on some jobs the Model 195 can be even more than three times as fast as the Model 85. High performance systems of tomorrow are likely to be much too complex in design for one cpu to be evaluated with reasonable accuracy in terms of another cpu by comparing only their cpu cycle times, memory cycle times, add times, or all of these. A host of other parameters must also be considered, as a brief description of the Model 195 will show.

structure of model 195

The Model 195 is a compatible member of the System/360 line, having the Universal Instruction Set and supported by the full array of channel and I/O equipment now available on the Model 85 and other System/360 computers. The design of the cpu incorporates both new

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ideas and improvements on many of the best features of the large-scale computers previously developed in IBM's Poughkeepsie, N.Y., laboratory. Embodied in the design are, for example, the buffered main storage of the Model 85—but further developed; improved versions of the Model 91's assembly-line instruction processing and pipelined operations in parallel computing units; and block transfer of information from main storage, with "load-through" to computing units. Not only have the Model 91's best algorithms for floating-point operations been retained, but new hardware algorithms have been added for parallel decimal operations. Control techniques employed in the storage and computing elements of the Models 91 and 85 have been combined and improved in the Model 195.

The fully checked cpu features a monolithic technology similar to that proven reliable in the Model 85. It consists of five functionally separate units (see Fig. 1) that operate concurrently and independently, but under constraints needed to preserve program integrity.

Processor storage (main storage) consists of either 8, 16, or 32 quick-change modules, each consisting of 131K bytes of 756-nsec. core. The 1-million-byte version is 8-way interleaved, while the 2- and 4-million-byte versions are 16-way interleaved.

Buffer storage. Actually, the cycle or access times of the individual memory module is less important because of the effect of buffer storage (contained in the storage control unit). This buffer for processor storage consists of 32,768 bytes of monolithic semiconductor storage, with an access time from the central processor of three cpu cycles, or 162 nsec. The buffer is not program-addressable, and its operations are completely transparent to the programmer who addresses main storage in the usual manner. Main storage does not have to be accessed very often, however, because most demands of the central processor for instructions or data are satisfied from information retained in buffer storage.

When requested information is not in buffer storage and processor storage has to be accessed, hardware algorithms move a 64-byte block of information into buffer storage, from which 8-byte portions of the block are supplied repetitively in response to requests from the processor. The function of buffer storage is performed so that, for most programs, main storage appears to the central processor to have an access time almost as fast as that of buffer storage.

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Processor storage. When processor storage responds to a request for information, it supplies first the 8-byte portion identified by the storage address given to it, then the remainder of the block of which that information is a part. If the requested information is an instruction or an instruction operand, only that first 8-byte portion is sent simultaneously to both the buffer storage and to the element needing the data. This procedure is called "load-through."

The storage control unit. The SCU enables the operations of the 8- or 16-processor storage elements to overlap each other, and their combined operation to overlap the internal operations of the central processor. In controlling references to buffer storage and the interleaved elements of processor storage, the SCU maintains a pipeline for addresses and data that permits 8 bytes of information to be fetched from or stored in the buffer (and also in any one of the storage elements) almost every cpu cycle. The SCU also

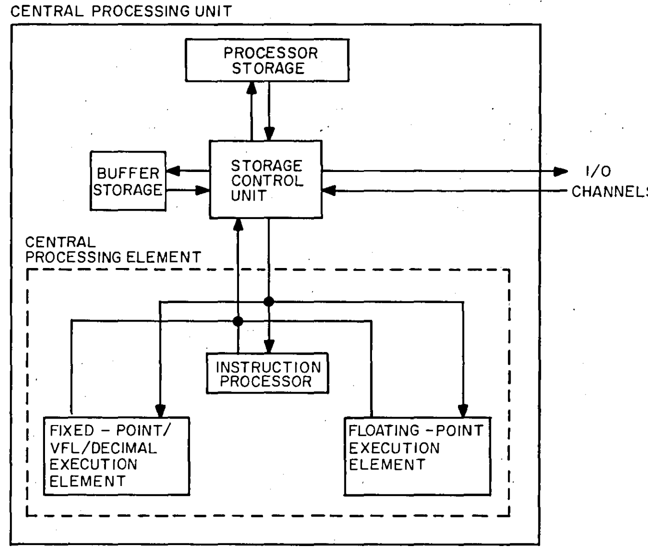


Fig. 1. Structure of the Model 195.

controls the flow of information between the I/O channels and processor storage, invalidating any block of information in buffer storage when the contents of the matching area of processor storage are changed. In addition, the SCU updates processor storage for any change to the contents of buffer storage requested by the central processor, and properly sequences successive references to the same storage address.

The central processor, also called the central processing element (CPE), is the name applied jointly to the floating-point execution element, the fixed-point variable-field-length decimal-execution element, and the instruction processor.

instruction processor

The instruction processor coordinates program execution and attempts to overlap instruction fetching, instruction decoding, operand address formation and fetching, with the final execution of the primary procedure ordered by each instruction operation code. Look-ahead hardware algorithms continually fetch 8 bytes of instructions into a 64-byte instruction stack, which, therefore, holds as many as 32 instructions, depending on the lengths of those currently held. The stack is generally able to maintain a steady flow of information to the instruction decoder which is capable of decoding one instruction each cpu cycle.

When an instruction is decoded, the operation code is examined, and, if necessary, an operand address is formed in a three-input adder. Operand addresses are usually passed to the SCU for action. When the target address of a branch code refers to an instruction already in the stack, instruction fetching into the stack is suspended until the program loop contained in the stack has been fully executed. For other branch codes, the SCU is directed to fetch 16 bytes of instructions along the branching path of the program into registers associated with the stack, while instruction fetching along the "not-taken" path continues. Depending on its identity, an operation code may be passed on for action by an execution element; or the procedure called for by the code may be fully carried out by the instruction processor—as in the case of branch, status-switching, and I/O operation codes.

When a program loop fully contained in the instruction stack is being executed, the instruction processor is said to be operating in loop mode. During periods of loop-mode operation, the maximum rate at which instructions can be decoded (one per cycle) is more nearly attained as an average condition, and the time required for each execution of a branch instruction is reduced by at least three cpu cycles.

Hardware algorithms in the instruction processor assume that a program will proceed on the not-taken path after a conditional branching instruction, except during periods of loop-mode operation when it proceeds on the branching-target path following each occurrence of the loop-closing branch instruction. Until a branching condition is resolved, the instruction processor attempts to continue fetching, decoding, and "conditionally" issuing for execution the instructions along the assumed program path. Whenever an assumption proves incorrect, the conditionally issued instructions are "cancelled." Otherwise, issuance is confirmed and the instructions are fully executed. Until cancellation or confirmation, the instruction processor operates in the conditional mode—a procedure that tends to avoid delays in the preparation of instructions for execution.

floating-point processor

If the execution of a floating-point operation code from the instruction processor cannot be initiated at once, the floating-point execution element puts the code in its operation code stack, which can hold a queue of eight. A local decoder servicing the queue makes operational assignments to six logical execution units, irrespective of the immediate availability of operands (data). A two-stage add unit and its three reservation station subunits can process three add or subtract codes simultaneously; but during any one cpu cycle the add unit can execute one stage each of only two of these operations. One multiply/divide unit and its two reservation station subunits can process two operations simultaneously; but during any one cpu cycle the unit can execute one stage of only one operation (one of the three stages to a normalized operand multiply operation, or eleven stages to a long precision divide operation, for example). The extended precision unit and its reservation station subunit process one extended precision (112-bit fraction) operation at a time. An extended precision multiply operation also uses the unit for long precision multiply/divide operations.

Otherwise, the functioning of any one of the six logical units can overlap the functioning of the others, and the hardware attempts to secure the highest possible degree of overlapping. Shared in common by all six logical execution units are four addressable floating-point arithmetic registers and six buffer registers for floating-point input operands. A common data bus (CDB) interconnects all the units, subunits, and other hardware facilities contained in the floating-point processor. Note that none of the six logical units carries out a floating-point load or store operation. For example, in a store operation, the contents of an arithmetic register are carried by the CDB directly out of this processor to the storage control unit.

The data "forwarding" capability of the floating-point processor merits special attention. Hardware facilities within the processor communicate automatically by transferring "name tags," or internal codes, between themselves. When an operation is assigned to a logical execution unit before one or more operands are available, the unit receives, in place of each operand, a tag identifying the hardware facility from which it will eventually come. If receipt of a given operand is further delayed, the unit might have to forward the tag it was holding in place of the operand to an arithmetic register assigned to make use of that operand.

This might happen in the execution of the machine instructions generated for the coding sequence illustrated in Fig. 2. The tag for an operand buffer register might be given to floating-point register zero as part of the assignment of the load operation, only to be replaced with a tag for "result of multiply unit one operation," as part of the

```
      DO 1 I=1,N                 SIMPLE MULTIPLY-ADD FORTRAN DO LOOP
    1 Z=Z+X(I)*Y(I)

LOOP    LD    R0,X+INDEX         LOAD FLPT REG 0 WITH X(I)
        MD    R0,Y+INDEX         MULTIPLY R0 BY Y(I) & PLACE RESULT (X*Y) IN R0
        ADR   R2,R0              FORM NEW Z BY ADDING X*Y TO OLD Z IN R2
        BXLE  R3,R4,LOOP         INCREMENT INDEX AND BRANCH TO START OF LOOP
```

CODING SEQUENCES

Fig. 2. Coding sequences.

assignment of the multiply operation—and the second tag simply would be withdrawn as part of the assignment of the add operation, all without register zero ever receiving any program data. The multiply unit would then use two operands received directly from buffer registers, and place its result in the assigned logical add unit's reservation station. As the result of all this, expeditious assignment of logical execution units was made possible (a conventional processor would have stopped at the load operation until the operand was received from storage), considerable usage of register zero was avoided, and the entire sequence of operations is executed much faster.

In addition, the floating-point execution element may process operations out of their original programmed sequence. The hardware, however, sees to it that the final processing results are strictly proper and correct as called for by the program being executed.

fixed-point/decimal processor

If the execution of a fixed-point operation code from the instruction processor cannot be initiated at once, the fixed-point/variable-field-length/decimal execution element puts the code in its operation code stack, which has space for a queue of six. A local decoder servicing the queue makes operational assignments to three logical execution units, although only one of them can actually be executing an operation during one cpu cycle. The hardware, however, attempts to overlap the execution of one operation with the decoding and unit assignment of the next.

This processor contains 16 general registers (use of which is shared with the instruction processor) and six buffer registers to receive incoming operands for the fixed-point execution unit. Since virtually no decimal operations and relatively few VFL operations occur in the same program area as floating-point operations, operands for VFL and decimal operations are fetched from storage into the six floating-point operand buffers. The instruction processor initiates operand fetching. Fixed-point add, subtract, compare, load, or store operations, which are by far the most frequent operations assigned to the fixed-point processor, are usually executed at a rate of one per cpu cycle. The decimal execution unit processes, in parallel, eight decimal digits from its operands, thereby realizing operational execution rates never before attainable for the decimal operation group.

On the basis of this brief description of the Model 195, one might find it likely that the 195 satisfies requirements for a computer able to swiftly process through both scientific and commercial user problem code. But, how does one prove it? Simple formulae or other conventional methodology cannot supply convincing answers. How, then, did IBM get the answers long before a working prototype of the new system was constructed?

predicting internal performance

For design verification and early estimates as to how well the Model 195 would satisfy identified market requirements, job samples were collected from the workloads of possible users of the system. More than a hundred of these jobs were dynamically traced and analyzed in order to select a small number of job steps as a sample set for projections. For each selected job step, the one trace-output magnetic tape reel was found whose contents produced an instruction execution frequency mix most closely matching that of the job step as a whole. The resultant 17 job step segments were established as criteria for comparative, internal performance projections. With 17 tape reels thus taking the place of more than 1,300 trace-output reels, numerous repetitive measurements became feasible.

To predict the internal performance of the Model 195, a timer program was used to model cpu internal operations, to the extent of literally drawing timing charts accounting for all computation progress during each machine clock cycle. Output reels of a dynamic instruction trace program are the normal input to the timer. Summary reports provided by the timer tabulated data such as machine-instructions executed, total cpu time per run, and processor and buffer storage fetches and stores.

The accuracy of internal performance predictions based on this methodology has been found to be well within 10%. Results of the first several hundred runs completed on the Model 195 prototype substantiate predictions for the Model 195. Experiments performed by the authors have yielded much greater accuracy.

Table 1 identifies the 17 sample job segments and presents comparative projection based primarily on cpu time predictions provided by the Model 195 timer. The set seems to exhibit an appropriate distribution of examples of most of the application characteristics that principally determine the internal performance of the Model 195. These characteristics include instruction mix, instruction addressing patterns, sequencing of operation codes, operand formats, and I/O events that could result in the switching of cpu control between multiprogrammed tasks. Fig. 3 (p. 76), a graphic illustration of the ratios in Table 1, should give a good general impression of the internal computing speed of the Model 195 relative to another, well-known member of the System/360 line, the Model 65, and to the previously most powerful member marketed, the Model 85. The Model 195 is shown to be from 5 to 19 times as fast as the Model 65 and 1.2 to 3.2 times as fast as the Model 85 with 32K-byte buffer storage and high-speed multiply features (i.e., the "fully-featured" Model 85).

Table 1 and Fig. 3 reveal the wide range of performance for solid scientific and technical floating-point problem steps—which explains why half of the 17 segments are of

Segments	Ratios: 195K to 85K*	Ratios: 195K to 65J
Execute-type job step with moderate amount of decimal arithmetic.		
1. General Commercial Processing	2.1	7
Execute-type job steps with moderate to heavy amounts of floating-point arithmetic** varying amounts of fixed-point arithmetic.		
2. Photon Tracing (Monte Carlo Technique)	1.9	8
3. Gaussian Integration	1.9	11
4. Runge-Kutta Integration	2.4	14
5. Weather Model	3.2	16
6. Matrix Inversion	2.3	14
7. Gauss-Jackson Integration	2.4	15
8. Solution to Partial Differential Equations (ADI method)	2.9	19
9. Matrix Eigenvalue Calculations	2.7	12
10. Integral Evaluation	2.2	12
Execute-type job steps with none or light amounts of floating-point arithmetic and light to moderate amounts of fixed-point arithmetic.		
11. Curve Fitting (Lease Squares method)	1.5	8
12. Data Reduction	1.4	6
13. Heat Transfer Problem	1.4	6
System-type jobs		
14. Sorting	1.2	5
15. Linkage Edit	1.2	5
16. Assembly: Assembler F	1.3	6
17. Compile: FORTRAN IV	1.4	5

*Includes the 32K byte Buffer Storage and High Speed Multiply optional features.
**No extended precision floating point is included.

Table 1. Standard sample job segments.

this category. It is important to note that all 13 execute-type segments were generated by FORTRAN or COBOL compilers. Hand-coded job steps could be expected to show the Model 195 to even better advantage. These ratios are merely indicators of performance, even though based on measured samples of user work. Other user job steps, however, will not necessarily yield identical results. Different data formats and volumes, for example, could cause variance. Moreover, different control card parameters could

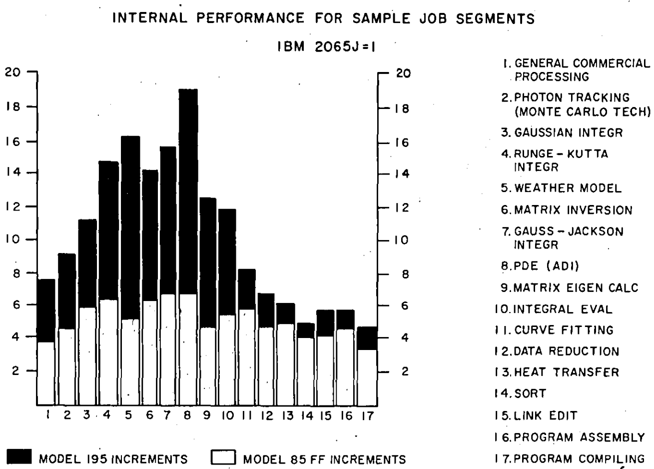


Fig. 3. Internal performance for sample job segments.

change the results of a sorting operation rather significantly.

To be really meaningful, these performance results must be interpreted with respect to the structure of the Model 195, which has already been described.

internal speed of the model 195

Very fast circuit speeds obviously contribute to enhanced performance; in fact, the contribution is even greater than it might appear to be. The 54-nsec. clock cycle is conceptually a "macrocycle" in the sense that, for instance, only one cycle is required by a computing unit to execute a fixed-point add or compare, most boolean operations, or to generate an effective address from base, index, and displacement addressing elements. The internal speed of the Model 195, however, is due far more to its system organization, which has been shown to exhibit a high degree of concurrency. For example, faster circuits alone would make the Model 195 just 3.7 times as fast in instruction execution as the Model 65, with its 200-nsec. cpu clock cycle; whereas the Model 195 is more than 19 times as fast on the partial differential equations standard job segment, as generated by the FORTRAN compiler.

As one would expect, the fixed-point and floating-point execution elements of the Model 195, by virtue of pipelining and more efficient execution units, require fewer cpu cycles than do the equivalent hardware of the Models 85 or 65. For example, the Model 195 takes about three or four cycles in the execution unit for a long precision floating-point multiply operation, compared to about 24 for the standard Model 85; five or six for a Model 85 with the high-speed multiply feature; or about 35 for the Model 65. The Model 195 needs no execution cycles to load from storage a floating-point register or to place its contents in storage (cycles taken for these operations in the floating-point processor overlap processing of other operations by the execution units); whereas the Model 85 uses one cycle for loads, or four for stores. The Model 65 takes four in both cases. Fixed-point general register loads and stores require only one execution unit cycle in the Model 195; but require one or two cycles for loads and two or four cycles for stores, in the Model 85; and in the Model 65, two or four cycles for loads and four to eight cycles for stores. On the average, decimal operations in the Model 195 take far fewer cycles than in the Models 85 and 65.

In comparing execution unit times per instruction, the 26 floating point add, subtract, multiply, and divide instructions average out to three to four times as fast in the Model 195 as in the fully-featured Model 85. This takes into account both number of cycles and circuit speeds. Extended precision (112-bit fraction) floating point instructions replace entire program routines and would further enlarge the speed of the Model 195 over any system with lesser capability. On the same basis of comparison as for floating point operations, the six decimal operations (ZAP, CP, AP, SP, MP, DP)[1] are also three or four times faster than in the Model 85. One or the other of these groups of instructions makes a major contribution to the performance of the Model 195 on each of the 17 standard job segments where the ratio is two or more times the Model 85.

At the next level of organizational improvement, the execution unit cycles taken for the processing of one instruction can overlap the execution unit cycles taken for the processing of up to four other instructions, as explained earlier. In short, during one cpu clock cycle, one execution unit cycle each may be taken in the processing of up to five instructions (three in the floating-point processor, one in the fixed-point processor, and one in the instruction processor). Overlapping is increased even more by forwarding operations in the floating-point processor, which can reduce execution time by more than 20% for a short sequence of instructions. The degree to which this entire category of overlapping is achieved in a given program depends, obviously, on the ordering of different types of operation codes in the program. Coding in assembly language would enable fullest advantage to be taken of this performance potential. This type of overlap is greatly reduced in executing programs that contain few or no floating-point operations; a fact which, together with frequencies of occurrence of branch instructions on the order of 25% to 33%, largely explains the results shown for the Model 195 on segments 12 through 17.

reasons for high performance

Another major reason for the high performance of the Model 195 is the successful overlapping of functions of execution elements by four functions of the instruction processor: (1) instruction fetching; (2) instruction decoding; (3) operand address generation; and (4) operand fetching. Considering these functions together with those of the storage control unit, the value of this level of concurrency has been measured in four ways:

1. Main storage is so well buffered by the instruction stack and buffer storage that, for the 17 standard job segments, fewer than five blocks of operands and instructions had to be fetched from main storage for every 1,000 instructions executed. In a multiprogramming environment, task switching increases this average, of course. This average of five for the Model 195 should be contrasted with an average of about 1,080 for the 17 segments when run on the unbuffered Model 75.

2. For small inner loops in programs, such as the one

[1] ZAP=ZERO AND ADD; CP=COMPARE DECIMAL; AP=ADD DECIMAL; SP=SUBTRACT DECIMAL; MP=MULTIPLY DECIMAL; DP=DIVIDE DECIMAL.

shown in Fig. 2, instruction fetching from the instruction stack (loop-mode operation in the instruction processor) can reduce cpu time per iteration of the loop by 20% to 30%, or more. Some job steps spend most of their time executing one or more short loops, while other steps spend at least a significant amount of time in them. The effect of loop mode accounts for some 20% of the speed advantage of the Model 195 over the Model 65 on Job Segment 8, the PDE (ADI method) segment.

3. When instructions or operands are needed from storage, excluding fetches from the instruction stack, the information required, in the case of the 17 sample job segments (Fig. 3), is found in buffer storage 99.6% of the time (without allowance for task switching impact). The percentage for a given program is determined by operand addressing patterns in the program. The significance of a high buffer hit ratio is indicated by the fact that, if this ratio for the Weather Model job segment when run on the Model 195 were no higher than the 94.4% on the fully featured Model 85, the present speed advantage of the 195 over the 85 on this segment would be reduced by 22%. The higher buffer hit ratio is due entirely to the new organization of buffer storage in the Model 195. Incidentally, this impressive 99.6% average of ratios for all 17 segments reveals why the capacity of buffer storage is not larger than 32KB. On the other hand, if it had only a 16KB capacity, the speed advantage of the 195 over the 85 on the Weather Model segment would be less than that on the PDE (ADI) segment, due entirely to a lower buffer hit ratio attainable with the smaller buffer storage. Capacity and type of organization of buffer storage are equally important.

4. Experience with the 17 job segments suggests that the effective main-storage access time is about 165 nsec. For the infrequent cases, the effective access time might increase to as much as 175 nsec. These statistics best illustrate why the three-level storage hierarchy so greatly augments the internal performance of the Model 195.

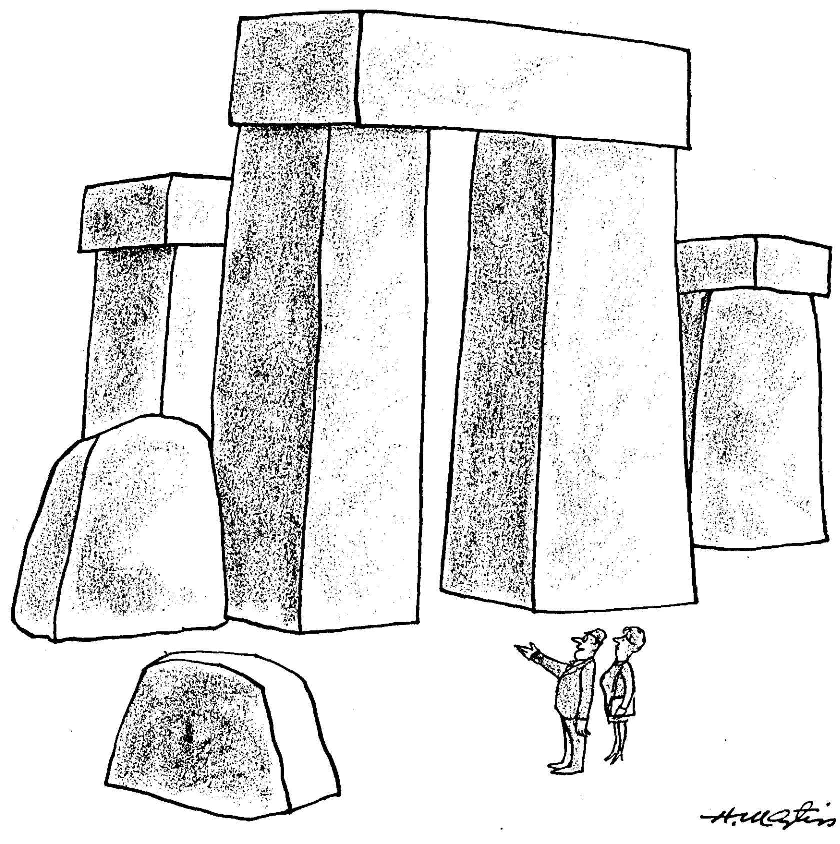
Performance on branch instructions, to summarize, is enhanced in at least three ways: (1) Fetching ahead of instructions down branch-target path as well as down branch-not-taken path; (2) Conditional mode of operation in the instruction processor permits continuance of instruction decoding and pipeline loading, pending resolution of a branching condition; (3) Loop mode of operation saves many cpu cycles for each "branch in stack," thereby reducing the execution time of some small inner loops by up to 30%.

16-way interleaving of main storage would tend to reduce I/O interference to a low level, even if main storage were unbuffered. The highly efficient buffering of main storage reduces the probability of interference much further.

From this discussion the three main application determinants of internal performance on the Model 195 are shown to be instruction mix, operand addressing pattern, and ordering of instruction codes in the program as executed.

The internal performance capacity indicated by the results just described creates an equal throughput potential for the Model 195. Case studies have been made to assess this potential in terms of user programs, operating system components, and I/O devices available in 1969; although the methodology will not be described here because of space limitations. The results indicate what can be attained. Actual runs on the engineering prototype of the Model 195 indicate that the throughput projections about to be described were conservative.

Throughput, as used here, means the work performed by the total computer system in executing a defined data processing assignment, and is measured in terms of the net run time for the total system in executing that particular assignment. A total system consists not only of a cpu and main storage, but also of a configuration of I/O channels and subsystems, a configuration of software that operates system components, and a problem program set—all working together in an environment of operating conditions and established operation procedures at a specific user installation. The throughput of the system, therefore, can vary widely with variations in the identity or use of the component elements of the system or in any significant aspect of its operating environment. Accordingly, a fairly large number of case studies were made to assess the current throughput potential in terms of an attainable range of throughput performance, particularly for mixed jobstreams (as defined at the beginning of this article). The scope of this article permits the discussion of only three case studies



"This, Margaret, was the System/360 Model 195 of its day."

that were quite useful in establishing a range.

As in the early evaluation of internal performance, the design of a predictive methodology was required to assess throughput potential long before the engineering prototype of the Model 195 could be operated as a complete system. Fortunately, the nature of the problem did not require that the predictions be quite as precise as internal performance predictions. Yet, the only methodology considered sufficiently reliable, and, therefore, the one used, required an even greater systems engineering effort on the part of a larger group of analysts. Once an acceptable jobstream had been constructed, it was run on each of three different hardware systems: a Model 65 system defined as the base for performance comparisons, a Model 85 system, and a Model 91 system. The results of these runs provided sufficient data upon which to base throughput projections for the Model 195. Each system had input-output equipment and os/360 component configurations appropriate for each jobstream used.

A typical I/O configuration for the Model 195 consisted of three IBM 2301 drums on separate channels and an IBM 2314 on a fourth channel, as well as a complement of assorted card, magnetic tape, and printing equipment.

three case studies

One jobstream, NORM, constructed in 1968 to run under Release 14 of os/360 (MVT option), consisted of 12 jobs from different IBM customers. It was set up for execution as 16 job steps: 10 problem execute, or GO steps, four FORTRAN compile steps, one Link-Edit step, and one Sort step. The GO steps, whose source language was FORTRAN, required moderate amounts of support by I/O equipment. I/O operating time was so well overlapped with internal computing (cpu) time that the jobstream generally was decidedly compute-bound. Results were obtained for three job steps simultaneously executed (i.e., three initiators) on the Model 65, and five initiators on all the larger systems. Table 2 is a summary of the results of this study, relative to the Model 65 base system.

A second jobstream, NCL, also constructed in 1968 to run under Release 14 of os/360, consisted of multiple appearances of four jobs. One job had an extremely heavy amount of I/O activity, a second had a heavy amount, one had a light amount, and one had very little. The four varied enormously in execution time. Each had been made to appear often enough in the stream so that its subset of the stream required Model 85 cpu time about equal to that required by each of the other three subsets. The stream was, therefore, run as 71 job steps, all of the GO step variety. All were originally FORTRAN generated. All steps executed only a moderate amount of floating-point arithmetic. The volume of I/O activity was so heavy that, for high system performance, two 2301 drum subsystems were needed exclusively for GO step support on systems larger than the Model 65 (a third subsystem is desirable on the Model 195). Three initiators were best for the Models 65 and 85, and five for the Model 195. Table 3 is a summary of the results of this second study for the same three systems.

The internal performance ratio of the fully-featured Model 85 for this stream was 6.3 times the Model 65, which should make possible a throughput of six times the Model 65, provided more core storage was made available on that system (i.e., use 85K instead of 85J). The NORM and NCL jobstreams have more recently been measured on the Model 195 prototype. Measured elapsed times of 0:33:59 for NORM and 0:43:51 for NCL prove that the computed projected times were correct.

The jobstream for the third study, CONGLOMERATE, consisted of sorts, a report generator, COBOL, PL/I, and FORTRAN jobs. The jobstream was organized for the execution of many job steps, which include compile, link edits, and problem execute steps. Although a mixed jobstream, it was more commercial than scientific in content, with few heavy scientific routines even in the FORTRAN programs. In the stream as a whole, amounts of floating-point and decimal arithmetic were very light.

The first run of the jobstream on the Model 85 resulted in cpu utilization of only 32% of the 2.268 seconds of elapsed time. Three major changes were then made. Seven magnetic tape drives were replaced with the faster IBM 2420 drives, and the recording density increased from 800 BPI to 1,600 BPI. Second, a sort was permitted to use 500K bytes of main core, rather than a meager 75K. Third, a more effective initiator-job class/priority combination was speci-

	Model 65J (measured)	Standard Model 85J (measured)	Model 195K (projected)	Model 195K (measured)
Throughput Ratios	1.0	4.4	12.9	13.1
Elapsed Time (in hours)	7:25:04	1:40:35	0:34:35	0:33:59
Internal Performance Ratios	1.0	4.5	13.2	13.3
CPU Utilization	99%	98%	97%	98%

Table 2

	Model 65J (measured)	Standard Model 85J (measured)	Model 195K (projected)	Model 195K (measured)
Throughput Ratios	1.0	4.1	12.2	12.2
Elapsed Time (in hours)	8:56:30	2:11:43	0:44:02	0:43:51
Internal Performance Ratios	1.0	4.4	12.6	12.6
CPU Utilization	97%	89%	94%	94%

Table 3

fied, in which I/O-bound jobs were assigned high priority for use of three Class A initiators (two on the Model 65), and compute-bound jobs were assigned low priority for use of three Class B initiators. Clustering of active I/O-bound tasks was thereby reduced. Table 4 is a summary of the results then realized (note the 55% reduction in elapsed time on the Model 85).

	Model 65J (measured)	Fully-Featured Model 85K (measured)	Model 195K (projected)	Model 195K (measured)
Throughput Ratios	1.0	4.5	5.9	
Elapsed Time (in seconds)	4639	1030	792	Not
Internal Performance Ratios	1.0	5.4	8.1	Available
CPU Utilization	85%	71%	61%	

Table 4

These are impressive results. As of October 1969, however, circumstances had not permitted this jobstream to be fully optimized and the case study to be properly completed. At least four more sources of improvement appear to warrant investigation. One is increasing the size of tape-data blocks and I/O data buffers in main core, the capacity for which remains in K-size storage. The same possibility exists for data files stored on the IBM 2314 disc drives. A second source is the splitting of critical data files between devices on different I/O channels. Third, the Link Pack area within the nucleus of the OS control program could be used to provide location pointers to, and/or residence for, frequently used modules of the sort and report generator programs or COBOL and PL/I compilers. Fourth, a peripheral processor might preprocess part of the workload, significantly increasing throughput the main processor. The first three sources alone should make possible Model 195 cpu utilization of at least 80%, resulting in a throughput for this jobstream greater than seven times the Model 65.

in conclusion

No matter what types of code are presented to the cpu, the Model 195 performs a wide range of internal operations at unmatched average speeds. It is equally impressive in its throughput capabilities, as demonstrated on three samples from today's world of mixed jobstreams. Operating System/360, in addition, makes possible the fully efficient operation of a complete Model 195 system immediately upon acceptance in the user installation. ■

complicated

THE CDC 7600 AND SCOPE 76

by Thomas H. Elrod

As Control Data Corp.'s 6000 Series computer line was being produced and marketed, CDC had already commissioned its Chippewa Falls Laboratory to develop a major extension of this already large scale system. The result was the 7600—a machine geared to the vast and rapidly changing requirements of the seventies.

"Distributed computing" is the basic architectural concept of the 7600 system. Distributed computing attempts to separate the processing functions of the cpu from those of I/O processing and control of peripheral devices. Input/-output tasks are performed by separate smaller computers so that peripheral equipment may be located either local to or at remote distances from the cpu of the 7600. In an environment of this type, large numbers of job input and output stations may be physically located at the central site (in-house batch processing, for example), or at remote sites. Peripheral equipment such as tape drives may be located remotely—at a tape vault, for instance.

Coincident with the basic architectural concept of distributed computing is a large capacity, high-speed central processor structure in the 7600. The cpu is comprised of a memory hierarchy with 65K of high speed executable and 512K nonexecutable 60-bit words, and a 12-word instruction stack which allows tight loops to be executed without requiring memory fetches for instruction words during the loop. Nine functional units (divide, multiply, add, increment, etc.) are arranged to allow parallel processing of different functions. The basic clock period for the cpu is 27.5 nanoseconds. It is also the same for the peripheral processor units (ppu's) which handle the I/O.

software concepts

CDC is building software to match the scope of the machine. This software is based on a design philosophy of providing all of a company's computing capabilities from one computer system on a continuous access basis.

The software is being developed in a three-phase plan.

In Phase 1, the SCOPE 70 system was produced to provide basic capability for installation with the initial hardware deliveries. The design criteria were simplicity of structure and close compatibility with the predecessor 6000 systems.

In Phase 2, Control Data is developing a broad-based applications product which is aimed directly at the batch and remote batch market of the seventies.

Phase 3 will be the development of a system oriented primarily toward access through large numbers of slow speed terminals.

This paper focuses on Phase 2 of this program. The design of SCOPE 76—one of the possible designs for the Phase 2 product—will be presented.

The dominant design criteria for SCOPE 76 are concerned with user access; computational and data management requirements; response and turnaround constraints; and user confidence.

User access. Large numbers and varieties of remote and local batch terminals will be supported as input/output facilities. These terminals will be augmented with flexible file handling schemes and generalized operator communication methods. Conversational access will be handled by individual systems based at communication stations.

Computation and data management requirements. A broad based application system together with flexible permanent file features will provide extensive computing and data management capabilities to both the scientific and business data processing user. Fast sequential I/O as well as multiple record access methods (random, index-sequential, etc.) will be available to all classes of users. Extended FORTRAN I/O is supported in full. Complete file privacy controls will be provided.

Response and turnaround requirements. Real-time applications will be supported with "demand" access to resources, fast response to external stimuli, and "guaranteed interval" computation. A sophisticated job scheduling and time-slicing mechanism will be provided to meet the turnaround demands of the non-real-time user.

User confidence. Insuring reliability and availability from the user's standpoint is a strong influence on the design of such a large scale system as SCOPE 76. Sophisticated permanent file techniques will be provided to insure data base integrity. System recovery will be performed on a centralized basis with checkpoint/restart being aimed at the individual user.

The development of any software system is based on and takes its basic structure from the architecture of the hardware. The important elements of the hardware are dis-

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cussed here to provide the base for discussing the software.

The 7600 system can grossly be described as a central processing unit and a number of peripheral processing units which interface to various stations. Some of the stations are physically located with the cpu and others may be remotely located. The stations communicate with the cpu through ppu's over high speed data links, with the data buffered at the cpu end of the data link. The stations provide a communication and message switching function between the cpu and individual peripheral equipment.

The cpu consists basically of four elements: computation section; small core memory (SCM); large core memory (LCM); and I/O multiplexer (IOMUX).

In the 7600, the code to be executed must reside in small core memory (SCM). Associated with the execution of any program is a set of 24 operating registers (accumulators, index registers, etc.).

Each instruction to be executed is first moved from a location in SCM to the current instruction word (CIW) register where it is decoded and interpreted by CONTROL, which has the funotion of:

1. Relaying commands (from the interpreted instruction) to the one or more of nine functional units to perform the actual instruction.

2. Fetching and storing data in a parallel manner and moving this data between the operating registers and large or small core memory.

The nine functional units are concerned with operating on data already in the operating registers according to specific hardware algorithms. The functional unit receives one or two operands from the operating registers, performs the specified algorithm, and returns the result to the specified operating register.

The 12-word instruction stack is used to save previously executed instructions (up to 48 may be saved) in case a branch should be made in the current instruction back to one of these previously executed instructions. If such a branch is made, the current instruction word register is filled from one of these extremely high speed access (82.5 nanoseconds) instruction stack words rather than having to reference small core memory (302.5 nanosecond fetch) again. This facility allows short, tight loops to execute at ultra high speed.

With the previous description of instruction flow in mind, it is seen that data flow, in conjunction with cpu execution, is from either SCM or LCM to the operating registers (where it is manipulated by the functional units) and then back to SCM or LCM.

CPU instructions may also be executed that will effect the transfer of large blocks of data from SCM to LCM and vice versa. This transfer facilitates the buffering of files and the swapping of jobs.

In order to give a complete picture of the system architecture of SCOPE 76, three perspectives will be presented:

Agency concept. Here the system is viewed from the "eyes" of the system itself. The various areas of responsibilities are isolated and identified. This view is very high level and does not consider residence or module identification.

Job flow concept. Here the system is viewed from the "eyes" of a job as it travels through the system. During this system walk-through, the components of the agencies outlined in the agency concept perspective description begin to come into focus. In this view, the modules have still not been identified, nor has the component residence been specified.

System layout. Here the system is viewed from the eyes of a system programmer. The residence (i.e., where the modules are stored and executed) and execution mode of important components and modules will be delineated and the basic form of system tables will be described.

The system (nonjob) portion of SCOPE 76 is outlined at this point into various areas according to responsibility. These areas of responsibility can be thought of as "agencies" and are the basic pillars in the system architecture. These are: physical I/O, job management, logical I/O, resource management, information routing, and utilities agencies. Support for all of these is provided by the "groundstone" or system control agency.

Physical I/O agency. This agency is concerned with the movement of physical data blocks between various sources and receivers in the system. The primary paths concerned are from I/O station to the logical I/O agency and vice versa.

The physical I/O agency is, in general, not responsible for or interested in the logical format of the data being moved. Some of the identifiable areas of responsibility within the physical I/O agency are:

1. Peripheral equipment (mag tape, disc, etc.) drivers
2. I/O interrupt processing
3. Data channel information movement between computer units

Job management agency. This section of the system is primarily responsible for the initiation, advancement, and termination of user jobs. These responsibilities begin at the job queue where jobs are stored waiting to be selected for the job management processes. These responsibilities end when all output files of a job are dispatched to an output queue waiting to be returned to the submitting user at a station.

Some of the tasks of the job management agency are:

1. Verifying that a job is in an acceptable format.
2. Selecting jobs to be moved from the job queue to an executable state.
3. Interpreting and processing job control language statements.
4. Terminating jobs that have finished execution.

Logical I/O agency. It is the responsibility of the logical I/O agency to translate the user's logical I/O instructions into physical I/O commands to be handled by the physical I/O agency.

Input operations involve the transmission of blocks of data in "physical" format from the physical I/O agency to the logical I/O agency where they are translated and delivered in logical record format to the user.

Output operations involve the translation of logical record output requests into physical block format and the delivery of this physical data to the physical I/O agency.

Logical I/O capabilities in the system allow the user to think in terms of "logical" records (i.e., records which relate logically to his problem), rather than having to think about recording characteristics on a device such as a tape drive or disc pack.

Logical I/O also provides device independence for files. That is, the user need not be concerned with the kind of device on which his file is going to reside. The system will handle his file in a logically consistent fashion in all cases. This permits the user to switch from one external device to another, without having to change his program.

In SCOPE 76, special requirements are placed on the logical I/O agency for its components to be common to the entire applications base and all user routines. That is, all applications languages, such as FORTRAN and COBOL, as well as user jobs use the same logical I/O components. This provides a unified set of file structures for all applications and facilitates sharing of files by applications.

Some of the specific areas of responsibility in the logical I/O agency in SCOPE 76 are:

1. I/O command translation
2. Record translation—physical to logical and vice versa
3. Buffer management

Resource management agency. This agency is responsible for allocating and accounting for the system resources. Resources are things which are assigned to jobs or tasks which permit work to be done. For the 7600, these resources include the following:

1. The cpu
2. Small core memory
3. Large core memory
4. Mass storage
5. Data channels
6. External peripheral equipment

resource assignment

The resources of the system can generally be thought of in two different connotations: dynamic and static.

Dynamic means that allocation and de-allocation of this resource is a very convenient and relatively quick matter. The cpu is an example of a dynamic resource. It can be switched between two jobs which are already resident in SCM in less than 800 nonoseconds.

Static means the allocation and de-allocation require a long time to effect. External equipment such as magnetic tapes are static resources because they are hard to switch due to the long period required for distribution between jobs or tasks. If one job is writing in the middle of a reel of tape and another job requires that same drive, considerable work must be done before the second job can actually obtain the drive. The first job will probably have to be completed, the tape rewound and unloaded, a new one mounted, labels checked, etc.

However, the same resource can be hard to assign for some cases and easy to assign for others, depending on the allocation techniques used. Small, *not necessarily contiguous,* areas (allocation units) of large core memory may be allocated relatively easily (using a table of pointers to keep track of which units are available, and which are linked together in various chains). Such a use of LCM is analogous to allocating disc space in units of one sector or track at a time and is considered dynamic resource allocation.

In SCOPE 76, LCM may be shared by hundreds of jobs. To allocate large *contiguous* amounts of LCM, (i.e., a significantly large percentage of the total available) to one job might require suspending many other jobs and moving these jobs to rotating mass storage (roll-in, roll-out). This action might be difficult as well as time consuming, and is considered static resource allocation.

In SCOPE 76, the general job scheduling philosophy is not to allow jobs to begin execution unless all maximum static resources are available for the job to run to completion. Dynamic resources are continually in an overcommitted state and the availability of these resources is not required for job selection.

The resource management agency performs a service role to the other agencies of the system. When other agencies such as job management or system control need to allocate resources, the resource management agency is called upon to perform the task.

Information routing agency. The responsibility of this agency is the management of the movement of files and control information through the system. In SCOPE 76, only three types of files are used: data files, job files and message files.

A data file is one which is used and operated on by a job. Data files are in the form of INPUT files, OUTPUT files (containing the results of a computer run), and SCRATCH files (used for storage of intermediate results). SCRATCH files are returned to the system after completion of the job. LIBRARY and RESTART files are thought of as data files that are used as input to the utility agency.

A *job file* is a collection of data which specifies to the operating system a unit of work to be performed by the computer. This unit of work is called a job and is really defined by the person who submits the job to the computer. In a batch processing environment, a job file normally consists of everything between the job card and the end-of-job indicator. A job file may contain job control language statements (control cards), programs, and data.

A *message file* contains an interactive message that is to be displayed or operated on by a computer unit separate from the sender. A message file functions on a computer-to-computer rather than a user-to-device basis such as with job and data files. Also, message files are considered infinite and each segment is treated as a logical entity whereas job and data files are finite and the whole file is treated as a logical entity.

The movement of these files mentioned above is directed by control information communication blocks. An example is the acknowledgement of a message file segment by the receiving computer to the sending computer.

Utilities agency. The responsibilities of this agency cover a broad spectrum. Some of these areas of responsibility are:

1. Loaders
2. File management—the access maintenance of a centralized data base.
3. System editors and maintenance routines
4. Dead start processes
5. Recovery processes: failsafe; checkpoint-restart.
6. Operator communications

System control agency. This agency is the basic foundation of the architectural structure of the system. The relation and interface of each of the other agencies is controlled by the system control agency. Some of the specific tasks of this agency are:

1. Cpu switching control—the selection of the job to which the cpu is to be allocated.
2. Queue management—the service of system queues.
3. Software clock servicing—conversion of the output of the periodic hardware clock to the formats required by the rest of the system.
4. Task synchronization — the supervision of event posting.

job flow

The next step in bringing the design into focus is to examine job flow through the system and identify which agencies would come into play at which points in the process. It should be pointed out that several *components* may comprise a particular *agency*. Also, these components may reside in different physical locations in the machine configuration. Each component may contain several *modules* of separate, distinct code.

1. The physical I/O agency reads the job in at a job station.
2. The information routing agency aids the physical I/O agency in routing the job to central where it is queued to a mass storage device to await scheduling for execution.

3. The job management agency takes over to schedule the job. It brings the job into core and leads it through its various stages of execution.

4. The resource management agency is called by the job management agency in order to allocate resources such as SCM, LCM, peripheral equipment, etc. to the job.

5. During execution of the job, the job management agency may also call other agencies, such as the utilities agency (for calls to system routines such as the loader, compilers, etc.), or the logical I/O agency. It is also possible for these agencies in turn to call another agency. For example, the logical I/O agency calls the physical I/O agency and vice versa.

6. At the end of execution, the output files are queued to a mass storage device to await routing back to the job station.

7. The information routing agency aids the physical I/O agency in routing the completed output file(s) to the designated destination(s).

8. Finally, physical I/O is called to output these files to the desired peripheral equipments.

Iterative walk-throughs. As seen in the previous discussion, jobs in SCOPE 76 come from input devices, are queued to mass storage and later executed and the output files sent to an output queue where they await transmission to output devices.

Additional "walk-through" sequences will be given for various sections of the system to permit some of the components and subcomponent structures to come into view. Two specific processes will be focused on:

1. Job input and output file queueing and dequeueing.
2. Job management execution sequence.

Job file queueing/dequeueing walk-through. The following steps are necessary:

1. Physical I/O performs the actual input from the hardware device at the station.

2. The *file router* component of the information routing agency aids the physical I/O agency in moving the job file between the station and large buffers in LCM.

3. The *data manager* component of the logical I/O agency operates on (interprets, decompresses, etc.) the data in the LCM buffer and translates this data from physical blocks to logical records and delivers these records to an SCM buffer for the job verifier component of the job management agency.

4. If the job verifier accepts the format of the job file, the data manager is called to translate the logical record to the physical blocking format of the system mass storage device. The data manager then moves this translated data record to LCM buffers. This buffering is necessary in order to minimize the number of accesses (and therefore repositionings) of the mass storage device.

5. When the LCM buffer is full, the physical I/O agency is called along with the file router to move the file to the mass storage device.

Job management walk-through. The job management process walk-through identifies the following components:

1. Job verification—component concerned with the verification of the job format. (Is the account card, resource statement, etc. correct?)

2. Job entrance—component concerned with the qualification of jobs to be selected as candidates for cpu execution. Subcomponents of job entrance are job staging, job scheduling and job initiation.

a. Job staging—responsible for the moving of a job between various stages of selection candidacy. Jobs are event-synchronized with other jobs and resource-synchronized with removable volumes (tapes, disc packs).

b. Job scheduling is dependent on resource availability and priority. Essentially, the execution candidates are selected as the highest priority jobs whose resources (drives, LCM, SCM basic job area) requirements can be satisfied.

c. Job initiation—component concerned with the housekeeping required to introduce the job as a cpu execution candidate once the job has been selected.

3. Job advancement—component concerned with the interpretation and system execution of the job control language used to specify the action of each job step. Some of the specific tasks here are library loading and the mounting coordination of removable volumes.

4. Job termination—component concerned with the housekeeping required to remove a job from the system after the job has completed.

system layout perspective

The operating system is readily divisible into two clearly distinct parts with respect to physical layout: central and stations. The physical layout of the central side will now be considered.

The agency and job flow perspectives do not clearly depict the final form of the implemented system. These perspectives ignore performance characteristics and hardware constraints, for the moment, in order to visualize the system structure from a gross point of view. These perspectives give a picture of the system "from the top down." That is, the system is described in a hierarchical fashion starting from very general concepts to more specific ones.

Before describing the actual layout of SCOPE 76, a discussion of the system "from the bottom up" will be given. Here the basic framework *structures* of the system will be described. The final layout of the system is described as how the various components and subcomponents described in the agency and job flow fit into these *structures*. The final form of the system is then seen when the "top down" and "bottom up" descriptions meet.

Residence considerations. As outlined in the hardware description, all cpu code must execute in SCM. Because of this, SCM is considered a precious system resource and, therefore, one of the design objectives of SCOPE 76 was to keep the amount of SCM required by the system to a minimum. SCM is 65K words long. The I/O hardware buffers in low SCM take up 4K words. A system resident limit of 4K words was established providing 57K words of SCM for user job execution.

To achieve this limit, the system resident was structured to use overlays in all areas except the most time critical.

Execution state considerations. The execution code in the cpu is controlled by system selection of the mode of execution. These modes are determined by the hardware and are used to control response to interrupt and permissible exit addresses.

The 7600 cpu can execute in two basic states:

1. Interruptible—processes executing in this state are subject to I/O interrupts.

2. Noninterruptible—processes executing in this state are not subject to I/O interrupts.

Within either of the above two states, two substates can be selected.

1. Controlled exit—processes executing in this substate can select the process which will execute next.

2. Uncontrolled exit—processes executing in this substate can only return to the process that preceded their execution.

Together, these states allow a process to run in any of four permutations of the above states.

1. User mode—user jobs execute in this mode. The process is *interruptible* with *uncontrolled exit*. Certainly, user jobs must be totally under control of the system and this execution mode insures such control. These processes may not lock out I/O interrupt servicing and are only allowed to give control of the CPU back to the process that originally gave control to them.

2. Interrupt mode—When an interruptible process is executing and an I/O interrupt occurs on some channel, control is transferred directly to specific routines to process the interrupt. These processes must be *noninterruptible* (dictated by 7600 hardware constraints).

It is desirable to blend the processing of interrupts into normal system and user job execution as much as possible. The concept used in SCOPE 76 is to execute the interrupt handlers in an *uncontrolled exit* substate so that control will return immediately to the process that was executing at the time of the interrupt. This minimizes the overhead of servicing interrupts, since the CPU is not required to do any software scheduling.

3. Transfer mode—The major portion of the system task servicing cannot be handled in either of the user or interrupt modes. These tasks are of such duration that they must be interruptible in order that I/O tasks can be adequately serviced but they are of such a control nature that the *controlled exit* state must be used.

4. Monitor mode—There are some tasks in the system that must be executed in *noninterruptible* state with *controlled exit* substate. This section of the system provides the balance necessary to keep the system running in a predictable fashion.

Timing requirements. In order to meet the external requirements of the system to respond to external stimuli (in less than 125 microseconds), the time spent in noninterruptible mode has to be minimal.

Effective use of the hardware requires interrupt handlers to execute in noninterruptible mode. To meet time critical response requirements, the interrupt handlers do not execute for more than 10 microseconds. Interrupt handler code resides in SCM so it is not necessary to load an overlay from LCM to execute this code.

The framework of the central operating system is now described with the above considerations and restrictions in mind.

Job structure. First, due to the requirements that noninterruptible mode be minimally used, it is clear that user jobs which will be in execution most of the time must execute in SCM in user mode (interruptible with uncontrolled exit).

Interrupt handlers structure. Routines to process external I/O interrupts must be executed in different execution modes than the user jobs. These processes, known as interrupt handlers, move data to and from special buffers in SCM that are connected to hardware channels to the stations. Data is moved from the SCM buffers to and from larger LCM buffers.

As mentioned previously, it is imperative that the interrupt handlers minimize their execution, due to the fact that their execution in noninterruptible. For this reason these processes are coded to move data between LCM and SCM buffers and then to immediately return to the interrupted program. This procedure is sufficient in normal continuous transfer of data between the stations and central. Other cases, such as buffer overflow or end of transmission, require more than simple data movement. The fact that these cases may require lengthy processing dictates that this processing must be handled outside the interrupt handlers.

To provide for system task processing, a separate structure of the central system was designed. It is called the executive structure, due to the executive nature of the tasks. The processes in this structure perform the major portion of the tasks of the information routing agency, the resource management agency, the job management agency, and much of that of the physical I/O and system control.

In order to distinguish between these tasks by priority, they were grouped into three substructures or levels. These separate substructures are:

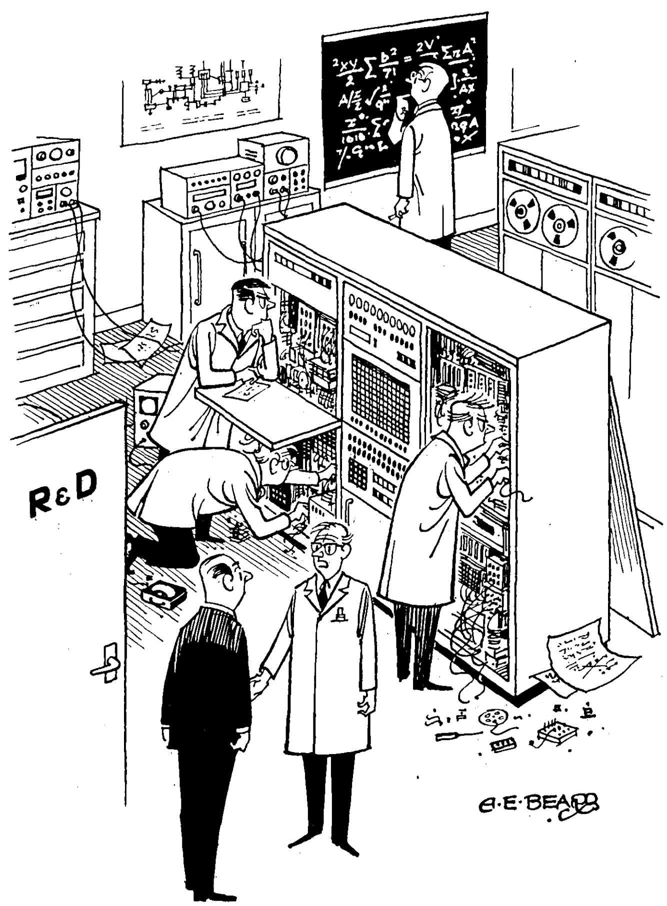
E1—This level performs basic job management and resource management tasks, as well as system control and information routing. This portion of the executive structure executes with the lowest priority.

E2—This level is concerned with physical I/O processing. The tasks are related to the start-up termination and special case handling of I/O requests to the physical I/O agency. This section runs at a higher priority than the E1 level in order to give precedence to the flow of data through the system.

E3—This level services real-time and time critical tasks. For this reason, E3 runs at a higher priority level than either E2 or E1.

Since modules in these structures may be called to service more than one task at a time, the levels are queue driven.

System interchange. In order to provide an orderly state of execution flow between the various elements of the system, a separate structure was required. This structure, the system interchange, is one of the basic parts of the



"If only we could get it to work, it could give us the answer to why it won't."

system control agency and it runs in monitor mode.

Modules in this structure are called by the interrupt handlers and other components whenever it is necessary to add an entry to any of the executive queues. The basic task of the system interchange is to queue these requests and then to select the next task for cpu execution.

Job supervisor structure. Because of centralization requirements, the data manager component of the logical I/O agency is designed to run as a separate module from the job it is servicing. Due to the responsibility of mapping logical orders into physical addresses, the data manager has wider access privileges to system information. That is, data manager reads and writes in SCM and LCM areas that are not accessible to a user job. These considerations require that data manager execute in a separate system structure than the user job. For this purpose, a separate system structure is used—the job supervisor structure.

In the job supervisor, tasks such as in the data manager are executed in a job oriented sense, yet with the privileges of system modules. Each job has an associated job supervisor structure. These two structures are juxtaposed to facilitate swapping (the job supervisor is swapped out with the job). Modules that execute in the job supervisor use a separate set of operating registers and memory bounds than those used by the associated job.

In addition to the data manager, many job-oriented tasks such as the job initiator, job advancer and job terminator execute in the job supervisor structure.

detailed architectural overview

The final system will now be summarized with emphasis on core allocation and code residence.

SCM organization is basically in three parts:

1. I/O section—area dedicated by hardware for input and output I/O buffers and the corresponding exchange jump packages.
2. System section—used for system overlays and tables. This section is a permanent part of the operating system and is never moved during system execution.
3. User section—available for user programs.

LCM organization is basically in two parts:

1. System section—used for permanent storage of system overlays, for various system tables and for allocatable system buffers.
2. User section—used for job image areas (for swapping) as well as job-related system tables and user direct access areas.

Only one program at a time is executed in SCM. The entire SCM object program field may thus be used for each program. Data is read from the input file in LCM and results are stored in an output file in LCM. If the amount of input and output data is small, the job may be run to completion in one execution interval. If job execution is delayed by buffer size or by intermediate file references, the program code is returned to LCM and another job uses the SCM while buffer data is transferred to (or from) LCM.

SCOPE 76 completes the concept of distributed computing by providing a sophisticated time critical component of the system control agency. The time critical component maintains ultimate control of the cpu and directly links transfer of data and execution of computational tasks to events detected by a real-time I/O station. The time critical component provides for priority execution of computational tasks within a job and for the allocation of the cpu between jobs to guarantee computational intervals. Real-time response is considered at all levels of the system design to ensure minimum switching time between non-real-time and real-time processing.

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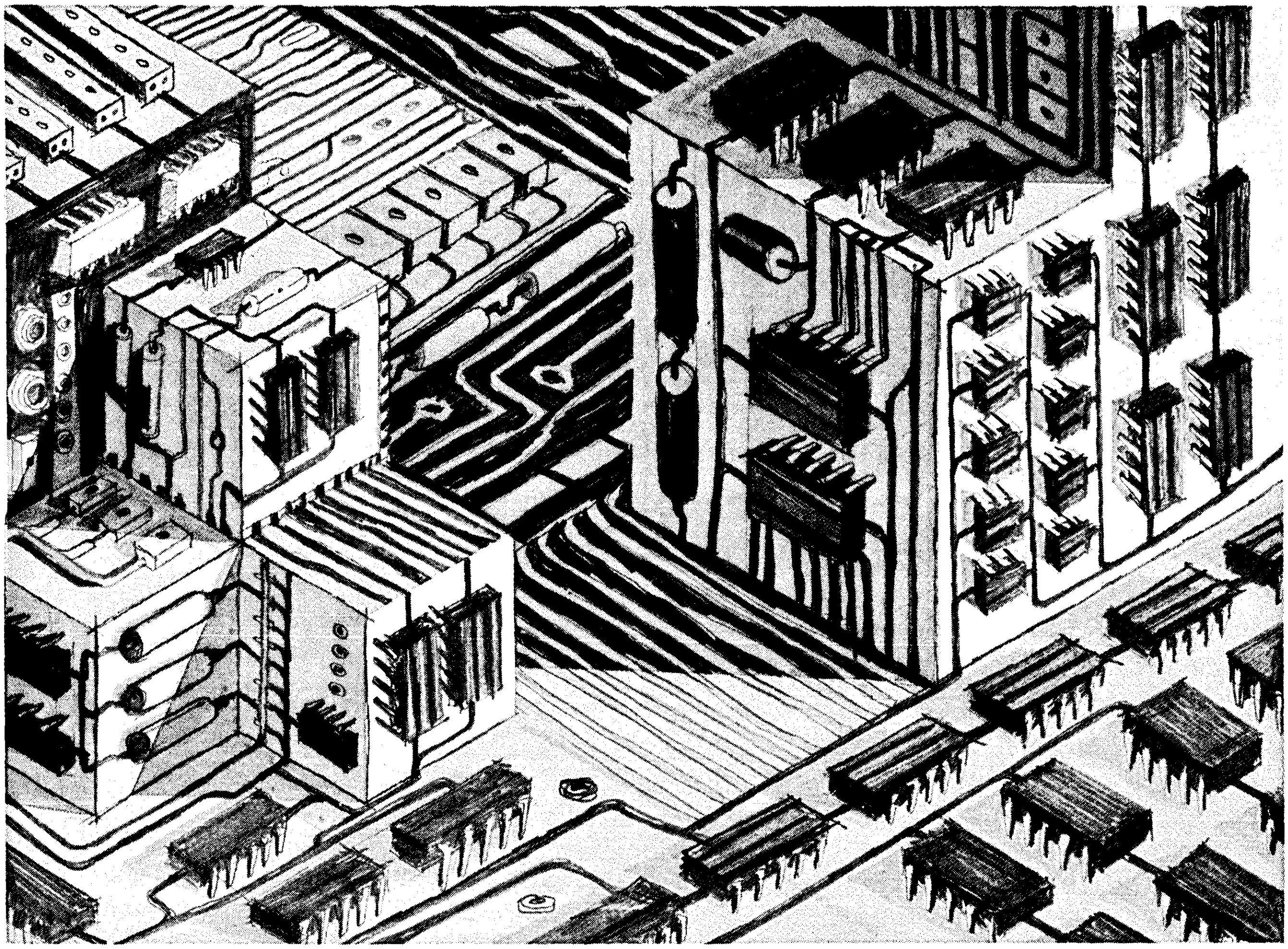
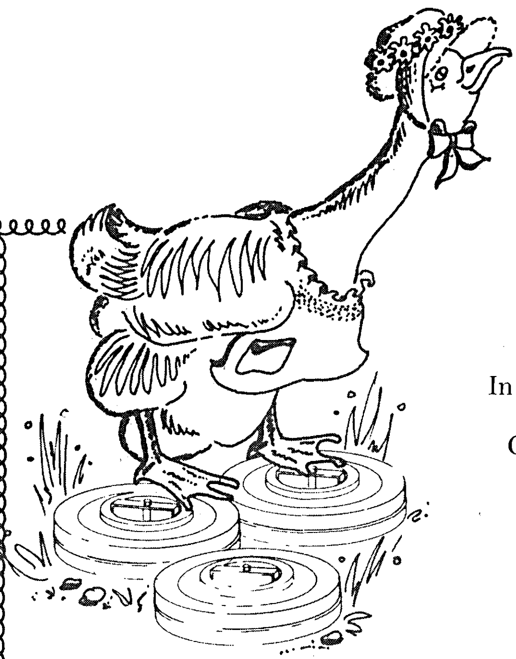


MOTHER GOOSE
another gander

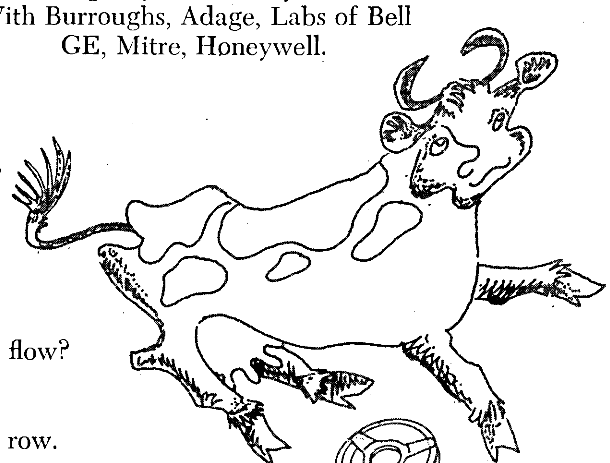


Georgy Porgy
Putting pi
In his program wondered why
All his data went astray
Out went Georgy's resume.

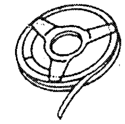
Old Ken Cole
Was a very old soul
And a very old soul was he
He programmed the ENIAC
And he programmed the 650
And he programmed the UNIVAC III.

Peter, Peter
E-D-P-er
Kept a job about a year
With Burroughs, Adage, Labs of Bell
GE, Mitre, Honeywell.

Little Jack Horner
Sat in the corner
Eating his peripheral pie, oh
He input his thumb
And output a plum
And said "What a good toy is I/O"

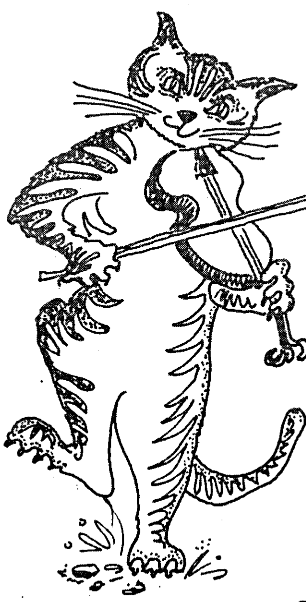


One, two
Continue my DO
Three, FOR-
TRAN's a bore.



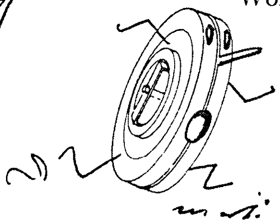
Mary, Mary
Quite contrary
How does your program flow?
With lots of loops
In nested groups
And neat arrays all in a row.

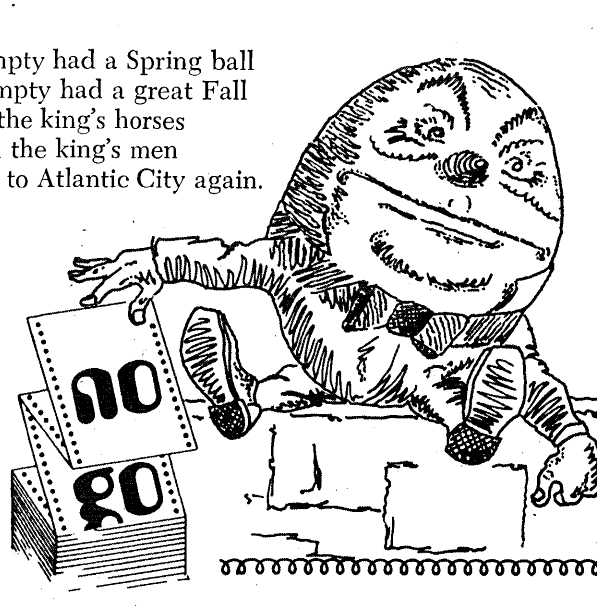
Jack and Jill
Went up the hill
With great anticipating
Jack came down
And with a frown
Gave up computer dating.



Hey, diddle diddler
The cat and the bit-fiddler
The cow jumped to a routine
The little DO looped to see such sport
And the disc ran around in the scene.

Humpty Dumpty had a Spring ball
Humpty Dumpty had a great Fall
But all the king's horses
And all the king's men
Won't get him to Atlantic City again.





Jack Spratt
At FORTRAN spat
His wife thought COBOL mean
And so between the two of them
They brought home lots of green.

—Edmund Conti

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data's wait-less wonder

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* * * *

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No waste space

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In orbit with ASCII

Inktronic KSR will generate up to 128 code combinations and can print 63 alphanumerics. Take your choice of an RO set with 5-level or ASCII code, or a KSR set with ASCII.

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The Inktronic terminal uses ordinary teleprinter paper. Inexpensive paper. A standard 8½ inch wide roll provides about 400 feet of data space. The ink Inktronic terminals use is inexpensive, too. One pint will deliver up to 15 miles of data. With a 1200 wpm capability these are important points to consider. Maintenance? Really low. The ink supply and guidance system has only one moving part. And you get more data on and off line faster which means greater economy, too.

The Inktronic is one of many exciting moves being made by Teletype R&D *in moving data at very little cost.* If you would like more information, contact Teletype Corporation, Dept. 81D, 5555 Touhy Avenue, Skokie, Illinois 60076.

MORMONS ADAPT COMPUTERS TO GENEALOGY

by Hoyt Palmer

The era of electronic data processing has expanded beyond the conventional and has invaded the unlikely field of genealogy.

The "Mormon" Church, officially titled The Church of Jesus Christ of Latter-day Saints, has been using the computer almost since electronic techniques became adapted to statistics, but it was only in 1962 that the church's Genealogical Society began an experimental program to see if data processing could be used for genealogy. The experiment proved successful, and the society has moved more and more into electronic data recording until now almost all the processing of genealogical information has been adapted to computerized techniques. No way has yet been found to adapt the computer to actual research work, but even this may develop in time.

Because the society has been sponsored from its beginning by the church, an explanation of its purposes and motives becomes necessary to show how the society operates. Members of the Mormon Church have the same interest in their ancestors as do any other people. But they are spurred additionally by their belief that all persons who ever have lived or ever will live on the earth will, through the gift of resurrection provided by Jesus Christ, live again as eternally existent immortal beings—each with the same personal identity by which he was recognized while here upon the earth.

They also believe in the continuity after death of the family relationships that exist here, but claim that this can be assured only through ordinances of binding or "sealing" of families into eternal family relationships. Similarly, they accept literally the statement of Christ that no one can enter the Kingdom of God without baptism. Billions of individuals and families have lived and died without ever accepting Jesus Christ or knowing anything about these scriptures or ordinances.

As an adjunct of this belief, justice demands that all those who have died must have the same opportunities as those who live now. The Mormons claim, through devine restoration, the same authority that was given to Peter—that whatsoever he should bind on earth should be bound in heaven—and claim the use of this authority on behalf of all who have lived before, by providing these ordinances of sealing for them—the living being proxy for the dead. This, they point out, is in keeping with the statement of the Apostle Paul, who refers to baptism of the dead as a proof of the resurrection, as recorded in I Corinthians, chapter 15. These ordinances, vicariously performed for the dead, are performed in temples built for this purpose. There are presently 13 beautiful and magnificently designed temples in operation—four located in Utah, two in California, and one each in Idaho, Arizona, Hawaii, Canada, England, New Zealand, and Switzerland. Two more are projected in Utah, and one in Washington, D.C.

This, in brief, explains why the Mormons have such a compelling interest in gathering the records of their ancestry. The long-range goal of the Genealogical Society is to eventually, by means of a worldwide microfilming project, gather into its huge Granite Mountain Records Vault the records of as many identifiable names as can be found in all areas and nations of the world, and to make these available for tabulation into the computer. This will eventually run into billions of entries. The task of processing and recording this tremendous bulk of information by manual means would border on the impossible, and the filing problem would become so unwieldy as to be entirely impractical.

The Genealogical Society had a modest beginning on November 21, 1894, with its first library housed in a single room, lined with donated books of genealogy, and with a few tables and chairs, an administrative desk, and an old wood-burning heater to keep the place warm on cold days. In November, 1969, when the organization celebrated its diamond jubilee, it was recognized as the largest genealogical organization in the world. The main library, located in Salt Lake City, is complemented by 90 branch libraries scattered throughout the United States, including Alaska and Hawaii, and in Canada, Mexico, and New Zealand, with more branches being planned in many locations. The society presently employs 525 persons at its headquarters in Salt Lake City, and, since it is a nonprofit organization, the payroll, maintenance, operations, and services of the organization are all underwritten by the sponsoring church.

Prior to 1962 all genealogical information was received from patrons who did their own research, or hired it done, and these records were examined, evaluated, and then typed onto standard forms. These were then sent to the church's temples for the ordinances to be performed vicariously for each person. When the ordinances were completed, the records were all filed and made available to the public.

A huge index of more than 37 million individual names, each filed on an index card with the identifying information

Mr. Palmer is publications editor for the Genealogical Society of the Church of Jesus Christ of Latter-day Saints. Previously he was a member of the society's research staff for several years. He is a graduate of Utah State University.

for each person, was maintained in a huge file termed the Temple Records Index Bureau (TIB). This file was arranged into areas, by countries or other appropriate area divisions, and also alphabetically, by surname and date arrangement (Fig. 1).

Another collection, comprised of family groups records, was maintained between 1942 and 1969, and is now posted in binders, called the Church Record Archives. This archive, containing more than 6 million family groups is located in the main building of the society's main library, where the binders are accessible to anyone who desires to

Fig. 1. Temple Records Index Bureau (TIB) files.

look through them. A rapid copy service is provided for making copies of any sheet desired.

To meet the society's objectives, a microfilming program was begun in November of 1938. Since that beginning microfilm operations have mushroomed until there are presently 80 cameras operating in 15 countries, and the program continues to expand.

The negatives of this enormous collection of microfilmed records are stored in a great tunnel complex blasted in the base of a solid granite mountain near Salt Lake City, Utah (Fig. 2). This huge Granite Mountain Records Vault of the Genealogical Society presently contains more than 700,000 (100-foot) rolls of 32mm microfilm—which collectively contain an equivalent of more than 3 million (300-page) volumes of genealogical information. The figure of 700,000 rolls of developed negatives is by no means static, as more film is arriving and being developed at the rate of approximately 4,000 rolls of film each month from many nations of the world.

No cutoff point is anticipated until all possible records available have been filmed and added to this already immense genealogical treasurehouse. The capacity of this film storage facility is figured between 5 and 6 million rolls of microfilm, and the vault can be expanded if necessary through further excavation.

The films are deposited in huge cross-storage tunnels of the vault, in cabinets constructed with a specially designed power lift to provide access to the upper sections of the nine-foot-high tiers of cabinets.

The first step toward computerizing genealogy was taken in 1962, as an assignment to a corps of typists to copy genealogical data from filmed copies of English parish registers onto cards, each card containing the complete identifying data for one person. This data was then Flexotyped onto paper tape in the form of machine-punched code, which was fed into the computer, and the information then electronically recorded on computer discs and/or tape (Fig. 3).

The tremendous reduction in weight and space as storage factors will play no inconsiderable part in the change to computerized genealogy. The present 35 million cards in the TIB index occupy 871 file cabinets, totaling approximately 900 lineal feet of floor space, and represent a combined weight of about 85 tons.

Using one billion card entries as a projected sample

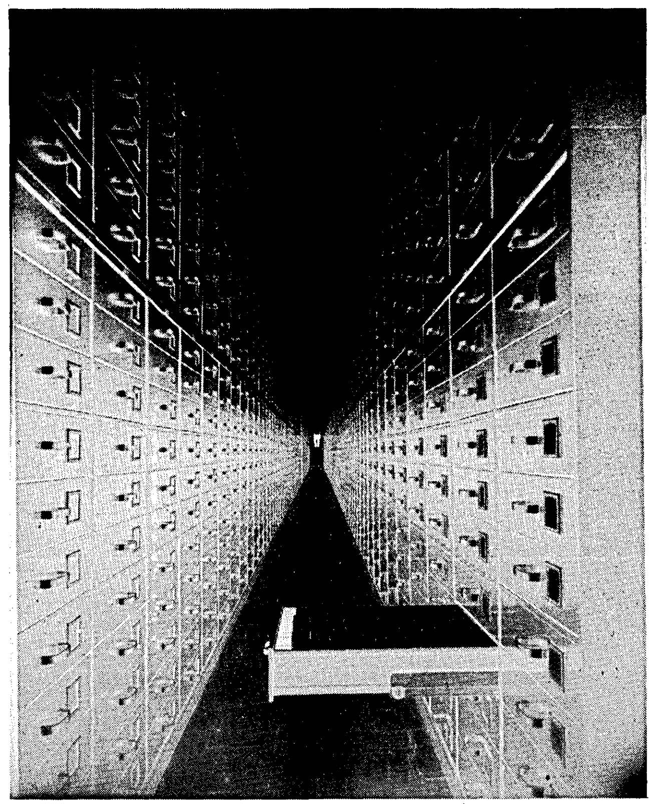


Fig. 2. Granite Mountain Records Vault.

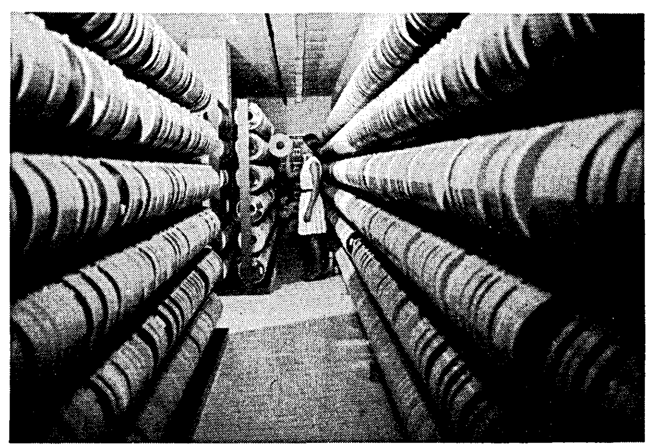


Fig. 3. Reels of computerized data stored on magnetic tape.

figure, the card file system would require an estimated 25,000 cabinets, weighing nearly 2500 tons, and extending a distance of about four and three-fourths miles. These same one billion entries on computer disc storage, placed on shelf racks of comparable height to the card cabinets, would take up only about 700 lineal feet of space—or, on tape reels, on similar racks, the required space would be less than 100 lineal feet.

The final big step to electronic processing of almost all of the genealogical data submitted to the society began October 1, 1969. Since that time only a few specified types of records continue to be processed manually. These include Polynesian, Oriental, and some Medieval European records, which require special manual evaluation and handling in order to provide sufficient information for complete identification.

Parish registers are perhaps the most lucrative source for genealogical information for time periods beyond the past 100 years or so. English parishes were selected first, and many of these records are written in very old script. To be sure the difficult Old English writing is correctly copied, a controlled extraction program was developed. Two girls separately read and copy the information contained in one of these registers, making an "A" and a "B" copy of each entry. This extracted information is then Flexotype coded from the cards onto paper tape and this is fed into the computer in what is called a "match/merge" process. If the two copies of the same entry coincide, they are "merged" into a single output entry. If the "A" and "B" copies disagree, the computer prints both copies as entered and a new study is made of the original source to determine what the correct reading should be. The corrected information is again coded back into the computer.

Printed card entries of each name with its identifying information are sent to the Temple Records Index Bureau (TIB) and checked to determine whether the ordinances of sealing have been previously performed in the temples. If they have been, the dates of these ordinances are written on the printed card in pencil, and this information is entered into the computer as a permanent record. If the ordinances have not been performed, the computer prints out the names onto sheets that are then sent to the temples for the ordinances to be performed.

Parish registers that are more easily read are Flexotyped directly from the registers onto the paper tape, for coding into the computer by a corps of 29 Flexowriter operators.

Names researched and sent in by patrons are submitted on special single entry forms provided by the society, and the information is Flexotyped directly from these entry forms.

Under the recently launched computer program the genealogical data will eventually be far greater than that in the present archives and indexes, and this data will be made available for study or reference through disc-pack and magnetic-tape storage. The data on these discs and/or magnetic tapes is coded into the computer on both a geographical and surname basis, and a coded record is maintained, defining just where on any given record or tape reel a specific entry may be found. This makes possible almost instant recovery of the information pertaining to any individual desired.

Through this method it is anticipated that, in the not too distant future, research as gathered by patrons or persons anywhere in the world—may be checked against the computerized records already recorded to determine whether or not an individual is a part of any particular family unit.

The computer program for the Genealogical Society is not specifically operated by the society, but is under the supervision of, and coordinated with, computer operations for other departments of the church, such as membership, finance, building, transportation, education, missionary, etc. A new Model 65 computer was recently added to the IBM system 360 Model 50 in use for the past several years.

The society makes every effort to assist all persons who have a desire to trace their ancestry. Classes are given periodically in methods of research for tracing ancestry in the various countries of the world. Assistance and instruction in research includes everything from basic courses to technical texts, brochures, pamphlets, and specific instruction by specialists in various fields.

The society also assists in training researchers, gives accreditation to those who qualify, and supplies the names and addresses of these researchers to anyone requesting them.

A permanent research staff of international specialists devotes full time, including considerable travel to all parts of the world, searching out and developing new record sources. These specialists author or compile valuable and informative papers and explanations on the type and availability of records pertaining to their respective areas. These papers are available on request through the Genealogical Society at nominal cost.

A complete dictionary card catalog of all library holdings is provided at the main library and is also on film at all of the branch libraries. This catalog provides descriptions of all of the volumes of printed matter acquisitioned, plus an index by subject and locality of the entire microfilm collection. This film index is also available at all of the branch libraries. Copies of any desired films are available for study or research through application at the main or any branch library, subject to a stipulation that they are not to be taken from, or used outside, the library. Filmed copies of the computer printouts are also made available to the public in any of the branch libraries (Fig. 4). The original printouts of the computerized information remain at the main library in Salt Lake City.

An indication of the extent of the current use of the society's facilities is evidenced in the approximately 10,000 persons who register at the main library in Salt Lake City,

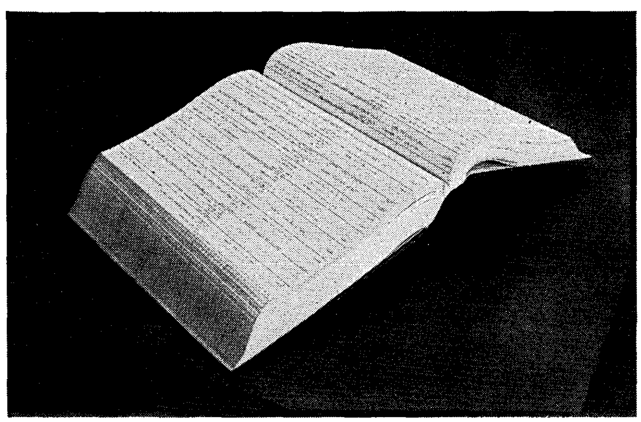
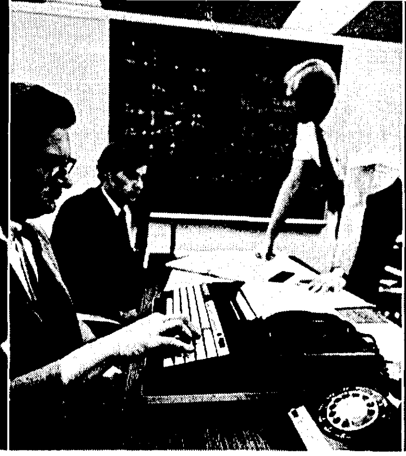
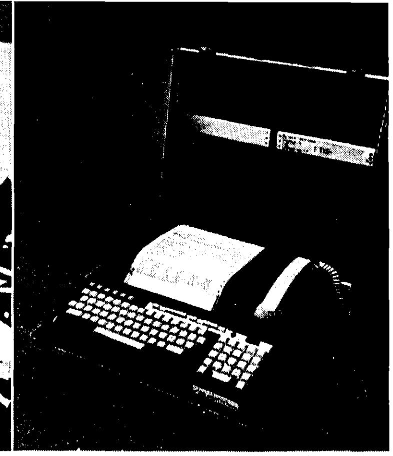


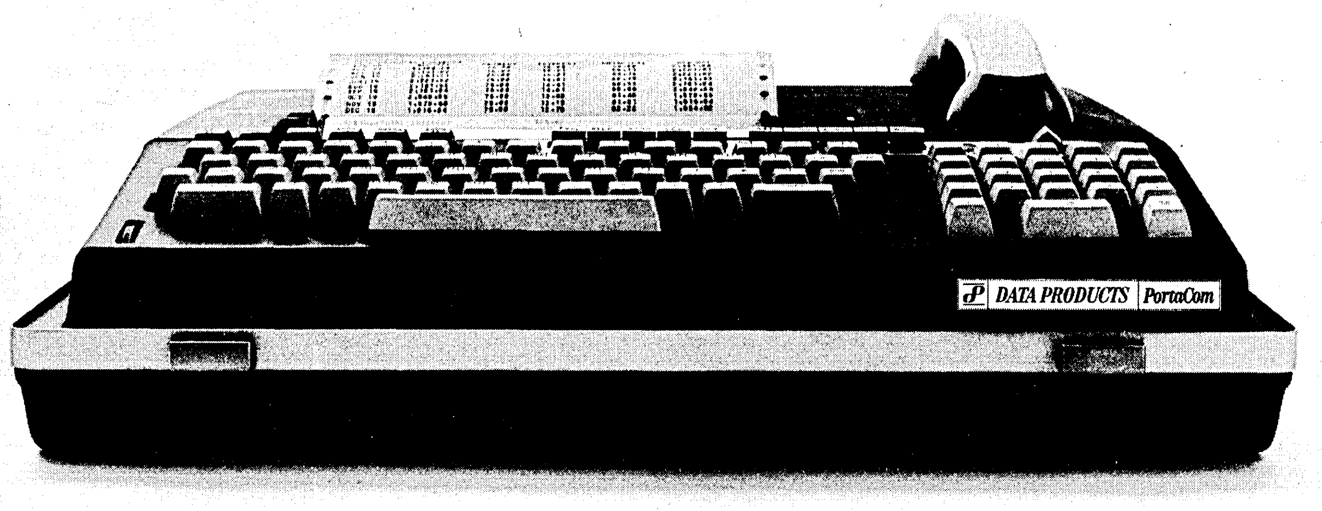
Fig. 4. Computer parish register printouts.

and 15,000 who make use of the branch libraries each month. The facilities and services are not limited to members of the Mormon Church, but are available to people anywhere who desire to trace their ancestry.

At the present time, names submitted by genealogists and patrons of the society are entered into the computer at a rate of 1 to 1.5 million per year. The society is constantly on the alert for new methods which may speed up any of their processing procedures and it is anticipated that, through use of the scanner or some other means not yet fully developed, the rate of incoming genealogical information may increase to many millions of entries per year. All the information thus gathered will be stored on microfilm and/or on computer magnetic tape or disc-pack recoverable storage, as well as the printouts that will come from the computer as time moves on. ■







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THE FUTURE ROLE OF MAGNETOOPTICAL MEMORY SYSTEMS

by R. P. Hunt, T. Elser and I. W. Wolf

To be acceptable from an operational and economic viewpoint, a new technology must provide characteristics which exceed the present state-of-the-art cost base and operational performance. It is expected that any new mass storage technique should improve significantly on packing density and data transfer rate, and should also provide a system reliability at least comparable to existing standards. In addition, the new technology should show long-life storage and involve no special environmental requirements. Finally, an erasable medium would be desirable.

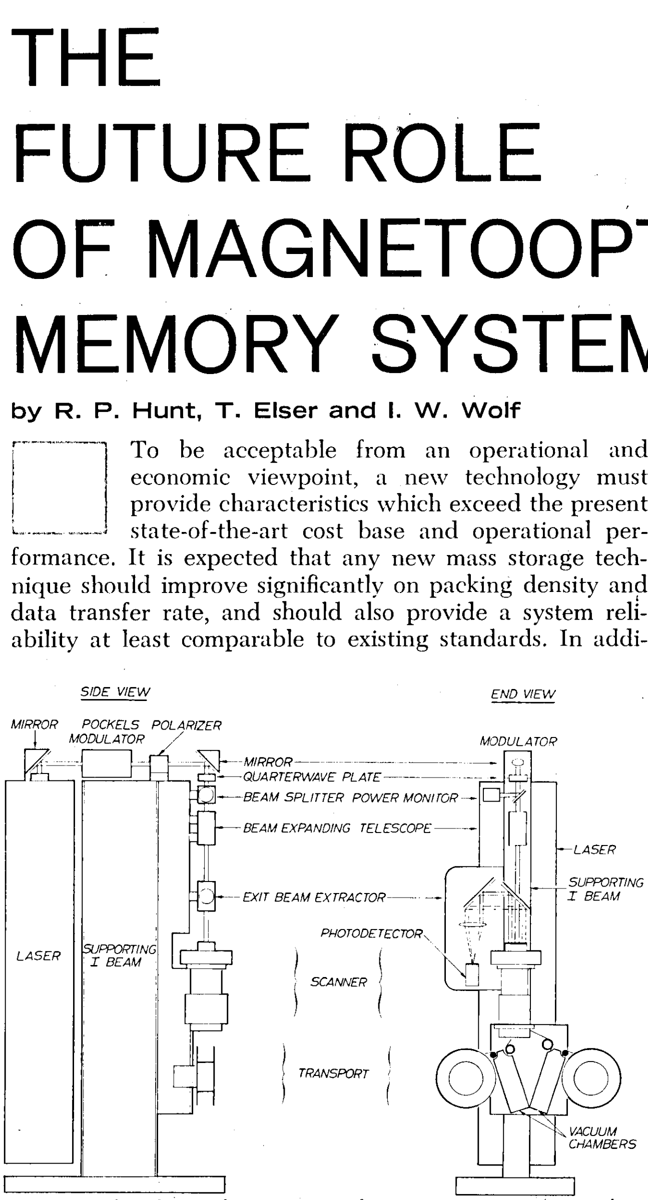

Fig. 1. The laser beam recording-magnetooptic readout system.

It appears that an optical memory system utilizing focused laser beams to establish basic resolution may meet the above objectives by providing an order of magnitude improvement in packing density.

Of all the available mechanisms likely to meet the storage requirements, only magnetic surfaces are versatile enough for consideration at this time. Magnetic films offer high density, erasability, low cost, easily controlled characteristics—which are amenable to production—and the ability to be deposited on a variety of rigid and flexible substrates.

Research at Ampex on laser beam writing and magnetooptic readout indicates performance characteristics that may challenge present oxide disc, drum, and tape systems. Sufficient progress has been made on all aspects of magnetooptic storage to demonstrate on a laboratory prototype memory system feasibility for on-line storage.

The basic magnetooptic storage system, Fig. 1, consists of (1) a light source, (2) optic system, (3) magnetic storage medium, (4) light polarization detection system, (5) scanning system, and (6) tracking system.

Light, directed and controlled by an optical scanning and tracking system, interacts with a magnetic storage medium which is manipulated by a transport system.

Writing information in the medium is accomplished by using the light source in a "high" intensity mode together with an applied magnetic field to switch the magnetic medium. The intensity of the laser light causes local heating

(continued on p. 98)

Dr. Hunt is presently a member of the research staff with the Ampex Corp. in Redwood City, Cal., working with magnetic thin films, magnetooptics, and magnetic memory systems. He holds a BA in physics and mathematics from Ohio Wesleyan University, and MSEE, EE, and PhD degrees from MIT.

of the magnetic material which decreases the threshold for magnetic switching. A bit is written when the magnetic field supplies a torque which "switches" the magnetic material in this hot region in the appropriate direction.

Reading is accomplished by use of the longitudinal Kerr effect with the light source in a "low" intensity mode. The Kerr effect results from interaction of the optical radiation incident on a ferromagnetic mirror with the magnetization of the material. A component of radiation is generated at the mirror surface which is normal to the incident polarization state, thus causing an apparent rotation in the plane of polarization. The sense of this rotation is governed by the direction of the magnetization.

Attempts have been made since the early 1950's to exploit these effects for the readout of magnetically stored data. Until recently none of these attempts demonstrated much promise because of low signal-to-noise ratio during readout. In fact, in the late 1950's, the process was written off by investigators because of the small Kerr rotation achievable at that time. The present improvement is due to two developments: an effective noise reduction technique, and the use of a laser light source.

Noise reduction. Due to pinholes, dirt, and other surface irregularities, light can be partially depolarized when reflected. Such irregular depolarization constitutes a major noise source. A technique we call "medium modulation" has been developed to eliminate this problem. It consists of detecting the presence or absence of a fixed modulation frequency component in the light rather than the level of light. The modulation is achieved by switching the direction of magnetization in a film, called the readout film, which is part of the medium. The readout film is switched at the modulation frequency by an external magnetic field. The switching causes a change in the polarization angle of the light and modulates the light into the detector. The electrical passband of the carrier and modulated data is chosen to lie outside the spectral region containing medium noise and laser noise.

There is a second film, called the storage film, separated from the readout film by a third nonmagnetic layer called the separation layer (Fig. 2a). Since the storage film has a sufficiently high coercivity, it is not switched by the external modulating field. The two films are sufficiently close together so that a field from a bit in the storage film couples

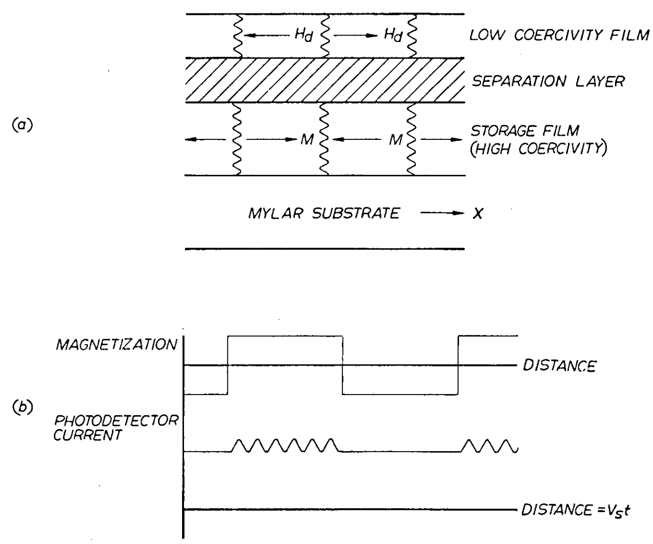

Fig. 2. The memory storage media.

to the readout film and causes it to be magnetized. When no modulating field is present, the storage film controls the magnetization in the readout film. With combined dc and rf modulating fields being applied to the medium, the readout film is switched at an rf rate on one type of bit, while switching is suppressed on the other type of bit. The resultant signal is essentially a suppressed carrier amplitude modulated signal. Fig. 2b shows the photocurrent as the spot traverses from one bit to the next.

The detection of the narrow-band modulated signal provides a readout much less sensitive to media noise effects with far fewer dropouts for digital recording.

Medium. The three-layer medium must have, in addition to the modulation capability described above, smoothness, fine grain size, and homogeneity; further, it must be

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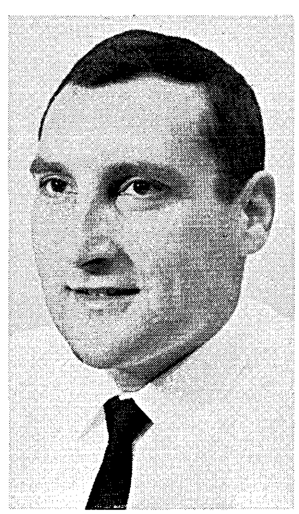

Dr. Wolf is manager of the Materials-Devices Research Section of the Ampex Corp., Redwood City, Cal. He was previously manager of the Functional Film Group with GE. He is treasurer of the Conference on Magnetism and Magnetic Materials and a member of the executive committee of the electrodeposition div. of AES. He has a BE and MS in chemical engineering from Vanderbilt University and a PhD from Illinois Institute of Technology.

capable of being recorded upon with laser illumination.

Laser recording is accomplished by using a storage film with a temperature-sensitive coercive force. At Ampex, electrodeposited cobalt films with a small amount of phosphorous were found to have ⅓ the value of the room temperature coercivity at 150°C. Thus, heat from a laser beam, along with an externally applied field, causes the selected spot to switch, which writes in the information.

A variety of low-coercivity films have been used as the readout film. Originally NiFe was successfully employed. However, more recently an electro-deposited Co-Ni-Fe alloy was found to have better magnetooptic performance. A typical M-H loop of the composite film structure is shown in Fig. 3.

system components

Light source. The light source is important for three reasons. First, it determines the wavelength at which the system will operate, and makes it a factor in determining packing density. Secondly, it determines the available power controlling the signal-to-noise ratio provided by the Kerr effect and the writing speed. Finally, since light is the communications link of the system, the light source can act as a noise source. Any noise in the light source is therefore also present in the over-all noise of the system.

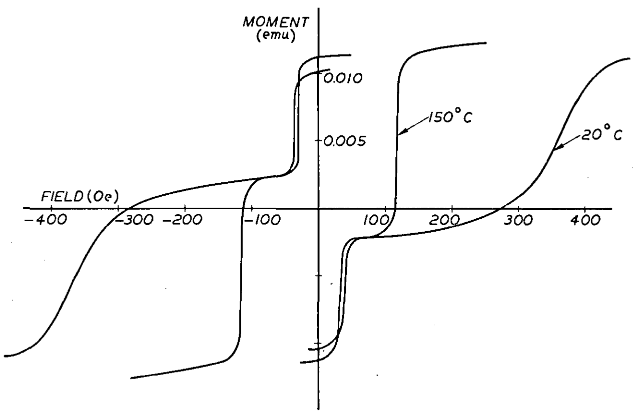

Fig. 3. Hysteresis loop of storage media.

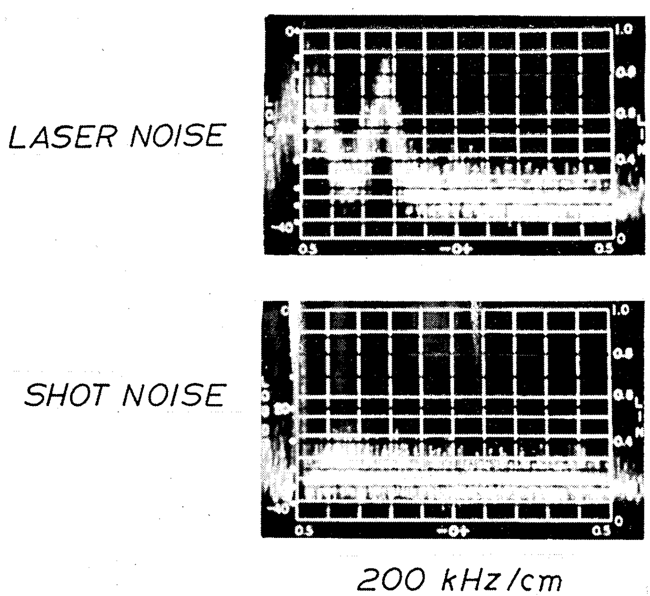

Fig. 4. Laser noise spectral distribution compared to White shot noise.

Present state-of-the-art argon or helium-neon lasers provide sufficient output power, but argon lasers offer the advantage of shorter wavelength and higher power. A three-watt laser is being used in a present demonstration model.

Laser noise is important even though few workers have indicated its potential seriousness. For example, one particular model tested had 2% noise between dc and 10 megahertz (Fig. 4). The origin of such noise includes power supply ripple, cavity vibration, and transverse mode fluctuation. For systems of interest, raw laser noise must be less than 1% of the dc light output. Lasers are now available which do provide such a characteristic.

Tracking system. A tracking system is usually required to correct small errors in medium speed and position. The exact correction will depend on transport design but, typically, a six- or eight-spot deflection at 10 kHz appears to be sufficient to handle most transport problems. Such deflections are within the capability of crystalline electrooptic deflectors.

Scanning system. In order to obtain the data rates necessary for future systems, a high relative velocity between the light spot and the medium must be achieved. At a 10 megabit/sec rate, the velocity required is approximately 1600 ips. This speed is easily achieved with drums or discs but is inconvenient for tape transports at the present time. State-of-the-art capability for a disc-type system is compared to a conventional magnetic disc system in Table I. It should be pointed out, however, that fundamentally the magnetic disc system is capable of an order of magnitude improvement in packing.

TYPICAL CONVENTIONAL DISC MEMORY CHARACTERISTICS

Disc capacity—one side	2.1×10^6 bits
Area packing density	33000 bits/in^2
Bit length	1 mil
Track-to-track spacing	30 mils
Signal-to-noise ratio (Peak-to-peak/rms)	35 db
Linear velocity	1000 ips
Disc size diameter	12 inches
Rotation rate	32 rps
Data transfer rate	2 Mbits/sec
Error rate	<1 in 10^{10}

ESTIMATED MAGNETOOPTIC DISC MEMORY CHARACTERISTICS

Disc capacity—one side	3.9×10^8 bits
Area packing density	6×10^6 bits/in^2
Bit length	200 μ inches
Track-to-track spacing—including equal guardband	800 μ inches
Signal-to-noise ratio (peak-peak/rms)	40 db
Linear velocity	400 ips
Disc size diameter	12 inches
Rotation rate	12.7 rps
Data transfer rate	2 Mbits/sec
Error rate	<1 in 10^{10}
Laser write power required	0.90 watt
Laser read power required	0.16 watt
Laser write pulse width	100 nanosec
Depth of focus	1 mil

Table I

A practical tape type system requires a method of transversely scanning the tape. A rotating mirror scanner, in the model constructed, causes the light spot to move across the tape at the required rate and the motion of the tape is required only for track-to-track displacement.

Experiments have also led to scanner designs utilizing printed-circuit motors and air bearings. These scanners produce the required spot velocity and resolution, yet avoid magnetooptic aberrations due to strains and surface imperfections. Table II compares the wideband magnetooptic tape system performance, which is believed to be within state-of-the-art capability, to a conventional digital tape system, and to a new system that is believed to be state-of-the-art technology for magnetic recording.

Modulators. Modulators have two critical aspects. First, some modulators are piezoelectric and thus susceptible to mechanical resonance. This resonance was found to be a problem which was solved by switching the crystal in a

CONVENTIONAL DIGITAL TAPE SYSTEM

Tape Capacity (2500 feet)	5×10^8 bits
Area Packing Density	2.24×10^4 bits/in^2
Bit Length	625 μ inches (1600 bpi)
Track-Track Spacing (including guardband)	70 mils
System Signal-to-Noise Ratio (peak-peak/rms)	34 db
Scan Velocity	60 ips
Tape Width	½ inch
Data Transfer Rate	10^5 bits/sec
Error Rate	<1 in 10^9

AMPEX TERABIT MEMORY SYSTEM

Tape Capacity (3800 feet)	6×10^{10} bits
Area Packing Density (with redundant recording)	0.7×10^6 bits/in^2
Bit Length	130 μ inches
Track-Track Spacing (including guardband)	5.3 mil
System Signal-to-Noise Ratio (peak-peak/rms)	33-35 db
Scan Velocity	1000 ips
Tape Width	2 inches
Data Transfer Rate	7 megabits/sec
System Error Rate (redundant recording, error correction)	<1 in 10^{10}

ESTIMATED MAGNETOOPTIC TAPE SYSTEM CHARACTERISTICS

Tape Capacity (3500 feet)	9.8×10^{11}
Area Packing Density (with redundant recording)	6×10^6 bits/in^2
Track-Track Spacing	500 μ inches
Bit Length	160 μ inches
Signal-to-Noise Ratio	32-35 db
Scan Velocity	1000 ips
Tape Width	2 inches
Data Transfer Rate	6 megabits/sec
Error Rate (estimated on basis of redundant recording and correction codes)	<1 in 10^9
Laser Power Required	1.5 watts

Table II

time shorter than the time constant of the resonance. Secondly, the modulator driver design places severe requirements on circuit design. It must provide pulses of 300 v. with widths of 50 nsec. Repetition rate is equal to the recording rate of the system. More recently modulators without an appreciable piezoelectric effect have been constructed from ammonium dihydrogen phosphate crystals.

system performance

Two magnetooptic memory configurations, a disc machine and tape machine, are now being evaluated. Fig. 5 shows the tape system with the laser and modulator assembly located on the left and the central control console in the foreground.

For the longitudinal Kerr effect with incident photon rate, N_i (photons/sec—equivalent to 2.5×10^{18} photons/sec/watt @ 5000 Å), the photo-induced current, I, is

$$I = qRLN_i\eta[\theta_a^2 + E + 2K\theta_a] + i_n \qquad (1)$$

where q is the electronic charge
L is the optical system loss
η is the detector's quantum efficiency
θ_a is the analyser angle
E is the extinction ratio
K is the Kerr magnetooptic rotation angle
i_n is the shot noise given by:

$$i_n = \sqrt{2q\Delta fI} \qquad (2)$$

To realize the optimum signal-to-noise ratio, the analyser angle must satisfy the relation $\theta_a^2 >> E$ since the extinction coefficient admits light to the detector unrelated to signal. The signal, S, is simply I (+K) − I (−K) so that the ratio of peak-to-peak signal-to-rms noise is:

$$\frac{S}{i_n} = \frac{I(+K)-I(-K)}{\sqrt{2q\Delta fI}} = 4K\sqrt{\frac{RLN_i\eta}{2\Delta f}} \qquad (3)$$

When a 5 μm round spot with 30 mwatts of read power ($N_i = 75 \times 10^{15}$ photons/sec) is used in the system of Fig. 5, a combined reflectance and lens loss product of 0.25, and a detector quantum efficiency of 10%, yields a signal-to-noise ratio of about 40 db into a 1 MHz bandwidth. Examination

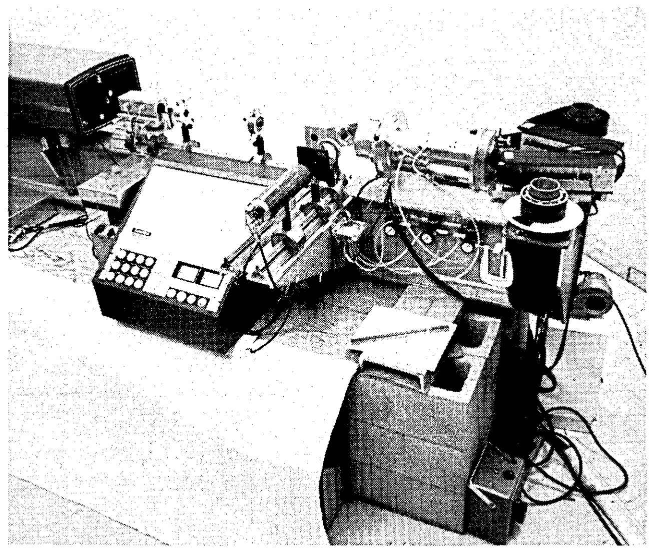

Fig. 5. The magnetooptic read-laser beam record system.

of the spectral content of the photocurrent signal in Fig. 2b, when using medium modulation readout, shows that only 50% of the signal appears in the data passband while 50% remains baseband. Thus a signal-to-noise ratio of about 34 db is to be expected. Fig. 6 shows typical data readout of bits recorded with the scanner system, with medium modulation of 5 μm round bits thermally recorded on a pliable media. The signal-to-noise ratio is well in excess of 30 db.

It is interesting to note that the signal-to-noise ratio in a magnetooptic readout system decreases very slowly with bandwidth because, as the bandwidth is increased (and with it the scan velocity), more laser power may be used. This partially offsets the deleterious effect of bandwidth increase in equation 2. In fact, the signal-to-noise ratio varies as $\Delta f^{1/4}$.

system readout

The intrinsic capabilities have been indicated above. In practice, burst errors due generally to media imperfections occur to limit data reliability. By recording the data in a spatially redundant fashion, the data reliability may be improved significantly at the price of a twofold reduction in packing density and added scanner complexity. Finally, by use of error correction codes and by deletion of particularly bad areas of the medium (thus losing perhaps 1% of the tape), high data reliability may be achieved. The current "best-guess" figures on data density and data reliability are indicated in Table II.

conclusions

Magnetooptic readout-laser beam recording systems will play an important role in future high density memory storage applications. The memory system offers a practical way to improve packing densities by substantially more than an order of magnitude over commercially available equipment. The memory system has no indigenous wear problem, such as arises between head and medium in conventional tape systems. Due to the slow decrement in signal-to-noise ratio with increase in bandwidth, it is feasible to consider memory systems with data rates of 100 megabits/sec, packing densities of 10^7 bits/inch^2, while maintaining a minimum signal-to-noise ratio of 25 db.

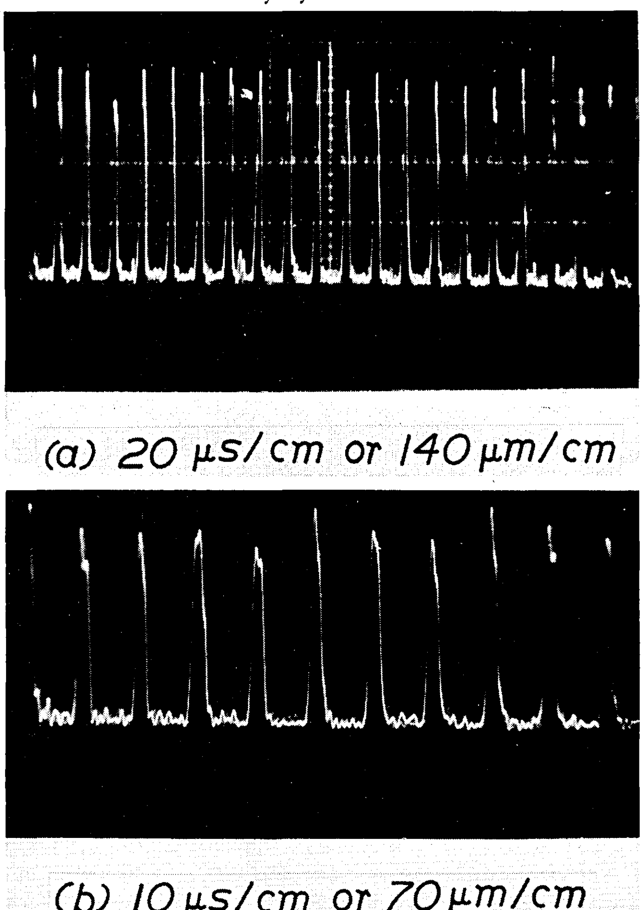

Fig. 6. Readout signal of laser beam recorded bits.

The available signal-to-noise ratio should produce an acceptable digital error rate with no special correction. However, the extent of burst error effects from imperfections and other sources has not been completely investigated. At the present time, it appears that those burst errors which occur exhibit behavior similar to those found in magnetic tape.

Finally, as the cost of optical systems, and particularly lasers, continues to decrease, such memory systems will become economically feasible. ■

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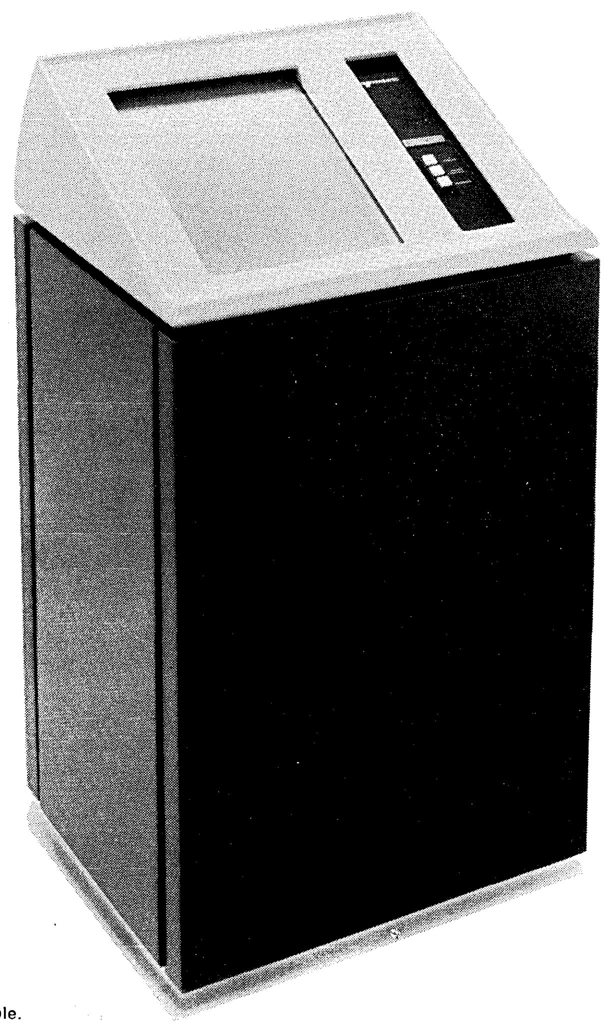

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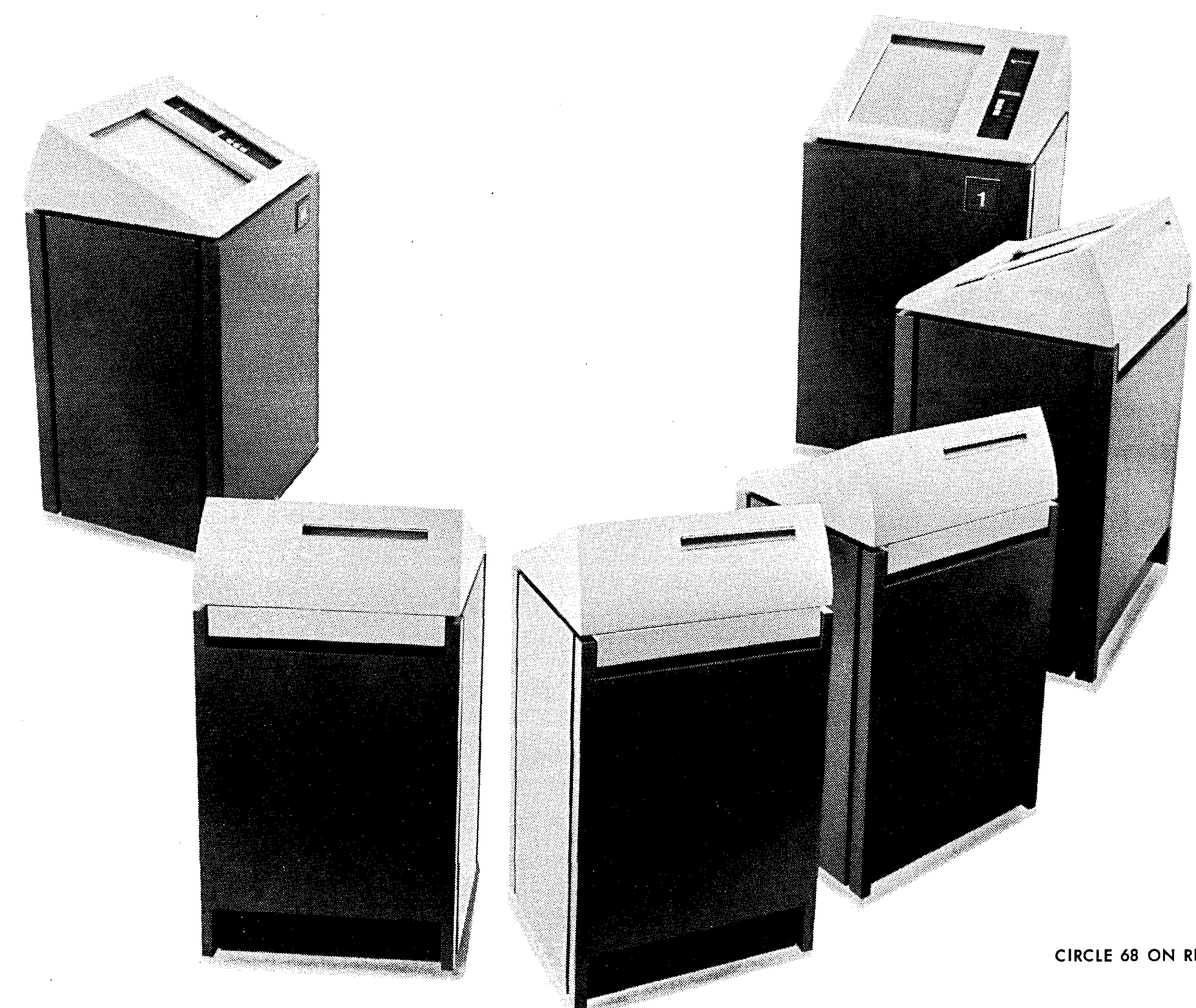


CIRCLE 68 ON READER CARD

carry over

SOME NOTES ON PORTABLE APPLICATION SOFTWARE

by Trygve Reenskaug

These notes are based mainly upon experience gained with the Autokon system for the design of ships' hulls and their detail—the end product being engineering drawings and tapes for N/C flame-cutting machines. The first version of the system went into operation for practical production at a shipyard in late 1963. It was built on the now popular concept of a central, random access data base surrounded by about a dozen independent application programs for various purposes.

The system is offered to shipyards as an application package consisting of some 35,000 source cards (FORTRAN) and 1000 pages of documentation. Our customers have computers of varying manufacture, configurations, and operating systems, and at present the programs run on Univac 1107 (Exec 2), Burroughs B5500 (DF MCP), IBM S/360-30 (DOS) and IBM S/360-40 and 50 (DOS and OS). Work is in progress for converting to Siemens 4004, Univac 1108 (Exec 8), ICL 1903A, CDC 1604 and CDC 3300. It is therefore important to us that the programs are as portable as possible, consistent with reasonable efficiency, so that work with conversion and maintenance is minimized and reliability is kept as high as possible.

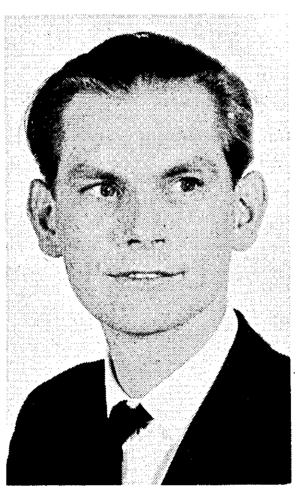
from one computer to another

We have tried three different methods for transferring the programs from one computer to another: reprogramming, generative coding, and use of high-level language.

Reprogramming. While the system was still written in assembly language, it was reprogrammed twice due to change of computers. Reprogramming was time-consuming, expensive, boring, and prone to error. We will never do it again if we can possibly avoid it.

Generative coding. This was attempted in 1963/64. We wanted something that could take the Autokon programs which were written in some symbolic language, and convert them to object code for any digital computer we fancied. The problem was thus the inverse of ordinary compilation where the source code is variable and the object computer fixed.

The solution chosen was based upon the marcroprocessor of the Univac 1107 assembler Sleuth II. The Autokon programs were described in a hierarchical structure of macros. Machine-dependent macros were at the lowest level only, describing operations for arithmetic, logic I/O,



Mr. Reenskaug is head of the Software Development Dept. at the Central Institute of Industrial Research in Oslo, Norway. He has been active in computer programming for the past 10 years, and previously worked with digital control systems. He has a BS and DIC from Heriot-Watt Univ., Edinburgh, and Imperial College, London.

and backing-store handling. The transition to a new computer should then, theoretically, only involve the following steps:

1. Redefinition of the machine-dependent, lowest-level macros.
2. Assembly of a standard test program with these macros included on the 1107, transferring the object deck to the new computer for the actual test. This step to be repeated until all new macros work according to specification.
3. Assembly of all Autokon programs on the 1107. Upon transfer of the object deck to the new computer, the system should be operative.

We actually did transfer a small program to another computer in this fashion, and wrote the complete Autokon system in the macro language, running it on the 1107. The scheme was dropped, however, despite its obvious advantages of: good protection of the proprietary programs, automatic updating of all versions when bugs were found in the main body of the system, uniformity of installations, and so on. The problem of generating relocatable object decks for a new computer with an unknown operating system proved to be larger than anticipated—relevant information being well hidden in the manufacturer's literature. Furthermore, some computers, like the Burroughs B5500, have no binary formats available to the user at all. The main consideration at the time we dropped the scheme, however, was that it would be quite unacceptable to customers to receive the programs in object code only, this making it virtually impossible to make any corrections or modifications to the programs at the installation without previous reassembly at Oslo.

High-level language. The recognized way today of achieving portability is to use a standardized high-level language. We are using FORTRAN, our first choice being the FORTRAN IV on the Univac 1107. Gradually, we have had to restrict ourselves to USASI BASIC FORTRAN with two exceptions: line control shall be used in print statements, and A1-formats are permitted for character handling purposes. Even this restricted language has to be used with caution, however. EQUIVALENCE between real and integer arrays has given trouble on some computers, low precision in the representation of REAL variables on others. Another source of much confusion are the widely varying character sets and character representations used both internally and externally by the various manufacturers.

conversion

These are small details, however, compared to the conversion work necessary on those parts of the programs which are outside the scope of a FORmula TRANSlator. These parts have not been subject to standardization, and all a supplier of software can do is to assume a "normal" environment for his FORTRAN programs and then try to simulate this environment as closely as possible on the various object computers. In the terminology of Bemer[1] the parts are:

1. Identification
2. Environment
3. Data structure
4. Data procedure

In addition, we have something which should not be part of the program at all:

5. Segmentation

Identification. The rules for identifying programs and subprograms are different in different operating systems. This has only caused small difficulties, however, since the differences apply to control cards only.

Environment. The Autokon System requires certain input, output, and backing-store facilities. For I/O we require that three fixed FORTRAN unit numbers must correspond to the card reader, card punch, and high-speed printer respectively. Operating system assign cards have solved this problem so far, even though some systems have peculiar restrictions on the choice of FORTRAN unit numbers.

One of the major outputs from Autokon is, however, paper tape for N/C machines. For some peculiar reason, U.S. manufacturers do not give proper support for paper tape equipment. The hardware cost is usually exorbitant, and the documentation and software support poor or nonexistent. Every new installation entails a research project, usually ending up with experimental programming to find out how and if the equipment works. We have, for example, still not found a satisfactory way of coupling a tape controlled N/C machine to an IBM S/360.

The other part of the Autokon environment is the backing store. The physical unit here may be a drum, a disc, or some such device. The unit is to be accessed through an operating system which invariably has strong opinions as to how the data base should be organized physically. Random access with mixed block sizes is not a popular organization, and we have had to do a considerable amount of converson work for each new operating system.

Data structure. The data base is fundamental to the whole system. Its structure and the layout of the various records may not be modified without heavy penalty in reprogramming of a large part of the system. The data base is defined down to the bit level for all computers with minimum 32 bits word length, and this has to be kept identical in all installations. For machines with longer words, this may lead to somewhat inefficient utilization of the storage medium. We are therefore introducing some variability of the packing of data, the variability being governed by global parameters rather than generative coding, since standard FORTRAN unfortunately contains no means of conditional compilation.

Data procedures. The communication between the data base and the application programs is channeled through a set of service routines. The function of these routines is to store away records of data under their identifications, to retrieve the data later when the same identification is presented, and to reduce the number of disc transfers through a dynamic core storage allocation scheme. The service routines are not concerned with the contents of the records, and they must put up with records of any length, even exceeding the total core space.

The data base service routines are of course very sensitive to changes both in hardware configuration and operating system. An absolute requirement is, however, that this variability is not propagated into the application programs. Further, the service routines follow the same programming conventions as ordinary application programs for minimum transfer trouble. Portions which are particularly sensitive to operating system changes, e.g., BLOCK READ and BLOCK WRITE, are isolated in small and simple subroutines. Even with these precautions, however, the conversion work has been considerable.

Segmentation. Partition of large programs is necessary on large computers to make the programs run efficiently together with other programs, and on small computers to make them run at all. The whole effort towards portability would come to nothing if segmentation statements had to

[1] R. W. Bemer, "Straightening Out Programming Languages." A presentation to the 10th anniversary meeting of CODASYL, May, 1969.

be spread out within the FORTRAN procedures, making each installation unique. Fortunately, we have only encountered one operating system so far which required calls on an overlay routine at various places in the program. We have therefore been able to build up a standard card deck, giving all other installations a dummy overlay routine which does nothing.

The marketing of nontrivial application packages today entails a large number of bigger and lesser problems which are connected with the portability question. The scene of computing is in utter confusion, with the very few really accepted standards acting as solitary lights in the darkness. The clearing of this mess would enable programs to be moved from one installation to another with little or no effort, making it possible to build up a real software manufacturing industry. This industry could well be the most significant contributor to the satisfaction of the ever-increasing demand for more software.

Clearly, true portability can only be attained through standardization, irrespective of whether one uses program generators or high-level language compilers to produce the object code. Somehow, a standard interface has to be established between the general computing tool on the one hand, and the special application requirements on the other. In the early days, the interface was placed between hardware and software, but the variability of hardware requirements and possibilities made standardization on this level impractical. Today, the computing tool is usually regarded as the combination of hardware and its operating system and compilers, with languages like USASI BASIC FORTRAN being used at the interface.

If the interface shall remain at this level, however, languages for the other aspects of information processing must also be standardized—notably languages for defining the data bases. There is, however, no reason to choose English-like languages for the portability interface. A high-level language for machine-to-machine communication could be devised where the emphasis would be on flexibility and information content rather than readability.

conclusion

Knowing the relative ease with which new languages are proposed, and the almost insurmountable obstacles to their standardization and adoption, the chances for obtaining a comprehensive set of adopted standards for high-level languages seem very remote indeed. Standardization seems to be progressing more rapidly in another field: that of data communication. Information networks consisting of terminals and computers of various types will soon be in general use, the exchange of information being governed by well-defined standards. This opens up another possibility for interface between tool and application. The tool may be the computer utility accepting the high-level languages, as far as these are standardized, through the data communication links. The application package may consist of programs for the utility, as well as programs (or parts of them) for a terminal computer, when these are not expressible in a standard language or are more convenient to execute locally. At the Central Institute, we plan to adopt this solution for our next generation systems which will combine technical and management information handling capabilities.

acknowledgement

Permission to publish the information given in this paper has been given by Shipping Research Services A/S, Oslo, Norway, who have the exclusive rights for marketing the Autokon System. ■

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CIRCLE 204 ON READER CARD

WALL STREET AUTOMATION: A PRIMER

by George Schussel and Jack May

During the latter part of 1967, all of 1968, and the early part of 1969, it was hard to pick up any financial journal without reading an article about the problems that stock brokerage firms were having in the back-office processing of securities orders. The front office is responsible for selling securities and thereby generating a brokerage firm's income, but the back office provides the production capabilities to process trades generated by the front office. Insufficient back-office capabilities have caused grave crises for some brokerage firms and for the securities industry as a whole in the last couple of years. As an example, in September of 1969 the Securities and Exchange Commission (SEC) announced that it had fined one of the largest brokerage houses $150,000 for violations of SEC regulations caused by the firm's back office in the preceding year.

The principal cause of the back-office problem is the huge growth in securities trading since 1966. In 1965, the New York Stock Exchange projected that an average trading volume of 10 million shares per day would be reached by 1975; in fact, this figure was reached as early as 1967, while double this volume (20 million share days on the New York Stock Exchange) was not unusual in 1968.

The Exchanges and the individual brokerage firms were not prepared for the fantastic surge in volume; their back offices, which were responsible for processing the sales, were primarily oriented towards manual methods and first- or second-generation computer systems that could not be easily modified to handle large additional volumes. As a result, brokerage firms were far short of the number of trained personnel needed to process all the paper work that was generated; and those firms that did have automated systems found that the computers were swamped.

Because business conditions in the securities industry allow only a very limited time during which the processing for the trade must occur, the additional volume of sales could not simply be backlogged until a capability for handling them appeared. Therefore, this large growth in volume resulted in several problems, many of which were basically related to a large increase in errors. Brokerage house account books became quickly fouled up as securities, trades, and cash were credited and debited to wrong accounts. In the brokerage industry, one error of this sort has a multiplier effect since it can cause several others to follow quickly. For example, when a trade is put into a wrong account, margin interest may be computed incorrectly for both accounts, dividends are credited to the wrong customer, and many other accounting records are similarly in error. In addition to the increase in bookkeeping errors, the high volume strained manpower resources to the limit. This caused the time devoted to internal auditing to be sharply reduced and resulted in an increase in the number of securities misplaced.

The problem which perhaps received the most attention was the fails problem. Once a trade is consummated, a security has to be delivered by the seller to the buyer within five working days. If it is not delivered by this settlement

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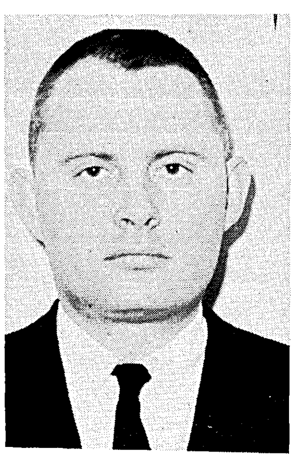
date, it becomes a fail-to-receive for the buying broker and a fail-to-deliver for the selling broker. In short, the resulting effect is that these securities have disappeared from the system. The resulting snowballing effect can be illustrated as follows:

Broker A sells 100 XYZ at $20 per share to broker B and fails to deliver. Broker B sells those shares to broker C, and broker C to broker D. If none of the deliveries can be made because of broker A's fail, the number of uncompleted transactions result in liabilities of $6,000 caused by the initial $2,000 trade. Arithmetic like this resulted in what has been estimated to be a total value of fails outstanding of about $4.2 billion in December, 1968. If the value of the XYZ stock rose from $20 to $30 per share and broker A still could not find the security, he would, as a result, have to buy the security on the open market for $3,000; but since he would only receive $2,000 in return for delivering it to broker B, he would incur a loss of $1,000. Multiplying the number of fails by this kind of price increase—which was not uncommon during the strong bull market of 1968—and the fails situation and resulting losses became a national problem.

To alleviate these problems, the stock exchanges reduced the hours that they were open during the week in an attempt to cut the trading volume and allow brokerage firms to catch up on their paper work. Brokerage firms hired more personnel, ordered new computer equipment, and the various regulatory bodies (Securities and Exchange Commission, Federal Reserve Board, New York Stock Exchange, National Association of Securities Dealers, etc.) tightened regulations in an attempt to prevent the fails situation from destroying confidence in the securities exchange business. As a result of these interim and costly measures, the cost of business rose sharply and a few houses were taken over or restricted by authorities in the amount of trading that they could do.

As a general rule, the largest security houses weathered the 1968 operations crisis better than the smaller firms because their percentage growth was less and they had far greater financial resources to draw on to alleviate the operations problem. An example of such a firm is Dean Witter & Co., Inc., one of the three largest stock brokerage houses, as measured by sales, in the United States. At the start of 1968, the Dean Witter back-office edp systems were largely second generation, using a Control Data 8050 for communications and four IBM computer systems: a 7074, a 360/30 and two 1401's. All of this equipment was running 24 hours a day, seven days a week. Thus Dean Witter's management, looking towards the future, decided to design a completely new, much more efficient back-office system built around the capabilities inherent in third-generation equipment. It was determined that twin IBM System/360 Model 50's would be adequate to handle the processing workload, so these machines were ordered and Informatics Inc. was retained to help Dean Witter design a comprehensive, completely integrated, and totally automated back-office system. The resulting system, when it becomes completely operational in the Summer of 1970, will be the first (as known to the authors) completely third-generation system to automate the entire back-office procedures of a brokerage house.



Mr. May is manager of systems projects for Informatics Inc. and was responsible for the design and implementation of the Dean Witter system. He has an AB from the University of Pennsylvania and an MS from New York University.

automating a brokerage firm

Computerizing a brokerage back office can be analogized to automating the entire production process of a major firm. The brokerage function is primarily related to the handling of information representing a very large dollar volume. Most brokerage firms of any size have their business generated by a number of geographically disbursed offices. Therefore, the design of a brokerage automation system necessarily encompasses various problems that are encountered in a communications-oriented environment. Fortunately, many of the functions that must be performed by a back-office system are not real-time, because a period of hours or days is allowed from the time data enters the system before certain activities must be performed. Therefore, some of the processing work of the system has to be real-time and on-line in terms of accepting data and transmission, but other functions of the system are much more efficiently, and in some cases, necessarily, processed in a batch-processing environment. The interaction of the real-time and batch-processing modes on the same computer system provides an interesting scheduling problem.

The brokerage back-office system also has the characteristics that many different functions in different programming subsystems may be triggered by one activity or one entry into the system. In addition, most of the system's functions are governed by the various regulations that have been created by government, the exchanges, and the brokerage houses. These regulations change often, so a system has to be constructed in such a manner that it can readily respond to changes.

In laying down the basic foundation for the new operations system, the first and possibly most difficult problem was that it could not operate as a closed loop within the Dean Witter organization. It had to interface with the stock exchanges, clearing houses, and all other brokers, and therefore, the internal system had to be designed to be general enough to interface effectively with outside operations of many different types (for sometimes similar functions).

To give an example of some of the dp problems of the brokerage industry which were encountered, we can cite the following:

1. Dean Witter trades all securities handled by brokerage firms and currently has an active file of over 35,000 such securities. Except for the common symbols of securities listed on the New York and American Stock Exchanges (less than 10% of the above) and a few over-the-counter issues, there is no uniform number identifying a security. All brokerage firms and clearing houses use different numbering systems making communications extremely difficult. In

short, there is no unique way to identify all securities common to the whole industry. (Hopefully this will be alleviated in the future when the CUSIP numbering system designed by the American Bankers Association is adopted throughout the industry.)

2. There is no central depository for securities information, such as dividend and tender announcements, tax exemptions, and transfer agents; all of which are needed for bookkeeping, billing, and handling purposes.

3. Procedures on the floor of the New York Stock Exchange permit specialists (those brokers making an orderly market in certain securities) to execute trades for brokers without returning to the broker certain key information about the order. This information can include the order's internal sequence number which, if it were available would simplify the process of matching the notice of the trade's execution to the order under automated techniques.

Many more such problems could be recounted here, but basically the problem of automating back-office operations in the Wall Street environment is one of subjecting to dp techniques an extremely large, legally complex, and manually involved system that has grown up through the years without any regard to processes for making the system tractable to machine operations, or without any really effective technique of enforcing uniformity on over-all operations.

the brokerage back office

To describe how the back office (or "operations") functions, it is instructional to follow a trade from its inception to its culmination, and to note all of the resulting effects on the various departments of the back office. This description is simplified for the sake of brevity and ease of understanding. In "real life" there are many exceptions to the flow given below.

A trade usually originates with the customer's account executive at a branch office of the brokerage firm. The account executive fills out a form indicating the customer's account number, the side (buy or sell), the security name or symbol, the quantity of shares, the price basis (trade at the market price or a specific price), and miscellaneous information that may be necessary for certain types of trades. Once this is completed, the order is turned over to the back office, which then has complete responsibility for processing, recording, and reporting the transaction.

Most large brokerage houses have communication systems for transmitting orders from branch offices to the appropriate location where the securities are traded. In most cases, this is the floor of the New York or American Stock Exchange; but for over-the-counter securities, most bonds, and securities traded on regional stock exchanges, this may be company installations in New York or other cities.

If the stock is traded on an exchange, the buy or sell order is transmitted to the exchange floor by the brokerage firm. As orders are received by a firm's telephone clerk in his booth beside the trading floor, he signals his firm's floor member on the annunciator boards by pushing a button next to his phone. The member then goes immediately to the booth. Each stock is traded at a particular place on the floor. All buy and sell orders for a particular stock are funneled through floor members of the brokerage firms to this post, where the trade is consummated, and a record of the transaction is published on the ticker tape.

When an order is executed, a wire is sent by the firm's floor representative to the originating branch office, giving the side (buy or sell), security name or symbol, quantity of shares, price per share, executing broker (broker who acted for the firm), and opposing broker (broker from whom the security was bought or sold). Conspicuously missing is the account number of the customer, since the source document for the execution is not necessarily the original order.

internal structure

The order department, which receives copies of all order and execution wires, is responsible for monitoring the system, making sure that all orders are executed properly, and matching and validating the orders to their corresponding executions (there may be more than one execution per order; e.g., an order to buy 300 XYZ at the market price may be executed as 200 XYZ purchased at 10¼ and 100 XYZ bought at 10⅜). These matched orders are then called trades, since they now contain all the necessary information for all accounting and paper work that takes place later.

The purchases and sales (P & S) department (or section of an automated system) is responsible for "figuring the trade"; that is, computing the principal, commission, taxes, fees, and net amount for the particular transaction; recording the trade; and officially notifying the principals of the consummation of the trade. A written confirmation is sent to the customer for each trade, informing him of all the pertinent information about the trade, especially the amounts of money involved. This is equivalent to an invoice for buy trades and a credit memo for sale trades. The trade blotter is prepared, containing a tabulation of all the day's trades for reference. Other blotters, subsets of the trade blotter, are also prepared. They can consist, for example, of all trades in bonds or mutual funds, or trades for a particular branch office or a series of branch offices, and are used for reference by the specific department or office for whom they are prepared.

The P & S department is also responsible for verifying the trade with the opposing broker or the appropriate stock clearing corporation (this is called the street side of the trade). Securities that trade on the New York or American Exchanges, and some over-the-counter securities, are settled through clearing houses. The P & S department informs the clearing houses of all trades in the securities they handle. The clearing house matches the buys with the sells from all brokerage houses and then prepares "balance orders" which inform the brokerage houses as to which other brokerage houses to settle the trade with (these houses may be different from the opposing brokers involved in the original trades; e.g., brokerage house 1 buys 200 XYZ from house 2 and sells 300 XYZ to house 3; maybe it is told by the clearing house to deliver 100 XYZ to brokerage house 4, as a result of all the day's trading in XYZ. Also, the clearing houses note any discrepancies in trades (the brokerage houses may disagree as to price, quantity, etc.). Trades not handled by clearing houses are verified directly to the opposing broker.

Some brokerage firms maintain special records on all trades between trade date and settlement date. On settlement date, payment is made for the trade and the physical securities are delivered. For most trades, settlement date is five working days after the day the trade occurred. During the period between trade and settlement date, it is possible to correct trades that were entered incorrectly before they hit the books. These corrections are usually generated as a result of research based on inquiries from customers regarding their confirmations, brokers regarding their comparisons, and from clearing house reports showing mismatched trades.

The cashier's department, or cage, is responsible for settling the trade on the street side. It receives or delivers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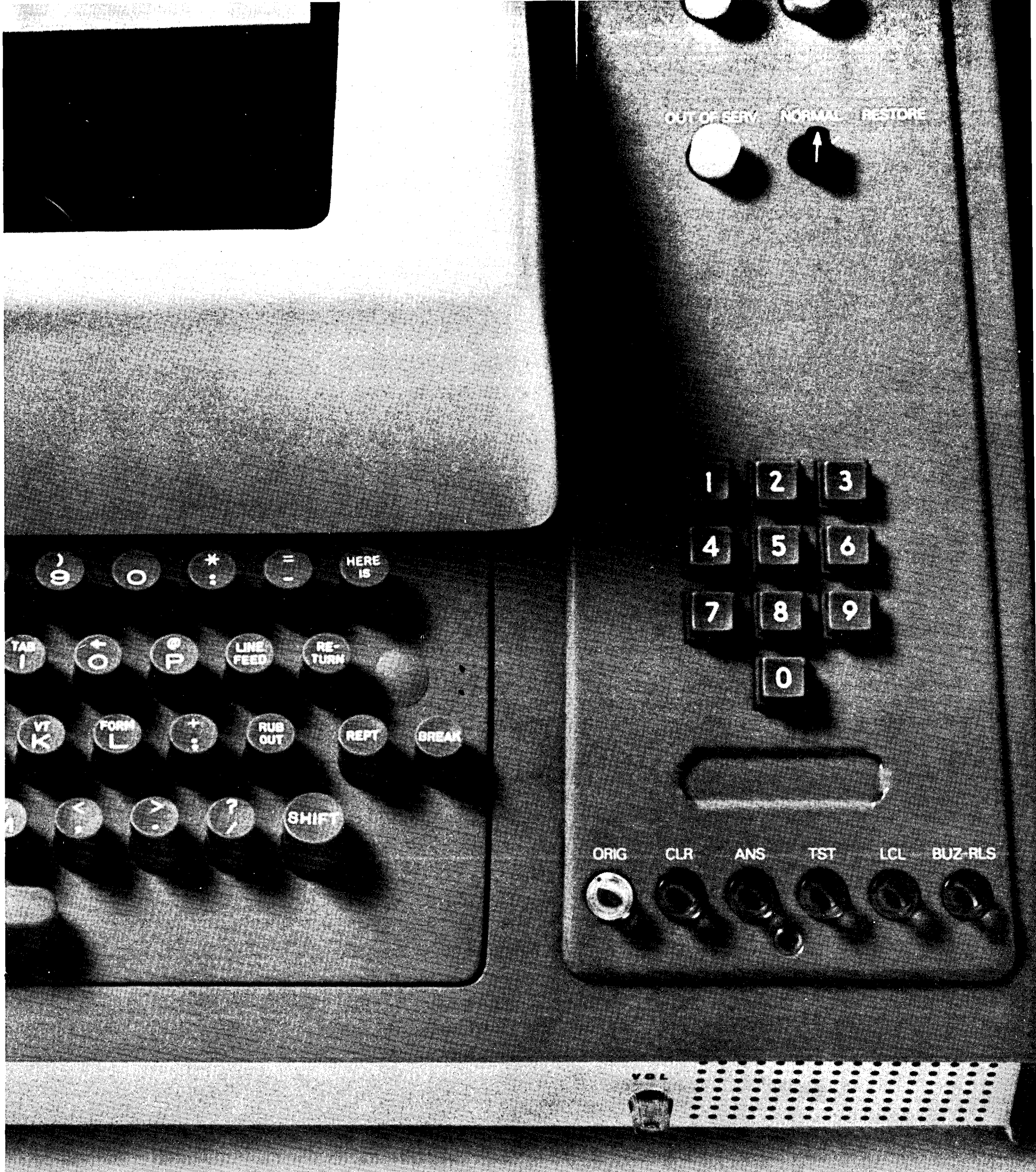

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the securities from one owner to another, and is responsible for borrowing or lending securities for short sales and working capital. In short, the cashier's department has physical custody of all securities and handles all securities movements.

The margin department (which is sometimes called the bookkeeping, or credit, or computer records, department) is responsible for recording all transactions by account. The margin department performs the function of customer accounting and therefore is usually the most vital link in a back-office system. All customers have account numbers, as do other brokers (fail accounts, borrow accounts, loan accounts). There are also house accounts, for items like dividends, taxes, profits, commissions, vaults (where securities are kept, called boxes), and so on. The accounts contain the current cash balances and positions in securities.

It is customary for brokerage houses to lend money to customers for buying securities. This is called "buying on margin," and is regulated by government and stock exchange rules. The margin department takes the role of a credit department with regard to margin transactions, and is responsible for determining whether the collateral (the securities themselves) is sufficient for the money lent to the customer. This is not a simple task because the value of securities may vary extensively in an active market and the holdings of a customer may change significantly if he does a great deal of trading. Thus, the margin department must be aware of the current status of every account.

The stock record department is responsible for maintaining an accurate record of all securities in the possession of the brokerage house. For each customer position, there must be a corresponding house position. For example, if a customer buys 100 shares of XYZ, he is debited this position. There is a corresponding credit position of 100 shares in a house account; for example, the box (vault), if that is where the securities are located, or a broker fail account if the broker failed to deliver the securities on settlement date. This record is maintained by security, giving a picture of the holders and locations of all securities at a glance.

The dividend department, which in some firms is part of the cashier's department, processes all cash dividends, stock dividends, stock splits, and bond interest. These payments, in cash or stock, come from the corporations declaring the dividends, and must be allocated to all the holders of the securities. The dividend department must make sure that the number of shares (or bonds) on the corporation's books, as being in the name of the brokerage house, match the number on its own books.

Finally, statements must be sent to all customers. These statements accumulate and list all the activity occurring in the account for a period of one month. They contain all trades, payments, adjustments, deliveries of securities, dividends, interest—everything that affects the cash balance or security position of the account. The statement also contains the closing balance and positions, reflecting the account's status at month's end.

system background

For automating this large data processing problem, Informatics and Dean Witter developed a four-stage plan for implementation.

Phase 1 called for a completely new communications and back-office accounting system, tailor-made for third-generation hardware. The specific goals of phase 1 included:

1. Reduction of the manual workload in the back office as much as possible.
2. Minimization of the number of incorrect transactions entering the system.
3. Prompt detection of the errors that do enter the system; data to be supplied to indicate the source of each error, allowing for quick correction.
4. Reduction of the workload in the cashier's department.
5. A system design anticipating future developments both in the brokerage industry and in computer technology in order to be continually effective and avoid early obsolescense.

Phase 2 called for the use of advanced on-line techniques for communications, order processing, and operation of the cashier's department, plus the addition of a greater number of management reporting functions.

Phase 3 called for an on-line inquiry and processing system for all phases of the back office, including immediate updating of all accounts.

Phase 4 called for the addition to the system of inquiry, management reporting, and processing facilities for the front office, including both research and sales support functions.

The result of the above four phases is a totally integrated and expandable brokerage information system utilizing random-access storage and on-line terminal-oriented processing techniques that will have cost well over $1 million for the software development alone.

The objectives of the four-step approach were to permit:

1. Early development and installation of system capabilities.
2. Minimum disruption and reprogramming as the system evolved through the four phases.
3. Maximum reliability, backup, and cost effectiveness as a result of phased hardware procurement and upgrading.
4. Modularity and expandability.
5. Comprehensiveness.
6. Realizable goals.

In the early stages, the objective was to automate in a fully compatible and integrated fashion the basic batch processing-oriented bookkeeping function. The later phases bring on the real-time systems to support on-line cage functions and order processing.

The final system will allow the execution message of a trade to trigger the trade's complete processing without human intervention. The execution will be matched to the proper order; commission, taxes, and fees will be computed; confirmations will be sent out; and all other tasks associated with purchases and sales will be performed. The customer's account will be updated and the trade stored in the computing system for future processing by fails, bookkeeping, stock record, transfers, dividends and statements—all automatically.

software and hardware

The problem of choosing a programming language for the coding was relatively straightforward to solve. The computers for the application were manufactured by IBM, and, therefore, a choice limited to FORTRAN, PL/I, COBOL, or basic assembler language seemed to be most reasonable for a large-scale system of this type. Within the system itself, there are two distinctly different types of environments. One very important part of the system involves real-time, on-line processing, including message switching, order transmission, and the processing of any inquiries that need real-time response. The bulk of the system, however, is more of a standard batch-oriented, data processing problem, involving the construction of transaction files which are passed against master files for updating and report-generation purposes.

The re-entrant nature of the code and the efficiency needed for the on-line part of the system required assembly languages to be used. PL/I could have been used but its efficiency is very low.

The remainder of the system, involving the great bulk of coding and use of large disc files, was a dp effort of great magnitude. To implement it using an assembler language was considered excessive in cost, and would have resulted in more difficult maintenance problems (over 100,000 lines of source code in a problem-oriented language were needed). FORTRAN was eliminated due to its lack of orientation toward file processing and report generation.

Thus, the selection had to be either COBOL or PL/I. PL/I was ruled out because its disadvantages in poor running time and wasteful, ineffective use of core storage outweighed such advantages as flexibility and re-enterable object code. Meanwhile, COBOL had the advantage of being largely self-documenting and of being known by most dp programmers. Thus, COBOL was the language choice for the New Operations System.

Phase 1, the interim capability, was split into two stages. Stage 1 was the installation of a new message-switching system, during the middle of October, 1969. It was decided to utilize the IBM BCCAP (Brokerage Communication) package for the System/360 Model 50, extensively modified by Informatics in order to allow effective multiprogramming and to allow on-line data capture of items that would otherwise require keypunching to enter the system. BCCAP took over all message-switching and order-processing functions that were handled by a Control Data 8050 system. Because of the importance of communications, the Model 50 is backed up by another Model 50 which is used for the back-office processing and accounting portion of the New Operations System.

Stage 2 encompassed the implementation in COBOL of all back-office processing utilizing the two IBM System/360 Model 50's. This part of the system runs under OS/MFT2 and automates the following functions in a batch environment: (1) purchases and sales; (2) fails and stocks borrowed & loaned; (3) margin (bookkeeping); (4) stock record; (5) transfer; (6) dividends; and (7) monthly statements.

system specifications

Fig. 1 is a generalized flow chart of the entire phase 1 system, showing only the mainline programs. There are additional reports and communications programs associated with many of the modules shown in the diagram.

A detailed description of the various programs and the functions that they perform is far too lengthy to be presented here. For example, the system design specification report alone comprised over 1,200 pages. However, out of the very large number of programs and automated functions that are required to support a brokerage house back office, several function areas stand out as being most important.

Communications and order processing. The order processing and communications function is essential to the operation of a brokerage house. The firm cannot function without communicating orders from branch offices to the traders. As mentioned before, BCCAP was chosen as a basis for the communications and order processing for phase 1 of the system. Basic IBM BCCAP performs the following functions:

1. Validates and routes all orders for securities to their proper location for execution.
2. Logs and switches all messages between terminals.
3. Provides hard copy of all messages sent.

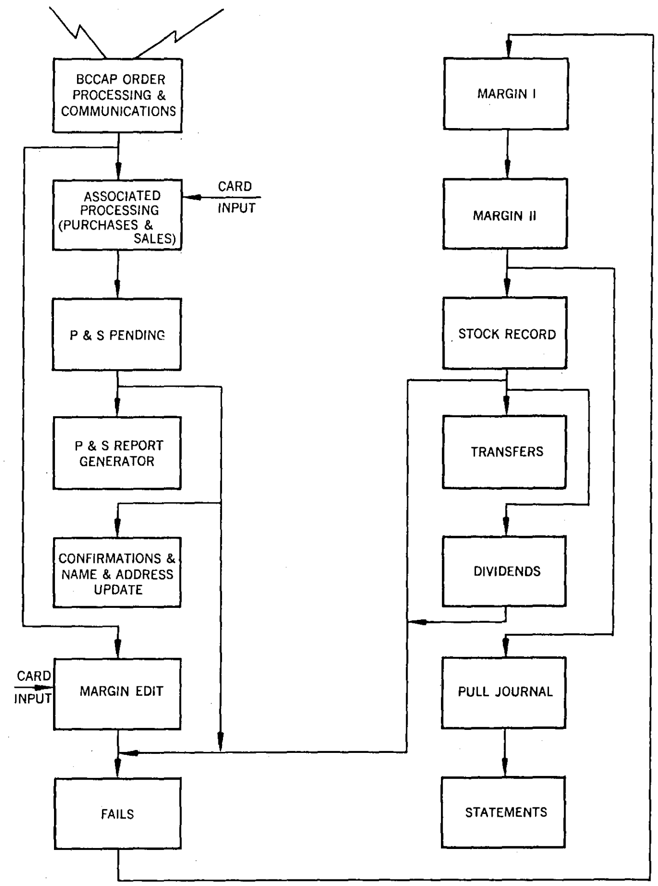


Fig. 1. Program flow.

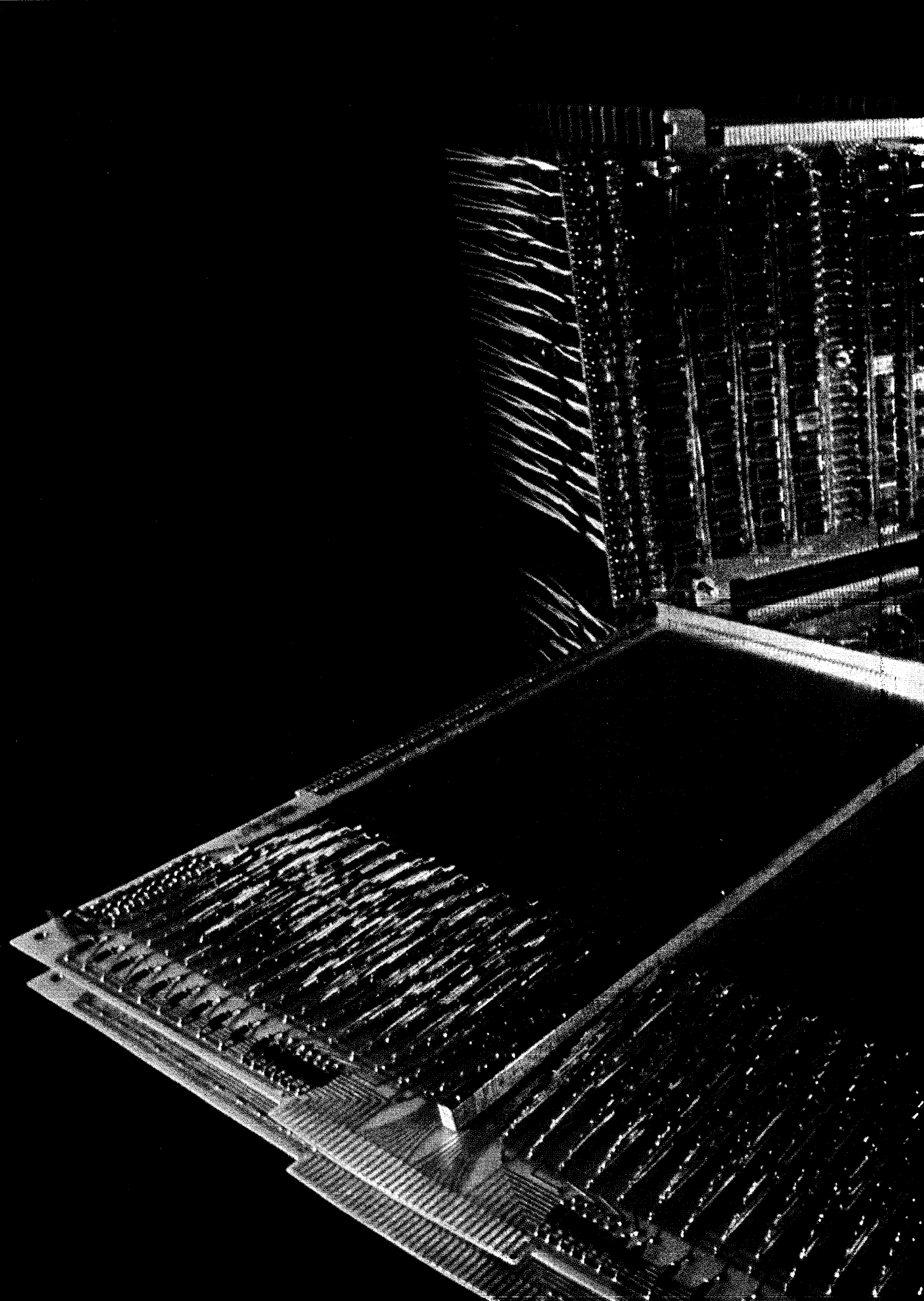
These functions are necessary but far from sufficient for meeting the standards for a third-generation system. BCCAP was modified extensively to validate, capture, and output in a fixed format the following types of messages:

1. Orders
2. Order executions.
3. Movements of cash in the firm.
4. Movements of securities in the field.
5. Name, address, and other customer control and information changes.

The system requires wire operators in the field to input messages in a fixed format. This data is then entered automatically into the back-office accounting system, eliminating the current need to keypunch all of the same hard-copy data produced by the message switch.

In almost all currently operating brokerage systems, cards are the basic source of all input. In the third-generation system, whereas cards will still be a source of input to data bases, much incoming data is taken directly from communication lines and stored on magnetic tape or disc files. This is a useful capability since all remote data is eventually channeled through the communications system. Obviously, an intermediate hard-copy output and then a re-keypunching of this same data is an inefficient process.

The BCCAP communications system operates during the



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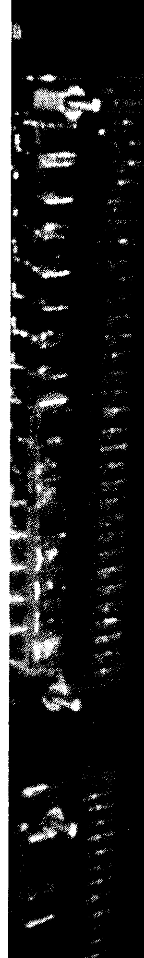

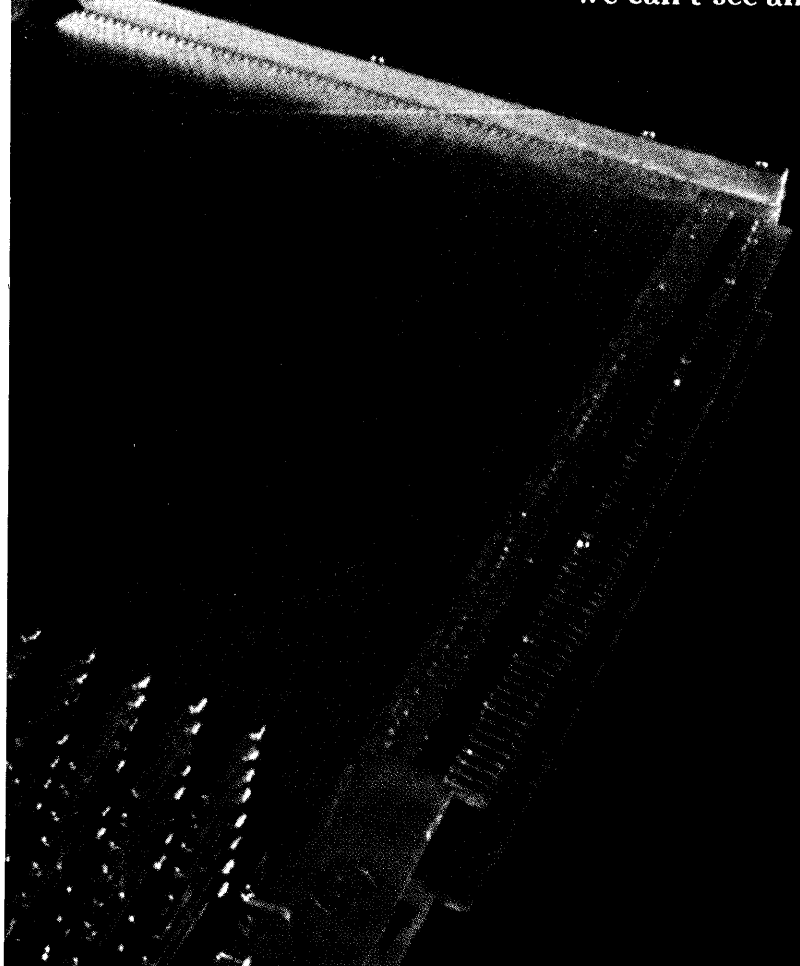

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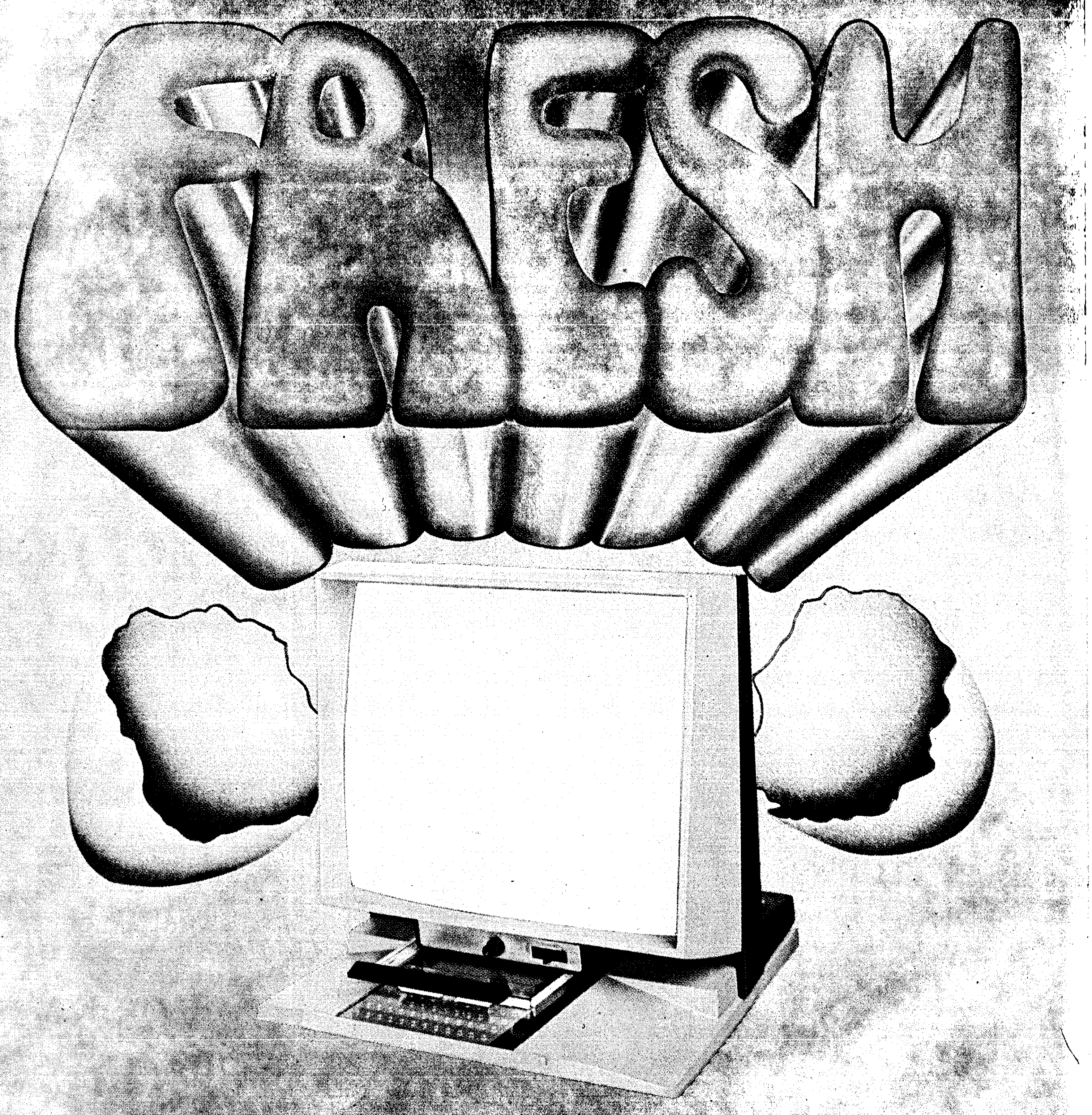

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daytime hours for the purpose of message switching and automatic data capture, and during this time period, it routes and prints all messages and prepares two output files of the day's formatted message activity to be processed by the New Operations System.

The order matching process is one of the more interesting aspects in the processing of an order. After an order for a listed stock is placed, it is wired to the floor of the New York or American Stock Exchange by the brokerage house communications system, which also sends a copy of the order to the firm's order room. Fig. 2 is an example of such an order

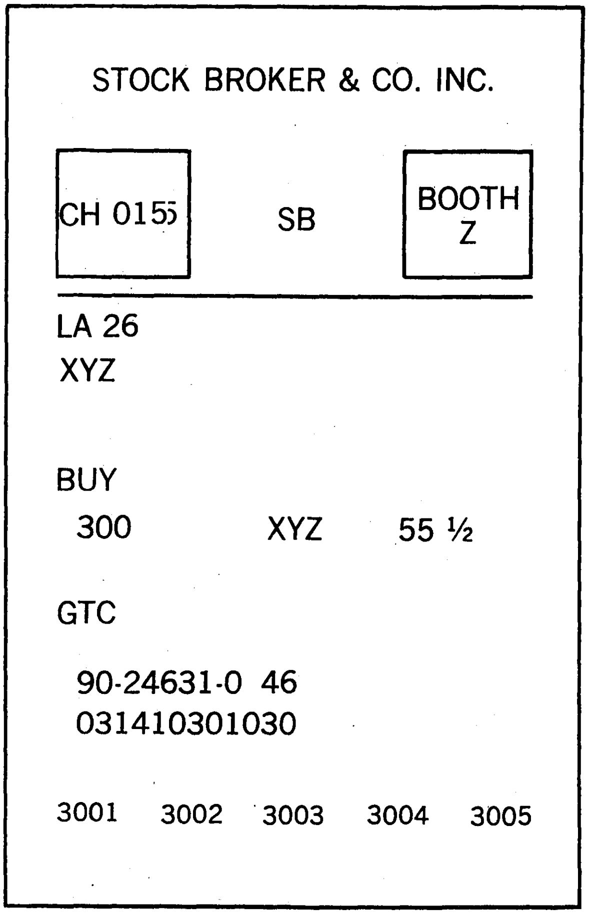


Fig. 2. Stock order.

as it would be printed on a Teletype at any brokerage firm's booth on the floor. The data on an order includes the following items and illustrative examples:

Originating branch office	(LA)
Sequence number of the order	(26)
Buy/sell indication	(BUY)
Quantity	(300)
Security symbol	(XYZ)
Price basis	(55½)
Time in force	(GTC)
Account number	(90-24631-0)
Account executive	(46)

The system goes on to add the date and time of the order. Other control information, including special handling instructions, may be present on the order but are not necessary for this discussion.

The price basis for an order may be MKT for a buy or sell at the market price; a limit price as shown in the above example (which means the customer does not wish to buy until the price falls, or sell until the price rises); or a stop price (STP price), which means the customer wishes to stop a loss by selling if the price goes down to the number given, or by buying if the price goes up to the number given. A combination of stop and limit orders is also allowed. The time in force can be DAY—good for one day; GTC—good until cancelled, or good until a particular date, or for a particular date, or for a particular period of time. If the time in force is left out, the order is assumed to be for one day.

If the order can be executed by the floor broker of the brokerage house, he will execute it and scribble the price, or prices, and the broker, or brokers, from whom he purchased the securities onto the order. He will circle his own (executing broker) number at the bottom of the order slip.

This information is transmitted back to the branch office from the floor of the exchange as an execution message with a copy being dropped off in the order room. Fig. 3 is an example.

The execution message contains the following data:

Branch office	(LA)
Order sequence number	(26)
Bought/sold indication	(BOT)
Quantity	(100)
Security symbol	(XYZ)
Price executed at	(55)
Executing broker	(3001)
Opposing broker	(ML)

The system also adds the date and time.

Notice that the information on the execution message is

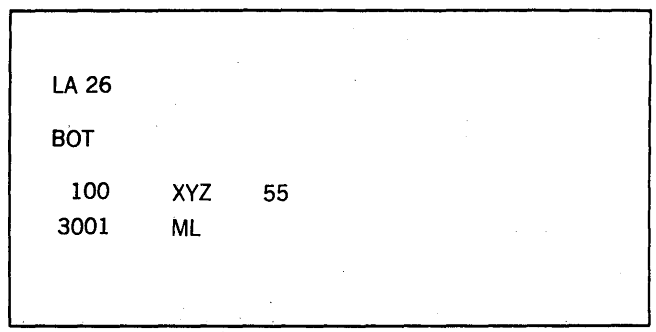


Fig. 3. Order execution message.

not exactly comparable to that on the order. Most significantly, the price, the executing broker, and opposing broker are identified in the execution message, while the account number and account executive are left off the execution message although they appeared on the order.

Under a standard, manual order-matching system, the orders are placed in cubbyholes according to the security symbol. When the execution is received, the cubbyhole is searched for the proper order and the price, quantity, and brokers are written onto the order. It is then sent to keypunching as a trade. This data, plus the data in the security master and name & address master files, is necessary and adequate for all further calculations relating to the trade.

The automated order-matching system, on the other hand, records all orders on random-access devices and contains logic which enables an automated match of cancellations, executions, or partial executions, to the stored order. The matched trades are then sent on, in the automated system, to the figuration run. Of course, extensive validation procedures, as well as inquiry and correction facilities, are required to control orders and executions that might be improperly entered into the system.

If everything ran smoothly, order matching would be a very simple application problem. The date, branch office, and sequence number of the execution would be used to locate the matching order; quantity, security symbol, and price would be used for validation. However, a problem exists when orders are executed by brokers other than those of the brokerage houses. This occurs when the "home" broker is too busy and gives the order to a "two-dollar broker" or when the trade must be executed by a specialist because the limit or stop price is not close enough to the market price. In these situations, the brokerage house does not always get the original order back; instead, it receives a similar piece of paper on the executing broker's stationery.

Such trades on the New York Stock Exchange do not necessarily contain both the originating branch office and sequence numbers. Therefore, in these cases the execution must be matched on the basis of security symbol, and there is a problem of not being able to guarantee an exact match if two similar orders have been placed. One way to solve this problem is to chain all orders for a particular security together and search for the first order (on the basis of time entered) that meets the proper criteria. From a computer point of view, this may be a time-consuming operation, and results in the possibility of ambiguous situations which require human intervention to straighten out.

The remainder of back-office processing can be split into two general areas:

1. Trade activity (purchases and sales).
2. Record-keeping activity.

The two files prepared by the communications system correlate to these functions. One file (P & S) contains orders, executions, and name and address data, while the other (record keeping) contains cash and stock movements.

purchases and sales

The purchases and sales (P & S) portion of the back-office system is like the billing or invoicing function in an ordinary business. In most brokerage firms, the purchase and sales functions also support the cashier's department, since trading activity generates the movement of cash and stock.

After input handling and validation, the most important function handled by purchases and sales is the order matching. The BCCAP file of orders-and-executes is read in time sequence. When an order is encountered, it is recorded on disc as an unexecuted order. The file of unexecuted orders is continually matched against the incoming stream of executed orders. Once the appropriate order request has been found and matched off against the order execution, the trade is considered to be matched, and this important requirement is satisfied.

This system only performs automatic order matching for trades on the New York or American Stock Exchanges (which constitute most of the brokerage house's business). Order matching is performed several times each day, as the incoming data accumulates, to allow detection of invalid items early enough to provide for correction and re-entry into the system.

During a later phase, the system will be modified to provide expanded security-identification symbols for matching more trades and operation in a real-time, on-line environment. This will result in a far more efficient system because it will permit much earlier detection and therefore easier correction of bad data.

The purchases and sales subsystem also performs trade figuration, the computation of commission, taxes, fees, and any other miscellaneous charges for the trade, using algorithms and tables based on regulations and policies of federal, state, stock exchange, and brokerage house authorities. These values are then passed on for further processing by the system.

The trade figuration is batched and run after the communication transmission cutoff time because of the requirements that some trade calculations are to be dependent upon other trades, either for a single account or for an individual security within a single account.

The pending portion of the P & S system initiates all reporting of trades. On trade date, report records are generated for all trades and sent to the P & S report generator and the P & S confirmation run for printing. The pending run determines the number and types of reports to be produced, based upon the nature of the trade (e.g., a bond blotter record is sent only for bond trades, while a confirmation record is sent for all trades). One of the chief concerns of pending processing is to keep track of security trades (and trade corrections) between trade date and settlement date. During the five-day period between the trade and settlement date, both the customer and broker are given written confirmations of the transaction. If an error in the trade is detected as a result of this procedure, an appropriate adjustment can be made prior to the settlement date of the trade to prevent erroneous information from entering the brokerage house's customer books.

The pending run is also the interface between the purchases and sales and record-keeping functions of the system, and initiates data into all customer and street side accounts. For customer accounts, trade data is sent on both trade and settlement date, the former to give the system an advance picture of the account after the trade settles, and the latter to perform the actual bookkeeping operation. Fig. 4 shows the flow of trades through the P & S system.

The P & S report generator prepares some fifteen reports, including the trade blotter (all of the day's trades), division blotter (trades by divisional offices), exchange blotter (trades by exchange traded on), foreign security blotter, bond blotter, etc. It also maintains the allocation of trade income by salesman and office so that income may be apportioned and commissions paid on a monthly basis.

The confirmation run is another report generator, but it is a separate processing step because of its high priority. Since the confirmation is the customer's invoice, it is important that he receive it as soon as possible in order that the brokerage house receive payment prior to settlement date. In fact, the speed of payment has a significant effect on the day-to-day cash flow position of the brokerage house. The task of updating the name and address file is part of the confirmation run, and assures that the most recent mailing information is available for the customer. The confirmation contains the customer's name and address (from the name and address file), the description of the trade (from order matching), the amounts of money involved in the trade (from figuration), and instructions for payment (name and address control information). Confirmations for customers outside of the eastern United States are teleprocessed to high-speed line printers in Chicago, Los Angeles, and San Francisco immediately after BCCAP is shut down. At these regional locations, the confirmations are burst and placed in window envelopes for mailing, greatly improving the delivery time to customers compared to nationwide mailing from New York.

record keeping

The margin program of the bookkeeping subsystem is considered the heart line or the most important functional program of a brokerage back-office operation.

All the bookkeeping activity of the day is input to this run. This includes stock and cash movements (from communication and cards via margin edit), trades (from pending), "swings"—activity resulting from changes in the names and/or numbers of securities (from stock record), and dividends credited and paid (from dividends). In

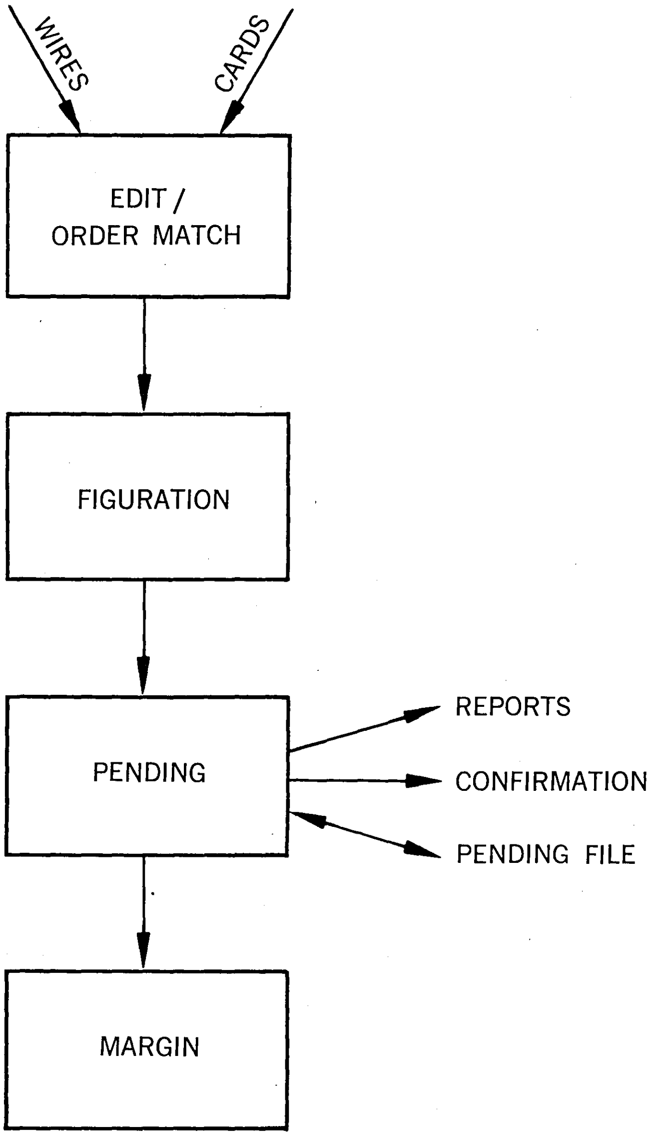


Fig. 4. Trade data flow.

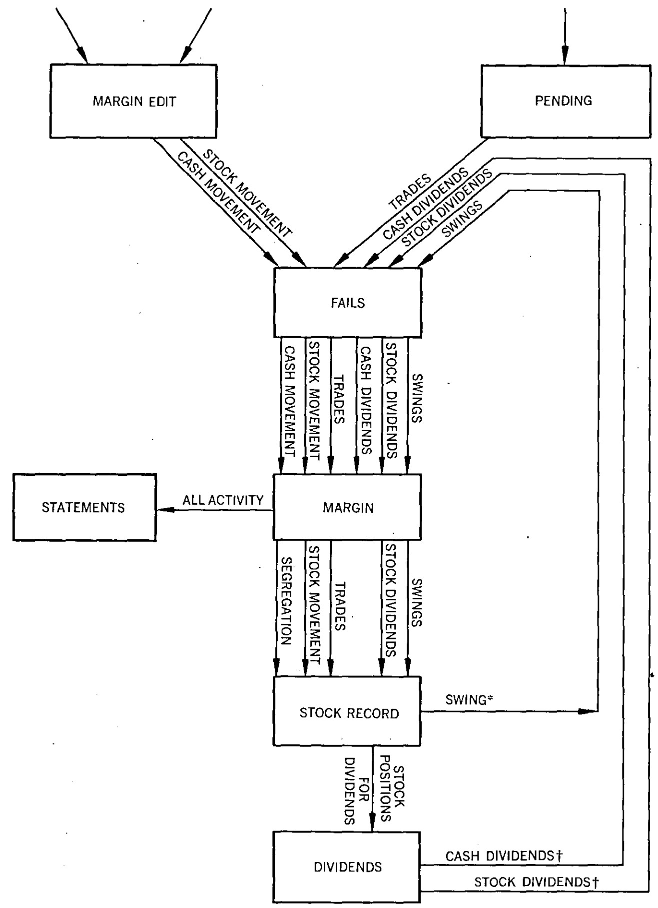
addition, a file of current closing prices of active securities is entered into the system for the purpose of valuing accounts. Fig. 5 shows the flow of this input through the bookkeeping system.

Prior to the start of margin processing, this same input is processed by the fail run, where it controls the two subsidiary files of detail transactions—the fail file and stock borrowed & loaned file.

Because a lack of tight control on fails can easily lead to financial losses, the fails system has to be extremely tightly constructed, with an ability to respond readily and generate management information that is both accurate and current. In the early processing for fails (in the pending run), a determination is made as to whether securities will be handled through a clearing house, or not. This is based on the type of trade and where it was executed. If the item is a clearing house trade, balance cards (punched cards) will be received from the clearing house and will indicate from (to) whom the receipt (delivery) will be made; otherwise, the trade will be settled with the opposing broker, and the fail will be generated automatically by the system.

The processing of fails is separated into three major parts:

1. The first part is the fail-update run, which includes the maintenance of a fail master file, and the preparation of detail fail-activity input for margin processing.



*GENERATED BY SWING REQUEST INPUT

†GENERATED BY DIVIDEND REQUEST INPUT

Fig. 5. Bookkeeping flow.

2. The second part is called fail balancing, which performs the function of balancing the money value of securities received and delivered by the brokerage firm, from and to the clearing houses.

3. The third part, fail reporting, produces all of the fail and stock borrowed & loaned reports needed for research and control purposes, as well as any of the reports required by outside agencies such as the New York Stock Exchange or National Association of Securities Dealers.

The fails processing system centers around a master file which is updated daily. The day's activities in the cage are matched to individual entries on the file (cleanups), and new entries (new fails) from trades that were executed earlier, but are settled now, are also used to update the master file.

The input of activity in the cage for the phase 1 design is off-line. The later phases of the system will change this inventory management from a batch-oriented subsystem to a real-time, on-line system that is more intimately tied to communications access to various data bases and the use of display terminals.

As soon as the updating of the detail fails and stock borrowed & loaned subsidiary files has been completed, the margin (or bookkeeping) processing phase begins. The day's activity is used to update the two margin master files, the money balance file, and the security holders file—the combination of which constitutes the basic books of a brokerage house. The money balance file contains data relating to money, equity, market value, buying power, etc., of the account, as well as customer control information; while the security holders file contains a record of the positions in securities for each account.

The margin processing system is primarily responsible for updating the customer books of the company and determining whether transactions adhere to rules of the various regulatory agencies, including the Federal Reserve Board, the New York Stock Exchange, and, of course, the policies of the brokerage house itself. Some of these rules can be quite complicated and change relatively often. The system reports all violations or potential violations, and monitors the removal of these anomalies.

The margin processing system is divided into two main phases, margin I and margin II—plus a margin report generator. Margin I accepts the daily transaction files and passes them against the two margin master files to produce an updated money and security position record. Margin II then processes the interim margin master files and produces completely updated master files, report files, and activity output for follow-on portions of the system.

About a dozen reports are generated each day by the margin system. Among the most important are the: (1) daily margin printout; (2) delinquent report; (3) account executive report; and (4) overdue cash report.

The daily margin printout is the largest and most important produced by the system. For each account having activity, this report shows the opening and closing balances, the positions, and the day's activities. In the Dean Witter system, these reports are wired to remote printers in Chicago, Los Angeles, and San Francisco, in addition to being printed locally in New York. This allows Dean Witter's margin departments to have up-to-date status reports on every customer's account.

The delinquent report is transmitted daily to regional offices and contains all violations and exceptional items to be drawn to the attention of the margin department; while the account executive report is a one-line message transmitted over the communications system to account executives at the branch offices, describing balances and buying power for all accounts selected by the account executives. The overdue cash report is wired to all branch offices and indicates those customers who have an outstanding obligation to pay funds to the brokerage house. This data is used by account executives to monitor the status of their customer's accounts.

The progression of margin processing through its final phase causes the following output files to be produced for further processing by other parts of the system:

1. A daily statement detail file (to statement processing).
2. A daily transaction detail file (to stock record processing).
3. A monthly interest file (to purchases & sales reporting).

After margin processing, several other systems process the data and generate reports. The stock record subsystem is responsible for keeping track of all securities for which the firm has responsibility. These securities are owned by Dean Witter's customers or by Dean Witter itself. They are located in vaults (boxes) at various Dean Witter offices, in transfer (from Dean Witter's name or to Dean Witter's name), owed to Dean Witter by other brokers, and so on. The stock record master file contains the locations of the certificates in security sequence to give the total picture of the status of any given security at any particular time. The stock record system prepares transactions deleting old positions and adding new positions as a result of mergers, changes of name, and any other organizational changes of companies that affect customer holdings. These transactions, called security swings, update the bookkeeping files and the stock record master file on the next day.

Stock record also prepares the basic information for dividends processing. When dividends are declared, payments are made to Dean Witter for all securities held in house name; however, most of these securities are really owned by customers, and the payments must be passed on to each customer in proportion to the number of shares of the security in his account. The stock record run has this information in its master file and passes it to dividends processing.

Dividends processing computes dividends, prepares dividend checks and notices for customers, prepares bookkeeping entries for margin processing, withholds taxes on dividends, controls "due bills" from and to other brokers for stock on loan or failed on, maintains an overpayment/underpayment file for dividend payments that do not correlate exactly to its own record, and prepares operational reports for the use of dividend department personnel.

In the logical flow of the system, the final run is statements. Statements are produced periodically, showing the activity and status of all customers. Although such statements may be as infrequent as quarterly, most brokerage firms produce the statements monthly. This run essentially merges all of the detail activity from the margin-processing system with the closing balances and positions, creating statements for all customers. It is the most time-consuming process in the system because of the large amount of printing required. The run also accumulates tax information for reporting to the customer and the government at year-end.

conclusion

This article has described some aspects of back-office brokerage operations, and parts of one major project to automate these functions. Besides being used in back offices, computers are automating many different activities on Wall Street at this time. The Exchanges themselves have developed large computer capabilities and have automated communication nets to expedite the flow of information. Systems have even been designed and proposed for automating the actual trading of securities themselves. And, of course, for some time computers have been very important in stock market research.

The people involved in Wall Street automation problems sense that major changes will be forthcoming in the way that the Street does business. Many of these changes will come about because of the computer capabilities. No matter what changes occur, however, the basic functions described in this article will remain necessary for brokerage firms. As time progresses, the emergence of the computer's capability for managing large information flows will become more and more obvious as the only solution for the major operational problems of the brokerage industry—an industry whose major function can be interpreted as the processing and transferring of information. ■

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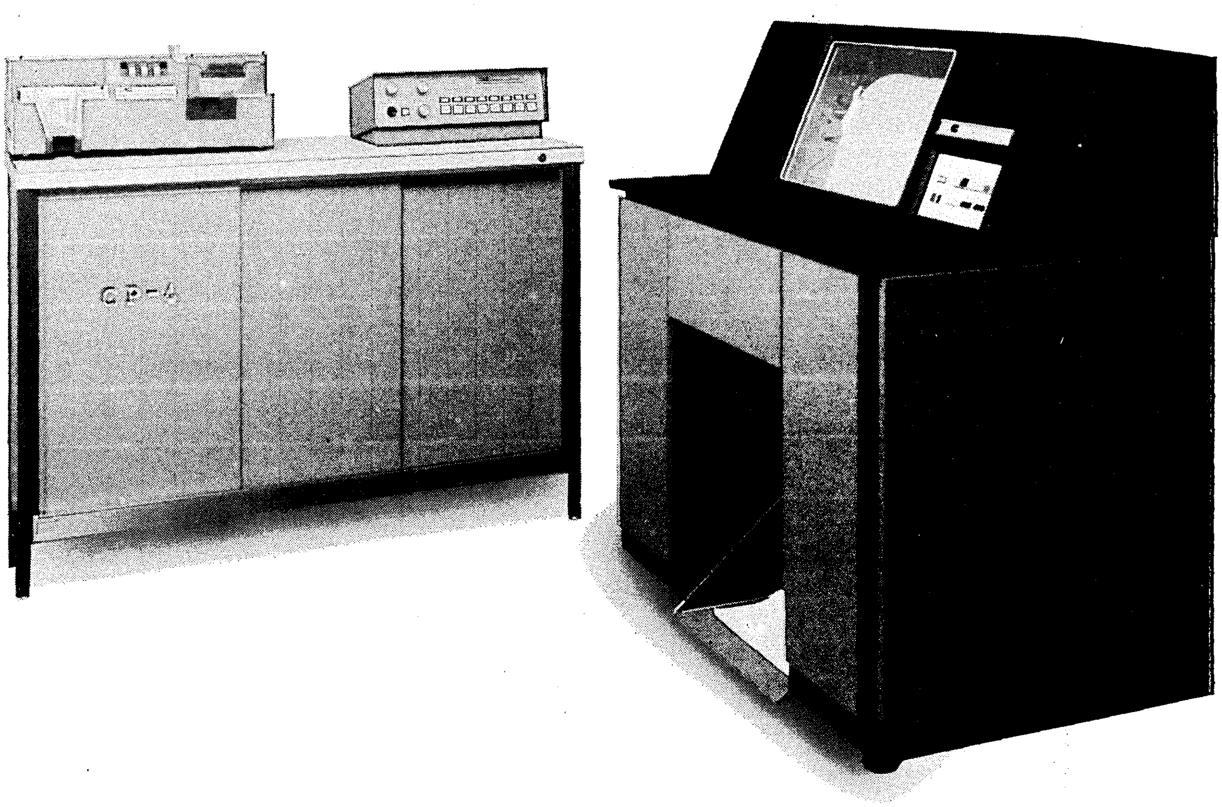

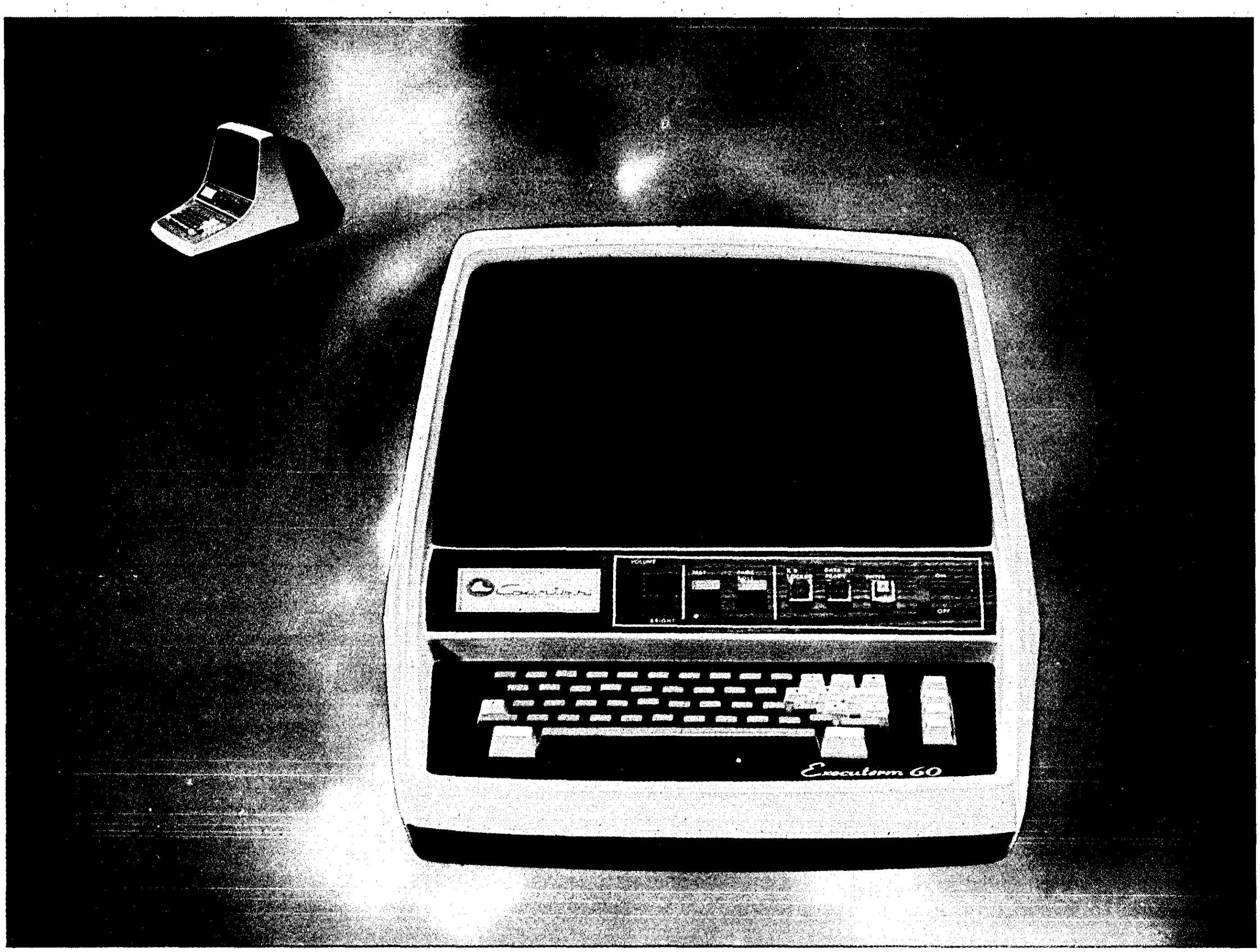

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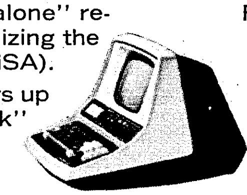

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OCR IN NO MAN'S LAND

by Edward H. Utley

"No man's land" is that war-torn real estate lying between two opposing forces but owned by neither. The no man's land in OCR is the application area between the highly constrained, centralized "clean room" approach to OCR-input preparation and the "greasy mechanic proof" applications at the credit card level. In this now largely forsaken area will be fought the future OCR battles.

The Marine Corps characteristically has launched its OCR attack into no man's land in its manpower data application. In this new system the Marine Corps can neither be content with the small amount of variable data obtainable in credit card applications, nor create the controlled conditions often thought necessary for full-scale, page-reader scanning operations.

To understand how the Corps uses OCR, an understanding of the application (which is obscure to most people even in the military) is necessary. People unfamiliar with military personnel accounting often assume it is merely a "nose count." There is nothing simple about the new Marine Corps Manpower Management System in which there are over 400 different kinds of transactions, each of which has an average of about 50 edits associated with it. Not only a roster of the people on board is maintained by a system of this type, but also an inventory of their skills; their status (sick? in the brig? on leave? AWOL? AWOL while sick? etc.); and a myriad of data elements which can affect a Marine's pay or future assignments, or which are required for proper management of the military member or his unit. There are a lot of questions asked of a system of this type both from within the Marine Corps and from external sources.

keeping a diary

The Marine Corps has had a computerized personnel system for many years. Keypunching was the means of input preparation. Marine Corps units (most are 200-or-so-man rifle companies, artillery batteries, or aviation squadrons) submitted a daily Unit Diary (morning report) with free-form narrative statements which described events affecting the records of individual Marines. These diaries were mailed to an accounting center where a Marine who was a "personnel data analyst" interpreted the unit's statements and assigned transaction codes according to his judgment and interpretation of the rules. These transactions were then keypunched, verified, and entered into the computer process.

The old system was a good second-generation application. But by present day standards, its computers were slow, data both before and after processing was transmitted by mail, programming was relatively inflexible, and input was subject to severe queuing problems as the supply of trained analysts and keypunchers ebbed and flowed. The analysts at times were inexperienced and quickly trained, resulting in some rather unusual transactions being pumped into the system from time to time. Differences between individual analysts in the interpretation of the rules were a constant problem. Other little annoyances sometimes were present. For instance, Private Ludwig van Beethoven once was carried on the master record for a short hitch.

The worst feature of the old system was that the unit which originated the entries into the system never knew

Lt. Col. Utley, a career data processing officer with the USMC, is presently serving in Vietnam. As head of the Manpower Systems Branch of Marine Corps Headquarters, he was responsible for the development of the system described in this article. He has a BS from the University of Maryland and an MS from the U.S. Naval Post-graduate School in Monterey, and has been on the faculty of the University of Maryland and American University.

whether the information "took" or not. In some cases, data was entered on the Unit Diary, but never was posted to the computer record, due to a failure in the analyst or keypunch process. Also, there was simply no way for the unit to relate the free-form entries to specific machine transactions, even when given access to transaction data. The commanding officer was technically responsible for the data on members of his unit, but he had no real control over it.

Since July 1, 1969, the Marine Corps has been operating a new, third-generation system in which OCR is the keystone. The concept of the new system is simple. The company clerk types his report and sees that it is delivered to the data center. The report is scanned, processed by the computer, and transmitted to the central data bank. The unit is then given a listing of all transactions accepted and rejected with indication of any corrective action required.

By expanding from two to eight data centers, the use of the mail has been decreased radically except for remote units. Now, diaries affecting most Marines can be hand delivered to the data center the day they are prepared. Eight automated service centers plus the center housing the central data base, stretch from Camp Lejuene, North Carolina, to Danang, Republic of Vietnam. All are equipped with an IBM 360 and a Farrington 3030. All operate as service centers, with the manpower application as only one facet of a multiprogramming environment. With this understanding of the over-all system, examination of the OCR subsystem and the constraints under which it operates is possible.

In the approximately 2,000 reporting units, the action centers around the company clerk. This young man has the task of diary preparation. These are some of America's finest. If you ever spent a night in a foxhole with a young Marine, you develop a real respect for our younger generation. However, he has about as much innate aptitude for the OCR world as his civilian contemporary in a filling station. The big problem to be solved initially was to give this clerk a standard means of communicating with the system without resorting to a completely esoteric assortment of codes. This communications problem was solved by creating a jargon-filled "manpower language" not unlike a high-level programming language.

an easy language

The Corps established this new language with a one-for-one relationship between the specified set of English-language statements and system transaction codes. Creating this relationship, while keeping instructions simple enough for untrained personnel to understand, was the crucial step in the entire process. However, as far as the company clerk is concerned, he is as unaware of the language as Moliere's hero was that he was speaking prose. No attempt is made to teach the clerk the language. He, in fact, is trained not to depend on memory. He uses a procedures manual which is constructed around decision logic tables which direct the user to the precise statements needed to report an event.

Once a clerk threads his way through the decision logic tables, he is ready to commence his daily task of typing the diary. At this point it is important to know that every man and woman entering the Marine Corps is screened for typing ability. It may be interesting to know that the Marine Corps considers 15 words per minute a significant level of competence—perhaps good enough for assignment as a clerk when demand for typing skill is high and typing talent available is low.

Every unit, except those in Vietnam, is equipped with a typewriter with the type A USASI font. (Units in combat submit their diaries any way they can, and the diaries are retyped at the data center.) It was known from the outset that it would be necessary to buy new typewriters for nearly every unit in the Marine Corps in order to achieve the required OCR print quality. OCR typewriters are more than a font. Ribbons and embossing density are critical. Reusable cloth ribbons "splash" when struck by the key, and the scanner reads the splash mark as part of the character. Key pressure must be accurate so that the typed character is free from shadows caused by hitting the page too hard or unblackened areas in the letters caused by hitting the page too lightly. The Corps' older nonelectric typewriters clearly would not make the grade in the OCR world.

all new typewriters

It was apparent that if a large investment in typewriters was to be made, standardization of a single font would be the economical approach. Single-font readers cost less to rent or buy than multifont readers. When systems designers are in a position to specify a single font for input preparation, they usually find the dollar savings dictate that approach. The fact that the Marine Corps uses a total of 10 readers magnified the dollar savings considerably, and more than paid for the cost of new typewriters early in the game. This was especially true since the Marine Corps had anticipated arrival of the scanners, and long before scanning operations commenced had ordered that the routine replacement for all Marine Corps typewriters would be OCR-font machines.

Sometimes the big problem with OCR typewriters is the platen. It must be designed so that proper vertical alignment will be maintained on *your* input forms. There must be, in other words, six lines to the inch and not six and one half. If vertical alignment is not maintained, by the time the scanner is halfway down the page the sweep of light will be skimming the top or bottom of the characters and the line will be rejected. In the Marine Corps, a four-part form for OCR input in the field is used. The original is sent to the scanner, first copy goes to the old system (while being operated in parallel), the second copy goes to the pay people until the integrated pay portion of the system takes hold, and a file copy is retained by the unit. There were some typewriter manufacturers who couldn't believe OCR input would be prepared in a multipart set. If thinking is limited to a centralized clean room approach, then multiple copies indeed do not make sense. But if the system uses decentralized document preparation, snap sets are quite useful. If a multiple-part form is used, special platens may be required for some brands of typewriters to overcome alignment problems.

The Marine Corps tested all type A USASI-font typewriters on the market at the time the system was being designed, and from OCR print quality there was little to choose from. You may prefer one brand of typewriter over another for some reason, but they all do an excellent job from the standpoint of OCR print quality.

So we have our Marine with his new typewriter; now he needs a form. When buying OCR forms, pick a printer with a proven record of satisfactory performance in OCR forms. Printing a form in two colors, one of which must be seen by the human eye but not by the scanner, is one part of the problem. Geometry, squareness of the form and correct spacing of printing, is another. Picking the printer is a privilege those in government do not enjoy. Buying from the low-bidder has produced some exceptionally fine forms, but luck plays a part here.

When the company clerk types the form, it passes through the hands of the chief clerk, the first sergeant, and the executive officer, and is signed by the commanding officer. This ensures that it is not only technically correct

but often smudged, finger printed, stapled, and even folded. These problems have led to the revision of an ancient military maxim: "If it moves, salute it; if it doesn't move, pick it up; if you pick it up and it's wet and soggy, scan it." The form when signed is placed in a flat manila envelope and carried or mailed to the service center. No special mailers are required.

Each of the Marine Corps' automated service centers has an Administrative Control Unit. This unit consists of two or three NCO's and some younger Marines who are principally typists. One of their jobs is to take the diaries from the envelopes, remove the staples, and stack the forms in preparation for scanning. No other preprocessing is necessary.

scanning the forms

The Marine Corps' Farrington 3030's are equipped with two tape drives and an 8K CPU as well as the usual console typewriter. Scanning then has the flexibility of an off-line operation. The reader output tape is input to the IBM 360. The readers have an oscilloscope which displays unreadable characters for the operator so that he can type in the correct character. This slows the scanning process somewhat, but it is worth it to keep transactions from becoming annoying retypes. The Marine Corps has programmed many edits into the initial scanning process, so that certain exceptional transactions are rejected before processing on the IBM 360 commences. For instance, if any diary entry starts with the letters SFNP (short for "statement format not provided"), it means that the unit could not find an appropriate statement in the manual for the event reported, or has a problem that requires human judgment, SFNP's are automatically rejected to be given personalized attention by the members of the Administrative Control Unit. Even with these and other edits executed under program control, over 95% of the transactions go through the reader successfully the first time. The remainder get speedy corrective treatment by the Administrative Control Unit and are soon back on the track.

The Corps has a standard technique for controlling input quality. Whenever a new typewriter is purchased, or an old typewriter is overhauled, or input quality as monitored by the control unit drops, a predetermined test pattern must be typed by the unit and submitted to the data center. A computer analysis of the reading of the test pattern is returned to the unit, and if adjustments are required, the analysis is of course available to the repairman. Scanning operations for the day—or after any power fluctuation—start with the reading of a test pattern of known accuracy. This is a "fail-safe" on reader adjustment.

When the scanner output tape goes into the IBM 360, system transactions are processed to completion. If a transaction is logical and compatible with the Marine's record, it is posted. If not, it is rejected. The system prepares a transaction register which goes back to the unit. The register tells the unit what was accepted and what was rejected and what action must be taken to correct any error. Syntactical errors in the manpower language which have been rejected during IBM 360 processing do not appear on the unit's transaction register. They are corrected and typed by the control group and resubmitted to the process. The unit is, however, charged with an error, but nothing is returned to the unit purely for retyping.

Data collected at the eight service centers is sent by AUTODIN digital transmission network to the Marine Corps' Automated Services Center in Kansas City, Missouri. The central data base is maintained at this location which is shared by the Marine Corps' Finance Center. The Automated Services Center has three IBM 360's and two Farrington 3030's to handle the central data bank processing workload. Scanning operations support certain specialized payroll functions using scannable input prepared in disbursing offices around the world.

The Marine Corps' system is set up so that only the unit commander or Marine Corps Headquarters can change an individual Marine's record. If Headquarters puts in a transaction, the transaction prints out on the unit's transaction register. This feature gives the unit commander total visibility of the system and, except for Headquarters' input, total control over the system. It also gives him total responsibility, which with proper supervision should promote efficiency. The computer, with Orwellian thoroughness, gives the unit commander and his superiors a complete analysis of the accuracy of his unit's transactions.

In creating this new system, the objective has been much more than simply converting keypunch to OCR. What the Marine Corps has achieved is source-data automation, with typewritten OCR input as the means. The Corps' new system is far more flexible than a credit card type application, having almost infinite ability to vary the input to the existing system. Yet the Marine Corps is relatively free of constraints. The principal constraints in force are use of a standard typewriter and form. Some of the unfettered features of the system which do not detract from over-all success are: a relatively inexperienced clerk with limited typing ability; 2,000 locations putting input into the system without direct day-to-day supervision; use of any OCR typewriter on the market; and forms purchased from the low bidder. By employing OCR methods the Corps now has a personnel system—and will have a pay system integrated with it—in which the Marine's immediate commander has control and responsibility for accounting in his unit.

The Marine Corps does not consider this system to be the ultimate. OCR is now the Marine Corps' way of life, but for the Corps the typewriter is a millstone around the proverbial leather neck. Why are typewriters a problem? They must be plugged into a power source (a small number of manual OCR-font typewriters are being tested in Vietnam); they require maintenance (the nuisance value of which is proportional to the remoteness of units); and typewriters require a skilled operator. In a world where a skill of 15 WPM is significant, no further amplification of this point is required.

What are the alternatives to the typewriter? The imprinter lacks flexibility. The "black box" has the maintenance factor and, so far, a prohibitive price tag. Most require a power source. The answer could be scanning of hand-printed information, although the number of digits in a coded transaction could very well prove a limitation (not of the hardware but the users). Perhaps some of the Corps' remote locations will be brought closer through transmission of scannable hard copy over telephone lines. In any case, the present system is a revolutionary step towards an ultimate but as yet undefined goal.

the potential is there

One thing quite clear is that when industry solves the type of problems the Marine Corps needs to solve, a lot of other peoples' OCR problems will be solved also. On the other side of the coin, when the user looks at the true source data automation potential of OCR (and does not limit his thinking to converting current keypunch applications), he will reap the true benefit of OCR. Industry and the user will then both be moving out into the middle of no man's land, which is the area which must be exploited if OCR is to meet its full potential anytime soon. And when you are out there in no man's land, Marines are good company. ■


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THE SERIES DATA MANAGEMENT SYSTEM

by David C. McElroy

The problems associated with the development and operation of information systems employing computers are widely recognized. SERIES, an upward compatible group of data management systems developed by Information Systems Management Corp., is designed to alleviate these problems. The name SERIES is not an acronym, but rather a descriptive name for a modular family of data management systems with varying functional capabilities.

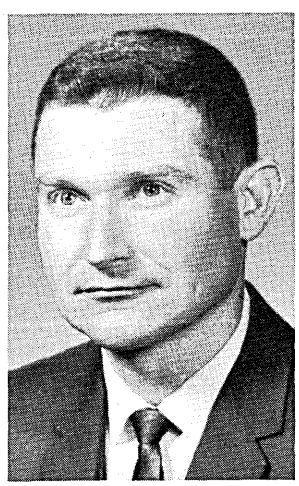
The fact that there is no commonly accepted means of defining information processing requirements, nor a universally accepted generalized structure for processing information (primarily due to the relative infancy of the dp field), has imposed the greatest difficulty in developing SERIES, as well as other generalized data management systems. However, the technology necessary to develop generalized systems to solve dp problems has been evolving for many years. For example, generalized sort systems, initially developed as early as 1955, have virtually eliminated the need for writing sort programs. Instead, the sort user specifies very briefly his requirements and a sort program is specialized for his specific needs.

what these systems do

Additional systems were developed based on the concept that an acceptable generalized logic structure could be developed to solve even more complex problems. The development and use of early systems for the IBM 702 and 709 were described by W. D. McGee in the late 50's in a DATAMATION article entitled "Generalization—Key to Success in Electronic Data Processing," and more recently by Harrison Tellier in the June, 1968, issue of *Data Processing Digest* in an article entitled "The Role of the Generalized Program." The systems described generalized the processes of sorting, reporting, and file maintenance.

On a more contemporary basis, a number of systems have emerged which are referred to variously as generalized file management systems, data management systems, information management systems, etc. A data management systems survey of some of these systems was prepared in early 1969 by the MITRE Corp. for the Department of Defense (Document Number MTP-329). This survey was followed by a CODASYL committee report entitled "A Survey of Generalized Data Base Management Systems," published in May, 1969. These systems (generally grouped together in any discussion of data management system technology) vary functionally all the way from systems which provide a common data management interface between multiple user programs to a shared or common data base, to systems which interpret user requirements and either execute generated programs or interpretive routines to solve the user problems. Some are oriented to on-line processing; others to batch processing; others are a combination of both. As a result of this varying capability, it is extremely important to evaluate "how" and "to what degree" the points surveyed are accomplished.

Basically, these systems permit the information user or the system analyst to communicate information requirements. The systems consist of program generators, as well as interpreters, which accept the user's requirements and either generate programs or execute interpretive routines, dependent on the response time required and the economic value of processing the information. The systems have the inherent knowledge to "design" information processing systems and "write" programs based on a comprehensive general structure. An analogy between these systems and computer programs currently in existence (which interpret engineering specifications and automate the design of circuit logic for electrical transformers and even computers) adds to the credibility of this approach. Programs which design circuit logic have the inherent knowledge of the electronic engineer and are capable of designing circuit logic to conform to a comprehensive general structure. In the case of information system development, these systems



Mr. McElroy is an independent consultant serving the computer industry. He was the founder and president of Information Systems Management Corp., Richland, Wash., prior to its acquisition by Western Operations, Inc., in 1969. He has had many years of experience in management and operations, and has conducted numerous presentations for various dp and management organizations. He studied accounting at Washington State University.

Mark of Distinction...

have the inherent knowledge of the system analyst and programmers to design computer systems and write computer programs.

The problems and the requirements associated with information system development and operation—coupled with the experience gained through the development and use of early and contemporary systems—form the basis for the development of SERIES. SERIES has been designed specifically to combine into a single integrated compatible grouping of data management systems a combination of the major functional facilities associated with information system development and operation. It permits the user to concentrate on information system design and development, thereby reducing or eliminating the need for programmers to design, code, and debug computer programs. It is integrated and compatible with existing software facilities to provide a sound basis for the evolutionary development of complex information systems.

The major components of SERIES are briefly described here, primarily to indicate how the information system developmental and operational problems are solved, and to illustrate the comprehensiveness of the system.

1. Languages: To define information systems tasks and conditions which control the processing of the tasks, and to communicate requirements for immediate information storage and retrieval.
2. Data organization and access routines to organize, store, and retrieve data.
3. Language processors to interpret the languages and either generate programs, or interpretively execute programs to meet the requirements specified by the language.
4. Control mechanism to maintain the integrity and security of the data base, to control all external communication with the system, and to automatically schedule applications based on the conditions which control their processing.

The integration of these parts into a standard operating environment is important (from the standpoint of current operations and cost) to maintain compatibility with and to prevent duplication of facilities. This integration is illustrated in Fig. 1.

language

Since there is no commonly accepted language for describing information system requirements, and the process being described cannot be expressed in mathematical terms, new language(s) have been developed which can be employed to specify information requirements. Other systems mentioned earlier employ different forms of languages varying from highly structured fixed forms with columnar headings to English free-form statements, and, in some cases, simply subroutine call statements integrated with manually written procedural language programs. An analysis of these languages indicates many common elements and a general orientation to certain classes of users. Based on this analysis, the SERIES language has evolved to provide a comprehensive language oriented to different classes of users. For example, there is a language for system analysts to define information system data and processing requirements, and a language for management, administrative operations, and sales personnel to dynamically obtain information and alter data. The SERIES language includes a very simple subset of statements designed to produce extremely simple reports and to maintain and create simple files. Portions of these languages and their use are illustrated in the following examples.

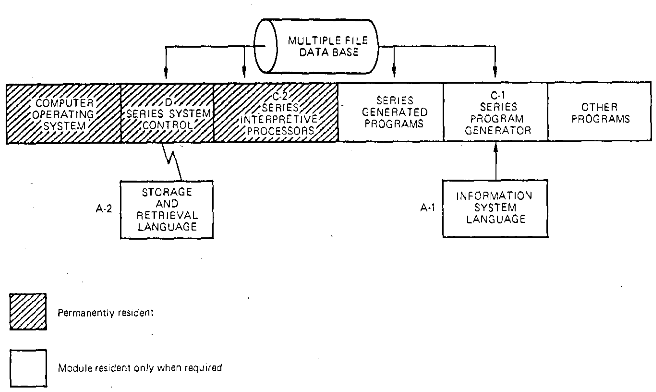


Fig. 1. Major SERIES components integrated with operating system.

a sample language

Fig. 2 shows a very simple information system, involving personnel, cost, and projects files, which are updated on a dynamic direct-access basis with applied-time transactions. These transactions are received from remote terminals and can be either dynamically processed or batched, based on the number of transactions or elapsed time for periodic processing. The SERIES information system language required to complete this task is shown as follows:

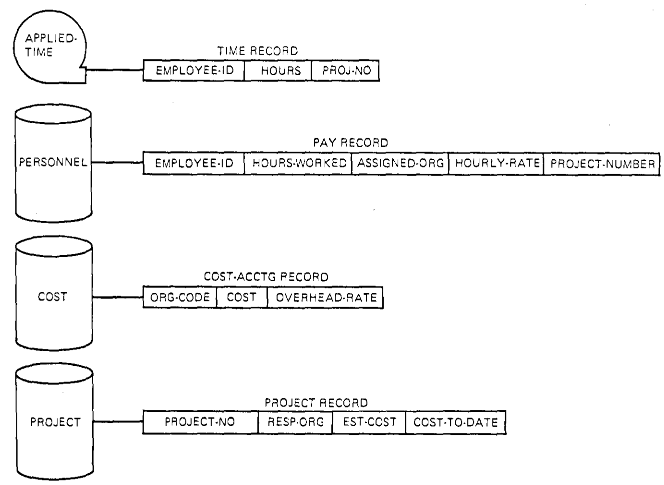


Fig. 2. Multiple file maintenance.

MAINTAIN-EXAMPLE: DEFINE MAINTAIN.

What data is to be processed?

INOUT MASTER FILE IS PERSONNEL ACCESS DIRECT.
INOUT AUXILIARY FILE IS COST ACCESS DIRECT.
INPUT AUXILIARY FILE IS PROJECTS ACCESS DIRECT.
INPUT TRANSACTION FILE IS APPLIED-TIME ACCESS SEQUENTIAL.

What relationships between data are required?

LOGICAL1: LINK PAY RECORD OF PERSONNEL FILE USING PROJECT-NUMBER TO PROJECT RECORD OF PROJECTS FILE USING PROJECT-NO.

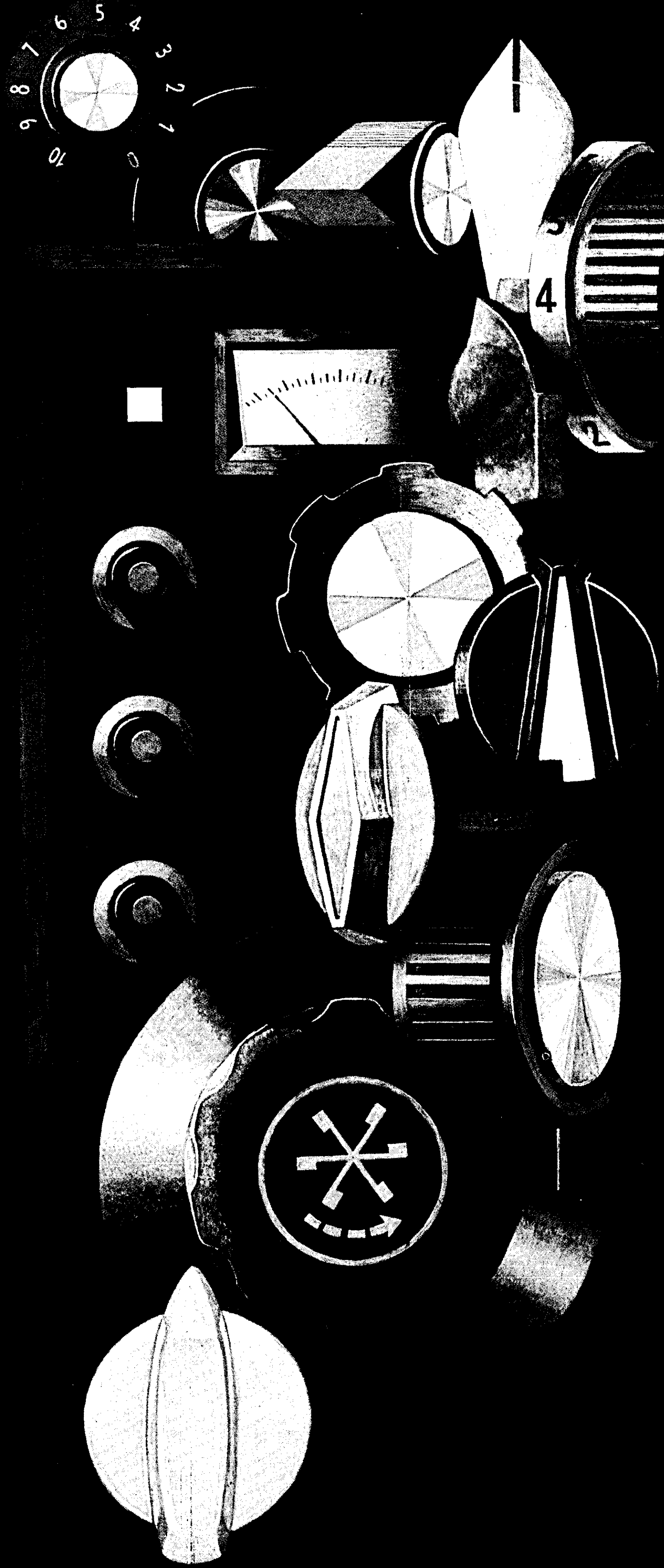
LOGICAL2: LINK PROJECT RECORD OF PROJECTS FILE USING RESP-ORG TO COST-ACCTG RECORD OF COST FILE USING ORG-CODE.

CHAIN LOGICAL1, LOGICAL2.

How is data maintained?

PAY-UPDATE: MODIFY PAY RECORD FROM TIME RECORD.

(Continued on p. 135)



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```
  MOVE SUM OF HOURS-WORKED AND HOURS TO HOURS-
    WORKED.
  DO   PRJ-UPDATE.
  DO   COST-UPDATE.

PRJ-UPDATE: INSMOD LINK PROJECT OF LOGICAL1 LINK
  FILE
  DO PROC1.
PROC1:  BEGIN.
  COMPUTE COST-TO-DATE = HOURS* HOURLY-RATE
                         * OVERHEAD-RATE
                         + COST.
  END.

COST-UPDATE: MODIFY LINK COST-ACCTG OF LOGICAL2
  LINK FILE
  DO PROC2.
PROC2.  BEGIN.
  COMPUTE COST = HOURS* HOURLY-RATE
                 * OVERHEAD-RATE
                 + COST.
  END.
```

project record language

The functional program created from these task specifications would read the transaction records; serially link to all of the corresponding records in the personnel, cost, and projects files; and modify individual records. In addition, in the case of the project record, new records would be inserted automatically when no project record was found corresponding to the applied time transaction record.

Fig. 3 pictorially illustrates a very simple report combin-

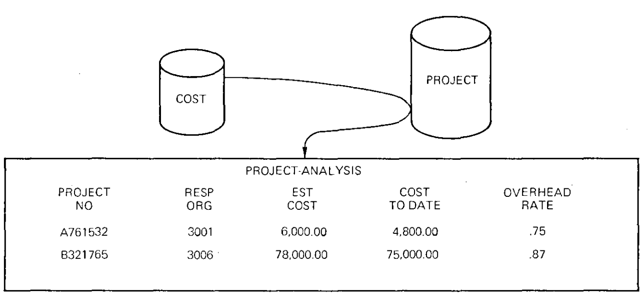


Fig. 3. Multiple file system formatted report.

ing data from the cost and projects files. The SERIES information system language required to complete this task is shown below:

```
PROJECT-ANALYSIS:  DEFINE REPORT.
```

What data is to be selected and processed?

```
INPUT PROJECTS IF EST-COST* .75 GT COST-TO-DATE THEN
  SELECT PROJECT RECORD.

INPUT AUXILIARY COST ACCESS DIRECT IF ORG-CODE EQUALS
  3001 THEN SELECT COST-ACCTG RECORD.
```

What relationship exists between the data?

```
LOGICAL3: LINK PROJECT RECORD OF PROJECTS FILE USING
  RESP-ORG TO COST-ACCTG RECORD OF COST FILE USING
  ORG-CODE.

CHAIN  LOGICAL3.
```

How is information to be presented?

```
DETAIL FOR PROJECT RECORD.
LIST PROJECT-NO,RESP-ORG,EST-COST, COST-TO-DATE,
  OVERHEAD-RATE.
```

The functional program created from these task specifications would read the projects file; select appropriate records; link to the cost file to obtain the required data; and format a report, using the task name "PROJECT-ANALYSIS" as the report title and the field names as columnar titles.

Language elements are provided to specify variations in response and processing requirements.

for the on-line user

For the strictly on-line user, the SERIES interactive language provides capability to create files, maintain files (record modification, insertion, and deletion), search indexes, and retrieve and format data. Examples of this language are shown below:

```
PRINT   PROJECT-NO,EST-COST AND COST-TO-DATE FROM
        PROJECTS FILE WHERE RESP-ORG EQUALS 3001; AND
        COST-TO-DATE GREATER THAN 100000.00
```

RESULTS AT TERMINAL

PROJECT NO	EST COST	COST TO DATE
A700516	150000	100321.00
A693417	250000	175672.00

In this example the SERIES interpretive processors search the indexes for RESP-ORG and COST-TO-DATE and retrieve all records for organization 3001 exceeding $100,000.00.

```
MODIFY PAY RECORD IN THE PERSONNEL FILE WHERE
HOURLY-RATE = 5.738 WITH HOURLY-RATE = 5.765
```

In this example the SERIES interpretive processor searches the hourly rate index, retrieves all records with an hourly rate of 5.738, and changes the hourly rate to 5.765. In addition, for each record modification, the hourly rate index is updated automatically.

prompting

Prompting which is provided for the inexperienced user at his option follows:

```
          SIGN-ON
            .
            .
            .
SYSTEM    COMMAND?
USER      PRINT
SYSTEM    FIELD(S)?
USER      PROJECT-NO, EST-COST, COST-TO-DATE
SYSTEM    FILE?
USER      PROJECTS
SYSTEM    SEARCH CRITERIA?
USER      RESP-ORG = 3001; AND COST-TO-DATE
            GREATER THAN 100000.00
```

Dynamic linkages between files can be established by the on-line user, as was illustrated in the maintenance and report examples for multiple file activities. The user can eliminate optional words, such as AND THE FILE RECORD, etc., to reduce input volume.

The SERIES language and interpretive processors have been specifically designed to allow the language to grow, not only from a functional point of view but on a dynamic basis, to conform to the user's normal vocabulary. It has been anticipated that the language will evolve through the experience of the users, and that the need will exist to process other data vocabulary on a dynamic basis through the use of stored (and named) procedures which can be invoked repetitively as required.

The techniques employed for data organization and access have a tremendous impact on the over-all effectiveness and flexibility of any data management system. The fact that response time and volume requirements vary significantly between different sets of data, and that data relationships must be established on a dynamic basis to be responsive to users, imposes the greatest difficulty on designers to develop an all-encompassing data organization. This is combined with the fact that, in some cases, the value or absolute requirement for having data immediately accessible is contradictory to efficient use of storage facilities and computer time, when considered on an independent basis.

As a result, the system analyst defining data requirements must be given some effective choices which allow him to consider such things as the relative requirements (storage volume, frequency of access) between direct and/or sequential access; the degree of real-time on-line, batch on-line, or batch processing; and the probable access requirements. All of these considerations must be weighed based on the value to the ultimate customer (management, operations, sales, etc.).

The SERIES system provides a combination of sequential, sequentially oriented with secondary direct access, direct access, and direct-oriented with secondary sequential access organization methods. All are potentially accessible, not only through unique record identifiers, but also based on the data content of the records. Data may be combined into groups (either in single or multiple physical file) to provide both the simple and unlimited hierarchical relationships required to access data to meet the unpredictable information needs of the users. The logical structure of a multiple file data base is shown in Fig. 4. The chaining

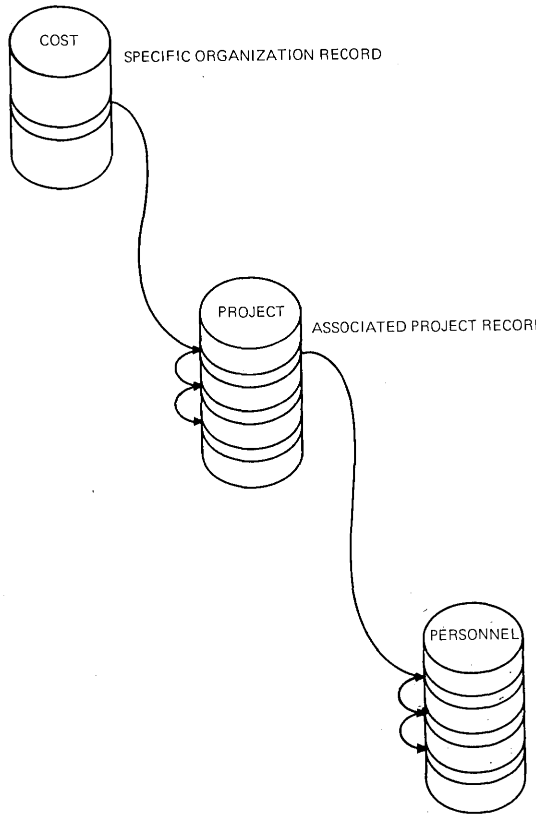


Fig. 4. SERIES logical file structure multiple file hierarchy.

illustrated is defined dynamically (at the time information is required), and the logical chain addresses are stored external to the data to allow their use on a dynamic basis and to conserve maintenance processing time.

structures and indexes

Data structures, such as required for the manufacturing "parts explosion" problem, also can be defined and processed by SERIES. Fig. 5 illustrates a manufacturing structure where bidirectional logical chains for each use of a component are constructed to provide the ability to locate all uses of a particular component as well as all parts associated with a product. These bidirectional chains are automatically constructed and maintained by the SERIES access methods for each insert, delete, or modification of

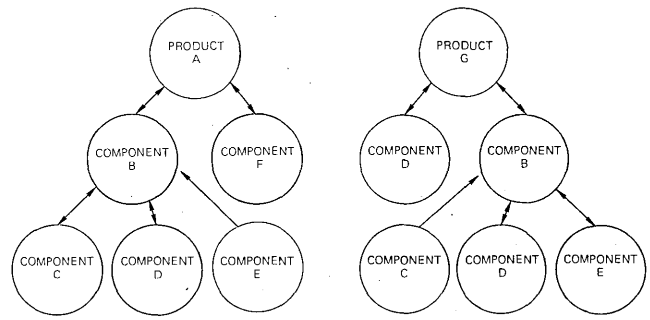


Fig. 5. Manufacturing product structure.

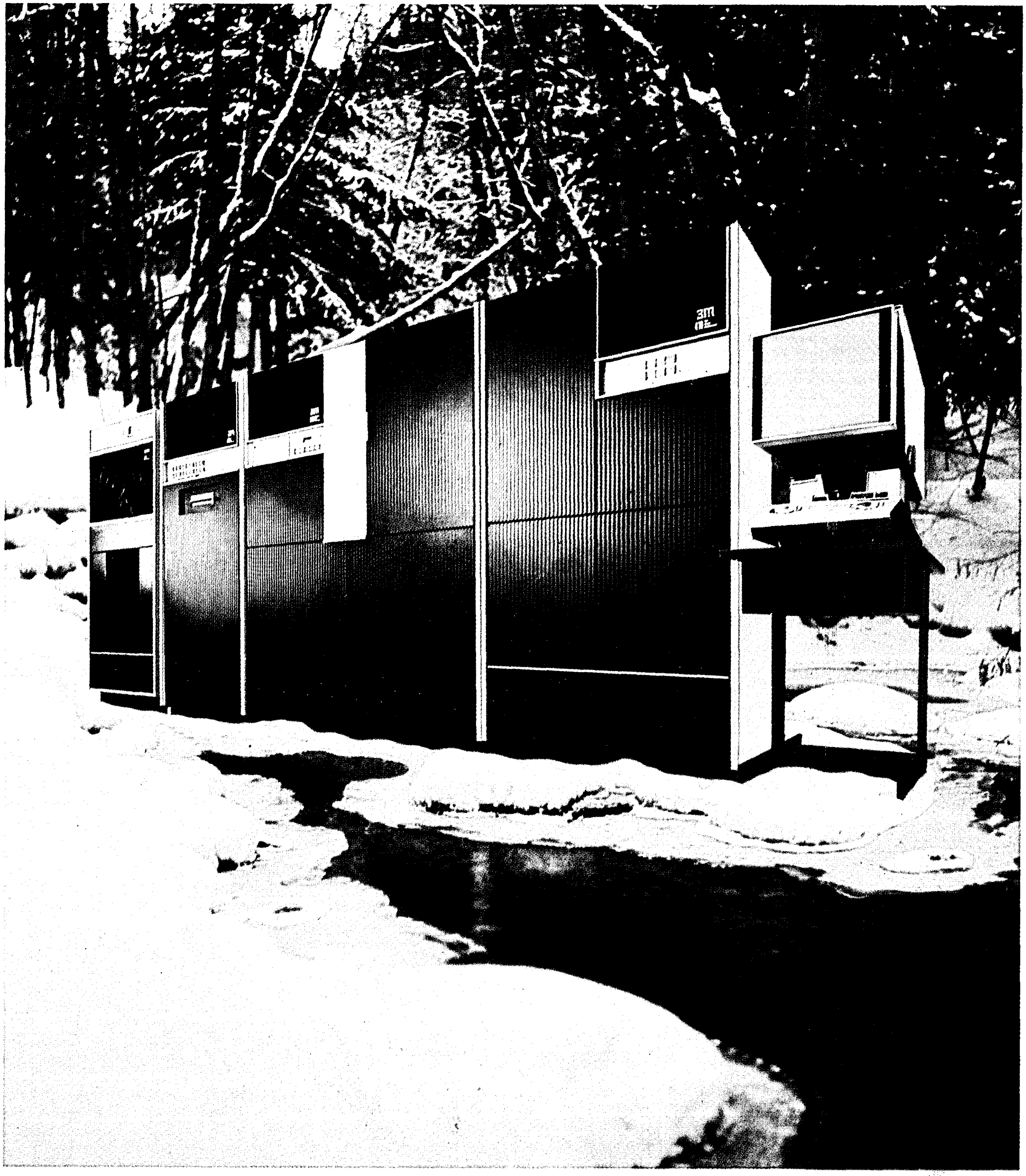
product component records, as well as the records describing the structural relationships between components.

At the user's option, an index of the content of any or all data fields for direct-access files can be specified. These indexes are automatically maintained by the system each time the field content changes. When all fields are indexed, the queries which can be conducted, and the relationships which can be established between them on a dynamic basis, are virtually limitless. Some examples of the type of data which could be located using these indexes without searching the data base are listed:

1. All unfilled customer orders assigned to salesman X where component Y is required for production and where the item sold is not in inventory.
2. All suitable substitutions for component Y.
3. All personnel assigned to manufacturing projects where equipment failure has occurred due to employee carelessness and customer order backlog exceeds 10% of monthly production.
4. All sales in excess of $1,000 for department 300 products sold in the southwest region during January and June, 1969.
5. All projects assigned to the maintenance department which exceed 75% of budget where assigned employee's absenteeism exceeds 10%.

Certainly the creation of indexes for every field and file is an ideal situation. In reality, however, the extremely large general purpose, integrated data base cannot be indexed to this extent from the practical standpoint, due simply to the increased storage volumes and maintenance time. SERIES provides the ability for the system analyst to be selective in employing these facilities, based on the value of obtaining information. This is important in order to obtain the most comprehensive capabilities which can be economically justified.

The SERIES data organization and access routines are



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sufficiently comprehensive to allow users to evolve into the future, where reduced storage costs coupled with microprogrammed access routines are anticipated, possibly residing in small peripheral computers.

language processors

The SERIES language and interpretive processors are designed to "understand" the languages, the associated data, and its organization, (as presented by the user) in order to direct the computer system in solving the problem specified by the user. They either "define" a computer system or "write" and/or "execute" computer programs to perform the tasks specified.

A general logical structure, comprehensive enough to effectively employ the hardware and basic software resources to solve the user's problems, is provided. To insure efficiency within the boundaries of the user's response requirements, programs may either be generated or interpretively processed at the user's option. Only those functional modules (within the general logical structure required to meet the specific problem) are employed in any specific process to prevent any serious degradation of performance (storage utilization and processing speed), compared to manually written specialized programs.

The approach of providing highly responsive, interpretive, as well as generative routines provides an additional benefit in that it allows information system users to make the transition on an evolutionary basis from off-line batch systems (which are paramount today) to on-line semibatch or real-time systems, yet remain in a compatible environment. This can be accomplished because various logic modules (applicable to an on-line process contained within the standard logical structure) may reside as executable reentrant subroutines "called" into execution in the proper sequence by the language processor; whereas in the batch or semibatch environment, the various logic modules are actually generated in-line in the processing order required to construct an object program.

The programs, themselves, could be generated in reentrant machine language: COBOL, PL/I, or any language comprehensive enough to fulfill the user's requirements through adaptation of the language processor (which has been specifically designed to allow future adaptation as required). SERIES has been initially equipped to generate COBOL. This provides the ability to retain compatibility with a commonly accepted procedural language during the transition from specialized to generalized systems. The use of COBOL minimizes the "shock" of employing a new language since, in fact, the system is completely COBOL compatible and is not contradictory to the goals of employing a common language. It even improves the common-language goal because the language processor is specifically designed to be adapted to generate syntactically and efficiently "correct" COBOL programs and the associated system-control language for different computers (initially System 360).

The language processor is specifically designed for expansion to respond on a dynamic basis to technological developments in the form of new processing techniques, new equipment, and new basic software. The concept employed is based on the fact that the inherent "knowledge" within the language processor is merely the "transferred" knowledge of the information system analyst and programmer, and that to be effective the language processor must "learn" as the knowledge within the industry grows.

In the future, with the acceptance of these generalized logic structures, it will be possible (as with the data organization and access routines) to provide the functional modules as microprograms possibly residing in small, peripheral, or terminal computers to dramatically improve their performance.

Potentially, one of the most important aspects of a data management system (to insure its success in meeting the needs of information users) is compatibility with existing facilities. Operating systems which provide time-sharing or multiprogram facilities need not be logically duplicated within the executive of the system, nor do the basic device handlers for various teleprocessing and storage devices. Duplication of development not only increases the cost, but also creates an incompatibility with the rest of the world, limiting the feasibility of transcending to this type of technology.

There are, however, some important control aspects which are necessary today because they are not supported by the operating systems available. Among these are automatic scheduling (not simply scheduling of jobs in the operating-system input stream or job queue, but all jobs in the information system); security control of the entire data base; creation of historical logs for back-up; centralized telecommunications control for the complete information system environment; controlled access where multiple users attempt to access the same data records simultaneously; and optimization of the use of shared facilities. In the latter case as an example, since SERIES is in control initially of all I/O access, it is possible to optimize access-arm contention on direct-access storage devices in a shared data base environment.

The control mechanisms are designed on the concept that their general services need not be redesigned and duplicated within user programs. There certainly was a time in the industry when most computer application programs had their own executive, their own sort, their own data organization, access routines, etc. Today, it has generally been accepted that general systems (sorts, operating systems, data organization, and access) should be used, rather than spending money and time to duplicate them or their facilities. On a contemporary basis, however, most systems requiring teleprocessing have their own specialized teleprocessing control programs, and this is also true for many of the other functions inherent in a generalized data management system.

The SERIES control mechanism can, in reality, provide those general functional services, which are useful during the operation of an information system, to reduce the operational problems associated with scheduling of jobs and communication with the information users, in a manner compatible with existing operating systems. Ultimately, these facilities will become a part of the "standard" operating system and become candidates for microprogrammed modules.

summary

The SERIES system has been designed to automate information system development and operation. It is comprehensive enough to produce conceptual information systems within the scope of today's technology, as well as being designed for expansion in the future. The value of the technology offered by SERIES is significant in terms of reducing programming cost and lead time alone. Even as early as 1958, a cost saving of more than 90% was achieved by employing a SERIES predecessor system for one application (Harrison Tellier in the previously referenced article). SERIES has been designed to allow a realistic evolutionary transition from today's technology and to provide continuity for the growth of information system technology. ■

THE CENTRAL PROCESS COMPUTER APPROACH

by Robert J. Matherne

The problem of economically controlling the processes of a large chemical plant has been approached by the design of an integrated computer system. It consists of three process computers connected via data links to one central computer. The functional jobs are distributed between the central and process computer to maximize the total output and reliability of the system. The techniques which were used in the design can be applied to any real-time computer system which must handle many cyclic and randomly occurring events on a priority basis.

The system to be described in this article is the process computer installation of the Union Carbide Corp., Chemical and Plastics Div., Taft Plant, located about 25 miles upriver from New Orleans, La.

In the Taft Plant each process computer has a data link for communication with the central computer, a drum for program and data storage, a line printer for printing logs quickly, an operator's console for man-machine interaction, and an alarm typer for each process unit. Each process computer can read into its memory about 2,000 analog field signals and convert these into engineering units. Each process computer can control 200 process loops, analyze multiple process streams, output 600 analog field signals, scan 1,500 process variables for alarm conditions, and record 4,000 process variables for logs.

The central computer system resembles a data processing computer with its card reader, card punch, I/O typer, and line printer. The major difference is the data link connections to each process computer. The 2 million words of disc are used to store the operating system and large quantities of data. The library maintenance software can automatically allocate space on the disc for 700 real-time functions, 1,000 batch-type programs, 500 FORTRAN subroutines, 1,000 data tables, and 100 undebugged programs.

process computer design

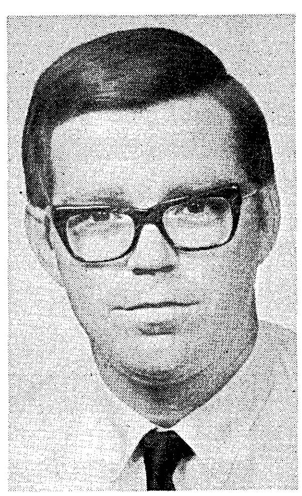
The basis of the operating system is the process computer monitor. It provides a high degree of multiprogramming, dynamic core relocation, up to 64 levels of priority interrupts, and cycle-stealing I/O. Fig. 1 (p. 141) is a block diagram of the interaction of the functional programs, the executive control program (ECP), and the interrupts. For example, if program no. 2 (alarm scan) is running and a "drum operation complete" interrupt arrives, the alarm scan program's registers are saved and control is transferred to the "drum transfer driver." After servicing the interrupt, the driver returns to the ECP which searches for more work to do. A priority of programs are established by having the ECP begin its search for work from the lowest numbered program. This scheme requires that the analog-scanning work be completed before the digital display program can run, for example.

Each of the three process computers has the same overall design. For purpose of this discussion, they will be treated as one process computer. The job the process computer performs is the direct acquisition and manipulation of field signals. A breakdown of the separate functions to do this job is given:

1. Analog scan: The input of field signals from the process, and conversion into engineering units.
2. Alarm scan: The comparison of selected process variables against high and low limits to detect alarm conditions.
3. Digital display: the display of selected process variables on an optical, digital-readout console.
4. Console operator: The man-machine interaction between the process computer and the process engineers.
5. Process control: The use of negative feedback for maintaining a process variable at the operating point set by the process engineer.
6. Update: The provision for changing the process being controlled.
7. Stream analyzer: The conversion of the output of on-line chromatographs to per cent composition.
8. Demand log: The provision for printing arrays of process variables with their descriptors for the last 8 or 24 hours upon demand on the process computer line printer.
9. Trend recorder: The driving of red/blue ink pens on a strip chart to display process variables as a function of time.

The process control functions such as alarming, analog scanning, and controlling are independent of the processes being controlled. These functions have update-in-place tables which contain the specifics of the job to be done. A process variable may have entries for it in the analog scan table and the log table, for example. The addition of new process variables, or the redefinition of an old variable, simply requires the changing of data in the associated tables. The "update" function accepts "update data" from the central computer and places it in the proper table.

The strong points of this type of process computer design is that it provides both flexibility and reliability, which are often mutually exclusive in process computer systems. The



Mr. Matherne is senior programmer in standard software development for the MAC 16 computer with the Data Products Div. of Lockheed Electronics Co. Previous to this he was with Union Carbide Corp., where he was responsible for systems programming, training, and operation of a multicomputer process control system. He has a BS in physics from Louisiana State University.

flexibility comes from the ease of changing process variables; the reliability from the elimination of reprogramming when process changes occur.

central computer design

Those functions not reserved by the process computers are placed in the central computer. A breakdown of these functions follows:

1. Optimization: The controlling of several process computer control loops according to an optimization scheme for improving the value of the products.
2. Update: The interpretation of engineering data on punched cards for changing process computer functional tables, and the transmission of the data to the process computers.
3. Demand log: The storage of 24 hours of process variables, and the transmission of arrays of process variables to the process computers on demand.
4. Production records: the preparation of management information reports for the entire plant.
5. Plant summary: The calculation of total plant usages of utilities such as electricity, cooling water, and steam.
6. Language processing: The on-line compiling, assembling, and debugging of both source language (FORTRAN) and assembly language programs for the central and process computers.

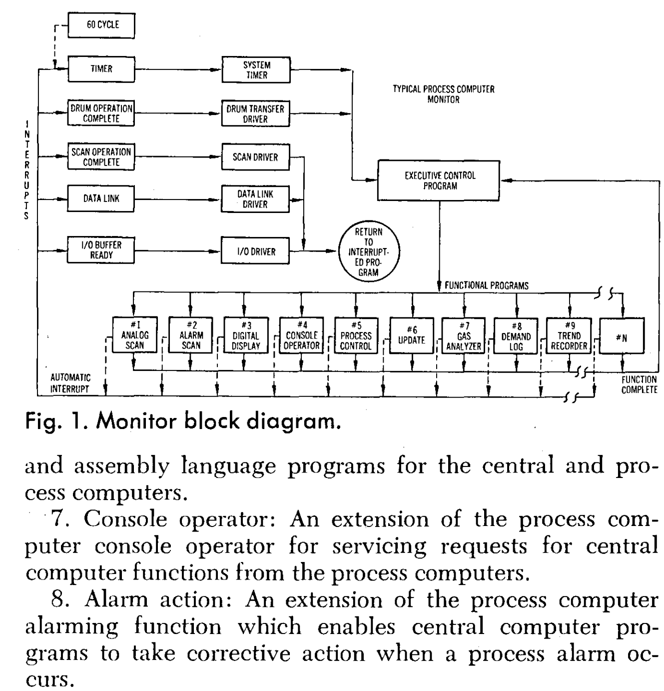


Fig. 1. Monitor block diagram.

7. Console operator: An extension of the process computer console operator for servicing requests for central computer functions from the process computers.
8. Alarm action: An extension of the process computer alarming function which enables central computer programs to take corrective action when a process alarm occurs.

The operating system for the central computer is a modified process computer monitor. The changes are mainly a deemphasis of the priority levels of functions in order to provide adequate servicing of the background processing system; that is, the function of a real-time computer utilizing the free time left over from controlling a process.

The design of the integrated, plantwide computer system required that the central computer have the following capabilities:

1. Communication with controlled processes through several process computers.
2. On-line compiling, assembling, testing, and library maintenance of a large number of programs.
3. FORTRAN capability with a real-time I/O submonitor for handling printing, disc read-write, and data transfer to and from the process computers.
4. Capability for handling the segmenting and scheduling of a large number of real-time functions (about 700).
5. A usable FORTRAN COMMON for data communication between real-time program segments.

The vendor's software met the second and third requirements above but was deficient in the other three. To provide a monitor with 700 independent functions would have required about 16 words of register storage and various pointers for each function, or a total of 11,200 words of core memory. This is unreasonable for a 24K machine. Real-time linkage software was available from the vendor whereby several programs could share the same monitor function. The real-time linkage enabled one program to link to another program to run, but was unsatisfactory for the proposed system. The problem was one of organization; the system had to be capable of handling several hundred unrelated, randomly occurring events as well as regular time-sequenced events.

Providing a usable FORTRAN COMMON was a problem. FORTRAN COMMON is a must for doing large amounts of program segmenting, because it gives the programmer a reserved section of resident core for transmitting data between program segments. The only alternative to FORTRAN COMMON is using disc storage which is expensive because of the slow access time. The vendor software had only one FORTRAN area. The individual programs which needed COMMON would have to be assigned individual sections of FORTRAN COMMON. This would have required an unreasonable amount of core memory.

The solution to both these problems was the development of an adjunct software package known as the SEE package, which stands for Sub-Executive Environment. The SEE package separates the 700 real-time programs into 6 partitions called program classes. All of the programs in a program class run as the same independent function under the control of another monitor function known as a subexecutive. To four of the six program classes, a section of FORTRAN COMMON is assigned. This solves the COMMON problem. A program running in one of these classes can safely transfer data via that class's COMMON area to its own subroutines or the next program to run in the same class. Fig. 2 (p. 142) shows how the division of FORTRAN COMMON is accomplished.

The scheduling of the execution of the real-time programs was accomplished by use of an auxiliary timetable. This timetable contains the next-time-to-run for all of the real-time functions. The next-time-to-run can be in increments of one minute or upon demand. A timer program decrements the time-to-run each minute. When the time-to-run becomes zero, the subexecutive for that program sets up pointers that monitor needs to run that program. Then the monitor schedules the execution of the real-time program.

Two subroutines which provide the scheduling capability are SEEON and SEEOFF. The SEEON call is used by one real-time program to begin the execution of another real-time program as soon as possible. SEEON places a zero in the time-to-run word for the requested program. The subexecutive will execute that program when all other real-time programs ahead of it in its class have completed.

The SEEOFF subroutine provides a segmenting and scheduling capability. A SEEOFF call has two arguments as shown:

CALL SEEOFF (t,p)

The t variable contains the number of minutes from the present time that the execution of the calling program is to occur again. The p variable contains the real-time program number that is to be executed as the next link of this program chain. If t = 9999, the program is to be executed again only by a SEEON call. This is known as a demand program. If p = 9999, the program simply turns itself off or stops executing. In this case the program class is freed for running other programs.

The first requirement, that of multicomputer communication, was solved by the design of a data link system using polling techniques. The central computer is the master

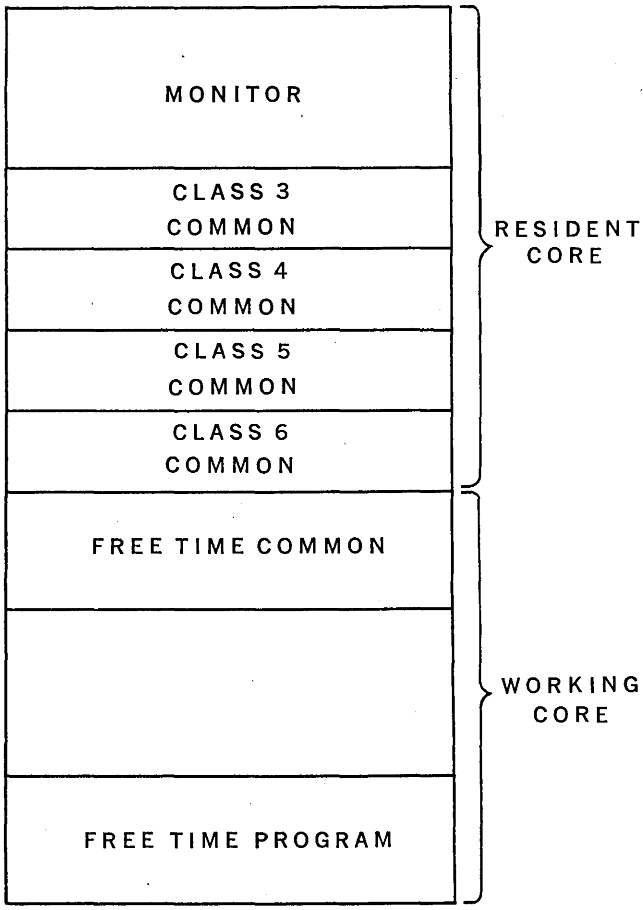


Fig. 2. Resident-working core.

controller of the data links. It keeps track of the traffic on the data links and schedules the transfers between itself and the process computers. It does this by initiating status polls to each of the process computers as shown in the flow diagram in Fig. 3. A transfer may be in progress in only one direction at a time and, like other I/O, the data link hardware uses cycle-stealing transmission.

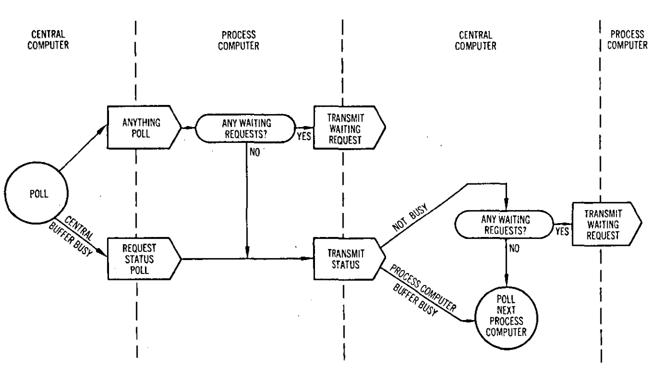


Fig. 3. Polling diagram.

The flow of data between the central and one of the process computers is shown in Fig. 4. The examination of the steps involved in an alarm limit change will shed some insight into how the data link software operates:

1. A central computer program lodges a data link OUTPUT request to process computer no. 1 by using the FORTRAN statement, OUTPUT 1, 5, 0, (DATA/ADDRESS), where 1 is the process computer designator, and 5 is the alarm limit change function code, DATA contains the new alarm limits, and ADDRESS is the process computer location, if required.

2. Program control is transferred to a transient system subroutine called data link submonitor which stacks the output request into the master driver stacking table and returns program control to the requesting program.

3. The master driver transmits the information to the process computer driver when all the previously stacked requests have been serviced, and the driver can accept a new request.

4. The request is serviced by the no. 1 driver by placing

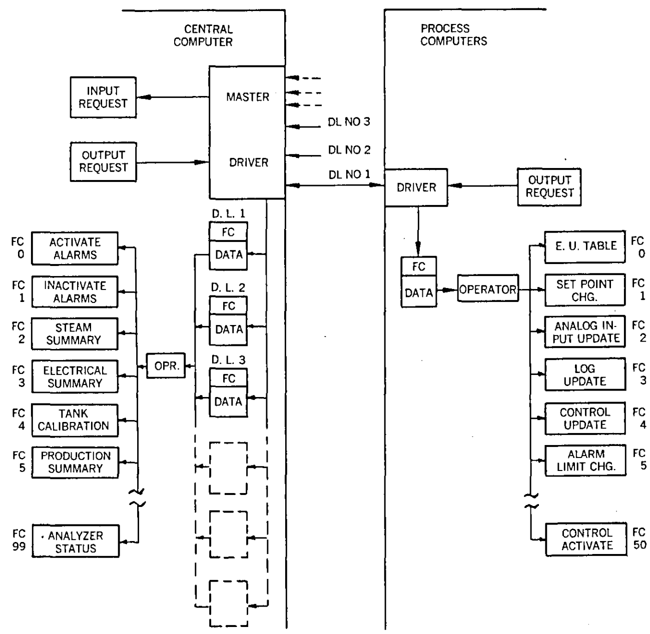


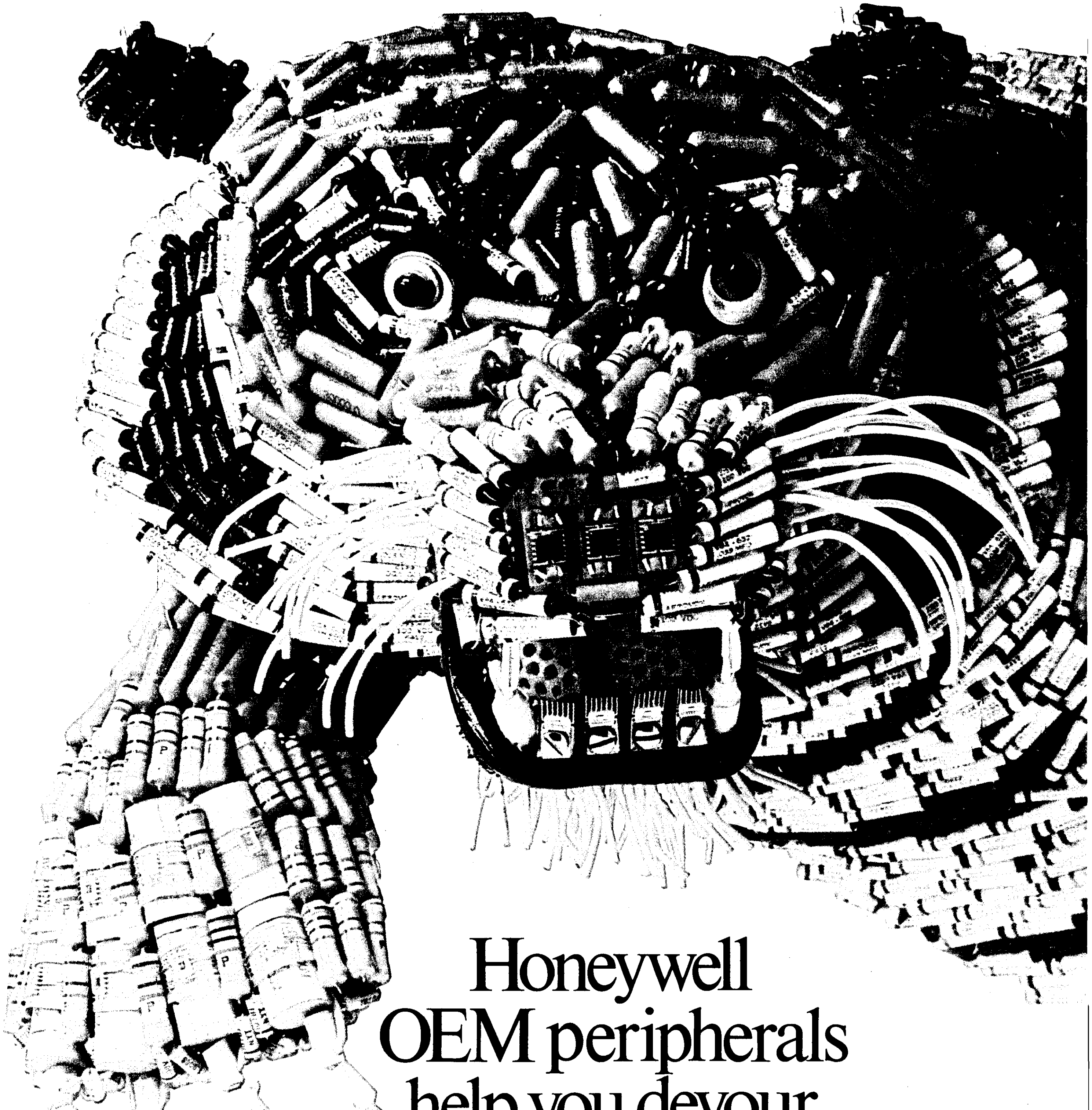
Fig. 4. CC-PC data link diagram.

the alarm limit change data into a buffer and turning on the data link operator program.

5. The data link operator determines that the function code associated with the data is 5, and turns on the alarm limit change function which removes the data from the buffer, releases it, and changes the alarm limits as requested.

Central computer programs can also do data link INPUT requests with FORTRAN statements. The sequence of events is similar to an OUTPUT, but the data flow is in the opposite direction. The major difference is that the program is placed in a suspended state in core while waiting for the transmission to be completed. To minimize the waste of core by programs waiting for INPUTS, they are serviced before OUTPUT requests. INPUT requests are used by central computer programs to provide the process information needed for its supervisory process control function.

The process computer may OUTPUT to the central computer, but may not request INPUTS because it cannot afford the resulting waste of core capacity. The OUTPUT requests



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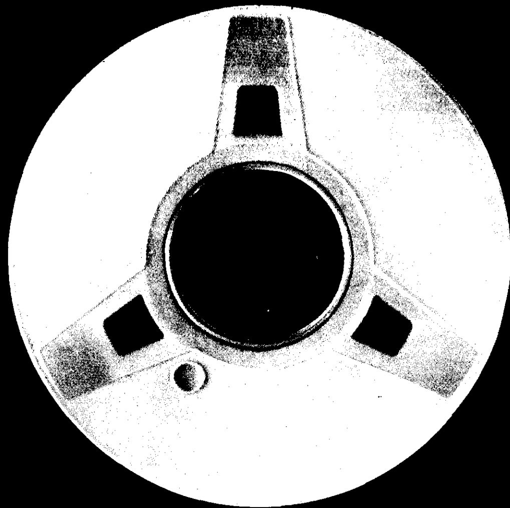

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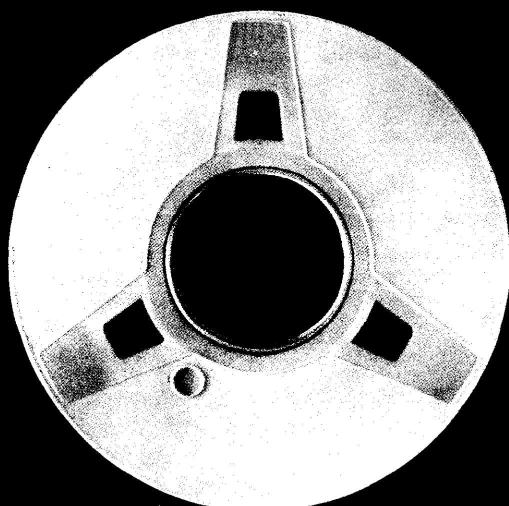

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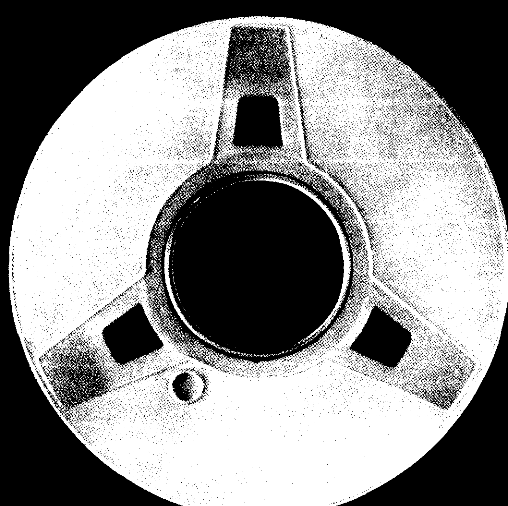

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CIRCLE 151 ON READER CARD

are made in assembly language direct to the data link availability and stacking subroutines. OUTPUT requests from the process computer are necessary for the central computer alarm action, console operator, and plant summary functions.

One other handy tool for multicomputer communication is the capability for programs in the central computer to print on any process computer devices using FORTRAN print statements. This was accomplished by a change to the FORTRAN print submonitor. Whenever a device code of 10 or greater is requested, the first digit is used as the process computer designator, the second digit as the device number, and the FORMAT and DATA words are transmitted to the selected process computer. A program there receives the data and prints it on the proper device. The examples below illustrate several of these print statements:

PRINT STATEMENT	SELECTED PRINT DEVICE
PRINT (0) 801, DATA	Central computer line printer
PRINT (1) 801, DATA	Central computer I/O typer
PRINT (10) 801, DATA	No. 1 process computer line printer
PRINT (20) 801, DATA	No. 2 process computer line printer
PRINT (34) 801, DATA	No. 3 process computer typer No. 4

optimization benefits

Two of the central computer functions, the plantwise summary and optimization capability, illustrate the benefits of the multicomputer aspects of the system. The plantwide summary is a console operator request function. The desired function is requested by a technician or engineer at the operator's console of one of the process computers by pressing a button. This turns on the selected function in the central computer, which inputs the data it needs from the three process computers, calculates the totals, and prints the data on the process computer line printer that is adjacent to the console.

The most important contribution of a central computer system is the ease by which unit optimization can be implemented. Optimization programs are normally large programming packages which are developed by specialists in the chemical process to be optimized. With a central computer system it is feasible for optimization packages for several different units to be developed in FORTRAN on another machine. Then, with a minimum of effort, they can be segmented to fit the core restrictions of the central computer and debugged in an on-line mode without interrupting the process control of each of the units.

The optimization begins with the current market prices of the various products which may be produced. These data are entered into the central computer optimization program which uses them as a basis for throughput and product mix regulation. The regulation is accomplished by the changing of set points and control parameters in the process computer. The process computer finally controls the process according to the specified set points and control parameters.

The central process computer approach to controlling a large chemical process has been described. The placement of fast-cycle, direct-control functions in the drum-core process computer, and slow-cycle, optimization functions in the disc-core central computer, provides the best use of both types of computers. This blending of computer power and costs makes this approach attractive for many large-scale process computer systems. ■

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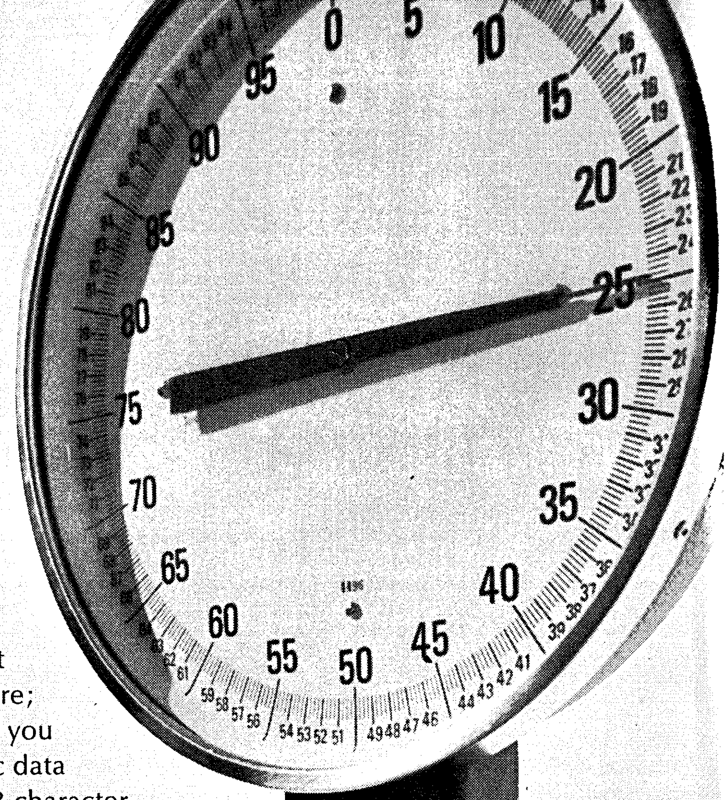

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CIRCLE 199 ON READER CARD

TACPOL— A TACTICAL C&C SUBSET OF PL/I

by Herman Hess and Charles Martin

Developing a military command and control language, TACPOL (*TAC*tical *P*rocedure *O*riented *L*anguage), as a subset of PL/I—a language unproven in this application—and implementing a processor *for* and *in* this same language in less than a year is a challenging and somewhat harrowing experience. Fortunately, it also turned out to be highly rewarding, since PL/I proved fully capable of supporting all specified command and control requirements, as well as serving as an excellent implementation vehicle for a sophisticated compiler.

Although TACPOL is the designated programming language for the Army's TACFIRE (tactical fire direction) system, it is broad enough to be applicable to similar real-time command and control systems, such as the Tactical Operations System (TOS) and the Combat Service Support System (CS$_3$). TACFIRE provides direct support to the Army field artillery in tactical situations. Its mission is to supply fire direction information and commands, perform fire planning (fire tables) for a whole gamut of weapons, and evaluate targeting and related intelligence.

The various functions of the TACFIRE system are directed and monitored by the Litton L-3050 computer, whose range of capabilities is roughly comparable to a system with the combined features of an IBM System/360 Models 50 and 44. Major programming areas include TACFIRE application programs, data base support programs, utility routines (memory dump, diagnostics), operating system routines (executive, scheduling, interrupt handling), the compiler and its support programs, and program and system test routines.

pols versus mols

It was recognized early in the contract-definition phase of the project that a procedure-oriented language (POL), rather than a machine-oriented (symbolic assembly) language (MOL), should be used for TACFIRE programming. The Army was fully aware of the relative advantages of a procedure-oriented language for program development, maintenance, and possible future conversion. A POL would be machine independent, thus simplifying program development for interrelated systems. Relatively inexperienced programmers would find it easier to learn a POL, would write programs with fewer errors, and would have less trouble debugging them. Better documentation of programs written in POL would reduce the cost of initial and ongoing maintenance, and facilitate cross-training for related systems on different machines. Moreover, program conversion to successor machines or languages would be far simpler in a POL than in a MOL.

Among recognized advantages of an assembly language (MOL) are the ability to achieve a better balance between storage utilization and execution time, and the ready access to specific machine characteristics, not generally available in a POL. To preserve these MOL advantages, the selected POL should provide a MOL capability embedded within its procedures, thus permitting MOL programmers to hand-tailor a few time-critical portions of the TACFIRE system. A somewhat less efficient object code in the remainder of the system, produced at an acceptable performance level and at reduced cost, was considered a satisfactory trade-off.

selection study

Although the Army was convinced that TACFIRE programming required a procedure-oriented language, it did not prejudge the selection of an existing POL adequate for the task. While one of the key requirements—the ability to process character and bit strings—appeared to qualify immediately such languages as JOVIAL and PL/I, a variety of other considerations might, on balance, give the advantage to one of the other POL's. Accordingly, a study was ordered on the adequacy and implementation requirements of existing POL's for the TACFIRE mission. This study[1] set up nine general language criteria to be used in the selection of a POL. They were: applicability, legibility, brevity, independence, efficiency, parsability, safety, extensibility, and con-

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trollability. Let us briefly consider the significance of each.

To qualify for selection, the POL must be applicable to the problems to be solved; that is, it must embrace the broadest possible range of TACFIRE programming areas. Legibility implies that the POL must be easily understood by programmers—must be capable of being clearly expressed and easily learned. While the language must be legible, it must also be brief and concise: it should be no richer and redundant in its operations and algorithms than is necessary to retain legibility. It is obvious that the selected POL must be as independent as possible of specific machine characteristics and particular input/output configurations.

Perhaps most important for C&C language, the POL must provide for efficient generation of object code and data structures. There should be a near-optimum balance between conservation of storage space and execution time, tailored to the requirements of particular algorithms. To meet this requirement, the POL must provide language structures that parallel to a high degree the desired object code structures. This means, for example, that complex conversions of values should be permitted only *explicitly*, to encourage programmers to optimize coding. The Army's language strategy, generally, required programmers to be aware of all code generated and in full control of object code efficiency.

For easy parsability, the programs should be capable of being parsed automatically by a straightforward algorithm permitting the implementation of a relatively inexpensive, small, and fast compiler, with minimal maintenance.

Safety requires that the POL's program structures should aid the programmer in the prevention of programming errors and should facilitate error detection. Safety also demands the explicit specification of all operations and characteristics of a quantity. This should preferably be done in a single declaration to avoid accidental omission of characteristics used later in the program. Default characteristics are also considered error-prone for this particular implementation.

Extensibility simply means that the language should be adaptable to future changes in processing requirements. Finally, the selected POL was to provide adequate control over critical parameters of the programming system, including systemwide data files, storage allocation, program interactions, and hardware usage. This requires the inclusion of "compools" (communication pools) and appropriate control program features.

The degree of prior implementation of a POL considered for selection was not held important for the purposes of the study, primarily because this fact alone did not promise a significant reduction in the implementation effort. Moreover, a new implementation might result in a better product.

From these general characteristics the preliminary study then developed a comprehensive set of specific language requirements[2], which are summarized in Figs. 1 and 2. However, among predictable requirements were: the inclusion of fixed-point arithmetic with double-length capability; character and bit string manipulation; an embedded assembler language capability; procedures invoked by the occurrence of interrupts; fixed point and character string literals; the use of blocks; and a central definition—or compool—facility.

evaluation of existing pol's

In accordance with these criteria and requirements, Litton Data Systems Division performed, in 1967, the evaluation of seven existing procedure-oriented languages: FORTRAN, COBOL, JOVIAL, ALGOL, NELIAC, CS-1, and PL/I. The results of the study, shown in the two summary charts (Figs. 1 and 2), revealed that none of the seven eligible POL's completely met the requirements of the TACFIRE application. The ranking of the seven candidates, in order of relative adequacy, is as follows:

1. PL/I—modified subset acceptable
2. JOVIAL—substantially modified subset acceptable
3. COBOL—very substantially modified subset acceptable
4. ALGOL—very substantially modified subset acceptable
5. CS-1—inadequate
6. NELIAC—inadequate
7. FORTRAN—inadequate

The leader, PL/I, had approximately 81% of the specified language requirements present in some degree, the highest percentage of any of the candidates. The chief defect of PL/I (and its chief merit from another perspective) was the richness. Over 50% of PL/I's language features were not required or not applicable to TACFIRE. This, of course, made it easy to select a slightly modified subset of PL/I that would be adequate. PL/I lacked an embedded MOL (assembler language) capability and a central definition (compool) facility. Thus, the development of a suitable military subset of PL/I would require the addition of these two capabilities and the deletion of all nonapplicable features.

Since the runner-up, JOVIAL is the most widely used command and control language at present, some of the reasons for down-rating it may be of interest. Although JOVIAL contained approximately 66% of the specified language requirements, it had the following primary deficiencies: complex rules concerning spacing, reserved words, and scope of definition; limited legibility because of unfamiliar symbols and overly brief abbreviations; no provisions for recursive procedures; no interrupt handling capability; limited input/output logic; and too many operations tending to generate inefficient object code (for example, the FOR statement, which is too general; no concatenation operator, and no built-in functions).

While PL/I appeared to have a clear theoretical edge over other POL's for the TACFIRE mission, the decision to develop a PL/I subset had to take into account additional factors, such as compiler implementation problems, the available computer configuration and implementation software, language support and possible improvements, as well

(Text continues on p. 155)

Mr. Martin is manager, language development and system support, in the systems programming services department at Litton Systems, Inc. He was project manager for the development of the TACPOL compiler. He has a BS in Public Administration from the University of Southern California.

SUBSECTION AND REQUIREMENT	FORTRAN	COBOL	JOVIAL	ALGOL	NELIAC	CS-1	PL/1
4.1.1 LIMITED CHARACTER SET				N	N		N
4.1.2 NONSIGNIFICANT SPACES		N	L			N	L
4.1.2 NO INPUT FORMATTING	N	N				N	
4.1.3 18-CHARACTER IDENTIFIER	N				L	N	
4.1.3 MULTIWORD IDENTIFIER						N	
4.1.3 NO RESERVED IDENTIFIER		N	N		L	N	
4.1.3 DEFINED BEFORE USED	N		L	L	L		N
4.1.4 LEGIBLE WORD SYMBOLS			L			L	
4.1.5 FLEXIBLE COMMENTING	L	L				L	
4.2.1 27-BIT PRECISION							
4.2.1 54-BIT PRECISION	N			N	N	N	
4.2.1 FLEXIBLE SCALING	N			N	N		
4.2.1 UNSIGNED STORAGE	N			N		L	N
4.2.2 500-CHARACTER LENGTH	N			N	N		
4.2.2 ASCII DATA SET							
4.2.2 SINGLE-CHARACTER DESIGNATION	N	L		N	L	N	
4.2.3 WORD LENGTH BIT STRING	N	N	L	N	L	L	
4.2.3 SINGLE-BIT DESIGNATION	N	N		N		N	
4.2.4 BOOLEAN		N			N	N	N
4.2.5 SYMBOLIC VALUE	N	L	N	N	N	N	N
4.3.1 MULTIDIMENSIONS					L	N	
4.3.1 1 TO n, NOT 0 TO n			N		N	N	
4.3.1 ALIGNED OPTION							
4.3.1 PACKED OPTION	N		N	N	N	N	
4.3.1 EXPRESSION SUBSCRIPT		N			N	N	
4.3.1 ARRAY DESIGNATION					N	N	
4.3.1 SUBARRAY DESIGNATION	N		N	N	N	N	
4.3.2 MIXED GROUP	N		N	N	L		
4.3.2 ARRAYS IN GROUP	N		N	N	N		
4.3.2 MIXED DIMENSIONS	N		N	N	N	N	
4.3.2 PACKED OPTION	N		N	N	L	L	
4.3.2 ALIGNED OPTION	N		N	N	N	L	
4.3.2 GROUP DESIGNATION	N		N	N			
4.3.3 TABLES	N			N	L		
4.3.3 ARRAYS IN TABLE	N		L	N	N	N	
4.3.3 PACKED OPTION	N			N	L	L	
4.3.3 ALIGNED OPTION	N			N	N	L	

SUBSECTION AND REQUIREMENT	FORTRAN	COBOL	JOVIAL	ALGOL	NELIAC	CS-1	PL/1
4.3.3 EXPRESSION SUBSCRIPT	N	N		N	N	N	
4.3.3 GROUP DESIGNATION	N			N			
4.3.3 TABLE DESIGNATION	N			N	N	N	
4.3.4 OVERLAYED STRUCTURES				N		L	
4.3.5 DYNAMIC STRUCTURES	N	N	N		N	N	
4.4 RECORD TYPE FILES				N	N	N	
4.4 EXTERNAL DEFINITION	N			N	N	N	N
4.4 SERIAL OPTION				N	N	N	
4.4 DIRECT OPTION	N		N	N	N	N	
4.4 EXCLUSIVE SEIZURE	N	N	N	N	N	N	
4.4 RESTRICTED ACCESS	N	N	N	N	N	N	N
4.5.1 PROCEDURE BLOCK							
4.5.1 MOL BODY	L						N
4.5.2 FUNCTION BLOCK		N				N	
4.5.2 MOL BODY	L	N				N	N
4.5.3 LOCATION PARAMETER		N		L		N	
4.5.3 VALUE PARAMETER		N					
4.5.3 STATEMENT PARAMETER	L	N	L	L	N	L	L
4.5.3 EXPRESSION PARAMETER	L	N	N	L	N	L	L
4.5.3 NO PARAMETERS	L						
4.5.4 ARITHMETIC INTERRUPT	L		N	N	N	N	
4.5.4 I/O INTERRUPT	N		N	N	N	N	
4.5.4 OS INTERRUPT	N	N	N	N	N	N	N
4.5.5 REENTRANT CODE	L		L		L	L	
4.5.5 RECURSIVE PARAMETERS	N	N	N		N	N	
4.6.1 FIXED-POINT LITERAL					L		
4.6.1 DECIMAL EXPONENT	N	N		N	N	N	L
4.6.1 BINARY SCALE FACTOR	N	N		N	N	N	N
4.6.1 +, -, *, /							
4.6.1 EXPONENTIATION					N	N	
4.6.1 IMPLICIT PRECEDENCE							
4.6.1 ( )					L		
4.6.1 FULL PRECISION OPERATION	N		L	N	N		
4.6.1 NO MIXED EXPRESSIONS	N	N	N	N		N	N
4.6.1 SQUARE ROOT		N	N		N	N	
4.6.1 EXP, LN		N	N		N	N	
4.6.1 SIN, COS, ARCTAN		N	N		N	N	

NOTE: N = INADEQUATE, L = LIMITED ADEQUACY, BLANK = ADEQUATE

Fig. 1.

SUBSECTION AND REQUIREMENT	FORTRAN	COBOL	JOVIAL	ALGOL	NELIAC	CS-1	PL/1
4.6.1 SIGN, ABS	L	N	L		N	N	
4.6.1 ROUND, TRUNCATE	L	L	L	L	L	L	
4.6.1 RESCALE, NEW PRECISION	N	N	N	N	L	N	
4.6.1 MIN, MAX		N	N	N	N	N	
4.6.1 REMAINDER		N			N	N	
4.6.1 BIT, CHARACTER CONVERT	N	L	L	N	N	N	
4.6.2 ANY CHARACTER STRING	L			L	L	L	
4.6.2 CATENATION	N	N	N	N	N	N	
4.6.2 REPEATED STRING FUNCTION	N	L	N	N	N	N	
4.6.2 BIT, DIGIT CONVERT	N	L	N	N	N	N	
4.6.2 ARBITRARY FUNCTIONS	N	N		N	L	N	
4.6.3 BINARY LITERAL	N	N	N	N	N	N	
4.6.3 OCTAL OR HEXADECIMAL	N	N		N			N
4.6.3 CATENATION	N	N	N	N	N	N	
4.6.3 INTEGER, CHARACTER CONVERT	N	N	N	N	N	N	
4.6.3 ARBITRARY FUNCTIONS	N	N	N	N	L	N	
4.6.4 UNIQUE BOOLEAN LITERALS		N	N		N	N	N
4.6.4 AND, OR, NOT					L	L	
4.6.4 SIX RELATIONS							
4.6.4 NUMERIC RELATION					L		
4.6.4 CHARACTER RELATION	N			N	L	N	
4.6.4 BIT RELATION	N	N	L	N	L	L	
4.6.4 NO MIXED RELATIONS	N	N		N		N	N
4.6.4 IMPLICIT PRECEDENCE					N	N	
4.6.4 [illegible]					N	N	
4.6.4 LETTER, DIGIT TESTS	N		N	N	N	N	N
4.6.4 GENERAL TRUTH FUNCTION	N	N	N	N	N	N	
4.6.4 ARBITRARY FUNCTIONS		N			N	N	
4.6.5 CONDITIONAL EXPRESSION	N	N	N		N	N	N
4.6.5 MULTIPLE CONDITIONS	N	N	N		N	N	N
4.7.1 NO MIXED ASSIGNMENT	N	N		N	N	N	N
4.7.1 MULTIPLE ASSIGNMENT	N		N				
4.7.1 EXCHANGE ASSIGNMENT	N	N		N	N	N	N
4.7.1 STRUCTURE MOVE	N		L	N	L	L	
4.7.2 OPEN IN, OUT, UPDATE	N		L	N	N	N	
4.7.2 CLOSE	N			N	N	N	

SUBSECTION AND REQUIREMENT	FORTRAN	COBOL	JOVIAL	ALGOL	NELIAC	CS-1	PL/1
4.7.2 READ RECORD				N	N	N	
4.7.2 WRITE RECORD				N	N	N	
4.7.2 REWRITE RECORD	N		N	N	N	N	
4.7.2 DELETE RECORD	N		N	N	N	N	
4.7.2 WAIT LOGIC	N	N	N	N	N	N	L
4.7.2 POSITION FILE	L	L		N	N	N	L
4.7.2 REFERENCE POSITION	N	L		N	N	N	N
4.7.3 GO TO STATEMENT							
4.7.3 FLEXIBLE POINTS		L				L	
4.7.3 MULTIPLE IDENTIFIERS	N	N				N	
4.7.3 END OF BLOCK POINT	L	L	N		N	N	
4.7.4 CALL STATEMENT		L					
4.7.5 STOP STATEMENT				N	N	N	
4.7.6 NULL STATEMENT			N			N	
4.7.7 IF BOOLEAN STATEMENT						L	
4.7.7 ANY SUBORDINATE STATEMENT							
4.7.7 SUBORDINATE BLOCK	N	L			L	L	
4.7.7 ELSE OPTION	N					N	
4.7.7 MULTIPLE ELSE OPTION	N				N	N	
4.7.8 SPECIFIC VALUES SWITCH	N	N		N	N	N	N
4.7.8 ANY SUBORDINATE STATEMENT	L	N	L	N	N	L	N
4.7.8 SUBORDINATE BLOCK	N	N	N	N	N	N	N
4.7.9 INTEGER PROGRAM ITERATION			L	L			L
4.7.9 EVALUATION BEFORE ITERATION		N	N	N			
4.7.9 NO ASSIGNMENT TO CONTROL			N	N	N	N	N
4.7.9 WHILE BOOLEAN EXPRESSION OPTION	N		L		N	N	
4.7.10 FLEXIBLE BLOCKING	N	L			N	N	
4.8 PROCESS, FUNTION PROGRAMS		N	L				
4.8 CENTRAL DEFINTIONS	N	L		N	L	N	
4.9 SCOPE BY BLOCK	N	N	L		L	L	
4.9 NESTED BLOCKS	N	L	L		L	L	
4.9 NO TRANSFER INTO BLOCK	N	N	N	L	N	L	N
4.9 LOCAL CONTROL VALUES	N	N	N	N	N	N	N
4.9 LOCAL PARAMETERS		N				N	
4.9 GLOBAL SCOPE	N	N		N	L		N
TOTAL NUMBER OF "Ns"	80	57	49	76	78	89	28

NOTE: N - INADEQUATE, L = LIMITED ADEQUACY, BLANK = ADEQUATE

Fig. 2.

as financial considerations. The costs of implementing a language and its processor were believed to be essentially the same for any of the existing POL's, size being the major factor. It is, obviously, easier to implement a small language than a large one, but the size of the language and compiler should be controllable by choice of an appropriate subset. The relative difficulty of developing a compiler also appeared to be roughly the same for the major POL's but the fact that PL/I had provisions for recursive procedure—needed for the parsing phase of the compiler—gave it the advantage over JOVIAL.

However, the key factor in making the language decision was the delivery by IBM in October, 1967, of a workable PL/I F Compiler. While PL/I had been announced earlier, it was still only a dream in the eyes of the implementation team. The demonstration of a workable compiler permitted the drafting of a detailed implementation plan with specified delivery dates.

Over-all, our proposal to implement a subset of PL/I appeared sound for three major reasons. First and foremost, the suitability of a PL/I subset for the TACFIRE mission had been determined by prior studies. Secondly—and this proved to be an important time and cost consideration—it should be possible to implement the compiler in its own language (PL/I), thus avoiding the cumbersome process of writing it in assembly language or developing a special compiler-oriented language. (The prior implementation of the NELIAC compiler in its own language provided a strong precedent.) Writing the compiler in PL/I, moreover, would permit more or less "mechanical "bootstrapping" in the Litton computer, aided by PL/I's character and string processing ability. Thus, we hoped—justifiably so, as it turned out—that in implementing and bootstrapping the compiler we would never need to descend from the level of a procedure-oriented language (POL) to a machine-oriented language (MOL). Training in only one language—PL/I—was an additional advantage.

Finally, we felt that implementing a subset of PL/I was commercially sound. Although operational experience was lacking, PL/I's excellent language capabilities promised a viable future. Since the language was primarily an IBM development, we anticipated that IBM would continue to give it strong support. We would also be able to use the growing body of IBM's PL/I publications and training literature, not available to this extent in other languages. Thus, the choice of PL/I should place us in a good competitive position against the other bidders.

the tacpol language

PL/I is a very rich language, designed at the outset to be used in subsets. As mentioned earlier, our major task was to delete the nonapplicable features of the language, add a central definition (compool) capability to facilitate inter-program communication, and permit procedures to be written, optionally, in a machine-oriented (basic assembly) language for optimal coding of critical TACFIRE program portions. There was also the tactical implementation requirement to provide adequate control over the interface of TACPOL with the compool and the assembly language (MOL).

The major consideration that guided the development of TACPOL—again, primarily for tactical reasons—was to hold down the size of the TACPOL program by restricting or eliminating PL/I language features that would tend to generate large volumes of object code. This also demanded that all coding be explicit to make programmers aware of the amount of code being generated.

Space does not permit outlining the structure of the TACPOL subset of PL/I, which is described in the TACPOL language specification[3]. The richness of PL/I was self-evident when it became apparent that TACPOL used only 25% of the full language, while meeting all specifications and requirements.

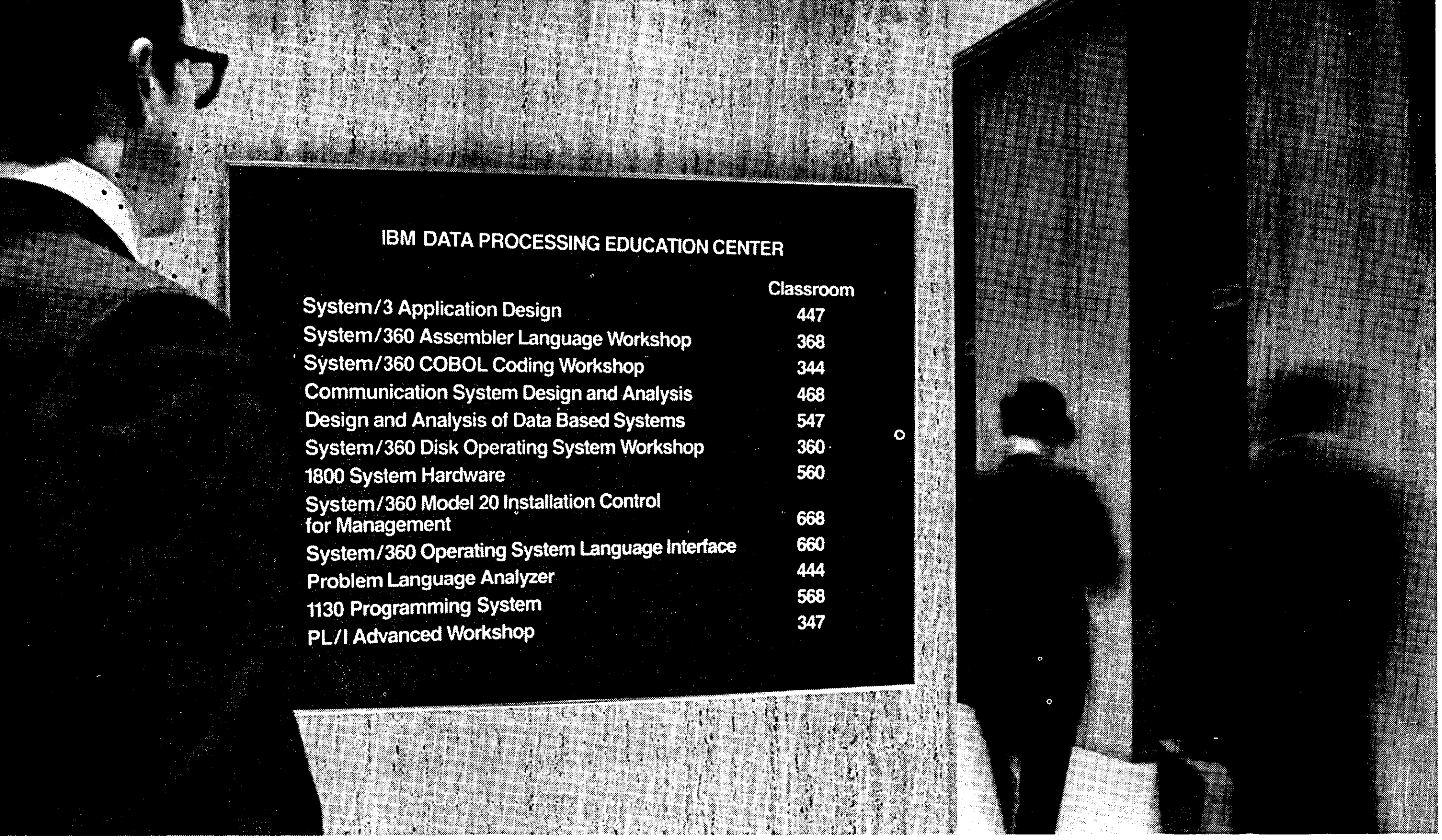
Some of the few deviations from PL/I, in the TACPOL subset—primarily restrictions—may be of interest here. In line with the prohibition on implicit coding mentioned above, TACPOL does not permit the use of default attributes and mixed-mode expressions; they are not really needed in the TACFIRE application. The number of dimensions in arrays was held to three, which is adequate for the problem. Since TACPOL does not use floating-point arithmetic, the number of arithmetic attributes could be restricted to binary fixed characters and bits. Similarly, the factoring attributes associated with PL/I declarations were considerably reduced. In general, however, the declarative and procedural capabilities of TACPOL are functionally the same as in PL/I.

While the TACPOL subset of PL/I was considerably restricted to conform with requirements, the design permits future extensions for features not in use now, such as mixed-mode expression or floating-point arithmetic (this may eventually be needed). Mixed-mode expressions and other implicit functions that were eliminated, moreover, can often be performed *explicitly* by the use of intrinsic functions. Intrinsic procedures also were used to implement features not present in PL/I or to compensate for those eliminated. Thus, it became necessary to compensate for the absence of floating-point operations in TACPOL by slightly augmenting PL/I's fixed-point arithmetic. TACPOL has provisions for handling fixed-point double-length products. Similarly, intrinsic functions are invoked to provide for a catenation capability, since it is not possible to *implicitly* concatenate a character with a bit string—although catenation of bit and character string is possible with a bit converted to character. We also anticipate that TACPOL's procedure capabilities will permit later compensation for PL/I features that were underestimated or unintentionally omitted.

compiler design and development

It was fairly evident that we would need to design and custom-build our own TACPOL compiler, rather than modify some version of the PL/I F compiler, which in any case was not available to us for modification. The TACPOL language was only a small subset of PL/I and, hence, would require a much smaller compiler than existing PL/I versions. In addition, the PL/I F compiler was tied strongly to the IBM operating system and machine characteristics. The addressing features of the L-3050 computer are substantially different than those of the IBM System/360 and require a different coding technique to produce efficient code. In view of all this, it appeared easier to develop our own compiler than modify a PL/I version and thereby have the opportunity to employ the machine characteristics of the L-3050 computer.

Having made the decision to custom-build a TACPOL compiler, as far as possible in its own language, we foresaw some additional advantages. Instead of producing directly loadable object code, as in the PL/I F compiler, the TACPOL compiler could provide for a separate assembler phase, which could be developed in parallel with the compiler proper. A separate assembler would permit optimal interfacing with the full TACFIRE programming system and allow a free mix of assembly and higher-order languages. For example, compool information could feed directly either



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into the TACPOL compiler or into the assembler, and time-critical portions of programs coded in assembly language could be intermixed with TACPOL. Our own TACPOL compiler, moreover, could provide for extensive interrupt capabilities (PL/I's ON condition) invoked by a variety of conditions.

Because of the short time available, the TACPOL compiler was developed in three major phases (Fig. 3). In the first phase, a TACPOL compiler written primarily in the PL/I

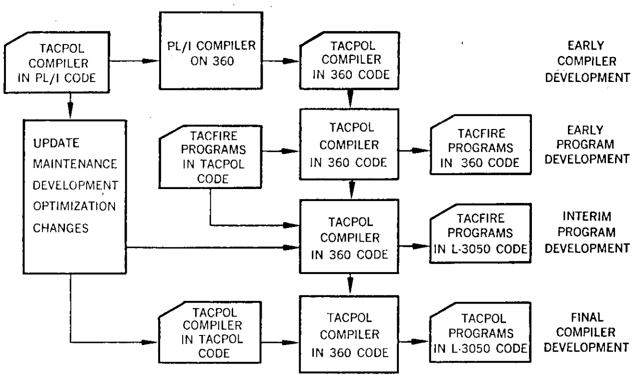

Fig. 3.

subset produced object code for the L-3050 computer, but actually ran on System/360.

The early compiler development had a twofold purpose: it would prove the basic compiler concepts and logic, and also would quickly produce object code for the L-3050, to permit testing and debugging TACPOL programs. As is illustrated in the flow diagram (Fig. 3), the early TACPOL compiler written in the PL/I subset was converted to System/360 machine code by compiling it on the 360 PL/I compiler. TACPOL programs were compiled by this TACPOL/360 compiler to produce the required L-3050 machine code. It is worthwhile noting that it never became necessary to fall back on the IBM system assembler language (BAL) for debugging or other purposes, even in this initial compiler.

The second phase of compiler development aimed at providing an improved production version designed to be resident on the System/360. It provides us with an alternate capability of processing TACPOL jobs. The improvements consisted primarily of filling in details and optimizing the generated code. In addition to operating in the System/360 OS environment under MVT, considerable revision was required to obtain satisfactory operating characteristics.

The third phase is the bootstrapping operation. It consisted of reviewing the second-phase PL/I source code and revising the same code to TACPOL. Again, it was not necessary to resort to L-3050 MOL for any portion of the coding. The TACPOL compiler in TACPOL source code was then compiled in the second-phase compiler to produce the L-3050 resident TACPOL compiler.

pl/i features used

In writing the TACPOL compiler, we attempted—as far as practicable—to restrict PL/I programming usage to the TACPOL subset described earlier. This held generally true in the use of the various types of structures, data attributes, and PL/I's block and program organization. The deviations from TACPOL were minor and were confined to the extensive use of recursive attributes, some differences in format and procedure, and a few cases where the TACPOL subset tended to generate excessive code. We reverted to PL/I features when they were needed for bootstrapping (i.e., recursive attributes) and when there were obvious simplifications in code.

The TACPOL compiler was developed in less than a year, during 1967-68. It passed the stringent five-part acceptance test practically without a hitch (the major hangup was a displaced comma in a "Comment" line) and proved fully capable of generating executable code for a series of sample TACFIRE problems. Based on our experience, we believe that PL/I's superior language capabilities qualify it not only for use in military command and control subsets, but generally, as an excellent vehicle for compiler implementation. There is no doubt that, in our application, the use of PL/I had significant advantages for implementation over an assembly language of some other POL. With PL/I's logic imbeded in TACPOL and our own extensive debugging system at the symbolic level, we never had any need to retreat to basic assembly language (BAL) or even look at a hexadecimal (ABEND) dump. Compiler maintenance and debugging at the symbolic level has proved to be relatively simple.

Needless to say, there were a few flies in the ointment. These had to do with our own and our supplier's early lack of experience with PL/I and the System/360 operating system. The insignificant backlog of experience with PL/I in 1967 resulted occasionally in programming problems to which there were no ready answers. The Army's contingency planning permitted us to fall back to BAL in such situations but, happily, this proved unnecessary, and we were able to program around the difficulties.

More serious were the difficulties with the operating system, which went through several versions in less than a year. It is no secret that the early versions of OS/360 had a number of problems and deficiencies. To escape the doubtful benefits of the early operating system revisions, we suspended them during critical phases of development and finally froze the hardware and operating system (OS/13) 30 days prior to the Army acceptance tests.

In conclusion, we feel that PL/I is sufficiently rich and comprehensive to support any sophisticated language development. Because it is so rich, it has to be treated with care, and it is at times necessary to restrict features that tend to generate excessive code. The Link-Edit facility and the operating system (OS/360) should be improved to provide more meaningful diagnostics for the type of software development we were engaged in. In all, however, we feel PL/I has proved to be an excellent tool. A subset of about 25% of the full language was demonstrated to be adequate for the demanding TACFIRE task. Using PL/I, we were able to complete compiler development on a very tight schedule—in time to win an incentive bonus (and avoid a stiff penalty). We are convinced we would never have made it had we attempted to implement the compiler in another language. ■

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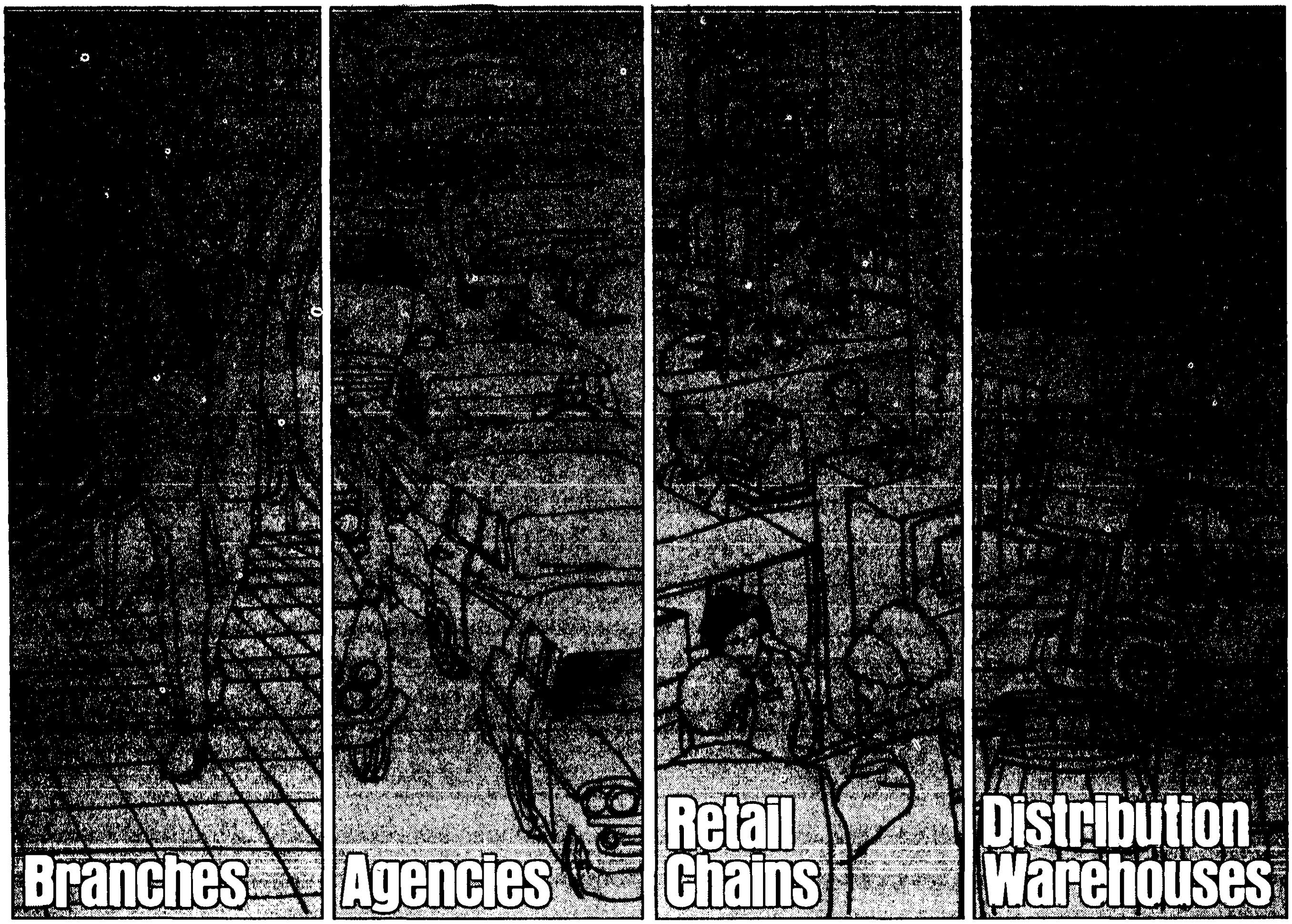

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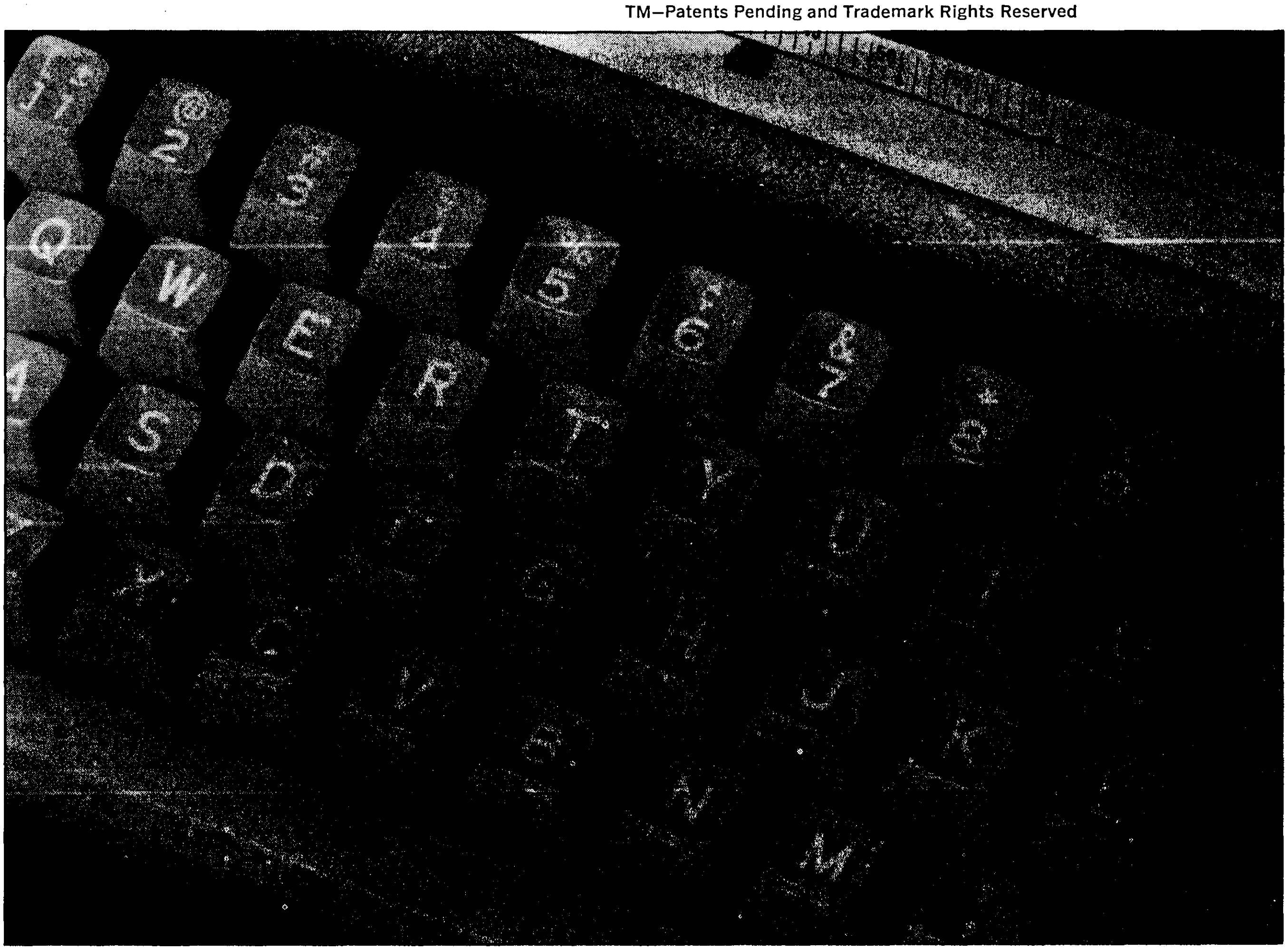

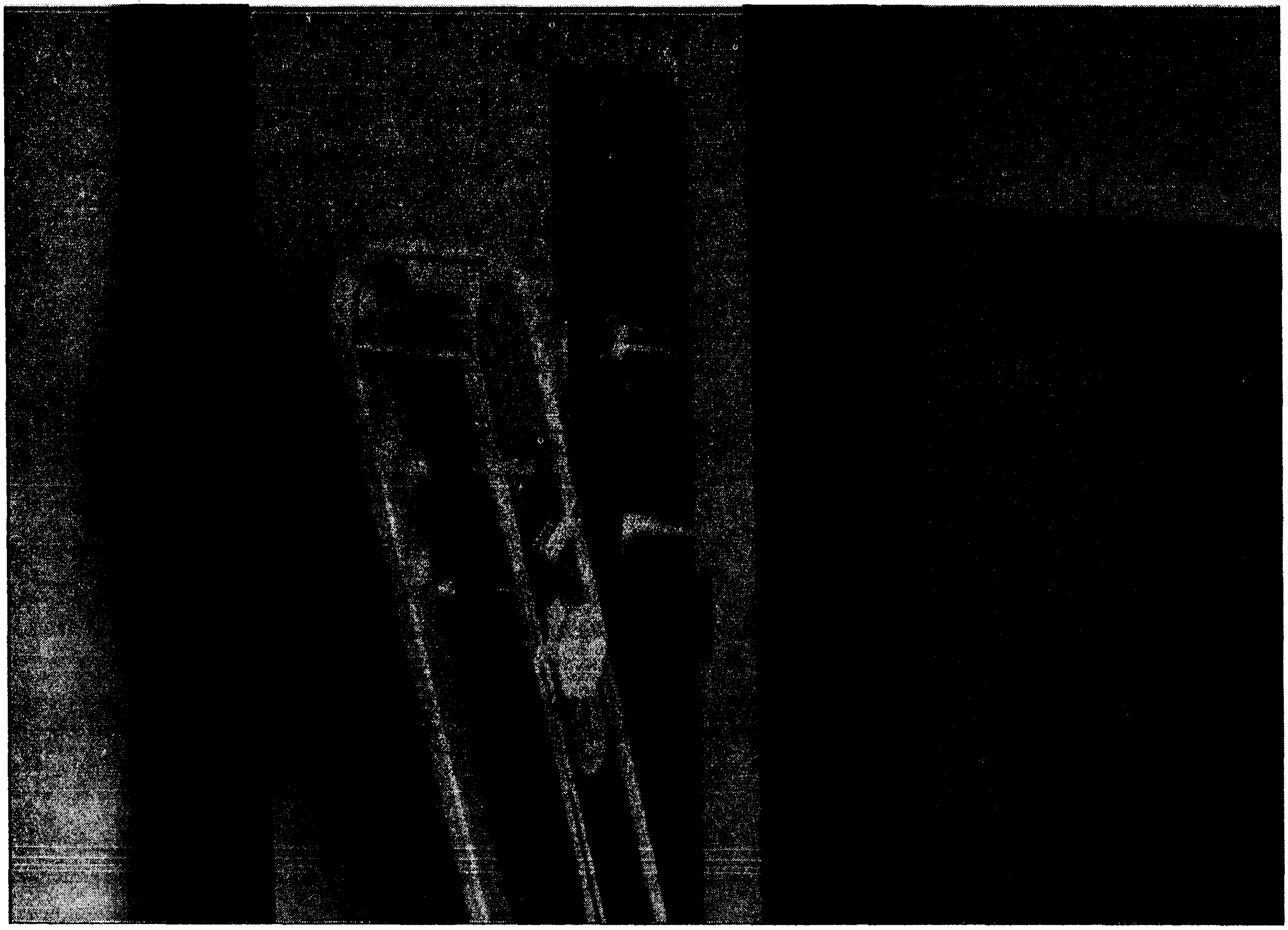

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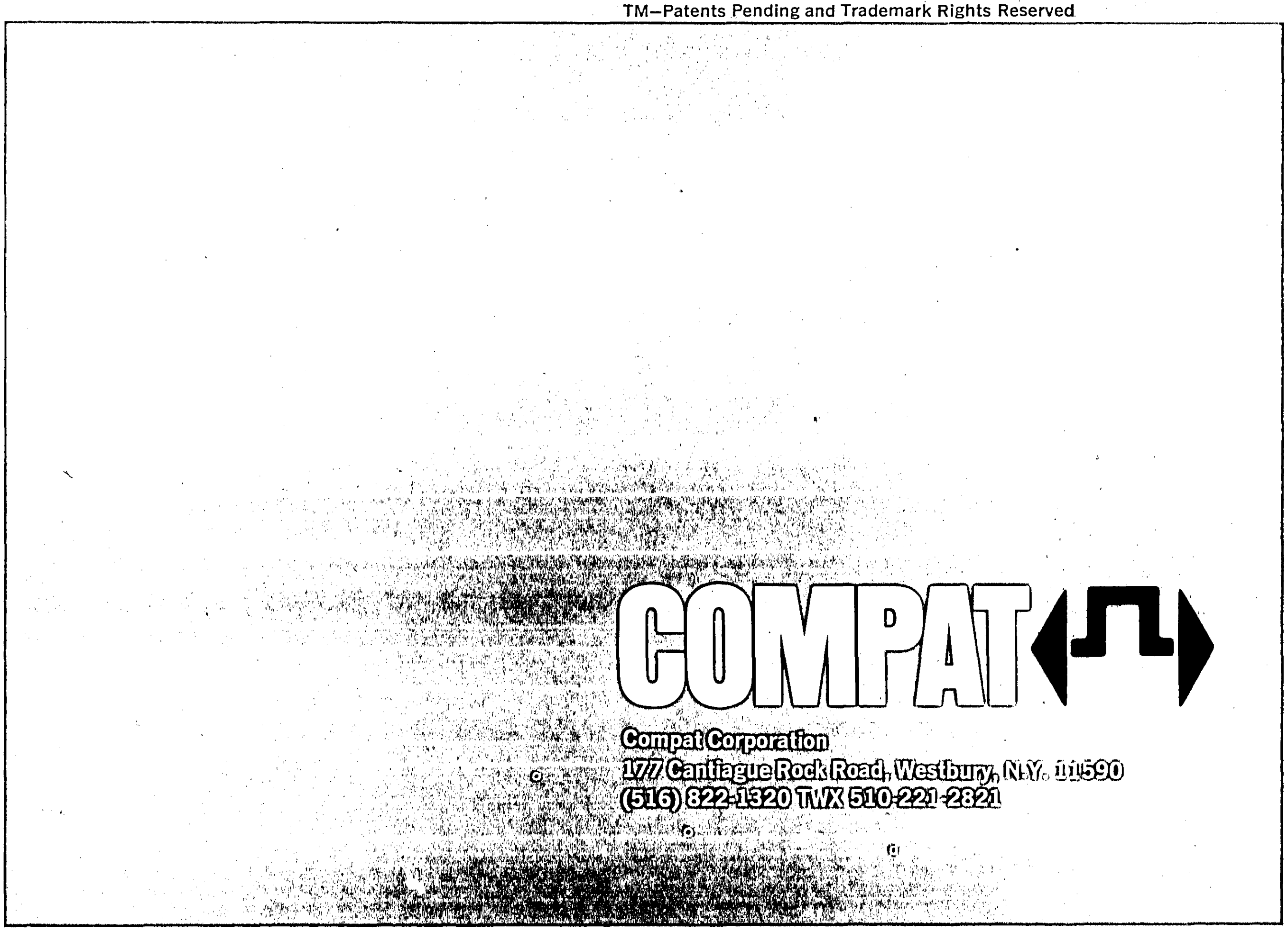

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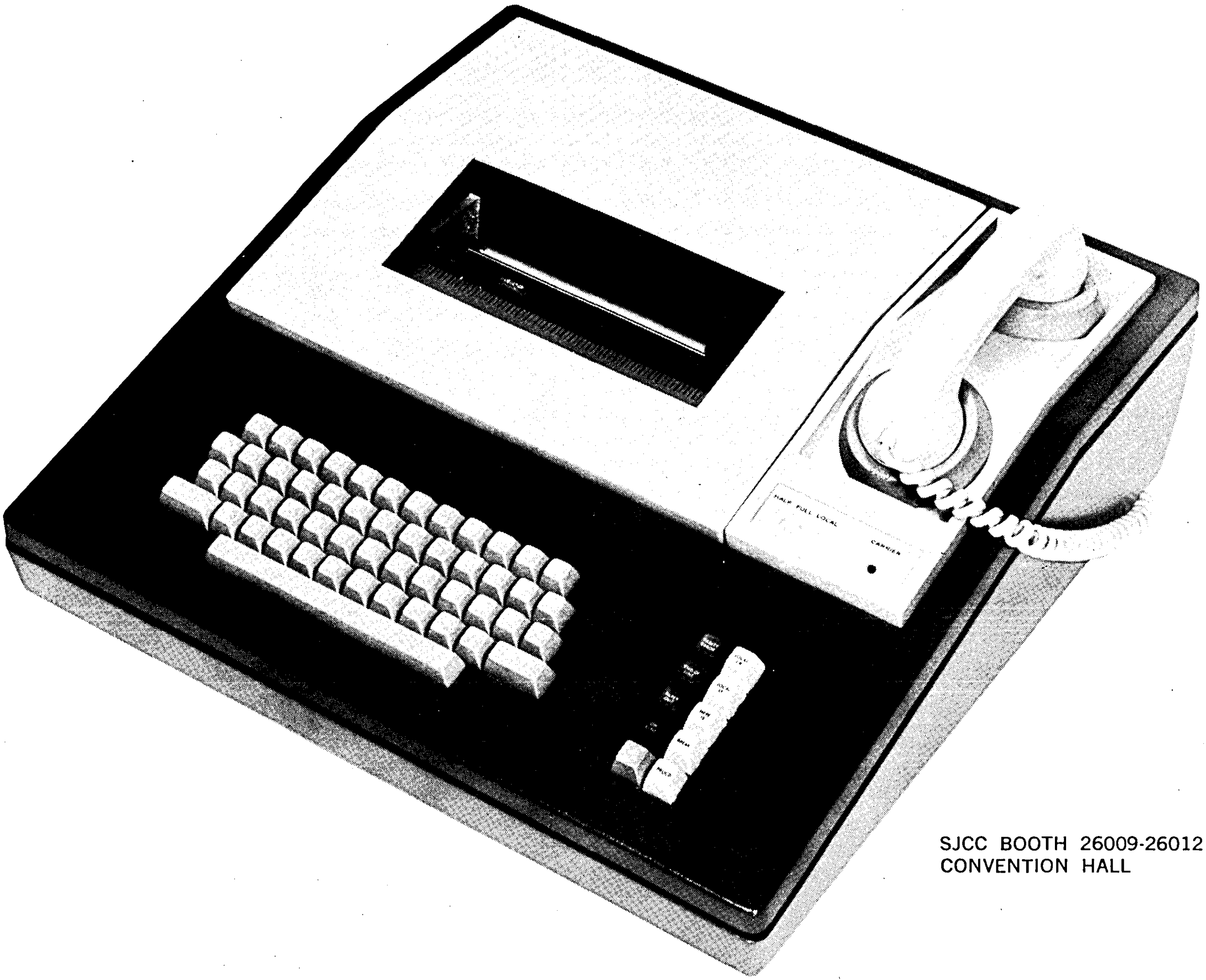

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CIRCLE 233 ON READER CARD

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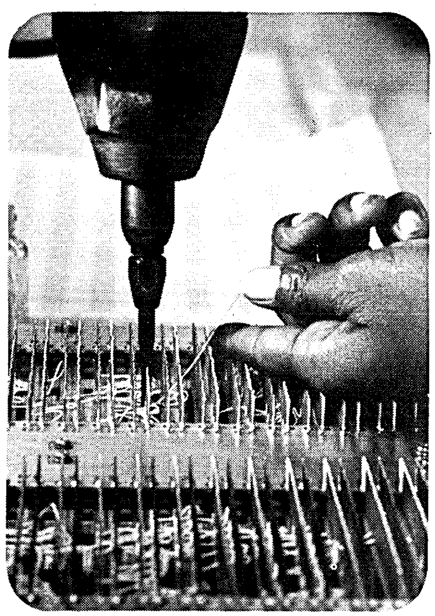

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CIRCLE 24 ON READER CARD

THE U.S. BUDGET AND THE COMPUTER

by Forest W. Horton, Jr.

Introductory note: Perhaps the last federal agency to employ computers was the Bureau of the Budget. Until 1968, automation tools and techniques used in support of the federal budgetary process were experimental in design and were approached somewhat warily. Many reasons might be given for this cautious attitude—a studied image of traditional bureau conservatism, mixed results throughout the executive branch establishment with the use of computers and automation methods, and a rather entrenched "cultural" suspicion toward modern management technology in general. But in 1968 the overwhelming mass of detail finally forced the bureau to develop an integrated computer system to support the budget process.

The preparation of the Budget of the United States is perhaps among the most complex and demanding administrative tasks in the federal government.

The task is complex because it involves collecting detailed information from over 100 different agencies, in some 50 different formats and for nearly 6000 different government programs and activities. This information is then checked, tabulated, and summarized in order to prepare over 200 summaries and tables and over 2000 pages of text material.

The task is demanding because the time allowed for this gigantic exercise is a scant three months each year—roughly from the first of October until shortly after New Year's Day. During that brief period, thousands of individual figures and pages of narrative must be checked for accuracy and completeness. Tables must be cross-checked with one another to insure consistency. And the fiscal integrity of the budget as a whole must be carefully maintained to insure that the President's program is presented to the Congress and to the public faithfully and conscientiously.

John Q. Public's exposure to the budget process and backstage maneuverings is in the form of bits and pieces of news articles each fall. Neither he nor public and private interest groups with high stakes in the outcome of the process are likely to grasp the full impact of what goes on "behind the scenes." Indeed, there are very few people within government who do understand the process. Most of them are in the Bureau of the Budget—a small but highly skilled and dedicated group of experts whose claim to fame, lamentably, is in wielding the highly unpopular Presidential budget axe on the spending plans of agencies and myriads of interest groups both inside and outside of government.

Mr. Horton is now assistant director for management systems, USAID, Saigon, Vietnam. He was previously assistant director for management information systems, Bureau of the Budget, and helped develop the system to handle the U.S. government budget. He has a BA from the University of California, Berkeley; an MA from UCLA; and a doctorate es science economique from the University of Lausanne, Switzerland.

While the budget process, to all outward appearances, is a fairly systematic and orderly procedure, in reality the last few weeks of the process can only be characterized as a series of last-minute crises—what budgeteers call the "budget crunch."

During the last weeks of every December and early January, as the President is putting the final touches on his plans, an inevitable hue and cry over anticipated cuts goes up. The President calls in his budget director to discuss the strategy of particular concessions and withdrawals. The director then calls in his lieutenants who begin talking their own brand of bureaucratic jargon. One hears in the halls of the old Executive Office Building on Pennsylvania Avenue mumbo-jumbo that is undecipherable to all but the high priests of the budget—"Let's offset interfund and intragovernmental transfers in table 12 at the bureau level but net them out at the detail level in the sidewise table."

the changeover

In January of 1969 there was a certain air of excitement in the staid old budget offices where the 500 technicians of the Bureau of the Budget labor to put together the five printed budget documents.

There were two reasons for this feeling: First, outgoing President Johnson was negotiating several transition year political issues with President-elect Nixon, including the government pay raise, surtax extension and social program levels. Second, the Bureau of the Budget had succeeded for the first time in putting all of the myriad, detailed budget data on the computer and could, if required, produce multiple sets of budget tables based on alternative revenue, fiscal, economic and other policy assumptions.

On Jan. 17, 1969, the following article appeared in the Washington Post: "Nixon Surtax Support Decided Budget Plan. If the President-elect Nixon had not agreed, almost at the last moment, to support continuance of the 10 per cent surtax, President Johnson was ready to announce a totally different budget projection from the one issued Wednesday. It would have had a small deficit, instead of a surplus.

"The alternate or B budget had been fed into a computer along with the A version finally agreed upon. By Friday noon, Jan. 10, however, Budget Director Charles Zwick told President Johnson that a decision had to be made because the Government Printing Office was running out of typesetting equipment. President Johnson, officials said yesterday, finally settled the issue directly with Nixon at 5 p.m. Friday. At one point, it was reported, impatient with Nixon's delay, LBJ quipped that 'his economic advisors must be as stupid as mine.'

"The 'B' budget would have postponed the Government pay raise, and delayed some social programs. But without the revenue from the surtax, there would have been a deficit.

"Congressional leaders, it was reported, told Mr. Johnson that Democrats would not vote to retain the surtax later in the session unless the President included it among his recommendations. But the President felt Mr. Nixon had to share some of the political responsibility for the proposal. Majority Whip Teddy Kennedy, it was reported, urged not only continuance of the surtax, but an increase to support further civilian spending programs.—H.R."

The bureau's computer had indeed worked overtime to produce the "A" and "B" versions of the Johnson budget. What many did not know was that there was also a "C" version and several "subversions" of the A, B and C versions! For weeks the twin RCA Spectra 70's high-speed printers at Silver Spring, Md., had ground out thousands of pages of printout as budget analysts and computer technicians stood by to crossfoot totals among the hundreds of tables to insure that all $190 billion was accounted for. Although the basic unit of measure in the federal budget is thousands of dollars, many of the summary budget tables are rounded to the nearest million. For many experienced members of the team of computer analysts who helped design the automated budget preparation system, and who had previously worked on other systems where they had to account for even the mill, rounding to the nearest million was something quite novel.

troubles predicted

Mechanizing the federal budget has always been an elusive target. Some old-timers at the Budget Bureau despaired, saying that trying to plug into a computer the thousands of accounts and hundreds of thousands of detailed budget figures would surely cause the poor machine to have a nervous breakdown. Others wryly remarked that if there was any truth to the adage "garbage in, garbage out," the Executive Office would surely have to hire a fleet of trucks to have the output hauled away.

But, in truth, once the initial explorations of the feasibility of automating the budget were completed in 1965 and 1966, the bureau moved quickly to design a system to handle the budget preparation job.

The preparation and execution of the federal budget for any fiscal year covers at least 27 months. Thus, each spring attention is directed to the control of federal obligations and expenditures during the final months of the year in progress; to the planning of programs for the next fiscal year, which will begin the next July; and to the development of preliminary plans and policies for the succeeding fiscal year. Even during the period of specific work on a particular budget, attention is also given to projecting the effect of program decisions on subsequent budgets and to identifying major issues or problems affecting the budget in the future.

The process of compiling the detailed estimates begins with the personnel who are responsible for carrying out the actual operations. They prepare information on obligations, personnel, workload, and other supporting data, for the year just ended (the past year), the amounts planned for the year just beginning (the current year), and the estimates for the budget year, which still will not begin for almost a year.

In most federal agencies preparation of the budget begins at the field station level. It then goes through successive stages of review within the agency. At each level of review the viewpoint is different—the regional office must consider the estimates of each field station in relation to other field stations and to the total requirements for the region. Finally, at the departmental level, the estimates for bureaus and major programs must be judged in comparison with other bureaus and programs and with the total for the agency.

Agency budget submissions are due in the Bureau of the Budget in September. The submission covers all accounts in which money is available for obligation or expenditure, whether or not any action by Congress is requested.

When the estimates are received in the Bureau of the Budget, they are referred to the examiners assigned to the programs involved. All the knowledge the examiners possess about the agency—whether based on long-run analysis, field investigations, special studies, or conferences held with agency officials—is brought to bear on the estimates at this time. The examiners must be thoroughly familiar with the President's budget policies and previous congressional ac-

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tion, as well as with the programs of the agency and their relationship to activities of other agencies.

It is at the stage of estimate examination and evaluation that the data processing and data control elements are most crucial. Uniform Bureau of the Budget instructions spell out in detail the precise form and content for all of the source data. Over 50 basic source documents are prepared by most agencies and submitted to the bureau. All of this information must be properly classified, coded, tallied, and crossfooted with related information. An agency cannot, for example, ask for $100 million in new monies on one schedule and say it plans to use $200 million on another. So the first big job the bureau faces is checking agency compliance with instructions, accuracy and completeness of the numerical data, and consistency of figures between the several source schedules involved.

The next big problem with which the bureau is confronted is that of controlling changes. The budget process is a dynamic, year-round process. It doesn't come to a sudden stop with submission of agency estimates to the bureau in September. Even as the estimates are on their way to the bureau, people are working on revised estimates; unforeseen developments are causing revisions to the original estimates; or the President or agency head may be developing new policies and plans which necessitate a review of the initial resource requirements.

So budget examiners and analysts in the bureau must keep their figures current from the time of initial receipt until final Presidential decision to "put the budget to bed." Since changes must be crossfooted throughout all tables, the control problems are staggering and compound the already difficult problem of insuring accuracy in the original data.

Finally, the President uses the budget itself during these critical months as a decision-making tool. For it is not until September that all of the detailed figures are pulled together for the first time so that the total picture can be looked at. The President and his policy makers ask such questions as: "What if the economy took this turn or that, what effect would this have on my federal program, spending policies, or the revenue picture?" Decisions are then often made which, of course, have an effect on his program, and figures must again be changed.

To handle this gigantic information processing problem, the bureau, in collaboration with a team of analysts and programmers from the Office of Economic Opportunity, and assisted by Computer Sciences Corp. and by Computer Usage Corp., designed a management information system. Nearly 200 separate computer programs were needed. Approximately 30,000 computer records comprised the master budget file, each with an average length of 100 characters. The entire system took about eight hours to run, including updating the master file and printing all the various tables and reports needed.

During those critical days in early January, 1969, when the "A," "B," and "C" versions of the budget were being run, the turnaround cycle was cut in half so that the reports could be rushed back from Silver Spring to the Executive Office Building as soon as the magnetic tapes stopped spinning and the high-speed printers stopped their staccato 1100-line-per-minute spillout. Each morning a team of budget analysts would then quickly review the computer reports. Many tasks had to be taken care of rapidly and efficiently so that the latest "budget picture" could be given to the director and other key officials.

Last-minute top-level changes in either summary or detail figures may have thrown an account out of balance. If this happened, the computer first detected the out-of-balance condition, then identified its source, and finally "advised" the analyst how the account could be brought back into balance. Sometimes the problem was simple—perhaps a keypunch operator had mispunched a figure or someone had added figures together incorrectly. But other times a complex problem might be involved, so that the analyst would have to call other people in to examine the detailed columns and rows of figures to diagnose the causes of the problem.

Once the accounts were checked out and corrected figures determined, other analysts began examining the summary and special tables to see what effect the latest updated figures and changes were having on particular sets of totals for which they were responsible. For example, how the new obligational authority picture was shaping up; or the revenues and receipts picture; or the outlays and spending situation. Other specialists received their morning editions and began scrutinizing them for accuracy, consistency and possible policy implications.

At the top level, the director and his key assistants were receiving intelligence reports every few hours. From time to time the director might receive a call from the White House inquiring about the situation. Toward the end of December these calls increased in number and urgency.

Finally, the President's budget was transmitted to the Congress in January. After action on the bill was completed by the House and the Senate, the bill as passed was presented to the President. President Johnson's 1970 budget was presented to the 91st Congress on Jan. 15.

A few days later, the President of the United States, as is often his custom, called the Budget Bureau staff across the street to express his appreciation—as the "unsung heroes of the battle of the budget." This time, at the back of the East Room standing in the last row, close to the gold drapes, several proud computer analysts listened attentively. ■

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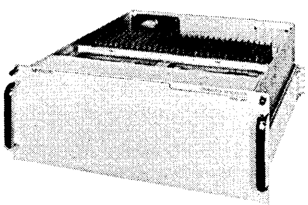

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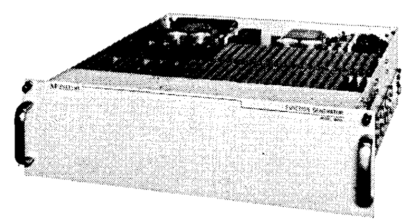

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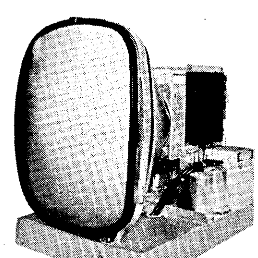

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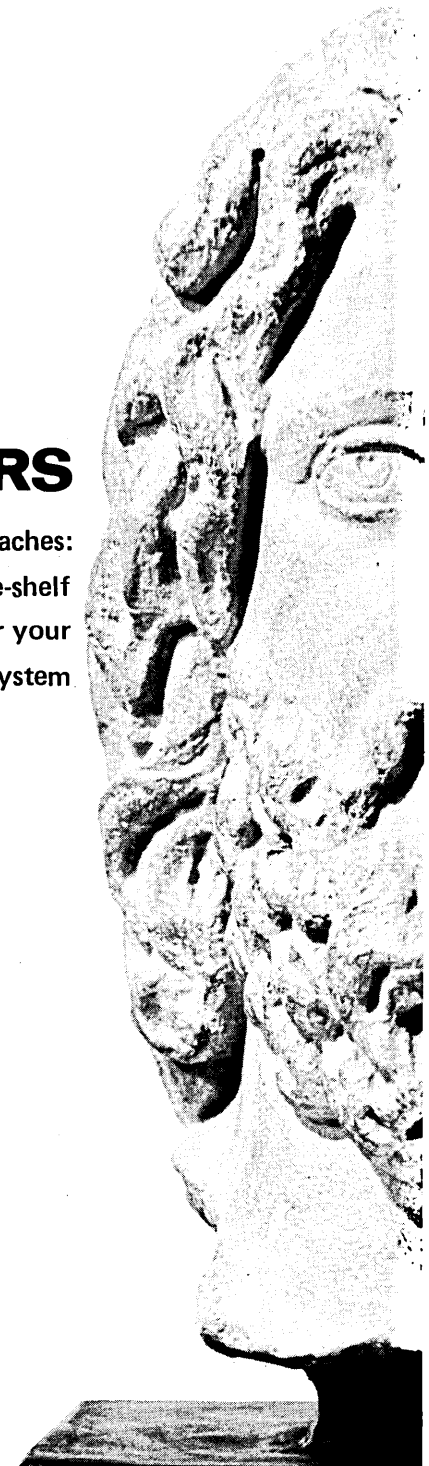

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RIGHT OF PRIVACY AND MEDICAL COMPUTING

Traditionally, in his office practice, a physician keeps his clinical observations in informal records and stores them locked in his filing cabinet. In the hospital, the patient's chart is a more formalized document, but still handwritten and thus usually illegible; and after discharge these patient charts are stored in the hospital's record room, under the control of the record librarian. This system is disorganized and hence implicitly safe. Medical records very seldom get into the hands of an unauthorized person; even if they do it would require much patience and substantial knowledge of medicine to understand them.

Despite the great need for computerization of medical data, the method cannot evolve until clear answers are formulated as to the risks involved. One obvious risk, to privacy, has been much discussed. Interestingly, when reading through the voluminous literature on the subject one is overwhelmed by the uniformly strong emotional arguments against computerization and is left with the feeling that the objective scientific methods used effectively elsewhere when dealing with social problems are conspicuously absent. Many writers put computerization in the same category as "death and taxes": inevitable and we can't do a thing about it. Actually, the majority of the statements tend to arouse a resistance, to close our minds to rational arguments in favor of computerization; that is, simply to listen to the devil may be too much temptation.

At the meeting on the Use of Computers in Clinical Medicine (Oct. 2-5, organized by Continuing Medical Education, State University of New York at Buffalo), an objective assessment of the issue of privacy was attempted by a group including medical, legal and technical experts. This part of the meeting was cosponsored by the Department of Social and Preventive Medicine of the State University of New York at Buffalo, the Faculty of Law and Jurisprudence, the Medical Society of the County of Erie and the Western New York Hospital Association. The prestated purpose was to formulate some recommendations, rather than to reiterate the known arguments.

Dr. J. R. Nunn, president of the local Medical Society, emphasized that all privileged information revealed by the patient in confidence must be protected in a computerized data system. Otherwise, confidence would be eroded. "I do not believe that many will argue the necessity of computerizing medical data. Indeed, the efficient and economical practice of medicine in the future depends on the establishment of these computerized data systems." But the patient must be assured that unauthorized nonmedical persons or agencies will not have access to his medical data, and that impersonal machines will not make important clinical decisions, or print canned medical advice.

G. E. Alfano, M.D., a prominent Buffalo surgeon, reviewed the physician's fears and concerns. "I believe the physician would insist on positive assurance that the computer system will enjoy the same testimonial privilege as that which is conferred on him and the hospital. . . . And while I am on the subject of the testimonial privilege I should like to suggest absolute privilege be extended to cover all data in the computer, that which is now privileged and that which is not. . . . Computers *per se* cannot lawfully practice medicine. Their role must be a secondary one, auxiliary to the medical practitioner. I am sure that my patient will want to hear *my* recommendations for treatment and diagnosis, and not that of the computer . . . if a cloud of distrust arises between physician and computer, the physician could passively withhold data and seriously damage the usefulness of the computer system. This is a justifiable, but largely neglected, aspect of health data automation."

E. V. Leslie, M.D., is the president of the medical staff of a unique Buffalo hospital where standardized, machine-readable medical records are employed. Self-evaluating feedback from these records greatly improves medical judgment. However, this potential "cannot be fully exploited if such analyses are not afforded the protection of confidentiality. Only by guaranteeing the anonymity of various hospital medical staffs can the accumulated data from the total community be a real value." The data, which represents a monumental opportunity for self-education and self-improvement, can be harvested by mature, competent, dedicated individuals. For them to do so, however, the privacy of the institution as such must be guaranteed by the data security system.

In the name of the American Hospital Association, Miss M. E. Converse pointed out that it is the right and obligation of the hospital to withhold confidential information. "The one course of action that is open to the hospital at this time is to develop policies on the use of the medical record and the release of medical information that are based upon the (a) purpose of the request, (b) nature of the information being requested, (c) individuals or organizations requesting the information, and (d) need or no need for an informed written consent from the patient."

Mr. William Holmes, director of the Computer Science Division of Cornell Aeronautical Laboratory, Cheektowaga, N.Y., presented the technical aspects of data security. After examining the characteristics of operational structure and general file organization of computer-stored medical records, he considered the various "users" of the data as potential sources of leak of confidential data. Mr. Holmes proposed the concept of a privacy administrator, who will control the hazardous areas, such as the work of all programmers, unauthorized inquiries and the release of data to other data centers. Mr. Holmes showed how data privacy, clearly exceeding the standards currently available, can be achieved at a reasonable cost. The basic rules of authorization must be explicitly formulated, and the privacy administration should implement these policy rules. The cost of securing adequate privacy includes the privacy

MEDICAL COMPUTING . . .

administration, programming, incremental cost in computer memory, incremental running costs due to privacy programs and "nuisance cost" for identification of users. It also should include a one-time incremental storage cost of $10-20,000, about 10% of additional programming, and a 2-10% increase in running cost of programs providing the privacy features. "To a great extent, the questions which need answering are ethical and medical in nature and may best be approached through cooperative discussions among medical, legal and computer people."

Mr. Anthony L. Mondello, presently general counsel of the Civil Service Commission, a former member of the U.S. Attorney General's Office, reviewed the legal aspects of privacy of Civil Service employees with their entire personal records in a computerized system. He stressed that the government pledged confidence in order to obtain this information concerning the employees. This pledge must be kept, regardless of the data storage technology.

Data security at the computer level represents a 5-10% cost increase, covering both hardware and software expenses. A multiplicity of identification procedures are available at the level of the remote terminal: code number, identification card, fingerprint, voice recognition, and others. Another security measure is the continuous auditing of computer transactions. This reveals the vulnerable points in the security system, and enables the upgrading of the data protection. Of course, absolute security is not attainable, but highly effective data security, similar to that for protecting national security information, is feasible.

Mr. Warner F. O. Daechsel, representing the Canadian Department of National Health and Welfare, proposed the involvement of social scientists to clarify the borders of the right of privacy, both for the patient and for the government. "As a consumer, I want a health information system which provides free exchange of information within the health service system and protection from access by those who would use the record in prejudicial manner against me. These requirements are the same, regardless of the mechanism used, machine or hand copy, for communicating and storing data about myself. If the laws need to be changed, change them."

The rest of the Buffalo meeting was planned to lead to a legislative proposal to protect health data. Hon. Albert J. Abrams, secretary of the Senate of the State of New York, reviewed the legal aspects of computer-handled health data. The definitions of privacy, confidentiality and testimonial privilege was followed by the review of the currently existing laws related to these issues. Then, the operation of a health data system was scrutinized from a legal point of view. "Inevitably there will be pressure for the release of medical information on specific individuals. This is the crux of objections to the establishment of a health data bank, Some of the pressure will come from medical researchers and might be considered to be justified. Other pressure may come from employers, credit agencies, insurance companies, private investigators and the police. A simple ban on the use of information about specific persons would not be justified. . . . If it becomes known that such persons and groups have access to such information the doctor-patient relationship may be seriously impaired. . . ." Whether or not the health data bank will be able to withstand pressures from other sources depends largely on *who administers such a bank.* The health data bank's administration should be sufficiently independent to withstand such pressures.

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cumvent the legal problems, since "most patients would not appreciate the significance of the consent statement at the time that they signed it."

The mechanics of preparing and passing legislative measures was then reviewed, emphasizing the importance of education of all those who have to support such legislation, as well as those who would oppose it simply as another risk to privacy.

In the name of the faculty of law and jurisprudence of the State University of New York at Buffalo, provost William D. Hawkland focused on the legislation to be drafted. "In preparing it, I think we should keep in mind the fact that we are not working out answers for the next 400 years. Statutory law only reflects the wisdon of a particular moment. Successful legislation frequently is the result of evolution, starting with the best ideas of a particular moment in time and refining those ideas in the light of experience. I suggest that we have enough information right now to make a start. We may not have all the answers, but we can start. Let us regard this legislation, then, not as a precedent, but as an experiment. We should review it periodically to see how it is working, and we should firm up its weaknesses and fortify its strengths. Three values are involved: (a) 'privacy' (factored down to true privacy, confidentiality, testimonial privilege and consent); (b) justice, and (c) scientific progress."

In order to balance these values, provost Hawkland proposed *absolute privilege to computer-stored health data,* similar to that in the accident report system. "It does not protect the guilty motorist from a civil or criminal lawsuit." The accident victim or the district attorney cannot get hold of the accident report, but they can "bring the man in, take his deposition, use witnesses that saw the accident, etc. We can do many things to prove the case, and the fact that he has filed an accident report does not exonerate him from liability. Only the report itself is immune." Full privilege will encourage candor and accuracy in data recording by the doctors, critical for a good data base. "At the same time, the doctor would not be immune from civil or even criminal prosecution for malpractice."

The discussions of the formal speakers brought out additional issues. Dr. John Smiley of the Department of Health, Toronto, Canada, emphasized that we should honor the right of the individual to delete a part of his record, and the right to know who has used his health records. Dr. Smiley emphasized the importance of considering privacy, but said this issue should not be overstressed. "Since the law accepts the concept of reasonable practice of medicine it surely will accept the concept of reasonable security of health information."

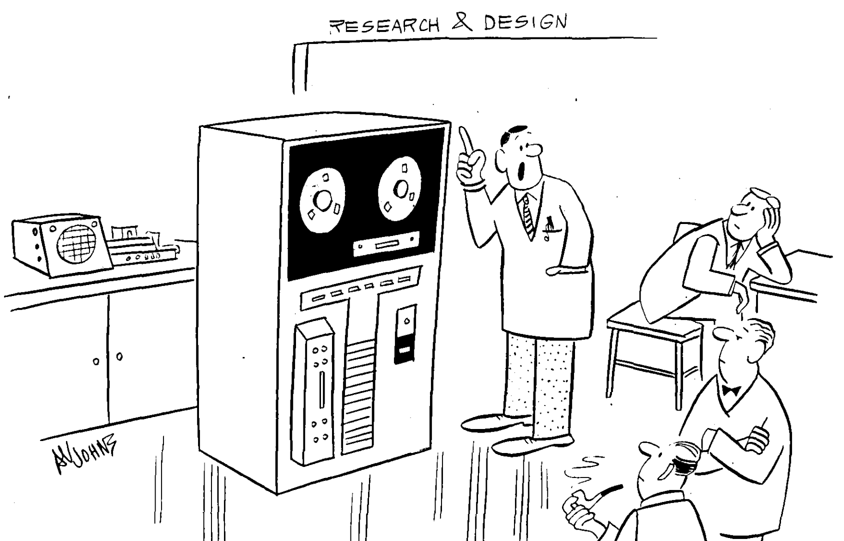
Dr. Thomas Bumbalo, chief attending pediatrician of the E. J. Meyer Memorial Hospital in Buffalo, reminded the audience of the child abuse reporting law. In 1964 the state of New York made it mandatory to report child abuse. The reporting physician "participating in good faith in the making of a report pursuant to this section shall have immunity from any liability, civil or criminal, that might otherwise be incurred or imposed as the result of the making of such report." Analogously, health records could be protected by assuring immunity to the data recorder.

Dr. P. Matte, a physician-attorney, pointed out many problems in our present law system with regard to privacy. "The laws of the United States in the area of privileged communication are a real morass. In some jurisdictions there is no privilege as far as medical communications are concerned. This means that if a physician is called to court as a witness and is asked to report on some aspects of his patient's behavior, he may not legally refuse to do so. The conflict here between medical ethics and in some cases the state licensure laws and the legal requirements of the situation are obvious. In other jurisdictions the patient by exercising his privilege may prevent the physician from answering. In all jurisdictions—and it is worth noting that lawyers write the statutes—the communications between a lawyer and his client are privileged . . . In some jurisdictions the patient of a psychologist or of a psychiatrist is privileged, while the patient of a general physician is not . . . I would suggest that you first bring these medieval privilege statutes up to a reasonable standard. It is ridiculous to try to build a basis for privacy for the massive data retrieval system we are evolving if the basic protection of confidential communications does not exist in the jurisdiction concerned." A national health data network cannot be implemented until national standards for privileged information are updated, Dr. Matte argued. He also suggested that libel and slander may be a good approach to protect confidential material.

The Buffalo conference, briefly summarized, has been effective. The legislative proposal drafted by the School of Law and Jurisprudence, following the conference, is now in the hands of the New York State legislature.

To assist our legislators, the transactions of the meeting have been transcribed. A limited number of copies of these transactions are available.* It is hoped that the approach taken in New York State will be followed by others.

Effective education of the health industry *per se,* of the legislators and of the population at large, is of great importance, to accelerate the evolution of medical computing, an economic and operational necessity of highest national priority for our health industry. —Dr. E. R. Gabrieli



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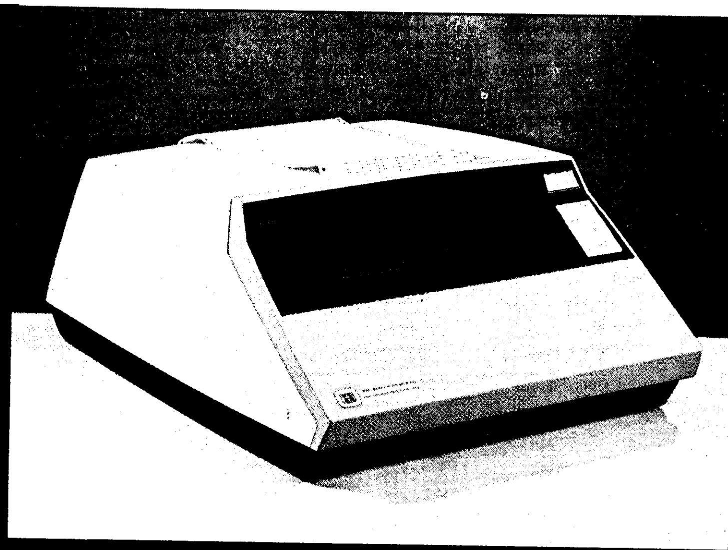

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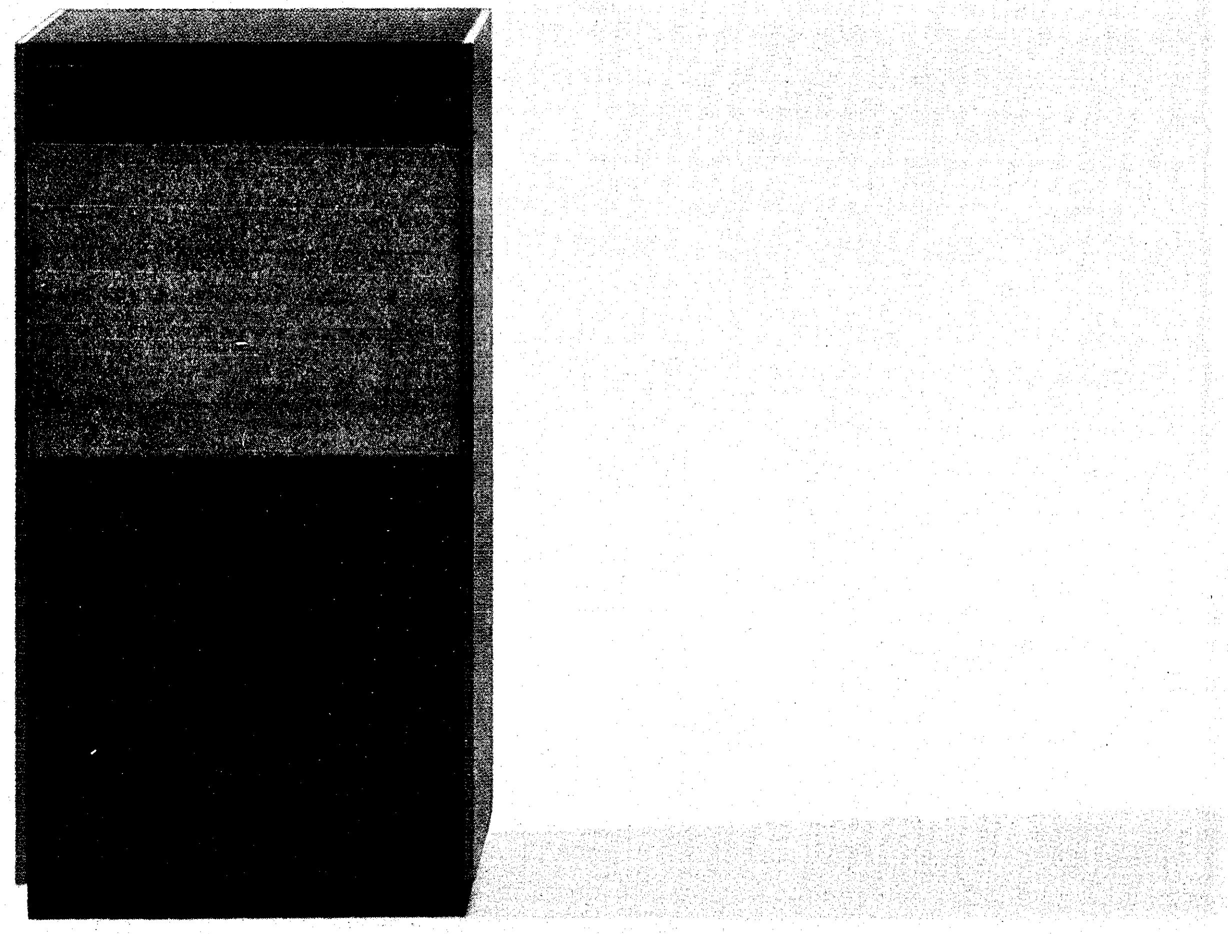

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news scene

an interpretive review of recent important developments in information processing

THE MARKET DROPS, MONEY STAYS TIGHT, AND THE INDUSTRY EXAMINES ITSELF

The first-quarter droop in the market that saw the stock of such glamour companies as IBM and Control Data Corp. fall by 50 points or more and the performance of other computer stocks prove less than reassuring gave rise to the speculation (nothing else rose) that perhaps, at last, the computer industry was becoming keyed-in to the national economy and would react to such situations as tight money and the recession much the same as the auto or pizza pie industry. In an effort to determine the worth of this speculation, DATAMATION conducted interviews with spokesmen for most of the nine major mainframers in the U.S. to find out where their companies are going and how or whether they are affected by the general downturn in the nation's business climate.

As, perhaps, could have been expected, those firms that had already indicated they were entering a retrenchment period were the least responsive, while those whose fortunes continue good were somewhat more communicative. Whatever the reaction, there was at least some indication that the computer industry was becoming responsive to current economic strictures.

cut it back

Control Data is the most prominent example of those firms that are experiencing a slowing growth rate serious enough to cause cutbacks and layoffs. The company announced that because of inflation, tight money, reduced federal budgets (CDC's largest customer is the federal government) and an "uncertain economic outlook," there would be some reduction in personnel from its worldwide total of 37,000 (some estimates put it at 10%), a consolidation of divisions, a policy for reduction of day-to-day operating costs (travel, telecommunications, overtime), a halt to new construction, and a review of major programs with an eye toward canceling or delaying some of them.

CDC's financial statement for 1969 indicates that the corporation's net, before adding in the earnings of Commercial Credit Co., was about $18.5 million, only a little over $200,000 more than in 1968. With Commercial Credit, which was acquired a year and a half ago (Oct. '68, p. 83), net earnings are over $53 million, which would seem to indicate where the present financial strength of the company is (Commercial Credit increased its earnings $9 million over 1968).

A large part of CDC's troubles can be traced to federal cutbacks in the war and defense effort, but some of the stock weakness is attributable to the considerable selloff by mutual funds that reacted typically to the news that the growth curve had flattened out. The drop in IBM stock probably was caused by the same lag in growth — and this by a factor of less than one percent in the last quarter of '69.

CDC president William C. Norris said that economic factors had resulted in a slowdown of domestic orders for large computers during the latter part of '69 and as a result a sharp reduction in large computer shipments and profits will be experienced in the first half of '70. He predicted improvement during the last half of the year, but without much assurance.

but look at this

A brighter side of the picture was painted by Joseph L. Sturdevant, vp of marketing at Univac, who confirmed the slackening of federal purchases (also confirmed by every computer manufacturer interviewed) and said that business for the number two computer manufacturer is "healthy, very healthy," with bookings in excess of a 25% increase in the domestic market, and over 30% abroad.

Analysis of revenue figures indicates that Univac now contributes over $700 million of Sperry Rand's approximately $1.7 billion a year, and the firm expects computer sales to increase at approximately the same 25% rate during the current year. Sustained growth for the entire industry will approximate 15% over current levels, according to Univac president Robert E. McDonald, with shipments by American manufacturers expected to reach $9.6 billion compared to $8.3 billion in 1969.

Univac has concentrated on increasing its sales force in recent years, and the firm feels it has built up a momentum in its marketing force that will stand it in good stead during the unbundling days ahead — Univac is still bundled and intends to stay that way. The company is focusing on the world market, will aim at both higher level and lower level machine markets, will become more involved in such vertical applications as law enforcement, education and medicine, and considers computers a good business. Sturdevant confided, "I'm advising my son to get into it."

Honeywell reported record sales and earnings for '69, with an 11% increase to $1.4 billion, with computer revenues rising over 32% to $351 million, and feels optimistic about the future. In an address before the New York Society of Security Analysts in February, J. H. Binger, chairman of the board of Honeywell, said that "We expect the slowdown in business which has been underway since the third quarter of 1969 to continue through 1970. However, we feel that the ... automation business ... will show some increase over 1969 ... Some portions of computers and communications are expanding at rates approaching 40% right now."

Binger also spoke of the technology pool Honeywell has, over 10,000 people in R&D and engineering, on which the firm spent over $142 million in '69 to research areas "which seem to us will most likely aid in the advance of automation techniques and systems of the future: materials research, magnetics, gaseous electronics; large scale integration, and optical phenomena."

For some reason, the company is also laying heavy emphasis on marketing.

Burroughs also reports that business is good (in all areas except custom contracts with the government). The firm had a 38% growth in computer orders in '69 and expects about the same for this year. One trend noted by the company is that purchases began a definite downswing at the end of the first six months of '69 with an accompanying upswing in rentals, probably due to the impact of the high cost of money. At the end of the year, Burroughs was renting nearly 80% of its edp gear.

The firm is expanding its marketing force, adding technical support people (a palpable pattern), increased its expenditures for R&D 42% last year to $37 million and will increase them another 25% in '70.

Burroughs stock has been one of the minor heroes of the market, staying around 20% below its all-time high of 172. A company spokesman stated that the only effect a firm's stock price has is on the company's ability to finance and the methods chosen. Burroughs has been able to sell convertible issues at a low interest rate for convertibility at a high stock price. Last year the firm borrowed $100 million at 4⅝% a 20% conversion premium on the U.S. market, and recently raised in the U.K. about $14 million at 5½% (vs. over 10% regular interest rate there) and at a 17% premium above the current stock price.

And the Burroughs spokesman felt that the palmy days of computer stocks will continue as long as computers stay the top growth industry.

golly, ge

General Electric has had its troubles, it seems, as always. Its hopes for the Tradar point-of-sale system went aglimmering with the cancellation of the contract with Penney's (Feb. p. 163), and its Information Services Division has undergone a thorough shakeup as a result of difficulties in its time-sharing effort (Dec. '69, p. 85). GE spokesmen were not available for comment on its plans and aspirations with respect to the economic situation, which hardly deserves any.

How's business at RCA? James R. Bradburn, exec vp of the Information Systems Group, said "It's great. First quarter, we're right on target ... in fact, we're slightly ahead of the '69 rate." He projected sales for '70 to move ahead in the range of about a 15% increase and predicted that '70 will be a "phenomenal year for shipments for us." In general, the firm is enlarging its marketing force and is in good financial shape: "We can get new money from Sarnoff just as fast as we can absorb it here."

Bradburn predicted that, early in the '70's, RCA will be number two in the computer business. The company is eyeing two big Uncle Sam contracts, WIMMIX and the Air Force Logistics Command, and it will probably bid on one of them but is not sure which one. He said it costs too much to bid on both and he thinks only IBM could afford to.

1969 was a record year for National Cash Register — $1.25 billion, an 11% increase over '68. All activities were up except for defense business, and edp led the way, anchored by Century Series sales. "For the second consecutive year, incoming domestic edp orders exceeded either cash register or accounting machine volumes." Bookings abroad were up 52%, and sales continue strong so far in '70, edp again leading the way with "incoming orders running ahead of the record pace at this time last year."

NCR will announce a new addition to the Century Series in '70, a medium-large-scale system offering "advanced" time-sharing capabilities, the "most powerful system yet" from NCR. The firm also will introduce in '70 "a new family of data terminals for the retail field ... the conerstone of completely new systems covering all phases of merchandising data collection and processing."

NCR anticipates growth of all the edp fields it serves in '70 with the exception of defense.

up and up

L. B. Horwitz, senior vp of XDS, was sanguine about the recently acquired firm's future, and stated that the fourth quarter of '69 was excellent. January and February of this year have been slow, he said, but he considers it a normal first-of-the-year trend. XDS, too, is feeling the falloff of defense business, but Horwitz said that XDS was able to forecast the situation and is able to move into other government-funded projects, primarily biomedical and educational.

The company is expanding its marketing force, of course, and also is increasing its emphasis on software development. Its software personnel in R&D now number more than hardware people. The firm has been growing at a rate of 35% a year, and while Horwitz would give no statistical projections for the future, he did say that computer sales would be "up."

Horwitz's view of the computer market is that even if only $6-7 billion of the projected $9-10 billion in sales comes about in '70, XDS will get its share and "a few hundred million isn't too much to ask." The firm will tend more toward leasing its equipment than it has in the past because of the way the market is going. XDS is going after the business data processing market and leasing is the trend in that area, he confirmed, because of tight money. XDS has traditionally produced real-time, time-sharing equipment and will continue to do so.

IBM's response was befittingly lofty. Its spokesman said that the overall business outlook is favorable, although there will be "periodic fluctuations" because of business conditions. Makes sense. The company expects to make no significant organizational changes because of the economy and contemplates no additional financing arrangements in '70.

Latest research by International Data Corp. indicates that IBM dropped from 72.7% to 69.2% in worldwide dollar shipments of computer equipment in 1968-69. That's 3.5%. That's CDC's share of worldwide dollar shipments. Or NCR and XDS combined. And just about the increase registered in those shipments by Univac, Honeywell, Burroughs, and GE combined.

That's something to take stock in.

—AUBREY DAHL

COLLEGE COMPUTER CENTERS: ECONOMY AND COST CAUSE PARANOIA AND PAIN

"The federal government is after us. Inflation is after us. IBM is after us."

This is a succinct summary of the current plight of the university computing centers, as given by Kenneth King, Columbia Univ., at an Assn. for Computing Machinery Conference on Unbundling, Feb. 16-18. The Special Interest Group of University Computing Centers (SIGUCC), sponsored this Atlanta, Ga. meet.

There, amidst the decaying splendor of the Dinkler Plaza Hotel, 81 edp professionals from education, government, and industry discussed the "fall from favor" of university computer activities. The slashing of funds from all government levels, coupled with the increased costs due to unbundling and the near-extinction of the educational

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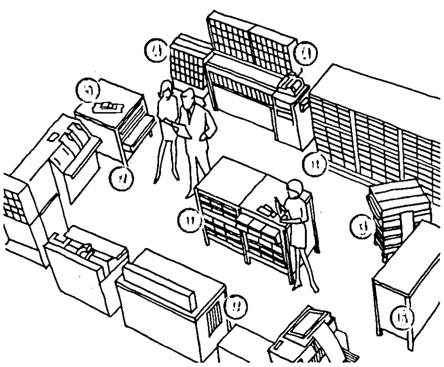

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discount, could force a cutback in computer education activities. If so, "it will be the (computer) industry that will suffer and the national economy as a whole," warned chairman E. P. Miles of Florida State Univ. in his conference preamble.

In the next few days, speeches by David Kearns, IBM vp, and Vincent Swoyer of the Office of Computing Activities (OCA) of the National Science Foundation, did not help assuage their fears. Kearns indicated that IBM is anxious to discuss the user's objections to all unbundling policies, but in no way could the universities expect special treatment, except for the current educational allowance. (This did not mean IBM would not make changes affecting all users, however.)

falling budgets

Swoyer drew a bleak picture of future support for the OCA. Its budget has fallen from $22 million in 1967-68 to a planned $15 million for 1970-71. The institutional computing services section, which provides funds to centers to help in upgrading to new equipment, has seen a steady drop from $11 million in 1967-68 to $6.5 million in 1969-70. In 1970-71, its name changes to "special computer services" and the emphasis will be on "institutional sharing of resources to allow the facilities to develop more in educational directions." And the budget drops to a mere $4 million.

(State funding difficulties are epitomized by Temple Univ., which by February still had not received over $30 million in state support for 1969-70, and lived on borrowed funds.)

In numerous workshops during the conference, the attendees drove honestly, but often helter skelter, toward resolutions of action that ranged from committees and liaisons with government, education, and industry groups, to pricing recommendations for IBM, to individual avowals of legal action against IBM.

Four things became clear: The university centers would have to get used to having fluctuations of the national economy affect their support; they would have to try running like business operations rather than endowed prodigies; they would have to seek sources other than the manufacturer for software and services; and they would have to combine to form effective work and pressure groups.

Specifically concerning unbundling, universities are strongly against the discontinuance of service on equipment purchased before June 23, 1969. The City of New York is threatening suit, and several small colleges indicated they would like to tag on as party plaintiffs. Stanford, Harvard, Princeton, MIT, and others have met repeatedly with IBM to discuss the problem (March, p. 41). University of Texas' legal/edp expert Michael Duggan told attendees that precedent considers all salesmen's promises — oral and written — as part of the contract (and many eyes and eyebrows reacted). IBM already faces suits based on that premise, and Kearns emphasized that IBM feels it met its responsibilities by providing free services in the transition period.

Duggan gave a packed workshop session some lessons on class actions in law suits, how to become a party plaintiff, and the illegalities of forming a group for an economic boycott. His major recommendation became a resolution of the meeting: Urge the Justice Department, in the case of a consent decree resulting from its current suit against IBM, to include a clause in the decree allowing private parties to go into court and enforce it. (Under the 1956 decree, only Justice can take IBM to court for its violation. Duggan has felt this an extreme weakness of that Decree.)

Another unbundling issue was the monthly charge per cpu for program products. This issue has been raked over many times, but it stands as the major problem for university, if not industry, users. The schools need a wide range of software, noted Miles; at FSU, in 1969, "2700 students from 23 departments used our central computer in support of course work in 140 sections of around 70 courses." But not all of the programs are used enough to justify the cost.

be it resolved

Several resolutions were put forth on alternate methods of pricing, such as on a use basis or with a ceiling on total software cost not to exceed 3% of the cost of the leased system. Kearns told the group that such pricing policies were not likely, and the indication was that IBM would stand pat. During a workshop session, Robert Johnston of IBM told the universities that IBM would like to find "mechanisms" for giving them "relief." He stressed "value received," which meant that universities could get a break in cost if they could quantify what the manufacturer received in return from them, such as future personnel, program and hardware improvements, etc. — none of which seemed quantifiable at the time.

There was considerable discussion throughout the sessions about IBM and CDC contracts for services and software. Since then, parts of these contracts have been changed. (See News Briefs, p. 201). The user groups, SIGUCC, and other organizations are currently studying them.

Beyond what is currently provided, SIGUCC resolved to request: from IBM and CDC, full support of a package for one year after it is superseded by a new version; 90-day free use of software from IBM (CDC provides it); and that programs be provided in source code.

Getting the idea that software for a fee is a fixture, the attendees considered other avenues of supply. Numerous projects were noted: Argonne National Laboratories, with Stanford Univ. and the Univ. of Texas, is developing a mathematical subroutine library. Univ. of Wisconsin is gathering programs for the social sciences. The EIN project of Educom, with liaison personnel at member Educom institutions, is putting together a catalogue of software available from these institutions. And the Univ. of Georgia provides NASA-sponsored programs. IBM's Type IV library is dead, but CDC has a SISTAR library of all public domain software for its equipment.

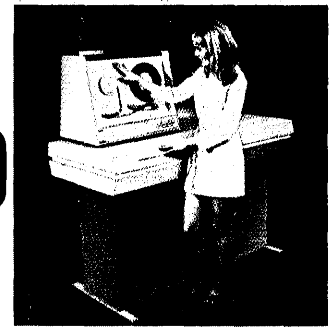
kill

"Eye for an eye," the centers also discussed charging for programs they develop; for example, a statistical package for the social sciences, SPSS, is now being offered for a fee by both the University of Chicago (for the IBM 360) and Northwestern (for CDC-6000 series). The fee is $400/year to schools and nonprofit organizations and $2,000/year to business. It's not the first such effort, but this has not been widespread. Attendees indicated it might be a means toward helping some friends, but all agreed it was fraught with tax, marketing, maintainance, and legal problems.

The small college, like small computer users everywhere, received attention in direct disproportion to the degree of damage by unbundling and neglect by federal funding agencies. It was clear to its representatives that the small and poor must link up with regional networks in order to share computing power, software, and systems engineers. The circuit-riding SE promises to become common among universities.

Some of the resolutions are noted throughout these paragraphs. Others included setting up liaison between SIGUCC and the more powerful National Assn. of College and University Business Officers, which has been in regular discussions with IBM. (Since the meeting SIGUCC's representatives have been invited to join them.) Simi-

Peripheral Technology announces the PTI 2600 online/offline COM.



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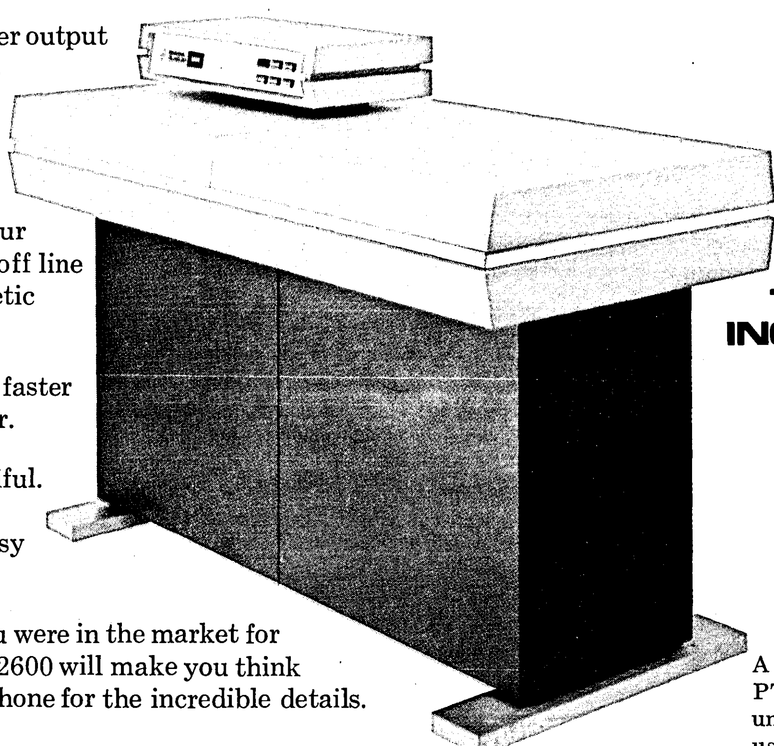

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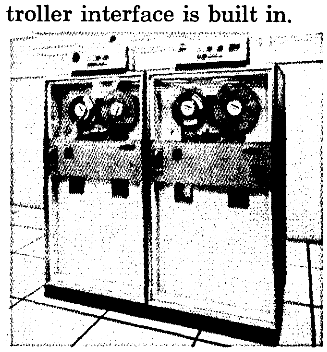

See the PTI 2600 first at the National Microfilm Association Convention in San Francisco (ah! an excuse for a spring trip to The City)
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lar contact and liaison would be made with state governments, federal agencies, and the Justice Department to convey the severe financial problems of the centers. For the complete proceedings, send $1.00 to SIGUCC-ACM, Dr. E. P. Miles, Jr., Computing Center, Florida State Univ., Tallahassee, Fla. 32306.

—ANGELINE PANTAGES

FACILITIES MANAGEMENT, THE LATEST CRAZE, STILL MORE TALK THAN ACTION

Facilities management — the latest of the big implication phrases and possibly a future big business — is, for the time being, more words than deeds.

The use of the words has increased in the past year as new companies have formed to emulate Ross Perot's EDS, and older companies (leasing firms, software houses and service bureaus) have reached for new glamor and, hopefully, more dollars.

For added hubbub, large users have split out these operations and called the results facilities management. And Computer Technology Inc. ballyhooed FM to the end that the LTV organization made a fast buck on words and everyone else still wonders what they have — even UCC, recent purchaser of a substantial interest in CT.

what it really means

What is the meaning of facilities management? The simple definition is the take-over of all edp operations — equipment, people, and functions — of a business by a service company. The facility manager promises savings in money and headaches for a fixed-fee, long-term contract. EDS calls it "total systems service," and "turn-key operation" is another possible synonym.

To the people involved with facilities management, it is not that simple. Turning over complete control of data processing to an outside company is not a simple matter. Discussion of it rapidly becomes subjective. Opinions on its viability as a solution to edp management problems or as a vehicle for highly profitable business tend to be influenced as much by emotion as by reason.

The reality of FM is Electronic Data Systems. EDS feeds the emotional and rational support of FM. The story of Ross Perot, his $1000, the faith of his womenfolk and the success of his vision is part of the industry's folkore. It's inspiration to many a would-be entrepreneur or security analyst looking for another IBM. Many of the latter have settled for EDS.

Since August, 1962, EDS has been selling its total system service with success. From selling a block of IBM 7070 time to Collins Radio, Perot has gone on to selling facilities management deals to the Blue Cross, Blue Shield organizations in a number of states, Frito-Lay and Pepsico (since terminated), insurance companies, banks, and larger and larger companies.

In 1969 EDS signed one contract for $160,000 a month and a few weeks later wrote another for $300,000 a month. By the end of FY 1969 that 7070 time sale money and Perot's $1000 had been parlayed into $16 million in annual revenues; 31 computers, all IBM, in a variety of models; and close to 2,000 people.

"It's been a very fine business," Perot has said, and critics and supporters can only agree. But will it remain a fine business? Can the increasing number of edp managers be sufficiently won over to facilities management to accept it on a large scale?

The critics and supporters of the concept also agree that the EDS success is secured on two points: the long-term fixed-price contract, and the assured use of well-qualified people. Perot once said, "businessmen like to do business in a business-like fashion." What could be better business practice than to secure, for a relatively long period of time, a constant price for a service beset with spiraling costs and the services of well-qualified edp talent in a dwindling labor market?

But is it good business for the facility manager? Sooner or later he will need more qualified people, and rising costs will always chisel at profits.

the bandwagon

They're all optimistic. From newcomers Data Dimension Corp. and Cambridge Computer Corp. to Computer Applications, Inc., they say labor is no problem. Programmers will besiege them. Facilities management will offer the most attractive challenges to those who must keep on proving themselves. It will be ideal for the specialist, for he can go from client to client plying his specialty. And it will permit handsome remuneration since the high price for these qualities will be spread over all clients.

(Hasn't this all been said before by service bureaus, software and systems houses, by time-sharing companies and every other group that has sought to be the broker for the user and his edp?)

Data Dimensions' Les Gottlieb notes that an ACM study claims some programmers are worth 50 others. He claims the ratio is even greater and that these are the people he expects to attract, hire, and keep. Perot endorses this by quoting a Wall Street Journal article which says EDS gets six times the profit per professional employee of the above-average service company.

EDS took seven years to assemble these people; it has a horde of recruiters for elaborate screening of applicants, plus strong and steady indoctrination and continuous training to maintain its standards. Can any of the new FM entries take the time for this, or spend the money?

cost cutters

The FMers are also optimistic about reducing hardware overhead. They talk of consolidation and Grosch's Law. Everyone is going after IBM Model 30 and 40 installations where, they say, underutilization is rampant. They plan to put a number of these batch operations together on a single machine or bring in Model 65's to do the work, either at one customer site or their own computer centers.

Another cost cutter which EDS is implementing (and others will undoubtedly use) is standard systems for specific industries.... the development of proprietary software packages for relatively less investment and lower entry cost per user. According to Perot, if it takes $1½ million and 20 man-years to build a system for one life insurance company, an industry package can be put together for $5 million, and two or three men can tailor it for specific users in 90 days. EDS already has system centers for health insurance, life insurance, the distribution business, and the food industry.

types of contracts

Most of the management companies are flexible on how they implement facilities management, but they want a long-term deal and total systems control. They will take over management of customer equipment and personnel at the customer's site, or put their own equipment and people at a customer site, or give the customer a terminal and remote-batch the data, or give the customer what is tantamount to service bureau service. But a long-term contract is necessary, they say, to amortize the resystemization usually needed in taking over an operation and to cover the initial investment if equipment is bought and personnel hired.

The companies are flexible on the location of the computer, the ownership of equipment, and employment of personnel, but they want full control over the entire facility — hardware, software, and documentation — and full responsibility for everything except perhaps, the role of business analyst. He is the person who would have final say on what the business needed in the way of systems, both manual and edp.

the sales pitch

The seduction of the potential facilities management customer begins with consulting and systems design jobs. It intensifies with turnkey operations, systems implementation and other on-site work that permits the FMer to show his stuff, get a good idea of what the customer's problems are, and to win the existing edp staff over to his side. Existing edp people can stop a deal no matter how good the pitch to top management is.

This approach, however, does pose an ethical point. If the consulting and design work get the customer installation running well, then there is no facility management contract; and if a company is in facility management, will it do a good consulting job?

vertical industries

Most of the companies, rather than just randomly pursuing individual firms, are following the EDS lead and specializing in one or two business fields. The best criteria for this selection are an industry's disinterest in edp and inept handling of it. EDS began with the food processing and insurance businesses. A group with applications and operations know-how in these fields was collected and achieved contracts with Frito-Lay and the Blue Cross organizations.

Data Dimensions figures advertising and the publishing and printing business are good prospects. John D. Kettelle Corp. has contracts with two Long Island beverage distributors, and Cambridge Computers has concentrated on the wholesale drug business to the extent of having a 20% interest in National Wholesale Druggists Association's Drug Distribution Data subsidiary. This has paid off in a contract to extend DDD's geographic market reporting operation nationally and manage the data processing. Three major drug houses are underwriting the work.

Some others in FM are: Delta Data Systems, Inc.; Computech Systems, Inc.; The Computer Exchange, Inc.; Cybertronics International; John Keane Associates, Inc.; Trilog Associates, Inc.; Bradford Computer & Systems, Inc.; Aries Corp.; Management & Computer Service, Inc.; Systems Management, Inc.; and Software Services, Inc.

long-term insecurity

Facility management is a long-term business. The companies that are offering the service must prove themselves to customers, and they must survive. To survive, many diversify. Data Dimensions, on the verge of its first facilities management contract, already has a profitable small systems software operation and edp personnel agency.

The insecurity of both parties is reflected in the contracts written to cover facilities management. Some of EDS's have run to 85 and 100 pages, detailing present and future data processing operations, care of people, payment for changes in the system and, very importantly, how the deal will be terminated if that comes to pass. The last is very important. A company could be left with a system it didn't create and nobody around who knows how to operate it. There are reports that this has occurred. On the other hand, there are some FM operations based on nothing more than a letter contract.

The longevity of FM contracts has yet to be put to severe test. EDS is the only one with any "old" business; but its Pepsico contract ended after three years, and there is the report that the Blue Cross people are somewhat defensive and apologetic about their use of facility managers. At Pepsico, the word was that its intention had been to have EDS get the operation running and then the company would take it back.

the market

The market for FM, according to the purveyors of it and interested observers (Quantum Sciences Corp., for one, is doing a study of the business), has a current value of $200 million. The federal government is the big buyer of the service. A seven-year relationship with Goddard Institute of Space Study encourages Computer Applications to say it has a long history of FM.

Much of the remaining market has been created and is still controlled by spin-off companies. Seldom do these companies do more than operate their parents' edp. Usually they are set up to get uncontrollable edp operations out of management's hair and losses off corporate books. There is also the attraction of taking this enterprise public a la Computer Technology. A final reason for the separation is to provide career paths and equity to hold qualified edp personnel. In this three-way split, the independent FMers are left with $30 to $50 million for the time being and $200 to $300 million five years from now.

—JOHN WESSLER

DPMA, ACM, EVEN THE GOVERNMENT SEEK EDP SCHOOL ACCREDITATION GUIDELINES

The observer seeking to learn how far the dp industry is from agreeing upon guidelines for the accreditation of private schools must ask a number of questions, the answers to which may confuse him.

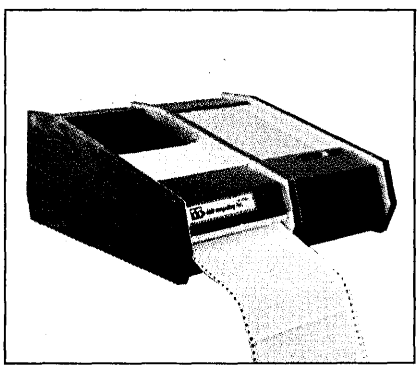
Can we develop a single set of guidelines? "Yes," replies Carl Hammer, director of computer services for Univac and chairman of ACM's commission on accreditation.

"We've got a long way to go," says Donald P. MacPherson, education director for DPMA, and a chief architect of his association's guidelines.

"We'd very much like to have something before 1971," says John Profit, U.S. Office of Education, who has been an observer and catalyst.

The agreement of these responses, insofar as it exists, may be more apparent than real. DPMA insists that accrediting guidelines must spell out business procedures for private dp schools. ACM, on the other hand, feels that the three accrediting agencies have the experience and savvy to make these judgments about business practices. This difference between the two national dp associations was not resolved at meetings of an ad hoc committee established by AFIPS for

Kick the smoke habit



Smoke signals are fine for giving the Indian sign. They're far too slow for pow-wowing with a remote computer. Still, there are people using puff-at-a-time, typewriterlike devices that take many moons to complete printouts . . . while computer time is elapsing and running up the bill.

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that purpose. So two subcommittees — one on curriculum, chaired by Anton G. Myse of General Services Administration, the other chaired by Jerry W. Miller, of the National Commission on Accreditation, which has been tackling business practices — were formed.

And the business practices subcommittee has not gone well. There is even some doubt as to who is on it. DPMA sees as members only itself and the three agencies now empowered to accredit private dp schools — the National Association of Trade and Technical Schools, the Accrediting Commission for Business Schools, and the National Home Study Council. The subcommittee under the impression that ACM wishes to send only "observers" (who have not yet attended a subcommittee meeting), whereas ACM, though admitting that its chief interest lies with curriculum, does regard itself as having representatives — Dr. Richard Powers of American University and Anita Cochrane of Bellcomm, Inc. — as members of the subcommittee, not observers.

But these misunderstandings are only a minor part of the main question: "What kind of guidelines will eventually emerge?" DPMA's MacPherson argues that the accrediting agencies need specific business guidelines to help them, that the agencies are doing less than an adequate job because of their inexperience with dp. Carl Hammer of ACM points to the recent revocation of a chain of schools by the National Home Study Council as an example of diligence displayed by the agencies.

oh yeah?

At a late-February meeting of the business practices subcommittee, held in the Washington offices of the National Commission on Accreditation, the arguments polarized to such an extent that John Profit of the Office of Education stepped in to suggest the preparation of a position paper that would "distill the essentials" from the stances of everyone involved.

Says Profit: "People have tended to polarize their positions. We were getting into a situation where all the groups were taking defensive postures — ACM, DPMA, AFIPS, and the accrediting agencies." He will ask an independent education consultant to prepare a paper that will extract the broad agreements upon which further discussion may proceed.

Will this plan eventually lead to agreement? Profit insists that it will, that it must — within the next year. He stresses that the first set of guidelines need not be regarded as if they were to be cast in bronze. Rather, he suggests, they should represent a broad consensus for a pilot period of perhaps two or four years. Then another look can be taken.

Protesting that DPMA will change its point-of-view "whenever it is shown to be wrong," MacPherson expresses reservation concerning consensual guidelines because they will not grapple with the specifics contained in DPMA's set and which, he says, nobody has yet discussed. His point is clear: If eventual agreed-upon guidelines are general, they will in effect be ACM's because *their* business practices guidelines are general, he says.

yeah!

Yet when DPMA and the agencies get into the messy specifics, the disagreements among them are clear. Should an aptitude test be given in the school to which the student is applying? The National Home Study Council, perhaps understandably, says no; MacPherson says yes — vigorously, as is his won't. Besides, DPMA does not believe that entry level programming jobs can be taught by mail; the home study people, of course, beg to differ with him.

That kind of disagreement illustrates John Profit's observation that consensus on curriculum will be much easier to achieve because nothing now exists. On the business side, however, each accrediting agency already has standards and each defends what it is now doing.

Profit agrees that the accrediting agencies are not now doing the job that might eventually be expected of them, but he adds that "no standards ever reached perfection, so it may be beneficial to all if we take a look at the standards of the agencies without attacking them directly." He also emphasizes that the schools themselves are not satisfied with the job they are doing. "They are the first to admit that they need better guidelines," he says. Precise figures of the number of schools now accredited were not immediately available, but the total seems to be fewer than 70.

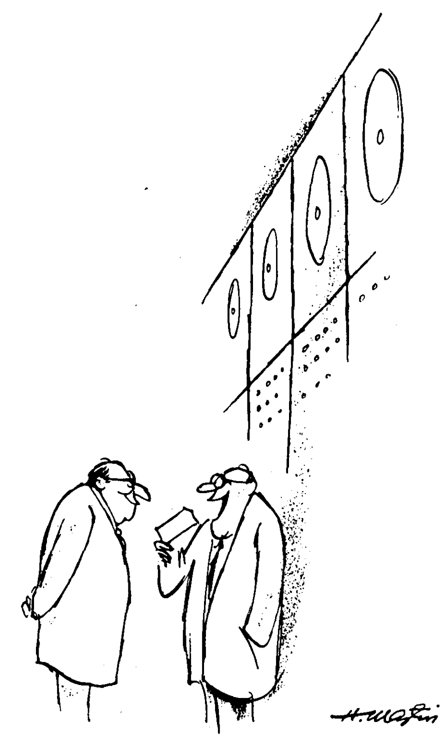
must have them

Why is the Office of Education interested? For two reasons, says Profit (who is director, accreditation and institutional eligibility staff): to protect the public and to develop a mechanism that will permit students to take advantage of public funding for study at approved schools. A single, agreed-upon set of guidelines is necessary, he said, even if they are not ideal the first time around: "That is the best solution for all. Instead of government regulation, the improvement of private accrediting procedures is to be desired."

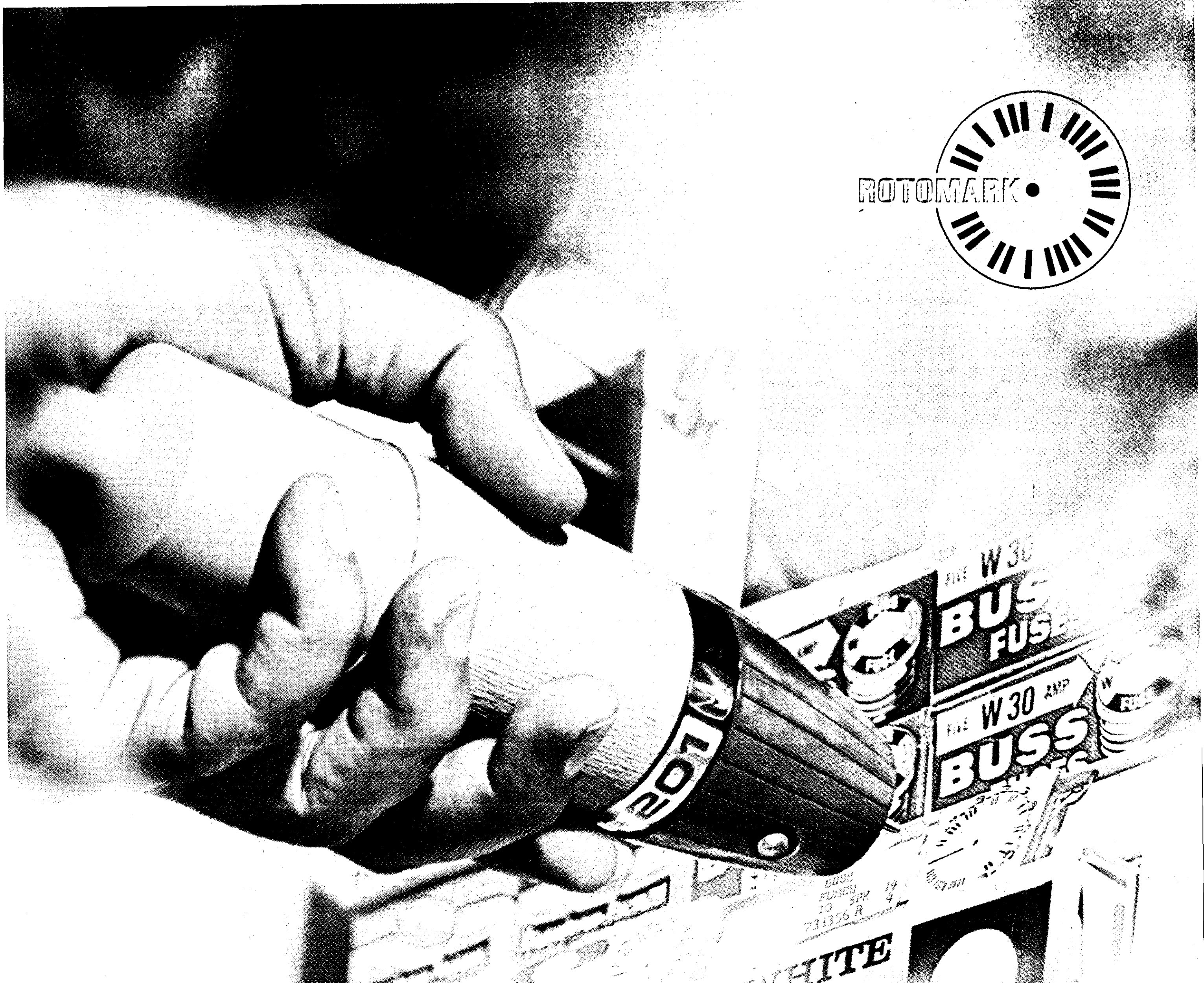
Responding to a question, Profit admitted that it would be possible to take accrediting authority from present agencies and lodge it with a more comprehensive industry-wide body. He said that such an agency should be composed of educators and members of the public, not practitioners. "It should not be a device for any one group to get control over the educational process of any given field." Would that rule out the possibility of either ACM or DPMA as an accrediting agency? Yes, he replied.

When his report of "distilled essentials" is prepared, the subcommittee will study it and strive to move forward. Despite the difficulties now evident, each person to whom DATAMATION talked agreed that everybody *wanted* a single set of guidelines. And each looked upon that fact as hopeful.

—LAWRENCE RAGAN



"This is rich, Harry. Account number 345-26-4155 wishes correspondence with a human being."



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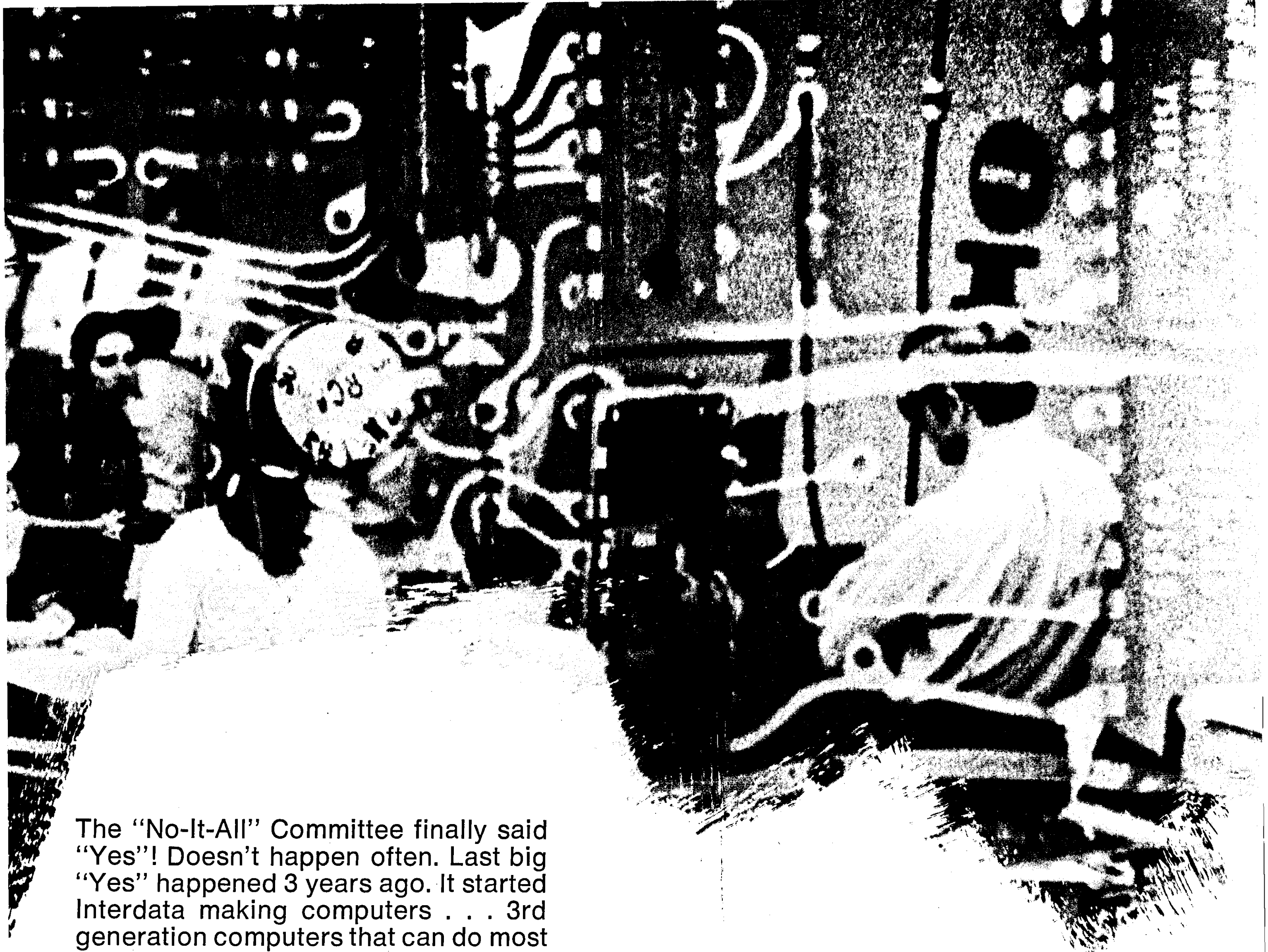

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news briefs

USERS, UTILITIES ANSWER THE BELLS

Ohio Bell has rescinded the higher computer access line charges it imposed last summer (September '69, p. 134), setting the stage for similar reductions in several other states. If that happens, users and operators of commercial time-sharing services are likely to save millions of dollars annually.

Ohio Bell's higher rates were imposed by setting up a new service classification, Information Systems Access Lines (ISAL), for the links between a computer and a local telephone central office. The rate for ISAL and PBX trunk line service was the same under this new arrangement. Originally, computer access lines had been tariffed as "1MB" service, which carries a far lower individual business line rate.

GE, Com-Share, and other affected users subsequently complained to the Ohio Public Utility Commission and, early last month, Ohio Bell agreed to restore the 1MB classification. The phone company probably caved in because a bigger fish is frying — a general rate increase worth about $55 million in additional revenue if the PUC goes along with it.

The rescinded ISAL rates are an average of 200% higher than 1MB rates, and in some case, 400% higher.

At least one of the participants in the Ohio case has decided to fight the increases proposed by Bell operating companies in other states. So, even if the other state regulatory commissions don't become aware of last month's developments on their own, they are certain to be told. Illinois Bell is the latest operating company to impose higher charges for computer access line service. The other states, besides Ohio, include Texas, Kansas, Arkansas, Utah, and Georgia. AT&T headquarters now admits officially that it inspired all these efforts, after vigorously denying any connection earlier.

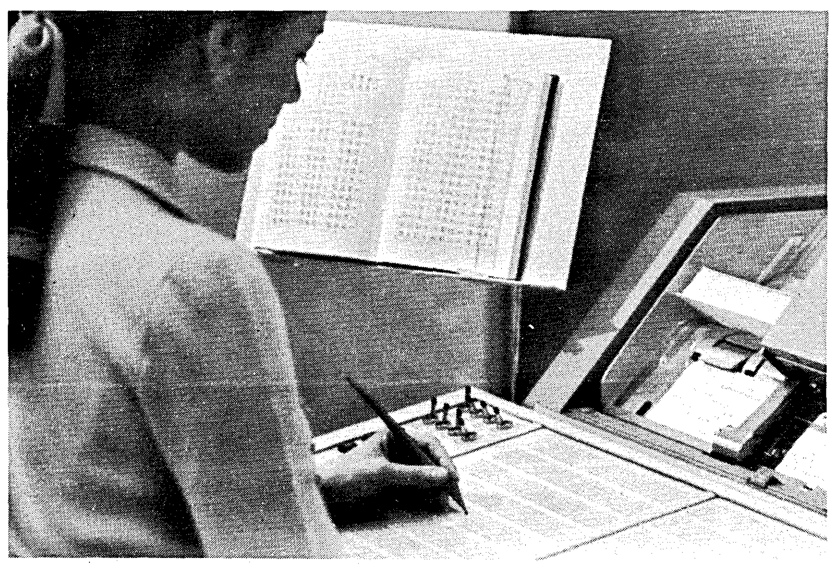
Reportedly, Ma Bell has agreed to sit down with computer users and discuss the ratemaking principles on which computer access line charges across the nation should be based. This meeting may begin within the next two months. Meanwhile, BEMA is considering whether to request FCC jurisdiction over charges for computer access lines. One knowledgeable observer sees AT&T's willingness to negotiate as an effort to keep out the federal government.

Proponents of federal intervention say it's justified because the bulk of all phone company lines supplied to t/s computer users cross state lines. The phone companies insist that rates for facilities that serve both interstate and intrastate customers are governed by intrastate tariffs. Also, an interstate access line usually passes through a concentrator located in the same state as the computer it serves, and this — according to the phone company — makes the computer-concentrator link intrastate. But a 1968 court decision seriously weakens both of these arguments (Sept. '69, p. 135).

Meanwhile, back in Ohio, some users are thinking about suing Ohio Bell. It seems that long before the phone company officially proposed changing computer access lines from an individual to a trunk rate basis, the company began charging t/s service center operators at trunk rates, under a "special assembly" provision in the tariff. The users contend the provision isn't applicable. More important, Ohio Bell allegedly made the change without telling them, which is illegal. One firm that plans to sue thinks it was robbed of $50-60K.

In related telecommunications developments, Ma Bell looked like King Canute recently, as it went to court in a last-ditch effort to keep MCI from offering microwave communications service between Chicago and St. Louis. Since last August, when FCC granted MCI a license, myriad other microwave system operators have applied for similar authority. Bell filed its

(Continued on p. 198)

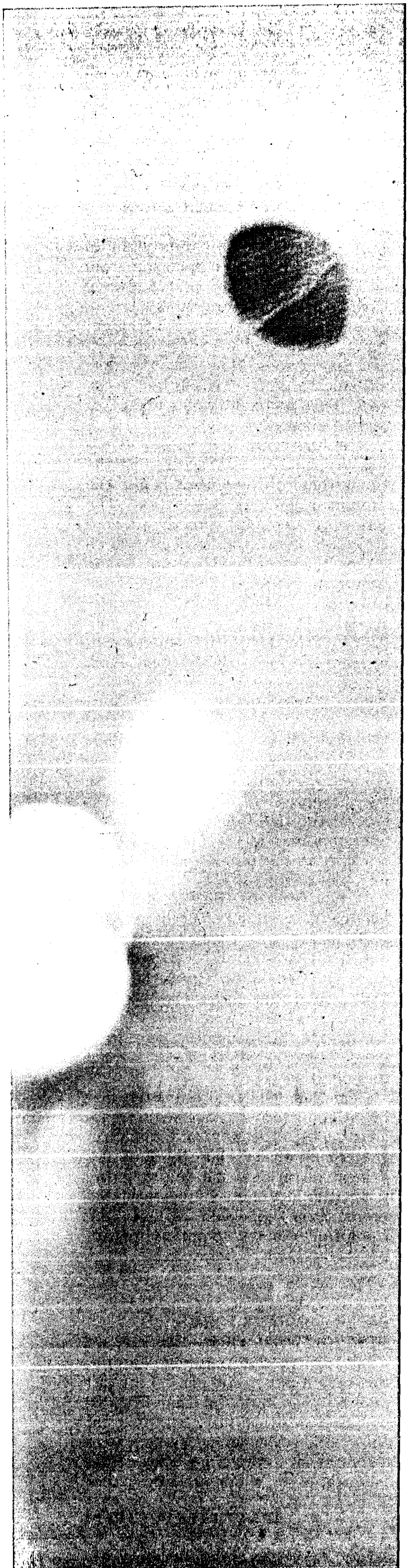


FIRST KANJI PRINTER HAS 3,520 KEYS

That's right, it's only an experimental model, but it's the world's first data processing impact printer for Kanji characters (Chinese graphics), the written language of Japan. The keyboard and printer were displayed last month at the opening of Expo '70, the Japan World Exposition. The units, which also print Hiragana and Katakana (Japanese phonetic alphabets), Latin, numerics, and punctuation, operate with System/360. Speed is 300 lpm with quarter-inch-square characters on 16-character lines. The characters are formed by a series of overlapping dots that create straight or curved lines. The dots are made by tiny print wires inked by a ribbon. Dots are overlapped by means of programmed incrementation of the paper.

The keyboard comprises an array of 3,520 characters and symbols, and if that's not enough to shake the operator, he has to master depression of the keys with a *stylus!* Information entered on the keyboard can be displayed on a 2250 crt, and the unit can be used either as an on-line input terminal or to drive a key punch.

It's all sort of reminiscent of NCR's 640-300 (Jan. p. 187) which prints Latin, Arabic, Farsi, Katakana, and numerics — but *not* Kanji.



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TEMPO COMPUTERS, INC. 1550 SOUTH STATE COLLEGE BOULEVARD, ANAHEIM, CALIFORNIA 92806 PHONE: (714) 633-3660 petition with the U.S. Circuit Court of Appeals for the District of Columbia.

ADAPSO has told FCC that what's good for the CATV industry ought to be likewise for the commercial service center industry. Specifically, ADAPSO wants the commission to bar communication common carriers from offering commercial dp service. The association thinks this is a logical extension of philosophy espoused by the commission a few months ago when it barred the phone companies from operating CATV subsidiaries within their service territories (March '70, p. 149).

Comsat vp George P. Sampson, addressing the National Telephone Cooperative Association in New Orleans recently, suggested that the White House policy statement on domestic satellites begs more questions than it answers — notably, "Who is financially big enough to play the game ... what happens to the small users who can't afford ... their own systems" and is Comsat now free to "enter competitively into the terrestrial communications market."

FCC has ordered Western Union to amend its private line, Sicom, and Infocom tariffs so that customer-supplied attachments can be used. The new tariff language was supposed to be delivered to commission headquarters by March 20th.

IBM REVISES PROGRAM PRODUCT AGREEMENT

IBM announced its revision to the program product agreement last month. In the words of one major user: "It solved most of the problems IBM is willing to solve, but the major problem — the license fee per cpu — is untouched and will probably stay that way."

In a prepared statement available on request, IBM said that the revisions, noted below, were made to "broaden and clarify the operating conditions under which a licensed program product can be used."

The "minimum use" period (the minimum time the user must pay for the program) was reduced from three months to one month. The IBM limitation of liability relative to damages for copyright infringement was deleted. Previously IBM said it would be liable only for court costs and one year's charges for the program in case of such infringement.

IBM, however, has not changed its limitation of liability on patents. This is a far more difficult and still uncertain subject, especially since patent infringement can be claimed not only on the program but also the use to which it is put. That is, the program plus certain hardware may in use result in infringement on a "special system" patent, even if the program itself is not patented; in this case the user and not the vendor may be responsible. IBM is said to be studying this.

The old agreement permitted IBM to terminate a license with six months' notice. Says IBM, "The new agreement limits IBM's right to discontinue a license or terminate the agreement to two conditions: failure of a customer to comply with its terms and conditions, and under certain claims of copyright or patent infringement.

"The revisions also include provisions to accommodate transfer of a program to a backup central processing unit during preventive maintenance, engineering of model changes, or cpu malfunction, and when program assembly or compilation cannot be made on the designated cpu because of specification limitations." IBM feels this answers most user complaints about the operating problems caused by the designation of a particular cpu for each licensed product. One user said he was "glad they've legalized this, because we were going to do it anyway."

Sources say the task force on the revisions has adjourned for the time being. An IBM spokesman says, "We do not contemplate any additional changes at this time."

IBM will at least continue to consider some changes, according to vice president David Kearns, who spoke at an unbundling conference sponsored by ACM's Special Interest Group on University Computing Centers, in February. In addition to the problems IBM has now corrected, he also noted that the lack of warranty is a problem, but "nobody knows how to certify an error-free program yet," so there is "no solution in sight." The fact that new versions of a product means gradual withdrawal of support for the old can create problems if the upgrading is too frequent, so IBM is considering reducing the number of released versions to one a year.

Kearns also said that because the user will find it difficult to guarantee protection against copying of the programs, IBM plans to reduce the "customer obligation to that of exercizing due care to avoid unauthorized copying."

Kearns noted that the sale of program products will continue to be evaluated, but the "problem is protection, and no decision can be expected for a long time." He did note that "I believe we will at some point" get to the "paid-up license," meaning that after x number of months of licensing, the user will be given ownership or allowed to buy.

SB'S WIN COURT DECISION AGAINST COMPTROLLER & ABA

Service center operators last month won a key victory in their fight to eliminate growing competition from national banks; the U.S. Supreme Court decided the operators have legal standing to oppose a government rule that lets the banks offer commercial dp services. Now, the operators are free to argue the substantive issues. This probably won't occur for several months.

The high court decision involves a suit brought by ADAPSO against the Comptroller of the Currency and the American Bankers Association. The service center most directly affected is Data Systems, Inc., St. Paul, which claims it has lost two customers to the American National Bank and Trust Company of Minneapolis. A virtually similar suit, involving the Wingate Corp., a Providence, R. I., service center, and the Industrial National Bank of Rhode Island, is still pending before the Supreme Court. Last month's opinion makes it likely that Wingate will also win legal standing.

The opinion says only that service center operators have standing to sue the Comptroller; it carefully walks around the question of whether the operators are really facing unfair competition, so the ultimate outcome remains in doubt.

A key issue is whether the Bank Service Corporation Act, passed in 1962, allows banks to offer dp services only to affiliated banks, or to bank customers as well. The Comptroller, in 1966, ruled that customers could be served, and this was the basis on which the Minneapolis and Providence banks set up their commercial dp operations.

The Comptroller also insisted that his administrative order wasn't subject to judicial review, and, even if it was, that neither Data Systems nor Wingate had legal standing to bring the matter into court. Last month's Supreme Court decision reverses the Comptroller on both points as they apply to the Data Systems case.

PAPER COMPANY FORMS NEW SOFTWARE FIRM—IMI

Chalk up another industry entrant, this time a paper company. Late last month "some assets" of a San Francisco-based software firm, four-year-old Information Management Inc., were acquired by Bergstrom Paper Co., Neenah, Wisc., which produces paper products. Included in the purchase, for an undisclosed amount of cash, were the IMI name, proprietary software packages, and the consulting services — along with the personnel who support this activity.

The new president of the newly-formed IMI, now a wholly owned subsidiary of Bergstrom, is Howard Bromberg, who had been executive vice president. Dan Haagens, founder and ex-president of IMI, continues in business under another corporate name, Information Equities, Inc., taking with him some eight or nine people and the Autologic and HOSPACT systems. The old IMI was partly owned by Matrix Corp., a Los Angeles time-sharing firm, which will continue to own a part of Haagens' new operation.

Four proprietary packages that go to Bergstrom are MAGIC, a COBOL shorthand; TDG, COBOL test data generator; DETAP, decision table system; and UPGRADE, a 1401-to-COBOL translator. In addition, IMI's New York City office and staff also transfer to the Bergstrom fold, joining a 65-year-old firm that seeks to broaden its corporate base. Significantly, this comes at a time when many industry firms are in a difficult financial bind. Time-sharing firms, as reported last month in DATAMATION, are currently experiencing this trauma, to which neither software nor hardware companies are immune.

According to Bromberg, it is time for software houses to rethink their role in the industry. If they are to survive, he explains, it is necessary for them to make a "contribution to learning." Accordingly, the reorganized IMI plans to expand into education and training activities, the plan being to use videotape, CAI, and programmed texts.

SUN SHINES AT MARCUS HOOK

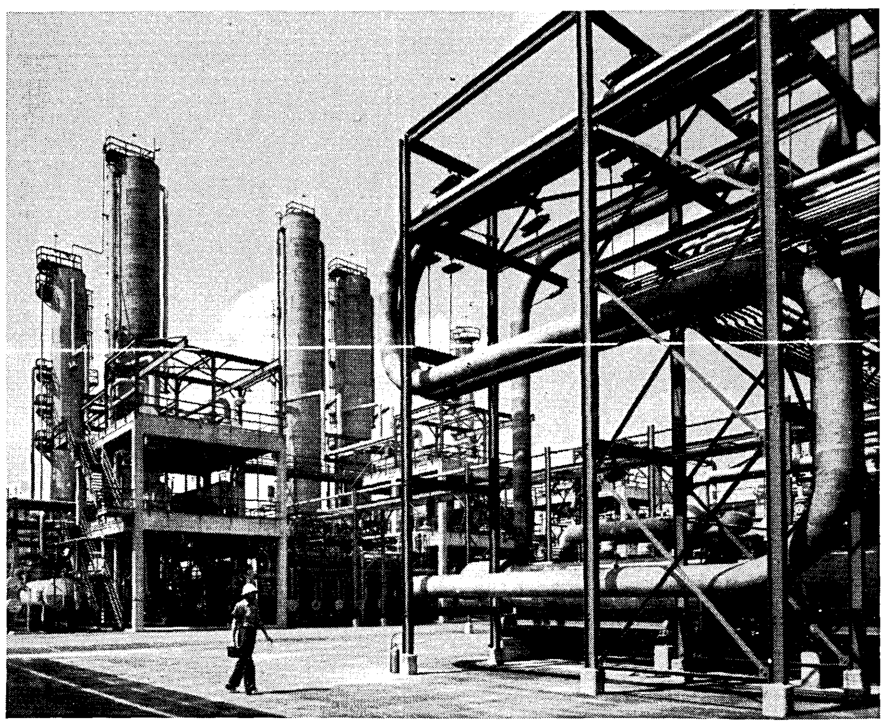
Sun Oil's process control computer at Marcus Hook, Pa., unveiled at a recent press conference, is a Foxboro contrivance running a 20-acre snarl of pipes, loops, valves and tanks that yield about 100,000 barrels of chemicals and gasoline a day. A vast complex of computer and industrial processing, it is claimed to be the first large-scale direct digital computer (DDC) petrochemical installation in the country, and one of the most sophisticated in the world.

The Foxboro configuration — two PDP-8's, two fixed-head discs, Foxboro I/O and interface — controls five plants (two gasoline, two aromatics and one feed preparation), 170 control parameter loops, 1,000 process variables such as pressure, temperature, compositions, analyses, flow rates and tank and tower levels, and performs up to 5,000 readings a second. If a tolerance is off a fraction of a percentile, a minifoghorn croaks a warning to ever-watchful operators at the control panel.

Savings and economies? None to speak of yet. Company efficiency experts predict "significant savings in quality control and cost of utilities such as heat, steam and electricity." But only modest fuel savings are reported to date. More interesting, perhaps, is Sun's attitude toward computers in general.

Sun's computer people (about 700 working on 27 systems at 15 sites), counselled by dp author and computer heavyweight Eric Weiss, now talk in terms of seriously implementing a computer hierarchy stretching from the lowly loop control at Marcus Hook right into Sun's boardroom.

For example: Sun has a model of the entire corporation on a GE-635 that simulates a year of operations in 14 seconds. An even more sophisticated model, called the "Five-Refinery Model," gives management an unusually detailed operating profile of its five continental refineries at Marcus Hook, Toledo, Corpus Christi, Tulsa and Duncan, Oklahoma. The models, as such, are not unique. The rate at which they are proliferating at Sun might well be, though.



A section of Sun Oil's refinery run by process control computers at Marcus Hook, Pa.

EUROPE MAY BLOCK EXPORTS OF U.S. ELECTRONIC PARTS

Assistant Secretary of Commerce Kenneth W. Davis suggested last month that France, Germany and Britain may want to rethink a proposed agreement barring, or limiting, exports of U.S. electronic components, lest they push Congress into rejecting the Trade Act of 1969; this bill repeals the "American selling price system" for chemical import valuation, "a change long sought primarily by Europe," said Davis. He spoke at the Spring conference of the Electronic Industries Association, meeting in Washington. But he was clearly talking at least as much to an overseas audience.

The proposed agreement, the "Tripartite Accord for Electronic Components," is still in the initial stages of negotiation, said another speaker, Deputy Assistant Secretary of Commerce Richard O. Simpson. "But we have reason to believe, after a recent meeting ... in Geneva last January, that France, Germany and Britain will proceed with the scheme, and also that other industrial products will be covered by similar systems in future. Members of EIA, along with government representatives, have made repeated efforts to 'open' this accord to U.S. interests at this formative stage. Our results have been less than satisfactory."

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U.S. negotiators are pinning their hopes on a U.K. resolution that schemes like the Tripartite Accord "should be designed to be open to all countries that are able and willing to accept the obligations of participation," Simpson indicated. But the resolution has not yet been accepted by the group negotiating the accord.

"EIA has estimated that U.S. exports of electronic components to Europe could be reduced by as much as 35% under the proposed restrictions," said Davis. "We could not help but be very disappointed with the lack of interest shown by common market officials when we raised this matter with them last week in Washington."

One reason the Europeans say they object to U.S. participation is because our standards effort is allegedly inadequate. Simpson, without referring to this objection specifically, tried to sell EIA members on the need for committing more money and personnel to standards activities.

"If international standards are to be compatible with American standards," he said, "U.S. industry and business must provide highly competent experts at each international technical committee meeting where critical standards are discussed . . . Someone said it takes three years to produce a 'good' delegate to a standards meeting. Under the American system, this means that his company must free him for this work and pay his expenses . . . Also urgently needed is better support for the American National Standards Institute."

Simpson implied that Europeans may be right about the inadequacy of the U.S. standards effort when he asked his audience to measure our program against theirs in terms of the capability for certifying products.

"Do we have a nationally recognized testing laboratory, or federation of laboratories, independent of the trading interests, with the expertise to certify that products do, in fact, conform to the standard on a continuing basis?" And, "Does this independent national authority have a system of administering a national certification mark of quality?" Simpson asked.

Last fall, the Budget Bureau sponsored a meeting of federal dp policy makers and users in Charlottesville, Virginia, at which participants expressed interest in a system for cataloging, qualifying, and evaluating dp products acquired by the government. Such a system could be integrated into a certifying program for U.S. dp exports, according to H. R. J. Grosch, director of the Center for Computer Sciences and Technology at the National Bureau of Standards.

NBS is obviously the sort of "nationally recognized testing laboratory" Simpson had in mind. But from non-Bureau sources, we learned there is intense opposition to establishing a certification program. The General Services Administration, which has developed qualification and certification procedures for mag tape and discs, might be a more logical source.

CDC USERS DEBATE THE ARRANGEMENT

An arrangement has been agreed to by Control Data Corp. so it can go on living with its users after unbundling. In its contracts, the "what's yours is ours" clause has been dropped from both Schedules G (analysts support services) and H (software). What software and dp techniques the users develop is now theirs, acknowledges CDC.

Another controversial thorn, paying separately for software that was originally projected or discussed as part of a package deal before the unbundling deadline on January 1, has been removed. Now, users who signed up before that date will be licensed for any new software that comes out between January 1 and June 30. The June 30 extension does not apply to new customers in 1970, however.

CDC spread the conciliatory news at VIM's user meeting in San Diego in March. Vernon Sieling, CDC's unbundling chief, had already similarly informed FOCUS users of the concessions in a February conference call. But the FOCUSers were not easily mollified. They have issued an acidly worded position paper deploring the fact that the government and foreign commercial users still enjoy bundled prices from CDC, and demanding that it "cease this discriminatory practice" and return to "the simple arrangement which historically has served us so well." But there was not much prospect that the new, less simple arrangement would be changed, at least until after the next semi-annual FOCUS meeting May 25 in St. Paul, Minnesota.

SOFTWARE SPOKESMAN JONES RESIGNS AS ADR PRESIDENT

Richard Jones — the industry's evangelist on software patents, separate pricing, proprietary packages, and the right of all firms, large and small, to cut a swatch from IBM's hide — has willingly resigned as president and director of Applied Data Research, Inc. But the position of the Princeton, N.J. software firm on its antitrust suit against IBM and on other Jones-spearheaded causes remains the same.

Mr. Jones has also resigned as president of the Assn. of Independent Software Companies because the post must be held by someone in a member company. ADR will be represented, probably by Martin Goetz, vp.

The main reason for his "amicable" departure, says Jones, is that he has ruled ADR in "autocratic style" since he took over as president of the 11-year-old firm in 1963. And, he is candid to admit, "I agree with the other directors of the firm that what is now needed is a structured management organization." Jones recommended his replacement, John R. Bennett, who has been vp of marketing since 1966 and was a co-worker with Jones at Univac's federal government marketing division in the early '60's.

In the release ADR issued on the changes, Henry R. Wickenden, board chairman, stated that the board and President Jones disagreed on "management and operational philosophy in such areas as acquisition policy, corporate structure, and management controls." Bennett, on the job two days at writing, could not yet specify the changes that would be made in the organization.

1969 at Applied Data was not a good year financially: earnings dropped from $352,849 or 39¢/share in '68 to $104,139 or 11¢/share. But one would honestly have to say part of that was attributable to plain bad luck. In November a light plane struck the roof of the ADR headquarters in Princeton causing a fire that destroyed two floors, while the ground floor where the IBM 360/50 and PDP-10 were housed was waterlogged. The computers weren't seriously damaged, however. Jonkers Business Machines, which had subcontracted Applied Data for work on an Army contract, went inconsiderately bankrupt and hasn't paid the firm. And '69 was the year ADR chose to file suit against IBM, which costs, of course, and to buy Programmatics, which was not profitable and was filing its own suit against IBM. There was the usual: startup costs for a new center, development costs for new products, and an office that had "overhead problems" (Washington, D.C.). Bennett says that both Programmatics and the D.C. operation have improved. He noted, that "we'll be trying to improve our earnings posture," but the emphasis and goals of the company will remain the same.

Jones says he will continue advising ADR on the antitrust suit — and help-

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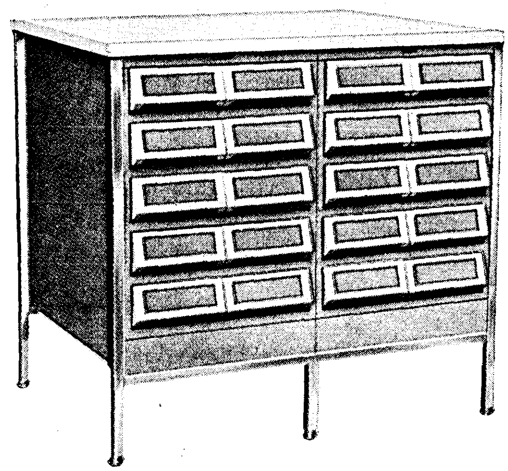

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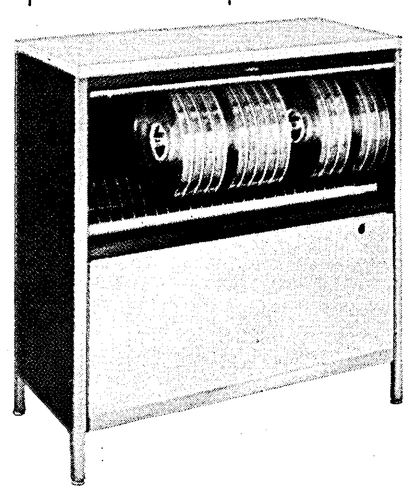

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ing the Justice Department "where I can" on their suit against IBM. This month he may be in Europe visiting various ADR offices and affiliates as his last official duty. Applied Data is dickering to buy a firm in Stockholm, Sweden, and is opening a new office in Germany.

After that, Jones will tend to personal matters, improve his proficiency in tennis and golf, and decide what to do next — which *will* be in the computer industry.

RCA OFFERS UNBUNDLING OPTION

At press time, RCA is preparing to announce unbundling of its systems support charges. The company will offer a 3% reduction in hardware costs to those opting to purchase unbundled, or will permit the customer to buy hardware bundled at the same price as before. Company spokesmen say this "optional unbundling program" is unique in the industry, and permits RCA to offer its customers an alternative available from no other mainframer today.

With RCA's move, the over-all unbundling picture now looks like this: IBM — 3% decrease, unbundled; Univac — no price change, bundled (and little likelihood of change); Honeywell — 1% increase, bundled; Burroughs — no price change, bundled (except for some accounting and billing systems); RCA — 3% decrease if unbundled, no change if bundled; CDC — 5% increase, unbundled; GE — 5% increase in rental, 3% increase in purchase, bundled; NCR — no price change, 30 man-days per $1K rent included; XDS — 5% decrease, unbundled.

Accompanying the unbundling announcement, RCA will reveal a new lease-purchase plan offering 15% off for those who sign for six years. Indications at higher RCA marketing levels are that long-term lease arrangements are desirable in the company's present marketing strategy.

AND THEN THERE WERE NONE . . .

First there was Digi, a small Salt Lake City company formed five years ago to specialize in custom and industrial systems.

Then there was Computer Update, a Salt Lake City time-sharing outfit which bought Digi in October of 1968. Then, in March, 1969, came Industrial Computer Laboratories (ICL), Information Network, Inc. (INI), and Information Technology & Systems (ITS), formed as Delaware corporations by Computer Update management. Through exchanges of stock, ITS acquired ownership of INI and ICL. ICL bought the assets and liabilities of Digi from Computer Update and INI bought the Computer Update time-sharing operation and Computer Update was no more. And now, neither are Digi, ILC, INI, or ITS and, according to the Salt Lake County Sheriff's office, "they're lining up for what's left." They being creditors.

"They" began to line up on Feb. 6 and the landlord was first in line. Second in line was DEC with an $80,000 claim for logic modules, PDP-9 systems, printers, readers, etc. ITS was using a PDP-10 in its time-sharing operation but DEC has made no claim on it. The $283,000 computer was bought and paid for a year ago by DPA, Inc., a Dallas computer leasing firm which had been backing ITS financially. ITS had assigned all rights to the computer to DPA. DPA removed it from its premises Feb. 6, moments before sheriff's deputies arrived to attach whatever was left. DPA now has the computer out on lease.

An estimated $½ million in claims have been filed against ITS by creditors, among them the University of Utah ($60,000).

What went wrong? The second guesses are as legion as the creditors. Back in March '69 when ITS was formed, the aim was to build an umbrella-covered group of companies with ITS as a holding company. ITS was to go public. Target date was June, 1969. It didn't happen.

Directors of ITS came from Dallas (DPA) and California as well as from Utah and the out-of-staters were in the majority. One guess is there was too little attention paid to cultivating existing business in the Mountain states while money and efforts were diverted to California where the firm had no business. ITS did start up a software operation in San Diego and there had been some talk of moving ICL manufacturing operations to the Los Angeles area.

Dick Jepperson, who founded Digi and was with ITS until last October, said Digi had $½ million in contracts for its proprietary Command 690 system when it was purchased from Computer Update by ICL. This system was a line of small computer packages developed for industrial control applications. Three actually were delivered before ITS folded and are in use, unsupported at the Ampex Colorado Springs plant (a $200,000 system), at the South West Regional Laboratories of the Department of Health, Education and Welfare in Los Angeles ($100,000) and a small unit at the University of Utah. Ordered but never delivered were two larger units for the University of Utah and one for United States Steel.

The time-sharing operation (INI) was doing about $12,000 a month in business in June of 1969, Jepperson said. "DPA was committed to an investment of $1 million. ITS went through it and that was it."

A spokesman for one of the ITS creditors said DPA had "pumped $1.3 million into ITS preparing it to go public but ITS wasn't building up its contracts or accounts the way it should and DPA cut off the water supply."

Edward E. Winkelman, treasurer and assistant secretary of DPA, said it wasn't a matter of cutting anything off. His firm committed $1 million in backing to ITS a year ago to see them through development stages after which they would go it alone. "The million's gone and they didn't make it." His guess toward the cause, in part — they invested too heavily toward fulfilling a proposal from a big Chicago customer which eventually fell through.

In California the ITS fate was described as the normal attrition of a company in a soft money atmosphere. Whatever the reasons, ITS is gone but not quite everything that went into it.

Jepperson and the nucleus of the original Digi staff, who all parted company with ITS last October, have started all over again. The new company will develop and market what Jepperson describes as a small, rugged, sophisticated, LSI-based terminal aimed at the blue collar market. They also will be in the remote batch business.

The terminal has reached the prototype stage. Hopes are for a Fall Joint introduction and full production in early 1971.

Terminus is operating out of office space at 2880 So. Main St., Salt Lake City. They have a CDC 6400 on order and expect delivery in about two months. Jepperson said they have a commitment on a 30,000-square-foot building (for $50,000 in stock) to house the computer and ultimately their production operations. The computer comes first, he said, "as we need it as a design base and then we hope it will help us meet overhead." The company is looking for private financing and hopes to have this by the time the computer is delivered.

Officers of Terminus, in addition to Jepperson, are Ray Jepperson, secretary and treasurer and Ray Jentzsch, production manager. Both held the same positions with Digi. Rounding out the staff are two University of Utah graduate students in computer

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science, Devon Mecham as systems management specialist and Charles Brauer, information retrieval specialist. Dr. Frank Wanlass is under contract to support their LSI work.

Jepperson sees the market for the Terminus terminal as "three to four times that of Viatron's," because of its blue collar aim. And, he says, an overriding philosophy of the new company is "not to be bought out."

RAYTHEON SHIFTS 180° AND FINDS A NEW WAY

Ever since Raytheon acquired Packard Bell's computer activity in Santa Ana, Cal., in late '64, they've been trying to figure out a way to make a buck while carving out their own special niche in the computer industry.

When current head man Andy Huson took over Raytheon Computer in late '67, the parent company had put the nix on the special-systems-for-vertical-markets approach of Joe Ricca. The ghost of old, unsuccessful Packard-Bell hung heavy over the plant. The 703 — a $13K, 1.75-usec, 16-bitter had just been announced, but there were no orders and no strong sales organization.

Now, a little more than two years later, Huson has presided over a 180° shift in philosophy . . . to the development of a family of program-compatible, commercial machines. Starting from ground zero — no orders in Jan. of '68 — he's installed 250 machines. There are seven sales offices, 10 salesmen, 35 maintenance engineers.

Presiding over the sales resurgence is Tom Quinn, a bright, intense refugee from Digital Equipment Corp.

The company started rounding out its line with the 706, a $19K system announced in the fall of '68, and followed by the 704 last fall. It sells for under $10K, just started shipment.

Of the 250 installations, 160 are 703's, a lot of them OEM deliveries. Major applications are small-scale data acquisition, control, communications, plus geophysical and seismic data reduction and research labs.

After significant personnel cutbacks about a year ago (May, '69, p. 35), the company is hiring again, is up to about 425 employees. Production problems of a year ago – "we underestimated sales," says Huson — have been solved, and the company is quoting deliveries on the 703 and 706 of 45-60 days, with longer quotes possible for peripheral-heavy systems.

Raytheon Computer has stayed out of the peripherals ratrace, offers AID (Application Interface Device) featuring "functional blocks essentially common to all interfaces." But they have a couple of disc drives under development.

The company has produced all its own software for the new line, and it ranges from a 4K Operating System for the basic 4K core computers through multiprogramming and a real-time OS. And they offer FORTRAN IV and a conversational F-IV requiring 4K core. Believers in their own software, they're inviting benchmarks, have entered what they call "the nitty-gritty area of demonstrating programming efficiencies."

Raytheon West is high on a new Array Transform Processor (ATP) for fast fourier transform or signal processing. They've sold six of the units — they sell for around $20K — without promotion, and say that at a total system price of about $75K, including computer, it competes favorably with more expensive systems from Texas Instruments, IBM and XDS. ATP production starts in June.

They also offer a software simulator of the ATP for about $2,500 that can work on 8K machines, but requires 16K core for efficient operation. They've sold six of those.

Raytheon hasn't forgotten the old Packard-Bell module business. Updated, naturally, it — along with d-a, a-d devices, etc., — accounts for about 25% of RC's sales.

Dollar figures on the computer operation are not available. They're buried in the corporate revenue accounts. But Huson says '69 sales were a bit more than double those of '68, and he's hoping to almost double again this year.

If he can, it's possible that this will be the year corporate Dad sees his long-struggling step-son achieve profitability. It's been a long time coming. The next question, obviously, is how fast corporate HQ will let its west coast adoption grow.

NEW MINICOMPUTER MFR. WILL SELL, LICENSE OEM'S

A new California minicomputer manufacturer, gearing its products to the OEM market, has reached the breadboard stage and will have a prototype of its initial product by May 1.

Computer Development Corp., Santa Ana, will begin full-scale production and marketing of the product, a 4,000-word, 8-bit minicomputer, in September. The firm will sell both the computer and/or its elements for systems incorporation by OEM's. "We're unbundling hardware-wise," says Lambuth Cox, Jr., vice president, marketing.

Cox said a complete system, including cpu, enclosure, power supply, console, and a 1K bite memory, will cost from $3,000 to $3,500 singly, with volume discounts to 40%. The cpu all by itself, which he describes as essentially three circuit boards, will sell for $1,400 singly, and from $900 to $1,000 in volume.

Computer Development Corp. was formed last November in Dallas with financing provided by the founders. President is William Roessl who had been vice president, R&D, and was one of three partners in International Computer Products, Inc., a Dallas manufacturer of digital, cassette tape recorders. Cox also comes from ICPI where he was director of marketing.

Other officers are Richard Pasternak, vice president, engineering, formerly senior engineer, Microsystems, Inc.; Jack Riley, vice president, operations, formerly manufacturing and engineering manager, Dana Laboratories; and Russell Lasker, vice president, finance, formerly in the same post with Microdot.

The company moved to Santa Ana in November and began design in December. They occupy a 24,000 sq. ft., leased facility of which they use 7,000 sq. ft. with plans to tap the rest as needed, probably beginning this summer.

Cox said 10 pilot production models of the firm's minicomputer will be ready by July or August. He sees the present staff of 19, including 12 engineers, being augmented by 50 to 60 production people by year end.

In addition to selling its computer and its elements, the firm is talking about licensing to OEM's for either or both. Cox said a marketing program has not been firmed but will include a minimum of two regional sales managers.

He said the company currently is seeking an additional $1-1½ million in private financing and anticipates going public in from six months to one year.

TI SCIENCE MEDAL WINNER IN ENTREPRENEUR PROGRAM

Jack Kilby of Texas Instruments, Nixon-acknowledged father of the integrated circuit, has been given the title Director of Engineering & Technology for TI's 20,000-employee Components Group. As such, he will have a major responsibility for "monitoring emerging technologies that represent product promise 5, 10 and 20 years down the pike."

The responsibility is a fitting one, since Kilby's own idea for integrated circuits emerged ten years ago as a development that now brings an estimated $500 million in sales to the

electronics industry annually. Kilby was awarded the National Medal of Science by President Nixon on February 16 for "original conceptions and valuable contributions in the production and application of integrated circuits."

Hundreds of new companies have grown out of the Kilby patent and one of his duties will be to shepherd bright young TI engineers along a company path to ensure that they don't take their new ideas to outside investors and start miniature TIs of their own.

As overseer of a new IDEA System (Identify, Develop, Expose, Action), Kilby will chair special meetings designed to allow prospective TI entrepreneurs and innovators an opportunity to air their proposals to management. Engineers and scientists get a chance to outline their ideas with complete proposals for personnel, facilities, budget and schedules in the same manner that they would have approached outside investors. Management will actually provide venture capital for ideas accepted for further investigation. As one executive put it: "We are offering our fledgling entrepreneurs that most tangible of prime movers, money." Employees who have their ideas accepted will, in effect, be running their own business within the framework of the TI corporate structure.

Jack St. Clair Kilby receives the National Medal of Science from friend for invention of the integrated circuit.

Jack Kilby can easily identify with younger men who will take part in the IDEA System. When he came to TI in 1958, from Centralab where he had worked on silk screen circuits, he was already "sensitized to the need" for integrated circuits over discrete component circuits. At TI he found a receptive atmosphere, was "given his head and some resources" and actually designed the first integrated circuit within a year of the date he was hired.

Holder of 33 electronic patents, Kilby was 34 when he patented the integrated circuit. He counters questions about future inventions with a statement he says he read somewhere: "Some studies have shown that a man is most inventive around age 35 . . ."

Kilby, however, doesn't consider this age to be a peak, but more of a plateau. It is safe to say that Medal of Science winner Jack St. Clair Kilby looks forward to being the potential sponsor of another National Medal of Science winner in electronics "down the pike ten years or so."

REPORT URGES START OF CANADA INFORMATION SYSTEM

Canada needs a modern and sophisticated information system for the dissemination of scientific and/or technical information, its federal government has been told.

The advice comes from the Science Council of Canada, a key advisor to the federal cabinet on scientific matters. The report, known as Science Council Report No. 6, *A Policy for Scientific and Technical Information*, urges the adoption of a scientific and technical information (STI) dissemination service. The report suggests that this service is necessary for any technologically advanced country.

Although the report doesn't say so, there is also a sense of urgency in some of its proposals. For example, the report states that eventually the system would become totally computerized and quite sophisticated. In effect it would be the first Canadian national data bank.

In recent months the whole question of Canadian data being stored at the subsidiaries of U.S. companies located in Canada has received widespread attention. The feeling is that a lot of the data will be of a socioeconomic and political character so that the question of who has access to it becomes paramount. Hence the fear that the U.S. through its Canadian subsidiaries could have access to information vital to the country's security.

In spite of the federal government's anti-inflationary policies resulting in heavy cutbacks in spending, there is a feeling among informed observers that the report will be adopted. The proposed STI service under the National Research Council's direction would build on existing information outlets — among them, the National Science library and other libraries and research centers across the country. The STI service would provide the link between the component parts of the network and act as the center point. The council says it would become the key to an information service that would serve the present and future needs of "the generators, processors, disseminators and users of information in Canada."

The council, although primarily concerned with the policy of setting up the STI service, says eventually the whole system could become computerized. "The Science Council's view of a network is that a set of independent information sources developed to meet particular needs . . . are linked by an efficient communications system. This communications system could initially be as simple as a Telex system, backed up by the rapid mailing of microfiche or hardcopy of the information, and ultimately as complex as a totally computerized system with the user having his personal terminal from which to interrogate a series of distant computerized information sources, with the desired information between transmitted by broadband system.

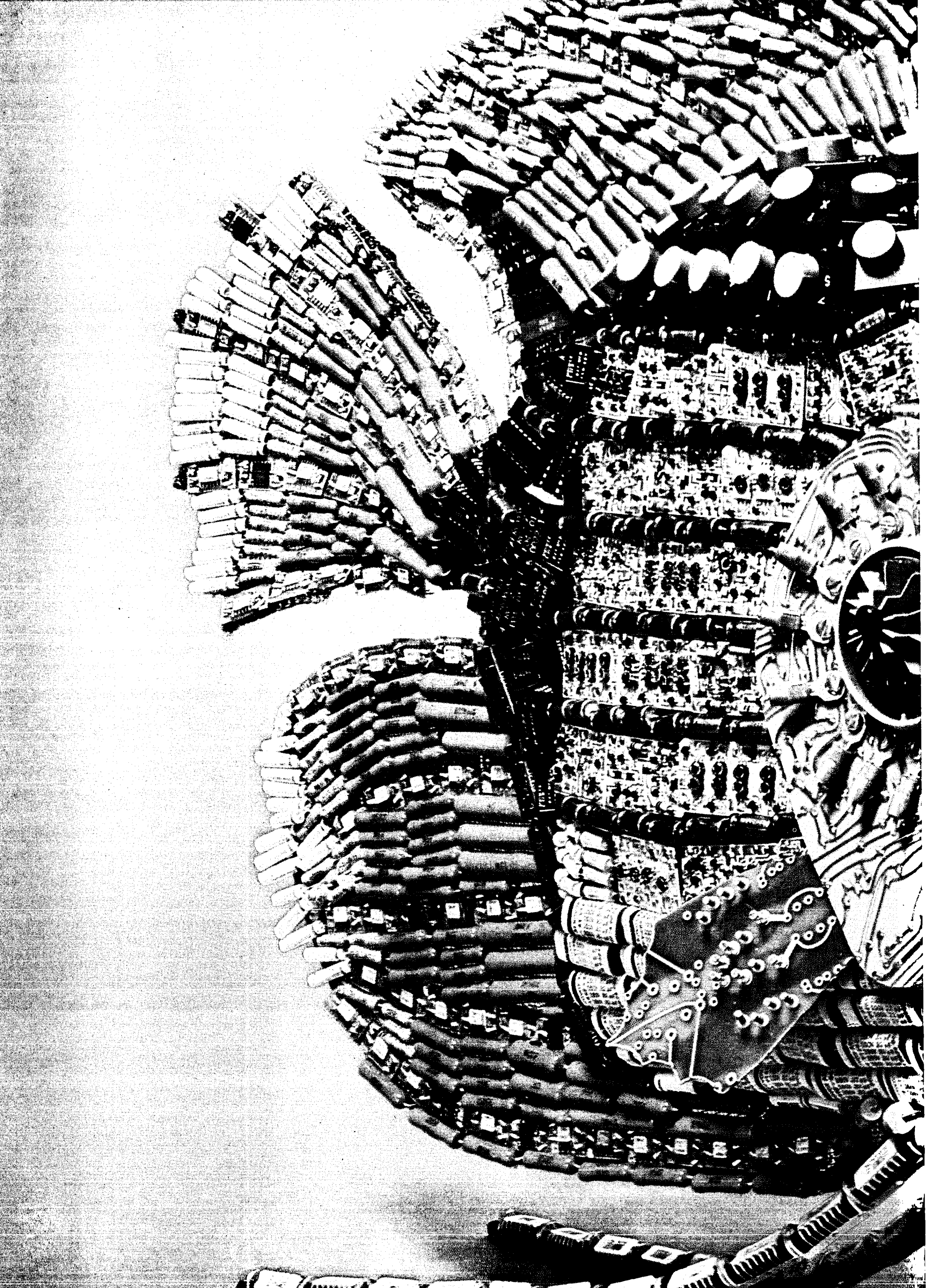
"The development of a national information network, if actively pursued along the lines outlined in this report, should provide a wide range of opportunities for Canadian companies specializing both in hardware and software to make important contributions. The role of the STI service in this area should primarily be that of an initiator, and it should seek to contract out specific projects to appropriate groups," the report says.

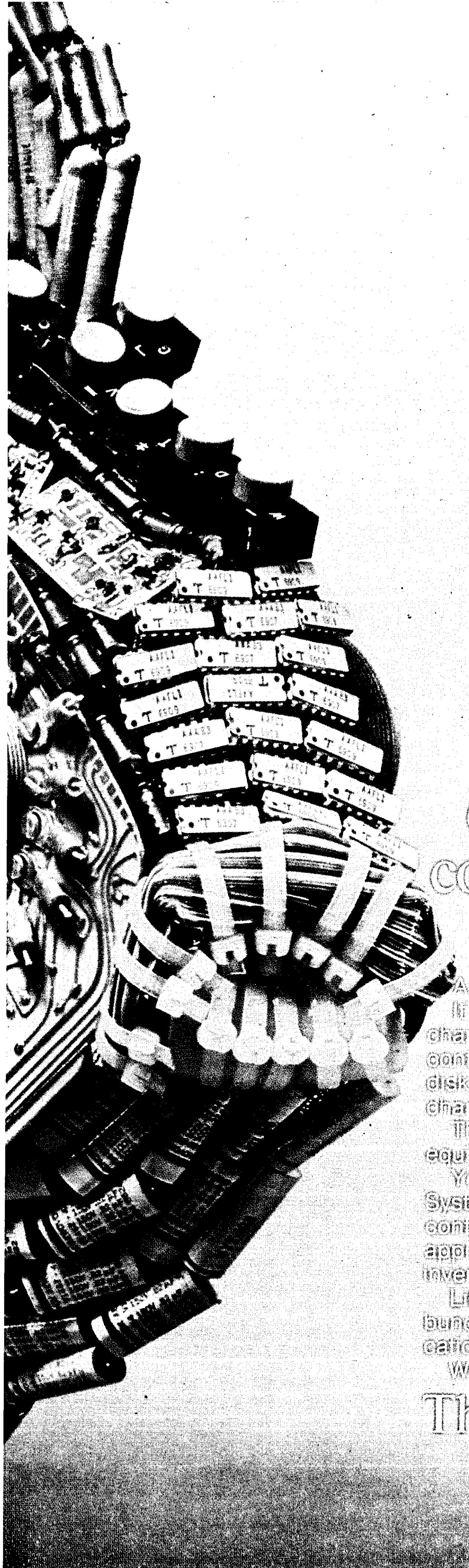
It is not essential, the council notes, to have "a single centralized collection of all available scientific and technical information in Canada: it is imperative, however, that the sum of Canadian collections provide as complete a coverage as possible, and that links with other countries be forged which will give access to any other information which may be sought." Control of the STI service would lie with the National Research Council and a board of directors composed of members from industry, government, universities and the information and communication sciences. A full-time secretariat would be provided.

The question, of course, seems to be, will the report be acted upon? By all indications the chances are good, for the following reasons:

The growing concern about U.S. companies and their involvement through their Canadian subsidiaries in the computer information field.

The proposals wouldn't really cost that much extra. The council suggests that the STI service would give better





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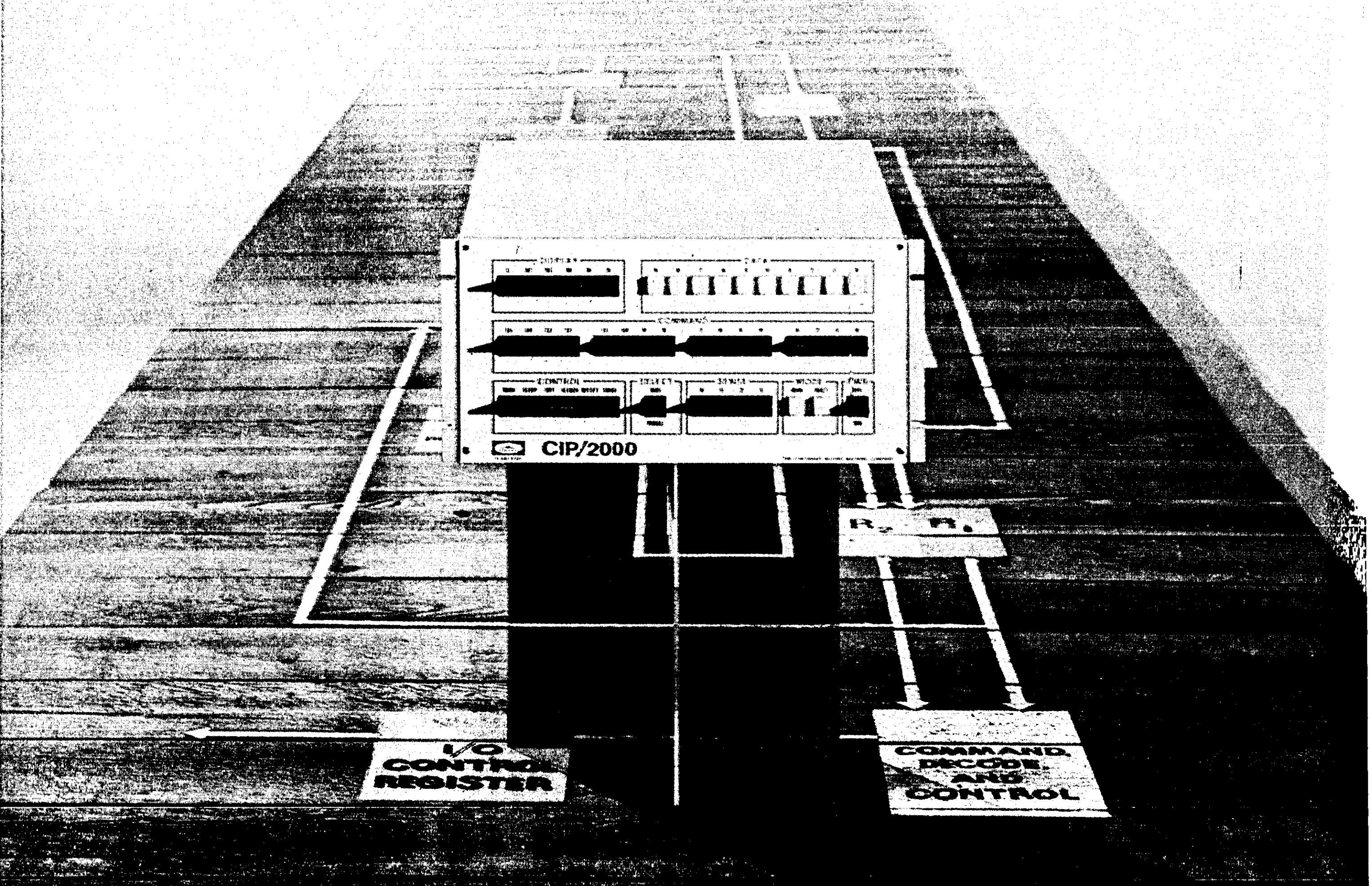

value for money already being spent. (Spending on library and information services currently amounts to about $150 million annually, the council states in its report.) Minimum costs for the "large scale application of computers within a national information system" could exceed $50 million within a decade.

BETTER CHEMISTRY THROUGH COMPUTERS

Computer control of wet chemistry processes is not a startling concept but obviously one difficult to implement economically since the first commercially offered computerized system controlling laboratory test processes began operating in the U.S. only last month.

The system was developed by Vickers, Ltd., of Britain to do blood tests in clinical laboratories. Designated the Vickers MC-300, it is distributed in the U.S. exclusively by Medi-Computer Corp., Greenwich, Conn. MC stands for multi-channel. Up to 20 test units can be connected to the system, and 300 denotes the number of samples that can be processed each hour.

Fourteen thousand clinical labs performed 1.5 billion blood tests in this country last year. Test volume increases 20% annually. Between 85% and 90% of these tests are basic — for albumen, glucose, cholesterol, uric acid, etc. — and can be accomplished in fairly routine manner, a routine that has the qualified technician serving as a test tube filler and emptier and report writer. Even if the lab is automated he remains tied down with translation of analog instrument readings and report writing.

A similar situation exists in Britain, possibly aggravated by the national health programs, but nevertheless sufficient reason for the Ministry of Health to provide Vickers a grant to develop the computer controled and monitored blood test system.

There are three basic modules in the MC-300 in addition to the computer, which is a PDP-8L. They are the control console, the distribution system and the analytical reaction consoles.

The control console and the distribution center are tied together. The desk-size console holds the system's drive mechanism, is entry and check point for blood samples and the operator's console. Magazines of blood-filled vials (already centrifuged) are loaded onto the console for automatic passage before a plasma monitor that checks each sample for amount, proper separation of plasma and red cells, for hemolization and turbidity. The vials, slim plastic rectangles, are wrapped in silver foil printed with 10-digit six-column coding that is perforated for positive sample identification tests to be performed, and destination of results. A pencil point can be used to punch out the significant digits.

These consoles are about the size of a shallow three-drawer file cabinet and each can do two tests. They contain chemicals, the reagents for the tests, and pumps to move the reagents up and out into one of the 120 reaction tubes set in the rotor on the console top. Reagent and blood mix and react in the heated tubes as they are rotated around to the point where a double-beam colormeter (housed in a small box set above the rotor on a thin neck) makes a reading.

While the blood samples are being distributed and the reaction consoles are doing their processing, the sample vial continues to move across the control console (a ten minute trip) toward a scanner (a light sense diode address reader) that picks off patient identity, laboratory accession number, and desired tests. This information reaches the computer as the results of tests on that specific sample are being recorded.

The vials are stored automatically within the console for 20 minutes, in case tests must be checked or rerun.

The computer has controlled the entire cycle. The basic time unit for the cycle is 12 seconds. Every 12 seconds the system moves, advancing a vial, swinging a siphon probe, moving a sample cup, moving a reaction console rotor, pumping out a quantity of reagent or laundering a cup or reaction tube with air and water.

The critical functions of the computer are control of the mechanisms of the system, keeping them in equilibrium and attuned to the chemical processes, and preventing self-destruction; control of the chemical processes, primarily the physical aspects such as quantity and contition of liquids, heat of units, time lapse; conversion of analog measurement from colormeter into digital quantities and units of measure; correlation of the measurements with the patient sample they apply to and printout of the test information.

The system is set up for processing through a dialog between computer and operator via a Teletype unit. The various tests that will be performed are named and assigned to reaction consoles. The number of tests can vary. Currently, Medi-Computer is offering software for 16 tests. With a 10-reaction console system, this leaves four test channels free for comparison testing or lab programmed tests. Parameters for the tests are entered, including standardization factors and alterations in the speed of the system, which can be set for handling samples at a rate ranging from 50 to 300 an hour.

Test measurement is standarized by run-through of a standard sample. The linear programming that controls analog to digital conversion automatically adjusts its curve to account for electronic and baseline drift. Standardization is done periodically during regular operation.

Correlation of test data with sample identification is done by sequencing, simply the arrival of both groups of data at the computer simultaneously. The computer then prints out — on two teletypes for a 20-test system — identification, the requested test results (in units of measure) and destination. Medi-Computer is also offering a data acquisition unit to collect and store MC-300 and other lab instrument output.

Vickers developed the majority of MC-300 software. The Medicomputer people say they are adding flexibility and marketability. The company is headed by Perry Seamonds, Australian emigre, U.S. educated MD with an intense interest in computerizing medicine. Formed in 1968 and still with only a handful of people, it captured the U.S. distribution of this system in the face of competition from some of the largest U.S. corporations.

Medi-Computer has been running a test installation for the past few months and last month installed the first MC-300 at a customer location. The marketing pattern will expand from the New York area along the East Coast and then west. Part of the limitation on this is field servicing. Personnel for this is now being selected.

A 10-reaction console. 20-test MC-300 system with PDP-8L and Teletypes is priced at $242,000.

DATA BANKS AND PRIVACY . . . A LONG HARD LOOK

One of the longest and hardest looks yet at data banks and personal privacy will be taken by the National Academy of Sciences, funded by the Russell Sage Foundation.

The foundation, which specializes in applied social sciences, is providing $149,500 to support a 2½ year study directed by Dr. Alan F. Westin, professor of public law and government, Columbia University. Backing him up is an army of big name consultants, "to insure that the project's re-

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news briefs . . .

search and its judgments are exposed to the full range of viewpoints on the data bank and civil liberties problem."

The study is sponsored by the National Academy's Computer Science and Engineering Board. Its chairman is Anthony G. Oettinger, professor of applied mathematics at Harvard University. Oettinger describes the study as "focusing a truly interdisciplinary effort on the data bank problem ... bringing experts in computer technology together with specialists representing law, the social sciences, information users, and citizen groups."

Dr. Westin said the project will provide: systematic information on the number, types, and functions of computerized data banks that have been created; data on what measures have been installed already in these systems to safeguard citizen rights; an evaluation of the effectiveness of these measures; and information on how these systems plan to expand or are tending to drift in the 1970's.

"Our study," he said, "is intended to give the Computer Science and Engineering Board and the American society a factual account of what is happening, and to describe the kinds of legislative, judicial, administrative, technological, and organizational measures that might be taken to assure the proper balance between information-collection and personal liberties."

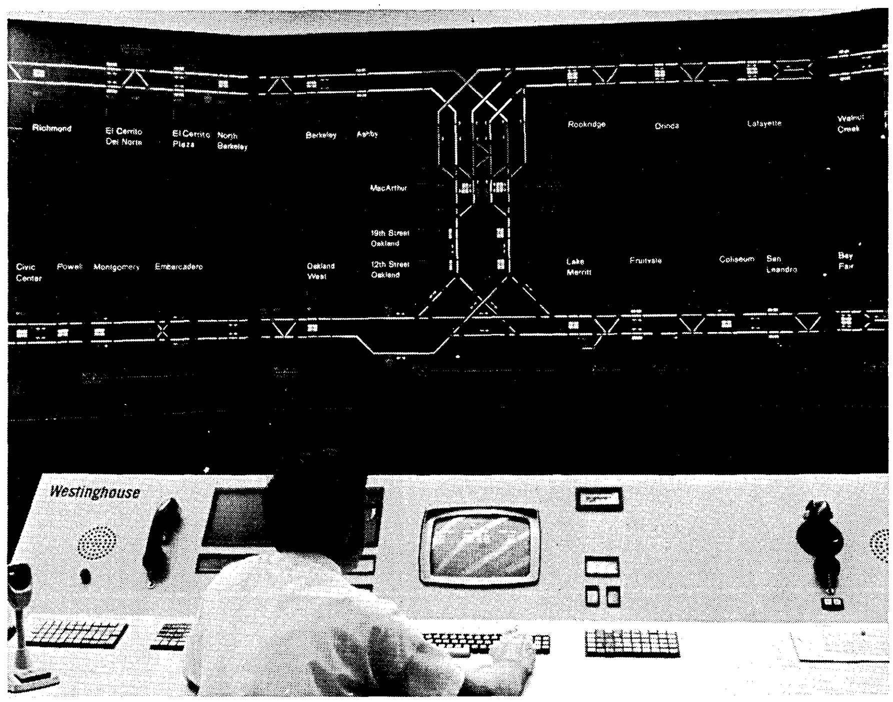
The study report will be made to the Computer Science and Engineering Board in 1971 and a longer monograph by Dr. Westin will appear in 1972.

WESTINGHOUSE BOWS BART TRAIN CONTROL SYSTEM

A $26-million computerized train control and communications system, being provided by Westinghouse Electric Corp. for San Francisco's Bay Area Rapid Transit (BART), was unveiled to members of the press last month. The computer system is reportedly 80% toward completion, and the individual stations only 10-15%, but officials there are looking toward the initial operation with revenues coming in along the first leg of the system in August, 1971. Little was said of the fare collection system being developed by IBM for BART, but a year-end status report says this is 15% toward completion.

The BART system is being called the first completely new metropolitan rail transit system in the nation in 60 years, and the first in the world to be completely automated. Along the 75 miles of tracks, including a stretch running below San Francisco Bay, will be 34 passenger stations in a three-county area. There will be as many as 105 trains in operation during peak hours, some running as close as 90 seconds apart. The 72-passenger cars, assembled in trains up to 10 cars long, will be operated at speeds up to 80 mph. Including 20-second station stops, average speeds reportedly will reach up to 50 mph — said to be twice as fast as any existing urban transit system. (It was said that Chicago's RTD runs at an average 25 mph.)

All this, including train scheduling, speed setting between stations, and the opening and closing of doors, will be automatic, with supervision coming from back-to-back 24K Prodac 250 computers from Westinghouse. The on-line processor supervises the scheduling and monitors the operation of the network; the standby unit provides backup and is used to simulate the system for off-line experimentation and for operator training. Guided by the operating schedules, the computer checks for correct train makeup, determines departure times from yards and stations, and sees that trains are properly routed. It requests train speed adjustments and makes other corrections. Some of these corrective strategies are: distribute intervals between trains, adjust station dwell time, control sequence of trains, and revise train dispatch schedule. The computer also keeps records of accumulated car miles and operating hours, and can analyze system power consumption.



At the BART train control console, operator can display train operations at console and on display board. Keyboard can be used to request various displays on the crt. It is also used to enter minor program changes, such as in the nominal (20-second) dwell time at a passenger station. Other buttons make hard copies of crt-displayed information and of all alarms associated with train operations.

KIDNEYS MATCHED BY COMPUTER

The first experimental phase of a planned computer communications network that will determine within seconds the patients most suitable for kidney transplants among those available in the southeastern U.S. went into operation last month. Dr. William W. Anderson, director of the Artificial Kidney Center at the Univ. of Miami is now online to a kidney data bank at a GT&E Data Services' computer center in Bayside, N.Y. If the system works satisfactorily, it will ultimately be expanded to serve approximately 15 hospitals in 12 states.

The program was developed by Dr. Anderson and Dr. Robert K. Ausman, deputy director of the Florida Regional Medical Program, a federal grant agency. Both are accomplished programmers, able to do systems design as well as coding. They are using APL with a Datel terminal to access the GT&E 360/50. In order to assist additional users, they are going to write a program for self-instruction of users.

Goal of the system is to assure the closest possible matching of the tissue types of the kidney donor and the transplant candidate. The speed of the system is particularly important since no more than six hours can elapse between removal of the kidney from the donor and completion of the transplant operation. Using the computer, a physician can match a kidney against hundreds of potential recipients in a matter of seconds, in comparison with 10 or 12 tissue comparisons per hour that are possible with conventional manual methods.

AC&C READIES MAG STRIPE READER/ENCODER PRODUCTS

A company that has been laying low during two years of development and testing is now about to spring with a line of reader/encoders that they think will be a boon to airlines, point-of-sale device manufacturers, banks, and everyone else with ideas for making use of magnetic-encoded credit cards.

American Computer and Communications Co., in Torrance, Calif., is aiming at the OEM market for their readers and encoders, which come in a variety of types and combinations. For example, there will be a manual keyboard encoder — suitable for occasional use — as well as an automatic unit, now in production, that turns out 1,000 cards/hour. Manufacturers can also get just a reader or a combination reader/encoder.

According to president Tom McGeary, AC&C and IBM are the only companies so far to complete production models and accumulate enough data on reliability to be ready for volume production. But a couple of dozen others are working on it. To get adequate reliability data — assuming users will find some way to scratch the magnetic stripe and otherwise foul things up — AC&C has also designed and built its own test equipment.

Although the company has been supplying the equipment in modest quantities for currency dispensers and other applications, the hottest initial market appears to be the airlines (if they ever get any money).

Univac and AC&C have combined efforts to attack this market, with Univac now demonstrating a system at their Bluebell, Pa., facility that makes use of an AC&C credit card reader/encoder, airline ticket reader/encoder, and data transmission equipment. As with other airline ground facilities, the project has been prompted by the arrival of the jumbo jets. The airlines would like to decentralize their ticketing. Instead of having a horde of passengers bunched up at the ticket counter for one of the monster jets, the customers would put their credit cards in any of several terminals. There the magnetic stripe is read, space verified, and other data passed on to a central reservations computer. From a printer at the terminal, the passenger gets his ticket — also with a magnetic stripe — and moves on to the boarding area. Insertion of the ticket in another unit lets him on the plane. If he's in the wrong place for the flight, or his watch has stopped and he's early or late, an alarm sounds to show something's wrong. The set-up can also include a crt display; if the passenger doesn't have a reservation, it will show him what's available.

Chances of these kinds of systems being widely accepted have been enhanced by the adoption of a magnetic stripe credit card standard by two big airline organizations — the Air Traffic Conference of America and the International Air Transport Association. Besides the Univac/AC&C activity, IBM now has a prototype system in action at Chicago's O'Hare airport. Some 17,000 of American Airlines' Admirals are trying out the cards and American Express has several thousand of their cardholders participating.

McGeary sees his company as the potential supplier to several mainframe makers, who may want to compete with IBM without going through the development stage with the reader/encoder modules. AC&C is still pretty small, with about 30 people — nearly all engineering development types, plus administrative people, and marketing head Mark Kimmel. A production chief has just been hired. Privately held, the company expects to have sales of about $500K this year but sees prospects in the $2-5 million range by two years from now. For information:

CIRCLE 309 ON READER CARD

HONEYWELL ENTERS KEY-TO-TAPE MARKET

In a long-expected move, Honeywell's Data Products Division has announced its entry into the keyboard-to-tape through a computer market with the introduction of the H-5500 system, which will enable up to 64 stations to simultaneously encode data onto the same reel of computer-compatible mag tape. Similar to other systems now in the field, the Honeywell equipment is unique, says the firm, "because all subsystems are Honeywell-made ... Complementing the single-vendor advantage is a large and experienced international field service organization."

Deliveries of the new system will begin in January '71, with a 25-station system expected to lease for from $2,800 to $3,800 per month. A system will operate at "full performance with 32 keystations." Applications requirements will determine whether a larger number of stations is required. The system will utilize all standard tapes; 7-track BCD, 556 bpi; 9-track EBCDIC, 800 bpi. The record type/size is variable to 400 characters, and the storage capacity is 16K 16-bit words (core), 3.5 million bytes.

James K. Sweeney, president of the current leader in the field, Computer Machinery Corp., Los Angeles, stated that he welcomed Honeywell's arrival on the scene. "We're glad they waited this long to do it," he said. "It gave us about a year and a half lead time when we expected only a year." He stated that Honeywell's joining the fray will open up the market, inasmuch as Honeywell users "will also have to look at us on a competitive basis."

Honeywell will offer with its new system currently available Keytape attachment capabilities such as communications, line printing, serial printing, and adding. For information:

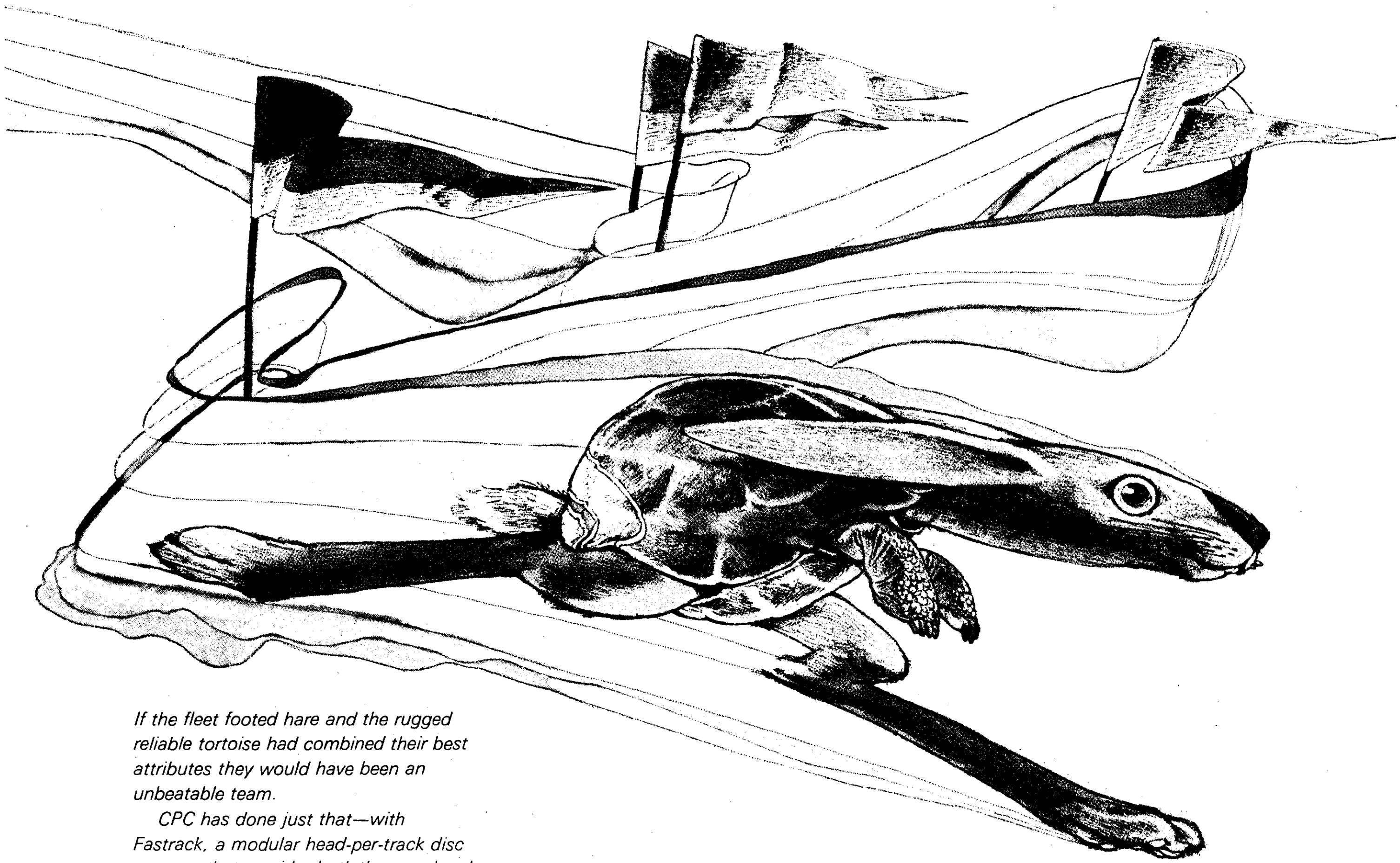
CIRCLE 308 ON READER CARD

LEVIN TOWNSEND — ALL THAT GLITTERS

Excursions among the bright lights of Broadway and Las Vegas by Howard Levin didn't meet with the approval of partner James Townsend and now the latter is top man at Levin Townsend. How long this will last is the question, since Levin is contesting his ouster in a New Jersey state court and wants to be recognized as company president again.

Townsend took over as president Jan. 16, when the board of directors in a surprise move voted Levin out 4 to 2. There have been claims of internal dissension at Levin Townsend and counterclaims that all was peaceable until Townsend presented the resolution that Levin go. However, Townsend tried for the presidency in March 1969 and lost by the same vote that gave him the office this time. That vote also lost the company Thomas E. Dewey, Jr., its director from Kuhn Loeb & Co. and a $20 million financing that investment house was getting together.

Townsend said the change of executives was necessary for management to concentrate on those areas that afford it "the greatest growth potential and profit return." These include computer leasing and certain real estate operations (National Equities, Inc., for one). The money losers



If the fleet footed hare and the rugged reliable tortoise had combined their best attributes they would have been an unbeatable team.

CPC has done just that—with Fastrack, a modular head-per-track disc memory that provides both the speed and the data reliability so necessary in this exploding world of program swapping, time sharing, message switching and real time computing.

It's the head arrangement that does it!

IT'S THE HEAD ARRANGEMENT THAT GIVES FASTRACK™ BOTH SPEED AND RELIABILITY

Fastrack Speed vs. the Disc Pack

Too often, Disk Pack Manufacturers define "access time" as the time it takes the moving head to reach the desired track. They conveniently fail to mention the additional time required for the rotating disc to reach the data point.

In reality, the fastest disc pack takes an average of 30 ms to move the arm plus an additional 12 ms to reach the data. That's an average total time of 42 ms. And typically, disc packs take 70 ms or longer.

This slow access time is just not acceptable in most real time computing applications.

On the other hand, CPC's head-per-track modules gain access to data in 16.7 milliseconds average because hundreds of "fail safe" flying heads hover micro-inches above each track. There is no time lost in head motion. No errors caused by positioning. Data transfer is fast, too — 3 MHz bit serial or 6 MHz two-bit parallel. And a single Fastrack disc module can store up to 48 million bits of data.

Fastrack Data Reliability vs. Disc Pack

Fastrack has a maximum of one recoverable error in every 10 billion bits of data transferred. Compare this with the one in a million error rate of the typical disc pack. This means that Fastrack's data reliability is ten thousand times better! Disc packs may be OK where errors are easily recognized and can be tolerated — but not when the disc memory is the heart of a real-time system where the drop of a bit could be a disaster.

Fastrack also eliminates the possibility of head avalanche. Each disc is sealed. The precision flying-heads never touch the recording surface and automatically retract if motor speed, internal voltages or air pressure varies. The continuous air filtering system makes it impossible for self-generated contamination to accumulate.

There's a lot more to the Fastrack story — the fast modular disc memory which provides from 24 to 96 million very reliable bits in a compact cabinet. Call us today or write for our brochure.

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CIRCLE 60 ON READER CARD

are the Bonanza Hotel and Casino in Las Vegas, Cobbs Co. a franchiser of restaurants and gift shops, and Levin-Townsend Service Corp.

The service corporation reportedly lost $351,561 for the first half of this fiscal year and continues to lose $100,-000 a month. Levin claims this is due to Townsend's ineffectiveness.

Levin filed his suit on Feb. 13 charging Townsend and the three directors who sided with him with illegal and improper conspiracy and claiming his removal was invalid. An affidavit filed with the suit revealed that Levin has lost his supporting director. Alfred W. Martinelli, an assistant vp of Penn Central resigned the Levin Townsend board Jan. 17 at Penn Central's request.

The following week the Townsend group issued nine-month figures for the company that showed a $15.9 million net loss that included $10.5 million in write-downs and operating losses from the Bonanza. Levin Townsend had previously registered $3.6 million net income for the first half. Townsend also blamed Levin for the Las Vegas investment, some $500,000 lost on Broadway flops, and $3.5 million invested in Cobbs Co.

He took exception to Levin's efforts to live the good life — a four-engine jet plane that cost $60,000 to $70,000 a month to operate, some $250,000 spent on art objects and paintings, and the hiring of a restaurant consultant, art adviser and corporate physician. The latter reportedly was an obstetrician. And he canceled Levin's orders for a $28,150 Mercedes limousine and a $900 attache case.

Clarification of the executive hassle at Levin Townsend awaits court action and stockholder action. Levin has started a proxy fight to win control of the company and plans to contest the election of directors at the annual meeting in July.

Townsend in the meantime is moving to prune the company of poor performers. The Bonanza is for sale (a Canadian company bid of $8 million already has been received) and he is recommending a write-off of the Cobbs costs. To get some money, Levin Townsend would like to issue some of the stock it holds in National Equity. This was one of the topics of discussion for the directors when the vote was taken to change presidents.

The other topic at that meeting was how to raise the money to cover $11.2 million in back payments owed IBM for computers. Private financing was the answer. and Levin Townsend went looking for money to borrow. IBM said it would defer action on the bill until after March 17, and if the company was negotiating for the money in good faith it would favorably consider extending the time. Levin Townsend has a $47.3 million computer bill with IBM and will be paying it off monthly through 1972.

GOV'T FUNDS SUPPORT IN-HOUSE TRAINING

A relatively new source of funds for training the underpriviledged isn't being tapped by the edp industry as it could be and should be.

This according to Bernard Brady, formerly with the Automated Information Services staff of the Economic and Youth Opportunity Agency (EYOA) of Greater Los Angeles and now with the Department of the Army. Brady was EYOA systems specialist and a volunteer instructor in a school started some two years ago to train underprivileged people in the Los Angeles area in keypunching, computer operations and programming (May '68, p. 127).

The school was started in a period when little or no government money was available for such training. It was run by volunteers and equipped with donated supplies and equipment. It is still going strong and to date has trained and placed 206 people.

This and similar private enterprise projects, Brady said, provided the push that led to creation of two government funds for manpower training for the underprivileged, MA-5, about six months old, and JOBS-70, new this year. But, he adds, too few companies are aware of their existence.

The two funds are set up for government financed on-the-job training programs and are administered by Associated Services, with manpower specialist offices throughout the country. The two are similar in operation but MA-5 is recommended for training programs for larger groups (30 and above) and JOBS-70 for smaller units.

Associated Services will write or help write proposals. A $500 confidence fee is charged so that a company does not take up the agency's time, then fail to go through with a program.

In implementation, the government bears complete cost of supportive services needed. These can be subcontracted and the agency helps arrange this. These include such things as coaching and special counseling, sensitivity training and testing, transportation, day care for dependent children, and medical and dental services.

Each program is tailored to the skills being taught. Where it is determined 600 hours of total training is needed and assumed that 300 would be totally unproductive, the government picks up the tab for all the unproductive hours, figured at full starting salary per hour per trainee at starting level for the skill. For the remainder of the training period, the employer picks up hourly productive time and the government makes up the difference.

Brady sees the program as a prime source for edp firms who want keypunchers, computer operators and programmers trained inhouse but unable to bear the costs of unproductive time. And, he said, the supportive services keep turnover rate way down.

BURROUGHS-COMPATIBLE DISC DRIVE DEBUTS

While the rest of the world is off building IBM-compatible equipment — witness the number of IBM 2311 and 2314-compatible disc pack drives being marketed — Computer Peripherals Corp. of San Diego has decided to follow the beat of a different drummer. It seems that Burroughs has a highly successful head-per-track disc called the 9370. Some large number of these, well over 5,000, estimates say, are in the field and the market still looks strong. The trouble is that Burroughs believes in BCD and in decimal organizations, so although other discs have been offered with the same storage capacity, or with similar transfer rates, CPC thinks it has the first ever to be plug-to-plug compatible.

The CPC unit is called the Fastrack. It can be organized as a two million byte (8-bit bytes) or a three million byte (6-bits) memory. In either shape it uses 200 tracks, not some power of 2 like 256 tracks. CPC claims a size advantage, since Fastrack fits in a rack unlike the several hundred pound original. It will be priced at about the same figure, under $16,000 in quantities. Its biggest advantages may be in lead times and ease of repair and in the fact that Burroughs does not allocate a large percentage of its production to the OEM market. Deliveries will begin in May. For information:

CIRCLE 307 ON READER CARD

WHY THE DEVIL DID THEY NAME IT DIABLO?

The first product of recently formed Diablo Systems, Inc., Hayward, Calif. (Jan. Look Ahead, p. 131), is a removable cartridge disc drive, the Series 30, aimed at the quickly expanding minicomputer market. The unit is befittingly mini, weighing in at 25 pounds

and measuring 6½ inches in height.

The drive is the result of a design philosophy developed by George Comstock, president of the firm, who was formerly vp of operations for Friden's advanced systems division, and Andrew Gabor, a double PhD in ME and EE, who headed mass memory development at Friden. Gabor, a careful, articulate man, outlined for DATAMATION his design principles, which he considers essential for the design of peripherals in the 70's especially for systems that cannot afford a dedicated service (maintenance engineer) man.

Thus far in small systems, said Gabor, only the cpu's are reliable. Peripherals, which make up 80% of the cost of a small system installation, slow down the computer by a factor of between 1,000 and 10,000. They require 90% of the maintenance effort, take up 90% of the space, and must plead guilty to a long list of indictments: Electromechanical devices are slow, expensive (there's no way to mass produce them so far, unlike semiconductors), noisy, bulky, unreliable, and they generate dirt, require much maintenance, and wear out.

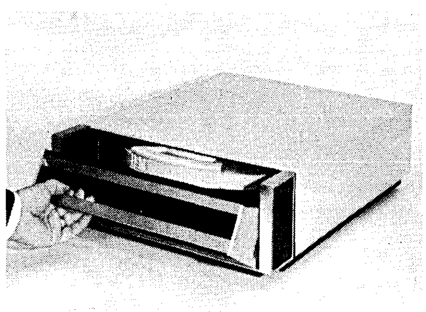
This, Gabor said, is a revolting state of affairs, because electromechanical mechanisms dominate small systems. In the 70's, the goal is to get the small computer into the hands of the small user, using the Henry Ford approach, and Gabor believes Diablo people have learned enough useful knowhow to offer some helpful design pointers. These were followed in the design of Diablo's drive, but are applicable as well to other peripherals.

Do: Eliminate or combine functions
- Avoid moving parts — minimize them by combining functions and replacing mechanical with electrical functions.
- Use more desirable moving parts (in order of desirability):
  - flexing (loudspeaker or quartz crystal)
  - rolling (ballbearings last a long time)
  - sliding (causes abrasion, wearing off of particles)
  - impacting (the worst troublemaker)
- Design conservatively, with minimal stress and load
- Life-test when in doubt

Don't: Use close tolerances (they're expensive and cause production inconsistencies)
- Provide field adjustments (avoid potentiometers — they're also expensive and usually only one man knows how to tune them)
- Use noninterchangeable parts
- Push the state of the art (a common pitfall: firm gets committed, spends more money, and can't back out. Behind many company failures)
- Engage in horsepower race

Gabor noted that rotating mass memories are extremely delicate instruments, especially the read/write heads. There's a relationship of four between the raw power pumped into a motor and the improved time of moving heads. Thus, to double speed, 16 times as much power is required. The result is heat. To get rid of the heat, systems include blowers, which are unreliable, noisy, and cause heat of their own. On one competitor's disc drive, there are seven blowers — one of them is used to cool another blower. When things have gone that far, says Gabor, they've gone too far.

On the Diablo unit, the disc is speeded up when it first starts; this pushes the "bad" air in the unit out before the head is allowed to lower to reading station (it's floating head, but with a cushion so small it won't pass cigarette smoke). The electrical heat-producing elements are connected to the mother board, which is located on a heat sink at the back of the unit. Gaps between the mother board and the heat sink are so located that these are the paths through which the filtered air is passed out of the system. On its way, the air helps cool the heat sink.



Diablo Systems' new miniperipheral for minicomputer systems, a removable cartridge disc drive in the firm's Series 30.

Diablo claims that such principles of design have produced a unit that requires periodic service only twice a year, and the firm estimates that the drive will operate for several years without requiring repair. The unit uses a single or dual cartridge system, with a file capacity per cartridge of 12 million bits (the IBM 2315 cartridge, or approved equivalent). The average access time for the device is 70 msec or less, and bit transfer rates are at 781K bps. Prices start at $4,950 and fall to $2,000 per unit in OEM quantities.

Oh, yes. They named the company Diablo for Mt. Diablo in a nearby valley. Of course. For information:

CIRCLE 306 ON READER CARD

PRODUCT LIABILITY ...
THE BATTLE OF THE FORMS

With the laws of product liability becoming more and more consumer minded (let the seller beware), determination of liability is boiling down to the "battle of the forms" and the pointing of fingers.

And nowhere is this more true than in the edp industry. There are the software producers who are not subject to the Uniform Commercial Code as their wares are not "goods" as defined by the code, and who must, therefore, rely heavily on forms. And there are the unbundled systems situations where, when something goes wrong, fault must be determined to establish liability... so, the pointing of fingers.

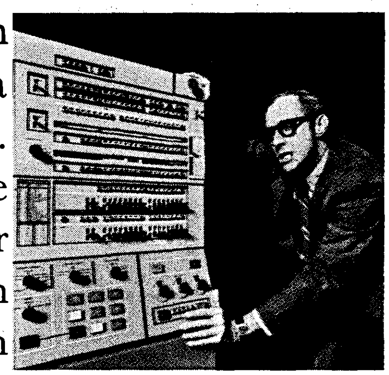
Jack Paul, a partner in the Los Angeles law firm of Paul & Gordon, last month described some of the pitfalls and protections attending the "perceptible shift of risk" that is taking place for the Los Angeles Council of the Western Electronic Manufacturers' Association.

He said the government has begun to enforce strictly the terms and conditions of its contracts, and this practice has spread through subcontractors and into the commercial area. A company whose philosophy had been "we warrant nothing" is likely to come up against a potential customer who says, "no warranty, no sale." He can say, "OK, I'll put one in and you pay for it," and, in many cases, he will.

Or there is the warranty a customer will include on the back of his purchase orders: "It's good to read the back and study his language." Paul cited an example of a customer who gave notice of breach of warranty based on the back of his PO on which he had used the term "timely notice." He had failed to specify time, so the supplier was protected. "Reasonable time" was in force and, according to Paul, this can be anything from a few hours to a few years and is very hard to pinpoint.

For companies who do come under the Uniform Commercial Code and who don't warrant and don't disclaim implied warranties, the implied warranties of "mercantibility" (the product will meet requirements of use for certain ordinary purposes) and fitness (the seller knew the buyer's purpose and had freedom of choice of supplies

COMPUTERS CAN BE CONQUERED.



Before your frustration gets you to turn all your edp operations over to a facilities management firm, let's get together. There's another, far less drastic, and much more reliable way to get back control of your computer operations. And in an hour long meeting we can describe it in detail. The approach uses your own computers to diagnose and then solve your edp systems, operations and scheduling problems. Our services include everything you need to get full control, fast—the top level people, special computer management software, systems monitoring hardware, and training for your staff. It costs money, yes. But far less than all other alternatives available to you. The important fact is that it works. Our more than 400 clients in industry and government will tell you that. Our reputation and experience was first built with SCERT—our dynamic software package that uses computer simulation techniques to solve edp management and expansion problems. And to SCERT we added several advanced new tools and techniques and services to provide the full range assistance that today's computer control crisis calls for. For full information, write or call: Comress, Two Research Court, Rockville, Maryland 20850. (301) 948-8000. Or call the local Comress office nearest you. Together we can get your computer to remember who it works for. You.

COMRESS
THE CONQUEROR.

CIRCLE 17 ON READER CARD

to come up with a product that would meet that purpose) are in force. These generally are considered supplementary to express warranties unless a disclaimer is included, and the disclaimer, said Paul, "must be conspicuous."

IBM, for example, includes in many of its warranties the phrase, "in lieu of all other warranties."

Sometimes the inclusion of implied warranties with express warranties is spelled out. This is the "ad infinitum" warranty and usually includes the phrase, "this warranty is supplemented by all other warranties implied in law."

And what of the software producer who doesn't come under the Uniform Commercial Code and its implied warranties? This is a pretty hazy area which hasn't faced legal test simply because it's so new, said Paul. There was no such thing as software when most Uniform Commercial Codes were written. Legal tests are bound to come which will more clearly define the software liability position.

Paul feels software could fall under the Uniform Commercial Code where it is part of an unbundled system, and here the software producer would be in the same position as the hardware builder were fault in a failure deemed his.

He feels, in almost all cases, liability for failure of a computer system would be limited to actual damages. Punitive damages imply intent, and a timesharing service which guaranteed a customer complete security only to have that security violated could hardly have intended this to happen; nor could the hardware or software providers.

How far our does liability go? Paul said a pedestrian hit by a wheel spun off an auto could go back to the manufacturer of the device which held the wheel to the axle if the device was made expressly for this purpose. With a third party, he said, there is no contract to modify liability, and modification of liability with a third party is not legally determinate except in a very few jurisdictions.

Paul suggested a regular insurance review. Product liability insurance generally can be extended to cover third parties at a small extra cost. An indemnification agreement can contain either an acceptance or inspection clause, he said. The former is more widely used in commercial markets. The government quite frequently uses inspection.

With an inspection clause, the buyer has the right to inspect and reject the product before acceptance. The burden of proof that the product is up to specifications is on the seller. With an acceptance clause, once acceptance has been made, it is up to the buyer to prove that it doesn't meet specs. Once a buyer accepts, even if he can prove defects, he cannot claim the seller was in default of contract. "Damages, maybe, but default, no."

And when liability and damages are being contested, the buyer brings out any of his paperwork he considers part of the contractual agreement, the seller arms himself with his, and the battle of the forms is on.

THOMPSON MERGES WITH TECHNICAL PUBLISHING CO.

F. D. Thompson Publications, Inc., — publishers of DATAMATION — has merged with Technical Publishing Co., of Barrington, Illinois.

As of presstime, the new arrangement will have been formalized on April 2. F. D. Thompson Publications became the Thompson Publications Division of Technical Publishing Co. Arthur L. Rice, Jr. becomes the president and chief executive officer of the new company. Heading up the Thompson Division will be Gardner F. Landon, executive vice president, and formerly president of F. D. Thompson Publications. He will continue to serve as publisher of DATAMATION.

Top man at the Technical Publications Division of the surviving company is James B. Tafel, executive vice president. The division will continue to publish *Plant Engineering* and *Power Engineering. Pollution Engineering*, a publication produced in the past cooperatively by Technical Publishing and F. D. Thompson, will be published by the Technical Publishing division of the surviving company. The Thompson division will continue to publish Research/Development magazine.

In addition to Rice, Landon and Tafel, officers of the new company include Calverd Jacobson, financial vp, and E. C. Prouty, secretary and treasurer.

OUTBACK IS UP FRONT

The most telling evidence that Australia is no longer considered to be out back in dp is the parade of computer industry brass that has gone through Sydney within three months.

Visitor Robert E. MacDonald, president of Univac, told the Australians that for the next ten years computer expansion there will be at double the U.S. rate (30% vs. 15%). Stanley Laing, president of National Cash Register, followed shortly on an overlook of the Far East and Australian area and staff.

The English contingent was represented by Sir John Wall, chairman of International Computers Ltd. ICL is setting up a software operation in Adelaide. A week later came William E. Norris, president of Control Data Corp., concerned with CDC's new Melbourne venture, where it will manufacture ticket issuing terminals. All reassured the already quite self-confident Aussies of their future — and present — importance.

INSURANCE CO. COMBINE TO STREAMLINE MEDI-CAL

California's much abused Medi-Cal program will get most of its loopholes plugged up soon by a big computer system for claims processing.

The state is negotiating a $5.7 million proposal with a combine calling itself HCSA (Health Care Services Administration) made up of a group of insurance companies, Occidental Life, Pacific Mutual, Pacific National and California Western States Life, with IBM as equipment subcontractor.

The HCSA proposal, which won state favor over one called CenPro (Central Processor) from a Blue Cross-Blue Shield-Lockheed combine, is for an on-line system with data-gathering terminals in 33 offices throughout the state. Center of the system would be in Los Angeles, partly because Occidental's headquarters are there but also because some 35% of all of the state's Medi-Cal claims come from Los Angeles county.

Bill Marks, Occidental's vp and director, planning division, said the system, if and when it goes state-wide, will utilize an IBM 360/65, video-type terminals and line printers. The prototype will use a Model 360/50 and will consist of two local review centers in two pilot counties, yet to be selected, and the central site. The pilot counties chosen will represent 10% of all claims. The state-wide system would be capable of processing 150,000 claims a day, which the state expects to be getting by the time the system is ready. Currently, claims are running from 110,000 to 120,000 daily. A year ago the rate was about 80,000.

Dr. Merle Shields, project director for the state Department of Health Care Services, looks for a contract signing by April 15. He estimates seven months for system design and specification and predicts the prototype will be operational by mid-April '71. He said the prototype would have to operate a minimum of six months to demonstrate feasibility.

The state's biggest problem right

Announcing the Patriotic Data Communication System: All American!

In data communications systems, American Data Systems **supplies everything but the telephone line.** Whether you want to communicate with a remote computer, or merely transmit data from one location to another, ADS has the teleprocessing and telecommunication systems know-how. And ADS has the hardware and software ready to do the job.

Systems Engineering. Only ADS can offer you the system study, software, hardware and field maintenance to move data from fingertips to readout – hard copy to video – **designed** as a compatible system – **manufactured** under strict quality control to work as a compatible system – **backed up** by unbeatable know-how and customer engineering to continue reliable operation as a compatible system.

Hardware. ADS hardware includes terminals, multiplexers, modems and communications controllers. All hardware items are super-modern with LSI, MOS, and other state-of-the-art ADS design features.

Terminals. In production now are two major terminals – a hard copy teleprinter and a video terminal. Various configurations of the compact video terminal make it useful for silent paging, data display, remote computer operation, and "instant" data transmittal. The teleprinter operates in three code-modes at the flick of a switch – ASCII, BCD, and Correspondence. It is self contained within a standard typewriter case. Off-line storage is offered for both units via a magnetic cassette unit.

Multiplexers. Time-division multiplexers and Frequency-division multiplexers by ADS save telephone line costs, simplify system design, and feature complete front panel diagnostic display – an ADS exclusive. Many channel capacities, intermixed baud rates, byte-interleaved, bit-interleaved, full contention, automatic baud rate detection, data set replacements, modular growth design.

Modems. Star of the ADS modems is the 4800 bps automatically-equalized modem with data rate division that converts your data communication network into a reliable, efficient data communication system – it even tells you when the telephone line goes bad. Other ADS modems are keyed to specific, specialized jobs.

Communication Controllers. An ADS communication controller, sitting at the computer end of the teleprocessing network, is the real quarterback of an ADS data communication system. A sophisticated data traffic cop, the ADS controller receives, stores and routes incoming data messages; it feeds data to the computer appropriately addressed, in proper sequence, with minimum delay. Then it returns the "answers" back to the proper originating terminal, all in the proper order, all in the proper code. The ADS communication controllers are the newest additions to the ADS All-American family.

Software. Software is a vital part of our All-American System approach. We are still bundled; software is provided with hardware in all ADS data communication systems. Specialized software to meet your specific requirements is also available from the ADS team.

Maintenance. A system that is not operable is of no use to you. We are aware of this basic truth, and are prepared to furnish you with professional, dependable, continuous maintenance and repair service as part of our All-American System approach.

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Ads

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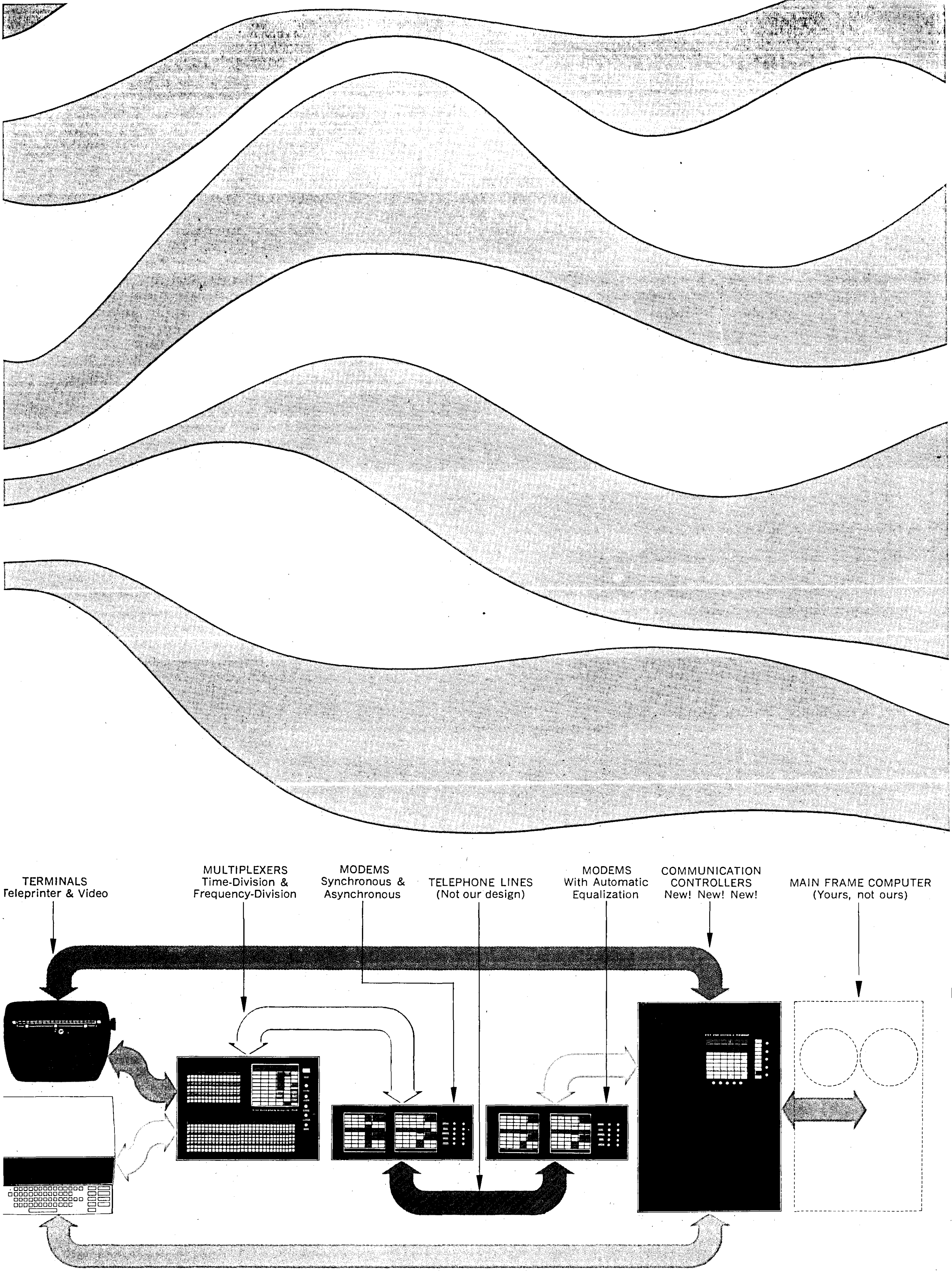
TERMINALS
Teleprinter & Video
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Frequency-Division
MODEMS
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Asynchronous
TELEPHONE LINES
(Not our design)
MODEMS
With Automatic
Equalization
COMMUNICATION
CONTROLLERS
New! New! New!
MAIN FRAME COMPUTER
(Yours, not ours)

now, says Dr. Shields, is inability to control the program as it should. Money goes out and little is known as to why or where for about a year. The new system will bring claims processing current. Now, a clean claim is processed in about 45 days and those not-so-clean can take up to a year and one half. This will be cut to five days from filing to payment. The system would quickly spot abuses by recipients or providers (doctors, nursing homes, hospitals, etc.). It would quickly kick out a profile of a doctor who was free-handedly doling out shots of vitamin C to one and all and charging it to Medi-Cal, or of one whose charges against the program are excessive.

In Medi-Cal operation it is the provider who files the claim. The system has some safeguards for him, too. The doctor who now has to take eligibility on faith or an ID card that may or may not be valid can make a local telephone call to an operator who, armed with the patient's name and address, can query the system on-line and verify eligibility in seconds.

Currently, the state does not control its claims processing for Medi-Cal. The processing system is owned and operated by Blue Cross North, Blue Cross South and Blue Shield. Processing is completely manual but once a claim is cleared it is put into a computer for payment. The new system, said Shields, would be "ours." He said the state has the ability to take over operation of the state-wide system completely but whether or not it will is still up in the air. A lot will depend upon results of a suit pending against the state by the CSEA (California State Employees' Assn.) which contends when state functions can be performed by state employees, they must be.

The Department of Health Care Services issued its RFP for the system on the basis of a $250,000 management systems study completed for the state by Lockheed that recommended an on-line real time system. The only mandate the department has to date from the state legislature is to study the concepts outlined by Lockheed. Shields said the CenPro group, of which Lockheed is a part, has been advised their proposal will not receive further study. Where CenPro could draw on the experience of Blue Cross and Blue Shield and Lockheed's background in preparing the management study in drafting its proposal, HCSA had experience closer to home. Occidental developed and is operating a similar system for processing Medi-Care claims in Los Angeles and Orange counties and it appears this experience has paid off.

NOW IT'S OFFICIAL: S/3 COMMUNICATES

Everyone knew it was coming all along, but now it's official: The IBM System/3 will have a communications capability, but it won't be ready for delivery until the first quarter of next year. This should vastly extend the market for System/3, and also partially assuage such critics as the National Bureau of Standards' Dr. Herb Grosch, who had bemoaned the lack of compatibility. Both EBCDIC and ASCII code compatibility will be available. Price of the necessary communications adapter is $12,985 or $265/mo., plus $1,725 or $35/mo. for an adapter attachment that is also required.

In order to accomodate teleprocessing applications, the RPG II language will have a special feature that includes a fill-in-the-blanks telecommunications specification sheet through which the user can describe the communcation tasks he wants to perform. This information is then punched into cards and fed into the computer, along with other RPG II instructions which comprise the user's application program. Price of this capability is $35/mo. under license.

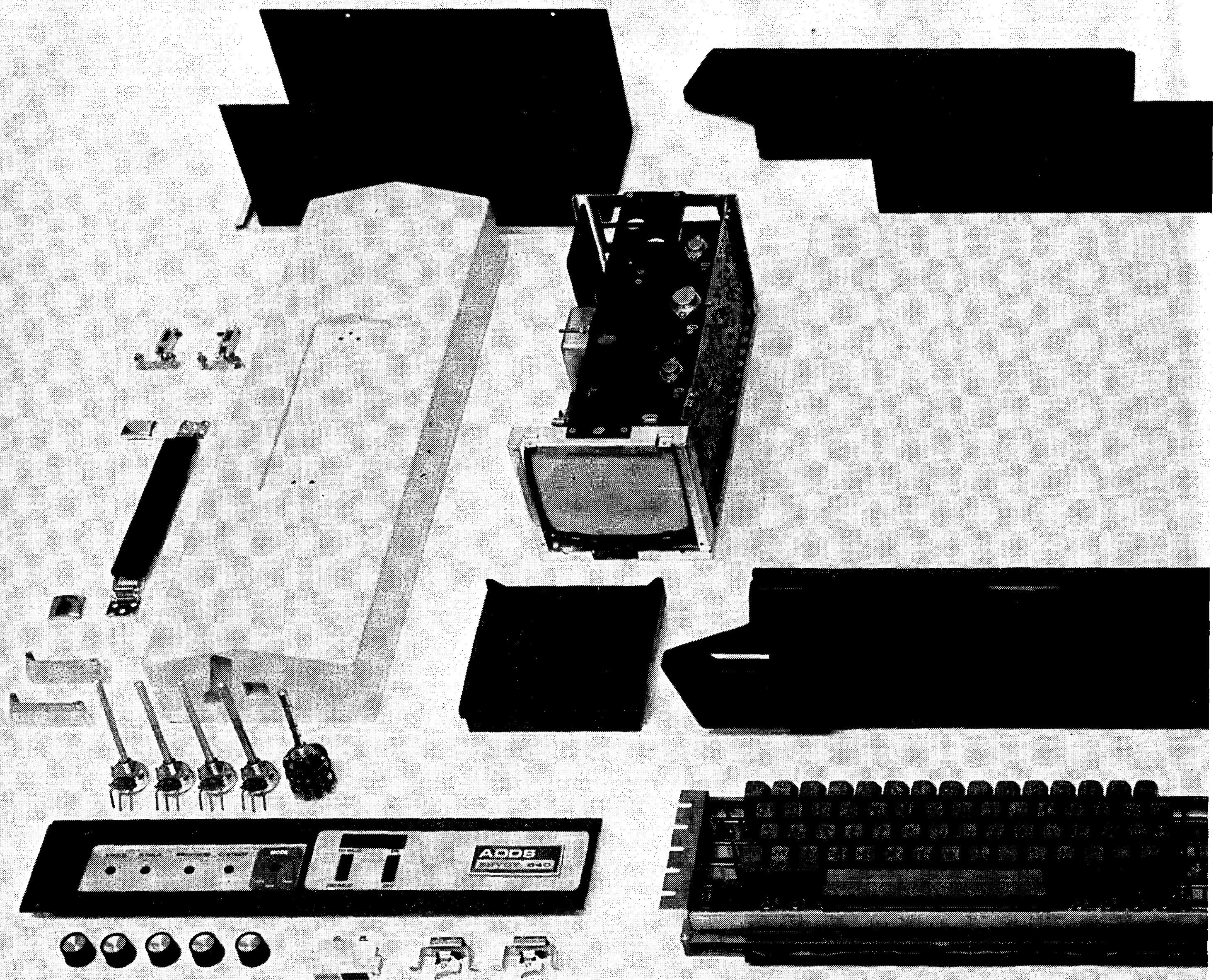
The communications adapter with the RPG II programming feature allows System/3 to exchange data directly with other System/3's and all System/360's except the Mod 44. System/3 can also function as a station on a communications line with other IBM computers and terminals that have compatible binary synchronous capabilities, including 1130 and 1800 computers, 2770 and 2790 communications systems, and the 2780 data transmission terminal — thus, the System/3 can communicate indirectly, through a 360, with these systems. It will handle data at medium speeds (600 to 4800 bps) or high speeds (up to 50,000 bps).

An automatic answering capability built into the communications adapter will allow a remotely located System/3 to answer calls from another computer when the machine is unattended. Incoming data is automatically stored on a disc or punched into 96-column cards. When operations are resumed, the computer prints out all data that it has received. In addition, an optional feature will enable System/3 to dial up another computer under program control.

Any maybe this is only the beginning for System/3.

new companies . . .

Humanity and dp, supposedly at odds in the popular mind, are being combined in some new ways. Maintaining that "the breakdown in effective people-to-people relationships commonly called company politics has caused many of the inefficiencies in data processing," Elliott H. Ketay has announced formation of **Andover Systems Education Corp.,** N.Y.C. computer training and consulting service which will use clinical psychologists along with the usual dp instructor/personnel to tackle "people problems." President Ketay and three other breakaways from Brandon Applied Systems have started the firm at a time when they expect unbundling to give them an added boost. They are offering 25 training courses . . . The Small Business Administration has licensed **UCC Venture Corp.,** an offshoot of University Computing in Dallas, to provide capital and management assistance for minority group businesses. The MESBIC (minority enterprise small business investment company) operation will enable them to spread up to $2¼ million of bread upon the waters . . . **Plan Resources** is the result of a joint effort by Donald Simmons, former director of Harlem Commonwealth Council, Inc., and Scientific Resources Corp. to develop minority enterprises for the inner cities and help them in urban planning, using the latest data management methods. The Philadelphia firm will be 55% black-owned. SRC also has united four of its subsidiaries under a new name, **Digital Resources Corp.,** which will be hq'd in L.A. The united companies are Digital Seismic Corp., Hybrid Systems, Inc., and Paragon Systems, Inc., all of Houston, and Mauchly-Wood Systems Corp., Newport Beach, Calif. The conglomerate DRC will have three divisions: computer equipment, seismic, and systems. Its first main thrust will be in manufacture and sale of peripherals, such as the Comp-Ex computer expander . . . A line of products for real-time voice response systems in data communications is already on-line at **Dash Data Systems, Inc.,** Stamford, Conn. The company says it can provide everything from a voice generator up to a turnkey system within 120 days after receipt of order . . . Also in Stamford, **Pitney Bowes-Alpex, Inc.** is a combined operation wherein the company before the hyphen is backing the company after it, to produce computerized transaction-recording systems (mostly point-of-sale) and other related products for the wholesale and retail trade . . . **Katun Corp.,** hq'd in San Francisco, has been formed by Philippe Yaconelli, formerly president of Caelus Memories,



How to build a portable CRT terminal.

A piece of cake. First, you establish your goals. You want a full-scale computer terminal that plugs into an ordinary outlet, uses an ordinary telephone and has full editing controls. You want it to be simple, quiet, rugged, fully compatible with Teletype* systems and you want to be able to carry it easily. Also, you need one model that will display 512 characters and will sell for about $3200; another model that will display 1024 characters and will sell for about $3700.

Don't despair. We know it can be done. Here's what you need:

An acoustic coupler that is 10 times better than anything around—one that can operate on 40 dB attenuated lines in half duplex. You'll have trouble finding this because we're the only one who makes it. Also, you'd better use complete acoustic shielding because your terminal is going to be used in a lot of noisy places.

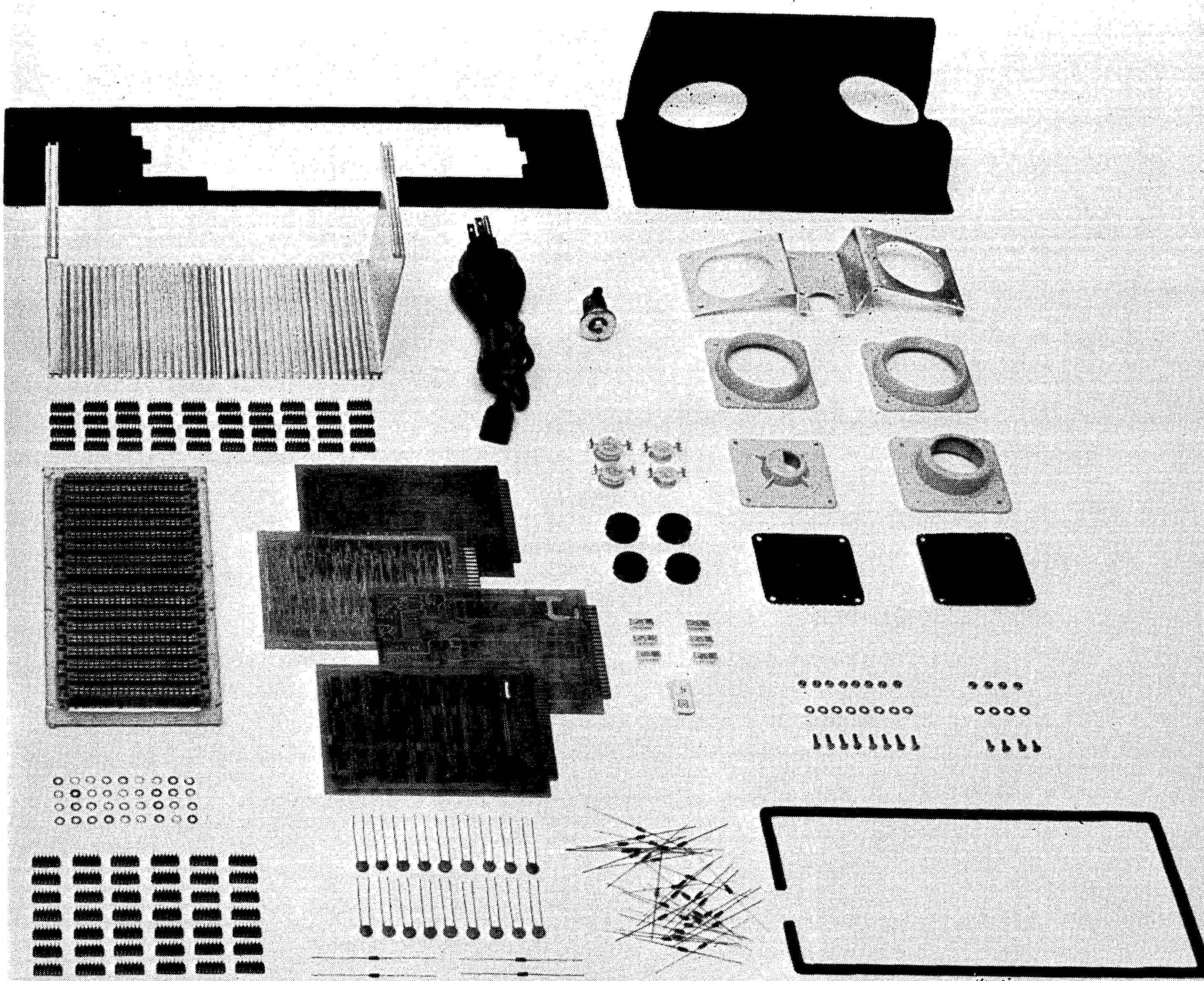
*Registered trademark of Teletype Corporation

Electronics. We tend to take these for granted because when we made our portable we took the guts right out of our MRD-200 readout display. You may have a problem here.

Now you'll want a CRT. Get a proven commercial TV monitor. It will buy you a lot of reliability and let you use TV raster techniques which make for sharp, legible characters. You might also consider using black characters on a light background and a page format for display. Both drastically reduce eyestrain.

Then you'll need a heavy duty keyboard, because the terminal is going to be taking a pounding. So find one that is solid state, rugged and can take extremes of temperature. Better buy the best available.

Suppose you drop it in a puddle. This is not recommended, but no matter. The frame is all of cast magnesium parts. It's fully gasketed and weatherproofed. There's a scuff-proof vinyl finish on the outside. The keyboard travels on jam-proof nylon bearings. Circuit boards float on foam pads and are clamped into a locked position.

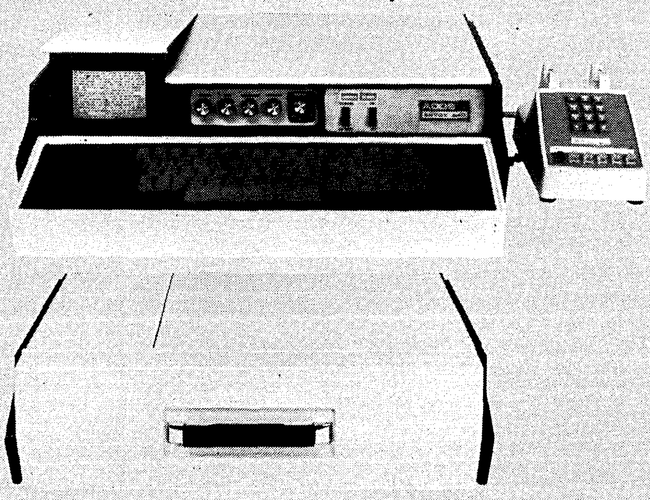


Piano movers need not apply. After you put all these components together in a self-contained carrying case, your terminal will weigh 30 pounds and will measure 6″ x 17″ x 22″. You can slide it under your airliner seat.

So who needs it anyway? That's what they said about the telephone. Nobody needs it or everybody does, depending on your viewpoint. Take the traveling salesman who sells from inventory. Consider what remote, mobile access to a computer would do for him for checking credit, inventory and closing an order on the spot. Then, there's the scientist working in the lab, the engineer at the construction site, the programmer working at home, the time sharing salesman. And on and on. A lot of people would use your portable terminal. If you can build one.

ADDS

Applied Digital Data Systems, Inc.



See a demonstration at SJCC.

Mr. Richard Kaufman, Dept. 27
Applied Digital Data Systems, Inc.
89 Marcus Blvd., Hauppauge, N.Y. 11787 (516) 273-7799

Please send me more information about your portable terminals—the Envoy-600 and the Envoy-640.

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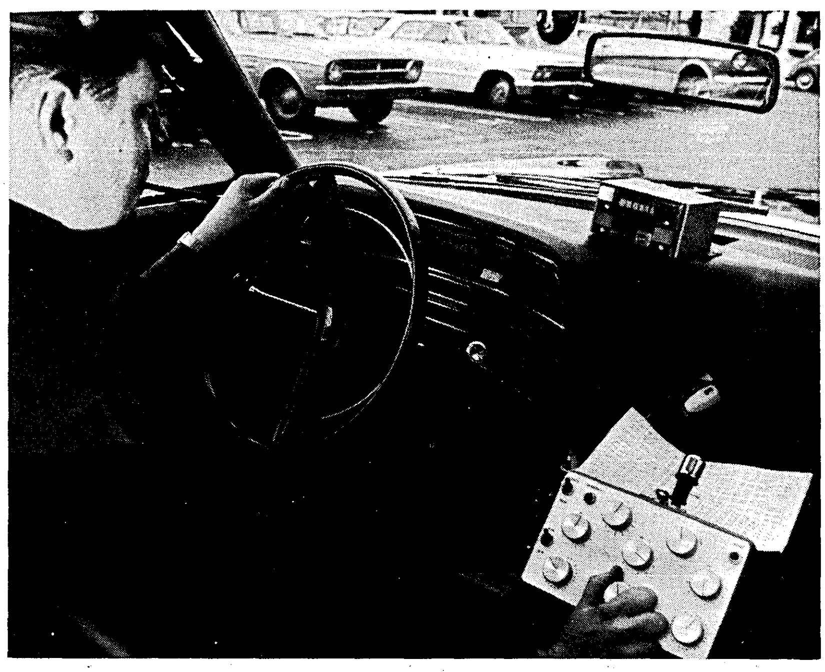
CIRCLE 4 ON READER CARD

news briefs ...

who has conceived it as a "total resource" company. Its computer management division will have its own president, Paul Osborn, who formerly headed his own computer operations company. Yaconelli has recruited directors from Data Industries, Hewlett-Packard and TRW ... With a plan to offer time-sharing, batch processing, and software capability to users throughout Australia, and eventually in New Zealand, Computer Sciences Corp. has joined hands with the Australian Mutual Provident Society, that country's largest life assurance organization, to form **Computer Sciences Australia,** with facilities scheduled at Sydney, Melbourne, and Perth (to take advantage of the mining industry business) ... Credit card readers for both industrial and retail use will be provided by **Athena Systems, Inc.,** out of Bedford, Mass. They say the readers will be inexpensive enough to be used at gas stations, airline counters, and department store stations ... **Innovative Products, Inc.,** is the name of an L.A. area company formed to make LSI test equipment. Its president is William Knebel, formerly engineering product manager for Litton Data Systems Div.... Although actually founded a year ago, **Micro Computer Inc.,** North Hollywood, Calif., has just announced its formation after moving to a new facility to make space for its first product, a numerical control system for machines ... Campus-developed computer programs will be packaged, marketed, and installed by **Hygain Technologies, Inc.,** Westport, Conn. The first two, SYSTEL (time-sharing for the 360) and SYSMAC (management control over multiprogramming OS/360) were developed and tested over two years by an unspecified Ivy League university ... In Richmond, Va., four ex-IBMers have hit upon a simple expedient in calling their new organization **The Computer Company.** It will "assist businesses in maximizing and optimizing their uses of dp equipment" in time-sharing and facilities management ...

mergers, acquisitions ...

Deciding that the pooling of interests going on in current mergers is getting too swampy, the Accounting Principles Board of the American Institute of Certified Public Accountants has recommended a stiffer set of rules for companies who want to get together and look as good as possible while doing it. The new conditions would be reflected in the altering of earnings and total asset figures that the board feels are now often unrealistic to the actual situation. And companies that are born only to merge immediately wouldn't carry the advantages along with them that they have enjoyed until now. Comments on the proposed new principles will be received until May 15, when the Board will take a final vote, which will have the effect of formally binding industry to whatever decision it makes. If the new regulations go into effect, they will be applied to mergers initiated after June 30 ... Meanwhile the effects of the action aren't immediately apparent: **Philip Diamond Enterprises** in the L.A. area, has just been formed to furnish management counsel specializing in mergers and acquisitions in the electronics-industrial fields. Diamond was formerly a top executive for two electronics companies ... **Coordinated Computer Concepts, Inc.,** N.Y.C. dp specialist for the garment industry has acquired **Grotel Adjustments, Ltd.,** a nationwide collections firm which services the apparel and other trades ... **KBM Data Systems, Inc.,** Atlanta-based computer service company, has acquired **Computer Control Corp.** of Miami, giving it more than five times its former service capacity, with a Honeywell 2200 and an inventory control system thrown in. KBM operates a nationwide stockbroker information system ... **Brodsky, Hopf & Adler Technical Services, Inc.,** specialists in air terminal design and planning, have tentatively agreed to become part of **Computer Data Enterprises, Inc.,** Jenkintown, Pa. CDE concentrates on dp systems for the air/transport industries, has proprietary and time-sharing systems software ... **Texas Scientific Corp.,** Houston developer of an alphanumeric cathode ray tube display system, is merging into **Digicon, Inc.,** which conducts international seismic data collection (in Bari, Italy, and Singapore) ... Another Houston firm providing technical services for oil and gas customers in seismic exploration, **First Business Computing,** has sold a 45% interest to **Aquitaine Oil Corp.** ... And in Dallas, **H. J. Gruy Associates, Inc.,** and **Gruy Management Services, Inc.,** which provide geological engineering and computing services to the oil industry, have been acquired by **Tracor Computing Corp.** of Austin ... **Systems General Corp.,** L.A., has acquired **Dealers Exchange, Inc.,** a new-car exchange information system operating in 20 U.S. and Canadian cities, and **Electromec Computing and Technical Services,** which has provided computer and graphic services to the San Francisco bay area for 15 years. A third firm on SGC's acquisition schedule is **Coordinated Data Systems, Inc.,** an L.A. marketing organi-



The "Car 54 Where Are You" days are over. This San Francisco police officer is sending a digital message to a command and control unit installed in a headquarters dispatching center that processes calls for assistance, dispatches patrol cars, and provides a visual status display of all cars in an area. The control unit and the equipment in the car are part of a system developed by Sylvania's Sociosystems Laboratory in Mountain View, Calif. It can handle 100 data transmissions in the same time it takes for one voice message and can be expanded to include a car locator system that automatically keeps track of the exact location of every patrol car. San Francisco police are testing the unit under a grant from The Law Enforcement Assistance Administration of The Department of Justice. Digital equipment has been installed in 20 cars so far. The complete system will be operational in June.

zation . . . **Serendipity, Inc.,** systems analysis and software company, is acquiring **Geolabs, Inc.,** both also in the L.A. area. **CompuCom Inc.,** a Dallas company which has been developing computer programs for restaurants, has been purchased by **Happy Buddha Junior, Inc.,** a Tulsa, Okla., dispenser of Chinese food . . . **Com-Share, Inc.,** Ann Arbor, Mich., and **Computer Complex, Inc.,** Houston, have agreed to call it a non-merger.

• System Development Corp. has dropped its time-sharing venture after six months of operating centers at Santa Monica, Calif., and Falls Church, Va. There just weren't enough takers. But information salvaged from the experience shows, says SDC's commercial systems division manager Robert Hamer, that there is greater interest in setting up specially designed systems tailored to the individual customer. This SDC plans to do through its commercial data management system, with emphasis on facilities management and specialty software.

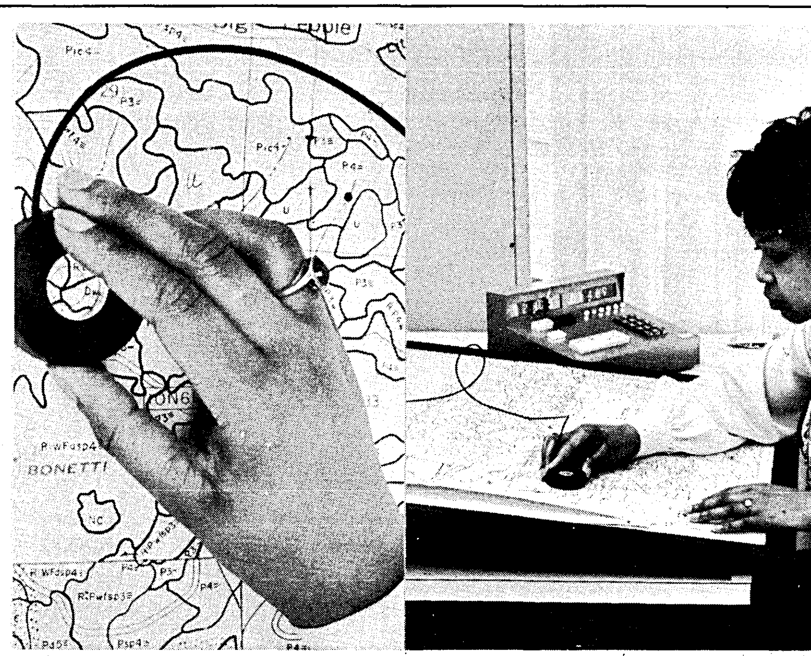
• The internationalist of the IBM founding family, Arthur K. Watson, has been nominated as ambassador to France. Chairman of IBM World Trade Corp., he has been with that subsidiary since it was formed in 1949; it now employs 15,000 people in France and has two plants there. Although he has never held a government position, Watson has always been concerned with international affairs, from the time he majored in that subject at Yale. He holds the French Legion of Honor, has been recognized for various contributions to international commerce, and is multilingual — French, Spanish, some German. Should the conflict-of-interest question arise because of IBM's French holdings, he could presumably put his portion in trust for the duration of the appointment. If confirmed, he will succeed Sargent Shriver, who is quitting the ambassadorial post to reenter domestic politics.

• Fourteen years and seven children after he joined IBM, John F. Sitar and five fellow employees set forth upon White Plains, N.Y., a second firm with "business" as its middle name: Corstar Business Computing Co. The intent is to provide consulting in the area of management information systems. The group worked as a team under Sitar's direction while at IBM, developing two large marketing-oriented MIS's. Now they've moved a few blocks away to go it on their own. They're billing themselves as problem solvers who can create MIS's from existing vertical systems of user firms (such as accounting, inventory, production, etc.) by abstracting the "management-oriented" information to form a "picture of total company operations." Or, Corstar can start from scratch and do complete MIS design. The firm concedes its best sales pitch will be successful systems to point to (outside IBM). Since inception in October only "mini-contracts" have been won, but a couple of big fish were nearly on the hook at press time.

• The character of software houses is in doubt, if we are to believe Michael J. Neuman, vp, System Interaction Corp., whose firm has been forced to drop publication of a planned guide to software houses called "Software Contractors: Credentials and Capabilities." Neuman claims that responses to announcement of the service were good, but his firm was unable to obtain reliable information from the software companies. Investigation of software houses found instances of reporting of contradictory sales figures, fee schedules, and technical abilities. Staff make-up and strengths were also misrepresented, "often dramatically." "It is obvious," said Neuman, "that the software industry has not yet matured enough to be candid about its own character and capability."

• Of interest to those in the field of data processing systems and management are individual awards of $2,000 made available annually by The Data Processing Management Association's doctoral candidate research grant program. Grants are made to advanced doctoral candidates at accredited graduate schools who are ready to devote full time to their dissertation. Another prerequisite is that the doctoral committee must have already been appointed by the university and the proposed research, including content and methodology, must have been approved by the DPMA committee. May 1 is the deadline for filing the applications and the forms are available from DPMA's International Headquarters, 505 Busse Highway, Park Ridge, Ill.

• Hewlett-Packard's Data Products Group has upgraded its customer support with establishment of seven regional data centers staffed by systems analysts, systems engineers, and staff engineers and equipped with some $2 million worth of the company's newest computers, peripherals, and specialized instrumentation systems. The centers will provide such pre-sales support as equipment demonstrations, systems analysis, benchmark program-

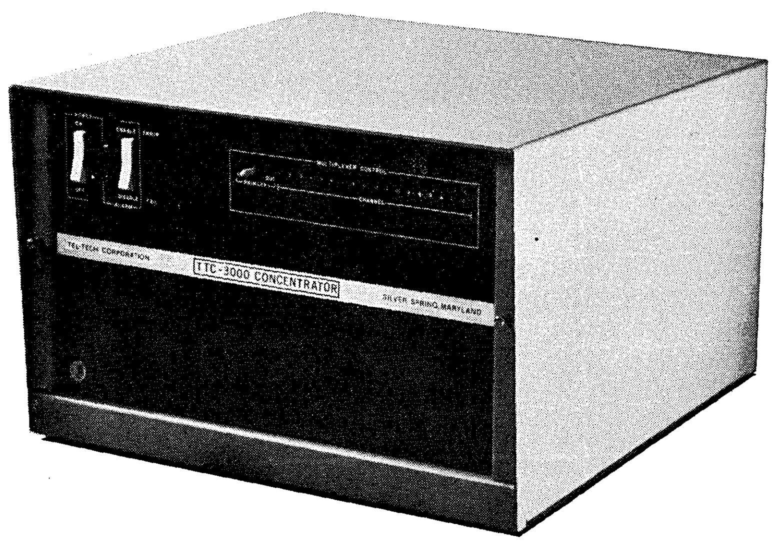


Mrs. Voloria Drew, project clerk for the Watershed Systems Development Research Unit of the Department of Agriculture Forest Service, is not playing with a Ouija board. She is using a Datagrid Digitizer developed by The Bendix Corp. to trace information from a forest area chart and feed it into a computer. The Forest Service is using the Digitizer to record information on mountain watersheds. Once fed into a computer and placed on tape, the information can be stored, analyzed or reproduced as needed. The Service is developing an information system that will enable foresters to determine in advance the effects on the watershed of various land uses.

From Tel-Tech

two new multiplexers

Full contention . . . total traffic monitoring . . . proven reliability



Over a year ago, Tel-Tech introduced the TTC-1000 Concentrator. Several hundred are on-line today. It has proven utterly reliable and is practically maintenance free. Ask a user.

Now Tel-Tech proudly introduces two new models . . . the TTC-2000 and TTC-3000. Both embody the proven technology of the TTC-1000. With this range of units you can select the multiplexer with the precise features you require.

TTC-2000 Concentrator . . . The ideal unit for point-to-point communications networks. Gives you basic simplicity and flexibility for changing requirements. Individual channel indicators show system traffic and verify the availability of channels. Multiplexes 2 to 38 channels.

TTC-3000 Concentrator . . . Provides full contention. Ideal for a network where the load shifts from city to city at different times of day. It allows multiple cities to contend for up to 38 channels on a single phone circuit giving you more efficient use of your computer.

With both models, you can intermix data speeds . . . connect to any terminal . . . have built-in modems . . . and choose from a host of industry-first options. And you'll like the price too. Delivery is quick and engineering support is alert and responsive.

Call or write for information.

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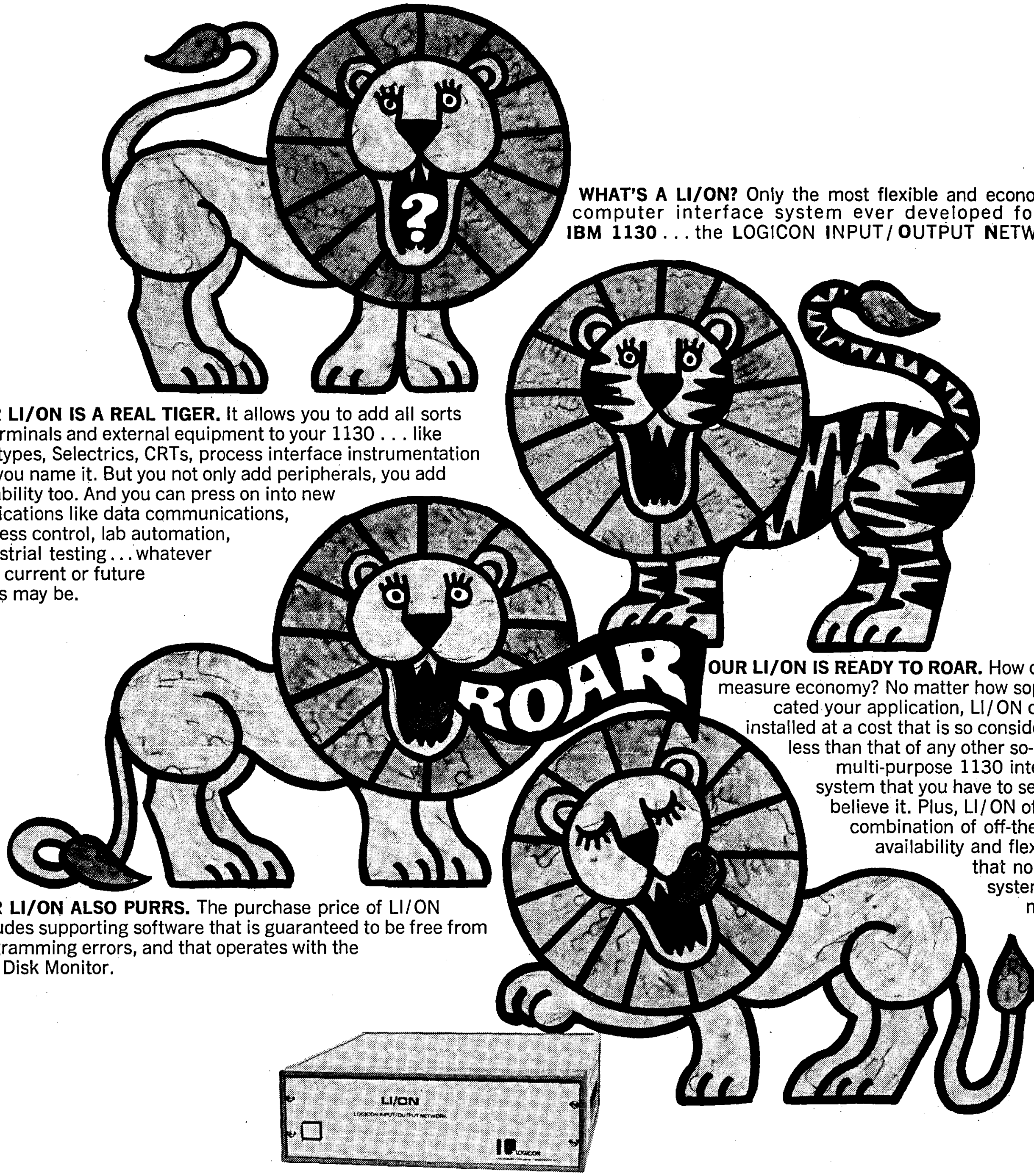
Also ask about Tel-Tech's line of Bell compatible modems . . . TT-103, TT-202, TT-201.

Got 1130 Paper Tigers by the Tail? Let LI/ON™ Sic 'em.



WHAT'S A LI/ON? Only the most flexible and economical computer interface system ever developed for the **IBM 1130** . . . the LOGICON **I**NPUT/ **O**UTPUT **N**ETWORK.

OUR LI/ON IS A REAL TIGER. It allows you to add all sorts of terminals and external equipment to your 1130 . . . like Teletypes, Selectrics, CRTs, process interface instrumentation . . . you name it. But you not only add peripherals, you add capability too. And you can press on into new applications like data communications, process control, lab automation, industrial testing . . . whatever your current or future plans may be.

OUR LI/ON IS READY TO ROAR. How do you measure economy? No matter how sophisticated your application, LI/ON can be installed at a cost that is so considerably less than that of any other so-called multi-purpose 1130 interface system that you have to see it to believe it. Plus, LI/ON offers a combination of off-the-shelf availability and flexibility that no other system can match.

OUR LI/ON ALSO PURRS. The purchase price of LI/ON includes supporting software that is guaranteed to be free from programming errors, and that operates with the IBM Disk Monitor.

So if you feel caged, call Lee Eckert collect or write him today.
Get a LI/ON and be a tiger.

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ming, and preparation of proposals and quotations. Post-sales support includes training of customer personnel in operation, programming, and maintenance of their system plus software support and consultation. Time also will be sold on center equipment. Some training and software support, such as standard software packages and two-week programming courses, is included in system price. The rest, says HP, is provided at "prevailing rates."

• Honeywell has set up a new marketing force to sell peripherals. Thomas C. Munnel, formerly with the international management consulting firm, McKinsey & Co., will head it up as director of OEM sales. Headquarters are in Billerica, Mass. Peripherals to be sold include 300- and 950-line-per-minute printers, cartridge, 10-surface and 20-surface disc pack drives, card-reading and punching equipment, and 7- and 9-channel magnetic tape units.

• General Electric has taken its time-sharing service south of the border — way south with the opening of its first South American center in Buenos Aires, Argentina. The tenth center opened by GE in the past year, it is near the headquarters of Bull General Electric of Argentina. Official ceremonies await the close of the Southern Hemisphere's vacation season.

• Dr. Ivan Selin, acting assistant secretary of defense for systems analysis until January 31st, and Charles O. Rossotti, his principal deputy until that date, announced the formation of American Management Systems, Inc., a firm intended to provide "full and continuing consulting and software service" such as has not been available "outside the Pentagon." The firm's services include "identification of management's needs for information and analysis as well as implementation of related computer software," and are aimed at serving corporations, state and local governments, and non-defense federal agencies.

• Late this month an edp trade mission will set out for Southeast Asia, captained by Werner L. Frank, senior vice president of Informatics, Inc. On the trip, sponsored by the U.S. Commerce Department, representatives from 10 manufacturers of edp equipment will explain current products, services, and packages at seminars in Taipei, Djakarta, and Singapore. Frank has been 20 years in edp, directs Informatics' eastern operations from Bethesda, Maryland. Two more Southeast Asia missions are planned for late '70 and Spring '71.

• The first examination for the title of "registered business programmer," under certification of the Data Processing Management Association, is scheduled for October 10. Applications to take it, however, must be filed by August 1. DPMA has been working since 1967 to devise a means of measuring the ability of senior programmer applicants. The exam evolved by its certification council will be given only once a year at 100 locations, mostly colleges and universities, in both the U.S. and Canada. There are 150 test questions, requiring 2½ hours to complete. Categories covered are (1) principles of programming; (2) meta programming systems; (3) problem-oriented languages (ALGOL, LISP, SIMSCRIPT, FORTRAN, and COBOL); (4) data processing system design; and (5) computational topics. There is no membership or educational stipulation for anyone desiring to take the exam, but a fee of $40 is charged. Application forms are available from DPMA headquarters, 505 Busse Highway, Park Ridge, Illinois 60068. DPMA also has been giving a test for a certificate in data processing since 1962.

• The Mellonics Systems Development Division of Litton Systems, Inc., has opened an office in Australia with an instant manager, Tom Kirkpatrick, company man who was already on the spot after completing a Mellonics assignment to program and implement a system of on-line control of locomotives for the New South Wales Railways Dept. Kirkpatrick has stayed on in Sydney, where he will conduct simulation work on various transportation systems, including the bulk movement of ore, which bulks very large in Australia's economy.

shortlines . . .

Two Fujitsu computer systems from Japan, one mag tape and the other disc, have arrived in the U.S. and are alive and well at the new display center of Automation Sciences, Inc., in Jersey City. The Facom 230-25 systems will be sold and serviced by ASI, a firm which has been dealing in contract systems and computer programming for seven years and also has an equipment leasing company in San Bernardino, Calif. ASI says it will give in-depth training and maintenance support to Facom users at no additional cost. Fujitsu makes a complete line of computer and peripheral equipment, from minis to maxis.... IBM has announced it will build a manufacturing plant in central Japan, near Osaka; it already produces the System/3 and models 20 and 40 in Japan.... A microfilm publishing support program has been started by Dasa Corp., Andover, Mass., to provide microfilm indexing and editorial assistance. A portable microfiche reader, the PMR 50, will be available to support program in late summer.... A major price reduction on LSI memories has been announced by Intel Corp., Mountain View, Calif. Prices on the memories, employing MOS and bipolar technologies, have been lowered from 38% to 73%, because of high production yields.... The British National Computing Centre in Manchester has published two reports on computerized road transport planning, showing that a savings of $84,000 could be made in the English economy if computer methods were adopted. They are titled *The Impact of Computer Techniques on Road Transport Planning* (2) and *Computers in Vehicle Scheduling* (1). Part of the British reluctance to use more efficient transport methods, say the reports, is due to failure of early plans which did not take into account low bridges, local early closing days, and unique loading problems... A 5% increase in lease/purchase prices has been made by Sanders Associates, Inc., in display systems and in its 6000 display data recorder. Sanders has appointed four regional managers in Boston, Dallas, Detroit and L.A. to supervise its 26 branch and 38 field offices ... Timeshare Network Corp. has begun servicing the Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware and Washington, D.C., area from its New Jersey facility; and Dallas, Houston and Galveston from its Houston center. Its original Chicago t-s center still serves Illinois, Michigan, Indiana, Wisconsin and Iowa... A basic agreement has been made by 3i Company/Information Interscience Inc. to use the comprehensive data base of Engineering Index, Inc., a non-profit organization serving engineering societies, to provide EI with computerized services. 3i also has been licensed by the American Chemical Society to provide similar services for the Chemical Abstract Service. The company claims it is now the largest commercial scientific and technical information center in the world, processing information from more than 20,000 journals reviewed monthly...

THE SJCC CONFERENCE PARTICULARS

Last year, DATAMATION said: "The 1969 Spring Joint Computer Conference will take place, we hope, in Boston from May 14th through 16th. Initial phases in planning the conference were marked by confusion and disorganization, probably caused by the spiraling growth of the Joint Computer Conferences. As one insider put it, the SJCC is 'entirely too big to be run by a volunteer committee.' " This year, we need only to substitute "1970," "Atlantic City," and "May 5th through May 7th," for an equally valid summation.

The first session noted for last year's SJCC was the panel on "Increased Dialog with Society," which turned out to have continuing impact after it was disrupted by the Computer Professionals for Peace. This led to gestapo-like measures being taken at the FJCC in Las Vegas, although the CPP apparently wasn't about to travel en masse that far from its New York headquarters. So the SJCC is without preparation for a CPP onslaught, despite the geographical location which will make it easy for them to attend. Watch for the fireworks.

In keeping with the tradition that JCC's never repeat the mistakes of the immediately preceding JCC, registration procedures have been streamlined (see March, p. 153), while no preparations have been made for whatever disruption the CPP may be planning. (They weren't in Vegas, right?) Maybe it would be easier to end the war.

registration

"Remote registration" will be held at the Shelburne, Dennis, Deauville South, Holiday Inn, and Traymore hotels in addition to the Convention Center where most of the technical sessions will be held. It's a good thing, too. There have been wild rumors circulating that as many as 50,000 may attend the conference. Also, the fact that the technical program does not start until Tuesday afternoon should make both registration and transportation easier to arrange.

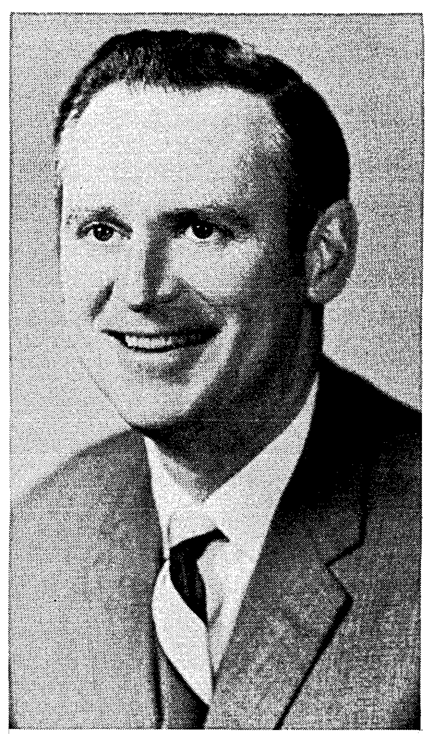
The theme of the conference is "The Computer: Gathering Force of the Seventies." In keeping with this idea, the committee attempted to obtain President Nixon as the keynote speaker, but a spokesman replied that Nixon does not want to address limited audiences, and only intends to speak through direct national media. Agnew was approached next, but he too declined. So, lacking a suitable national political figure, Sam Wylie of University Computing was commissioned for the role. At press time, an astronaut was expected to agree to give the banquet address.

technical program

An unprecedented 15 panel sessions and seven paper/panel discussions are scheduled. If you were thinking about catching up on the latest later by reading the *Proceedings*, papers from the 10 formal sessions published therein aren't going to give you a good summary of what really happened. In other words, you had to have been there.

Many of the industry's biggies will participate in the program, and the theme of the show is carried forth by those in the know: Now that we've got the technology, what are we going to do with it? Although the "social implications" of computers seems to be an unpopular subject with those working in the technology these days, the trend toward humanization of our world is, certainly, the gathering force of the '70's.

A large percentage of the session chairmen have written short articles on their sessions for DATAMATION. These appear in the Session Summaries in this section, and they should give you a good idea of what sessions will be of



Harry L. Cooke RCA Laboratories
General Chairman

interest to you. The official conference program booklet will not be made available prior to the show. Although the hardware session was cancelled because of lack of competent papers, within the other sessions you will find a broad range of state-of-the-art offerings. It looks as if this is one of the most interesting technical programs ever scheduled for a JCC.

the exhibits

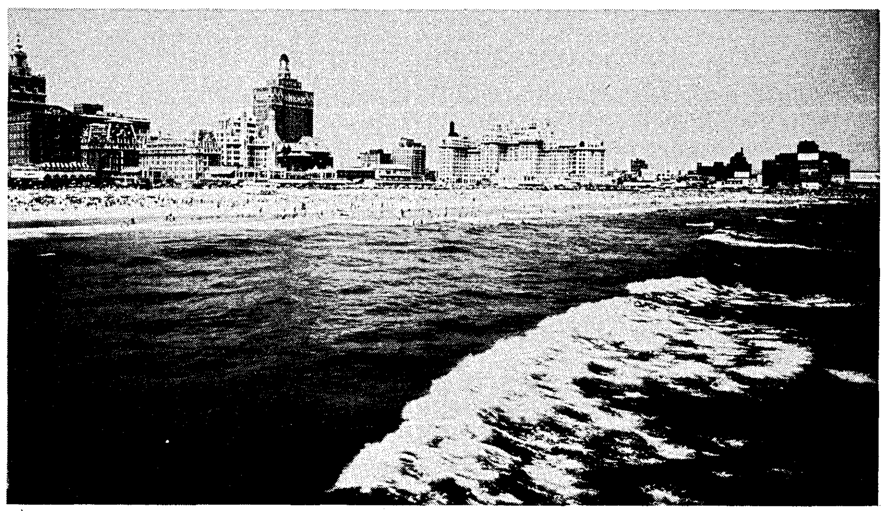
Yes, there will be exhibits. But all we've been able to find out about the official ones is that approximately a thousand 10′ x 10′ booths will be housed on two levels at the Convention Center. Unofficially, Comsyst, of San Mateo, Calif., has contracted for an ocean liner—to be anchored just off the boardwalk—and is offering exhibit space at slashed rates . . . probably because none of the three classes of accommodations allows for more than photo display exhibits. But it sounds like fun.

We presume, too, that there will be ladies' and other special activities.

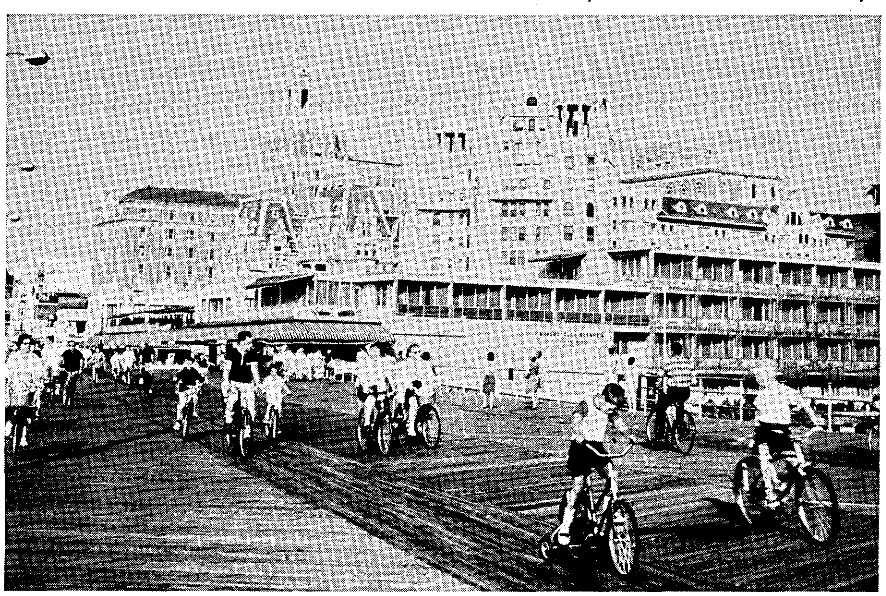
the setting

Atlantic City is an advantageous setting for a JCC in that it lacks distractions—you'll have to find your entertainment at company suites, and liquor will be needed for atmosphere. Don't let the beautiful coast line (pictured) fool you; a close-up would reveal the peeling paint. Nevertheless, Atlantic City is one of the few spots that can accommodate the thousands of people and the hundreds of exhibits that now characterize every JCC. And the somewhat-out-of-the-way setting may also serve to keep away those annoying students who hang around asking embarrassing questions and aren't in a position to buy anything yet. The R.E.S.I.S.T.O.R.S. of Princeton, N.J., will be back again (another group that wouldn't travel all the way to Nevada), and will present some technical sessions . . . just to make sure we big guys don't get the idea we're smarter than the kids.

Don't forget to send home some saltwater taffy. ■

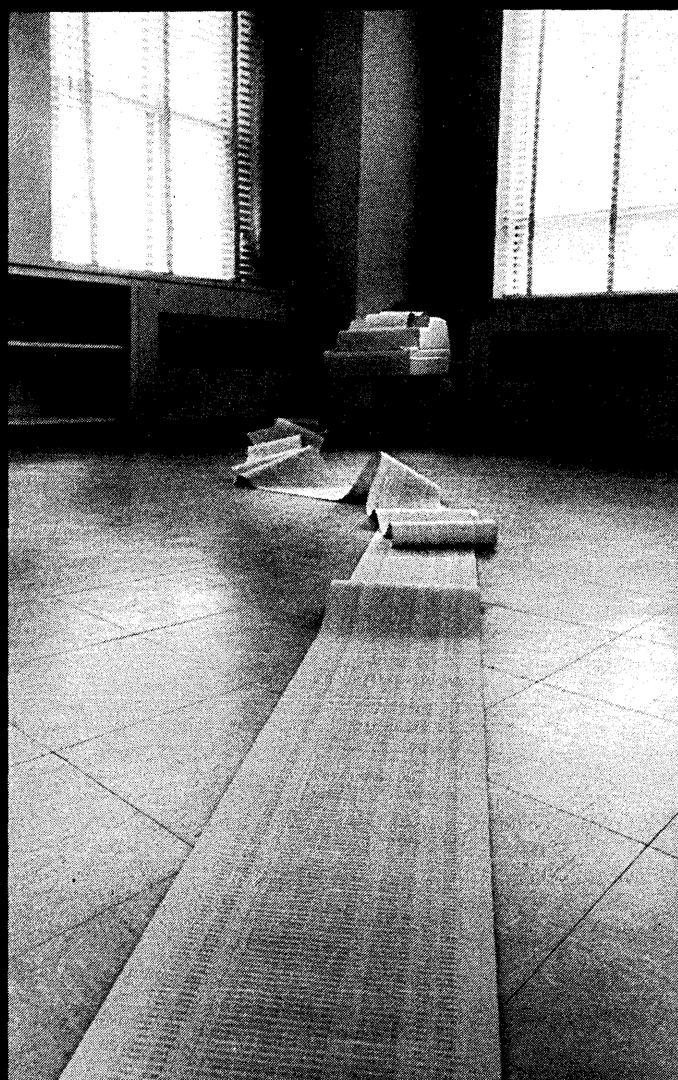


Atlantic City, N.J., site of the 1970 Spring Joint Computer Conference.



The Boardwalk.

Shhh...



We want you to hear our high-speed teleprinter at work.

At 400 characters a second, the loudest sound you can hear is the conversation in the next office.

The new Motorola MTP teleprinter may be the quietest machine on the market.

But silence isn't all we've got to offer. Stay with us for a few paragraphs and you'll see what we mean.

No ink. No toner. No ribbon.

The MTP employs a patented electrographic printing process. Characters are formed by continuously-moving print heads in contact with continuously-moving, current-sensitive paper. The printout is clean, dry, permanent.

The continuous-motion print action gives the MTP extraordinary reliability. The idea seems contradictory, at first. But when you think about the wear and tear of start-stop mechanisms, the logic emerges. Visualize the pounding of a piston aircraft engine as opposed to the smooth spin of a jet. You've got the picture.

A communicative machine.

The MTP can be interfaced to a computer or communications network in any of several ways, all of them quite uncomplicated. The basic model accepts a dot-matrix input, either directly from a processor or through an USASCII-to-dot-matrix IC chip. If you'd prefer direct 7-bit USASCII input, we'll supply the printer with a built-in 2-character buffer and ready-strobe interface. For dedicated communications service, we've got a model with a 200-character buffer and interface for a 202C data set or equivalent.

It's worth noting that the printer employs Motorola High Threshold Logic. MHTL provides extremely effective noise rejection, which is nice to have under any circumstances, and absolutely essential in most industrial environments.

Symbols. And Urdu, too.

In the USASCII mode, the MTP produces 63 printable characters. Characters are structured on a 7 x 5 dot matrix, which gives a character size equivalent to 10-point type. With appropriate computer software, you can have the dots form esoteric symbols, Japanese ideograms—or the Arabic alphabet of the Urdu language, for that matter. Practically anything is possible.

The printout, 8½ inches wide, duplicates beautifully on any conventional office copier or blueline machine. Page length can be any dimension up to the full capacity of the supply roll—400 feet.

Small package. Modest price.

The MTP is about the size of an office typewriter. It can be installed any place where the temperature is between 40° and 100°F, the relative humidity between 0 and 90 percent. In other words, no coddling necessary.

The machine can operate unattended. An automatic paper advance takes care of spacing between messages (you can switch this off, if you like, to eliminate message separation).

The MTP's price varies with the model and the quantity you order. The basic machine costs less than $4000, which ranks it as one of the great bargains of the moment.

At least that's the way we see it. You, of course, will want to make your own evaluation. Our MTP brochure will help. Or perhaps you'd like a demonstration. Either way, drop us a line. Motorola Instrumentation and Control Inc., a Subsidiary of Motorola Inc., P.O. Box 5409, Phoenix, Arizona 85010.

A note to OEM's. We're more than casually interested in working with you. Special packaging, chassis-only construction, private labeling, or any other options you may have in mind certainly merit discussion. Contact our OEM Sales Department.

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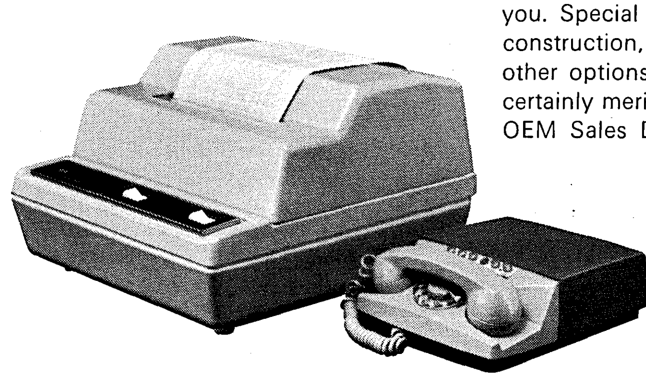


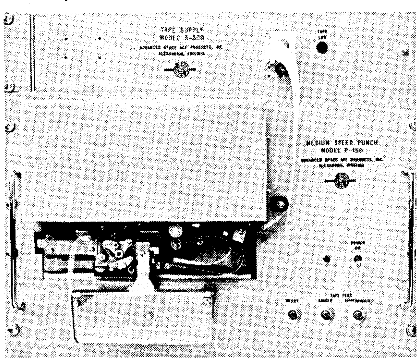
See us in Alcove BB at SJCC

MOTOROLA Information Systems

PRODUCT PREVIEW

ADVANCED SPACE AGE PRODUCTS, INC.
Alexandria, Virginia

The P-150 punches mylar/paper at speeds to 150 cps either synchronous or asynchronous. Levels are 5, 6, 7,

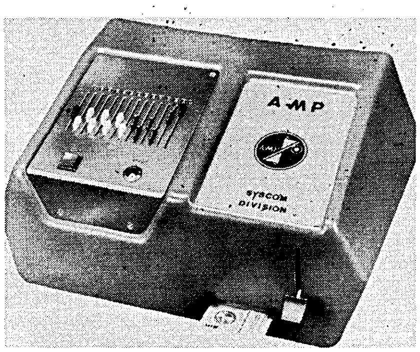


and 8 (11/16″ to 1″), and the unit is DTL and TTL compatible. It features solenoid sensing, read after punch verification, and parity check. An alarm warns of end of tape, broken tape, or slack loop. Price is $2250; delivery 120 days ARO. For information:

CIRCLE 383 ON READER CARD

A-MP INCORPORATED
Harrisburg, Pa.

The SYSCOM remote input terminal collects and transmits fixed and variable data in computer-compatible format, and is designed especially for data collection applications that do not require the on-line information feedback capabilities of crt displays

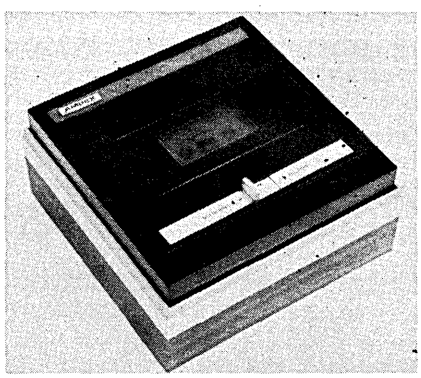


and interactive terminals. This unit accepts fixed data from punched badge cards, variable data through a set of operator-adjusted slide switches. The terminal scans and encodes data for bit-serial transmission over customer-furnished direct lines, or over existing telephone lines. Quantity price is about $500. For information:

CIRCLE 384 ON READER CARD

AMPEX CORP.
Culver City, Calif.

This vendor has long been in the standard size tape business, but its present offering is for the minimachine line. Its TMC cassette tape drive is a serial by



bit, dual track, read-after-write unit. Aimed at the OEM market, the TMC is priced at $550.00 in quantities. The drive has a recording speed of 12 ips and a recording density of 800 bpi, which yields a transfer rate of 9600 bps (just right for data communications). The second track is a redundant recording of the first, so the total cassette capacity is 350,000 characters. For information:

CIRCLE 385 ON READER CARD

APPLIED PERIPHERAL SYSTEMS, INC.
Houston, Texas

Source data collection requires several hardware components, a keyboard or other input device, an intermediate recording subsystem, and a central site collector. This vendor covers all the bases by building a DG-4 data entry terminal (numeric keyboard with 13 8-bit words of buffer, a cassette recorder good for 6,000 words per side, ANSI or BCD code transmission at up to 100 cps), a DG-103 acoustic coupler (300 baud, Teletype or EIA or Olivetti interface), and a central site DG-5 magnetic tape station (7- or 9-track, 556 or 800 bpi, 440 cps incremental recording). The DG-4 is priced at $50/month, the DG-5 at $150. For information:

CIRCLE 386 ON READER CARD

ASTROCOM CORP.
St. Paul, Minn.

There are three pieces of equipment needed for an automatic data sending phone call—an automatic dialer, a modem, and an automatic answerer. This vendor makes all three. The Astroset 120 is the modem, but not the only one this company makes, just the newest. The 120 is a 24-model series which operate asynchronously at speeds ranging from zero to 1800 bps. The series is directly equivalent to Western Electric 202 products. Unit prices begin at $600.

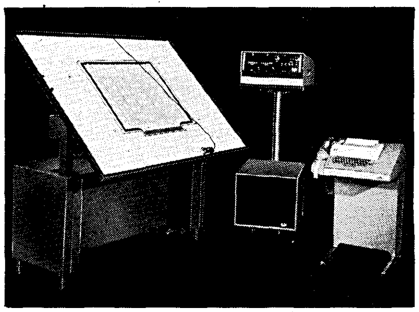
The Astroset 701 is an automatic telephone answering device made to work with the Western Electric Direct Access Arrangement F57951. Its electronics are mounted in a rack size package, and it has an auxiliary chassis that mounts on the phone handset. Each set of electronics is capable of handling eight phone lines. Prices start at $2000.

Finally, for dialing the phone there is the Astroset 708, which is a direct replacement for the Western Electric 801 (except that it, too, can handle up to eight phone lines). Prices start at $3500.

Deliveries of the pieces take from six to 10 weeks. For information:

CIRCLE 387 ON READER CARD

BENDIX CORP.
Southfield, Mich.
The Datagrid Digitizer System 70 can be used to prepare control tapes for virtually all N/C artwork generators. It digitizes two-dimensional, printed layouts with a basic system resolution of .001 inch. Over-all accuracy of the unit is .002 inch (rms), and maximum tracing speed is 300 ips. Usable draw-

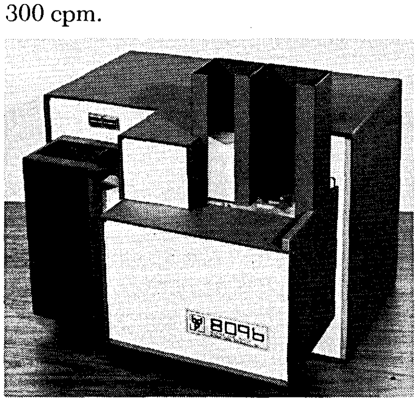


ing table area is 42x60 inches, with the work surface mounted on a pedestal base permitting tilting and height adjusting.

Digitizing is accomplished by positioning a free-moving cursor on a drawing on the table. The cursor position is sensed by an array of electrical conductors beneath the surface of the table. The system has no moving parts except the cursor. Standard output is 8-channel ANSI code to an ASR 33 tty which is included in the $19,800 price. Eight-channel EIA RS-244 code is accommodated optionally at $3,500 additional. For information:

CIRCLE 388 ON READER CARD

BRIDGE DATA PRODUCTS, INC.
Philadelphia, Pa.
Manufacturers building their systems around the System/3 will have a tool to provide their customers with the capability of reading both 80-column punched cards and the 96-column round-hole minicard used on the 3. End users will have the ability to read their old files and generate new ones on the new card form. The OEM product to do this job is the 80/96 Multiple-Card Reader. The device will read the round hole cards at a rate of 500 per minute, and the 80-column cards at 300 cpm.



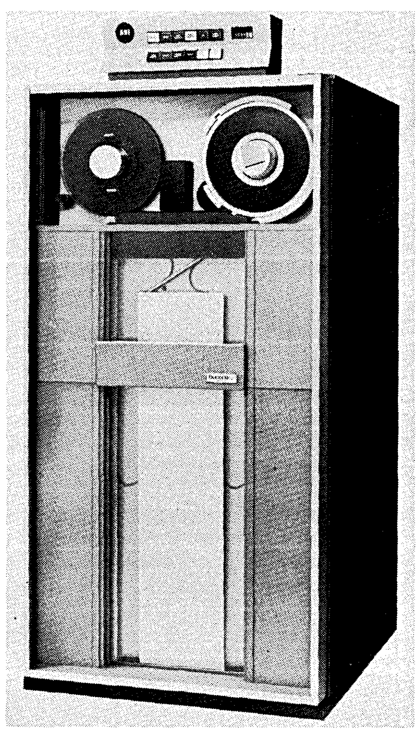
The trick is in the card magazines. Attaching the proper size card hoppers automatically causes the right sensor matrix to be selected. Quantity prices for the 80/96 are in the $1500 range for multiple card versions. Models to handle only one of the card sizes run about $200 less in quantities. Unless using straight Hollerith from the large cards, the OEM vendor must provide the decoding. For information:

CIRCLE 389 ON READER CARD

BUCODE, INC.
Hauppauge, N.Y.
An automatic loading, high speed tape drive is the latest from this company formed by ex-Potter Instrument people. Its Model 20290 operates at 100 and 200 ips and 1600 bpi. Electronics are also available for 800 bpi NRZI, 1600 bpi phase encoded and dual (800 and 1600 bpi) density recording. Transfer rate ranges up to 320 KC.

The automatic threading and loading feature will handle IBM tape cartridges and industry compatible reels. Loading time is seven seconds. Rewind time for 2400 feet of tape is one minute.

Bucode will be marketing all versions of the Model 20290 except for



those that are plug-to-plug compatible with the IBM 2420 (Model 5 and 7 drives). These will be distributed by Data Processing Financial and General.

The Model 20290 will be available 120 days ARO. Price for typical units in OEM quantities is between $13,000 and $15,000.

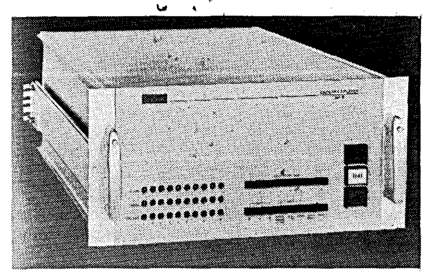
The company is also extending its previously announced Models 2010, 2015 and 2017 low speed tape drives with the addition of 1600 bpi read/write electronics. For information:

CIRCLE 390 ON READER CARD

CIPHER DATA PRODUCTS, INC.
San Diego, Calif.
This line of synchronous tape transports comes with "limited electronics," which means that it will take an OEM to use them. Called the 0700 series (because they come with 7-inch tape reels), models will be available for handling 7-track (200, 556, or 800 bpi or dual-density) or 9-track (800 bpi only) magnetic tape. Tape speeds go to 37.5 ips, and either read/write or read-after-write heads may be ordered. Prices for the 0700 series will be $2750 for the 0707-1 or 0709-1 7-track and 9-track read/write units, and $3500 for the corresponding 0707-2 and 0709-2 read-after-write models. For information:

CIRCLE 391 ON READER CARD

CODEX CORP.
Watertown, Mass.
Up to eight lines operating at 1200 bps to 4800 bps can be multiplexed by the TM-8. The time-division multiplexor can interface to switched network modems like the Western Electric 202C, and is completely transparent to EIA RS 232B control signals. The device can be used in the transmission of any 5-, 6-, 7-, or 8-level code, and



codes can be mixed. The TM-8 uses a 4800 baud or 9600 baud modem for its transmissions; the manufacturer suggests its AE-96 modem. The rack-mounting unit is priced at $4000; deliveries take 30 days. For information:

CIRCLE 392 ON READER CARD

COGNITRONICS CORP.
Mt. Kisco, N.Y.
This audio response unit is packaged in a free standing, multiplexed system called MARS (Multiplexed Audio Response System). It consists of a multiplexed Speechmaker, an interface to a computer—PDP-8 family, the Sigma 7, Varian 620; and certain Honeywell, CDC and Burroughs machines—and data set interfaces for both. Between

two and 47 communication lines may access the Speechmaker's stored words or phrases. Storage capacity of the photosensitive drum ranges from 31 to 189 words or phrases. In MARS it is expected that specific responses will be framed by computer controlled selection of words from the stored vocabulary. Base price for MARS is approximately $17,000. Cognitronics will also be showing the latest Speechmaker—the Model 636—which will take IC logic levels directly. For information:

CIRCLE 393 ON READER CARD

COMPUCORD, INC.
Waltham, Mass.

Compudette 1100, a cassette drive for digital recording, features a 5 ips bi-directional, incremental/continuous, read/write speed, a packing density of 500 bpi (1000 bpi is optional), 20 msec start/stop, 80 ips rewind speed and 5000 bps maximum transfer rate. The small 2.7 pound unit is designed for OEM application. Single unit price is $300 and quantity price (over 1,000) is in the $125 range. Delivery time is 30 days ARO. For information:

CIRCLE 394 ON READER CARD

COMPUTER DEVICES INC.
Cambridge, Mass.

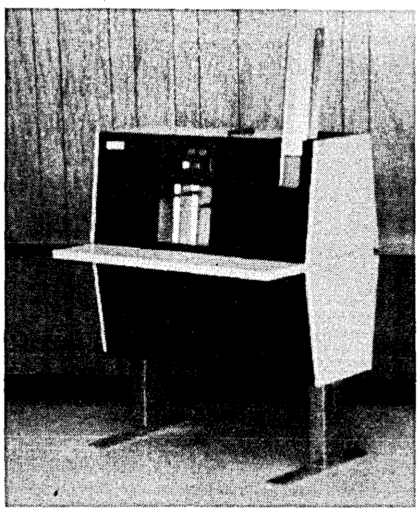
First product of this new firm is the Mini-Computer Console 8310, which combines the keyboard and printer functions of the ASR 33 with the recording and storage functions of the magnetic tape cassette. It uses the same subset of ANSI for compatibility with the 33, but employs two mag tape cassettes instead of a paper tape unit, providing a key-to-tape capability. Nine different on-line and off-line configurations are possible: input from the keyboard may output on the printer only; printer and cassette; printer, cassette, and computer; or printer and computer. Input from the cassette may produce output to the printer only, printer and computer, or computer only. Input from the computer may be output to tape-only or printer-only.

The keyboard has 53 keys, with electronic character interlock. The printer uses an impact printing mechanism, at a speed of 15 cps. Line length is 80 characters standard, or 120 characters optional. The cassette drives use 300-foot, 1.0 mil cassettes with 100K character capacity per cassette. Speed is 300 cps for reading or writing. Operation is incremental by character. Interfaces available are for: PDP-8/I and -8/L; DDP-116, 416, and 516; Varian 620i; Computer Automation PDC 808; and Nova. Its basic price is $3900; delivery requires 90 days ARO. For information:

CIRCLE 395 ON READER CARD

COMPUTER DIGITAL SYSTEMS
Norristown, Pa.

The Model 9606 punched card reader feeds, reads and stacks 96-column cards at the rate of 1000/minute. The free-standing unit is designed as an on-line input device with self-contained electronics and power supply. Input hopper has a capacity of 3000 cards; three output stackers each handle 650 cards. Pockets can be used as either select or overflow stackers. One pocket



can be used as reject stacker. Cards are fed, read and stacked serially, and punched information and column position are detected by solar cells. (Fiber optics split a single light source.) The reader is modular to accommodate various interfaces, and the standard interface is plug-compatible with the IBM System 360 multiplexor channel. An off-line sorter feature is available. Price with interface, reader logic and power supplies is about $10,000 ($5000 without the interface). For information:

CIRCLE 396 ON READER CARD

COMPUTER-LINK CORP.
Burlington, Mass.

The PT-1600 Disc Pack Tester is available in two configurations: one handles both six-high, 1316-type disc packs and 11-high, 2316-style packs, while the other handles only one or the other type. The units are intended for use by both manufacturers and users, and will test all IBM-compatible disc packs. Price for a single type of disc pack capability is in the $50-60K range, and about $80K for a unit to handle both sizes of disc packs. For information:

CIRCLE 397 ON READER CARD

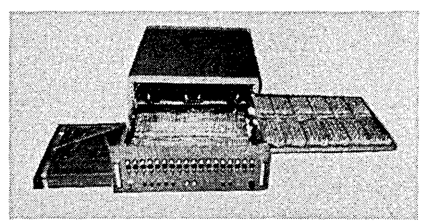
The Model 200 dual density magnetic tape evaluator is equipped to clean and test tapes at 800 bpi (NRZI), or 1600 bpi (phase encoded) at the turn of a switch. Recalibration and adjustment when changing densities is said to be eliminated. The unit is intended for tape libraries that are undergoing transition to high density tape operation and must check tapes at both 800 and 1600 bpi. Its price is $7,400. For information:

CIRCLE 398 ON READER CARD

COMPUTER LOGIC SYSTEMS, INC.
No. Billerica, Mass.

The CLS-18 general purpose 18-bit minicomputer is the first product of this year-old firm. The machine is intended for OEM's and is priced at $7500 in quantity. Memory cycle time is 960 nsec, and memory is 16K expandable to 32K. The machine has 15 hardware registers, of which eight are accessible to the programmer. It is claimed to be the first minicomputer with fully usable multi-accumulator architecture.

Seven addressing modes are used, including direct addressing to the first 1024 memory locations, indirect addressing through the first 1024 locations, direct indexing by accumulators two or three, and direct control of the push-pop register. Indirect addressing may be to any number of levels with indexing at any or all of the levels, again by accumulators two or three. Each indirect address, with or without indexing, takes one cycle. Arithmetic



operations are performed in parallel, binary, fixed point, and two's complement.

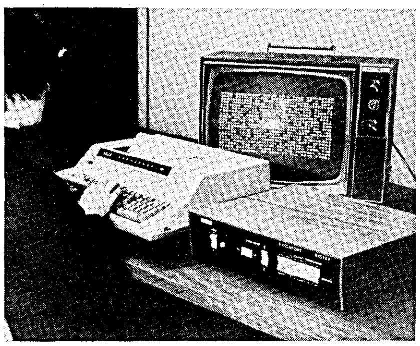
The priority interrupt structure is fully automatic and nested. There are eight external priority lines and five internal interrupts. Interrupts can be enabled and disabled under program control. Each interrupt causes an indirect branch through a dedicated memory location. A direct memory access channel provides peak transfer rates of over one million words per second between a peripheral and memory. The cpu responds to a device requesting use of the DMA channel within 960 nsec. Delivery of the CLS-18 requires 90 days ARO. For information:

CIRCLE 399 ON READER CARD

COMPUTER TRANSCEIVER SYSTEMS, INC.
Paramus, N.J.

Any tv can become a crt data display screen with the attachment of an Execuport 220TVT, a scan converter that takes its inputs from a Teletype. Up to 800 characters can be stored or displayed by the device in up to 20 lines of 40 characters each. The converter accepts full ASCII code and displays compressed (64 characters) ANSI. EIA RS 232B interfaces are used between the tty and the TVT and between the TVT and dataset.

A similar unit, called the 220TV, links a tv with an Execuport 300 terminal. Like the TVT, it can drive up to 15 display screens, making the tele-

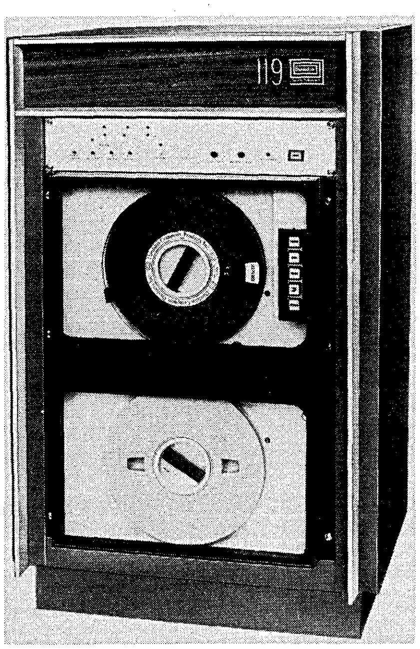


typewriter terminal into a crt terminal or into a driver for a larger display system. Features include a roll capability and a cursor. Unit prices are about $1500 and deliveries take six weeks. For information:

CIRCLE 310 ON READER CARD

DAEDALUS COMPUTER PRODUCTS, INC.
North Syracuse, N.Y.

The company is adding the option of tape data storage for its Model 711



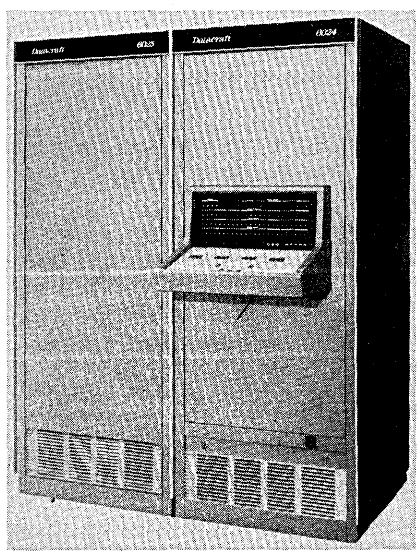
remote batch Programmable Data Terminal. The Model 119 magnetic tape controller permits 9-track, 800 bpi read/write at 5 ips. Rewind speed is 96 ips. Average purchase price for the 119 is $10,000. Delivery is 80 days ARO. For information:

CIRCLE 311 ON READER CARD

DATACRAFT CORP.
Ft. Lauderdale, Fla.

This 24-bit computer is aimed at applications requiring real-time control with complex calculations. It is the second computer in the company's line, and is rated at roughly 60% of the price and 60% of the speed of its predecessor. The machine has a 1-usec cycle time and requires about 1.2 usec to perform an addition. Its 8K core (expandable to 64K) has a cycle time of 1 usec and an access time of 350 nsec.

The 6024/3 also has hardware implemented multiply, divide, and square root functions, plus five 24-bit registers, three of which may be used for indexing. Its maximum data transfer rate is one million words/sec. The basic unit has four levels of interrupt and one 8-bit buffered data channel; this unit can be expanded to handle 32 interrupt levels and 14 concurrently operating channels. An optional Sci-



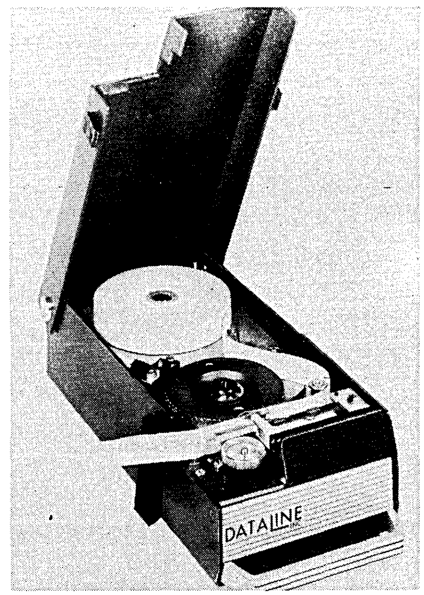
entific Arithmetic Unit is also available, which implements double-precision floating-point arithmetic (an add, subtract, or multiply in 14 usec). Instructions provide for word, byte, double word, and (optionally) bit manipulations.

Supplied software includes FORTRAN IV math routines, hardware test routines, and a modular Resident Operating System. The ROS has a link loader, I/O, operator communications, job control and on-line debug modules. Compilers and other operating systems are optional. The DC 6024 sells for $32,800 without options. An ASR 33 Teletype is suggested for basic I/O, but not included in the price. For information:

CIRCLE 402 ON READER CARD

DATALINE, INC.
King of Prussia, Pa.

The Model 3064-M is a digital impact strip printer nine inches long, weighing four pounds, designed for applications in which size and weight are significant. It can receive information without query when interfaced with remote computer or communications center. It prints up to 30 cps asynchronously in a 64-character ANSI subset font (full alphanumeric plus symbols) with a corresponding 6-bit code. Options include serial or parallel data buffer register, serial data buffer regis-



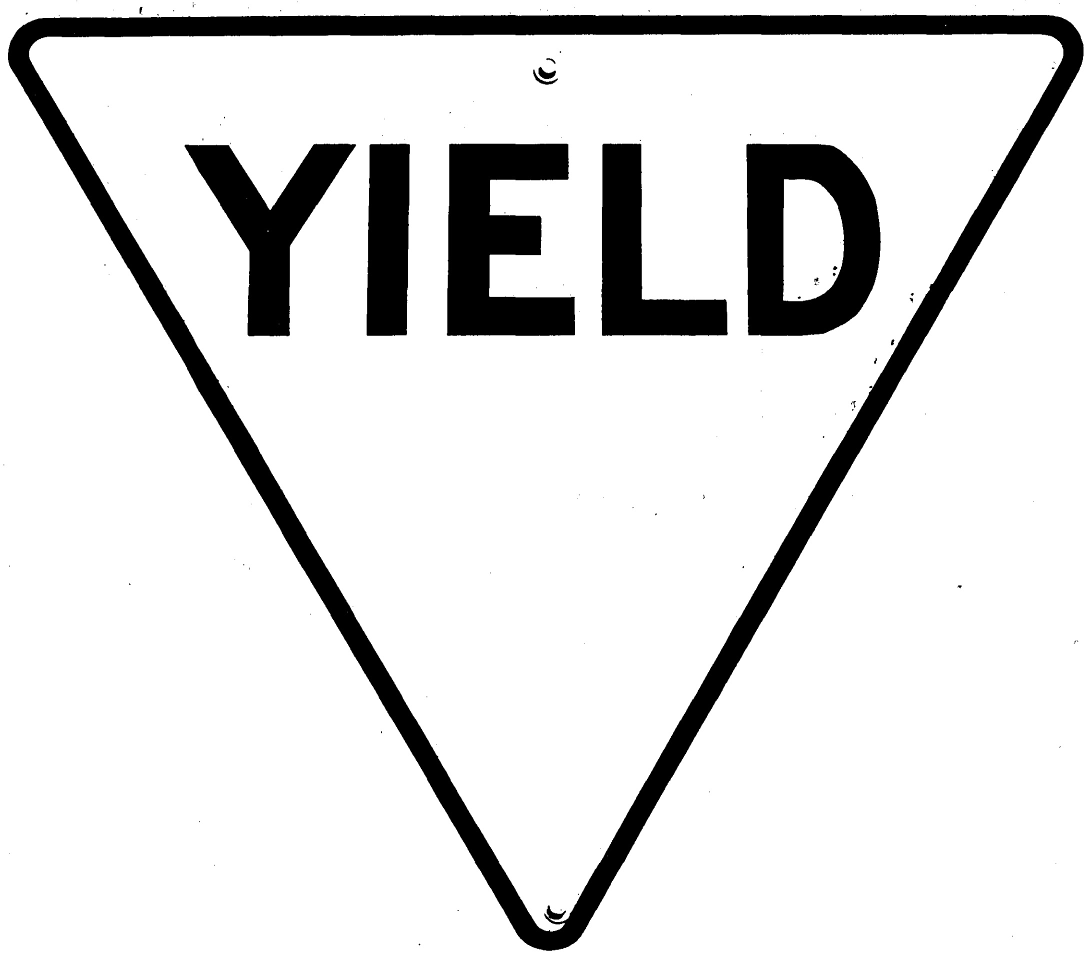
ter with autoprint command, external paper advance, autostart operation using carrier control, code conversion, and a heater. Standard units are available for operation from 12-, 24- and 48-volt power source. Dateline also offers a desk-top model: Model 3064-C (slightly smaller, but the same specifications). Unit price is $615; quantity prices are as low as $460 (including ANSI electronics, power supply and case). For information:

CIRCLE 403 ON READER CARD

Dataline also plans to introduce at the SJCC its 3064-DT Portable Terminal designed to offer portable two-way data communications capability. It has a full keyboard for data entry, and a Model 3064 strip printer for hard-copy printout of received and transmitted messages. An internal modem provides full- or half-duplex operation with either acoustical or data-access connection to telephone facilities. It is fitted in a standard attache case, weighs less than 25 pounds, and costs under $1000. For information:

CIRCLE 404 ON READER CARD

(Continued on p. 245)



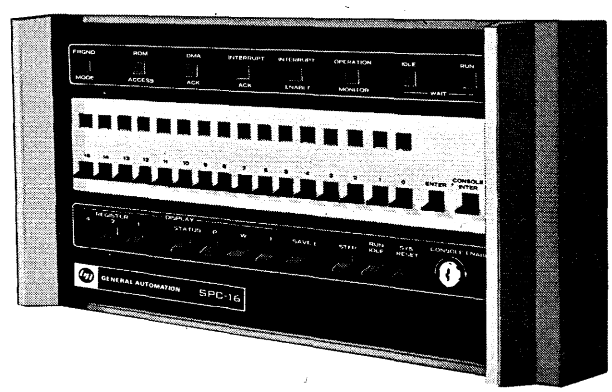
You can increase product yield today... ask about the performance of the SPC-16 industrial automation computer.

SPC-16 gives you big computing power, accuracy, reliability and programming simplicity . . . It's specially designed to work in industrial environments.

You can reduce your operating costs, increase the yield of better quality products . . . you can get your products to the market faster. And you can serve more markets with new levels of reliability.

And the SPC-16 is supported by expert consultation, systems engineering, programming and customer training services.

If you make, move, test or count, SPC-16 is your automation worker . . . ask about its performance today.



Ask about other low-cost computers in the GA family. The SPC-12 for less than $5000. System 18/30 for under $20,000.

GENERAL AUTOMATION, INC.
Automation Products Division
706 West Katella, Orange, Calif. 92667
(714) 633-1091, TWX 910-593-1601

CALIFORNIA
Los Altos, (415) 941-5966
TEXAS
Dallas, (214) 358-0271
Houston, (713) 774-8716
ILLINOIS
Des Plaines, (312) 298-4650
(California G.A. Corp.)
OHIO
Cleveland, (216) 351-2275

GEORGIA
Atlanta, (404) 261-6203
PENNSYLVANIA
King of Prussia, (215) 265-6525
MARYLAND
Silver Spring, (301) 593-6010
CONNECTICUT
Stamford, (203) 325-3883

MASSACHUSETTS
Waltham, (617) 899-6170
INTERNATIONAL
G. A. I.
24 Bvld. de l'Empereur
Bruxelles, Belgium
G. A. Ltd.
Wren House, Portsmouth Rd.
Esher, Surrey, Esher 65764

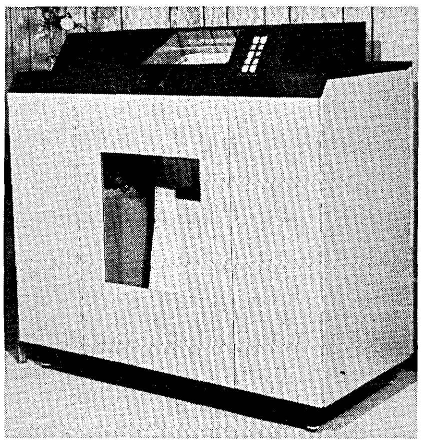
See General Automation at S.J.C.C., Booths 4401-4404

CIRCLE 247 ON READER CARD

DATAMARK, INC.
Westbury, N.Y.

This 300 lpm impact printer features something different in a print mechanism, an oscillating bar of type that passes over the paper from left to right and back and is struck by hammers in its travels. The mechanism is built for printing up to six-part forms and line widths up to 160 columns.

The base model handles 132 columns, but versions for 160-, 120-, or 80-columns are also offered. The printer uses a 64- or 96-character font as standard and prints 10 characters per inch. Both nonstandard spacing and

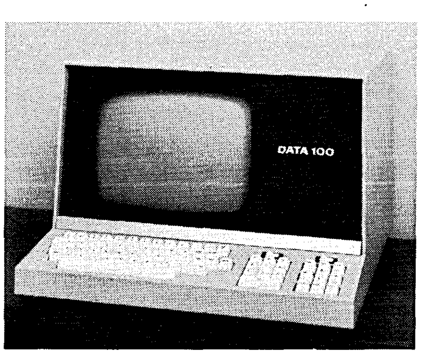


extended character sets (to 128 characters) are available. Line spacing is six lines per inch standard, eight optionally. Prices are given as between $12K and $14K. For information:

CIRCLE 405 ON READER CARD

DATA 100 CORPORATION
Minneapolis, Minn.

The 73-1 is designed to be plug interchangeable with Model 33 and 35 Teletypes. The terminal is a desk-top crt display and keyboard interfaced to a communications line. It uses the ANSI character and code set and displays the 64-character upper case graphic subset of the 1968 ANSI standard. The standard display has four lines of 5x7 dot matrix characters. The Model 73-2 has 12 lines; the Model 73-3, 24 lines.



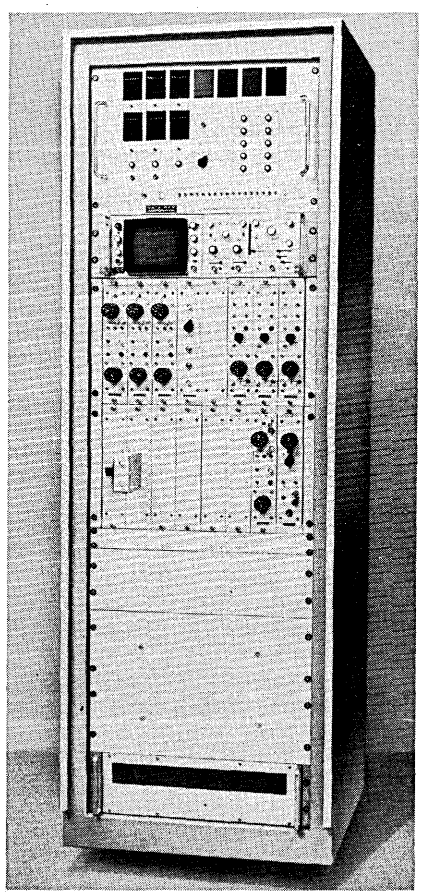
Characters are displayed either white on a black background or black on white. The keyboard has three sections: the alphanumeric keyboard duplicates the Teletype layout; the terminal control and edit keys move the nondestructive cursor, repeat other key actions, clear the display, cause printout on the optional hard copy printer, and start transmission in the block/edit mode; the optional numeric keyboard is an adding machine configuration.

The terminal operates in two modes. In the on-line mode, each character entered from the keyboard is transmitted to the computer, which retransmits it back to the terminal. The character received by the terminal is stored in the MOS memory and displayed. The "send" key causes the data to be sent back to the computer in a block. The standard terminal connection to an acoustic coupler or 103-type data set is through an EIA interface. The basic Interactive Display Terminal is priced at $3,400 in single quantities and can be leased for $100/month. For information:

CIRCLE 406 ON READER CARD

DATARAM CORP.
Princeton, N.J.

Either comparison or absolute value testing or both can be done with the Model 201 automatic memory core



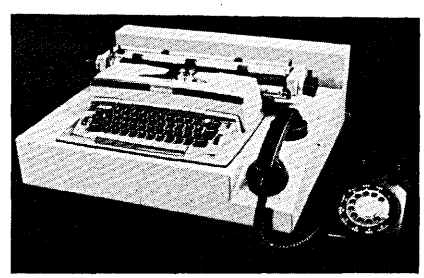
tester. Comparison testing employs a transformer to show any differences between a standard core and a test core. Absolute value testing measures the sense output at predetermined time and voltage. The Model 201 tests up to 25 cores per second. Card programming obviates the need for many knobs and switches, and a remote control box lets one operator control both the tester and the core handler from the same position when servicing the handler. The operator can reset all six of the six-digit counters with one common reset push button.

A 16-step program provides for a broad range of programming applications that require complex testing procedures. The 201's price is $21,500; delivery, 90 days ARO. For information:

CIRCLE 407 ON READER CARD

DATATERM, INC.
Levittown, Pa.

This year-old firm is introducing its first four products. The Model 35 Typewriter Input/Output Terminal provides hard-copy terminal capability, continuous-feed paper 15″ wide for



132 characters (or the normal 8½″ for 80 characters), and optional black/red send/receive discrimination. Available with built-in acoustical coupler, this Olympia electric typewriter includes the 128 ANSI characters, and all upper and lower case letters and standard typewriter symbols. Input and output are serial with Teletype interface, or TTL- and DTL-compatible. I/O rates are 10 or 15 cps, and Dataterm offers full duplex, half duplex and local modes. Weight is less than 50 pounds, and a carrying case is available. Unit price is about $1800; quantity price around $1400. For information:

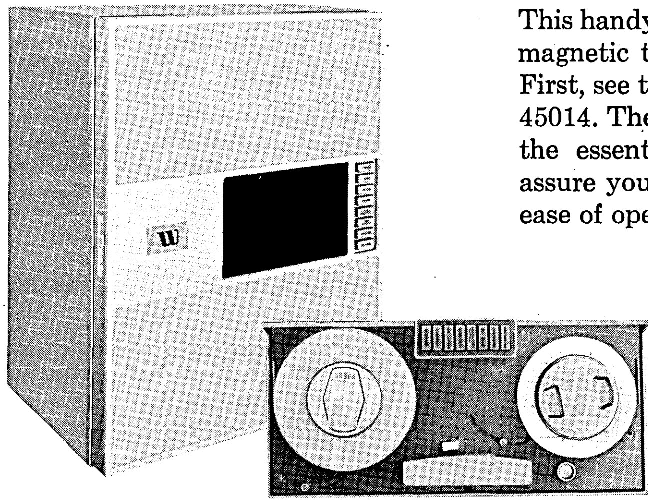
CIRCLE 408 ON READER CARD

The SOT-100 Typewriter Terminal (send only) is a standard typewriter equipped with reed switch sensors that produce an 8-bit code compatible with most computers, data sets and couplers. The unit is small, lightweight, produces hard copy, and can be used with an acoustical coupler as a remote input terminal. Sending speed is 10 cps. Unit price is $450, and quantity price about $350. (Coupler is $800 more.) For information:

CIRCLE 409 ON READER CARD

(Continued on p. 247)

SJCC is
YOUR BIG CHANCE
to compare tape systems!



This handy check list will make it easier for you to compare low-cost magnetic tape systems at the Spring Joint Computer Conference. First, see the Wang Computer Products Mod 10 and Mod 7 at booth 45014. Then look at the others; find out for yourself if they provide the essential prechecked qualities listed below. These qualities assure you of the performance, reliability, IBM compatibility, and ease of operation you need!

Start at Booth 45014

	Wang Mod 10	Wang Mod 7			
Simple, reliable design No belts or pulleys, no duty-cycle limits! Direct reel drive from servo-motor. Quiet operation.	☑	☑	☐	☐	☐
Precision tape guiding Optimum tape interchangeability with IBM tape systems, longer tape life.	☑	☑	☐	☐	☐
Complete front access Quick, easy maintenance; all subassemblies brought out of enclosure with mainframe of tape handler.	☑	☑	☐	☐	☐
Quick and easy threading Servo arms retract automatically for loading, less than 10 seconds threading time (even one-handed).	☑	☑	☐	☐	☐
Channel-by-channel electronic deskewing Positive tape interchangeability with IBM handlers; precise bit alignment on tape for reading on high-speed drives.	☑	☑	☐	☐	☐
Gentle, automatic tape unloading Prevents damaging high-speed flap in rewind; makes leaders last!	☑	☑	☐	☐	☐

	Wang Mod 10	Wang Mod 7			
Direct plug-in to controllers Provides immediate replacement for most low-cost tape systems of older design, without system changes.	☑	☑	☐	☐	☐
Program-controlled read threshold Dual read threshold permits automatic recovery of data from marginal tapes under program control from system.	☑	☑	☐	☐	☐
Tape cleaner located for best data reliability Tape is cleaned immediately ahead of read/write head assembly; no intervening components to contribute dropouts!	☑	☑	☐	☐	☐
Off-line test option Permits tape handler checking without controller, tape handler maintenance while system is on-line.	☑	☑	☐	☐	☐
Complete IBM compatibility Up to 37.5 ips with Mod 10, 12.5 ips with Mod 7. Seven or nine channel, up to 800 bpi NRZI, 1600 bpi PE.	☑	☑	☐	☐	☐

WANG COMPUTER PRODUCTS, INC.
2000 Stoner Avenue, Los Angeles, Calif. (90025) Telephone (213) 478-7727

Dataterm's solid state keyboard (one moving part) features an oscillator-driven capacitive keyswitch that eliminates the bounce in many mechanical-contact magnetic reed switches. Encoding technique permits dictation of any code arrangement up to eight bits. Two-key roll-over prevents entry of errors normally associated with burst-speed typing. Available in full body or mini-keyboard styles with a variety of key combinations at about \$2/key/keyboard in large OEM quantities. For information:

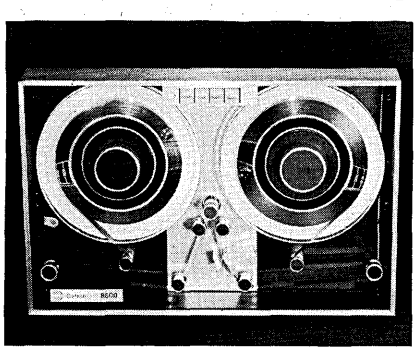
CIRCLE 309 ON READER CARD

The HS-300 Optical Tape Reader asynchronously reads paper tape character by character at rates up to 300 cps. A single moving element—a stepping motor—reduces wear, acoustic noise and dust problems. Models are available for use with 11/16", 7/8" or 1" 5-, 6-, 7-, or 8-channel tape, and for reading advanced feed hole tapes. Reading can be either bi- or uni-directional. Special circuitry permits direct plug-in replacement of capstan/pinch-roll or slower stepping motor readers. Unit price for bi-directional models with power supply is about \$850 (\$100 extra for fan-fold bins). Quantity price for the uni-directional model is \$520. For information:

CIRCLE 410 ON READER CARD

DATRAN CORP.
Norwalk, Conn.

Operating modes and recording densities can be manually or logically switched for the models 8551 (7-track) and 8552 (9-track) magnetic tape units. Densities of 200, 556, and 800 bpi can be selected, and the tape drives operate either incrementally or synchronously. When used incrementally, they are rated at 0-1000 cps



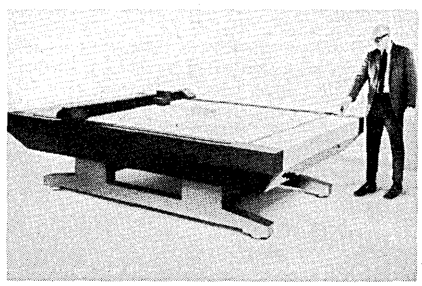
reading and 0-500 cps writing. There is also a "slew" mode read operation which can be used for reading at 1000 cps.

The units are rated at 30 ips when used in a synchronous mode, which makes for a maximum transfer rate of 24 KC at 800 bpi. Vertical parity bits, either even or odd, are automatically generated as are interblock gaps and check characters (LRCC and CRCC). Reel size is 8½ inches, and recording is said to be IBM compatible. Deliveries require 90 days, and the prices are \$6625 for the 8551 and \$6900 for the 8552. For information:

CIRCLE 411 ON READER CARD

ELECTRONIC ASSOCIATES, INC.
West Long Branch, N.J.

Need a larger copy of your plot? Try the 430/200 Dataplotter, a flat-bed plotter that makes drawings about the size of a bed sheet. (Might be an



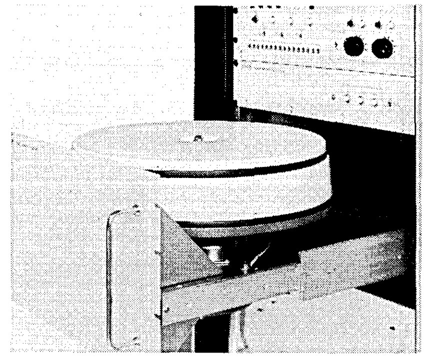
interesting application right there.) The 430/200 is a serious piece of equipment, however, featuring a four-pen assembly for multicolor or multi-line-width drawings, drafting speeds to 16 ips, and resolutions to .00125 inch. The drawing area is 54x76 inches. Curves are plotted with third-order fitting accuracy and a 48-character symbol printer is included for fast annotation. Prices for the 430/200 start at \$37K. Deliveries begin in five to six months. For information:

CIRCLE 412 ON READER CARD

ENGINEERED DATA PERIPHERALS CORP.
Santa Monica, Calif.

Minicomputers can conveniently handle data rates in the neighborhood of 1.5 million bps, which is the rate offered by the MDS-3000 disc memory system. Its storage capacity, which ranges from 0.4 million bits to 6.0 million bits, seems about right for minis and midicomputers, too. Also, unlike many peripherals touted for use with the increasingly popular small machines, the price of the subsystem is substantially less than that of the cpu it is designed to complement. The smallest versions run out at \$3200; the largest for \$8500 for a single unit.

For \$3200 the user would presumably get the 8-track 0.4 megabit system; for \$8500 he would receive the 120-track size. Each has a flying head per track, and can access data in 17



msec. None of the units requires periodic maintenance; 2500 hours of lab testing has been completed, the vendor says, without experiencing a mechanical or electronic failure. Current deliveries take 60 to 90 days. For information:

CIRCLE 413 ON READER CARD

GENERAL INSTRUMENT CORP.
Hawthorne, Calif.

The job of a power sequencer is to protect computer memories and other subsystems against AC input line faults. The Systems Power Sequencer 1000 provides ON/OFF control of up to three DC voltages under program control. It powers down and powers up in a predetermined sequence, monitors power supply overvoltage and undervoltage, and monitors AC line voltage simultaneously. Its price is about \$800. For information:

CIRCLE 414 ON READER CARD

THE GERBER SCIENTIFIC INSTRUMENT CO.
So. Windsor, Conn.

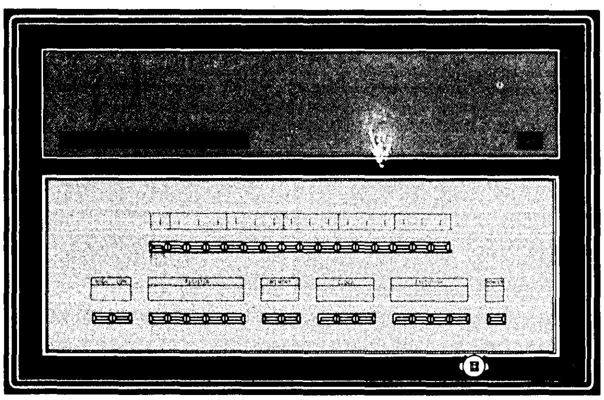
Draft Aid is a drafting system for direct translation of rough sketches into camera-ready, ink-on-vellum drawings. The self-contained system is specifically built for real-time operation by draftsmen, designers, publication personnel, etc. It is particularly useful for producing drawings containing repetitive symbology and text. Typical applications include logic diagrams, technical publications, schematics, flow and PERT charts. Over-all accuracy is ±.004 inch at speeds to 600 inches per minute, permitting drawing of an average "C" size schematic in six to eight minutes after completion of data input.

The system is composed of a Gerber Series 1200 stored program control including a Hewlett-Packard computer with 8K core, tty, and 400 cps photoelectric tape reader and spooler which processes the input data and outputs commands directly to the drafting table. A cartridge magnetic tape unit interfaced with the control provides

Computers designed to

CUT YOUR SOFTWARE COSTS

Until now, tedious time-consuming assembly language programming has been the most efficient means of programming small and medium scale computers. The CSI computer systems are programmed efficiently and more quickly through the use of high level compiler languages. The architecture includes hardware algorithms for all of the basic compiler language functions providing efficient integration with compiler language software requirements, thus optimum program efficiency. Compilers for ALGOL, BASIC and ASA FORTRAN IV, including real time extensions, are operable in the basic systems. Four levels of operating systems are available to tailor capability to the requirements of the application. All software is interchangeable between the systems.



CSI-16 **16-bit word length.**

Minimum memory of 4,096 words with expansion to 32,768 words, all in the mainframe. 1 us cycle time.

Integer arithmetic hardware (8.5/8.66 us multiply/divide).

Floating point arithmetic hardware (11.6/12.1 us multiply/divide).

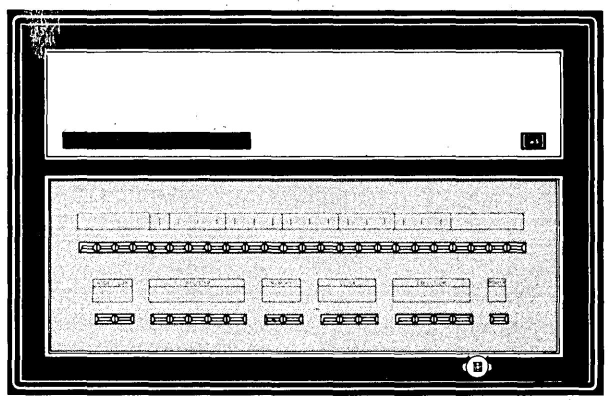
Three 32-bit accumulator/buffer registers and twelve 16-bit registers.

Hardware memory protection and program relocation.

Automatic Priority Interrupt Processor. Basic system includes 8 hardware interrupt levels with expansion capability to 256 levels.

Direct Memory Access I/O only via independent I/O Processors. Basic system includes one Processor with expansion capability to 256. Transfer rate is one million words per second.

$10,750 for basic system including all of the above features.



CSI-26 **24-bit word length.**

Minimum memory of 4,096 words with expansion to 32,768 words in the mainframe and to 8,388,608 words externally. 1 us cycle time.

Integer arithmetic hardware (10.33/10.66 us multiply/divide).

Floating point arithmetic hardware (17.0/17.5 us multiply/divide).

Three 48-bit accumulator/buffer registers and twelve 24-bit registers.

Hardware memory protection and program relocation.

Automatic Priority Interrupt Processor. Basic system includes 8 hardware interrupt levels with expansion capability to 256 levels.

Direct Memory Access I/O only via independent I/O Processors. Basic system includes one Processor with expansion capability to 256. Transfer rate is one million words per second.

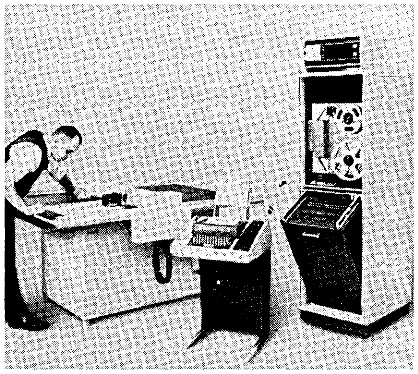
$14,950 for basic system including all of the above features.

SJCC Booth 25009/25010

CSI COMPILER SYSTEMS INCORPORATED

P.O. BOX 366 RIDGEFIELD, CONNECTICUT 06877 203-438-0488 storage for drafting symbols and commands.

Three tables are available: The Model 23 with 34x44-inch drawing area is standard; two electrically tilt-

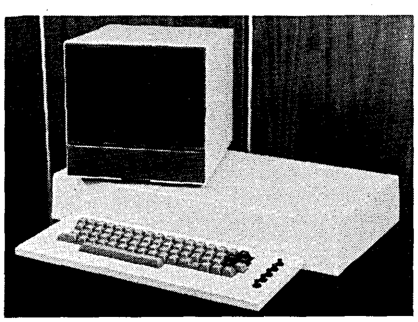


able tables, the Model 22 with 48x58-inch area and the Model 75 with up to 5 x 24 feet, are optional. Basic price is $89,800. Delivery is about 120 days ARO. For information:

CIRCLE 415 ON READER CARD

HAZELTINE CORP.
Little Neck, N.Y.

The 9-inch or 12-inch screen on the 1760 Desk Top Display can hold up to 32 lines of 55 characters each (hence the name 1760) or up to 1920 characters on 24 lines of 80 each. The characters are formed in a 5x7 dot matrix, using a 64- or 96-character ANSI set, and may be shown in either of two intensities. The difference in bright-



ness is used to set off computer protected information that cannot be changed by the keyboard operator, or for defining fields. Also useful for field definition is a split screen capability.

The 1760 normally transmits data at 110 bps over an acoustic coupler or teleprinter. It can be factory adjusted to run at speeds to 2400 baud, and refreshes the screen 60 times per second in either case. When used with a teleprinter, hardware features allow for copying the character display onto hard copy and protecting the display until the copying is completed. An editing terminal, the 1760 provides for line or character insertions and deletions. It is priced at under $5000. Deliveries begin in July. For information:

CIRCLE 416 ON READER CARD

HETRA
Melbourne, Fla.

Earlier this year it was the Hetra S Series/III (and II and I) computer and competition for the IBM System/3, and now it is the Hetra T Series (I, II and III) Remote Processing Terminals and still competition for the System/3 with its new communications capability. The T Series and S Series (Feb., p. 203) are based on the same processor—the Series 200, a TTL and partial MSI unit with a 1-usec memory cycle.

The programmable batch terminals gain their communications capability through front end firmware. This can provide just communication interfacing or be extended to give the unit the characteristics of existing data terminals. Variable instruction and word length permit compatibility with the more popular computer systems. Internal coding for the series is ANSI, but the other common codes—EBCDIC, binary, Baudot, etc.—can be processed. The terminals also handle RPG and Hetra's PWL (Programmers Working Language).

Hardware configurations for the T Series parallels that of the S Series down through a long list of peripheral equipment. The only exception is modem options. The terminals can interface with low speed and up to 230 kilobit units.

First delivery of the T Series Remote Processing Terminals is expected in May. Basic price—for a T/I with Teletype—is $10,000. Hetra expects a lot of sales to fall in the $12,000 to $13,000 range: the T/I with a 192-column, 30 cps character printer—a configuration that would "look like the Burroughs TC-500." For information:

CIRCLE 417 ON READER CARD

HEWLETT-PACKARD
Palo Alto, Calif.

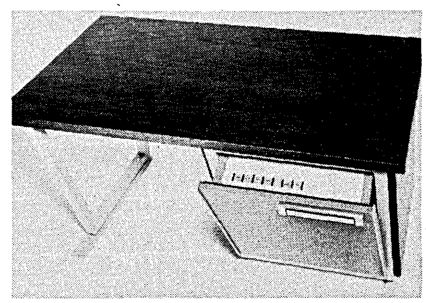
A dual-processor computer, the Model 2000B is predicated as the nucleus of a time-sharing network of up to 32 terminals. Built around two standard offerings in HP's computer line-up, the 2000B is an upgraded version of the 16-terminal 2000A already on the market. Its hardware configuration includes a 2116B central processor (a 16-bit machine with a 16K, 1.6-usec memory), a 2114B (a 16-bitter with 8K of 2-usec core and a transfer rate of 500,000 words/sec) for I/O processing, plus a 12-megabit drum.

With one control teleprinter, the 2000B lists at $119,000, which figure is about 30% higher than the price of a 2000A. Software available includes a general business package and a computer-assisted elementary math instruction package. The system is programmed in BASIC, as is the 2000A, and the "A" can be upgraded to the "B" configuration with few difficulties. For information:

CIRCLE 418 ON READER CARD

HOUSTON INSTRUMENT
Bellaire, Texas

Line speeds of 10 cps or 300 bps can be accommodated by the PTC-4 Plotter Teletypewriter Controller, a device intended to make time-shared plotting faster and more efficient. The PTC-4 is not a plotter, but a line interface that enables a time-sharing customer to use an HI incremental plotter—the DP-1, DP-3, or DP-5, depending on line speed—



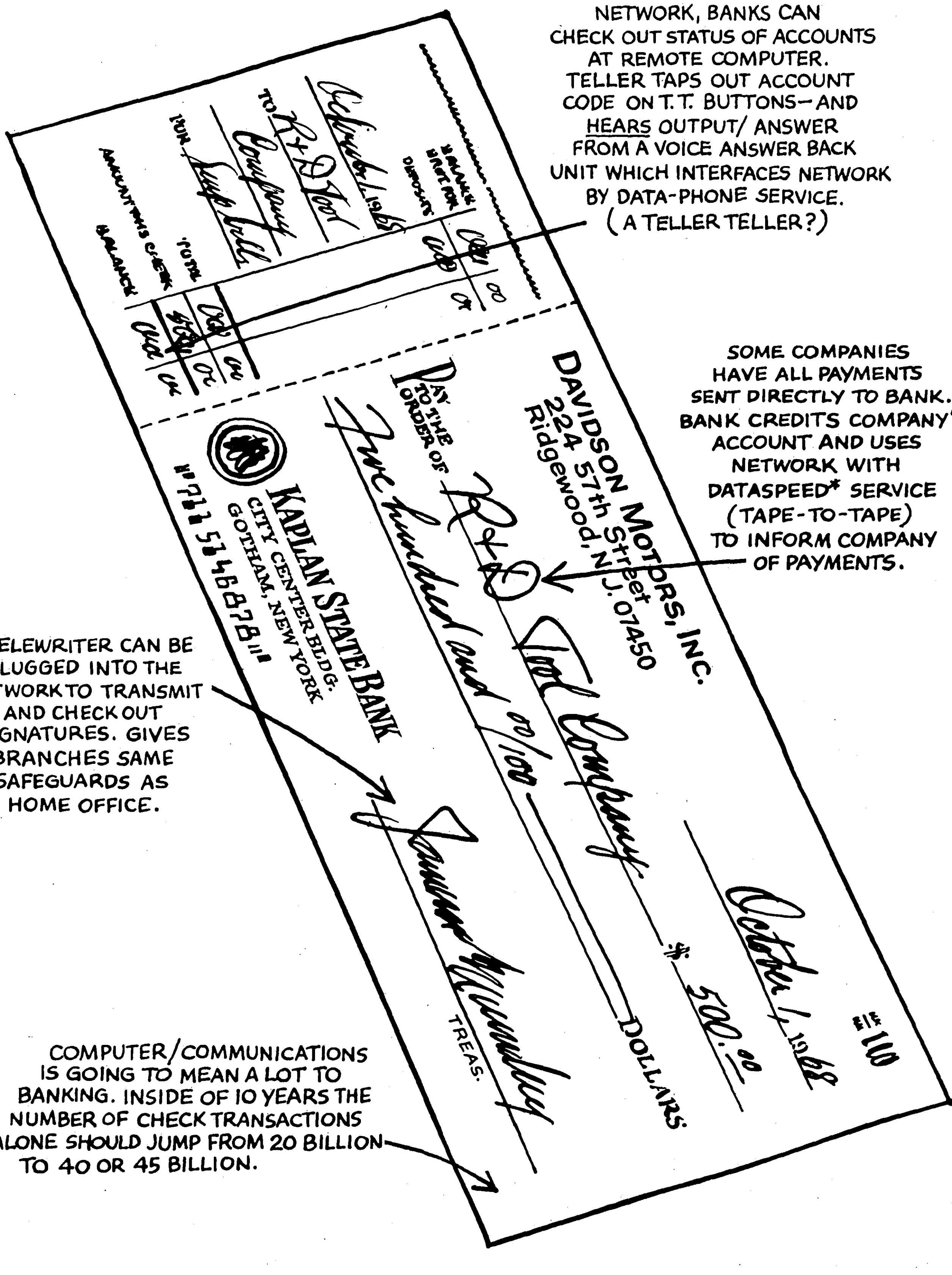
with a new variety of software. According to the company, the resulting HI-PLOTS system, composed of equal parts of hardware and software, can command a plotter to make up to 841 movements in more than 230 line segment vectors using only four data characters. Presumably, the user would have previously been limited to making only 116 incremental movements along eight vectors. The HI-PLOTS system is compatible with other plotters (how can anyone be non-CalComp compatible?), and its software is in FORTRAN, so compatible with almost all computers. The PTC-4 and the associated software sells for $5900 or leases for $295/month including maintenance (and with 60% of the rental applied to later purchase, if desired). For information:

CIRCLE 419 ON READER CARD

I E R CORP.
Arlington, Va.

The B series of magnetic drum memories offers a system expandable in one million-bit increments from one million to 19 million-bit capacities. The drums incorporate a fail-safe head retraction system based on a (patent pending) method of sensing the distance be-

THANKS TO OUR NETWORK, BANKS CAN CHECK OUT STATUS OF ACCOUNTS AT REMOTE COMPUTER. TELLER TAPS OUT ACCOUNT CODE ON T.T. BUTTONS—AND HEARS OUTPUT/ ANSWER FROM A VOICE ANSWER BACK UNIT WHICH INTERFACES NETWORK BY DATA-PHONE SERVICE. (A TELLER TELLER?)



SOME COMPANIES HAVE ALL PAYMENTS SENT DIRECTLY TO BANK. BANK CREDITS COMPANY'S ACCOUNT AND USES NETWORK WITH DATASPEED* SERVICE (TAPE-TO-TAPE) TO INFORM COMPANY OF PAYMENTS.

TELEWRITER CAN BE PLUGGED INTO THE NETWORK TO TRANSMIT AND CHECK OUT SIGNATURES. GIVES BRANCHES SAME SAFEGUARDS AS HOME OFFICE.

COMPUTER/COMMUNICATIONS IS GOING TO MEAN A LOT TO BANKING. INSIDE OF 10 YEARS THE NUMBER OF CHECK TRANSACTIONS ALONE SHOULD JUMP FROM 20 BILLION TO 40 OR 45 BILLION.

Our new $20,900 remote batch terminal interfaces with almost everybody

It takes an intelligent terminal to team up with the most important CPUs in the industry... and that's just what our new brain truster does. It will trade data with the IBM System 360, UNIVAC 1108, RCA Spectra 70 series, Control Data 3000 and 6000 series, XDS Sigma series, General Electric 400 and 600 series, Digital Equipment's PDP 10, plus less well known names.

You can also sneak in some on-site data processing because our new progeny has a 4Kx16 memory of its own, and you can add more in 4K increments. Other bright spots in its personality include: 2000 bits/sec dial-up and 2400, 4800, 9600 bits/sec leased line, half or full duplex operation (2 or 4 wire), EBCDIC, ASCII and Transcode operator selectable, terminal to terminal communication and interfacing for a wide variety of peripherals which can be added anytime without wiring modifications.

Further proof of its brilliance is borne out by the fact that auto answering for dial-up lines, automatic turnaround, multiple record transmission, horizontal format control, EBCDIC transparency and multipoint line control are all included in the basic price.

Call for details, and be sure to see the smartest terminal at the show.

M&M COMPUTER INDUSTRIES, INC.
770 North Main Street, Orange, California 92667 (714) 639-1134

tween head and recording surface. Model B-256 will be displayed; it is the model B-512 that is expandable all the way up to 19 million bits. Model B-256 has about half that capacity. Depending on the number of bits in the organization of the read/write system, prices range from $3K to $20K for drums with from one to 19 million bits. For information:

CIRCLE 420 ON READER CARD

IMAGE SYSTEMS, INC.
Culver City, Calif.
Microfiche records are becoming an increasingly popular way to present computer printouts and graphics. This vendor already makes the retrieval system for pulling and displaying stored microfiche and is now going into the support equipment business with a conversion station (for making fiche from 16mm and 35mm microfilm), a microfiche printer (like a Xerox copier, but for film), and a film developer. The three-unit conversion station is priced at $3200, the duplicator at $2850, and the diazo processor at $2300. For information:

CIRCLE 421 ON READER CARD

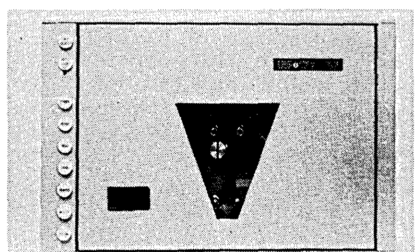
IMLAC CORP.
Waltham, Mass.
Latest terminal from this firm is the PDS-2, an extension of the PDS-1, which, like its predecessor, has its own local 16-bit processor as well as a display processor. Added hardware features of the PDS-2 make it more optimally suited for graphics applications, whereas the PDS-1 is evenly oriented towards alphanumeric text and graphics. The standard PDS-2 comes with 8K core, expandable to 32K; light pen; hardware looping for incremental vector operation; read only memory bootstrap; and software including a combination alphanumeric and graphics local editor compatible with t-s services, full graphics local editor compatible with t-s graphics packages, and a utility package. Prices start at $18,500. For information:

CIRCLE 422 ON READER CARD

INFORMATION DATA SYSTEMS, INC.
Detroit, Mich.
This firm is offering disc controllers to interface its series 7000 and 8100 disc memory subsystems with Interdata and Data General Nova minicomputers. (Controllers for Digital Equipment Corp. PDP-8's and for Lockheed MAC-16's were previously announced.) The devices sell for $4000 each on a one-unit basis and deliveries take 60 days. Called the 5000 series, the rack mounted units are capable of transferring up to 150K bytes/sec. For information:

CIRCLE 423 ON READER CARD

INFOTEC, INC.
Plainview, N.Y.
Although they operate at 7½ ips, the TD-7/Mod 1 and TD-9/Mod 1 can transfer data at 6000 cps since they use 7-track and 9-track IBM compatible tape at 800 bpi. The smallish 7-inch reel sizes allow for storage of up



to 5.5 million characters. The transports contain all read/write electronics plus the power supply, motor control electronics, and a tape cleaner, yet are priced at $1850 in quantities. Although the speed is less than half that of the more common small units like the Ampex TM-Z, these drives are about half the price, too. They seem to be standing in a middle ground between cassette tape decks and 25 ips tape transports, offering decent transfer rates and IBM tape compatibility at cassette tape drive prices. For information:

CIRCLE 424 ON READER CARD

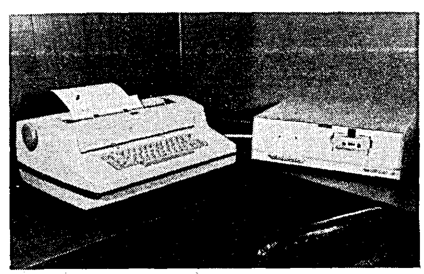
INTERNATIONAL COMMUNICATIONS CORP.
Miami, Florida
The Model 110D Transmission Test Set evaluates data transmission systems using synchronous modems operating at any speed from 10 to 330,000 bps which are equipped for RS232B/CCITT

v.24 interface, supplying their own clock. The test set provides isolation of fault in data communications systems and is intended for use by both technical and non-technical personnel. A removable cable expander allows access to the 25 pins of the EIA RS232 connector for testing while data processing equipment operates normally. The unit synchronizes itself with the received digital data stream, detects errors, and displays these errors on front panel lights. It is capable of supplying the 511 bps pseudo-random pattern standard with CCITT as well as the standard ICC and Western Electric test pattern rates of 2,047 and 63 bps. The 110D is based on the Model 110 introduced in 1968. Price is $1,450. For information:

CIRCLE 425 ON READER CARD

INTERNATIONAL COMPUTER PRODUCTS, INC.
Dallas, Texas
An IBM Selectric or Model 735 typewriter becomes a keyboard with a memory when interfaced to the Keycette/1000, a cassette tape-based storage system. The 1000 provides access to up to 800 typed lines of storage on a 300-foot cartridge tape. It allows for input to the tape at typist speeds and output to the typewriter at 15.5 cps.

The Keycette has a 96-character x 8-bit buffer which accumulates the line information as it is pulled from tape or as it is about to be recorded. For this reason, the typewriter memory uses

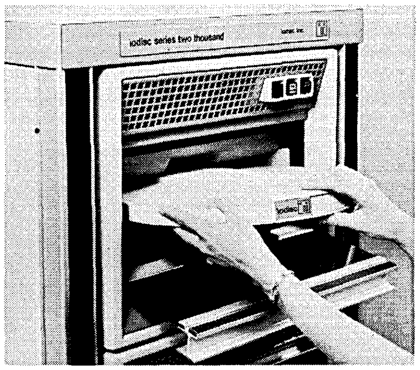


fixed (96-character) records. Stop codes can be inserted in records to provide for typist additions to text. Interfaces can be provided for some adding machines, calculators, and typewriters other than IBM's. The Keycette is priced at $2490 (without the typewriter). Delivery takes 60 to 90 days. For information:

CIRCLE 426 ON READER CARD

IOMEC, INC.
Santa Clara, Calif.
By doubling the recording density used on its earlier Iodisc 1012, this vendor has come up with a dual-disc storage subsystem that delivers 80% of the storage capacity of an IBM 2311

drive (which uses a six-disc pack and writes on 10 surfaces). The device is an unusual one, consisting of a drive for a



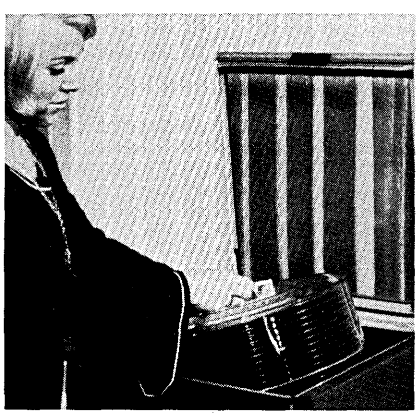
single disc cartridge and a permanent single disc. Each of the discs operates at the same data transfer rate (1.4 million bps) and uses the same packing density (up to 2200 bpi on the inside tracks), making transfers from fixed disc to removable disc easy. Access times for the device are in the 70 msec range, the vendor claims.

The 2012 is listed at about $9500 (about $15K with a controller, adapter, and power supply). IBM 2311 prices, for a comparison, are in the $22,500 and $25,500 range. For information:

CIRCLE 427 ON READER CARD

MARSHALL DATA SYSTEMS
San Marino, Calif.

Add another vendor to the list of those making IBM compatible disc drives of the IBM 2314 variety. This replacement is called the M2800 Disc Storage System, and comprises an M2800 dual mode controller and one or more M2700 single-spindle disc drives. The



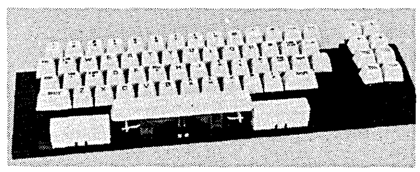
drives use the IBM 2316 11-high disc pack or its equivalent, offering about 29 million bytes per pack with transfer rates of 312,000 bytes/sec. The average access time quoted for the 2700 is 30 msec, which compares very nicely with the 60 msec figure given for the 2314. The price per drive of about $20K (less than $525/month) compares nicely, too.

A full-blown M2800—the controller and nine drives—will lease for $5K/month and sell for $225K. A comparable IBM system is leasing for $5505/month and selling for $249K. For information:

CIRCLE 428 ON READER CARD

MECHANICAL ENTERPRISES, INC.
Alexandria, Va.

A mercury-filled tube forms the switching element in the Mercutronic keyboards. There are no soldered connections or printed circuit boards; the keys press down against an 11-wire cable to make contact. Each key is individually mounted and can be pulled out for quick replacement. The keyboards come standard with 7-line ANSI (plus parity) coding, but can be ordered with any code using up to 10



bits per character. Key configurations are almost unlimited, but, for an example, an ANSI-coded 52 switch set with 8 more keys for control functions and two more for strobe signal inhibit and shift would run $247 for a single unit and about $99 in production quantities. A 10-key BCD numeric could go for as little as $15 in quantities. For information:

CIRCLE 429 ON READER CARD

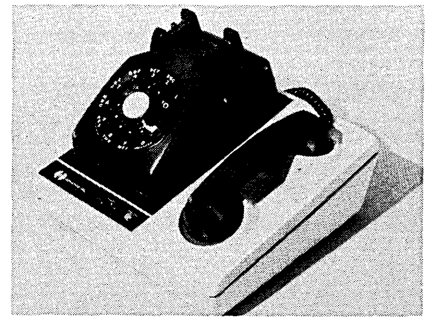
MONITOR DISPLAYS
Fort Washington, Pa.

The new CRT Graphic Terminal 8190, housed in a self-contained desk-style cabinet, displays alphanumeric and graphic pictures on a crt graphics monitor, and features a character generator (10 usec character writing time), vector generator with a resolution of 1:1024, and a writing time of 5 usec per inch, position generator, and crt with settling time of 14 usec. This unit can be interfaced to a display processor or computer interface, computer with refresh memory, cursor movement device (such as light pen, track ball, keyboard), to become an interactive graphics display terminal. Unit price is $19,975. For information:

CIRCLE 430 ON READER CARD

NOVATION, INC.
Tarzana, Calif.

This vendor claims that its DC-102 couplers are as sensitive and immune to noise in an acoustically coupled mode as are the Bell 103A hard-wired data sets. The 102 series is advertised with a sensitivity of -57dBm in a direct coupled mode and -50dBm in acoustically coupled operation. In addition to being sensitive, the sets are versatile. Side by side connectors on the sets allow for attaching both a Teletype and an EIA interface peripheral like a plotter at



the same time. Switches provide for choices of full/half duplex operation and—on the 102AD unit only—for acoustic/direct coupling.

Two models are produced—the 102A which only couples acoustically and sells for $315 and the 102AD which can couple either way and runs $350. OEM pricing is $190 and $215. For information:

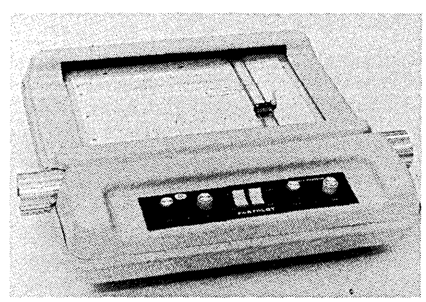
CIRCLE 431 ON READER CARD

Novation is also showing a redesigned and price-dropped Teletype cover which reduces printer noise. Made of molded plastic, the unit comes with a light and automatic fan for $285. A built-in coupler is optional. For information:

CIRCLE 432 ON READER CARD

OMEGA-T SYSTEMS, INC.
Richardson, Texas

This analog plotter can take its inputs from paper tape or directly from a teleprinter keyboard and plot its outputs at 10 ips on paper up to 11x14 inches. Resolution is determined by



the size of the paper used since the Fastplot plotter is capable of dividing the X and Y axes into 1000 increments and moving one increment at a time in any direction. An incremental mode of operation may be selected for either axis, allowing for convenient plotting of quantities that are expressible in set increments like dollar amounts or

Make your own mini computer.

You can build your own mini computer, or you can buy from us. There is no other way to give your system a perfect fit. True, the market has plenty of mini computers. Most are good and have features which seem ideal for a given system. But there is always something wrong. You settle for what is wrong to get what is right. Compromise becomes the rule, not the exception.

We developed the Micro 800 Series to eliminate compromise. Everything is there to choose from. Yet you pay for and receive only what you need. First we saved you money by stripping away all but the essential hardware needed for a dedicated application. Then we gave you versatility by coming up with two unique mini computer features—modularity and microprogramming.

Modularity lets you expand or reduce the core memory from 0 to 32,768 bytes and the ROS from 256 to 1024 words simply by plugging in boards. You can even add five interface boards to the main chassis. Through microprogramming, you can literally design your own proprietary computer. You can define your own instructions, input/output and interrupt capabilities.

A complete software system guides you from flow-charts to symbolic assembly, through interactive simulation to a read only memory map. Just mount the required diodes on a printed circuit board and plug it in. You've optimized a computer for your particular application. That could be anywhere from a hardwired controller to a complete software programmable, macro level, general purpose computer.

Take advantage of the fact that Micro 800 commands are read out of ROS every 220 nanoseconds, permitting execution of up to 4.5 million operations a second. Or that I/O interface and processor oriented functions can be put into firmware to increase performance, minimize hardware, and significantly reduce costs. Develop your own benefits. Be as creative as you like because there is a lot to work with.

If you are in the market for a mini computer, start with the irresistible Micro 800 Series. Prices begin at $3200. Write for details and our application note, "Introduction to Microprogramming." Micro Systems. 644 E. Young Street. Santa Ana, California 92705. Telephone (714) 540-6730.

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A Microdata Subsidiary

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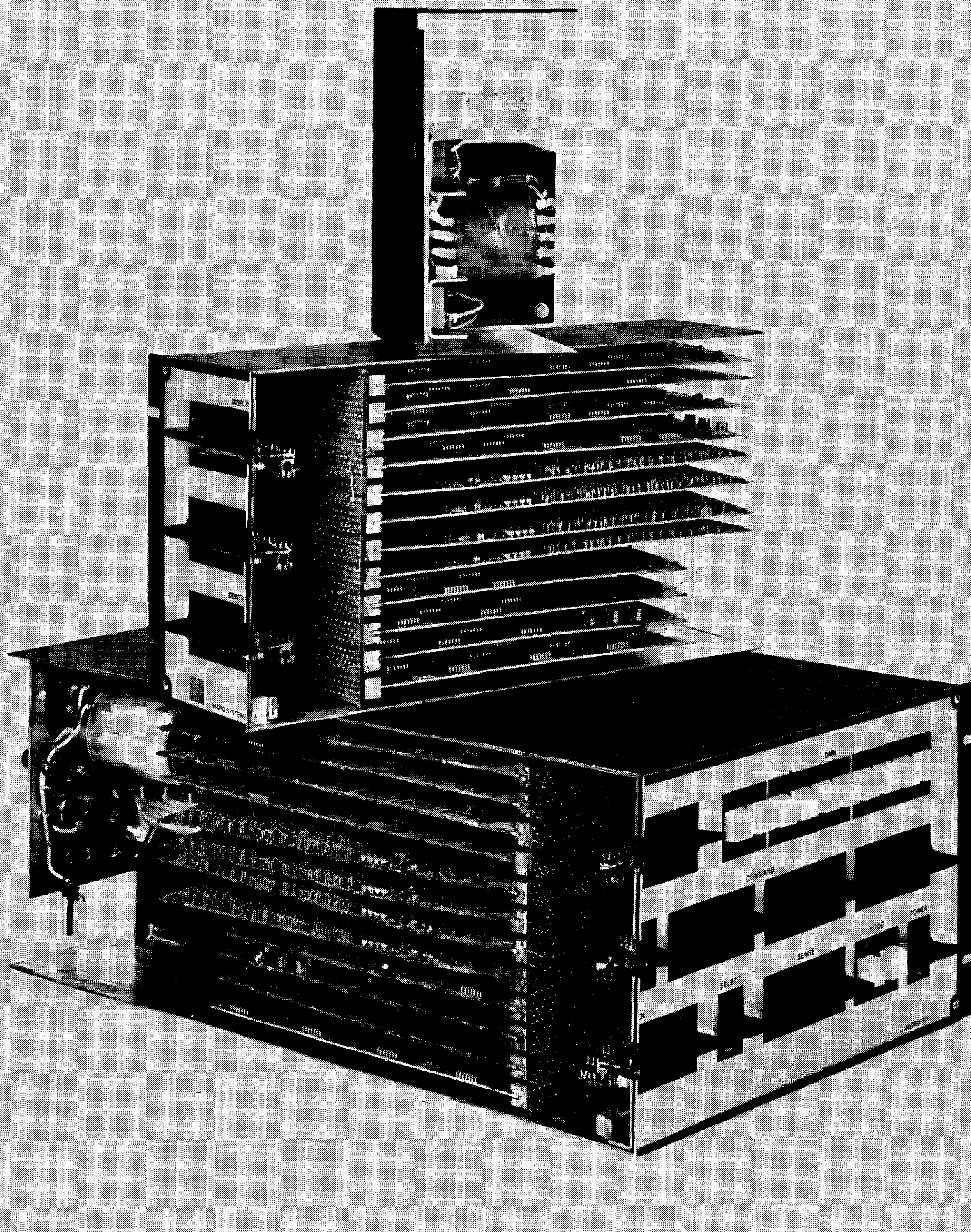


CIRCLE 76 ON READER CARD

months. The Fastplot Analog Plotter is unit priced at $4390, and a paper tape reader is offered as an option. Complete software packages are available on request. For information:

CIRCLE 433 ON READER CARD

PERIPHERAL EQUIPMENT CORP.
Chatsworth, Calif.

Designed to interface controllers with low-speed tape drives, these electronics packages are called formatters by their manufacturer. Two kinds are made—one to work with tapes recorded at up to 800 bpi and one to work with 1600 bpi tapes. The 800 bpi formatter can handle up to four 7-track or 9-track tape units at any two of three basic densities (200, 556, and 800 bpi) simultaneously, at one of several speeds (12.5, 18.75, 25, or 37.5 ips, corresponding to this vendor's product line). Transfer rates can be from 2.5K bps to 30K bps.

The 1600 formatters handle up to four 9-track tapes at speeds from 12.5 to 37 ips and character transfer rates from 20 to 60K bps. Prices range from $1000 to $1200 for the 800 bpi maximum versions, and from $2000 to $3000 for the 1600 bpi models. For information:

CIRCLE 435 ON READER CARD

PERIPHERALS GENERAL, INC.
Cherry Hill, New Jersey

The 816/716 disc storage system consists of a controller (the 816 part) and one or two disc drives (Model 716). The 716 uses the 1316 disc pack and is

plug-for-plug compatible with the 2311. It employs a hydraulic head positioning mechanism, and transfer rates are quoted at 156KC (8-bit bytes). The controller with one drive will sell for under $25K in unit quantities. For information:

CIRCLE 436 ON READER CARD

Also to be introduced at SJCC is the Model 700 disc drive exerciser. The portable test unit is designed for use with all 2311-compatible drives and some drives using the 2316 disc pack. Primary applications are in check-out procedures during production; to test and exercise the disc drive unit prior to on-line operation; and for field service as an aid in trouble shooting of seek, read, or write problems . . . DSD malfunctions can be localized without suspension of data processing. The 700 has no data verification capability; a cpu must be used to meet this requirement. The 700 is priced at $2500. For information:

CIRCLE 437 ON READER CARD

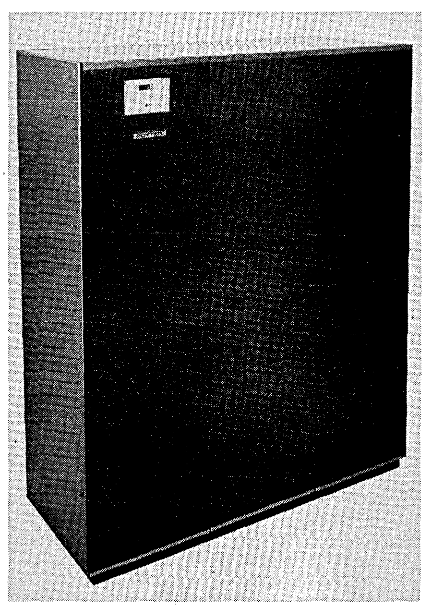
PENRIL DATA COMMUNICATIONS, INC.
Rockville, Md.

Automatic equalization is the prime feature of the PDC 4800 B Data Set. It is designed to work with Series 3002-C2 conditioned lines and handle synchronous data at 4800 bps. Standard interface for the unit is EIA RS-232C. As an option the PDC 4800 B can be supplied with four-knob manual equalization. The price per unit in small quantities is $3500. For information:

CIRCLE 434 ON READER CARD

POTTER INSTRUMENT CO.
Plainview, N.Y.

Until IBM starts building its peripheral controllers into the central processor or channel boxes, peripheral suppliers are going to have a field day making disc controllers or tape transport controllers like the Model TC 5803. Reportedly built for using Potter tape



drives on 360 series machines, the 5803 sounds like a direct replacement. It can operate up to eight (16 optionally) tape drives in either NRZI or phase-encoded format. Options are included for data conversion (which allows for reading 8-bit bytes with a 7-track head by throwing out the parity bit), for data translation, and simultaneous read/write. The controller will be priced at approximately $50,000; deliveries are expected to be late 1970. For information:

CIRCLE 438 ON READER CARD

PRENTICE ELECTRONICS CORP.
Palo Alto, Calif.

The prices for some acoustic couplers can be staggering when all the options are included; not so for the DC-22, a device that runs $298 with everything. Everything includes full/half duplex operation, originate / send modes, acoustic / magnetic / direct coupling (for the Data Access Arrangement), and the appropriate interface for Teletype or EIA terminals. Pushbuttons are provided for switching into the most common operating modes; straps for the selection of other modes or for controlling DAA levels are built into the base. The DC-22 is available from stock, and additional discounts are provided for OEM customers. Its plastic case has separate power and carrier indicators. For information:

CIRCLE 439 ON READER CARD

PRINCETON ELECTRONIC PRODUCTS, INC.
North Brunswick, N.J.

The 400 is a Video/Graphic Storage Terminal. It is built around a silicon image storage tube called the Lithicon, which is capable of storing an 800-line or 1200-line video or x-y image. (The Lithicon is not a crt screen size tube, but a 7-inch-long cylinder. In the Model 400 it is used to accept video or analog x-y position data and produce a 525- or 1029-line raster scan readout.) Basically, the terminal is intended for storing and generating graphics, for storing tv images, and for facsimile transmission scanning. Single unit prices for the 800-line and 1200-line versions are $3750 and $4250. For information:

CIRCLE 440 ON READER CARD

REDCOR CORPORATION
Woodland Hills, Calif.

Two MOS/LSI test systems will be introduced: MOS Memory Tester (MMT), and Programmable Automatic Function Tester (PAFT II). Both incorporate a 4K Redcor RC 70 digital computer as the control unit.

PAFT II performs functional and

The Tektronix T4002
graphic computer terminal

Displays high-resolution graphics and alphanumerics
Brings computer access to your desk
Retains the display without high-cost refreshing
Features a Line-Buffer Edit Area on the CRT

When you face the difficult, time-consuming task of analyzing reams of alphanumeric computer print outs, think of *graphics.* Graphics is a format which lends itself to quick, easy, more accurate and complete analysis of data. Don't hamper your decision-making process with reams of alphanumeric print outs when the same data is retrievable faster and easier in clear, concise *graphics.*

The T4002 brings the benefits of local or remote computers to you on an individual basis, in the office, laboratory, production area, or wherever GRAPHIC and alphanumeric computer support serves you best!

The display device of the T4002 is the Direct-View Bistable Storage CRT designed, developed, and manufactured by Tektronix. A few of the more important features of this unique storage CRT are zero flicker, zero drift, and a density of 39 lines of 85 characters each. But most significantly, it retains displays without costly refreshing.

The T4002 saves Central Processing Unit time through operator use of the Line-Buffer Edit Area, where you edit, compose, erase, retype, verify, or delete. Compose a line of data in the Line-Buffer Area; then transmit it at your maximum baud rate, rather than at the slow manual keyboard rate.

Alphanumeric outputs are displayed at an average rate of 2000 characters per second. Graphic outputs are by any of three programmable modes: Point plot, incremental plot and linear interpolation. The linear interpolate mode draws absolutely addressed vectors in 10 ms or less.

Tektronix has 57 domestic offices located in major cities throughout the United States and 48 foreign offices. For a demonstration or additional information, contact your local office directly. Or call (301) 825-9000 Baltimore; (617) 894-4550 Boston; (415) 326-8500 Palo Alto; or write Tektronix, Inc., P. O. Box 500, Beaverton, Oregon 97005.

T4002 Graphic Computer Terminal $8,800
U.S. Sales Price FOB Beaverton, Oregon

Call today for a demonstration of the T4002.

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committed to technical excellence

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CIRCLE 145 ON READER CARD

parametric tests on MOS/LSI devices by generating, under computer control, program-selectable clocks, strobes, I/O patterns and voltage levels that automatically execute pass/fail tests on a given device under test (DUT). If a device fails, its failure is shown on a panel indicator. Optionally, the channel number and test number can be listed at the operator's console. There are no complicated operator controls to monitor.

In addition to the RC 70, system components include up to 64 data and power channels (32 is standard) capable of transmitting or receiving 200-, 400-, or 800-bit word patterns to/from the DUT; d/a converters; a four-phase clock system (ranging from 10Hz to 2MHZ); two programmable strobe control channels; comparators; 300 cps paper tape reader for entering test programs; Mod 33 or 35 Teletype for operator interface with the system; and computer-programmable power supplies.

Software includes TEST (Test-oriented Engineering Symbolic Translator) that allows the technician to write test routines on-line in the easy-to-use, problem-oriented TEST language. The other standard software includes a single-pass symbolic processor that produces either absolute or relocatable code; a single-pass FORTRAN IV compiler; a math subroutine library; program utility package—paper tape edit program, debugging package, loaders, tape copy/verify program; and a three-pass assembler that allows PAFT II programs to be assembled on an IBM 360. This system is selling for $150K. For information:

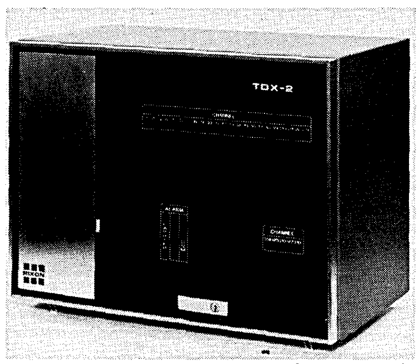
CIRCLE 441 ON READER CARD

The MOS Memory Tester is built for both manufacturers and users of MOS/LSI devices. Manufacturers can use it for testing MOS arrays, shift registers, and memory elements at any point during production or quality assurance testing. Users of MOS/LSI memory devices can perform incoming acceptance tests; MMT addresses memory and inputs data at frequencies up to 5 MHZ, allowing MOS devices to be tested at their rated speeds. All test system variables are under computer program control. System components include the RC 70 (which can control up to five test systems), a clocking subsystem, addressing subsystem, read/write control subsystem, d/a converters, comparators, paper tape reader, and Mod 33 or 35 Teletype. Software is the same as in the PAFT II system—test package, assembler, FORTRAN IV compiler, math subroutines library, utility package, and three-pass assembler. Purchase price of MMT is $45K. For information:

CIRCLE 442 ON READER CARD

RIXON ELECTRONICS, INC.
Silver Spring, Md.

The TDX-2 time division multiplexor can handle up to 88 channels with speeds of 110, 135, 150, or 300 bps intermixed. The unit is data transparent, and will transmit all combinations of 7- and 8-bit characters. The set has a diagnostic panel under its brushed aluminum door that provides status and data quality indicators. High speed modems (to 9600 bps) can be built in if desired. Optional multipoint and contention features



permit multisite sharing of line facilities without demultiplexing and remultiplexing at intermediate points. The 28-channel unit shown has a built-in 4800 baud modem and can handle line speeds of 110, 135, and 150 baud. Its purchase price is $12,500. Changing it to accommodate a different set of line speeds entails only the replacement of a few cards (one per line). For information:

CIRCLE 443 ON READER CARD

The Series FM-3 and FM-18B frequency division multiplexors will be marketed with as many or as few modem functions as desired. They can be used in two-wire or four-wire systems and can be provided with the standard EIA RS 232B/C, or with the mil spec 188B, or direct logic level interfaces. Their fully optioned unit price is about $200. The sets operate at speeds to 1800 baud and are primarily one-card units. For information:

CIRCLE 444 ON READER CARD

SCAN-OPTICS, INC.
E. Hartford, Conn.

First product of a year-old firm is the 20/20, an off-line optical scanner capable of handling both pages and documents, making it ideal for applications which require the processing of data from multiple input sources. The basic system includes a page and document handler, scanner, Hewlett-Packard 2114A cpu, 7- or 9-track magnetic tape transport, and an I/O typewriter.

Systems software includes editing, formatting, and error control functions. General purpose software (which will be in a higher level language) will facilitate error checking techniques, such as check digits and batch totals, and have provisions for selective verification by retyping or rewriting of data on the same page by a different person.

The 20/20 accepts page sizes from 3x4½ to 9x14 inches, and documents are handled without modification. Reading speed is up to 2000 cps. Input formatting is under program control and a maximum of 80 characters per line (10 cpi) may be handled. There can be up to six lines per inch. Free and fixed formats are accommodated in the same scanner pass. The system reads upper and lower case alphanumerics, punctuation, and symbols. Fonts available include: OCR A, 1403, IBM 407E, and self-check 7B and 12E. Other fonts and hand-printed numerics are optionally available. Delivery requires nine months ARO. Price is $100K. For information:

CIRCLE 445 ON READER CARD

SHEPARD DIV.,
VOGUE INSTRUMENT CORP.
Richmond Hill, N.Y.

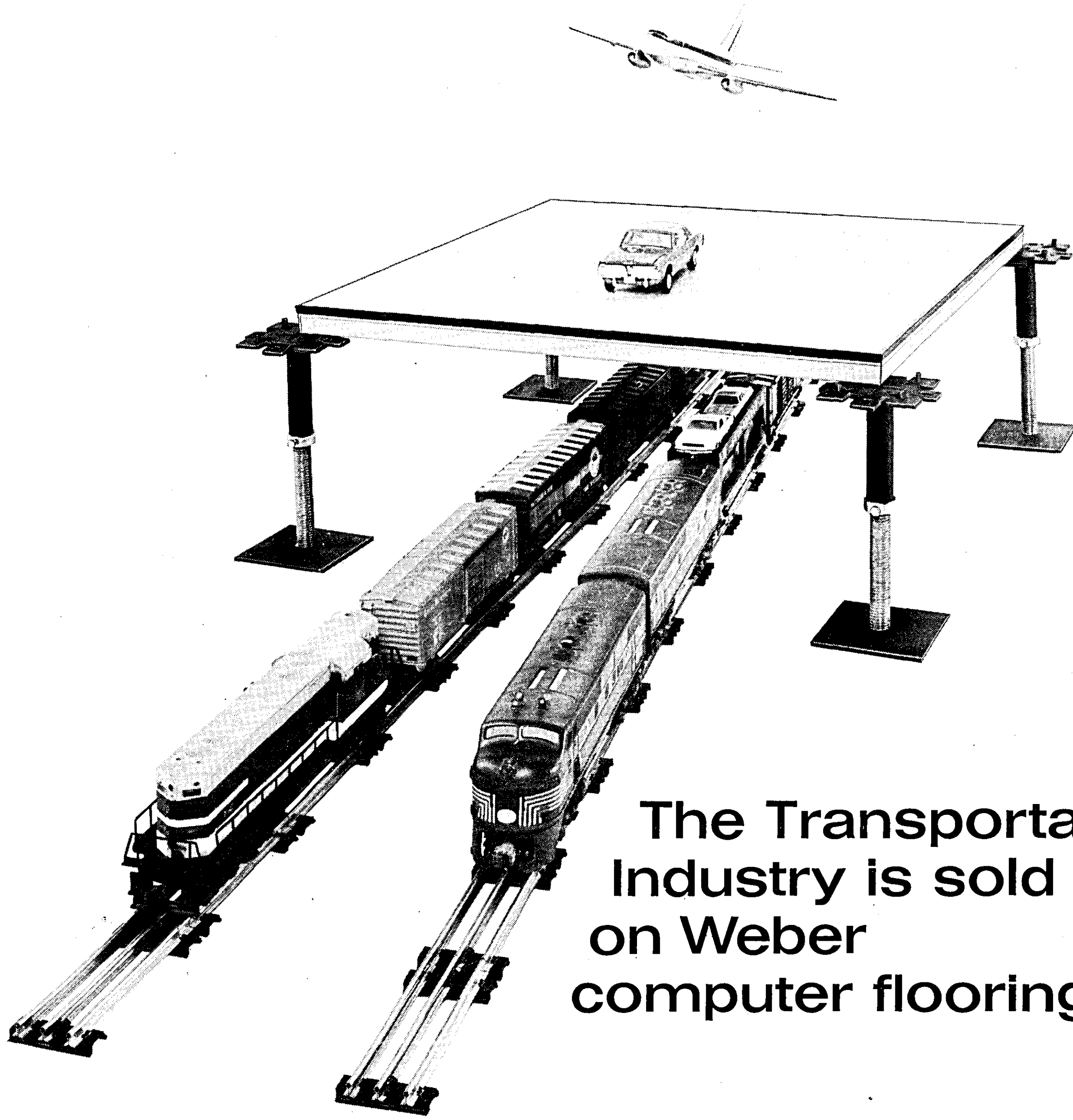
The 880D line printer features built-in interface to the PDP-8, H-P 2116, Varian 620/i, and Honeywell 316, 516 minicomputers. It prints 80 columns wide at speeds to 400 lpm. The printing mechanism uses an ink roller, tractor feed sprocketed multi-copy paper capability, and full line buffer memory. Price is $7600 including interface. Without interface, $6800. For information:

CIRCLE 481 ON READER CARD

STORAGE TECHNOLOGY CORP.
Boulder, Colorado

This company's initial products are four basic models of mag tape subsystems. The systems are plug-to-plug compatible with IBM equipment and are designed for use with 360/30's and up. All models feature cartridge loading, automatic threading, single capstan drive, on-line service, 60-second rewind time, and modular construction.

Model ST2430 is a 112.5 ips NRZI unit with a 90KC data rate and 800 bpi density. Phase encoding at 1600 bpi with automatic gain control will be offered as an option. Model ST2450 is a 1600 bpi phase encoded unit with a 100 ips tape speed and 160KC data rate. ST2460 is a 112.5 ips model with



There's an exciting whisper in EDP circles...

What's the message?

The new Hazeltine 1760
Desk Top Display Terminal is available.

Hazeltine 1760

Stand-Alone Desk Top Display

Hazeltine and the Pursuit of Excellence

Why a whisper?

With Hazeltine quality, production, and service, there's no need to shout.

Not the first on the market, but the first of its kind, the HAZELTINE 1760 Display Terminal offers flexibility and a combination of work-saving features that make it unique. Having surveyed the terminal market for the features valued most, Hazeltine applied its widely acknowledged expertise in CRT displays to the design of a display terminal that would meet all on-line systems needs.

The result is a CRT terminal which combines the most desirable capabilities with compact size, fast operating speed and low cost. The 1760, named for the number of its displayable characters, has flexible configuration, split-screen format, extensive editing capability including character or line insert and delete, programmable tabulation and a computer addressable cursor. The 1760 has an offline formatting facility (with consequent cost saving) and is fully interactive. The HAZELTINE 1760 Desk Top Display is designed for problem-free operation and interface with magnetic tape and hard copy devices and is completely human-engineered for ease of operation, long life, plug-in installation, and viewing clarity.

Why wait 'til the whisper becomes a roar?
Contact us for a demonstration of the new HAZELTINE 1760

Hazeltine Corporation

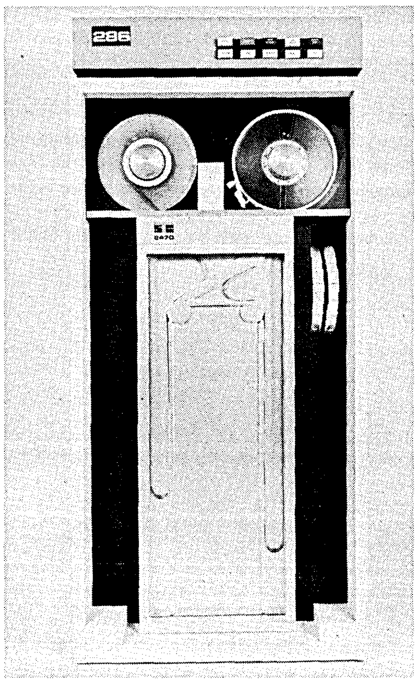
INDUSTRIAL PRODUCTS DIVISION
LITTLE NECK, NEW YORK 11362
(AREA CODE 212) 321-2300

See the HAZELTINE 1760 in action in our booth at the 1970 Spring Joint Computer Conference, Atlantic City—May 5, 6, 7.

CIRCLE 103 ON READER CARD

a 180KC data rate. It is offered in both 800 and 1600 bpi densities with NRZI or phase encoded formats. Top of the line is the ST2470, a 200 ips, 1600 bpi phase encoded unit with a 320KC data rate.

Lease prices will range from $505/-



month to $850/month for the four systems, and purchase prices will range from $24K-$40K. STC will also offer their products to OEM's. For information:

CIRCLE 446 ON READER CARD

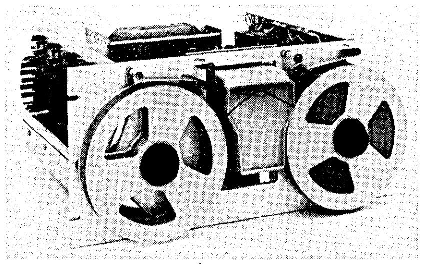
SONEX
Philadelphia, Pa.

The I/Onex Model 30 acoustic coupler will operate up to 300 baud in either half or full duplex. Loop current, EIA and IC logic interfaces are standard. All frequencies and levels are compatible with the Bell 103 Data Sets. A switch is provided to permit operation over any unconditioned two-wire system such as the Bell Data Access Arrangement. The units are available in mahogany or walnut finish and cost under $300. For information:

CIRCLE 315 ON READER CARD

TALLY CORP.
Seattle, Wash.

Paper tape is not dead. It may not even be sick. Witness the raft of equipment being currently introduced, like the R-5000 bidirectional tape reader. It is good for 500 cps reading synchronously; 300 asynchronously. It handles 750-foot reels and rewinds at

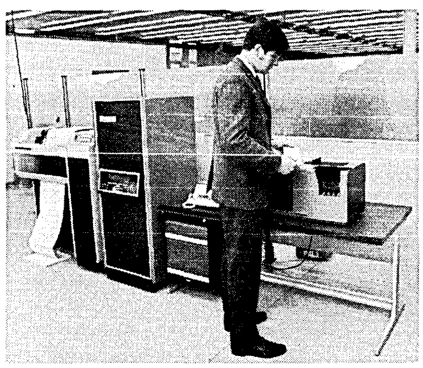


120 ips. Its price is in the neighborhood of $1500. For information:

CIRCLE 447 ON READER CARD

TEC, INC.
Minneapolis, Minn.

Remote batching is the order of the day with the advent of the 520-40 RJE terminal. The system comprises a 400 cpm card reader, 300 lpm 132-column line printer, an operator control panel, a synchronous or asynchronous serial communication interface, and the programmed controller. Obviously enough the unit is directed at the IBM 2780 terminal market. If offers, however, better performance and lower cost. For instance, a $900/month version of the 2780 delivers a 240 lpm 80-column printer and a 400 cpm card reader and a 2000 or 2400 bps communications channel. The 520-40—which has soft-



ware for simulating the 2780—sells for $29,400 (compared to about $40,000) and can handle line speeds from 110 to 9600 baud, asynchronous or synchronous.

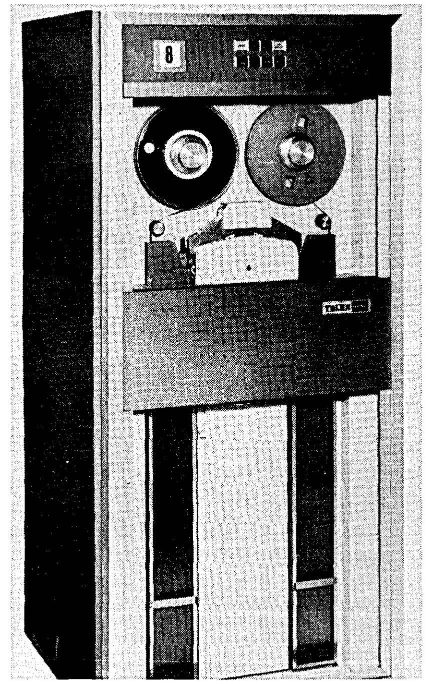
The standard code for the machine is ANSI; but EBCDIC, Transcode, and others are available. Also available are a card punch, crt displays, keyboards, and other peripherals. For information:

CIRCLE 448 ON READER CARD

TELEX CORP.
Tulsa, Okla.

The Series 4852 and 4862 tape transports are designed to be plug-in replacements for IBM 729 and 2401 drives. In all particulars they are identical with their IBM counterparts (except that the 4852 features a power window, unlike the IBM 729's). Telex is claiming a "first" in its development of the 4862 replacement for the dual-density 2401 (which operates at 800 bpi NRZI and at 1600 bpi phase-encoded).

The big differences are supposed to be in price. While IBM 729 rentals start at $700/month plus extra use plus maintenance, the 4852 leases for $480 month period, and sells for

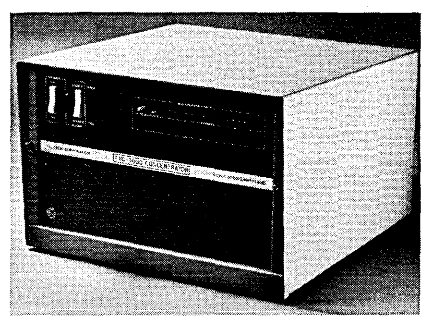


$19,900. The 4862 leases for $540/-month, again including the seven-day 24-hour maintenance and with no extra charge for extra use, and sells for $25,170. For information:

CIRCLE 449 ON READER CARD

TEL-TECH CORPORATION
Silver Spring, Md.

The TT-201 data set is a four-phase synchronous modem that transmits and receives binary serial data at rates



up to 2400 bps. Two models are offered: one (2400 bps) is compatible with Bell 201B; the other (2000 bps) with Bell 201A. The TT-201 is available as either a card set, mounted in a rack, or in a desk-top cabinet. It is unit-priced at $1800. For information:

CIRCLE 450 ON READER CARD

Tel-Tech's TTC-3000 concentrator is a time-division, bit-interleaved multiplexor that transmits multiple, independent data streams simultaneously over a single voice grade telephone circuit. It offers multipoint capabilities with full contention, and immunity to terminal disconnect. Expansion (as few as two channels at a time) is achieved by plugging in additional channel cards. Different remote terminal I/O speeds can be intermixed. All interfaces are standard EIA RS 232B. The unit can have two to 38 channels, and data input speeds of 110, 135, 150 or 300 bps (standard). A 10-channel unit with a mix of line speeds would typically run about $4000. For information:

CIRCLE 451 ON READER CARD

TETRA CORPORATION
Minneapolis, Minn.

The Alpha 10.3 and 12.4 offer capacities ranging from 3K-48K and 12K-320K bits, respectively. The 10.3 has a price range of $600 to $1090 for capacities from 256 x 12 to 1024 x 12. Expansion in modules is available in 24-, 36-, and 48-bit increments. Cycle time of the 10.3 is 1.5 usec; the 12.4 has a 1.75 usec cycle time. The 12.4 is priced from $1300-$2200 and comes in capacities of 4K x 12 to 20 bits down to 1K x 12 to 20 bits. Expansion is available to 24 up to 80 bits/words. The systems come with control logic, address register and data register. Plug-in board exchange makes maintenance a three-minute job. All semiconductors are silicon; no plastic packages are used. For information:

CIRCLE 452 ON READER CARD

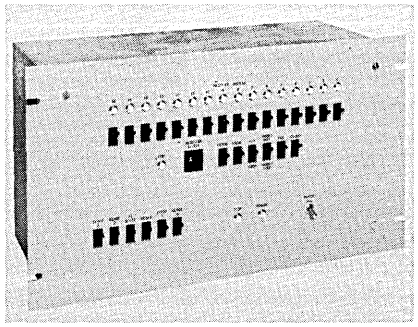
TIMEPLEX, INC.
Norwood, N.J.

The Timeplex Computer Calling Accessory is an automatic calling unit that permits a computer to dial local or long distance telephone calls through any dial-up network. It will work with any EIA RS-366 interface (on such units as the IBM 2701, 2702 or 2703) and with EIA RS-232 interfaces if at least two duplex control signals are available. It can also interface with any time division multiplexor capable of transmitting two or more duplex control functions. Connection to the telephone line is through a Bell System F-58118 data coupler and interface with a 103-type modem. First shipments are scheduled for July. Price of the unit is $2500. For information:

CIRCLE 453 ON READER CARD

VARISYSTEMS CORP.
Plainview, N.Y.

First product of this new firm is the PAC-16 Programmable Adaptable Controller, a byte-oriented minicomputer designed to be easily adaptable to system interfacing requirements. Each instruction is stored in two 8-bit bytes, providing an instruction length of 16 bits. The operation code portion of the



memory referencing instruction requires only 4 bits, leaving 12 bits for addressing. As a result, bytes may be referenced directly, without recourse to paging. Speed for memory referenced instructions is 3 usec, for I/O instructions, 4 usec. I/O capability includes two interrupt lines, six sense lines (18 optional), eight bidirectional data lines, four programmable sequential timing pulses, and an optional direct memory access channel.

Circuitry is MSI, dual in-line TTL IC's, mounted in wire-wrapped sockets. Memory is either 1K or 4K bytes. Software consists of the PAC assembler, which is assembled on the Univac 1108, and maintenance diagnostics which provide performance test and fault isolation when used in conjunction with front panel controls and indicators.

Interfaces available are for: CDC 9420 and 9432 disc drives, Invac 60 cps paper tape reader, GE PTR-70, TTY BPRE-110 tape punch. Price is $3,000 with 1K memory, $3850 with 4K. Delivery requires 30 days ARO. For information:

CIRCLE 454 ON READER CARD

VERSATEC, INC.
Cupertino, Calif.

Six electrostatic printers and plotters are offered for mini- and midicomputer users for communications applications using fast—2400 or 4800 baud—lines, and for pulling hard copies of crt images from crt terminals. The models unveiled are the 100, 100A, 200, 200A, 300 and 600. They make up the Matrix series.

The Matrix 300 and Matrix 600 are 300 lpm (or 400 cps) and 600 lpm (equivalent to 800 cps) and 80-column printers. Input alphanumerics are accepted in a variety of codes, including ANSI, in either serial or parallel transmissions, synchronously or asynchronously. From it, 5x7 dot matrix characters are formed on 8½ inch paper. These units are priced at $5500 and $6700, respectively.

The 100 and 200 are graphic output devices which use 7¾ inches of the 8½ inch paper for their drawing area and produce alpha and graphic output. Inputs are accepted in 70-byte chunks, either in serial or parallel form. The paper may be driven synchronously or asynchronously at speeds to 120 or 240 steps per sec. The 100 runs $5900; the 200 goes for $6500.

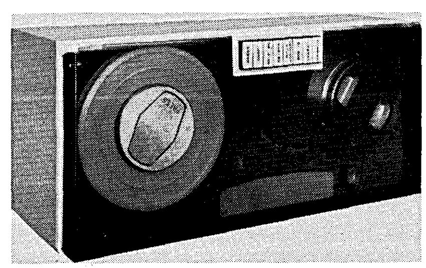
The 100A is a combination of the Matrix 300 and Matrix 100. It accepts two inputs, forming its alpha characters using read only memory. Its selling price is $7300. The 200A similarly combines the 600 and the 200 and sells for $7900.

Also to be demonstrated is the "Multiplus" system for distributing printed matter through multiple printer slave terminals. Each system will be based on one of the Matrix printers and several less expensive repeaters, which may be controlled by the master or by a central computer. All of the Matrix units are available for June shipments; delivery schedules for the Multiplus systems are quoted on request. For information:

CIRCLE 455 ON READER CARD

WANG COMPUTER PRODUCTS, INC.
Los Angeles, Calif.

For $2210 a user with a need for tape storage and no big requirement for high speeds can have a tape drive that will interface with almost any con-



troller made, according to this vendor. The Mod 7 magnetic tape drive has, in addition to this almost universal interface, the capacity to handle either 7-track or 9-track tapes (as a standard option), and a transfer rate of about 20KC with maximum packing density.

Models are available for 9-track tapes using either 800 bpi or 1600 bpi packing, or for 7-track tapes using dual densities (choose either 800 and 556 bpi or 556 and 200 bpi). All of the models use 7-inch reels and are the right size for rack mounting. For information:

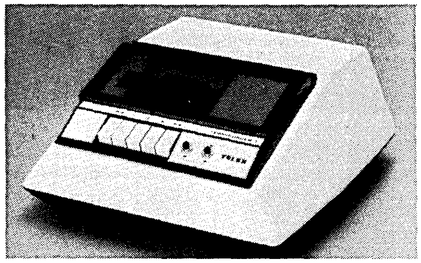
CIRCLE 456 ON READER CARD

WESTERN INSTRUMENTS
Tulsa, Okla.

This cassette tape drive is designed to be a memory subsystem for remote

CIRCLE 5 ON READER CARD

terminals. It is aimed squarely at the OEM marketplace, and its price varies



drastically with quantity, ranging from $900 to $300. It can be ordered fully interfaced or as a basic deck with either incremental write/continuous read, or synchronous read/write. When fully interfaced, the Termicorders are available with up to six read/-write rates for parallel or serial transmissions. For information:

CIRCLE 460 ON READER CARD

WEISMANTEL ASSOC. INC.
Philadelphia, Pa.

This manufacturer is relatively unknown, a newcomer to the data processing scene, yet has three large-scale products to show at its coming out party. One is a large-scale 16-bit computer. Sound like a misnomer? It isn't, considering that the machines, the Waicom-16s, are considered by their manufacturer to be in the Sigma 7 class and are expected to sell in the $100,000 range with few peripherals attached. They are built for time-sharing and have many fast I/O features, including a 500 nsec memory and a four million word/sec ("maximum possible") data transfer rate in the single-processor configuration.

When configured strictly for communications purposes, the W-16 can terminate 256 lines (360 through remote multiplexing). Called the 16C in this version, the machine is compared with the Comcet 80, and can act as a stand alone or front-end another W-16. When two cpu's, the 16 and 16C, are joined, they can share memory and peripherals. For information:

CIRCLE 457 ON READER CARD

Product Two is a remote communications concentrator labeled the RCC which can multiplex up to 32 low speed lines onto a 4800 baud circuit (or other combinations of low and medium speed lines adding to the 4.8 kilobit total). At the central site it can act as a demultiplexer, and is invisible to the computer and terminals in either application. It is priced at $15,200 and can be delivered in six months. For information:

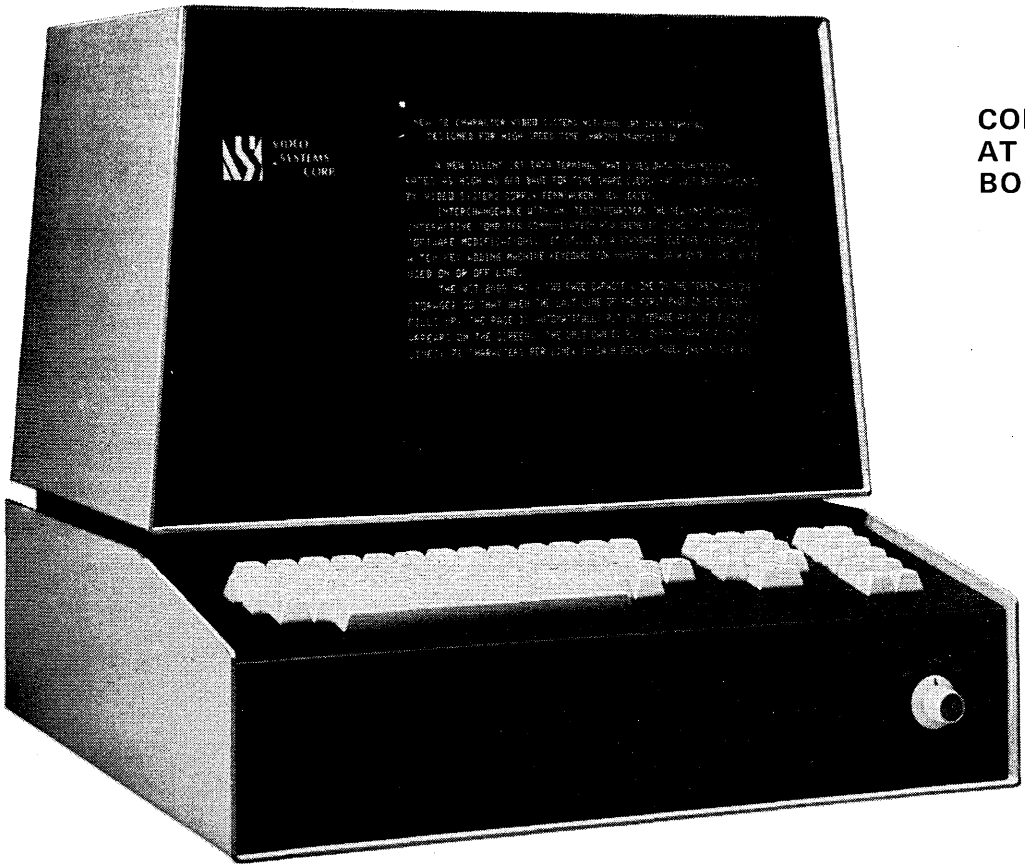
CIRCLE 458 ON READER CARD

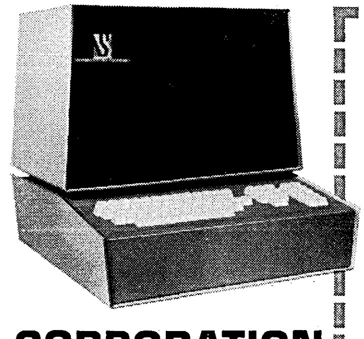
Third product is a line of large-scale memory systems, replacements for original equipment IBM 360/65, 360/75, and Univac 494 or 1108 systems. Sold in chunks of 256K bytes or 64K words, the Swift Memories have a cycle time of 750 nsec and are plug compatible with the original equipment. Each type performs 8-byte fetches. Delivery time is now set at six months. The 1108 cores will be shipped beginning in June, the 360 stuff beginning in the fall. Prices, in the $300,000 range, are claimed to be a $100,000 savings. For information:

CIRCLE 459 ON READER CARD

added attractions

Advanced Memory Systems will show their big, fast semiconductor memory, the SSU, scheduled for delivery in the fourth quarter of this year. . . . **American Data Systems** is introducing the ADS-900 Communications Control system that can act as a front end communications controller, an intelligent remote satellite, or a data switching controller. . . . A portable crt/keyboard terminal in an attache case will be exhibited by **Applied Digital Data Systems.** While details were unavailable at editorial deadline, rumor has it that they've got an ad somewhere in this issue. . . . **Auerbach Info** will announce the availability of Software Reports, an encyclopedic reference to the proprietary software industry. The reports will be offered as a full looseleaf service or in individual volumes covering specific fields. . . . A microfiche camera option to the Beta COM 600 will be demonstrated by **Beta Instrument Corp.** It allows the system to print 16, 35, 70 and 105mm film. Several software packages will also be introduced. . . . **Compat Corp.** will unveil another remote batch terminal, featuring 256K character storage from four Compat tape magazines, a high speed line printer, multiple input stations, and a stored program controller. . . . The Video System Utilization Monitor, to be shown by **Computer Synetics**, monitors the utilization of five computing system functions, and by logically combining these, televises a picture of eight system functions in the form of a dynamic histogram. Its $2750 selling price is said to make VSUM the lowest priced equipment that does real-time utilization work. . . . The DyneMaCC 90 Multi-Access Communications Controller, a product of **Dynelec Systems Corp.**, is adaptable to I/O channels of all major computers, emulating standard peripheral devices. Both hardware and software is modular, allowing the system to take over a few or all the communications functions of the cpu. . . . **Eastman Kodak** has added a Unit Record Adapter to its Recordak Motormatic Reader that extends its use to microfiche and jacket microfilm. Kodak will also show its Viscomat Model 36 film processor made for taking cartridges from COM units for daylight processing. . . . **Ferroxcube** is introducing the FI-4, a 1-usec core memory system with capacity of 4K to 8K words of up to 40 bits and a 390 nsec access time. . . . **General Automation**, which had been expected to show the SPC-16 minicomputer at 1969 FJCC, has promised now to exhibit it here. . . . **International Data Sciences** will be introducing a key-to-tape data entry station known at press time only as Product X. They will also be showing Model 510 Pseudo-Noise Transmission Test Set, a transmit only unit used to check out both synchronous and asynchronous data links . . . **Litton's DATALOG Div.** showing the MC 1000, a 65 cps nonimpact strip printer designed for OEM's; and the MC 3000 Digital Teleprinter, a 3000 lpm nonimpact page printer. . . . Photon's two printers—the off-line 7700 and the 7445 which will be both an off-line as well as a terminal device—produce completely formatted pages on phototypesetting paper, film, or directly on offset masters, ready for production run by any printing process. They will be exhibited by **Management Assistance Inc.,** who will market the units. . . . **Memorex** is announcing the Model 1240 communications terminal that features printing speeds of 30 and 60 cps. . . . **Motorola Instrumentation and Control Inc.** is introducing a device that interfaces the Motorola MDR-8000 document reader with the IBM 029 keypunch. The interface provides transfer of pencilled mark sense data to punched cards for entering mark sense data directly into IBM mainframe computers. . . . **Nortronics Co.** is showing their new line of 7- and 9-channel IBM-compatible digital magnetic heads. . . . **3M Company** is demonstrating "Page Search," which is incorporated into its 400 series of reader-printers so that selection of a specific microfilm frame can be made by punching up the numbers on a keyboard. Also being shown is Executive I, a reader-printer that produces 8½x11-inch prints in 30 seconds from microfilmed images. . . . **Victor Comptometer** will spotlight its Series 800 computer line in demonstrations of on-line terminals, data collection systems, inventory control, accounting and billing. The terminals will be on-line to larger computers. . . . **Xerox's** newest product is the 7000 Reduction Duplicator which can copy computer output and reduce it to 8½x11-inch format in a single operation at a speed of 60 copies/minute. ■





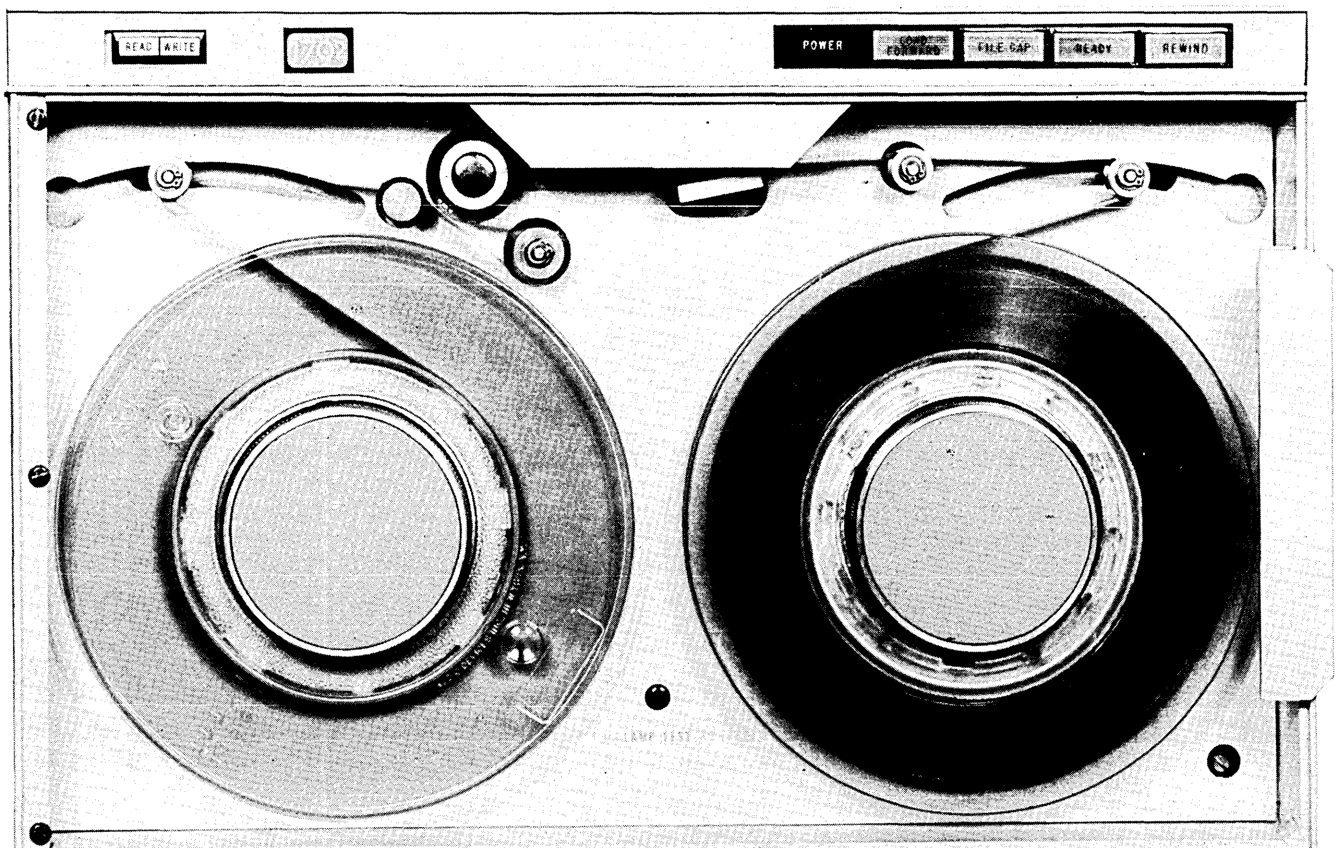
1702

From the TDS 1700 line......
Now... the TDS-1702 synchronous recorder

The TDS-1702 has a wider operating range than comparable competitive models—at a lower price. The TDS-1702 reads and writes synchronously from 4 to 37-1/2 IPS in System 360 7 or 9 track formats of 556 or 800 BPI with parity generation and checking. Skew and jitter performance are specified to provide sufficient accuracy to enable playback of 1702-written tapes on conventional large vacuum-column tape drives. System performance capability is verified by final computer system checkout of individual units.

Read-after-write and cyclic redundancy checking (CRC) are available in the TDS-1702 optionally.

SJCC BOOTH 26009-26012 CONVENTION HALL



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CIRCEL 106 ON READER CARD

1970 SJCC SESSIONS AT A GLANCE

			BALLROOM	ROOM HJ	ROOM FG	HOLIDAY INN	ROOM 20
MAY 5	TUESDAY	AFTERNOON	1. GRAPHICS—TELLING IT LIKE IT IS (Paper/Panel)	2. THE PATENT RAMIFICATIONS OF PROGRAM PROCESS INVENTIONS (Panel)	3. MULTIPROCESSORS FOR MILITARY SYSTEMS (Panel)	4. THE INFORMATION UTILITY AND SOCIAL CHOICE (Panel)	5. SIMULATION IN EDUCATION (Panel)
MAY 5	TUESDAY	AFTERNOON	(cont.)	6. PROGRAM TRANSFERABILITY (Panel)	7. COMPUTING IN STATE GOVERNMENT (Panel)	8. MICROPROGRAMMING (Paper/Panel)	9. AUTOMATA THEORY (Paper)
MAY 6	WEDNESDAY	MORNING	10. OPERATING SYSTEMS (Paper)	11. INFORMATION MANAGEMENT SYSTEMS—FOUNDATION AND FUTURE (Paper/Panel)	12. LESSONS OF THE SIXTIES (Panel)	13. ARTIFICIAL INTELLIGENCE (Paper)	14. COMPUTERS IN EDUCATION: MECHANIZING HUMANS OR HUMANIZING MACHINES (Panel)
MAY 6	WEDNESDAY	AFTERNOON	15. PROPRIETARY SOFTWARE IN THE '70's (Panel)	16. HUMANITIES (Paper/Panel)	17. DIGITAL SIMULATION APPLICATIONS (Paper)	18. SYSTEM ARCHITECTURE (Paper)	19. NUMERICAL ANALYSIS (Paper)
MAY 6	WEDNESDAY	AFTERNOON	20. SON OF SEPARATE PRICING (Panel)	21. SOCIAL IMPLICATIONS (Panel)	(cont.)	22. COMPUTER SYSTEM MODELING & ANALYSIS (Paper/Panel)	23. MEDICAL-DENTAL APPLICATIONS (Paper)
MAY 7	THURSDAY	MORNING	24. PROGRAMMING LANGUAGES (Paper)	25. RESOURCE SHARING COMPUTER NETWORKS (Paper)	26. MINICOMPUTERS—THE PROFILE OF TOMORROW'S COMPONENTS (Paper/Panel)	27. REQUIREMENTS FOR DATA BASE MANAGEMENT (Panel)	28. ANALOG HYBRID (Paper)
MAY 7	THURSDAY	AFTERNOON	29. DATA COMMON CARRIERS FOR THE SEVENTIES (Panel)	30. HARDWARE (Cancelled)	31. MAN-MACHINE INTERFACE (Paper)	32. BUSINESS, COMPUTERS AND PEOPLE?? (Paper/Panel)	33. PROCESS CONTROL (Panel)

THE SJCC SESSIONS

The chairmen of many of the sessions have written descriptive paragraphs on their sessions specifically for DATAMATION. Further explanation of these and other sessions may be found in the official conference program booklet to be distributed at the show.

James H. Bennett
Applied Logic Corporation
Technical Program Chairman

(1) GRAPHICS—TELLING IT LIKE IT IS

The sock it to 'um session of SJCC!! The computer may be a gathering force in the seventies, but it will be the peripherals that make or break. Obviously the display terminal will be one of the most important. Our more sophisticated jobs will require this device to function as a graphics terminal. And as assured by the already stern winds of austerity, "its gonna have to be inexpensive." Not cheap, inexpensive!

Computer - user interaction and communication will become the prime attributes of every system. This involves such unpleasant rigor and self discipline as standardization, commonality, and tons of the McNamara-type ilities. How the hell else can we prevent each newcomer from reinventing the wheel? If we expand our user base, educate ourselves, share experiences, motivate the participants, we can expect enrichment from the growth and more concentrated brain power. We must align ourselves to this goal, since the man who has been paying for it is about to stop. Uncle's got too many other problems. We must sell to the businessman! And the businessman of the seventies will be tough.

This conference will be introducing computer generated half-tone graphics with movable light sources. A significant achievement. The display of three dimensional objects that bear a close similarity to reality. One author has launched a re-evaluation of graphics as we know it. He feels that the approach has been all wrong. What we need is a generalized problem solver. As graphics should assist in solving problems, it should be organized in that fashion rather than geared specifically for each problem attempted.

It's only background and experience that provide the perspective for worthwhile projections into the future. In consideration of our austere position, we have spared no effort to do just that in a paper, film, and panel session. We have assembled a group of men who have influenced more of the outcome of computer graphics than any group ever assembled in a conference session. We will look long and deep at where we are, where we've been, and where we're going. If there is ever to be a group capable of worthwhile reflections . . . this is it. You may expect a commanding knowledge of IBM, CDC, Univac, GE and DEC hardware and software: the theoretical, practical and blue-sky. With film flashbacks we will relive a short history of graphics with narration by some of the original investigators. From 1958 to the present, the highlights of how this science has developed. The climax, of course, will be the hardly dry films of the new half-tone graphics.

The success of the session will depend in part upon the freedom of the workshop atmosphere generated: the interest and astuteness of the attendee and his *voiced* opinion. If the people who have to contend with what the manufacturers are dumping out are ever going to take issue, this is the time. Why doesn't the software type make himself heard? This is an open challenge for them to show up and get in their licks.

The very reason for the existence of a Joint Computer Conference is its interdisciplinary role. We have a free license to generalize. Each of the member societies has its own meetings for its specialist. Here specialists from the various disciplines are getting together to consider problems facing the general body of AFIPS. One thing is for certain: *no one will get away with telling it other than exactly like it is.*

—H. K. JOHNSON
Consulting Engineer
Session Chairman

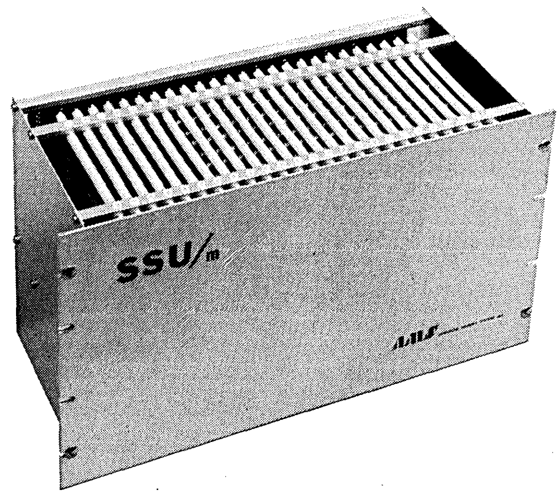
Papers:

An Algorithm for Producing Half-Tone Computer Graphics Presentations and Shadows and Movable Light Sources, by I. Bouknight and K. Kelly, University of Illinois.

The Case for a Generalized Graphic Problem Solver, by E. H. Sibley et al, University of Michigan.

Panelists:

Steven A. Coons, Syracuse University



40 times faster than drum! A modular semiconductor memory for mini-computers, I/O storage, general buffering applications, low cost main memory extension, general purpose data storage ...priced at drum memory costs

Applies to virtually any system. Word length, transfer rate, logic levels, capacity—one of our SSU/m's will fit your exact need.

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SSU/m's are a modular design, made from only five card types. No warm-up, no moving parts, and 100% usable storage space with no record gaps.

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Send for the facts. Now. The AMS Solid State Memory can give you a competitive edge. Now.

Performance Specifications, SSU/m

Access Time (μsec)	Min.	Av.	Max.
Random	1	131	525
Sequential	1	1	4
Capacity (No. of Bits)	Readout (Bits)	Data Rate (Megabits/sec.)	
2,097,152	64	64	
1,048,576	32	32	
524,288	16	16	
262,144	8	8	
Interface (TTL Compatible)	Address, Data, Control (Read, Write, Data Ready, Busy)		
Size (19″ Rack Mount)	Readout	Depth	Height*
	64	9″	31½″
	32	9″	17½″
	16	9″	12½″
	8	9″	12½″

*Height includes power supply.

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AMS

CIRCLE 202 ON READER CARD

THE SESSIONS . . .

S. H. Chasen, Lockheed Georgia
Bertrom Herzog, University of Michigan
Thurber Moffett, TRW Systems
Sam Matsa, IBM
Carl Machover, Information Displays Inc.
Frank Greatorex, Multilogic Inc.

(2) THE PATENT RAMIFICATIONS OF PROGRAM PROCESS INVENTIONS

Four lawyers who have played significant parts in the protection of their clients' investments in program controlled machines and processes will present papers and then discuss four different aspects of this work. To be covered individually and then discussed by the group are: 1) the effect of recent court decisions on protecting programmable process inventions; 2) the special problems that inventions in computergraphics and interactive processing present to patent attorneys; 3) what management and technical personnel including programmers can do to get better patents on programming inventions; and 4) what possible ramifications patents on programming processes might have in litigation.

Coming to the meeting from Seattle, Washington, is Gordon R. Sanborn who argued the Bernhart and Fetter Case in the United States Court of Customs and Patent Appeals. Mr. Sanborn will be the principal discussant of the problems presented by computergraphics. Michael I. Rackman of New York City authored one of the significant early works on the subject. He will provide additional insight into the things that programmers and engineers can do to make for better patents. Lawrence I. Lerner, who comes from New Jersey, will discuss the possible litigational aspects of programming patents. The session chairman, who participated as friend of the court in the Prater and Wei case, will discuss the implications of that decision as well as some of the other recent developments in the courts and Patent Office.

—HOWARD R. POPPER
Bell Telephone Laboratories
Session Chairman

Panelists:
Gordon R. Sanborn, Christensen, Sanborn & Matthews.
Michael I. Rackman, Amster & Rothstein.
Lawrence I. Lerner, Lerner, David & Littenberg.
Howard R. Popper, Bell Telephone Laboratories.

(3) MULTIPROCESSORS FOR MILITARY SYSTEMS

This session will bring together a panel of computer architects from companies who have built or are building compact multiprocessors for spaceborne, airborne, shipborne, and mobile ground applications. The session will consist of short presentations by the panelists on their machine designs, followed by a discussion of topics like: 1) design considerations for inclusion of unique multiprocessing instructions; 2) philosophy for having a design which is software compatible or noncompatible with a commercial computer; 3) design considerations for providing fail soft operation.

Dr. A. J. Ess will discuss the L-304, the L-3050, and Litton's new "Polyprocessor." The L-304 computer is an airborne militarized dual processor used in several tactical data systems. The L-3050 (AN/GYK-12) is the central computer used in the Army's TACFIRE System. The polyprocessor is a fourth - generation computer designed from inception to operate effi-

(Continued on p. 277)

ciently as a full multiprocessor.

Mr. Andrew T. Aylward will present IBM's VS A-NEW multiprocessor computer. This computer uses 4 Pi technology to implement a machine which is 360 compatible. The machine consists of two central processing storage units (CP SU) and two word-wide high speed channels, each of which has direct access to eight 16K word main storage units.

Dr. Ernest J. Dieterich will describe RCA's 215 multiprocessing architecture which provides compatibility with an existing family of commercial computers. The emphasis will be on features of the hardware and the executive program, designed as a single entity, which permit the capture of the complete package of commercial operation system software.

Mr. David McGonagle will discuss the design features of a multiprocessor designed for avionics applications.

—ALBIN A. HASTBACKA
RCA Corp.
Session Chairman

Panelists:
A. T. Aylward, IBM Federal Systems Division.
A. J. Ess, Litton Data Systems Division.
D. McGonagle, Burroughs Corp.
E. J. Dieterich, RCA Aerospace Systems Division.

(4) THE INFORMATION UTILITY AND SOCIAL CHOICE

The emergence of the mass information utility may become the overriding factor in evaluating the impact of computers on the general public.

First, recent federal rulings on the computer/communications scene are making it increasingly apparent that CATV (Community Antenna Television) will be the basic broadband communications highway into the American home. There are now more than three million viewing families subscribing to over 2000 operative CATV systems in the United States, and approximately half of the viewing public is expected to be "hooked on" to CATV by about 1975.

Second, technological computer/communications developments are being designed and tested by leading firms to make it possible to use the home TV, with appropriate modifications, as the basic display device for receiving information services. Feasibility is no longer questioned; the race is on for the most cost-effective package.

Third, by seizing upon economies of scale, leading computer/communications firms, in conjunction with CATV operators, will be able to offer the public a wide variety of information services at low monthly rates, perhaps approaching telephone rates, providing entertainment, educational, shopping, and homekeeping services.

Fourth, and most significant, no one is prepared to provide effective guidance toward achievement of social excellence in mass information utilities. The FCC and other cognizant government agencies follow rather than lead technology and have virtually no experience in this area. No one has faced up to the problem of social information as a regulated public utility. Computer manufacturers, software houses and the communications industry have virtually no guidance as to what the public wants nor what the public needs.

The socio-economic-political-educational implications of information utilities can easily stagger the imagination. In particular, new democratic forms may emerge, creating a new configuration between the citizen and the state. If immediate profits are the supreme end of all social planning because no other serious contenders arise, then the information utility could end up as the most barren wasteland of them all.

Building upon the results of an earlier conference on the same topic held at the University of Chicago in December, 1969, the interdisciplinary panel of this session probes the issues and comes up with novel and controversial recommendations.

—H. SACKMAN
System Development Corp.
Session Chairman

Panelists:
H. Borko, UCLA.
S. Drescher, University of Pittsburgh.
R. A. Dunlop, Logistics Distro-Data.
E. S. Dunn, Jr., Resources for the Future.
L. Kestenbaum, formerly with Dept. of Justice.
M. A. Melkanoff, UCLA.
E. Parker, Stanford University.

(5) SIMULATION IN EDUCATION (Panel)

Chairman: David Lamb
University of Delaware

(6) PROGRAM TRANSFERABILITY

The purpose of this panel session is to shed some light on the subject of moving programs from one environment to another. The bulk of all programs developed in the past, and indeed being written today, are tied to the specific environment for which they were originally implemented. Transfer to a different environment is usually a costly proposition requiring much planning, time, and reprogramming.

Whether one believes the problem to be that environments are not compatible between computer manufacturers and generations of computers, or, that programs are unable to accommodate differing environments, the fact remains that the lack of mobility which currently exists creates serious problems for both users and manufacturers of computers.

The panelists in this session are acknowledged experts. They will be speaking from firsthand experience, and each of them will give his views on a series of questions selected to permit a thorough examination of the topic. In addition to the question that usually receives the most attention—that is, the one on how to achieve transferability—the panel will set the stage by establishing the nature of the problem for which transferability is a solution (and perhaps it is not the only solution) and then explore such topics as the contribution of higher level languages, the effect of industry standardization efforts, and the possible effect of unbundling.

The panel will also gaze into a crystal ball to tell us what they think the situation will be by 1980. Will programs and applications be freely transferable between environments or will increases in complexity keep us where we are today? Will the question be largely irrelevant by then? Will data be transferable without conversion? What will be the cost of achieving transferability? What would be the effect on computer manufacturers, users, software houses, programmers, training requirements, salaries . . . ?

—A. METAXIDES
Bell Telephone Laboratories
Session Chairman

Panelists:
Kenneth R. Barbour, General Electric Co.
Philip H. Dorn, Union Carbide Corp.
Joel D. Erdwinn, Computer Sciences Corp.
George H. Mealey, Harvard University.

(7) COMPUTING IN STATE GOVERNMENT

There is a growing public awareness and concern regarding state administration of public assistance, employment security, public safety, and public health programs. In the 1970's problems of transportation, pollution control, housing, medical care, etc., will place heavy burdens on state agencies. Since more and more attention is being focused on the use of information processing technology to cope with these matters, this panel will discuss the capabilities and resources available to state governments to meet the challenge of the 1970's.

The panel discussion will be introduced by brief statements by four panel members. Donald Croteau will discuss the activities of the National Association of State Information Systems Standards Committee. John L. Gentile will cover the research and educational activities being carried on by the various states. Larry H. Walker, Jr., will examine the inter-governmental (federal-state-local) relationships affecting state computer systems. Carl Vorlander will conclude with a discussion of the various aspects involved in administering a statewide computer network.

—ALVIN KALTMAN
Commonwealth of Massachusetts
Session Chairman

Panelists:
Donald Croteau, State of New York.
John L. Gentile, State of Illinois.
Larry H. Walker, Jr., Commonwealth of Pennsylvania.
Carl Vorlander, State of Wisconsin.

(8) MICROPROGRAMMING

Microprogramming is one of the hottest subjects in the computer field today. It is also, unfortunately, one of the most misunderstood. This is due to the fact that only a comparatively small number of computer technologists have been engaged in actual work in the area. Also, since it lies somewhere between Software and Hardware, the work is performed by either logic designers or programmers, each with a different perspective of the function he performs. There is still too much turmoil in the field to come up with generally acceptable definitions of terms, although local working definitions are created within particular groups.

It is the goal of this session to present an overview of the field with the emphasis on current technology. The talks will include a survey, two applications, and an engineering paper, and will represent a balance of software and hardware interests.

The format of the session will include a discussant for each paper to add the extra dimension of a contrasting statement by another professional with experience in the subject.

—JULIEN GREEN
Scientific Resources Corp.
Session Chairman

Papers and Discussants:
A Study of User Microprogrammable Computers, by C. V. Ramamoorthy and M. Tsuchiya, Univ. of Texas at Austin. Discussant: R. McClure, Dallas, Tex.
Firmware Sort Processor with LSI Components, by H. Barsamian, NCR Electronics Div. Discussant: B. Huberman, The MITRE Corp.
System/360 Model 85 Microdiagnostics, by N. Bartow and R. McGuire, IBM Systems Development Div. Discussant: H. W. Lawson, Standard Computer Corp.
Use of Read Only Memory in ILLIAC IV, by H. White and E. K. C. Yu, Burroughs Corp. Discussant: R. E. Merwin, Safeguard Systems.

(9) AUTOMATA THEORY (Paper)

Chairman: Marvin Paull
Rutgers University

(10) OPERATING SYSTEMS

With the close of the sixties we have

seen that the multiprogramming system is well established. The profitability and convenient operation of these large systems however, is proving to be somewhat elusive. The great things expected of large, complex, generalized operating systems must be tempered by focusing more attention on other important (and often unglamorous) areas. This session brings to light such things as system architecture, computer center operations, data management, and price/performance considerations. The six papers reflect this change from early experimental prototypes to more pragmatic and profitable operating systems.

Katzan surveys the different types of operating systems. He simplifies many of the concepts (and the jargon) embodied in third generation time-sharing and batch operating systems. Selwyn addresses the problem of measuring and controlling the computer resources, both hardware and software, dynamically allocated in a time-shared environment. Andrews and Radice present some requirements for the effective operation of the computer center itself, especially in the area of operator/computer communication.

Molho presents his thoughts on hardware security in the controlled-access time-shared computer utility. Abate and Dubner describe a system where sophistication and generality must be traded for economic and reliability considerations. The result is a system supporting nearly 1000 terminal stations on a relatively modest equipment configuration. Symes considers a system providing the conversational problem solver with a powerful yet simple technique for manipulating data structures.

—Theodore A. Hess, Jr.
Applied Logic Corp.
Session Chairman

Papers:

Operating Systems Architecture, by Harry Katzan, Jr., Pratt Institute.

Computer Resource Accounting in a Time Sharing Environment, by Lee L. Selwyn, Boston University.

Multiple Consoles: A Basis for Communication Growth in Large Systems, by Dennis W. Andrews and Ronald A. Radice, IBM Systems Development Div.

Hardware Aspects of Secure Computing, by Lee M. Molho, System Development Corp.

Ticketron, A Successfully Operating System Without an Operating System, by Harvey Dubner and Joseph Abate, Computer Applications Inc.

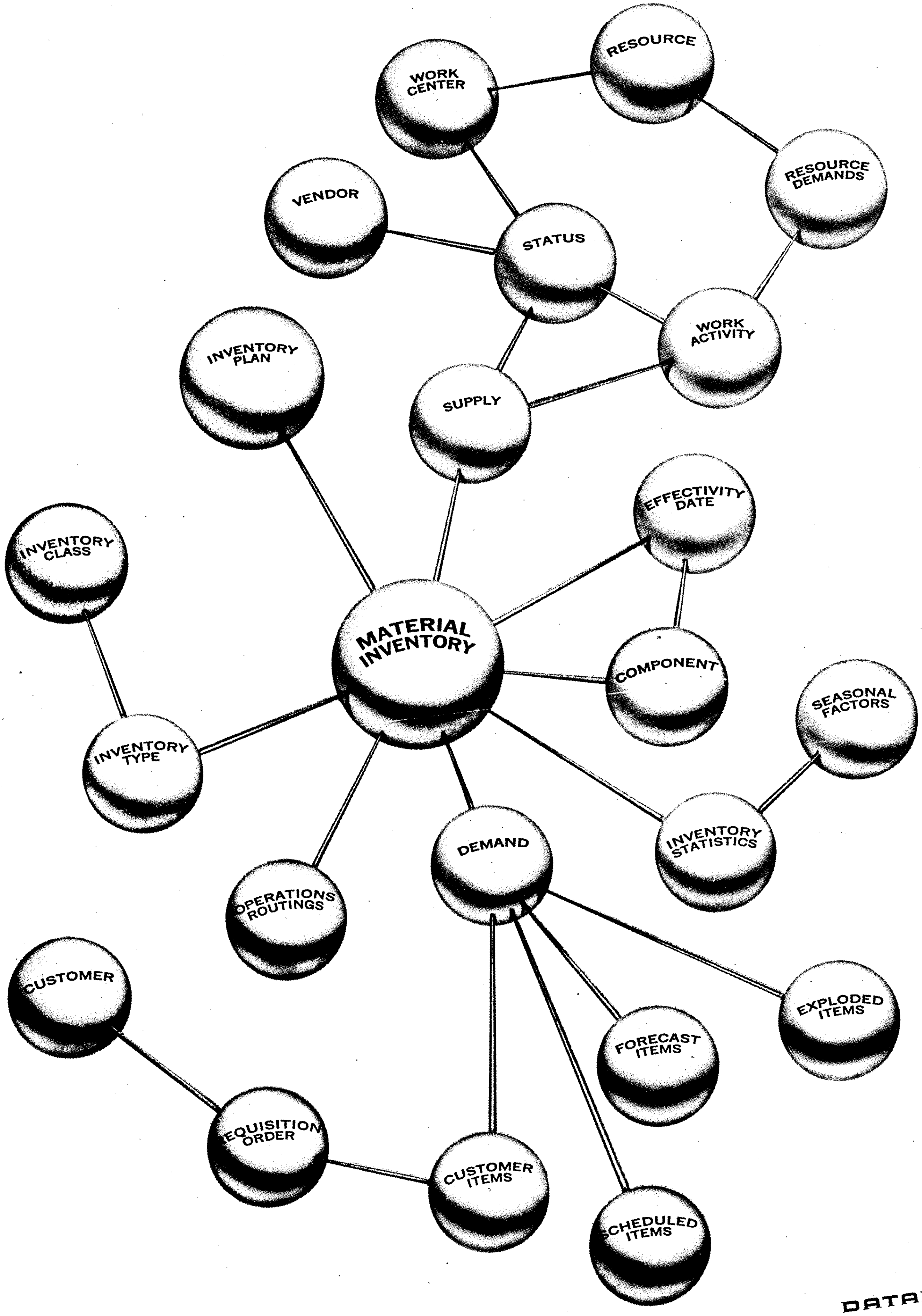
Manipulation of Data Structures in a Numerical Analysis Problem Solving System (NAPSS), by Lawrence R. Symes, Purdue University.

(11) INFORMATION MANAGEMENT SYSTEMS—FOUNDATION AND FUTURE

After many years of experimentation, a consensus on the approach to building information systems is emerging. These include: 1) separating the definitions and formulations of the logical data base seen by the user from the physical data base, stored and acted upon by the computer; 2) storing and acting upon single copies of data and providing facilities to logically relate one datum to any other datum; 3) providing facilities to let the data base dynamically change and adapt as new demands are made of it; 4) providing a user-oriented language for time-shared interaction with the data base.

In this session, the papers presented establish a foundation on which today's information management systems can become tomorrow's management information systems.

The first paper in the session describes the awesome task and many of the factors to be considered in the development of an information management system. This paper concludes



WORK CENTER
RESOURCE
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VENDOR
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INVENTORY PLAN
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INVENTORY CLASS
MATERIAL INVENTORY
COMPONENT
SEASONAL FACTORS
INVENTORY TYPE
INVENTORY STATISTICS
DEMAND
OPERATIONS ROUTINGS
CUSTOMER
EXPLODED ITEMS
FORECAST ITEMS
EQUISITION ORDER
CUSTOMER ITEMS
SCHEDULED ITEMS

DATAMATION

that "full participation and support of senior management in the organization of an IMS project is an absolute requirement."

The next two papers describe interactive time-sharing systems for use by programmers who would like to build a small information system. One paper emphasizes the ability to add new data types to the data base without preplanning, while the second is concerned with the use of virtual memory techniques for handling data bases.

The fourth paper addresses the problem of putting data into the data base and automatically classifying it. This is an important facet of the problem, since an information system has a value only when the large amount of data is present. Last, in the fifth paper, the session addresses a manager's use of quasi-natural English language to query a data base.

—GEORGE G. DODD
General Motors Research Laboratories
Session Chairman

Papers:

An Approach to the Development of an Advanced Information System, by J. E. Myers, Arcata National Corp., and S. K. Chooljian, Hughes Aircraft Co.

The Data BASIC Language—A Data Processing Language for Non-Professional Programmers, by P. C. Dressen, General Electric Co.

LISTAR, Lincoln Information Storage and Associative Retrieval System, by A. Armenti, MIT.

All-Automatic Processing for a Large Library, by N. S. Prywes, University of Pennsylvania, and B. L. Litofsky, Bell Telephone Laboratories.

Natural Language Inquiry to an Open-Ended Data Library, by G. W. Potts, Meta-Language Products.

Discussants:

E. A. Sibley, University of Michigan.

Richard Robnett, General Motors.

James P. Fry, The MITRE Corp.

(12) LESSONS OF THE '60's

This year marks the beginning of the third decade of the computer industry. In the past, our industry has often excused its mistakes and flaws as those of a growing adolescent. It is now time to stop using excuses and to examine our actions in a critical and constructive light.

Toward this end, the panel will review the events of the past decade—its successes and failures—and comment upon the lessons that may be learned. The topics to be discussed will include:

The Sado-Masochistic Love Affair Between the Vendors and the Users

The Feasibility of Building Large Systems

Microminiaturization of Expertise; e.g., Wanted—Tape Label Expert

The Time-Sharing Paradox

The Minniecomputer Revolution

The Mickeycomputer Revolution

Revolutions That Never Happened

Products That Never Died

The Throughput Race: Faster and Faster Hardware vs. Slower and Slower Software

The Usability Gap

Pushers, Users, and Junk

Wishful Thinking: A Growing Factor in Product Planning

The Desire for Glamor Rather Than Quality

Management Information Systems: Socratic Information Systems, Rogerian Information Systems, and Freudian Information Systems.

Can Six Computers Do All the Worthwhile Computing in the U.S.?

How You Gonna Keep Them Back in the Lab After They've Seen Wall Street?

When You Should Have Gotten Out of the Stock Market

We'll also look at some famous and some lesser known important laws:

Grosch's Law: Computing power increases as the square of the cost.

Parkinson's Law: Work expands to fill the time allotted.

Murphy's Law: Anything that can go wrong will go wrong.

Hill's Law: Nothing ever works and nobody cares.

—SHELDON B. WEINBERG
Cybernetics International
Session Chairman

Panelists:

Robert B. Forest, DATAMATION.

H. R. J. Grosch, National Bureau of Standards.

Richard Hill, Informatics.

Charles P. Lecht, Advanced Computer Techniques.

William R. Lonergan, International Reservations Corp.

Carl Reynolds, I/MAP.

(13) ARTIFICIAL INTELLIGENCE

This session will focus on three major areas of current work in artificial intelligence: the development of programs for improving the performance of heuristic problem solving programs, the application of interactive techniques and artificial intelligence concepts to complex problems of scientific inquiry, and the theoretical study of procedures for reasoning by machine. For each of these three areas there will be a contributed paper which will report on a specific investigation, and also an invited discussion which will present broad background in the area and it will examine the paper in the context of other related work.

Heusmann's paper will show that a heuristic program for solving a complex scheduling task can learn to improve its performance through feedback from intercomparisons of the solutions it has produced. Dr. Ira Pohl, an active contributor to the theory of heuristic search processes, will discuss this paper.

Foster's paper will describe an interactive program for the discovery of complex, highly abstract patterns in social science data. The paper will show that man-machine interaction can lead to qualitative changes in the nature of research and theory in the social sciences. Discussion based on this paper will be presented by Dr. Manfred Kochen, a pioneer in concept formation research, and a leading contributor to information systems, question answering, and mathematical models in the Social Sciences.

Anderson's paper will discuss the relationships between two methods for treating the equality relation within automatic theorem proving procedures that are based on the resolution principle. The main theoretical result of the paper will be a proof that a procedure using one of these methods, called E-resolution, is complete. Dr. Alan Robinson, the originator of the resolution principle and a central figure in theorem proving research in the last decade, will be the discussant of this theoretical paper.

—SAUL AMAREL
Rutgers University
Session Chairman

Papers:

A Story of Heuristic Learning Methods for Optimization Tasks Requiring a Sequence of Decisions, by L. Rowell Heusmann, Yale University.

Man-Machine Interaction for the Discovery of High-Level Patterns, by David F. Foster, General Electric Co.

Completeness Results for E-Resolution, by Robert Anderson, University of Texas at Austin.

Discussants:

Ira Pohl, IBM Corp.

Manfred Kochen, University of Michigan.

J. Alan Robinson, University of Syracuse.

(14) COMPUTERS IN EDUCATION: MECHANIZING HUMANS OR HUMANIZING MACHINES

Critics of computer-assisted instruction point out that actual benefits have fallen far short of what potential users were led to expect in the sixties. Despite the pitfalls of prediction, four recognized computer specialists will venture to assess possible computer contributions to education in the seventies.

Allen Newell will deal with the session's theme, "Mechanizing Humans or Humanizing Machines," by examining the essential intellectual operations which are required for a meaningful teaching agent. The source of his comments is an effort to construct an artificial teaching device named Merlin, and the subject Merlin tries to teach is artificial intelligence.

So far computers have been used by educators largely in drill or tutorial modes of instruction. Frederick B. Thompson will discuss how the computer will better serve the learner as a tool—a facilitating environment in which the student can discover knowledge for himself, for example, the laws of chemical combinations or the effect of demographic and economic conditions on political decisions.

For Robert Simmons some of the more exciting recent research in computer - assisted instruction concerns teaching programs which generate problems and analyze student responses and queries according to general rules and subject matter descriptions. Most demonstrations have been restricted to formalized subject matter such as mathematics, logic, and programming, but Simmons proposes the use of natural language for instructional communication in any well-defined discipline.

Consider the hypothesis that the slow rate and variable success of learning to think reflect the amateurish and inarticulated methods available to a child. Seymour Papert sees the computer as a machine which can offer a child an opportunity to experiment with the world on an unprecedented scale while at the same time providing him with articulate and developed models of the world and of himself.

A workshop will meet the following day to discuss these presentations as well as status reports on several computer science projects concerned with instruction and human learning. Details are given in the April Bulletin of the Special Interest Group on computers in education. Copies are available from ACM Headquarters, 1133 Avenue of the Americas, N.Y., N.Y. 10036. —KARL L. ZINN

University of Michigan
Session Chairman

Panelists:

Allen Newell, Carnegie-Mellon University.

Frederick B. Thompson, California Institute of Technology.

Robert Simmons, The University of Texas at Austin.

Seymour Papert, Massachusetts Institute of Technology.

(15) PROPRIETARY SOFTWARE IN THE '70's

The introduction of proprietary software in the late 1960's signaled, for the entire computer industry, new directions for the decade of the 1970's. In fact, much of the attention given this vital software area today has resulted in "program products" being promoted as a cure-all for many of the problems facing the computer industry at large. In evaluating the current and future impact of software, several questions naturally arise: Will future proprietary software developments compensate for the shortage of programmers? Will proprietary software be able to accelerate a company's ability to automate its application areas?

Will proprietary software be able to improve the quality and reliability of software in general? And will proprietary software development contribute to reducing the costs of computer usage?

These questions indicate a few of the possible far-reaching effects that proprietary software can achieve. The extent to which these possibilities are realized will largely depend upon the existence of competition in the software market, since competition traditionally results in improved quality and fair pricing.

In retrospect, the decade of the '60's was marked by hardware competition and software "give-aways." Hopefully, 10 years from now, the 1970's will be judged as the era of software competition and hardware "unbundling."

At present, various concerns are active in the software field. Saleable proprietary software is being created by computer manufacturers and users, as well as by independent software houses. The overall success of any product is dependent first upon its being sufficiently generalized for use by a large number of potential customers, and then upon the supplier's ability to effectively develop and service his product. It is still too early to determine which type of software manufacturer, if any, will be most able to achieve such success.

This panel session is designed to detail some of the problems facing the software manufacturer today. The areas to be discussed include interfacing software from several vendors, developing software standards, ensuring quality control, extending performance guarantees, and determining the legal position of the software industry. These problems will be approached from several perspectives. Two large organizations who were early users of proprietary software in the 1960's will comment on their experience and expectations. The viewpoint of the independent software manufacturer will be expressed, as well as the ideas of a computer manufacturer who has separated his hardware/software pricing. General legal considerations concerning proprietary software will also be reviewed. Audience participation throughout the panel session will be encouraged.

—Martin A. Goetz
Applied Data Research, Inc.
Session Chairman

Panelists:
Walter Bauer, Informatics, Inc.
Robert Spieker, Western Electric.
Ruth Block, Equitable Life Assurance.
Irving Kayton, Computers-In-Law Institute, George Washington University.
One computer manufacturer (currently unnamed).

(16) HUMANITIES

One of the unintended but inevitably dangerous consequences of the computer revolution is the increasing division between (on the one hand) scientists, technologists, and businessmen who use computers and (on the other) humanists who do not. The ignorance of this second group is matched only by its sense of powerlessness as it feels depersonalized and threatened by those computer applications which impinge on its private activities. The exaltation of scientific computing is also seen as a threat to the human values for which all scientific activity is supposed to be intended.

A small group of humanists is seeking to bridge this growing gulf, to employ computers in their research and thereby incidentally keep each community aware of the other's needs and aims. Humanities research can

clearly benefit from much that the computer promises: precision, speed, greater range. The computer world can also benefit from reminders that in all its activities, human values must reign; that valid traditions must be preserved; that without a moral system based on belief in truth and good, no mere technical advance can improve human life.

In this session, a representation of such humanists present surveys of current and typical activities in literature, musicology, and history, while two representatives of the technical community offer techniques for the analysis of visual art.

—JOSEPH RABEN
Queens College of CUNY
Session Chairman

Speakers:

Herbert S. Donow, Southern Illinois University: "Natural Language Processing and Literary Style."

Raymond F. Erickson, Yale University: "Music and the Computer in the Sixties."

Sheldon Hackney, Princeton University: "Power to the Computers: A Revolution in History?"

W. F. Bartlett, Bell Telephone Laboratories: "Picturelab: An Interactive Facility for Experimentation in Picture Processing."

A. Michael Noll, Bell Telephone Laboratories: A presentation of problems and proposed solutions in pictorial analysis and storage.

(17) DIGITAL SIMULATION APPLICATIONS

The papers in this session cover a spectrum of applications, including simulation of logic circuits, traffic flow and control, large launch vehicles, aircraft in a remote real-time environment, and general dynamic systems. Furthermore, these applications cover the spectrum from discrete to continuous mathematical models and thus demonstrate the trend toward unification of these two approaches to simulation which in the past have tended to remain distinct.

—W. E. SCHIESSER
Lehigh University
Session Chairman

Papers:

A Model and Implementation of a Universal Time Delay Simulator for Large Digital Nets, by S. A. Szygenda and David M. Rouse, University of Missouri, and Edward W. Thompson, Telpar, Inc.

UTS-I: A Macro System for Traffic Network Simulation, by Howard L. Morgan, Cornell University.

Real-Time Space Vehicle and Ground Support Systems Software Simulator for Launch Programs Checkout, by H. Trauboth, Marshall Space Flight Center, and C. O. Rigby and P. Brown, Computer Sciences Corp.

Remote Real-Time Simulation, by Omri Serlin, Control Data Corp., and Robert C. Gerard, The Boeing Co.

MARSYAS—A Software System for the Digital Simulation of Physical Systems, by H. Trauboth, Marshall Space Flight Center, and N. Prasad, Computer Applications, Inc.

(18) SYSTEM ARCHITECTURE

Chairman: Thomas DeMarco
Mandate Systems, Inc.

Papers:

Computer Instruction Repertoire—Time for a Change, by Charles C. Church,

How will you sell against the New Systems?

New computer systems will soon be announced. Systems built around monolithic memories. Five times as fast as today's machines. And five times as reliable. To stay competitive, you'll need monolithic memories for your own equipment. You'll need them soon. How are you going to get them?

The

1. You could make your own monolithic memories. But monolithics are a new breed. Batch processed instead of assembled. You'll need a new team of specialists in Large Scale Integration. Scientists, development and manufacturing engineers. Scarce talents, found one at a time.

And you'll need a unique facility. With specially designed continuous process equipment for masking, diffusion, epitaxial growth, chip packaging. It's a big investment. Say $10 to $15 million.

Most of all, you'll need about a year before you have your first component. And at least another year before you're producing a reliable product in quantity.

If everything goes well, you'll be two years behind the competition. Two years back on the learning curve. With little prospect of ever catching up.

Can you afford to risk two years in the competition for the New Systems.

2. Or, you could buy memory components. From one of the old-line semiconductor companies. Or the newer memory suppliers. And assemble your own memories.

But will they really work as your memory? The characteristics will be those of a group of components. Not necessarily those of an integrated memory design.

And you won't find enough profit in assembly. The more complex the component, the less opportunity there is for any significant value added.

Not enough to offset the components inventory you'll be carrying. Without knowing whether the components work together until you've got them mounted on cards. Not enough to pay for thermal analysis, reliability and stress testing and all the complex test equipment involved. To cover the cost of field servicing memories made from available components.

Is this really the place to add value?

Litton Systems, Inc.

The PMS and ISP Descriptive Systems for Computer Structures, by C. Gordon Bell and Allen Newell, Carnegie-Mellon University.

Reliability Analysis and Architecture of a Hybrid Redundant Digital System: Generalized Triple Modular Redundancy with Self-Repair by Francis P. Mathus, Jet Propulsion Lab, and Algirdas Awizienis, University of California.

(19) NUMERICAL ANALYSIS

Chairman: Herbert Greenberg
University of Denver

Papers:

A Non-Iterative Method of Solving Poisson's Equation, by R. Colony and R. R. Reynolds, The Boeing Co.

An Improved Generalized Inverse Algorithm for Linear Inequalities and Its Applications, by L. C. Geary, Gulf Research and Development Co.

An Initial Value Formulation for the CSDT Method of Solving Partial Differential Equations, by V. Vemuri, Purdue University.

Application of Invariant Imbedding to the Solution of Partial Differential Equations by the CSDT Method, by Paul Nelson, Jr., Oak Ridge National Laboratory.

Architecture of a Real-Time Fast Fourier Radar Signal Processor, by Sung Y. Wong and Arthur S. Zukin, Hughes Aircraft Co.

(20) SON OF SEPARATE PRICING

We return to the scene of the crime.

It was in Atlantic City two years ago that the industry first raised in formal, public session the great and burning issue of the separate pricing of hardware and software. I moderated that session, and my reward/punishment is to chair this review of that same topic.

Since our last debate, of course, separate pricing has become a fact, perhaps an alarmingly harsh fact. So the theoretical discussion of two years ago has become little more than an historical curiosity. For the record, however, it should be noted that our prehistoric panelists were somewhat overwhelmingly unanimous in their agreement that separate pricing would —and must—come about. I wonder how they feel today?

At any rate, this year's session will *not* be theoretical. We've assembled a handful of real-live, experienced edp specialists who will attempt to assess the general impact upon the industry of unbundling, and to focus attention on the basic issues and questions that must be faced and answered if the industry is to learn to live with this strange new way of purchasing and using systems that can come from a variety of sources in an amazing array of sizes, shapes and colors.

And to keep our experts honest, we've assembled another handful of discussants—also experienced (hard-nosed is another word for it)—who will represent varying types and levels of users. With advance copies of the position papers, they should be able to raise some interesting questions, and pave the way for what should be lively audience participation.

We'll start with an overview (maybe the user discussants represent the "underview") of the impact of separate pricing upon the industry as a whole. This will be followed by position papers that will cover such topics as legal implications, software packages, education services, and systems engineering services. The primary focus will be on the user in an attempt to help this sorely beleaguered chap cope with the awful realities of unbundling.

The Hollywood influence may be seen in the title of the session, which might have been alternatively titled "Separate Pricing Strikes Back."

It should be informative . . . and fun.

—Robert B. Forest
Datamation
Session Chairman

Panelists:

Lester M. Gottlieb, Data Dimensions, Inc.

Robert P. Bigelow, Attorney at Law.

David E. Ferguson, Programmatics, Inc.

George J. Ravezzolo, Advanced Systems Inc.

Wayne B. Swift, Computer Sciences Corp.

Discussants:

Philip H. Dorn, Union Carbide Corp.

Roy S. Dickson, Phillips Petroleum.

Robert H. Davis, American Express Co.

Peter J. Dawson, United Artists Corp.

Ann Marie Lamb, Bureau of the Budget.

(21) SOCIAL IMPLICATIONS

Chairman: Joseph Raben
Queens College of CUNY

Speaker:

O. E. Dial, Baruch College of CUNY.

Panelists:

Michael Maccoby, Institute of Policy Studies.

Leonard Rodberg, University of Maryland.

L. John Rankin, IBM Corporation.

(22) COMPUTER SYSTEM MODELING AND ANALYSIS

There has recently been a strong shift of interest to modeling and analyzing computer systems. This interest results partly from costly slippage of deadlines during initial implementations of third generation computer systems, partly from the realization that "sub-optimal" performance can be costly, and partly from the ascendance of Computer Science as an academic discipline. Although models tend to be simplified approximations to complex situations, there is no doubt that they can go a long way toward enlarging one's understanding of computer system behavior.

Dr. Kleinrock shows that a great many well known time sharing scheduling disciplines are members of a single large class. Each member discipline of this class is characterized by its priority function, which is a piece-wise linear time function. This priority function, changes the priority of a job at one rate while the job waits for service, and at a second rate while the job receives service. Kleinrock shows that this class contains some undiscovered scheduling disciplines, and gives an example of the analysis of one of them, the "selfish round robin."

Messrs. Baskett, Browne, and Raike study a problem that has received little attention in the literature: nonpaged multiprogrammed memories. They present a model from which one may determine values of various system parameters (e.g., block size, degree of multiprogramming, processor quantum size, and processing efficiency). They present also a mathematical programming model that determines an optimal policy for simultaneously

Dear Chief:

We really put it over on those Chaos agents this time. They never thought to search my attache case where the new Novation DC-102 data coupler was hidden.

Chief, this Novation coupler is fantastic! Would you believe that in the acoustic mode it is as sensitive as the Bell 103A direct coupled data set? An incredible -50 dbm.

That's why I'm sure that this vital message will reach you even though this phone line is noisy and full of transients. You see, chief, Novation's special filtering and multiple sampling techniques make data dropout a thing of the past.

And talk about flexibility! It doesn't matter who captures me anymore. I can plug into any EIA compatible terminal or Teletype printer up to 400 baud. Or by merely throwing a switch I can connect directly into the phone line through the DAA plug.

I think you should have our leasing company buy all of the Novation DC-102 couplers that they can. This coupler is five years ahead of its time. And since it is priced at less than $250 in quantity we can lease the DC-102 for just a few dollars a month. My underground informant tells me that Novation is tooled to produce this coupler in lots of 10,000. That's why we can get "off the shelf" delivery in small quantities and up to 1,000 per month on a scheduled basis.

One more thing, chief. The DC-102 is really good looking. Since it matches any office furniture it doesn't matter where those Chaos agents lock me up. And the lightweight plastic molded case is so rugged that it didn't even dent when I was thrown out of that speeding black limousine.

Tell 98 that I'll be home for dinner just as soon as I cut through these ropes.

Very truly yours...Agent 85.

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managing processor and memory resources. Their results have successfully been applied in the CDC 6600 operating system at the University of Texas at Austin.

Drs. Burnett and Coffman discuss another topic that has received little attention in the literature. Their model for memory-module request sequences distinguishes data and instruction references, determines the "memory bandwidth" (i.e., capacity) of the memory for various interleaving policies, and brings to light certain improvements over contemporary interleaving schemes. A numerical study shows that these improvements can be significant.

Each panelist will apply his extensive experience in operating system design and analysis to a critical analysis of one of the papers. Dr. Habermann is best known for his work on parallel processes and the solution of the deadlock problem in multiprocess computer systems; Dr. Lampson is best known for his work on resource allocation and protection; and Dr. Saltzer is best known for his work on traffic control and resource allocation in the Multics System.

—PETER J. DENNING
Princeton University
Session Chairman

Papers:

A Continuum of Time Sharing Scheduling Algorithms, by Leonard Kleinrock, UCLA.

The Management of a Multilevel Non-paged Memory System, by F. Baskett, J. C. Browne, and W. M. Raike, University of Texas at Austin.

A Study of Interleaved Memory Systems, by G. J. Burnett, Index Systems Inc., and E. G. Coffman, Jr., Princeton University.

Panelists:

A. N. Habermann, Carnegie-Mellon University.

Butler W. Lampson, Berkeley Computer Corp.

Jerome H. Saltzer, MIT.

(23) MEDICAL-DENTAL APPLICATIONS

Chairman: John Seed
Neighborhood Medical Care Center, NYC.

Papers:

A Computer System for Bedside Medical Research, S. I. Wixson, E. M. Strand, H. W. Perlis, University of Alabama.

Linear Programming in Clinical Dental Education, by C. F. Crandell, University of North Carolina.

Automatic Computer Recognition and Analysis of Dental X-Ray Film, by D. A. Levine, H. H. Hopi, A. L. Shakun, State University of New York at Stony Brook.

(24) PROGRAMMING LANGUAGES

This session will consist of five technical presentations. The authors of each paper will discuss the highlights of their contribution to the state of the art. The session exemplifies the current interest in interactive languages, extensible languages, and problem oriented languages.

—J. F. LEATHRUM
University of Delaware
Session Chairman

Papers:

Design and Organization of a Translator for a Partial Differential Equation Language, by A. F. Cardenas and W. J. Kaplus, University of California.

BALM—for Extendable List-processing Language, by M. C. Harrison, New York University.

AMTRAN—An Interactive Computing System, J. Reinfeld et al, University of Georgia.

Scroll, A Pattern Recording Language, by M. Sargent, University of Arizona.

A Translation Grammar for Algol 68, by V. B. Schneider, Purdue University.

(25) RESOURCE SHARING COMPUTER NETWORKS

During the next decade interactive computer networks will be required if we are to continue the current unprecedented progress in the computer field. We must reduce the ever-increasing workload of re-creating all software and data base resources at each computer center. The ARPA network described in this session represents a broad attack on this problem and utilizes a new communication system designed specifically for effective computer resource sharing.

—L. G. ROBERTS
Advanced Research Projects Agency
Session Chairman

Papers:

Computer Network Development to Achieve Resource Sharing, L. G. Roberts and B. G. Wessler, ARPA.

The Interface Message Processor for the ARPA Computer Network, by F. E. Heart et al, Bolt, Beranek & Newman, Inc.

Analytic and Simulation Methods in Computer Network Design, by L. Kleinrock, UCLA.

Topological Considerations in the Design of the ARPA Computer Network, by H. Frank et al, Network Analysis Corp.

HOST-HOST Communication Protocol in the ARPA Network, by S. Carr, University of Utah, and S. Crocker and V. Ceri, University of California.

(26) MINICOMPUTERS—THE PROFILE OF TOMORROW'S COMPONENTS

Over 5000 minicomputers of some 50 different types and worth in excess of $100 million have been installed. Including peripherals that broaden their scope, the dollar value has been estimated to be in the $300 million range. The immediate-term growth rate for minicomputers has been estimated at 30 to 50% per year, resulting in more than 15,000 systems shipped by 1973. Considering price trends, this means about $200 million in minicomputer sales and about $500 million in total minicomputer systems sales.

It is clear that minicomputers have emerged as a powerful system device in their own right. They will one day be so ubiquitous in such applications as control systems, communications, data acquisition, and signal processing that people will wonder how they ever did without them. They frequently present the least expensive and simplest approach to solving a problem, yet cost much less than large computers that perform many of these same functions with no more than comparable efficiency. Furthermore, their application to real-time environment is in most cases extraordinarily simple.

In view of the widening choice of minicomputers and their rapidly expanding uses, it is highly desirable that in this session we review the current status of minicomputers and project tomorrow's minicomputer systems.

The papers presented by four speakers will address themselves to the four main areas of minicomputer systems: design, input/output functions, software systems, and applications. The first paper, concentrating on the architecture of minicomputers, uses as an example the PDP-11 machine. This machine, in turn, is discussed at four levels: the external constraints, the way components are interconnected to allow free flow of information, the machine in the abstract that interprets programs, and the logic design. The paper attempts to give an unambigu-

ous, concise, and complete description of the machine and, in addition, presents a comprehensive understanding of the design constraints.

The emphasis of the second paper is on interface configurations. It is an attempt to analyze some of the basic characteristics of input-output (I/O) operations and, in the light of current technology, to suggest some possible new approaches to this particular phase of minicomputer design. One specific topic considers the problem of partitioning the necessary I/O functions within the framework of an integrated cpu-software-I/O system design.

In the third paper the operating software systems are given attention with the virtual memory system used as an example. The purpose of this system is to interface graphical terminals to a large computer. The system was designed to provide insight into memory management and the time-shared use of a small computer. To this end, such large-computer techniques as segmentation and virtual addressing were adopted. Multiprogramming aspects of the system are also described.

The applications and implications of minicomputers are the concern of the fourth paper. Here are discussed the applications of small, fast computers in areas usually assumed to require large and expensive machines. The scope of this paper includes time-sharing, message switching, nuclear power station control, graphics, and other applications. Also, questions of reliability and equipment redundancy, multiprocessing systems, programming problems, and peripheral requirements are investigated and solutions proposed.

To clarify some points made by the speakers and to carry a little further the discussion on minicomputers, a panel discussion will follow the papers. The panel represents expertise in such areas as the design and development of a multiplicity of minicomputers for a variety of market requirements. These include the uses of minicomputers for real-time signal processing and for control purposes and their uses in the ARPA computer-to-computer communication network and in simulation systems.

—REG A. KAENEL
Bell Telephone Labs
Session Chairman

Papers:

Architecture of Small Computers—The DEC/PDP-11, An Example, by Ronald P. Noonan et al, Digital Equipment Corp.

Interface Configurations for Mini Computers, by Fred F. Coury, Hewlett-Packard.

A Multiprogramming, Virtual Memory System for a Mini Computer, by Carl Christensen and A. Dick Hause, Bell Telephone Laboratories.

Applications and Implications of Mini Computers, by Gardner C. Hendrie and Chris B. Newport, Honeywell Computer Control Div.

Panelists:

Saul Dinman, GRI Computer Corp.

Donald N. Graham, Computer Signal Processors, Inc.

Frank E. Hart, Bolt, Beranek & Newman.

Dan Sinnott, Interdata, Inc.

William E. Ware, Systems Engineering Labs.

(27) REQUIREMENTS FOR DATA BASE MANAGEMENT

This session will be a discussion of the functions and controls needed to effectively use a data base in today's computer environment. The inability to properly manage the growth of the data base has been one of the major

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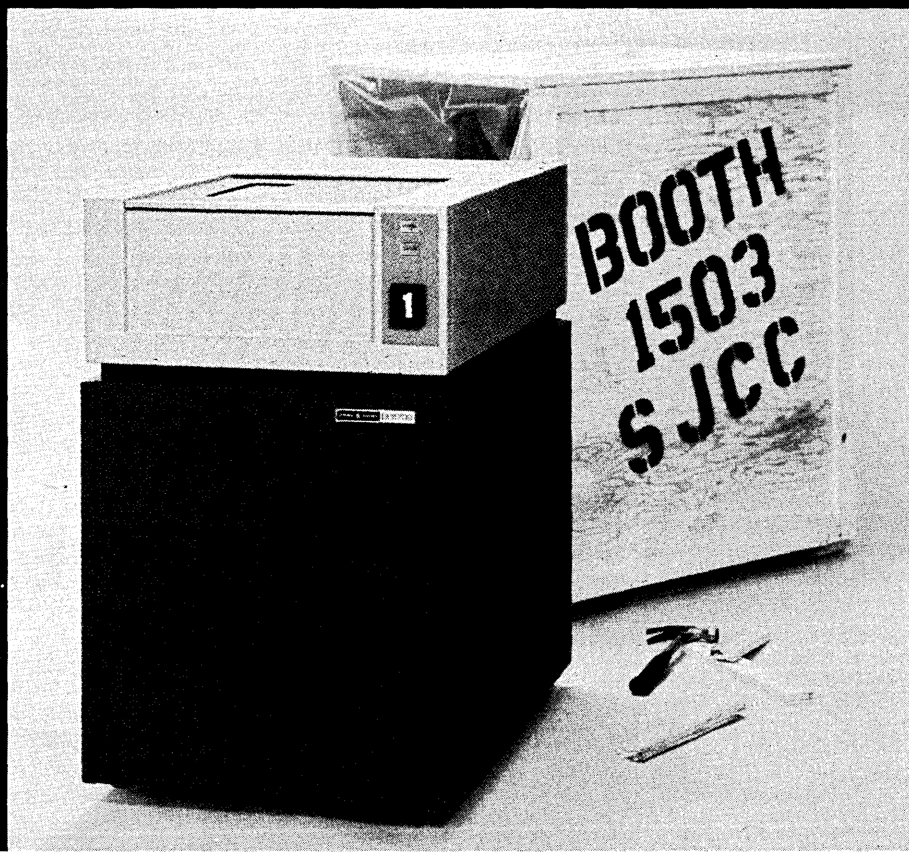

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hindrances to the development of management information systems.

Enthusiasts have expounded the theory of using computers to implement large management information systems ever since computers were first introduced to solve data processing problems. More than 15 years ago, R. F. Ashborn wrote in the Harvard Business Review about "weaving the initial and subsequent pieces into an integrated management control system."

In the years that followed, the name "integrated management control system" became "integrated data processing system" and finally a "management information system." While the name changed, the goal remained the same—to weave initial and subsequent pieces into a large all-encompassing system that would be *the* reporting system to management. However, most attempts to implement such a system have not been accomplished.

Panel members will present their views and discuss the requirements which they believe will allow for adequate growth and development of a data base. These will include functions that (1) permit expansion of the data base without requiring conversion or modification of established programs, (2) establish safeguards over the stored data and use of the data base, and (3) make it possible to take advantage of new developments in storage devices and techniques with a minimum expenditure of conversion funds.

—Kendall R. Wright
IBM Systems Development Div.
Session Chairman

Panelists:
Arthur Rosenberg, Informatics, Inc.
David M. Smith, Esso Mathematics Systems, Inc.
William D. Stevens, Skelly Oil Company.
Harrison Tellier, IBM Corporation.

(28) ANALOG HYBRID (Paper)

Chairman: David Lamb
University of Delaware

(29) DATA COMMON CARRIERS FOR THE SEVENTIES

Chairman: Stuart L. Mathison
Arthur D. Little, Inc.
Panelists:
Edward A. Berg, Data Transmission Co.
John A. Goekin, Microwave Communications, Inc.
Kelley Griffith, FCC Common Carrier Bureau.
James R. Rae, AT&T
Philip M. Walker, DOD Directorate for Data Automation Policy

(30) HARDWARE Cancelled.

(31) MAN-MACHINE INTERFACE

This session will be devoted to terminal oriented systems. Two hardware design papers, one system design paper, and one performance evaluation paper will be presented. Turner and Ritchie will describe a method for obtaining x-y coordinate position by means of linear current division in a resistive area. Wear and Dorf will describe a word-oriented syntax-sensitive keyboard. Ossanna and Saltzer will review the character stream processing of MULTICS. Jones, Hughes, and Engvold will present a comparative study of management decision making from different kinds of terminals.

—William M. Rogers
Mathematica
Session Chairman

Papers:
Coordinate Position by Linear Current Division in a Resistive Area, by J. A. Turner and G. J. Ritchie, University of Essex.
An Interactive Keyboard for Man-Computer Communication, by L. L. Wear, Hewlett-Packard, and R. C. Dorf, Ohio University.
Remote Terminal Character Stream Processing in MULTICS, by J. F. Ossanna, Bell Telephone Laboratories, and J. H. Saltzer, MIT.
A Comparative Study of Management Decision Making from Computer Terminals, by C. H. Jones, Harvard University, and J. L. Hughes and K. J. Engvold, IBM Corp.

(32) BUSINESS, COMPUTERS, AND PEOPLE??

It is frequently forecast that business in the seventies will become as universally dependent on computers as space exploration has always been; i.e., impossible in manner and scale without there having been the computer revolution that began for business in the early 1950's. Largely cashless, and with universal customer exposure and interface through direct computer-user interaction, business and society in 1980 will have become vitally dependent on the computer and information processing industry and people.

Looking forward to this great responsibility, and back over the 20 years of development that leads to such prophecy, one question continually arises—How can such advances over present capabilities be realized and yet be dependent on people?

Considering just the area of "prob-

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lem analysis and description," which involves the people-oriented disciplines of systems analysis, design, and programming, the question is—To what extent has such work been automated in 20 years, and what are the prospects?

Thanks to the concepts and work of such as von Neumann, Wilkes, Hopper and others, "automatic programming" has progressed from machine level to the symbolic-assembler *and* procedure languages of today, such as COBOL and PL/I. Yet these concepts are 15 years old, and are just realizing widespread and somewhat standard use (embedded as they usually are in a big ooze). And can it be said that they have made programming automatic? That they have even begun to minimize the human element in programming?

If it is correctly said that 80% of the problem and work of application of computers in business occurs in analysis of the business and design of automated processes, then to what extent has technological progress reduced the human requirement in this area since 1950? What are the prospects for the 70's?

As remote user exposure to and interaction with computers becomes the characteristic of business in the 70's, what can be expected from teleprocessing, time-sharing and operating system technology toward more automatic operation?

As business systems build larger and more complex "data bases" (called "master files" in 1950's) from more widespread and less disciplined customer "bases," will source data input/output, conversion and editing become less people dependent and more automatic? Is there hope from the necessarily general-purpose software packages to be supplied by that emergent giant industry? Will standardization provide a key?

Can the conceptual possibilities for use of computers in business be realized with the present people-dependent technology? What technological aid can be expected in the next 5-10 years?

This session will present the challenge to a panel of experienced business data processing workers in the form of representative papers. The panelists will respond to the papers and briefly present their individual views, before collectively discussing these questions of fundamental concern with the audience.

—R. E. UTMAN
Princeton University
Session Chairman

Papers:

Teleprocessing Systems Software for a Large Corporate Information System, by Ho-Nien Liu and D. W. Holmes, Pacific Gas and Electric Co.

The Selection and Training of Computer Personnel at the Social Security Administration, by E. R. Coady, SSA.

Panelists:

Margaret Harper, Auerbach Corp.

Vico Henriques, Business Equipment Manufacturers Assn.

Robert Rossheim, Philadelphia School District.

William Smeltzer, Trilog Associates.

Frank Wesner, General Accident Insurance Group.

(33) PROCESS CONTROL

Chairman: John L. Knupp, Jr.
E. I. duPont de Nemours

Panelists:

William Lewish, E. I. duPont de Nemours.

Robert M. Bakke, IBM Corp.

John McCarthy, Stanford University. ■

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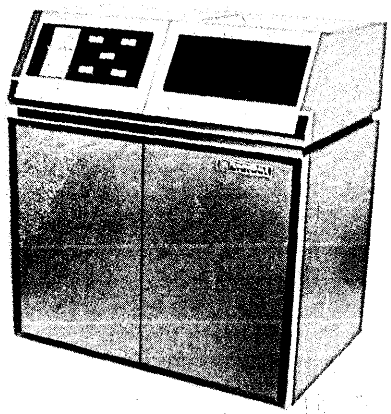

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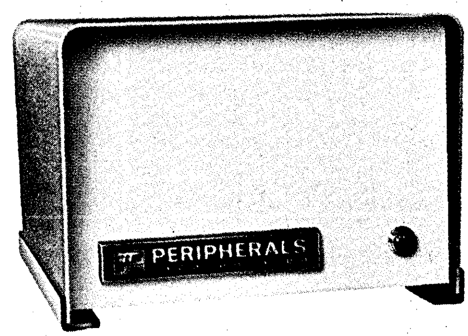

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University of Kansas, Lawrence, Kansas

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The Van de Graaff accelerator at the University of Kansas Nuclear Structure Laboratory is a four million electron volt machine, which means that it is capable of applying a force sufficient to bring a proton up to speed of roughly 10% the speed of light, or 18,000 miles per second, before it strikes its target. In nuclear physics, this is considered a low energy level.

Since atoms are mostly empty space (something in the order of one part in 10^{15} by volume is matter), most of the ions impinging on the thin layer of target material pass right through without hitting anything. Those that do strike a nucleus cause a kind of explosion which may produce many different fragments and tremendous—for the small scale involved—amounts of radiated energy. However, the fragments and radiations produced are characteristic of the target material, and hence give valuable insight into nuclear structures, their energy levels, and their binding forces.

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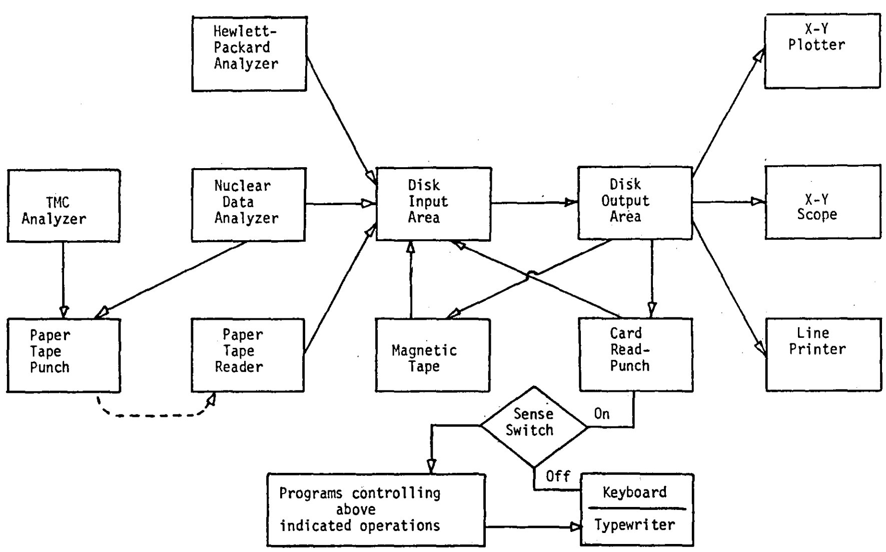
application

The Van de Graaff is basically an electrostatic machine. An electric charge from a 50,000-volt external source is picked up on an insulated belt and stored on the inside of the large, sealed tank. The tank is filled with nitrogen, carbon dioxide, and sulfur hexafluoride at greater than 20 times atmospheric pressure to prevent sparking or fires and to minimize the leakage of the static charge. When the charge builds to the 4 MeV level, the ion stream is discharged toward the target from an internal source. In the case of the UK accelerator, these ions may be protons, deuterons (heavy hydrogen atom nuclei), or alpha particles (helium nuclei).

The stream of charged particles begins its travels in a vacuum tube within the accelerator. The tube is surrounded by charged metal rings which create an electric field around it; the field, in turn, keeps the movement of the particles in a straight line. Just after passing out of the generator the particle stream moves through a mag-



Data flow under IOSUP

netic field which deflects it toward one of several target sites. Three types of detectors at the target station are used to determine how much radiation, how many nuclear fragments and, when possible, what kind of fragments are produced by the impact of an ion with the target. Gamma rays (including X rays) are picked up on scintillation detectors and on a special form of surface barrier detector made of germanium and lithium. Other surface barrier detectors are used to count the particles produced and to identify them when this is possible.

The analog signals emitted by the different detectors are amplified and fed to three different pulse height analyzers, including one supplied by Nuclear Data, one by Hewlett-Packard, and another by Technical Measurements Corp. The Nuclear Data 161F is a 4K-channel, dual-parameter analyzer with a buffer capacity of 18 bits per channel. It has dual analog-to-digital converters for translating voltages from the detectors into numbers of up to 12-bit resolution. These numbers, are then treated as channel addresses and are transferred to double-word tables with the 1800's core. Run numbers, read from toggle switches on the analyzer, are stored in a separate table. Once in core, the pulse height data is converted to floating point and stored on the IBM 2310 disc cartridge. Options in the operation described permit taking six-bit numbers from each a/d converter into core as fast as they are generated without intermediate storage in the analyzer, and for writing to mag tape instead of to disc.

The Hewlett-Packard 5400A analyzer is a 1K-channel single parameter device which converts data to six-place BCD integers and transmits eight 4-bit BCD digits for each channel into consecutive core locations.

The third analyzer is a 400-channel Technical Measurements Model 404. It allows for up to four inputs to its single a/d converter, and transmits five BCD digits per channel. Normally this device outputs to paper tape, which can then be read into core in a non-real-time mode.

The 2310 disc has only one drive and uses single-disc cartridges with a capacity of five million bits each. In the University of Kansas configuration, part of the cartridge is used for systems space, part for an input area to accept data from core, and part as an output area for driving the Fairchild crt, the line printer, and the two plotters.

From the real-time outputs the scientists can determine whether the sensors are functioning properly, when a sufficient amount of data has been collected, and when they can proceed to the next step safely.

software

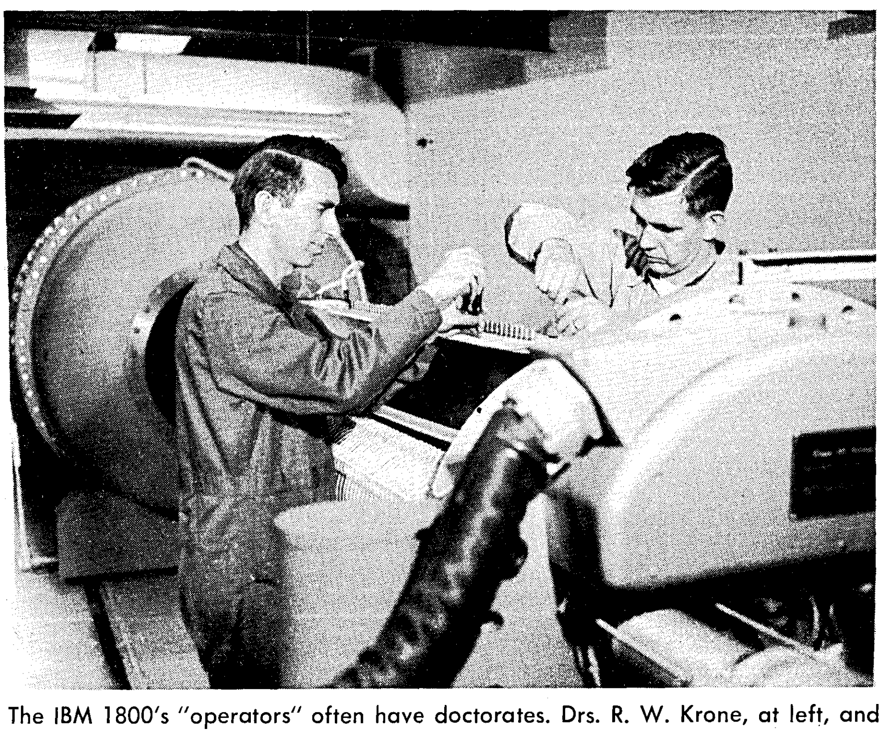
The operating system, IOSUP, is constructed for two main purposes: setting up an orderly sequence of I/O routines and causing them to be executed. Although it allows for auxiliary functions such as dumping portions of disc storage, it is not now required to perform sophisticated data reduction or supervisory tasks. The nuclear physicists at the laboratory are considering using the 1800 with an upgraded monitor to control the course of an experiment, but that software has not been prepared.

IOSUP and its attendant routines are coded in FORTRAN with the exception of seven specialized machine language programs. Each input routine begins its operation by requesting information from the operator concerning the number of pulse height spectra to be gathered in a run, the number of channels per spectrum, the run number and title. The information is supplied to the system through a typewriter console and the 1800's data switches in response to specific typed questions. At start-up time IOSUP also requires the priority assignments of the input routines. This information is supplied in card format.

For purposes of printer, plotter, or display screen output, data from the Nuclear Data and HP analyzers are treated by the same routines, while outputs from the Technical Measurements Corp. device are handled separately.

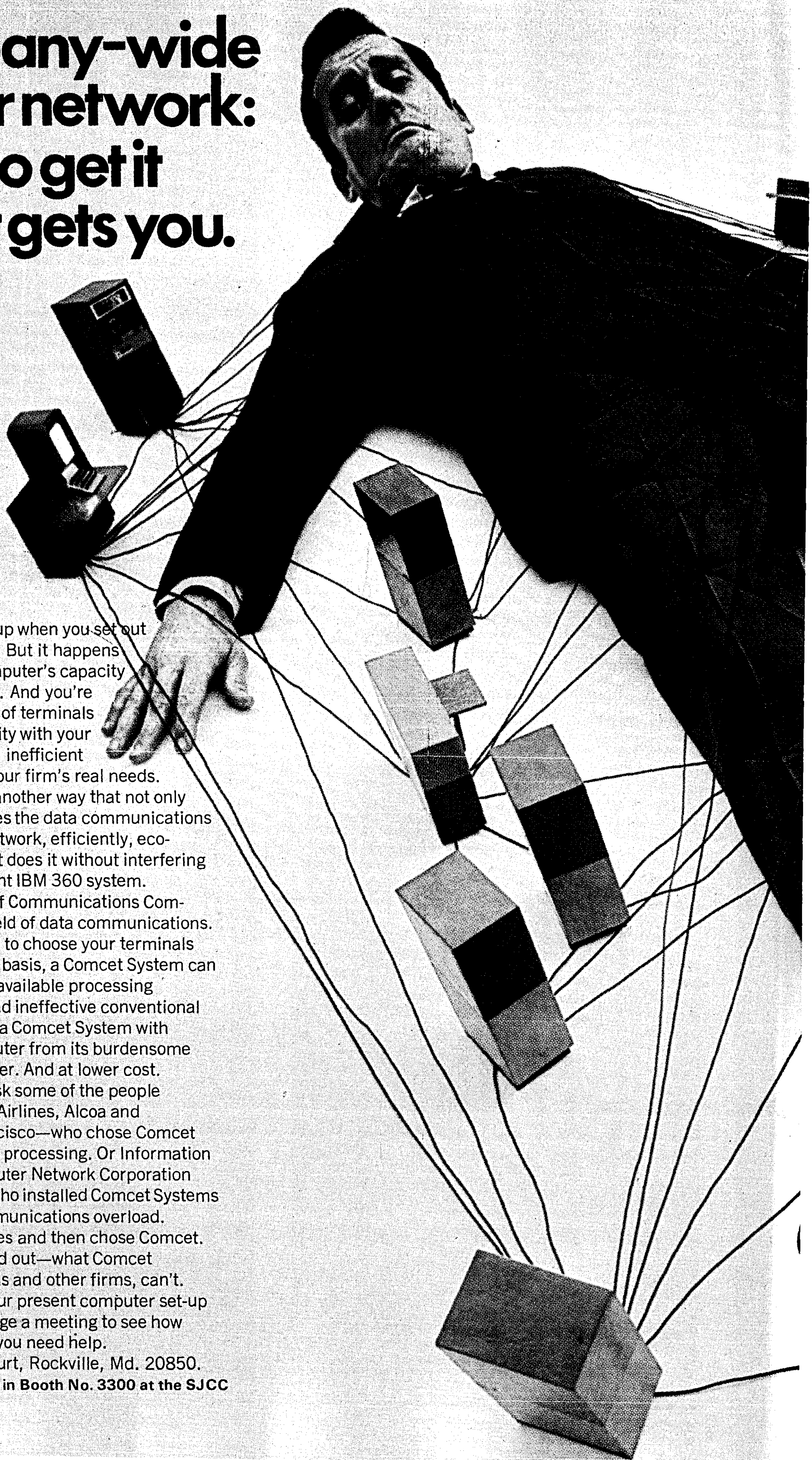
In addition to the I/O programs there are "system" and "user" routines for manipulating collected data. The system routines are all sorted on disc. They provide facilities for: (1) changing the run numbers, titles, or number of channels per spectrum; (2) adding a multiplication factor to data in the output area and calculating rms error for each channel in the input area; (3) calibrating the spectra in the output area by linear or quadratic means; and (4) gain-changing spectra in the output file.

User routines, which can also be stored on disc and executed under IOSUP, can be for anything. For example, some are written for running excitation curves, data format conversion, and spectrum compression. Basically, they perform the data reduction tasks not accommodated by IOSUP itself. ■



The IBM 1800's "operators" often have doctorates. Drs. R. W. Krone, at left, and F. W. Prosser, right, are shown with the accelerating tube (which has been removed from the chamber in the background).

The company-wide computer network: How to get it before it gets you.



You didn't expect to get all tied up when you set out to computer-link your company. But it happens too often. Too much of your computer's capacity gets tied up in communications. And you're still locked into a particular line of terminals based solely on their compatibility with your main computer. The result is an inefficient system that's unresponsive to your firm's real needs.

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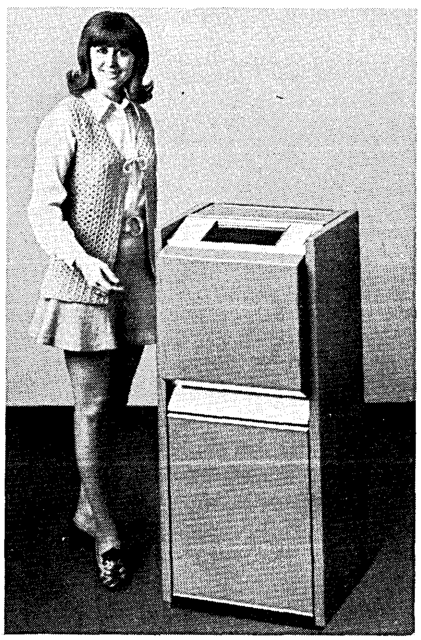
CIRCLE 124 ON READER CARD

new products

For additional new products being introduced this month, please refer to The Product Preview in the special Spring Joint Computer Conference section.

150 lpm printer

The Profitprinter 150 marks the entrance into the computer peripherals field of a company well known for its services (including the "Quotron" stock market reporting system). The 150 is a double-buffered line printer capable of spilling out copy at 150 lpm using a 64-character set. Versions are



available for 50-, 80-, or 132-column printouts. Spacings are six lines per inch, 10 characters per inch.

The standard model is built for 1200 baud asynchronous operation, with a communications interface and modem available as options. Also available are interfaces for plug-to-plug compatibility with tty networks, minicomputers, and IBM 360 systems 30 through 65.

The print mechanism is based on a plastic-tired drum which can quickly be replaced in the field if necessary as can 17 other primary components. To help the field engineer, a diagnostic panel with lights for these subassemblies is built in. Also, unlike most new vendors entering a market, this firm has 28 field service offices and 38 contracted service offices already in operation.

The Profitprinter is built to sell for $7500 in unit quantities, falling to about $6000 in quantities of 10. These prices include the "universal" interface set up as the user desires. SCANTLIN ELECTRONICS, INC., Los Angeles, Calif. For information:

CIRCLE 317 ON READER CARD

honeywell midi

Honeywell has extended the lower end of its Series 200 family with the eleventh machine in the line, the Model 115 (not to be confused with the new *Series* 15). The new machine is disc-oriented and will compete in the $2500-6000 / month range, against such contenders as the 360/20, Univac 9200/9300, and Century 100. It is intended for first-time computer users and users of competitive hardware who want random-access capability. Programs and applications now run on competitive equipment can be converted for the 115 using Honeywell Liberator techniques, such as RPG to COBOL and Easytran. The Mod 115 operates with the Mod I (Mass Storage Resident) Operating System or the Disk COBOL Programming System. It will be marketed bundled, of course.

The 115 is a fully integrated circuit computer with main memory cycle time of 2.75 usec. Basic core memory of 16K characters is expandable to 32K in 8K increments. Other features include two read/write channels, integrated peripheral controls for disc drives, punched card equipment, and a line printer. A third read/write channel is optional. Software includes financial editing instructions.

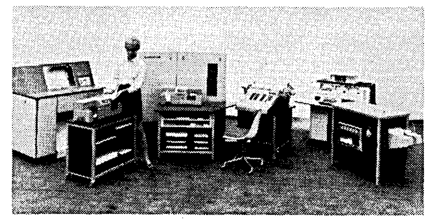
Peripherals available include printers at 300 to 1100 lpm, a card reader/-punch that reads 400 cpm and punches 100 to 400 cpm, and a variety of mag tape drives with read/write simultaneity. Disc drives available include the Type 155 two-spindle and the recently announced Type 172 single-spindle drive that accepts 10-surface disc packs. Up to four spindles of either type can be connected to the cpu to provide storage up to 36.8 million characters.

First deliveries of the 115 will be made in June. A typical configuration with 16K memory, 300 lpm printer, card reader/punch and 7.2 million characters disc storage will rent for $2,625/mo. on a five-year contract and sell for $125,890. HONEYWELL EDP, Wellesley Hills, Mass. For information:

CIRCLE 318 ON READER CARD

cobol accounting machine

As if in accord that there is only one way to go, calculator manufacturers have started building calculators that look like computers (or just started building computers period), and accounting machine manufacturers have begun building accounting machines that operate like computers. The



E8000 is described as a machine that can function under operator control like an accounting machine and also function under program control like a computer. It is something like its predecessor, the E6000, but has the significant advantage of understanding COBOL. It also has the advantage of dual card readers, a new keyboard, and a golf ball element printer.

The COBOL capability—a subset of the B500 COBOL—provides some program compatibility between the E machines, the Burroughs L and TC series of remote terminal processors, and the B500 computers. Programs written in E8000 COBOL will compile on any B3500. The accounting machine automatically assembles its own programs in a symbolic assembler language.

The dual card readers' prime advantage is their capability to merge data without collation and decollation of master file and detail punched cards. The units can handle 300 cards per minute in flow mode and 200 cards per minute in demand mode. In addition to the keyboard and ball printer (19 cps), I/O for the E8000 is magnetic stripe ledger card, perforated tape, and a 164 lpm wide line printer.

Storage capability of the E8000 is 400 words (12 digits plus sign) of core. The price of the machine will range between $35,000 and $60,000. Leases are from $875/month to $1500/month. BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 319 ON READER CARD

s/3 competitor

The success of the GE-55 and growing enthusiasm for the first-time user market has brought the GE-58 into the U.S. as part of GE's competition for the IBM S/3.

The basic GE-58 system includes a

cpu with 5K bytes (expandable to 10K) of 1.2 usec cycle storage, a data entry station, digital display, 100 or 200 lpm printer, 100 or 200 cpm reader, and 40 cpm punch.

Average instruction and execution speeds are 115 usec add time, 3.5 msec multiply and 20 msec divide time. The 58 has 100 index registers, eight high-speed and three standard I/O channels. Maximum transfer rate is 400K bytes per second.

The 58 has a read-only memory that performs basic arithmetic, I/O operation, and special functions such as disc management and data communications. It also controls machine programming. The 350 msec ROM has two sizes, 1024 and 1536 words. Each word is 40 bits plus parity. The smaller has a 63-instruction repertoire and the larger, 86 instructions.

Addresses per instruction are from 0 to 5. Floating point is available in a software subroutine. Multiprogramming is also a feature of the GE-58.

Embellishment to the basic system can take the form of either tape or disc and communications. The disc unit—GE's DSU-162—provides 2.88 to 11.52 million bytes of storage with a 72.5 msec access time. Communications capability is through the Datanet-51, a 2400 baud, single line communications controller.

The system has family compatibility with the GE-55 and can use its software library.

The GE-58 (and 55, IBM S/3, H 15 Series and Hetra S Series) market is seen to be divided between tab shop upgrading and accounting machine upgrading. The GE-55, according to the company, has had successes in the latter, and the 58 is expected to continue this and make inroads in the tabulating field.

GE feels its systems' use of keyboards make them attractive to the accounting machine people, and in combination with the 58's speed will be more attractive to the tab card processor. Acknowledging that the S/3 is a card walloper (all competition quietly

PRODUCT OF THE MONTH

portable crt

The Logiport/1 is probably the industry's first portable crt/keyboard terminal, although at press time another firm was preparing to announce a competitive product. It's the first product of a year-old firm which is so young that some of its officers still fear the draft. But their pitch is convincing, the product looks attractive, and they claim their market research shows a demand for such a unit.

The unit's portability is about the same as a typical portable stereo . . . though you don't see too many of those being carried about. Logiport/1 weighs about 26 lbs., measures 21x17x7.5 inches, and uses a retractable 5x7 inch screen. It includes a standard alphanumeric keyboard and integral acoustic coupler. Just plug it in and go.

A switch permits selection of 10 or 30 cps transmission. Two operating modes are selectable by a front-panel push button: the LOCAL mode, providing page transmission which allows local editing; and the ON-LINE mode, transmitting character by character identical to a tty. In either mode the user can select half or full duplex. When the screen is full, the top line is deleted and the information remaining on display is shifted upward to allow new characters to be entered on the bottom of the display, just as a tty rolls up the paper.

The unit is tty-compatible, of course. It uses semiconductor memory and an MOS character generator. A special power supply permits operation off "any line power in the world." The crt displays 16 32-character lines. Single unit price is $2950, with reduction to $2550 if you want 50. The Logiport/1 will be displayed at a suite concurrently with the SJCC.

It's ready for delivery in 60 days ARO. Sales and maintenance will be provided nationally through independent representatives. LOGITRON INC., Cambridge, Mass. For information:

CIRCLE 316 ON READER CARD

points out that their machines still use 80-column cards) it's felt that the combination of keyboard and card can offset it in all but straight batch operations.

But the company said its biggest marketing headache is not the S/3, but the problem of alerting potential users that there is a system they can afford and justify. Its monthly rental ranges from $910 to $2200 depending on whether it is a card or disc system. Purchase price begins at $35,490. Initial marketing will be in major metropolitan centers—with Chicago, Detroit, Philadelphia and Phoenix named. Delivery time for a card system is four to six months ARO. Disc system delivery is nine to 12 months ARO. GENERAL ELECTRIC CO., Phoenix, Ariz. For information:

CIRCLE 320 ON READER CARD

Always eager to see standards accepted, we jumped the gun in attributing ASCII capability to the Novar 5-41, which is compatible with IBM 2741 terminals instead. That sort of makes it "industry standard."

85, 195 channel, disc

Expanded high-speed data channel capabilities and a fixed head disc storage unit have been announced for the System/360 Models 85 and 195. The channel, called the IBM 2880, is a block multiplexor channel with a maximum data rate of 3 million bytes per second, double the rate available with present IBM channels. Using the 2880, up to 12 high-speed channels can be attached to the Mod 85 and up to 13 to the 195. Previously, six was the maximum.

The disc unit, called the IBM 2305 fixed head storage facility, provides access to up to 22.4 million bytes of information. Data blocks from direct access devices such as the 2305 can be multiplexed along the 2880 channel's single data path. The 2305 comes with one or two disc drives, each housing six 14-inch oxide-coated discs. Read/write heads are permanently fixed over the tracks on each disc, which may present a problem for IBM salesmen who denied the virtues of this design when offered by other manufacturers.

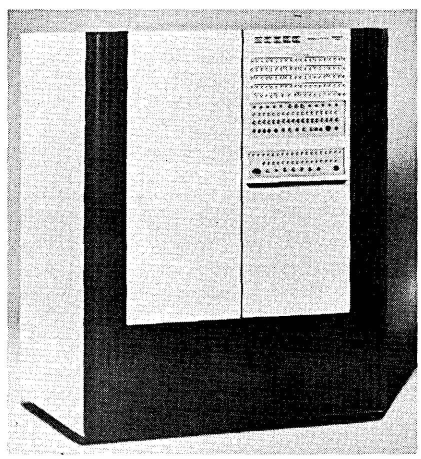
One version of the 2305 offers capacities of 5.4 million bytes per disc, with average access time of 2.5 msec and transfer rate of 3 megabytes per second. The other version has capacities of 11.2 million bytes per disc, with average access time of 5 msec and transfer rate of 1.5 million bytes/second. Rotational position sensing allows the unit to signal the channel when transmission should begin, keeping the channel's data path free to handle other requests in various stages of execution. Logic within the 2305 permits it to search for up to 16 requests simultaneously.

Rental for the 2880 is $3,000-4,950/month; purchase from $141,000 to $232,650. First shipments are scheduled for the first quarter of next year. The 2305 is $6,400-12,800/month; purchase $300,800-601,600. Deliveries begin in the second quarter of next year. IBM, White Plains, N.Y. For information:

CIRCLE 324 ON READER CARD

communications processor

GE figures place the growth of the time-sharing industry as going from $10 million per year to $150 million over



the past five years. GE seers also figure that the total on-line market—including remote batch and time-sharing and direct accessing—will reach $2 billion within three years and $3 billion by 1975. In an attempt to retain a big share of that market, the company has developed a communications processor far bigger than its previous offerings. Called the Datanet 500, the system is built much like a computer, with a processor, memory, communications subsystem, and I/O subsystem.

The CPU is capable of executing 200,000 instructions per second, and has a 100-instruction set. It has three accumulator/index registers, four levels of hardware interrupt, and a 256-word read only memory for bootstrapping. It performs an add in 2.4 usec.

Memory is available in 8K, 16K, or 32K modules for a maximum of 64K per system. Core cycle time is 1.2 usec. The word size is 20 bits—18 for two characters of data and one odd parity bit for each character.

The 500 can handle up to 250 low-speed (30-300 baud) lines or 125 voice-grade (to 2000 baud) lines, or other combinations of speeds to 2.5 million baud, transferring a total of 1.2 million cps. Outputs from dual arithmetic units are compared for every data transformation, to insure data validity.

The I/O subsystem is capable of handling two or three multiplexor modules, each with up to four peripheral subsystems or up to eight broadband (2.5 megabaud) channels. Discs and tapes and other peripherals can be directly connected to the 500 if desired.

Depending on the configuration, number and speed of lines, the Datanet 500 can run anywhere from $1500 to $20,000/month (putting it in the price range of an XDS Sigma 5); purchase prices start at $50,000. Deliveries are expected to begin in the fourth quarter. GENERAL ELECTRIC CO., Phoenix, Ariz. For information:

CIRCLE 322 ON READER CARD

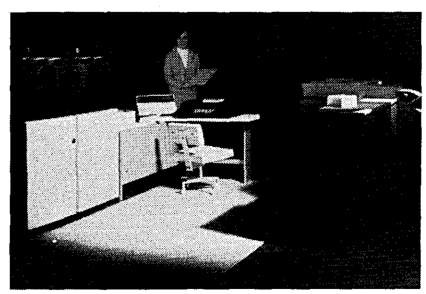
gp computer

In an effort to meet IBM head-on (at least in the lower half of the market), Honeywell has just developed its opponent to the 1130. This is the 1530, which with its less able sibling, the 1540, is the Series 15.

The systems, based on the Honeywell 316, have core memory expandable to 16,384 (16-bit) words, memory cycle time of 1.6 usec, priority and power failure interrupt, single addressing, integrated circuitry and a 72 instruction repertoire.

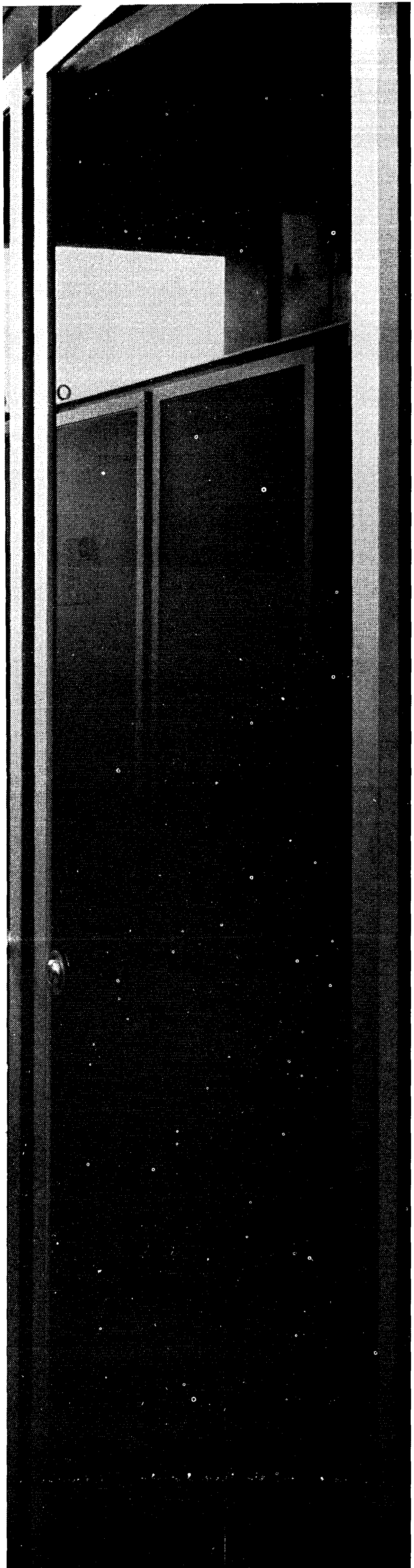
The 1530—for scientific/commercial use—has hardware multiply and divide, double precision add and subtract, and integrated peripheral controls. The same features are optional on the 1540.

The operating system for the Series 15—OS/15—is also new. It is disc resident and features a FORTRAN IV com-



piler, an assembler, scientific and commercial subroutine libraries, and a report program generator for commercial data processing.

The 1540's major uses are as a remote data concentrator or batch terminal in conjunction with the H200 computers. Its concentrator configuration would include the central processor, console, single channel communication control, and basic multichannel



Here's another good reason our time-share system is the most popular around:

90-day delivery!

You don't have to play the waiting game when you order our HP 2000A Time-Share System. It's ready for you almost as soon as you're ready for it. In most cases, you can take delivery 90 days after we get your order.

But getting customers on the air fast is just one reason for our system's success. There are plenty of others.

Like price. Our system costs only $90,500. Yet it handles 16 remote terminals simultaneously. This alone gives it one of the lowest costs per terminal-hour in the industry. And the modest initial investment is matched by the 2000A's remarkably low operating cost. Overall, it's the most economical time-sharing system going.

Simplicity is another reason for our system's popularity. HP BASIC is the easiest computer language around. That's why it's a favorite with scientists, engineers, educators, businessmen and other non-programmers. They can learn it in just a couple of hours, because it's almost like talking to the computer in English. Yet because the HP 2000A is so powerful, these users can put it to work on such sophisticated operations as matrixes, strings, and files.

The HP 2000A comes ready for your immediate use. All required software, control terminal and interfaces are included. And this system keeps on working and working and working. In fact, our customers have already logged over four million terminal-hours of successful, trouble-free operation.

With this kind of money-saving reliability, it's no wonder our time-sharing system is the most popular one around.

Need further proof? Call your local HP computer specialist. Or write to Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

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DIGITAL COMPUTERS

CIRCLE 64 ON READER CARD

22934

communication control that accepts up to 32 low-speed lines.

Single-channel control options permit either synchronous or asynchronous transmission, operation over private or switched networks and transmission of 6-, 7-, or 8-level code. The controller interfaces with standard Bell System or equivalent data sets for synchronous transmission at rates of 2,000 to 50,000 bps.

Peripherals for both systems include a disc drive with up to 2.88 million word storage, 100 msec access time and a 55,312 word/second transfer rate; a 300 lpm, 120 or 132 position line printer; 400 cpm card reader or reader/punch with a 100 to 400 cpm punch rate; and either 26 ips, 200, 556 or 800 bpi, 7-track tape drive or 36 ips, 200/556 or 200/800 bpi 9-track tape drive.

A typical 1530 system—cpu, console, line printer, card equipment and disc store—will lease for $1,841/month on a five-year contract. Purchase price would be $83,780.

The typical 1540—cpu, line printer, card equipment and communications interface—will lease for $1,671 on a five-year contract and have a purchase price of $74,970. Deliveries of both systems will begin in July. HONEYWELL EDP, Wellesley Hills, Mass. For information:

CIRCLE 323 ON READER CARD

intelligent controller

Remote batching is the order of the day, but even this leads to a difficult decision for some. Do you buy expensive but flexible remote batch controllers (generally units built around a general-purpose computer stripped down to lesser tasks) or freeze the terminal configuration so that hardwired controllers will do the job? The answer to the either/or question may be no.

There is a choice with units like the M&M remote batch terminal. For instance, the M&M has the ability to vary its I/O formats to fit changing requirements and to accept a varying configuration of terminals or peripherals. It can handle line printers, card readers, paper tape punches, up to 20 teletypewriters, 12 crt displays, or mag tapes. It can handle full- or half-duplex transmissions at 2000 or 9600 bps, and comes with built-in automatic answering, automatic turnaround, multiple record transmission, horizontal format control, EBCDIC transparency, and multipoint line control. It can also talk in ANSI or Transcode, and has a 4K 16-bit memory expandable to 32K.

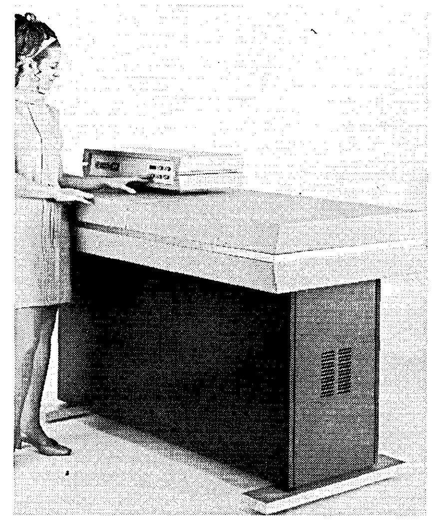
It isn't really cheap compared to a hard-wired controller. It runs $20,900 before line printers or card readers or whatever is attached. But at least this is an honest kind of pricing, with the vendor *not* providing peripherals at an additional mark-up but letting the customer order direct. M&M COMPUTER INDUSTRIES, INC., Orange, Calif. For information:

CIRCLE 325 ON READER CARD

on-line/off-line filmer

This vendor was one of the first to smash the $50,000 barrier for computer output to microfilm devices when it introduced the Model 1300 (Product of the Month, Dec., 1969). The 1300 is an off-line device. The 2600, on the other hand, is on again, off again. The follow-on unit prints 132-character lines on 16mm film at a rate of 2600 lpm (compared to 1300 lpm for the Model 1300), making for a claimed throughput rate between 240 and 600 pages per minute, depending on the number of lines per page. The characters are from a Gothic set of 64 that is expandable to 90 to include lower case. Bold and normal faces are a standard feature.

The 2600 can be connected on-line to an IBM 360 series machine, then taken off-line and used with any IBM-compatible 9-track 1600 bpi tape transport. It prints printer records of



fixed or variable length, blocked or unblocked, recognizing all the normal printer commands, using EBCDIC. Lines per page is an operator selectable function with a ceiling of 86 lines.

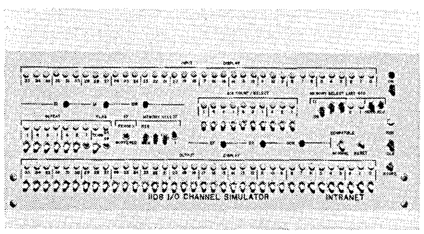
The company didn't quite break the $50,000 threshold this time. Instead, the 2600 is expected to sell in the $60,000 range. A card reader—for variable input formats—a print list

mode, and a 42X reduction feature are carried as options. PERIPHERAL TECHNOLOGY INC., Sunnyvale, Calif. For information:

CIRCLE 321 ON READER CARD

fake 1108

Not too many companies take the road that this firm has, starting out to be a service bureau and becoming a hardware vendor on the side. This product is called the Model 9181. It's an I/O channel simulator which looks like a Univac 1108 to a peripheral. Its reason for being is just that—to fool peripherals. When a vendor is building a plug-in compatible peripheral for Univac gear, why tie up an 1108 to test one peripheral? Similarly, when a piece of equipment goes down, why use an 1108 to debug it? This latter argument makes it sound like Univac should buy



them for its field engineering staff. Although not many will probably be bought by purchasing agents at Univac, some should find their way into private collections after the exchange of something under $20,000. INTRANET COMPUTING CORP., Los Angeles, Calif. For information:

CIRCLE 326 ON READER CARD

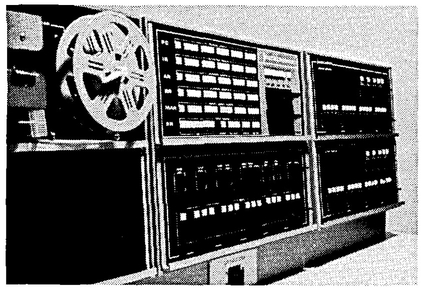
16-bit computer

A configuration diagram of a full-blown Mini/Max 16-bit computer would probably look more complicated than a similar drawing of the Manhattan phone system. For instance, the common I/O bus can handle a theoretical maximum of 256 devices. Each of the 16 buffered I/O channels has a maximum addressing capability of 256 devices, too. Plus, there are provisions for direct memory access. Although no one would try to draw it, the flexibility that drawing would demonstrate is there, anyway.

More practical measures of the machine are these: It has a 4K 2-usec core which is expandable to 64K in increments of 4K. And it can accommodate up to four modes of operation on a single channel. (For instance, this means that a teletypewriter could input and output in four formats, including perhaps single character ANSI, double character ANSI, sign and five digits, or four BCD digit transmissions.

Off-the-shelf peripherals include a 400 cpm card reader, a 125 cps paper tape reader, 110 cps paper tape punch, Teletypes, a disc, and a line printer. Each channel, including the bus, is good for a maximum of 250KC transmissions; the DMA runs up to 500,000 words/sec.

Supporting software now includes a two-pass assembler (rapidly being converted to a single-shot system),



floating-point arithmetic routines, debug, diagnostic, and peripheral utilities. The software can use the machines' 79 instruction types in up to 3000 generic forms.

The cpu hardware includes up to 21 registers—12 index registers, four auxiliaries, a couple of arithmetic registers, plus others. The hardware also provides for multiplication and division.

For the cpu with 4K and power, the vendor is asking $16,500. OEM builders are offered less of the hardware at costs reflecting quantity discounts and depending on how much circuitry they need. For instance, the cpu has been sold in large quantities in a stripped form for as little as $2500. INFOTRONICS, INC., Houston, Texas. For information:

CIRCLE 327 ON READER CARD

point of sale

Positran is an electronic cash register that can accommodate up to 20 digits of merchandise information, handle cash and credit sales, returns, refunds, mark-downs, payments, and compute the amount of change due the customer. The merchandising information is keyed in by the operator, but a tag reader is available optionally to automate this process. Also optionally, the unit can compute tax on a percentage basis. Positran provides up to eight totals and produces adjusted totals that will automatically reflect a true picture of the day's receipts.

For the smaller retail concern, the mag tape cartridge may be removed and sent to a service bureau. For larger organizations, Positran can be connected to the store's phone line and send the data to its center for overnight processing. Positran may also be

Get more out of your 360

Give this to your typist types

You're looking at the Bunker-Ramo 2206 Data Display Station. It lets your fast typists feed or retrieve information from your computer. Quickly. Because it's fitted with a standard typewriter keyboard. This desktop unit also has editing keys and 16 programmable function keys. Your employees read their questions or answers in plain English on its TV-style screen.

Give this to your non-typist types

The Bunker-Ramo 2212 Data Display Station is unique among CRT terminals because of its block-alpha keyboard. This keyboard speeds even the slowest hunt-and-peck inquiry or input. The 2212 also features a block-numeric cluster and 24 editing and programmable function keys. It is a podium-style unit for standup use in warehouses, ticket counters, etc., and is ideal for entry of brief messages and inquiries.

Both the 2212 and the 2206 work with the 360 or any other computer and connect over standard data communications circuits.

Find out how manufacturers, utilities, airlines, department stores, hospitals and others are using Bunker-Ramo CRT systems to get more out of their computers. Write or call Mr. Guy Mallery, Vice President, Business and Industry Division, The Bunker-Ramo Corporation, Stamford, Connecticut 06904. Phone (203) 348-4291.

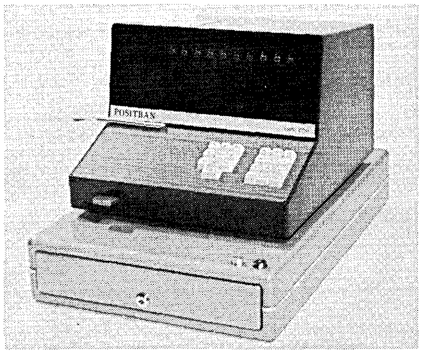
See us at the SJCC in Atlantic City, May 5, 6 and 7 at booths 47001 and 47008.

BUNKER-RAMO ®

CIRCLE 37 ON READER CARD

used in an on-line system.

Depending on the options, Positran rents from \$75-\$150/month. The vendor provides complete turnkey service, and if they do the processing, the rental price includes use of an \$18.5K



controller. Supplies, service, and communications costs are extra. The units sell for between \$2650 and \$4550, again depending on options, for the user with his own computing capabilities. UNIS CORP., Glendale, Calif. For information:

CIRCLE 329 ON READER CARD

s/3 terminal

Latest model in the ASC 1170 communications terminal line (Sept., '69, p. 205) is the 1170/3 with System/3-compatible peripherals. The new capabilities include 96 column, 500 cpm card reader and 120 cpm punch units that permit communication at rates up to 4800 baud. The 1170/3 system includes a processor in combination with a complement of peripherals for operation as a remote communications terminal or stand-alone batch processing system. Presently available peripherals include printer keyboard, 400 lpm printer, paper tape reader/-punch, crt, disc, and 80 column card I/O devices with appropriate communications line adapters. ASC 1170/3 communications terminal prices begin at \$20K. Deliveries start in the first half of next year. APPLIED SYSTEMS CORP., Detroit, Mich. For information:

CIRCLE 328 ON READER CARD

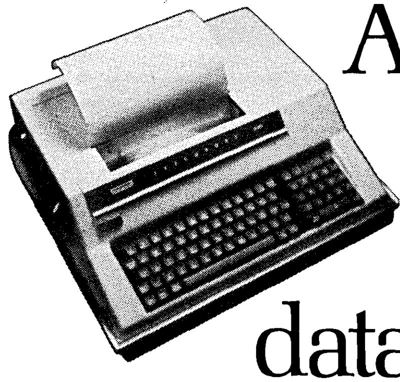
minicomputer

The Model 803, Processing System is probably best described as a byte-oriented 16-bit machine. It is byte-oriented in that its core memory is addressable to the 8-bit byte level, and in that its multiplexor channel—the primary interface between the processor and low-speed peripherals—is an 8-bit connection. On the other hand, core fetches always bring back two bytes, standard fixed-point arithmetic instructions act on 16 bits, and the read-only memory is arranged in 16-bit micro-instructions. To further complicate the word-size assignment, the manufacturer refers to 16-bit half-words in its documentation, and instructions may be either 16 or 32 bits long.

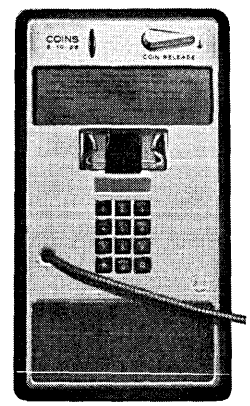
The 803 is built around an Interdata 3 with an 8K byte core (expandable to 64K) which has a 1.5 usec cycle time and is supplemented by read-only memory. There are 16 instruction types implemented in ROM, including some for byte processing, loop control, and testing and branching.

The multiplexor can connect up to 256 devices and transfers data at 6000 bytes/sec in a block transfer mode. Basic I/O is through a console with a printer and keyboard. The printer churns out lines to 192 characters in width at 40 cps (numerics) or 30 cps (alpha). Options include paper tape equipment, direct memory access, four kinds of disc subsystems, line printers, mag tapes, communications controller, card gear, ROM floating-point and trig, high-speed arithemetic in ROM, and a real-time clock.

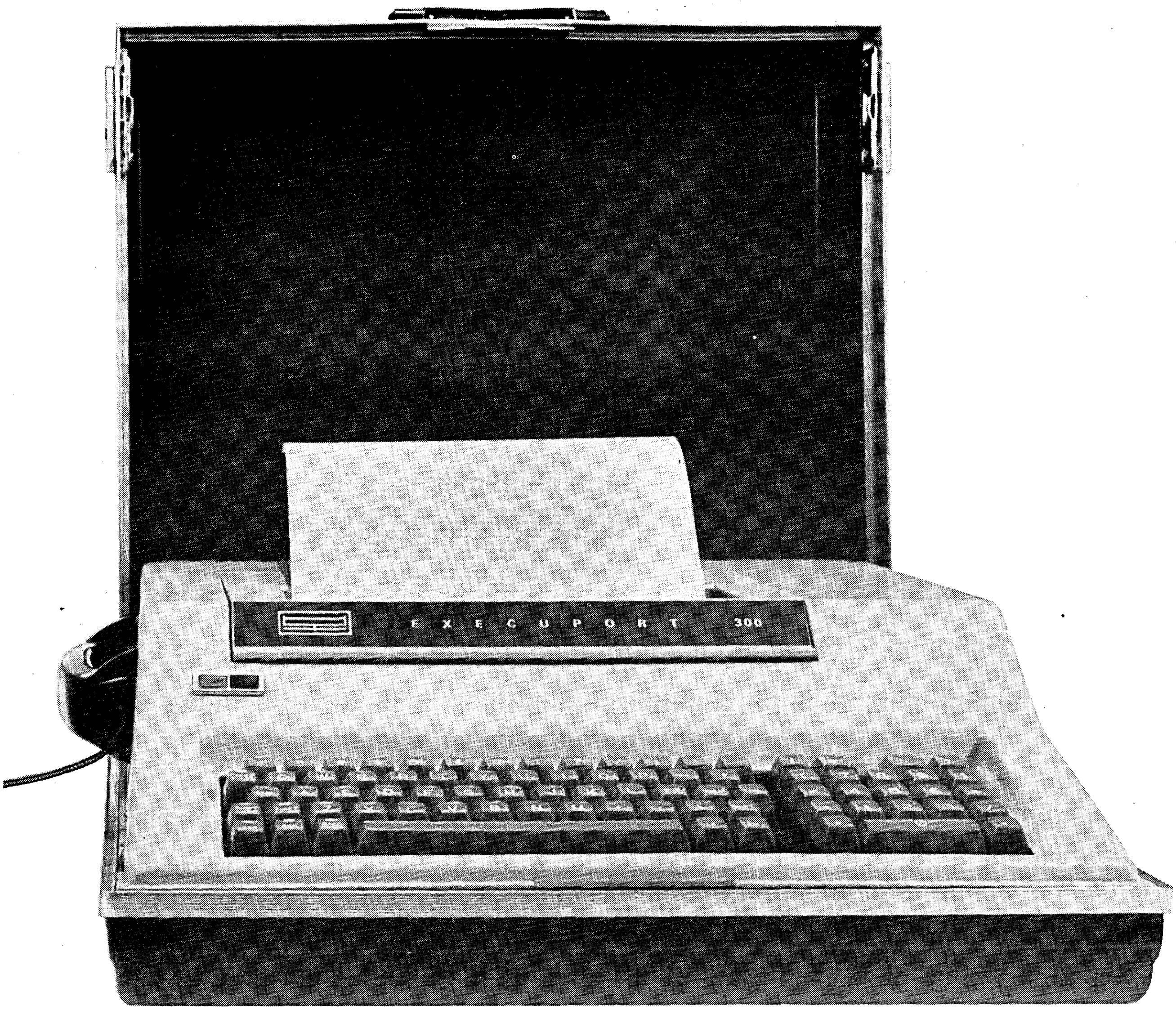
Software includes routines for loading, editing, debugging, an assembler,



All you need
to take our
data transceiver
anywhere at all
is a  dime for
the telephone.



Execuport 300



...the portable one!

Wherever business may take you, take along your Execuport 300. It's your indispensable link with the home-office computer.

Execuport 300 is the thermal page-printing data transceiver that's ready to go to work anywhere.

It's a high-speed printer: The operator selects 10, 15 or 30 characters per second. It's so quiet that all you ever hear is the unobtrusive tapping of the print-head. Solid-state circuitry promises a new level of maintenance-free reliability.

And Execuport 300 **is** the portable one. Keyboard, thermal page printer, solid-state control logic, telephone coupler, data access jack and interface, plus a universal interface for peripheral accessories — **all** components are enclosed in an attractive, integral carrying case.

Total weight is about 27 pounds. Including the dime for the telephone.

COMPUTER TRANSCEIVER SYSTEMS INC.
123 Pleasant Avenue, Upper Saddle River, New Jersey 07458

To see and hear for yourself, visit Booths 203-204-205 at the 1969 Spring Joint Computer Conference in Atlantic City, May 5-6-7.

This beautifully-put-together sample plot is yours for the asking.

It's a composite plot produced by Dresser's new Lasergraphic Plotter—the LGP-2000. On one 30-inch by 40-inch plot you'll get a glimpse of the LGP-2000's unique plotting capabilities. There's a photo of the earth composed of 1,600,000 points that's done in 16 shades of gray. There's a piece of a contour map that was originally produced with 3,000 inches of line and 2,000 characters of annotation. And there are other things like grid squares, alphabets, seismic records and concentric circles that will prove to you that the LGP-2000 is really a new dimension in computer graphics.

There are two things that you can't see on the composite plot: the LGP-2000's speed and its plotting size capability. It will plot up to 40 inches wide by 100 feet long. And it will do it as fast as your computer can feed it data. The LGP-2000 drew the entire 30-inch by 40-inch composite plot in only 3 minutes and 10 seconds. No other plotter can offer you speed like that.

Get your personal copy of this beautifully-put-together composite plot today. Write Dresser Systems, Inc., P. O. Box 2928, Houston, Texas 77001. Or call us at (713) 781-5900.

DRESSER

Dresser Systems, Inc.

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The average reading time for this ad is 30 seconds. In this time Dresser Systems' LGP-2000 could have plotted 30,399,690 bits of information.

CIRCLE 177 ON READER CARD

fixed and floating math routines. A disc operating supervisor is listed as an option.

The basic system comprises the cpu (the Interdata 3 for the first shipments at least), 8K bytes of core, the 1K bytes of ROM, the keyboard, printer, and a 50 cps paper tape reader/-punch. This configuration is the 803 and is priced at about $30,000 (plus an additional $500-$600 for the paper tape-based operating system). Many systems are expected to go out with dual-spindle disc cartridge drives for about $10,000 more.

For users with speed requirements above the Interdata 3's 39 usec add time, another model (the 804) based on the Interdata 4—with 3.9 usec add time and hardware instead of software registers—runs about $3,000 more. NORTHWEST DATA SYSTEMS, INC., Kirkland, Wash. For information:

CIRCLE 330 ON READER CARD

discs for mini's

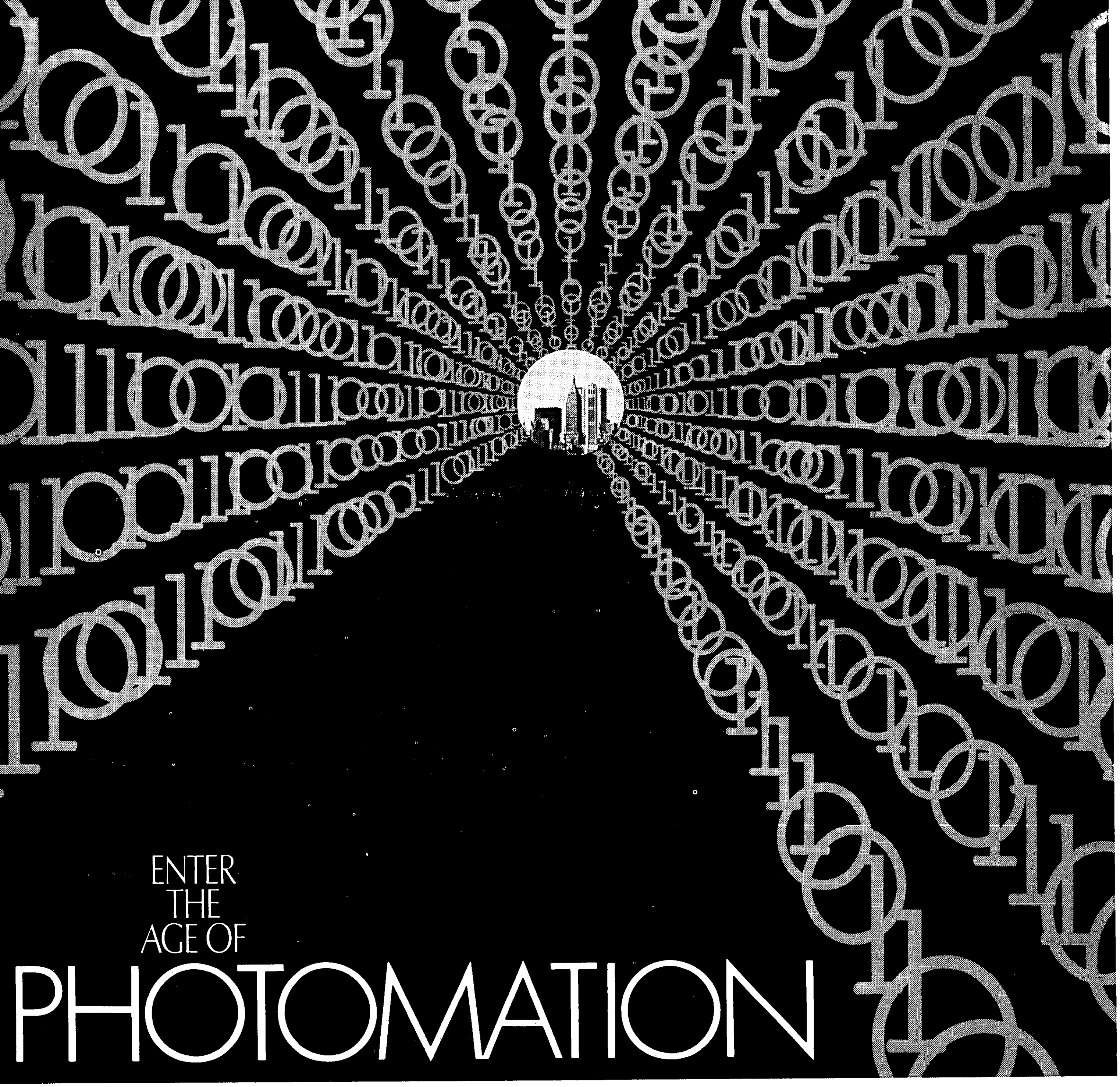
Plug-compatible disc memory subsystems are offered for use with the Hewlett-Packard and Varian families of computers. Given numbers in the 1700 series, the memories are rack-mounted and have access times of 16.7 msec. The 1703 is for the Varian 620i machine. It has four possible capacities, starting with a $7500 32K-word unit. The Hewlett-Packard version, the 1757, comes in four sizes, too, beginning with 46,080 words, also priced at $7500. Each subsystem comes with a power supply, a computer interface, installation, training, driver routines, and one year's maintenance. DATA DISC INC., Palo Alto, Calif. For information:

CIRCLE 334 ON READER CARD

universal interface

A computer-independent universal data interface that can couple any computer to any peripheral device—including one-of-a-kind units—that's the claim for the 832 Data Interface, featuring block transfer and priority interrupt capability for all peripherals. Different types of peripherals are controlled by individual device cards. Each card can service several peripherals of the same type, and the Data Interface can contain up to eight device cards. For example, at least four crt's may be interfaced with the cpu by means of a single device card while the other seven device cards service other classes of I/O devices, such as modems, rotating memories, or even satellite computers. Synchronization problems are solved by a system of registers in the device cards, whereby the computer is interrupted only when data to be transferred from the peripheral is already loaded into the registers.

The 832 Data Interface consists of three major sections: the host computer interface, the commandable executive structure, and the peripherals interface. The host computer interface uses one or two plug-in cards and occupies one position on the computer's program control bus and one on the direct memory access channel. The 832 utilizes automatic DMA channel transfer to achieve maximum throughput with minimum computer time devoted to I/O operations. Transfer time within the Interface is 600 nsec. The center section is the commandable executive structure which contains those portions of the peripherals interfaces and those of the host computer interface that are common. The executive structure handles all commands for data transfer between memory and peripheral in either direction, as well as priority interrupts. The third portion of the 832 holds the plug-in device cards. The cards make all periph-



Consider all that the digital computer has accomplished in the automation of words, numbers and lines. Now it's possible for pictures.

Photomation is the automation of halftone photographic images for transmission over telephone lines. Or for computer enhancing a reproduction to better quality than the original picture. Or for storage and retrieval.

The DICOMED 30 Image Display makes photomation possible. And practical.

It's a direct view CRT with a resolution of over one million points, each with 64 intensity levels.

This is *not* television. It's much more.

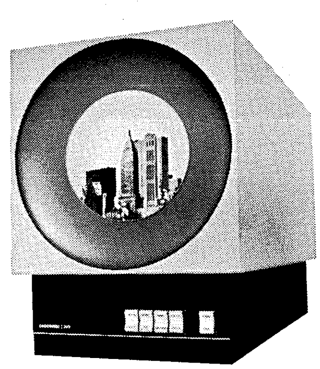
The DICOMED 30 needs no refreshing. It doesn't fade or flicker. Your picture stays solid as a print until you erase it.

This is *not* a film device. Digital film output takes most of a 24-hour day. The DICOMED 30 displays your picture immediately.

Photomation offers the advantages of TV and film without the drawbacks. And it costs far less than either.

Reproduce accurate pictures when and where you want them.

Write, or call (612) 920-8980.



BIRTH OF AN INDUSTRY

DICOMED

DICOMED CORPORATION Dept. D104 4600 W. 77th St./Minneapolis, Minn. 55435

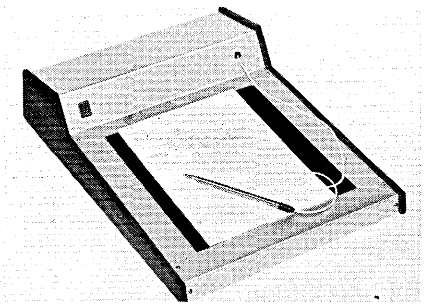
CIRCLE 132 ON READER CARD

erals appear logically similar to the computer. The computer's transfer speed is maintained unimpaired through the use of parallel transfer. A typical system runs about $10-15K, and requires 60 days ARO for delivery. EG&G, Salem, Mass. For information:

CIRCLE 331 ON READER CARD

x, y tablet

Ecricon 520 is a bidimensional, digital, graphic input tablet for use with general-purpose computers, remote display terminals, numerical control sys-



tems, and graphic communication equipment. The unit contains digital and analog outputs. Its resolution is 10 bits X and Y, and linearity is less than 0.5% peak to peak. Sampling rate is 1000Hz. Ecricon is available 60 days ARO and sells for $2,000 FOB Cambridge. SHINTRON CO., INC., Cambridge, Mass.

CIRCLE 332 ON READER CARD

audio terminal

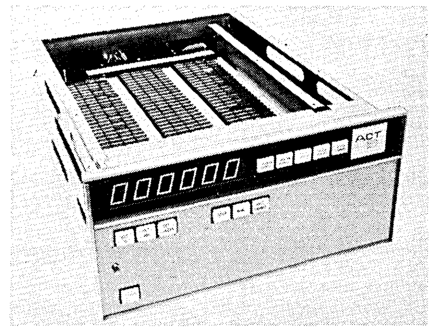
An eight-pound computer terminal like the Accutone 100 should be small enough to take anywhere, including into a prospective customer's home or office. Once there, it can perform two kinds of input functions, using plastic phone dialer cards with up to 14 characters each or its 12-key numeric keyboard. Its output is audio, through a built-in speaker system. In addition to these I/O components, the 100, of course, has an audio coupler for the phone. The terminal operates at 10 cps, and has indicators for power on, error, and data checks. Its price is $975 (or as little as $25/month). Deliveries require 30 days. COMPUTER UTILITIES N.W., INC., Seattle, Wash. For information:

CIRCLE 333 ON READER CARD

tough mini's

Somewhere between the realm of the commercial computer and the hardened military spec machine there is a place for the Micro/Magnum digital computers, the ACT-16 and ACT-18. These toughened mini's are described as having 1-usec memories of 16-bit or 18-bit words, six memory index registers, parallel I/O bussing, a direct memory access interface, and an octal readout on the front panel.

Built for rack mounting, they weigh about 45 pounds and are priced at $10,000 with a DMA and 4K of core. A

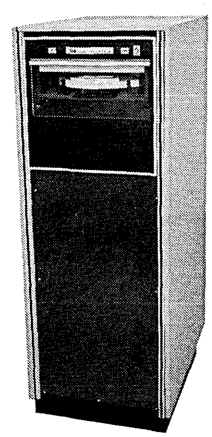


Teletype, real-time clock, interrupt unit, and magnetic or paper tape gear are listed under available options. Expanded memory, to 64K, is also optional.

Available software includes a relocatable (single- or double-pass) assembler, BASIC, conversational FORTRAN, multiple precision floating point routines for numbers up to seven

Now, a Disk Memory Drive, less than $3,000.*

IMMEDIATE DELIVERY FROM STOCK



A good Disk Memory Drive doesn't have to be expensive.

We're producing and delivering single-disk, removable-media, disk drives to major computer manufacturers at prices that are an industry breakthrough.

These disk drives, which utilize the IBM 2315 disk cartridge or equivalent, are built to meet the needs of the mini-, small-, and medium-size computer manufacturer. Conservative design and rigorous testing ensure ultra-reliable and consistent performance.

So if you spend more than $3,000 for a single-disk memory drive, you'll spend too much . . . a Disk Memory Drive doesn't have to be expensive to be good.

For further information and complete specifications, contact Jim Flynn at Computer Memory Devices, Inc., 5170 West Bethany Home Road, Glendale, Arizona 85301. Phone (602) 939-9444.

*In OEM quantities.

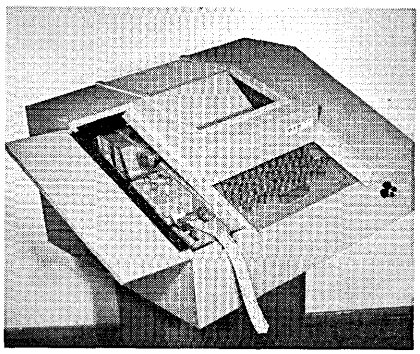
Computer Memory Devices, Inc.

5170 West Bethany Home Road, Glendale, Arizona 85301 words long, hardware diagnostics, math routines, and real-time control packages spanning fire control, telemetry, and process control applications. AMERICAN COMPUTER TECH., Northridge, Calif. For information:

CIRCLE 337 ON READER CARD

tty acoustic enclosures

Five layers of sound absorbing material are used in the construction of the 700 series SILENT TYPE acoustic enclosures that reduce noise from Teletype models ASR and KSR 32 and 33 by up to 12 db (90%). The vinyl covering



is offered in gray or tan; nine other colors are available optionally with quantity orders. Prices start at $139.50, and delivery is within 30 days ARO. DATA TERMINALS CO., San Jose, Calif. For information:

CIRCLE 335 ON READER CARD

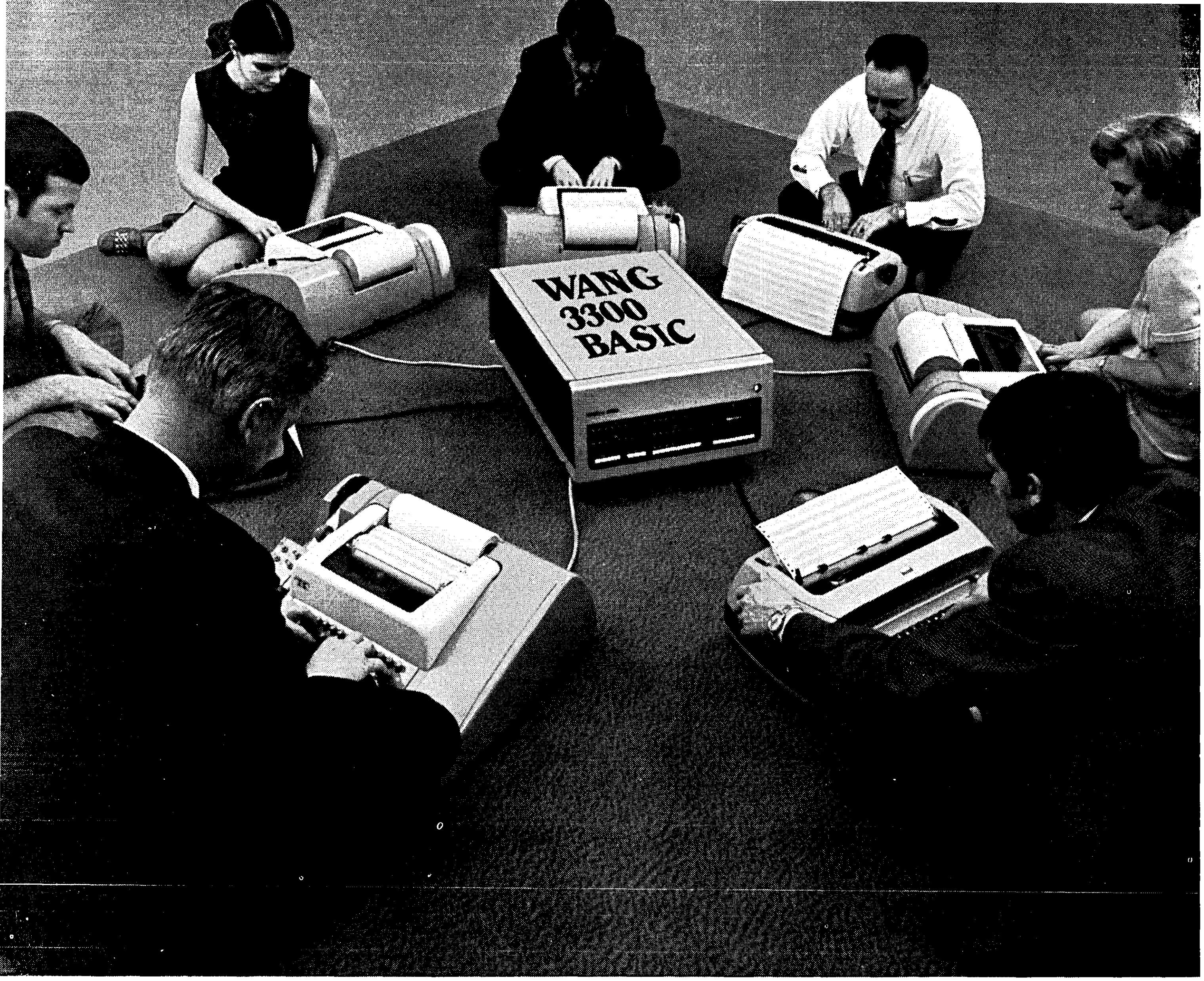
editing system

The Comtext-8 is an applications system consisting of both hardware and software, put together and marketed by a software/services firm—a new type of bundling that is becoming increasingly prevalent. The system utilizes the firm's on-line minicomputer system, Comdac-8, and its text editing software, the Comdac-8 Editor (Jan., p. 193). The purpose of Comtext is to create form letters, edit technical material, modify files, etc. A PDP-8 cpu is used, on-line to Selectric typewriters with bases which convert them for I/O use. Purchase price is about $35K, or $800/month rental, with delivery in three months ARO. Comtext-8 is also available as a service. THE COMSONIC CORP., New York, N.Y. For information:

CIRCLE 336 ON READER CARD

five disc drives

Honeywell's family of disc drives has been expanded to include five modular units, four of which are smaller versions of the Type 278 multiple-spindle disc



low cost group therapy

WANG'S NEW 3300

The First "BASIC" Time Sharing System Under $20,000

The 3300 is a time sharing mini-computer system for only ¼ the cost of subscription services or other in-house time sharing systems. That, in itself, is very therapeutic. And any anxieties about communicating with a computer can be eliminated by BASIC. The popular conversational language, ideal for beginners and experts alike. It's simple to get involved with a 3300. Begin a system with just one terminal if you like. Then add hardware as needed to accommodate up to 16 users, or to broaden system capability. It's truly mind expanding.

WANG
LABORATORIES, INC.

CIRCLE 244 ON READER CARD

WANG LABORATORIES, INC.
Dept. 000, 836 North St., Tewksbury, Mass. 01876
Tel. (617) 851-7311

☐ Please send more information on the 3300. I want to know how much it can help me in the final analysis.

☐ Please send a price quotation on a ______ user system.

NAME/TITLE ____________________

ORGANIZATION ____________________

ADDRESS ____________________

CITY ____________ STATE ________ ZIP ________

CalComp presents a brilliant new film producer.

Up until now, you could buy your computer either a brilliant and versatile microfilm plotter.

Or a brilliant and high speed microfilm printer.

But you couldn't buy, for any reasonable amount of money, one film output system that was both.

Now you can.

CalComp presents the 1670 COM system. It's a plotter.

CalComp's new offline 1670 COM system is the finest Computer Output Microfilm plotter you can buy.

It draws at a rate of 500,000 increments a second.

Features a programmable raster of 16,384 by 16,384 positions. The finest resolution available.

And cuts tape write time to a tenth or better over previous microfilm systems.

With twenty usable line widths, the 1670 COM system is ready to draw practically anything.

And with the support of CalComp's extensive library of basic, functional and application software, it practically can.

CalComp presents the 1670 COM system. It's a printer.

If your primary need is for a high speed printer, the CalComp 1670 COM system is that, too.

System throughput, using hardware character generation, is 7,000 to 12,000 lines per minute.

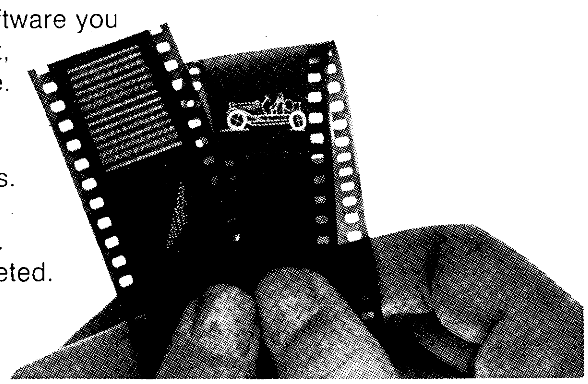
And with CalComp software you can put it in any type font, size, or language you like.

With an optional forms projector, you have 16 program selectable forms.

And take your choice of cameras. 16 or 35mm. Sprocketed or unsprocketed. Even a 105mm microfiche option.

So if you haven't been able to decide between a microfilm system that *plots* or one that *prints*, call your nearest CalComp man today. (CalComp has offices in 34 cities.)

And tell him you want to discuss the brilliant new producer that produces both.



CALCOMP

TEACH YOUR COMPUTER TO DRAW

California Computer Products, Inc., Dept. D-4
305 No. Muller Street, Anaheim, California 92803

drive announced in Oct., 1968. These units accept 20-surface, double density disc packs. The fifth unit, Type 172, accepts 10-surface, single density disc packs. Common characteristics of the new units include electronically controlled read/write head positioning involving a linear transducer and electronic servo mechanism, a slider bearing design for the read/write heads, an electronic noncontact braking unit, and the use of monolithic integrated circuits throughout.

Operating characteristics of all Type 278 disc drives are the same. Average seek time is 50 msec, and information is transferred at 416,667 six-bit characters per second. The series may be used on Models 1200, 1250, 2200, 3200, 4200, and dual-processor 8200 cpu's. Delivery will begin in the fourth quarter. The Type 257-3 control unit, built into each drive, rents for $1,345/month on a five-year contract, sells for $61,110. The 278-5 five-spindle drive with 175 million characters storage rents for $2,170-$2,420/month, sells for $98,490, while the 278-8 eight-spindle drive with 280 million characters is $3,355-3,740/-month or $152,250. Others are priced accordingly. HONEYWELL EDP, Wellesley Hills, Mass.

CIRCLE 339 ON READER CARD

training computer

The Digiac 3060 training computer is designed to give students practical experience in the *servicing* of digital computers and other digital devices. Wiring of the 3060 employs wire wrap techniques, and integrated circuits are used. Connector terminals are at the front of the unit so students can observe all operations. Electronic malfunctions can be introduced into the machine by the instructor for examination by the student. Problems may be inserted for arithmetic, input, output, control, and memory operations. Diagnostic programs are used for determining where a malfunction has occurred. I/O is by means of an octal keyboard on the front of the 3060 and a Teletype. Price including software is $8,700. Delivery is 60 days ARO. DIGIAC CORP., Plainview, N.Y. For information:

CIRCLE 338 ON READER CARD

disc for the 1130

For $750/month the IBM 1130 user can replace his IBM 1810 (neé 2310) disc drive with a 2311-compatible unit, the Model 3610. Made for use with the 10-surface disc packs, the 3610 puts 2.56 million 16-bit words on line to the 1130 and accesses them in 50 msec. According to the manufacturer, this represents an increase of 60% in capacity (over a full three-spindle 1810) and a 10 times faster access.

The 3610 has its own built-in controller, so it attaches directly to the computer's storage access channel or to an IBM 1133 multiplexor. Its rental price includes maintenance, and deliveries start this quarter. MEMOREX CORP., Santa Clara, Calif. For information:

CIRCLE 340 ON READER CARD

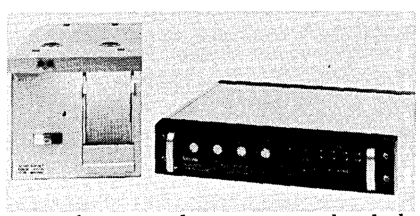
mag tape

There are two sides to every computer tape, and this vendor feels that the back side (the side without the oxide) has been too long neglected. A coating has been developed that can be added to MRX-3 and Quantum magnetic tapes which is intended to increase scratch resistance and to prevent the build-up of particle-attracting static charges. In addition, the coating is said to reduce slippage between tape layers, which may in turn provide better start/stop performance on many tape drives. The coating, called Astron, will add $2 to the price of tapes, bringing the Quantum tape to $23 per reel and MRX-3 to $17. MEMOREX CORP., Santa Clara, Calif. For information:

CIRCLE 341 ON READER CARD

channel monitor

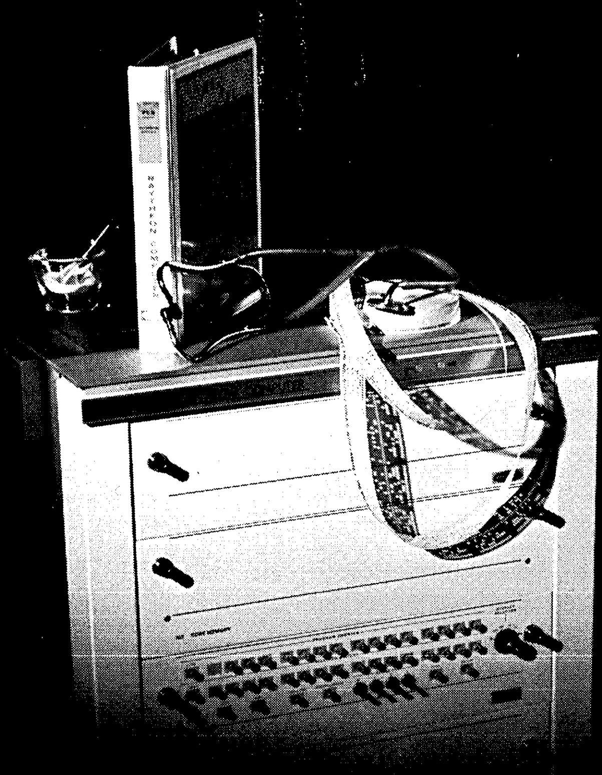
The Universal Monitor, a communications channel monitor, is intended to aid in diagnosing system problems. It connects to the terminal interface of standard modems, automatically synchronizes with the data stream, and prints out a hexadecimal representa-



tion of every character on the link. This includes not only text characters but also sync characters, line control characters, and format characters. It monitors any five- to eight-bit code at any speed to 7200 bps and accommodates all line coordination systems. The operator has the option of automatic or manual switching between the send and receive legs of duplex channels.

The complete system consists of four

If you think you need a giant computer for multi-programming, you don't know about Raytheon Computer.



DNA knows.

To get the power of multi-programming without paying the usual premium, Diversified Numeric Applications (DNA) of Minneapolis, Minn., selected one of our 16-bit computers and an auxiliary mass memory for their new Automated Clinical Laboratory System.

Testing has been made faster and more accurate in a versatile system that even allows real-time, on-line system interaction with lab personnel.

You can get the same kind of power into your systems from Raytheon Computer.

Power in hardware. CPU's with cycle times from 900ns to 1.75μs. All with direct I/O to the CPU, 4 addressable registers and 74 instructions. And priced from under $10,000 to $19,000.

More power in the options. Hardware multiply/divide. Direct memory access. An Array Transform Processor. All the standard peripherals. And instant Raytheon Computer interfaces for any non-stardard equipment your system needs.

And powerful software that bumps the Raytheon Computer 16-bit machines into the large computer class when it comes to doing your job.

Executives and monitors for multi-programming and time-sharing systems. Operating systems for mag tape and discs. A 360-compatible superset of FORTRAN IV. Conversational FORTRAN you can run in just 4k of core. And the fastest, most accurate math library in the 16-bit computer class.

In all, over 400 tested, debugged and proven programs and subroutines. All off-the-shelf today.

So write for all the details. Ask for Data File C-183. There isn't a better price/performance story in the industry.

RAYTHEON

Raytheon Computer, 2700 S. Fairview St., Santa Ana, Calif. 92704. Phone 714/546-7160.

components for modular buildup. A basic system comprises the Monitor Control Unit and Monitor Printing Unit. The MCU provides synchronization and control, and decodes the monitored information for printing. The MPU is a high-speed nonimpact printer. Each character on the monitored channel is represented by three symbols in the printed record. Price of the basic system is $7,500; delivery is 90 days ARO. SPECTRON CORP., Cherry Hill, N.J. For information:

CIRCLE 342 ON READER CARD

paper tape to cards

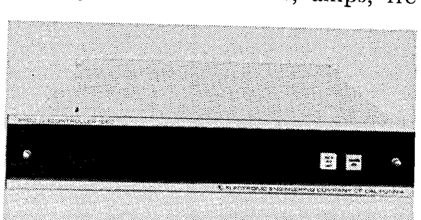
An 029 keypunch with the auxiliary duplicate feature can do double duty as a paper-tape-to-card converter when complemented by one of the 3000 series converters. Built as a matching console to sit next to the 029, the tape-to-card converters start at $97.50/month, including service, and come in three models. Model 3001 is for BCD tape inputs. It has prewired alphanumerics, automatic left zero, a column 80 check punch, and parity check features. Speed of operation is about 18-20 cps. Model 3002 offers basically the same features but is for ANSI input.

Model 3003 is for any 5, 6, 7, or 8-level code. It has a removable plugboard instead of the prewired alphanumerics, and is more versatile in a few other aspects. None of the models affects the 029 in its normal keypunching operations. SMI, St. Louis, Mo. For information:

CIRCLE 343 ON READER CARD

digital to voice

Hal, the computer from "2001," seems a step closer in the light of products like the Datavox I, a digital-to-voice converter. The Datavox vocabulary is limited now to words and numbers it can use in reading instruments. For instance, it reads numbers in English from .00001 to 999.99 and as digits from .00001 to 9999.9. It also knows the right words for volts, amps, fre-

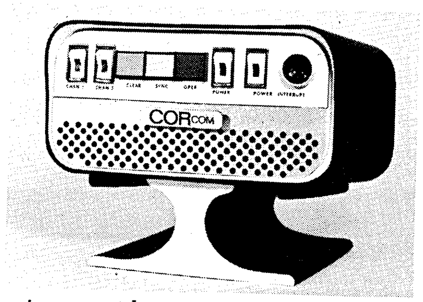


quency, etc. It has an enclosed speaker and a jack for earphones, and a sound belt that can be changed in seconds. It is offered with multiplexor units, and with them can do upper and lower limit testing on each channel. The Datavox I is priced at $795, and deliveries take 30 days. INSTRUMENTATION SYSTEMS, INC., Albuquerque, N.M. For information:

CIRCLE 344 ON READER CARD

error detection

The Cor Com error detection system is a form of mechanical insurance which can be purchased for data communications lines. Its job is simply to insure that data sent is received correctly. To do this, it uses a unique transmission code for each character sent and an echo-back check of sent versus received characters. Its manufacturer claims an improvement of the order of 10^5 for transmissions presently experiencing as few errors as one in 10^5. Translated this means that if critical data is being communicated at 1000 bps, then it can be expected to have one bit received in error every 1⅔



minutes without Cor Com, and maybe three bits per year in error with the system. Cor Com is capable of handling two channels simultaneously and sells for less than $10,000. MICRO DESIGN, INC., Rockville, Md. For information:

CIRCLE 345 ON READER CARD

burros modems

A new family of three modems transmit digital data in serial binary form over phone lines at up to 1200 bps. Line stabilization time is only .016 sec. Called the TA211, TA212, and TA713, the first two are for use with the TC500 or TC700 series terminal computers, and the last functions with Burroughs cpu's as well as other Burroughs terminals and similar equipment from other manufacturers. Prices range from $15-20/month rental and $590-790 sale. BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 346 ON READER CARD

printer for pdp-8's

The Eclectic 740 is built around the A. B. Dick Videojet model 960 printer (see Aug., '69, p. 168). Other hardware includes a controller, interface for PDP-8 computers, and the required cables. Software includes a text han-

The Computer Store.

Welcome to the Bloomingdale's of the computer industry. If you're shopping around at the SJCC for something nice in the way of a mini, drop in at the BIT booth. No.46020. You can get a swell little model right off the rack. And take it home with you. And if you're anything like a lot of OEM's we've been talking to lately, it should be a perfect fit. Our mini is the BIT 483. A fast number. With less than one microsecond speed, nobody's ever said, "Sam, you made the cycle time too long." And it's built like a brick one, too. It's fantastically reliable and ought to give you much less down time than some of those stripped-down models on the market. What's more, for all its power, the 483 is really quite a simple machine and easy to learn how to run. (If you're looking for that sort of thing, you may be interested to know it was one reason BIT recently decked a well-known competitor for a big order with a big manufacturer.) Other reasons why

the BIT 483 is a general purpose digital computer to contend with: proven design performance and unparalleled problem solving capability; BYTE orientation; variable word length; cycle stealing data channel; expansion to 32K memory within the same box; binary and decimal arithmetic; priority interrupt; and a complete line of I/O options. These are what make the BIT 483 the price/performance champion of the minis. And as the company that's popping them off our production line like so many two-pants suits, we're here to say we stand behind our merchandise. We produce in volume and we service what we produce. Come into the Computer Store for a little shop talk, a little demo. And maybe you can walk out with a little computer under your arm.

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Natick, Mass. 01760

CIRCLE 153 ON READER CARD

Mass memory and Massive memory
the cost cutters

Our Large Core Store offers mass memory in 20 million bit building blocks. Access is 1.1 microseconds. Bit cost is cut to about 1.5 cents. Only Data Products' unique core technology makes it possible. The other innovation, our Large Disc Store, gives you massive memory: two billion bits at a time and compacted into 13 square feet of floor space. A voice coil servo-positioner provides 55ms average access. LDS is sale priced under $60K in OEM quantities to celebrate a decade of disc file leadership. (Our Systems Division will interface either LCS or LDS for users) Ask Bob Englert what our memories are made of (213) 981-9600. See us at booth #1000, SJCC.

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dling package which will print one line at a time from a variable length text buffer and a diagnostic routine to check all line printer and system functions.

The system accepts 8-bit parallel ANSI data via accumulator transfers through the computer's I/O bus and

prints at 200 cps (approximately 200 lpm). Features include adjustable character height and width and variable line width. The 740 system will sell for around $8,000. ECLECTIC COMPUTER CORP., Dallas, Texas. For information:

CIRCLE 347 ON READER CARD

jcl videotape

First of a planned series of videotaped courses is a program of instruction in System/360 OS Job Control Language. Consisting of 16 half-hour segments, the course is designed for applications programmers, analysts, and operating personnel. The course material includes an introduction, job control statements, job statement, exec statement, DD statement, use of JCL, additional DD statement facilities, cataloged procedures, problems, and review. The idea is to provide in-house training capability. Price for the JCL course is $1400. And it will cost about $1K for a video monitor and recorder, or $50/day rental, but this equipment is not supplied by the firm. CONSULTANTS ASSOCIATED, INC., Wakefield, Mass. For information:

CIRCLE 348 ON READER CARD

intercomputer coupler

The Model 9035 coupler interfaces the Univac 1108 with an Interdata Model 4 minicomputer permitting system function expansion to include time-sharing, process control, terminal data collection, and other processing using the Interdata as a satellite computer. (Design is flexible, and other satellite and host computers may be interfaced.)

The coupler allows asynchronous core-to-core half duplex data communications between the I/O channel of the 1108 and the high-speed memory bus of the Model 4. It will execute block transfers up to 128 records of 144 bits each from either computer. The 1108 resident software determines the addressing of the data transfer in and out of the 1108 buffer.

The 9035 provides all real addressing for reading and writing into the Model 4 core memory and is capable of transferring 50K 36-bit words/second. (Actual transfer rate depends on activity level of controllers or processors on Model 4 memory input lines which are shared on a cycle-stealing basis.) The unit is panel mounted with self-contained power supply and costs $8100. TIME-ZERO CORP., Torrance, Calif. For information:

CIRCLE 349 ON READER CARD

teleprocessing converter

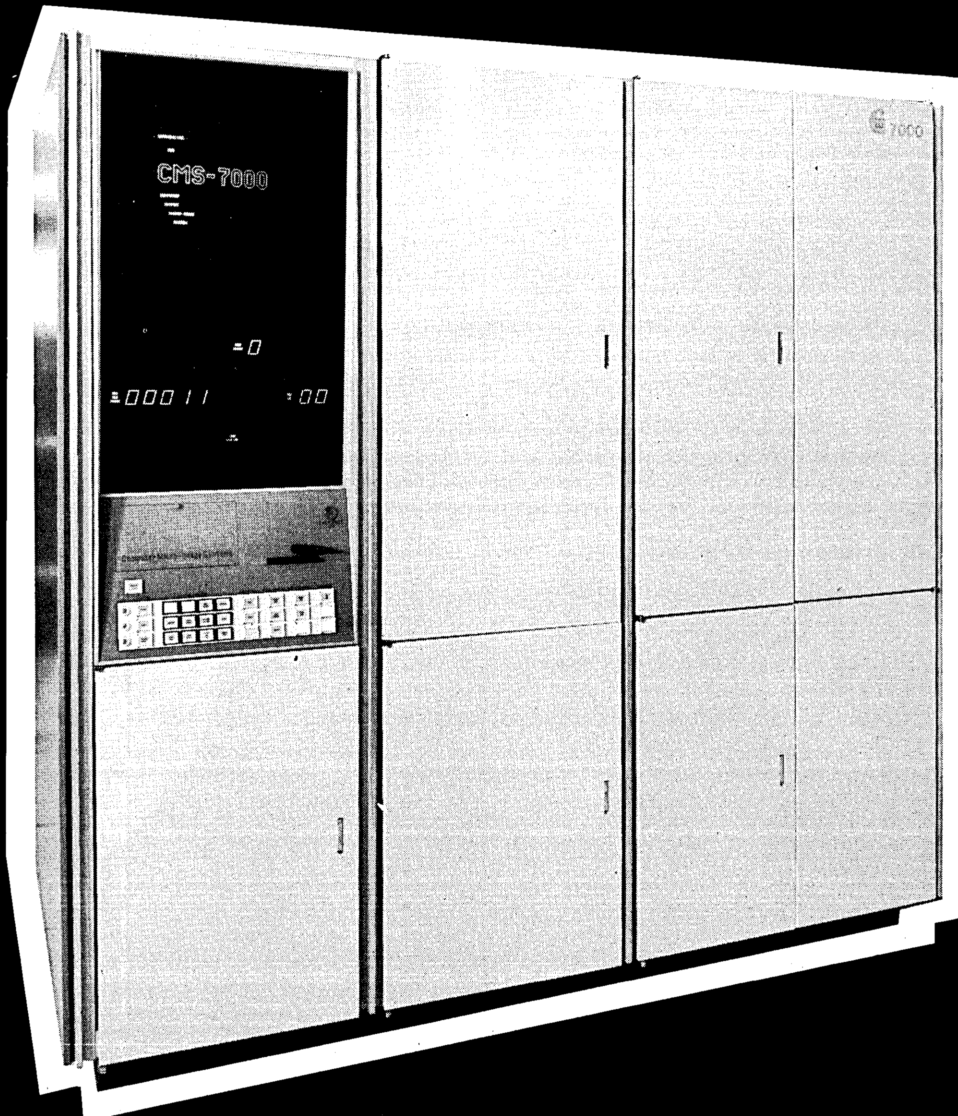
The addition of the MCS TELECONTROL permits the IBM Mag Card Selectric to be used as both a time-shared computer terminal and in a user-oriented message system. As a t-s terminal, the unit is compatible with any in-house computer or service that operates with a 2741-type terminal. The 5000-character magnetic card provides program and data entry, debugging and storage equivalent to 60 punched cards. Provision is made for an internal data set so that the Selectric may be used with the DAA attachment.

As an intracompany message system, the MCS TELECONTROL transmits, receives and records messages 50% faster than TWX. A 500-600 word message between Los Angeles and New York costs about $1.50 daytime rate. The unit is compatible with the company's CT series of interactive punched card terminals; the user then has both on-line and off-line punched and mag card flexibility. The MCS TELECONTROL is available in correspondence, BCD and ANSI code. Lease prices start at $50 a month. When equipped with an internal data set and the unattended answer feature, the converter leases for $75/month. The unit installs without Mag Card Selectric modification. WESTERN TELEMATIC INC., Arcadia, Calif. For information:

CIRCLE 350 ON READER CARD

keyboard

The ruggedized DC-303 keyboard is designed with 10 discrete function outputs in addition to ANSI codes. The solid state design has eliminated me-



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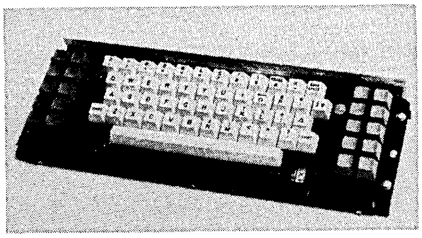
CIRCLE 209 ON READER CARD

chanical linkages and electromechanical parts. A switching module generates the strobe to the fully buffered outputs. Although physical arrangement of the keyboard is fixed, any keys

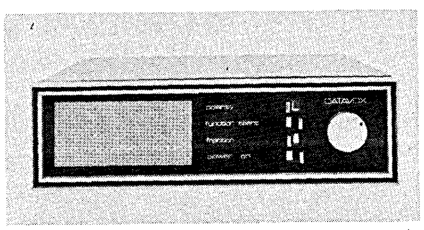


may be omitted. The DC-303 is priced at $350 and is available immediately; quantity pricing is offered. DATANETICS CORP., Redondo Beach, Calif. For information:

CIRCLE 351 ON READER CARD

disc drive controller

The EECO 1660 DISCONTROLLER is designed for 16-bit minicomputers and IBM 2311/2314-class disc drives. Data format is based on 10 and 20 sector records of 384 bytes each. Each record contains 340 bytes of useful data. This utilization efficiency is said to provide up to 53% more bytes per disc pack than standard IBM format. The software package required is different for each minicomputer, but only two ba-



sic commands—READ and WRITE—are needed. The vendor will provide software assistance and plans eventually to provide software packages for all popular minicomputers. The 1660 is unit priced in the $8K-$9K range, and OEM discounts are offered. ELECTRONIC ENGINEERING CO. OF CALIFORNIA, Santa Ana, Calif. For information:

CIRCLE 352 ON READER CARD

x-y recorders

The Plotamatic 705 and 715 plot on pads of paper rather than single sheets or continuous forms. Their drawing area is 7x10 inches, their accuracy within .2%, and their slew speed over 15 ips. They are electromechanical devices primarily, so relatively inexpensive (at $750 and $880). They differ only in operator conveniences. For instance, only the 715 has an electric pen

Start an 80,000 character automated master file.

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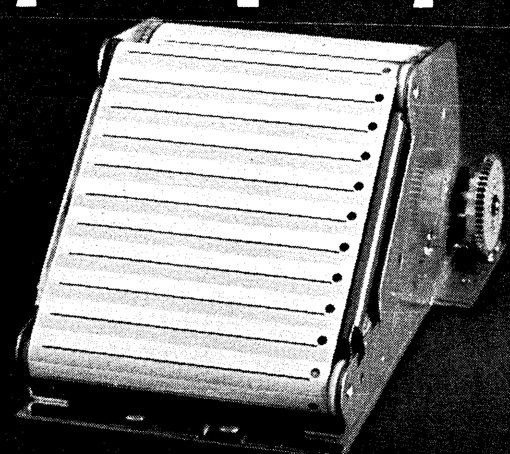

Datacall is DASA's fixed information storage and retrieval master file system. And it's the only system of its kind that's expandable. You buy one Datacall unit with a capacity of 80,000 characters. And you can expand it indefinitely with reusable and interchangeable 80,000 character magnetic tape cartridges . . . for just $45 each.

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Send us your name and address and we'll send you a Datacall master file sample so you can see for yourself. Write DASA Corp. . . . Data Products Division, 15 Stevens Street, Andover, Massachusetts 01810 or call (617) 475-4940.

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CIRCLE 217 ON READER CARD

See us in SJCC Booth 24010-13.

lift control and zero-check pushbutton. BOLT BERANEK AND NEWMAN, INC., Santa Ana, Calif. For information:

CIRCLE 353 ON READER CARD

analog to digital

Manufacturers trying to package their gear into small units may like the Model 1515 analog-to-digital converter. The single card system takes up about 4x5½ inches of space, provides 14-bit-plus-sign resolution, and performs its conversions in less than 18 usec. Both serial and parallel outputs are provided. The 1515 goes for $1400, and is delivered within 30 days. TUSTIN ELECTRONICS CO., Tustin, Calif. For information:

CIRCLE 354 ON READER CARD

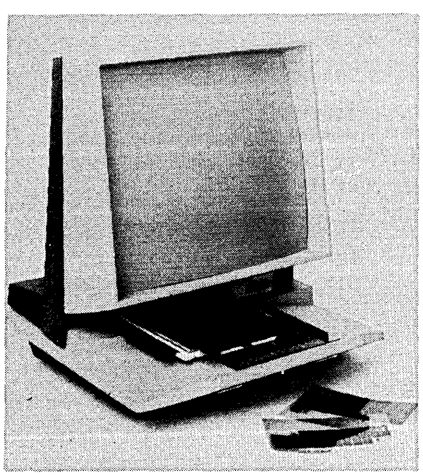
paper tape reader

Next thing to an Instamatic film cartridge is a paper tape cartridge placed in a Model 2758A Tape Reader Reroller. The unit reads up to 250 feet of 8-level paper tape, then rewinds it onto its original spool. No hands. Presently, the 2758A will not respool mylar tapes, but almost any other kind is okay. The unit price is $3000 and a $600 interface is available for any HP computer. HEWLETT-PACKARD CO., Palo Alto, Calif. For information:

CIRCLE 355 ON READER CARD

microfiche reader

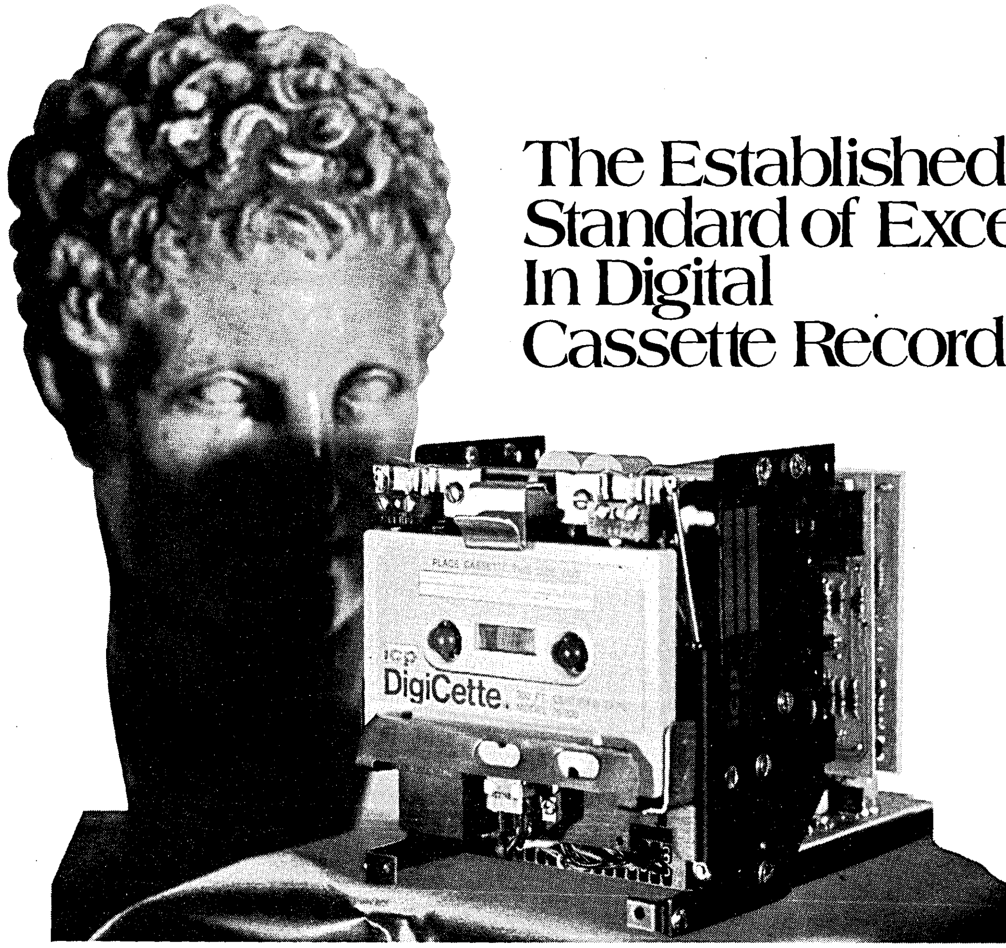
Magnifications of microfiche of up to 150 powers can be displayed on the 11x14 inch screen of this reader. A portable device, the reader weighs in at



less than 20 pounds. It comes with a price tag of $198. DIOPTRIX, INC., La Jolla, Calif. For information:

CIRCLE 356 ON READER CARD

The Established Standard of Excellence In Digital Cassette Recording



For $285 in OEM Quantities

Two and a half years ago, International Computer Products, Inc., began development of Philips-type magnetic tape cassette recording devices for digital applications. Tests quickly demonstrated that audio tape drives were not built for the rigorous, precise demands of digital recording. So ICP engineers designed a drive system specifically for digital use—the DigiDeck. It demands evaluation by any manufacturer contemplating a digital cassette recorder in his system. Here's why:

- Read/write speed is 500 characters a second.
- Servo-controlled spindle speed eliminates the need for capstan or pinchroller and results in less wear on the cassette and recording head. Since the tape touches only the head, greater tape life and reliability is assured.
- Motor speed control electronics is adjustable to fit most applications.
- Read/write electronics and EOT/BOT sensing are included.
- All these features are standard in this compact (5 in. h. x 4 in. w. x 7 in. d.) package that weighs about two pounds.
- Delivery is 30 days ARO.

Available now with Read After Write option.

The DigiDeck is a subsystem of these other ICP products:
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KeyCette: Key-to-tape system for direct incremental recording on cassettes.
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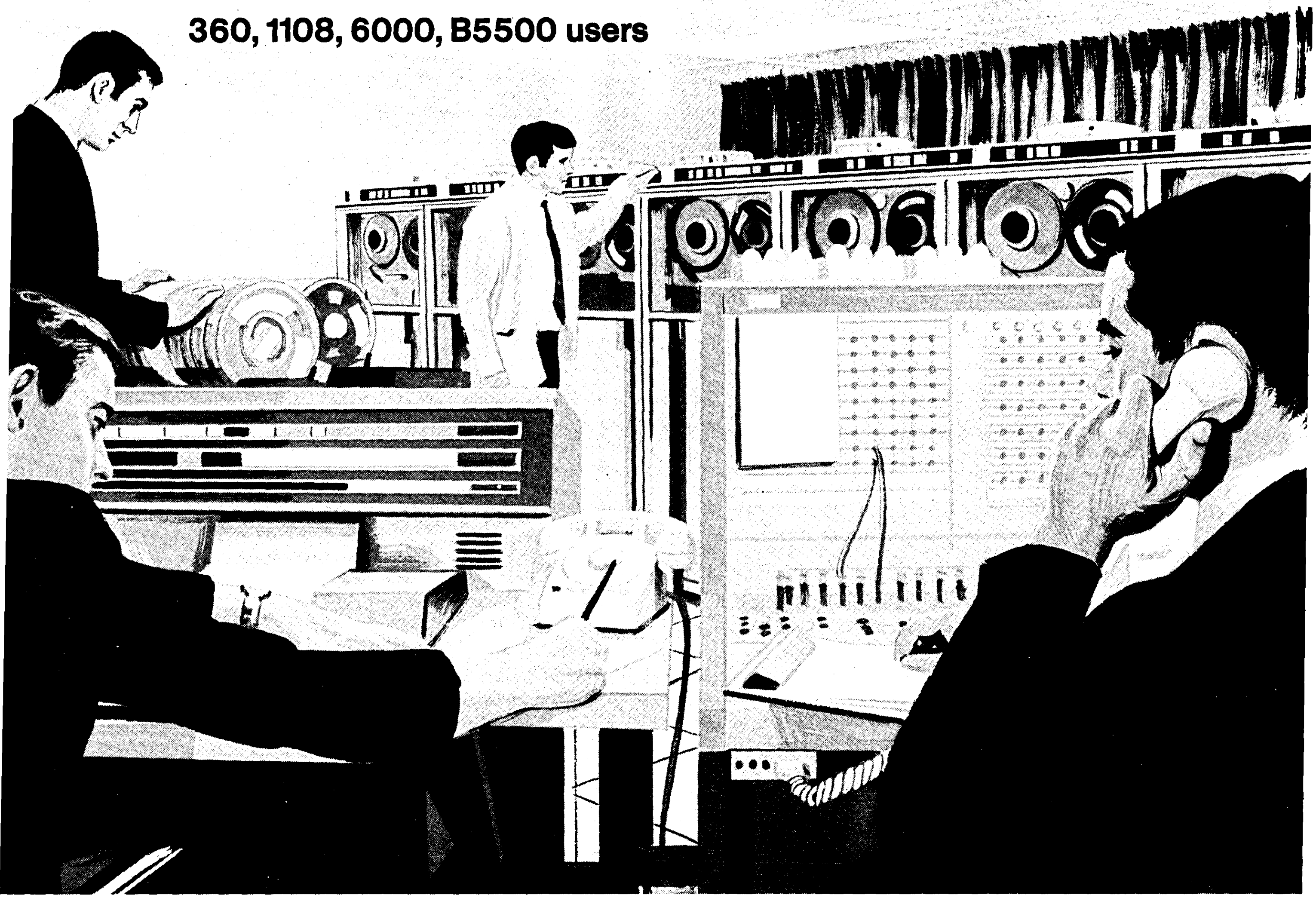

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The UCC COPE family of programmable remote terminals offers industry's best cost/benefit ratio. This family includes seven members, allowing you to select the reading/printing combination best suited to your requirements.

The COPE family can be field upgraded from the low cost COPE .30 series to COPE .45 status.

COPE terminals operate in the full duplex (concurrent reading and printing) mode over voice-grade telephone lines utilizing 4800 or 9600 bps modems. They also offer dial-up flexibility by simulating the IBM 2780, CDC 200UT and Univac 1004 terminals.

For more details call or write: Marketing Coordinator, Data Communication Systems Division, 2659 Nova Drive, Dallas, Texas 75229, (214) 241-3501.

Terminal Type	Communications Mode		Input/Output Device Speeds (Maximum)	
	Half Duplex	Full Duplex COPE	Reader C.P.M.	Printer L.P.M.
C.30	ATT 201A/B	No	200	240
C.32	No	Yes	200	360
C.34	Option	Yes	300	360
C.36	Option	Yes	300	480
C.38	Option	Yes	600	480
C.41	Option	Yes	600	1,250
C.45	Option	Yes	1,500	1,250

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CIRCLE 69 ON READER CARD

new software

peripheral monitor

Computer Efficiency Corp. has developed a package called Peripheral Monitor that enables the computer to monitor, measure, compare and document the actual performance of IBM/360 peripherals against the manufacturer's rated speed. Peripheral Monitor is system independent and can be used with any 32K 360/25 and up. The program, written in BAL, is self-loading and requires only two control cards. An average installation can measure performance of all its peripherals in less than three minutes. Output is a concise report describing actual performance as compared to rated speed, and the per cent of variance.

The purpose of Peripheral Monitor is to permit the user to get the most economical and efficient use of his computer system. With the package, the user can identify underperforming components for the field engineer, maintain performance trends to detect performance erosion, spot equipment degradation resulting from engineering changes, verify proper completion of field engineer adjustments, furnish data for calculating time required for new jobs, analyze performance prior to ordering or accepting components, provide performance goals for groups of identical components, and enable operations personnel to choose the best performing devices for lengthy jobs.

Peripheral Monitor is available on a permanent license basis for $4000. This includes program deck, documentation, maintenance, guarantee, program update service, and user information exchange. The package is marketed by NATIONAL SOFTWARE EXCHANGE, Great Neck, N.Y. For information:

CIRCLE 359 ON READER CARD

cobol program aid

Improved programmer productivity is the purpose of the Remote COBOL Program Development package, a conversational terminal-oriented system which allows programmers to create, debug, and test System/360 COBOL programs from a remote terminal, removing the testing burden from the in-house system. The vendor has been using the system since last fall, and claims usage of RCPD has increased programmer productivity by over 30%. System support includes a pre-installation course, a representative on-site for a month during installation, and continuing support. RCPD is available either as a service or for sale, but the present version only runs on the RCA Spectra 70/46, using about 70K core. A version for large IBM hardware is being considered. Price is $50K Canadian. AGT DATA SYSTEMS LTD., Toronto, Ont. For information:

CIRCLE 362 ON READER CARD

data base management

MIDAS (Modular Integrated Direct Access System) is a set of several hundred independent but compatible program modules written in 360 assembly language and controlled by a list-processing technique. It can be used wherever there is a need for maintenance of a large data base. To generate an application system, only the modules needed to meet the user's specific needs are installed. Each preprogrammed module performs a discrete task. These modules are tied together by master control blocks written for each application, making each installation unique. They can be integrated into any kind of information management, management information, or storage & retrieval system. Some possible applications include project monitoring, library operations, personnel, market research, accounting, and inventory control.

In a traditional library system, MIDAS could be used to produce book catalogs, shelf lists, special bibliographies, catalog cards, current awareness notices, etc. Statistical and report generator capabilities could be added to provide support for purchasing, receiving, and circulation control.

MIDAS is designed to run on an IBM 360 under OS. Core requirements depend on the application, ranging from 50K-200K. The most economical operation is on larger models having multi-tasking capability. One (maybe two) 2316 disc packs, two to four 2400 tape drives, or equivalent, a reader and a printer are also required. Modules are available for most common I/O devices as well as COM output. Teleprocessing modules are available for on-line search or other real-time operations. File structure depends upon the application. Data fields and formats may be variable or fixed length. Multiple data bases with records of different formats can also be handled with a single MIDAS application.

Output can be formal fixed format publications, or one-of-a-kind reports can be produced with a select sort report generator. Sequenced lists or indexes can be produced based on the data in any of the fields, and the data base can be searched in several different ways. Queries can be in terms of a Boolean equation or various weighting techniques, descriptive terms and contextual English language.

MIDAS leases for about $1000/-month for a straightforward application; prices increase as more systems analysis is required. This price includes user documentation, operator training, up to three man-months of on-call support, and a warranty against program defects. Purchase of the package or its use on an installation fee plus royalty could also be arranged. A library catalog system, for example, could be installed for between $40-$50K. COMPUTER REAL TIME SYSTEMS, INC., Newport Beach, Calif. For information:

CIRCLE 363 ON READER CARD

1400-360 conversion

The Convert-A-Code Translator, used by the firm for two years in its conversion service, is now available for sale. It accepts patched 1401, 1440, and 1460 object decks as input and produces 1400 Autocoder and 360 assembly language output in one operation. Price is $9K including documentation and one man-day of installation assistance (extra charge for air fare to customer location). The Translator runs on a 360/30. CONVERT-A-CODE CORP., Baltimore, Md. For information:

CIRCLE 361 ON READER CARD

1800 rpg

A new version of RPG provides commercial programming capability, such as payroll and inventory control, for the IBM 1800 data acquisition and control system. Programs written in RPG run under the 1800 Multi-programming Executive Operating System, enabling the system to process commercial work at the same time it is performing data acquisition or process control tasks. The new RPG will be available next month, at $60/mo. under license. IBM, White Plains, N.Y. For information:

CIRCLE 360 ON READER CARD

fortran equations

COMPUTE is a program, written primarily in FORTRAN IV, which enables the 360/67 TSS user to perform common algebraic equations without writing FORTRAN programs. The user may solve various numerical problems while at the terminal by simply communicating with COMPUTE. The number of rules used in COMPUTE are about 50, as compared to perhaps 200 in FORTRAN IV itself. The program, consisting of about 3500 cards, is available at $310. For more information, the documentation is available in the form of a 25-page book at $2.50. COSMIC COMPUTER CENTER, Athens, Ga. For information:

CIRCLE 364 ON READER CARD

message processing

UNIGEM is a package of assembly language subroutines which interface IBM's Information Management System with application programs operating under IMS. These programs are designed to provide the general message handling functions that are common among all programs that process data from remote terminals; to establish consistent formats and techniques for communication between message programs and remote users; and to reduce design and programming times and costs in the areas of data acceptance, message formatting, message validation, error notification, and error correction.

The programs need 23K of 360 core; this requirement can be reduced to 8K with the appropriate overlays. Nine routines are included in the package: message input, format next line, move to line processing area, error flag, line processed flag, notification text insertion, error/suspense output, correction verification, and end of day suspense processing. The $10K purchase price includes object decks, installation assistance, customer training and on-site user assistance, and a one-year warranty. UNITED COMPUTING CORP., Carson, Calif. For information:

CIRCLE 365 ON READER CARD

shareholder accounting

If it can truly be called a "software package," as the vendor states, then it's one of the most expensive ever at a starting price of $500K. Called LIBRA, the system performs shareholder accounting for stock transfer agents, and is intended to eliminate back office delays, reduce costs, and improve service. Although designed primarily to streamline accounting systems for mutual fund transfer agents, it is said to be applicable over a wide range of stock accounting functions for dealers, underwriters, etc. At press time, final studies for the first installation at a large Boston bank which is a major transfer agent for mutual funds have been completed; this contract will amount to about $500K.

The system makes use of a revival of the ledger card through crt viewing of the entire history and status of any given account, so the transfer agent can examine the status of the account and determine the validity of a transaction before it is made.

LIBRA requires a dedicated 360/40 or a partition of a larger machine, and multiple crt terminals. It is not only an on-line update system, but also serves as an off-line system for report writing. The complete package, which does not include hardware, does include training of clerical staff and reorganization of both clerical and computer operations. COMMONWEALTH COMPUTING INC., Lexington, Mass. For information:

CIRCLE 366 ON READER CARD

information retrieval

File Analysis and Selection Techniques offers a simple means of responding rapidly to special requests for retrieval of specific information from IBM 360 data files without writing a special program. FAST is a subprogram used for determining which records within a given file meet the criteria established by variable sets of parameter cards. Features include variable range selection, specific value selection, and comparison of one record field to another or an alpha or numeric literal.

FAST is written in BAL to be inserted in BAL or COBOL programs. Most types of disc or tape files can be handled. Some applications would be in personnel searches, accounts receivable analysis, statistical analysis, and exception reporting.

The $650 price includes the relocatable object deck of the FAST subprogram; program documentation, consisting of instructions and typical examples of uses of the package; a COBOL mainline program with file and record definitions for one user file. URS SYSTEMS CORP., San Mateo, Calif. For information:

CIRCLE 367 ON READER CARD

display monitor

Without XENO-101, all programs using the 2260 Video Display Unit must be written in assembly language. This package makes it possible to use locally attached 2260's in PL/I, COBOL, and FORTRAN programs. It consists of a series of subprograms which are invoked with simple CALL's in the user's program. XENO-101 runs under OS, taking advantage of OS/360 attention-handling capabilities, and provides error return codes. It occupies only 3K bytes and sells for $495. XENOGRAPHIC DATA SYSTEMS, Los Angeles, Calif. For information:

CIRCLE 368 ON READER CARD

bond accounting

Developed originally by United Virginia Bankshares, Inc., this accounting system for municipal and other government portfolios is being offered to banks. It enables banks to price bonds more frequently; to obtain pricing schedules when needed; and to communicate within multibank organizations through uniform reports and data.

Written in COBOL to run on 65K 360/30's and up, the system is composed of two sets of programs—bond accounting and bond pricing. The bond accounting program is designed primarily to produce a securities subsidiary ledger. Editing, accounting, tax reporting, and a coupon program are included. The bond pricing programs generate current market appraisals of government portfolios. Five reports are offered: statistical; combined portfolio pricing summary; category summary of par values, book values, etc.; individual pricing; and escrow.

The total system price is $10K, which includes two-day installation. The programs may also be purchased separately—$6K for bond accounting; $4K for pricing. URS SYSTEMS CORP., San Mateo, Calif. For information:

CIRCLE 369 ON READER CARD

back office

The Brokerage Package is a series of 30 programs, written in assembly language, for use by service bureaus providing computerization of back offices for over-the-counter brokerages. It is available to service bureaus outside the New York metropolitan area, in order to avoid competition with the vendor. The package conforms with National Association of Security Dealers standards, and provides overnight completion of paperwork, including confirmations and daily updated reports. It is aimed at business from small as well as large brokerages. Price beginning at $25K (depending on geographical location) includes documentation, brokerage manual for client use, and Operations Systems Guide. The vendor is also prepared to train service bureau personnel in the use and sale of the system. Hardware required is a 360/30 with minimum of five tape drives. ADMINISTRATIVE SYSTEMS INC., Mineola, N.Y. For information:

CIRCLE 371 ON READER CARD

input validation

The Validator takes advantage of common validation requirements to provide economical systems input validation: fields are checked for non-numerics, blanks and ranges; hash totals are taken; batches are settled. The package executes typical validation processes within parameters specified by the user. Instead of coding, testing, and documenting individual validation programs, only one parameter set need be prepared on the operator guides. The system may be used for reformatting, data transcriptions, conversion of files, and other manipulations. It runs on a System/360 with minimum 32K. A Spectra version is in the works. Written in assembly language, its price is $5K. DATA MANAGEMENT SERVICES, INC., New York, N.Y. For information:

CIRCLE 370 ON READER CARD

trust accounting

Developed initially for LaSalle National Bank, Chicago, the C&S Trust Accounting System contains 57 different programs and produces 47 different reports that include both cash and securities transactions. Basically, these reports cover external documentation, generalized tax reporting, and all accounting, including court accounting. The trust department may use its own security classification codes as a prefix to the standard CUSIP identification that is part of the C&S system.

Five major files are required: weekly transaction work file, cash inventory file, account master file, issue master file, and asset detail file. Three 2311 (or one 2314) disc systems and four 2240 tapes are required for storage. The account, issue, and asset detail files are maintained on tape for backup. All master files are supported by DOS ISAM and can be accessed both sequentially and directly. The others—weekly transaction work file and cash history file—are accessed sequentially, supported by DOS QSAM. Other required hardware includes a card reader/punch and a printer.

The C&S system is written in BAL to run on a 65K 360/30 under DOS level 18 and up. The programs take up 52K maximum, and the DOS supervisor requires 10K. Timing studies have found that from 15-20 minutes were required for each day's processing of approximately 5500 accounts and that an additional five to nine hours were needed for the weekly runs. Other versions of the system are being prepared to operate on larger machines under multiprogramming.

The C&S Trust Accounting System is available three ways. It may be purchased on a license basis for $45K—which includes all programs, user guide, system documentation, and 200 hours of technical installation assistance. Or, the vendor will offer, on a price/active account basis, batch processing from one of its centers in five major cities. The third alternative is for C&S to set up the system and run it on its own computers until it is working right . . . then turn the whole thing back to the customer. COMPUTING AND SOFTWARE, INC., Los Angeles, Calif. For information:

CIRCLE 372 ON READER CARD

spectra test data

PROSPEKTES is an automatic testing program, designed for the RCA Spectra 70/35 and /45. It develops complete test data that eliminates test setup time, turnaround time, and large volumes of data that are often submitted to analyze test results. It can be used in a multiprogramming environment. Automatic compilation and testing of programs is provided with no operator intervention. The package is written in COBOL, FORTRAN, and assembly language, for handling programs in those languages. It requires 15K core. Price is $5K. The system was developed by Owens-Corning Fiberglas Corp. SOFTWARE ASSISTANCE CORP., Ann Arbor, Mich. For information:

CIRCLE 373 ON READER CARD

accounts payable

The first proprietary product of this consulting firm is a $5000 accounts payable package written in COBOL for use on 32K IBM 360's with either disc or tape and disc storage. The system is presently operational at four New England sites. Major features include editing of all input data, manual or automatic due date calculation, prepayment audit ability, automatic check writing and reconciliation, and multilevel expenses analysis.

Included among the 12 reports produced from the payables processing function are batch edit listings, voucher maintenance and proof registers, cash requirements, remittance advises and checks, check register and reconciliation reports, expense distribution, payables activity, trial balance, 1099 report, and a vendor master file maintenance listing. The purchase price includes all programs and documentation. Installation and customizing are extra. KEANE ASSOC., Inc., Weston, Mass. For information:

CIRCLE 374 ON READER CARD

accounting

The vendor has combined its accounts payable, accounts receivable, payroll, and general ledger systems into what is called the Integrated Accounting and Business Management System. It is written in COBOL and is available for IBM, Honeywell, Burroughs, and NCR equipment. Originally designed for the 360/30, the system can operate with 32K of core. It is marketed at $32K under perpetual license. This includes source decks, user and operator documentation, installation assistance, user education, and system tailoring. DELTA DATA SYSTEMS, College Park, Md. For information:

CIRCLE 375 ON READER CARD

student scheduling

An educational software package for the Univac 9300, designated the Universal Student Academic Scheduling System, is designed for the assignment of students to a master schedule in such a manner that all students are ensured "sound academic" and chronologically operational programs. A mechanism to handle special requests such as choice of instructor, meeting hours and place, etc., is included. The general operating procedures are said to be such that the system could be used at most schools regardless of size. Features include a means to develop a master schedule, a means to detect overload conditions, classroom rosters, and teacher assignments. USASS is written in assembly language and requires a 16K, four tape configuration. UNIVAC, Phila., Pa. For information:

CIRCLE 376 ON READER CARD

pdp-12 crt

DIAL-2, a new version of the display-based system software for the PDP-12 computer, includes character editing capability, overlapped tape I/O, and a new peripheral interchange program, PIP. The Display Interactive Assembly Language package handles program editing, filing, and assembly, taking advantage of the PDP-12's built-in display and its peripherals.

The overlapped tape capability allows the operator typing in material that will appear on the crt to continue to type while characters are transferred to tape. PIP allows the operator to transfer data between devices, including LINCtape, tty, paper tape reader/punch, card reader, and line printer. DIGITAL EQUIPMENT CORP., Maynard, Mass. For information:

CIRCLE 377 ON READER CARD

food services mis

The Food Service Management Information Systems, developed in conjunction with the Texas Restaurant Assn., is designed to handle cost control and accounting for both large and small food service operations. The system keeps track of optimum food cost by recipe and menu items, labor cost, individual employee and labor classification. Overhead costs are controlled by budgetary analysis. Sales are analyzed periodically to determine the profitability of menu items, and purchases are analyzed for excess usage. General ledger, accounts payable and payroll are included in the package. The system is written in COBOL and may be processed in a batch or remote batch environment on a 128K IBM 360/40 under OS or DOS. For in-house use, the system can be purchased for $50K. Service bureaus may license it for $75K plus a royalty. Installation and maintenance are included. TELE-COMPUTING, INC., Dallas, Texas. For information:

CIRCLE 378 ON READER CARD

accounts receivable

CASARS (for CAS's Accounts Receivable System) provides automatic repeat invoicing, G/L summary totals, variable heading and trailing messages on statements, work-in-process accounting, and client combinations of open-items/balance forward statements and aged reports. It produces a journal of original entry, accounts receivable maintenance report, customer master list, aged accounts receivable, and prints statements two at a time and mailing labels as many as four at once. Service charges are not automatically calculated. All operations can be performed in one pass of the master file. Clients can be processed all at once or on separate days; and a suspense file of unprocessed clients is automatically created and maintained. All reports are written continuously without operator intervention.

Four programs and two sorts comprise the system, which can run on any COBOL-supported system with 40K bytes. Some external storage is also required. The basic CASARS package sells for $15K, which includes installation, COBOL decks, user's manual, operator's manual, and a starter package of input transmittals. On a three-year lease, CASARS costs $3500/year. COMPUTER APPLIED SYSTEMS, INC., Los Angeles, Calif. For information:

CIRCLE 379 ON READER CARD

circuit layout

There are three phases to the Printed Circuit Board Package. The first phase takes the inputs (composed of printed circuit board parameter assignments, an arbitrarily assigned arrangement of circuit elements, and a wire string list) and determines where on the board the integrated circuit modules will be located. Part two routes the connections between pins. Part three delivers to the designer the magnetic tape output necessary to drive the numerically controlled machine that drills the holes through the board for interconnections; that mag tape can also be used to produce a high accuracy print for manufacturing the circuit. Plots are available from parts two and three.

The program is written in FORTRAN IV and is currently operating on a Univac 1108. On that machine it requires 65K words of core, and with that much space it can handle up to an 8x7 matrix of IC modules. With the program the customer receives two weeks of installation help and two weeks of training for $40,000. SYSTEMS, SCIENCE, AND SOFTWARE, La Jolla, Calif. For information:

CIRCLE 380 ON READER CARD

gift reporting

GRIPS, a Gift Reporting and Information Processing System, supports fund-raising campaigns of colleges and universities and maintains alumni and prospect records. The system maintains files related to donors, accounts, and statistics for gift processing and selective mailing. It produces acknowledgements and pledge reminders as well as management and analytical reports. Flexibility is provided in report format as well as input control and code structure so that the system may be adapted to user requirements. GRIPS consists of three subsystems: alumni records, fund applications, and pledge control. It is written in COBOL and operates under System/360 DOS with minimum 32K core. Price is $25K for the complete package; subsystems are also individually priced. INTERNATIONAL DATA APPLICATIONS, INC., Montogomeryville, Pa. For information:

CIRCLE 381 ON READER CARD

tape testing

TAPE-TEST is a self-relocatable BAL program designed for a 10K IBM 360/25 or up under DOS utilizing 2400 tape drives. Up to six 9-track, 800 or 1600 bpi tapes and drives can be tested simultaneously in 16-24 minutes. All tape and drive read/write errors are logged telling to what extent and where (in feet from load point) each error occurs on each tape being tested. Processing and tape drive assignments are controlled by the operator using any combination of tape drives. Any drive can be removed from operation during program execution without disturbing program processing. The $2250 purchase price includes the services of a systems engineer for one day and all documentation, including any revisions that may be made for better operation of the program. SYSTEMS RESEARCH LABORATORIES, Kansas City, Mo. For information:

CIRCLE 382 ON READER CARD

accounts payable

This accounts payable package processes transactions and prepares reports in a manner designed to improve management of company funds and permit more accurate forecasting of cash requirements. Written in COBOL, the program runs on a 65K IBM 360 under DOS, and a peripheral configuration of six tape and two disc drives is recommended. The program accommodates either individual corporate requirements or those of service bureaus or banks. Program functions include input editing, check and statement printing (with cash disbursement report), reporting of future cash requirements, outstanding commitments, cost distribution and trial balances, vendor listings and updates, control and balance totals, and data for cost accounting and general ledger. It costs $6,000 outright, or can be leased for $200 a month (75% applied to purchase). Five man-days of installation support are included. URS DATA SCIENCES CO., San Mateo, Calif. For information:

CIRCLE 312 ON READER CARD

MOS.

You get less, but it does more.

MOS encoding, coupled with proven solid state switch modules, brings new miniaturization and flexibility to MICRO SWITCH keyboards.

What you get less of are the things that can go wrong. Like discrete components. We've eliminated more than a hundred. Reducing behind-panel space.

And we've also reduced the number of solder connections. All of which results in a simpler, more reliable keyboard. At a lower cost to you.

What you get more of is the ability to generate just about any code. Because there's no need for logical pairing. And speaking of codes, up to four levels can be produced from the same key.

Keyboard interaction with your system is expanded with features such as one-character storage, keyboard output inhibit and system shift. More than was ever possible before from a single keyboard.

You can get more information by calling or writing your MICRO SWITCH Branch Office.

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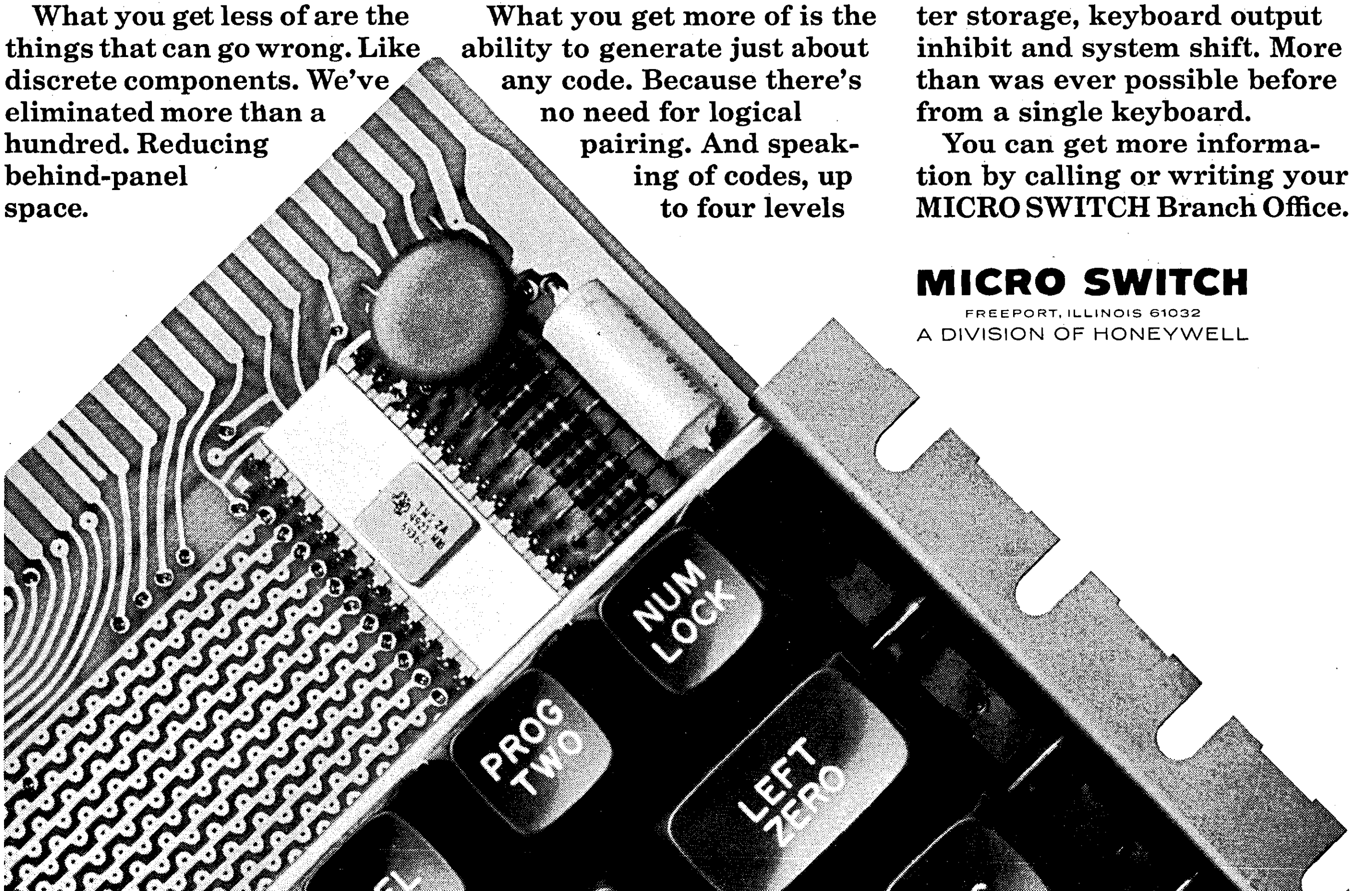

HONEYWELL INTERNATIONAL: Sales and service offices in all principal cities of the world.

COBOL CHARACTERISTICS AS REVEALED BY OUR INSTRUCTOR DURING A ONE-WEEK COURSE

Learning COBOL, I want you to know it,
For some is a real horror show; it
Is not quite enough
To read all the good stuff
'Cause without some real practice you'll blow it.

You press on with the courage of Daniel,
Quick and dirty you run through the manual,
Then you're zapped in your tracks
By the whole ball of wax
As 'twas said in the good book by Samuel.

You cannot proceed just by eyeball
To write a good program in COBOL,
For dumb, happy and fat,
You'll fall flat on your splat—
You have swallowed a cyanide highball.

You don't do it with mirrors quite slick,
Running through it just dirty and quick;
Baby, better believe
Hands do not leave the sleeve—
It's not a magician's cute trick.

You read your green sheet handy-dandy
And think it's vanilla, sweet candy;
Then you find a bad scene
In some hairy routine
And it turns out quite hokey, not handy.

In massaging the data you've had,
You buy a real hooker—quite sad—
But it's no use to grouse
When things get mickey-mouse—
You're dead in the water, my lad!

Here's a tip from "S.E.", an insider,
Better believe it, you betchum, Red Ryder,
Make your manual a lookbook,
And don't try to cookbook—
You'll clobber a field right inside her.

—DAVE SKLAR

new literature

INTEGRATED CIRCUITS: New 7400 TTL integrated circuit series is itemized in 32-page brochure along with the 5400 series. Items include gates, hex inverters, buffers, decoder/driver, input

expander and master/slave flip-flops. Information given includes electrical and switching characteristics, logic diagrams and pin configurations. Schematic drawings and diagrams of test circuits and voltage waveforms take up nine pages. FAIRCHILD SEMICONDUCTOR, Mountain View, Calif. For copy:

CIRCLE 461 ON READER CARD

OVERSEAS OFFICE COMPUTERS: 14-page full color brochure describes line of office computers conceived overseas, capable of processing multiple programs concurrently. They feature modular core memory which can store and retrieve up to 1200 words, serial printer with a capacity of up to 40 character positions/sec, programmer which will change function with a deck of less than 60 cards. They come with plug-in peripherals—punches and readers. A fold-out page sums up specs. NORTH AMERICAN PHILIPS CORP., New York, N.Y. For copy:

CIRCLE 462 ON READER CARD

BIBLIOGRAPHY: Updated list of 420 books "useful in teaching business applications of the computer" is furnished according to subject category. Listing also includes name of publisher (75 of them), date published, number of pages, and type of publication (textbook, reference or handbook). Titles run from *Introduction to Data Processing* to *We Built Our Own Computers.* Price: $3. COMPUTING NEWSLETTER, UNIVERSITY OF COLORADO, Cragmor Road, Colorado Springs, Colo. 80907.

MINI MANUAL: 408-page handbook describes the 520/i computer, including hardware, interfaces and software. Designed for use by designers, programmers and general users, the book is cross-referenced in its sections. Complete specs are included. VARIAN DATA MACHINES, Irvine, Calif. For copy:

CIRCLE 464 ON READER CARD

EDP EMPLOYMENT: One of the nation's largest executive and engineering employment organizations offers a monthly data processing opportunities bulletin, listing jobs available according to salary and geographic location. Potential applicants are advised to put themselves on the mailing list two or three months in advance of making a change. "If you are desperate, OK, we'll help you, but our . . . bulletin is primarily designed for the careerist interested in moving up to a better job via the scientific approach." Positions listed run the gamut of the industry. CADILLAC ASSOCIATES, INC., Chicago, Ill. For copy:

CIRCLE 463 ON READER CARD

FOR DIGGERS: In-depth studies, tailored toward supplying information on growth potential, are furnished on various aspects of the computer industry. Subjects covered by individual study include: remote crt terminal displays, remote data terminals, minicomputers, computer software and time-sharing service companies, optical character readers, key-tape and disc units, disc packs and drives, and lasers. Price for each study: $275. ROBERTSON & ASSOCIATES, INC., Newark, N.J. For information:

CIRCLE 465 ON READER CARD

DESIGNING AID: A free field computer program, DART (Design Analysis and Review Techniques) is explained in 16-page brochure. Developed under technical supervision of Stanford Research Institute, the program carries on from the logic diagram, with analysis including error detection and correction, and documentation. Punched paper tape is provided for numerically controlled wiring. DATA TECHNOLOGY CORP. Palo Alto, Calif. For copy:

CIRCLE 466 ON READER CARD

THE SCORE ON SCORE: Plastic-link bound notebook gives a rundown on SCORE, the COBOL Program Generator, in some 27 pages (on one side). Data from both matched and unmatched records may be processed for both report generation and file creation requirements; the user may retrieve data selectively from multiple tape, disc, or card input files. SCORE sorts, edits and performs computations, including exponentiation. It works with the IBM 360 OS and DOS, Honeywell 200 series, RCA Spectra 70, Burroughs 5500, and Univac 1108. ATLANTIC SOFTWARE, INC., Philadelphia, Pa. For copy:

CIRCLE 469 ON READER CARD

FUTURE FINDERS: The first annual Symposium on Automation and Society, which included Vice Adm. Hyman Rickover and Willy Ley as speakers, and gathered together other notables in education, research, government and industry for a three-day meeting at the University of Georgia, is summarized in 16-page booklet. Participants discussed the effects of automation on technology, education, social organization, business and the economy. Also discussed were some of the misapplications of information: "The automobile was on the scene in 1897, but that was the year some prognosticator saw all the farmland being gobbled up in 20 years to supply oats for the growing horse population." CENTER FOR THE STUDY OF AUTOMATION AND SOCIETY, Athens, Ga. For copy:

CIRCLE 467 ON READER CARD

FACTS ON MOFACS: Multi-Order Feedback and Compensation Synthesis (MOFACS) is a digital computer program to synthesize the feedback and compensation parameters for control of a multi-order system. It is explained in a 10-page paper giving its use-sections, I/O, and an example of feedback parameter synthesis in two runs. MOFACS can be applied in prototype design, to evaluate requirements for new or modified systems, in determining hardware specifications, in process control engineering, off-line adaptive control, and for sensitivity tests on both plant and controller parameters. Diagrams and graphs are included. COMPRO ASSOCIATES, East Troy, Wis. For copy:

CIRCLE 468 ON READER CARD

THE BEST OUT OF TIME-SHARE: Procedures for finding optimal values in time-sharing are given in 183-page study of t-s systems, assuming constant swapping time. Results were obtained from three models: infinite source round-robin, finite source round-robin, and infinite source foreground-background. Cost functions (based on response time) were then taken into account, and parameters for the systems designer arrived at. AD-697 788. Price $3; microfiche, $.65. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

GRAPHIC TRANSLATION: Hybrid controllers and graphic systems which translate digital data into graphic form are described in four-page illustrated brochure. The Transplot line includes a programmer module that scans source data, recognizes and processes graphic data blocks and returns them to the scanning mode; a decoder permitting selection of different recognition codes and pen operations (trace, nontrace or pen up/down); controllers which can operate virtually any one- or two-axis analog unit; and a choice of digital interfaces. The system may be connected by only four or five wires to data set or terminal. COBB ASSOCIATES, Sudbury, Mass. For copy:

CIRCLE 470 ON READER CARD

DISPLAY SOFTWARE: Eight-page brochure sums up information on the software packages that are used with the IDIIOM crt interactive graphics display system. Included are the basic MOS master operating system, a FORTRAN package, IDAS and DAS assembly systems, the TRAK light-pen tracking program, TED test editing subroutine, and debugging, maintenance and diagnostic routines. Functions and use of each are briefly described. INFORMATION DISPLAYS, INC., Mount Kisco, N.Y. For copy:

CIRCLE 471 ON READER CARD

REMOTE ACQUISITION: Four-page brochure is devoted to SDA-770 data acquisition system, which utilizes up to 128 remote terminals to operate with one central control. Nonclerical personnel can use the terminals to convey on-the-job data—in inventory, attendance, production scheduling, maintenance control, etc. Terminals have verification display and printed output record of data entered. The central

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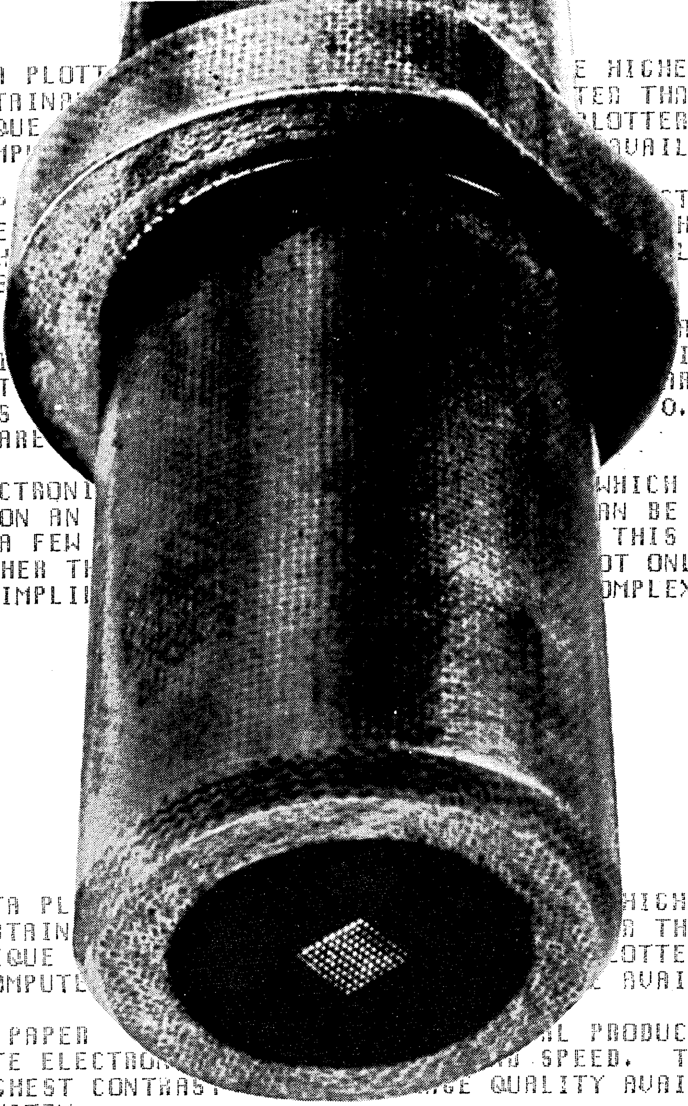

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COMPUTER GRAPHIC SYSTEM.

WRITING IS ACCOMPLISHED BY CHARGING THE PAPER IN THE AREA WHERE AN
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CONTROLLED PROVIDE THE BASIC WRITING ELEMENT. THESE WIRES ARE ARRANGED IN
A PATTERN OF 10 ROWS OF 10 WIRES EACH. THE RESULTANT IS AN 0.100 INCH SQUARE
IN WH…H THE WIRES ARE PRECISELY 0.01 INCHES APART.

T… CONTROL ELECTRONICS CONTAIN A VECTOR GENERATOR WHICH PERMITS THE
PLOT… TO OPERATE ON AN INTERRUPT BASIS. ANY VECTOR CAN BE GENERATED
BY …YING ONLY A FEW CONTROL WORDS TO THE PLOTTER. THIS TECHNIQUE OF
VEC…MMANDS RATHER THAN INDIVIDUAL POINT COMMANDS NOT ONLY REDUCES
COM… SIMPLIFIES THE PROGRAMMING TIME AND COMPLEXITY.

AMEN…

We generate characters!

GENERAL ECONOMICS CORPORATION company

Are you suffering from the generation gap?

The basic electronic writing head of our new second-generation plotter is a 10 by 10 matrix of wires spaced on .010 inch centers. This writing area is approximately the size of a typewriter character, and by proper address, characters of this size can be formed in one operation. It takes less than 200 microseconds.

You'll find that you can get high resolution and linearity over large formats . . . and get them fast . . . if you go "second generation".

The advantages are many. Our technique of vector commands, rather than individual point commands, not only reduces your computer time but simplifies the programming time and complexity. It can increase computer efficiency as much as 50 to 1. And, of course, we've developed software and interfacing to directly replace your present plotting system . . . both "on line" and "off line" operation are possible. Nothing is left to the imagination!

GRAPHIC DATA, INC. 169 Bedford Street, Burlington, MA 01803

CIRCLE 102 ON READER CARD

control is comprised of a processor, multiplexer and output unit using mag/paper tape, punch cards, or an interface to linkup on-line. Specs are included on all parts of the system. SIERRA RESEARCH CORP., Burlington, Mass. For copy:

CIRCLE 474 ON READER CARD

POWER: Regulated and parametric DC power supplies are itemized in eight-page catalog, listing six basic lines and models for both laboratory and systems requirements. Features of each model are given, with specs listed below. Among features: ±0.005% regulation, zero response time for noise and spikes. Data is also given on ripple, controls and circuitry. WANLASS INSTRUMENTS, Santa Ana, Calif. For copy:

CIRCLE 475 ON READER CARD

ESOTERIC GLOSSARY: *Glossary of Commonly Used Computer Terms* (seven pages, 8″ X 11½″ format) contains more than 100 "esoteric words coined by the computer industry," with definitions including cross references, synonyms/antonyms and table illustrations where necessary. Acronyms are broken down and explained. GENERAL AUTOMATION, INC., Orange, Calif. For copy:

CIRCLE 472 ON READER CARD

IMPULSE COUNTERS: Line of 48 different models of impulse counters is described in six-page bulletin. Plug-in connections, clamp and spring mountings, are provided for the 5, 6 and 8 digit variations available. Complete specs are given, with operating characteristics, reset information, dimensions and knock-out data. Counting speed goes to 60 impulses per second. LANDIS & GYR, INC., Elmsford, N.Y. For copy:

CIRCLE 473 ON READER CARD

SIMPLE RETRIEVAL: An "electronic file" developed by computer engineers, the DIMBO-10, is explained in four-page bulletin, which advocates its use as an uncomplicated information retrieval system for inventory and parts record, reference listings, and administrative and financial tasks. No programming, setup or operator training is required. The file will memory-store, locate and print-out records, alter any character in a record, delete, print-out entire file contents, and has a special printout for reorders and such. The bulletin provides a step-by-step example of inventory control application, a flow chart, and available options. BCD COMPUTING CORP. Deer Park, N.Y. For copy:

CIRCLE 476 ON READER CARD

DISC DRIVE: A disc storage drive that has been designed to match exactly the operation of the IBM 2311—even to contour, color and dimensions—is detailed in eight-page brochure. The magnetic disc drive has a random access memory, and uses removable disc packs. It has a storage capacity of 7.25 million bytes; average access time is 75 milliseconds. Maintenance service is also described, and specs listed. BRYANT COMPUTER PRODUCTS, Walled Lake, Mich. For copy:

CIRCLE 477 ON READER CARD

COMMUNICATIONS TERMINALS: Four-page brochure describes the ASC 1170, a modular computer system using a processor which employs fourth generation digital technology, a 4K magnetic core memory expandable to 32K bytes, and can be microprogrammed to use as a communications terminal, or for remote batch processing. Full memory cycle time is 1.1 usec. Peripheral options include printers, reader/punches and keyboards for tailored applications, with software also available for data compression, validation, formatting and compatibility. When implemented as a communications data concentrator, the system can be furnished with up to 64 lines, with adapters. APPLIED SYSTEMS CORP., Detroit, Mich. For copy:

CIRCLE 478 ON READER CARD

TAPE MEMORY: Digital tape computer-compatible memory system is described in six-page folder. This TMZ model has simultaneous read/write capability, conforms to all IBM and ASCII parallel digital recording requirements, and transfers data in 7- or 9-track formats. It is assembled in modules which can be removed or re-inserted in the field. Performance characteristics and available options are listed. AMPEX CORP., Redwood City, Calif. For copy:

CIRCLE 479 ON READER CARD

MORE IN MILWAUKEE: Report on the electronics industry in Milwaukee gives details on major electronics companies in the area, as well as major managerial, engineering, trade and technical training institutions there. Also included is comparative data on industry growth and employment, almost twice as much as the national


$1495

average. MILWAUKEE DEPT. OF ECONOMIC DEVELOPMENT, Milwaukee, Wis. For copy:

CIRCLE 480 ON READER CARD

ON HOUSE: *An Example of the Computer's Role in Residential Architecture* is four-page folder describing the use of computer-plotted drawings to help in planning wall planes and unusual room shapes for an already-designed exhibit house. Computed graphics were handled by the University of Washington's College of Architecture and Urban Planning. POTLATCH FORESTS, INC., San Francisco, Calif. For copy:

CIRCLE 482 ON READER CARD

BUSINESSMAN'S EDP: Multicolor-charted 16-page brochure shows how to select computer services, is primarily aimed at the nonexpert businessman who wants some basic answers about systems management and the compared advantages of buying, leasing, time-sharing, etc. The complete Exec 8 operating system based on the Univac 1108 is explained, with software and support services. Although simplified, most of the specs are given, and a diagram is included with detailed labeling of each system part. AXICOM SYSTEMS, INC., Paramus, N.J. For copy:

CIRCLE 483 ON READER CARD

SYSTEM SERVICES: Four-page brochure describes varied printed services available for use as aids in systems management, concepts and development—from a monthly letter, to four systems reference handbooks a year, as well as bulletins on administrative research. A yearly index includes all subjects covered during the year. Some of them: systems records, procedures, office layouts, reports, organization, policy, survey and analysis. Systems on-the-job courses also are offered. SYSTEMATION, INC., Colorado Springs, Colo. For copy:

CIRCLE 484 ON READER CARD

VOCATIONAL GUIDANCE: The use of computer-based systems for vocational guidance is discussed in 168-page report. Theoretical considerations in setting up a system as well as its use are taken into account. An examination is made of some systems now under development. FS 5.225:2503. Price: $1.25, SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, Washington, D.C. 20402.

MEMORY TEST: Bulletin describes automatic memory core tester, in which both comparison and absolute-value methods are combined, or can be used separately. Features include 16-step programming, up to six strobe discriminators, pushbutton reset for the counters, and a remote control box that allows the operator to run the handler and tester from the same position. DATARAM CORP., Princeton, N.J. For copy:

CIRCLE 485 ON READER CARD

CREDIT ON THE LINE: Eight-page brochure describes Credit-Chek, on-line system, which can be used to authorize bank credit when the main cpu is in operation, or as a backup system when the processing center is down. Authorizer units (terminals) are located at specified stations, feeding and receiving data from the central processor, with indicators telling whether the transaction is approved or "over limit." The cpu stores a negative account list available at all times, which is updated daily. This list is accessed by inquiry terminals which display an "approved" or "refer" light. The backup system also can be used to automate all interchange transactions. The system requires no programming, can be tailored to charge card plans of any size. MARKETING AUTOMATION, INC., Moorestown, N.J. For copy:

CIRCLE 486 ON READER CARD

MEXICAN SERVICES MARKET: Thinking of trying to offer computer services in Mexico? A report on the Mexican computer services market covers such areas as existing services, the computer population, current applications, potential clients, personnel, and companies which were interviewed and their equipment configurations. The report was prepared by a South American consulting firm and is being marketed at $5K by TIME-SHARING ENTERPRISES, INC., King of Prussia, Pa. For information:

CIRCLE 314 ON READER CARD

FORTRESS DATA BASE: The vulnerability of computers and their immediate surroundings are analyzed in four-page publication which takes into account natural disasters or sabotage. Possible total destruction of records is faced as an eventuality, and risk management tactics discussed. AUTOMATION TRAINING CENTER, Reston, Va. For copy:

CIRCLE 313 ON READER CARD

An open letter to AT&T

from the company who will let a lot of your data communications customers do you out of $100,000 a year.

Undoubtedly your first reaction to us will be a sense of irritation at a certain loss of revenue.

If that's your only reaction, you'll be making a big mistake.

Allow us to explain.

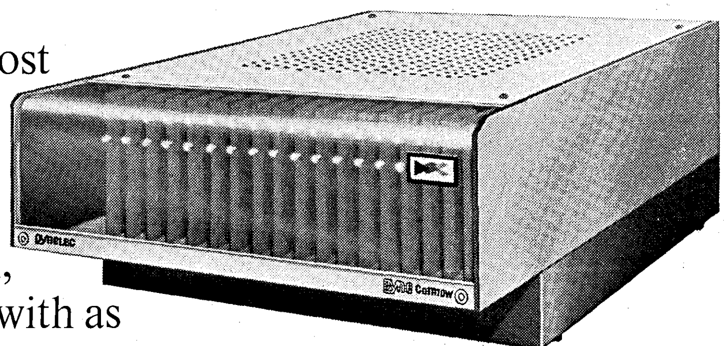
We, the Dynelec Systems Corp., have developed a unique approach to data communications that is, by conservative estimate, 400% more efficient than that used in other systems now operating.

With our equipment, up to 120 mixed-speed data terminals can be accommodated simultaneously over each voice-grade line.

This is 4 times as many as in any other system.

Which means that multi-location data communications customers will be able to concentrate and send far more data, more economically, to and from their computers than they ever could before.

But substantial reductions in leased line and modem costs alone are only part of the story. Great additional savings are made through use of our equipment.



For example, our basic, low-cost communications multiplexor, the ™DyneCoM 70W, grows as customer needs grow.

Because of its modular design, a user can start off inexpensively with as few as 2 channels and plug in additional circuit boards to handle up to 64 mixed-speed terminals.

Other 70W features include the unit remaining operative despite channel failure, simple visual diagnostics, self-service maintenance, up to 4 speeds and any code, and automatic speed selection.

Total annual savings can easily exceed $100,000.

The Dynelec approach opens such vast new vistas in data communications that they far outweigh any AT&T revenue loss that results from the savings we can help customers enjoy.

For full details, write us or call: (201) 447-0900.

DYNELEC™ SYSTEMS CORP.

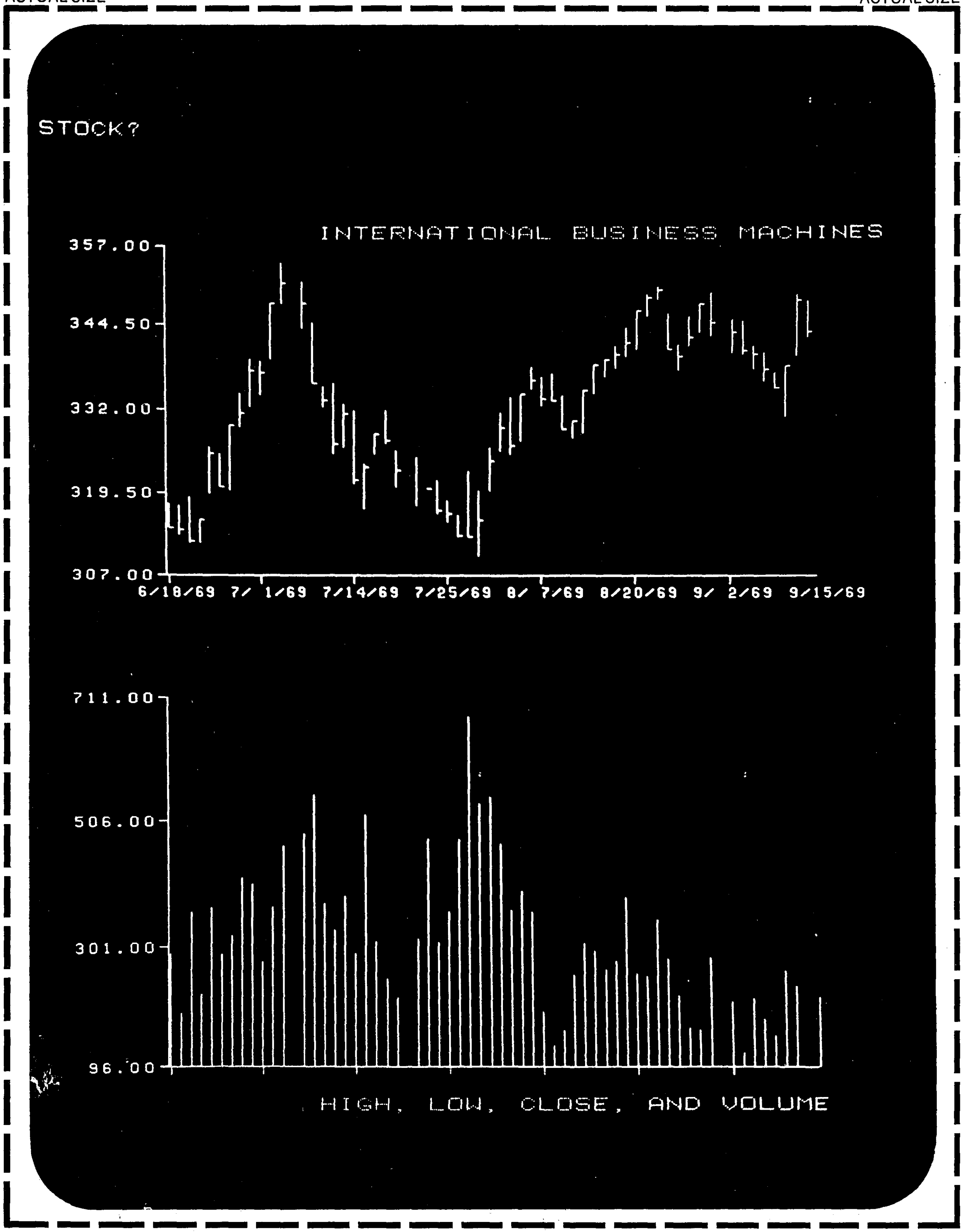
139 HARRISTOWN ROAD, GLEN ROCK, N. J. 07452

SEE US AT THE SJCC BOOTH DD

CIRCLE 29 ON READER CARD

Cut this out and paste it on the screen of your present terminal.

ACTUAL SIZE ACTUAL SIZE



Imagine getting details like this for under $8500.

We hate to superimpose. But it's one way to show you that our desk top terminal has it over other graphic displays. First, ARDS 100A costs less. Under $8500. Now, compare our screen. (If you don't have a display, compare it to the competition's.) ARDS has better visibility, higher resolution, easier readability of characters. Because we use a direct view storage CRT that doesn't need refreshing. Could you ask for clearer, sharper details? Only by writing us at 223 Crescent Street, Waltham, Massachusetts 02154.

Computer Displays Inc.

See you at the SJCC Show.

CIRCLE 158 ON READER CARD

systems this month. Current input says one is a mini that "will feature cassette tape" and the other is a large system (presumably larger than I's model 4) with much emphasis on applications software. This probably involves microprogramming, which Interdata has hawked since it was formed.

IC T-S CPU IS R-U-M-O-R-E-D

Looks as if DEC will upgrade its time-sharing PDP-10 with an ic version called the 10i, supposedly twice as fast as the 10 in pure arithmetic speeds, and carrying a cpu price tag of about $200K, about 1.5 times that of its predecessor. Major innovation--besides the belated move by DEC to integrated circuits--is the use of perhaps 16 associative memories (probably ic also) for mapping. The instruction repertoire will be the same, so the i should be compatible with its predecessor. The machine--reportedly available by mid-'71--could be a strong candidate for time-sharing service bureaus, many of whom are now evaluating the next generation of machines.

ROUND ROBIN RUMOR MILL IN FM, TS

Elsewhere in time-sharing, GE refused to dignify by answer the latest rumor that it was selling its Information Services Div. This must be tantamount to denial, especially since the division has had almost weekly press conferences announcing application packages for different vertical industries.

Meantime, University Computing Co., which was rumored to be interested in buying GE's t-s biz at one time, was rumored to be selling some of its centers and Bunker Ramo was said to be interested. Good sources say this can't be true of the computer utility network centered around the 1108's, since "all locations are profitable."

Instead, we also have the rumor that some Computer Technology Inc. execs (besides ex-president W. Woerner) think UCC only wanted their body--the LTV system management contract and will defect. The other side is that UCC reportedly wants only 20 of the 85 administrative CTI staff inherited, and won't be unhappy if some high-priced people leave.

BURROUGHS GOES AFTER 360 TERMINAL MARKET

In an extension of the DC product line, Burroughs is finishing up work on the DC-1800--a communications processor that will open up the vast 360 market to Burroughs' successful TC-500 terminals. The 1800 uses a Varian 520 mini and replaces the IBM 2701, 2, and 3 communications interfaces. An emulator supplies the polling and device selection requirements not included under BTAM and QTAM but needed by the TC-500. A maximum of 64 units can be handled by the 1800 and we hear one installation is already being put in that will use about 30 terminals. Presumably other terminals could be interfaced through special software, but Burroughs will supply it for the TC-500.

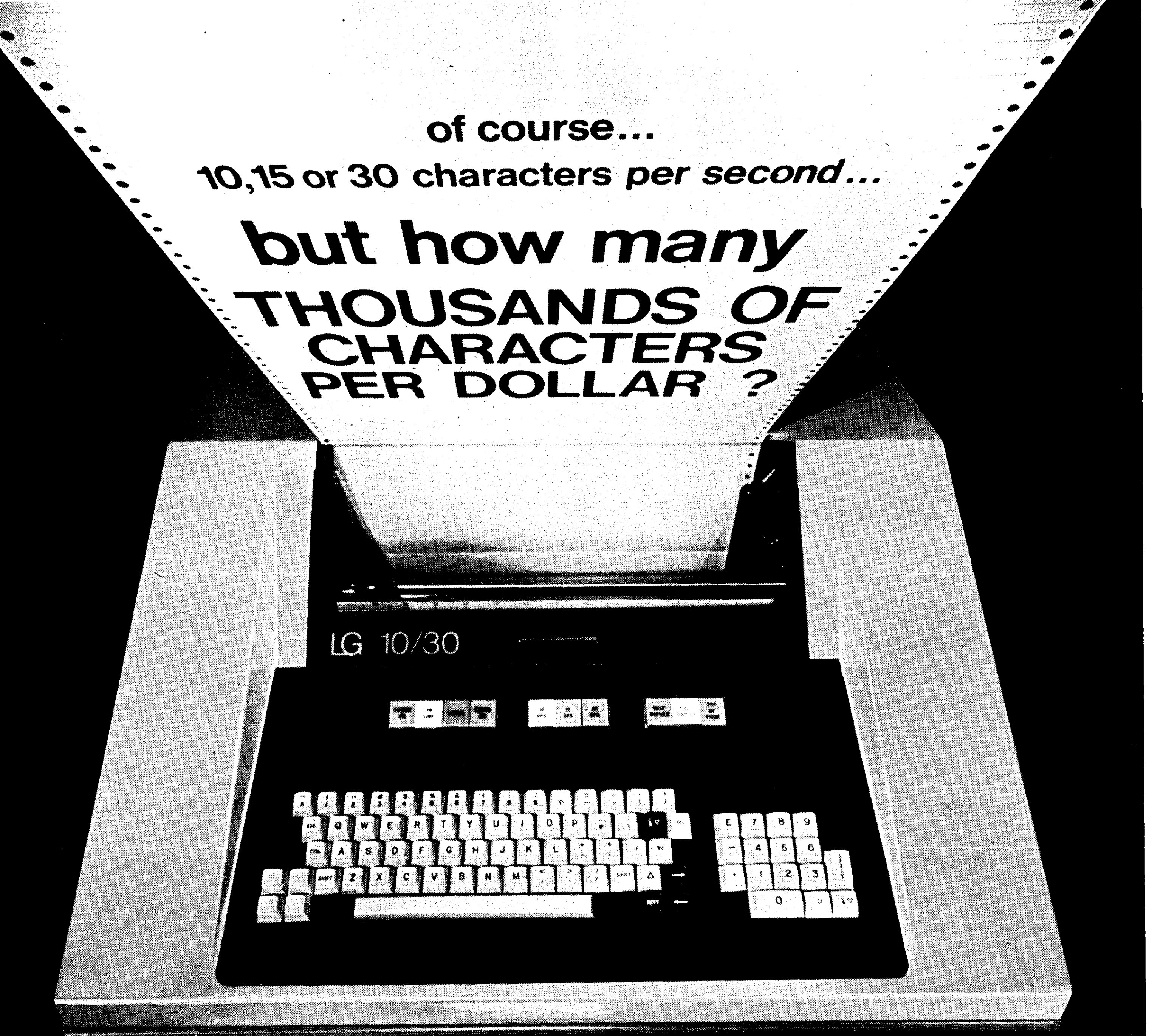
DISC MAKER BELIEVES IT'S ON THE RIGHT (HEAD-PER) TRACK

Its faith in head-per-track discs strengthened by the recent announcement of the IBM 2305 FHSF (Fixed-Head Storage Facility), San Diego's Digital Development plans a "more aggressive" marketing posture with the blessing of parent National General Corp., a $500-million LA conglomerate.

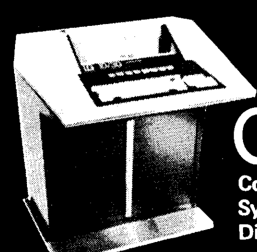
The 350-man company has almost a year's backlog, says '69 sales were 2½ times those of '68, mostly OEM, with 600 units installed so far. Plant will be tripled this year, with production doubled by early fall.

Evidently believing its claim to the most reliable disc in the industry, DDC will offer at a nominal sum

(Continued on page 373)



That's the realistic question when you're thinking computer terminal economics and end-user satisfaction. The **Gulton LG 10/30** answers the question in terms of reliability – continuous, uninterrupted hours, days – months of steady performance. But, that didn't just happen – the application of Gulton's advanced status in electronics technology is the basic reason for the **LG 10/30** Terminal's unique reliability. Inquire today about the **LG 10/30**, and the **LG 10/30 ASR** with magnetic tape reader/recorder.



Gulton
Computer Systems Division

See the LG 10/30 at the SJCC
Atlantic City, N.J. May 5, 6 & 7

Gulton Industries, Inc. 13041 Cerise Avenue Hawthorne, California 90250 Telephone (213) 679-0111

CIRCLE 251 ON READER CARD

"Flight Insurance," an extended warranty on currently installed gear. And we hear the firm will shortly announce a smaller, lower-cost addition to its line.

SE BODYSHOP BIZ TAKING HOLD, PMI JOINS RANKS

Plagued by user resistance to its system engineering contracts, IBM should be anxious to hear that it has one more competitor for these services. Programming Methods Inc., NY software house, will begin offering six SE plans in May, first to NY-area customers and later to the nation. The plans range from $6K for 26 days of SE time plus $28/excess hour, to $41K for 260 days and $18/excess hour. The service will include an audit report on the user's system and a comparison with peripherals competitive to those installed.

SCAN-DATA HAS $15K REMOTE RECOGNITION UNITS

New remote OCR units from Scan-Data Corp., Norristown, Pa., should reduce data transmission costs because both recognition and scanning equipment are at the remote location. One model reads hand printing, although initially only a truncated alphanumeric set; the other reads full alphanumeric, upper and lower case typewriter fonts. Prices are about $15K, delivery 3rd quarter.

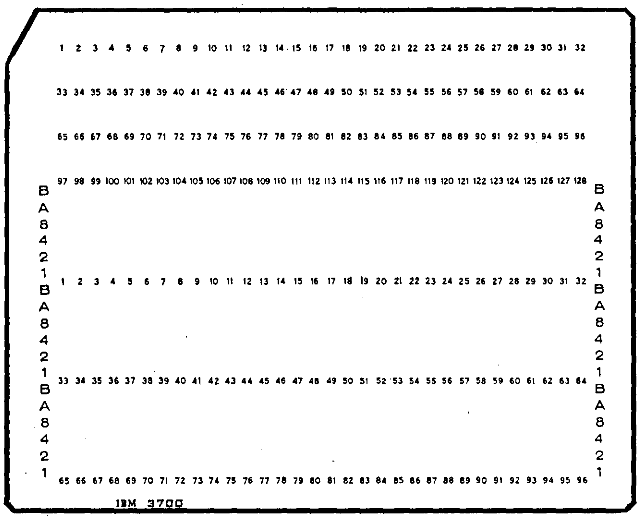
ARPA NET WILL LINK 10 MORE LOCATIONS

Ten more universities and other government-funded institutions around the US will be tied into the ARPA Computer Network before year's end. The Defense Dept. project intended to develop resource-sharing techniques among dissimilar computers and more reliable digital communications, has had four schools in the net since November--UCLA, Santa Barbara, Utah, and Stanford Research Institute. Bolt, Beranek & Newman is proud of the Interface Message Processor it's developed for the net, and is said to be eyeing a possible commercial effort if all goes well. So far each IMP (DDP-516 based) has been handling two 50 KB lines in round-robin communications among the participants. But it will be expected to handle up to 250KB maximum; typical will be two host computers on the IMP and three or four 50 KB lines.

RUMORS AND RAW RANDOM DATA

We hear the AEC has approved the contract for the biggie Star computer. At presstime, CDC's signature was being awaited...IBM's next big computer announcement will come in June, and it's supposed to be one or two of the NS systems oft-rumored here. They'll be in the /40 and /50 range, but numbered differently. Sooner or later, one of these rumors is bound to be right... Viatron's reportedly telling its sales reps to find someone who wants to buy 1,000 System 21s, 25% down, two years to pay. The firm's anxious to put the mother company into the sales column soon with respectable figures--hard to do at a clip of $39/month. Its subsidiaries posted all the '69 revenues...Terminal makers are being urged by numerical and process control computer users to develop color crts--the expensive multiphosphor kind--because of the importance of color to these manufacturing processes. And paper tape makers are trying to stave off the projected decline of their biz by developing p-t cassettes...IBM's Federal Systems Div. management is rumored unhappy with IBM's edict that the division justify its existence. Apparently, government cutbacks are hurting. FSD thinks it should have retained charge of commercial, as well as federal, custom contracts...Rumor: Honeywell's and NCR's next lines of computer will be devoted to semiconductor memories.

what's the secret behind this 96 col. card?



a new concept!

. . . to be unveiled at the SJCC, booth 50013.*
CDS will enter the 96 column market with a
dependable new line of peripherals. Don't miss it!

*and IEEE, booth 522, Washington Hilton Hotel, June 16, 17, 18.

Computer Digital Systems

LOGAN SQUARE, NORRISTOWN, PENNSYLVANIA 19401 (215) 272-5975

One problem built into computer terminal systems is getting hard-copy readouts out of them.

Until now, available devices have been too costly. Or too bulky or immovable. Or too slow, tying up the computer for too long.

But that's all over. The new CU-5 Hard Copy Land Camera from Polaroid has arrived.

You take a shot in a split second. And with Polaroid instant photography, in just seconds more you have a copy in your hand.

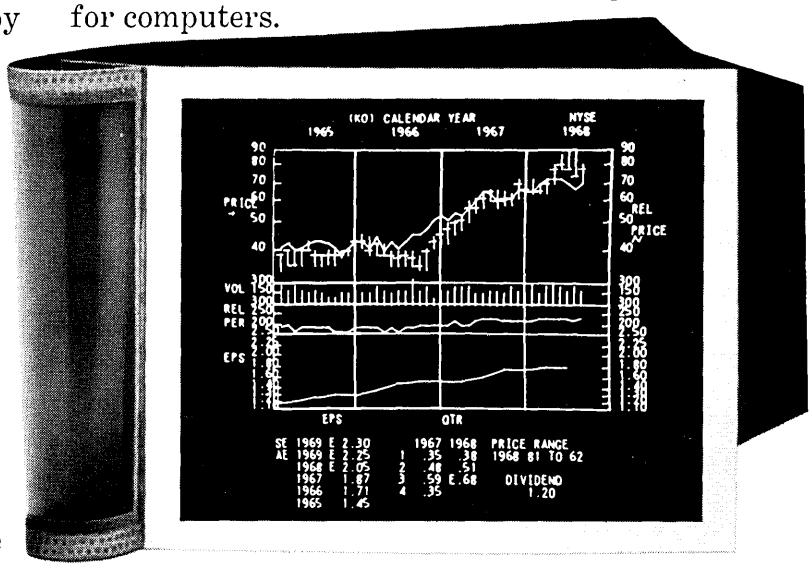
You don't have to be a photographer to use it. The hood positions the camera for sharp focus, frames the image, and blocks out ambient light. All you do is hold the camera against the display and pull the trigger. The CU-5 does the rest.

It's rugged and built to take abuse. But it's hand-held, light and easy to carry. So using it for a number of screens is no problem.

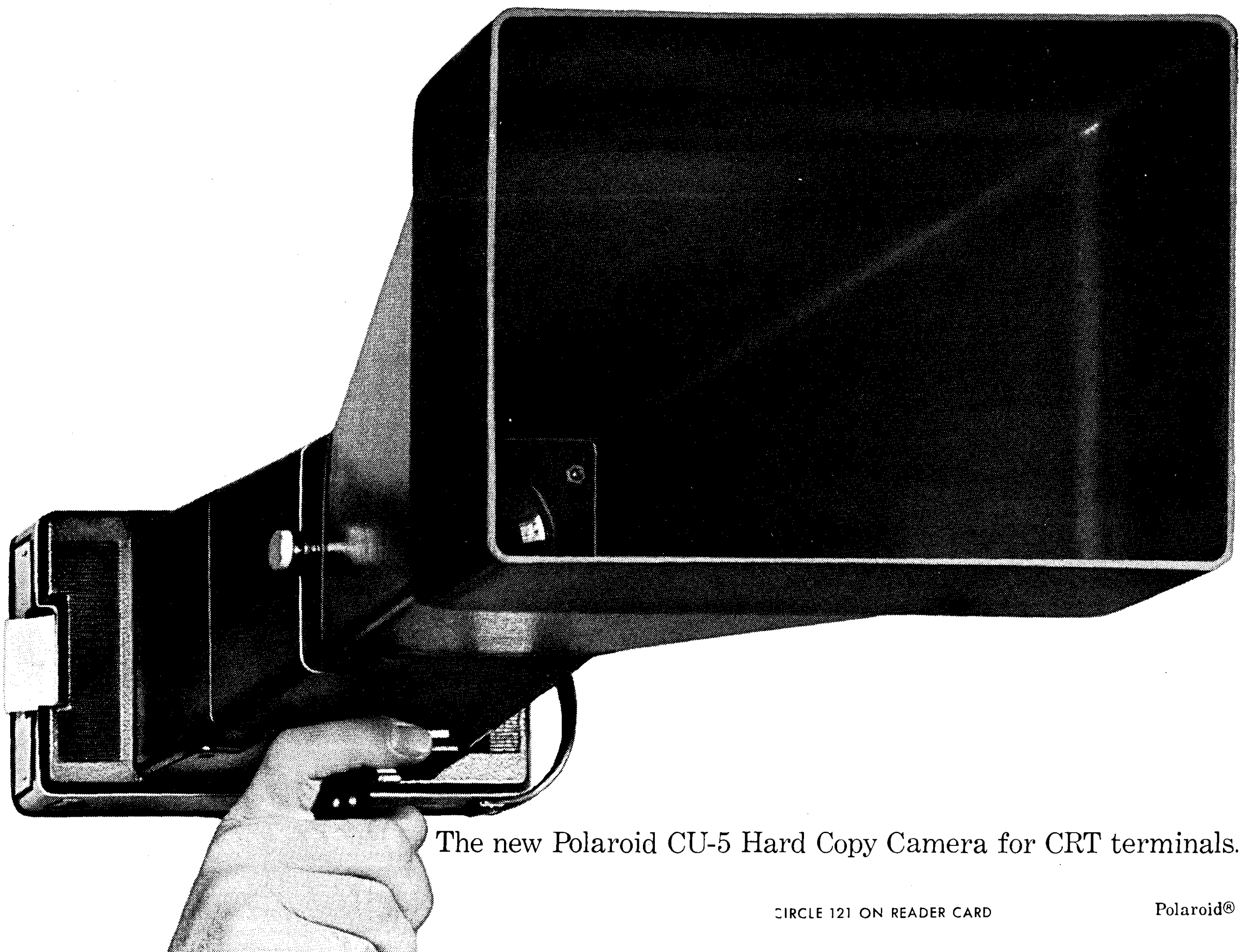
And you don't have to shoot the works to own it. It's under $300. A fraction of the cost of other equipment.

If you'd like more information, or a demonstration, write to: Polaroid Corporation, Dept. 88-163, Cambridge, Mass. 02139. (In Canada: 350 Carlingview Drive, Rexdale, Ont.)

We'll show you how Polaroid solves problems for computers.



For the record, nothing else can deliver hard copies for under $300.



The new Polaroid CU-5 Hard Copy Camera for CRT terminals.

CIRCLE 121 ON READER CARD

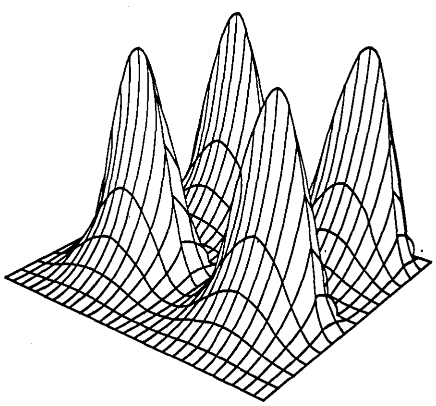
Polaroid®

New Plotting Software

TRIDEM*

3-dimensional perspectives, stereos and isometrics

Written in FORTRAN, the TRIDEM package expands a plotting system's capability to provide 3-dimensional, perspective or stereo plots of any data which can be expressed as a function of two variables or in XYZ coordinates. You can make machine tool design plots from many angles . . . create complex energy spectrums for isotope study . . . produce frequency and impedance curves . . . do optical studies . . . or vibration analyses . . . or provide insights and correlations on any subject rather than spend long hours in scrutiny of numbers on a conventional graph.

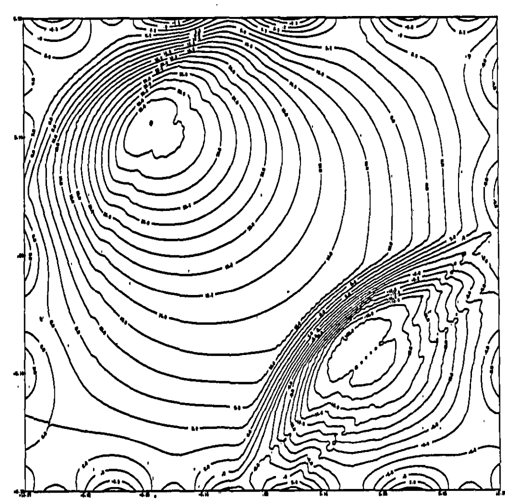


- Use with any standard plotting system.
- FORTRAN compiler and minimum core required.
- Lease price is $2500 total for the first three years, renewable for $100 per 3 year period thereafter.
- Complete programming documentation provided.
- Full maintenance and updating included.

CØNTØUR-PLØT*

30 times faster than hand drawn maps

The CONTOUR-PLOT system is a verb-orientated, inherently logical and flexible programming system to produce complex, fully-annotated contour diagrams of high graphic quality comparable to carefully hand-drawn maps—at a speed 30 times greater. An outstanding feature is the ability to manipulate surfaces stored within the system. Intersections, unions and other arithmetic operations are now possible with this contouring package. Surfaces are stored in the system and can be assessed at will. Applications include onshore and offshore geophysical studies for nuclear, radiation and thermal analyses; communication, aerospace, meteorology and other gridded data studies.



- FORTRAN IV language
- Use with Houston Instrument or any standard plotting system
- Lease Price:
  - Basic . . . . $8500.
  - Multiple Surface Option . . . . . . $2000.
  - Isometric Option . . . . $1000.
  - Statistical Surface Fitting Option $ 850.
  - Profile Plot Option . . . . $ 500.

CØMPLØT*

Anti·Work SOFTWARE

The CONTOUR-PLOT package works in conjunction with the TRIDEM* package to produce 3-dimensional contour plots. Send for brochures.*

*T.M., Houston Instrument

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world roundup

THERE'S NOTHING TOO ABSTRACT TO ABSTRACT

In view of the fascinating developments covered by our contributors in the February issue on the topic of libraries and automation, it seems worthwhile paying attention to a cautionary note that has been sounded by three scientists at Cambridge University. In a roundabout way they reflect an interesting user's eye-view on computer-based library abstracting services.

The three in question are Dr. J. P. Turner, in the department of Applied Maths and Theoretical Physics, and Drs. D. Davies and D. P. McKenzie in Geodesy and Geophysics. They recently published papers in the oceanographic field under titles incorporating the words "development," "evolution," "triple junctions" and "fingers." The key words have obviously been picked up and dispatched via computer abstracting services to thousands of child psychiatrists, biologists, neurologists and medical practitioners--to name but a few.

Hundreds have asked for reprints on a subject that can have little conceivable value for their specialty. So the Cambridge trio have reported this situation in a terse communication to one of the premier international journals of science. Mischievously, it has been published under the esoteric title of "Evolution-Development: Anatomical and Cerebral Features and the Pathological Consequences." Dr. Turner says "we are curious to know how many people over the next two months are going to request a reprint of this communication on the same basis as before."

It makes one wonder if the so-called information explosion is more a synthetic than natural event.

EUROPEANS TO JOIN IN SOFTWARE/SERVICES FIRM

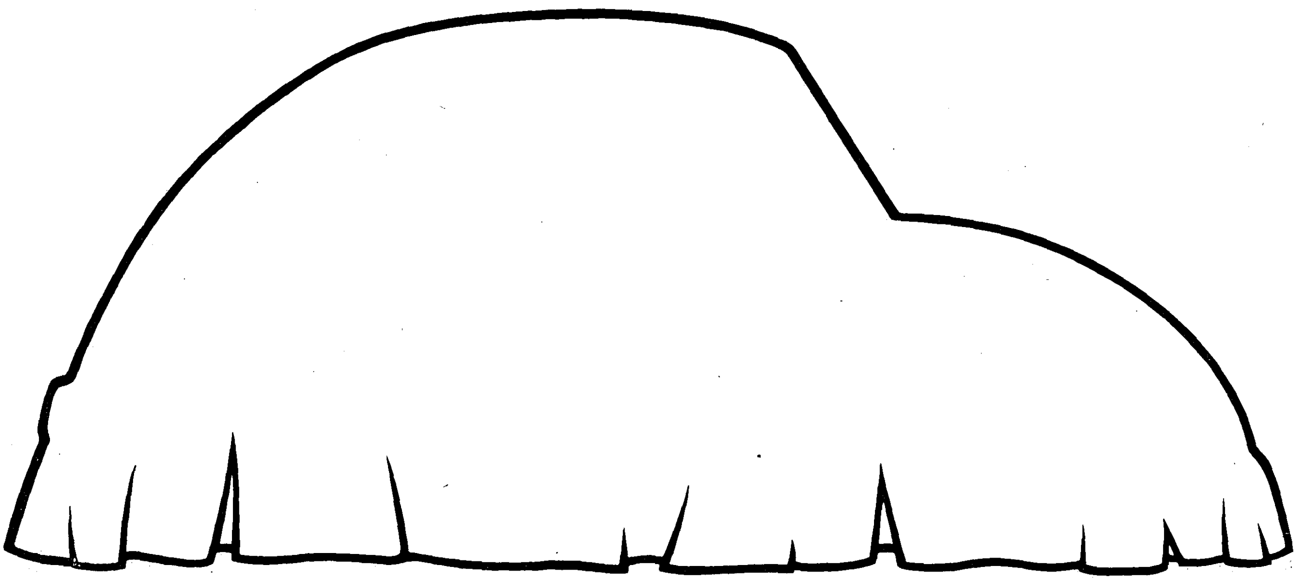
Preliminary details have been disclosed of the new European software and computer services venture called Systems International, incorporating partners from big users, finance houses and existing service organizations. Briefly, Systems International will eventually operate in the UK, France, Germany, Switzerland and Belgium with other countries coming in at later dates. An international management company of the group is registered in Brussels, chosen for financial reasons. Under its umbrella, operating companies will be established in selected countries.

The first of these national organisations has been established in the UK. One in France and one in Germany will be opened shortly. Financial participation and support for Systems International will be solely European and no single partner, or national grouping of partners, will have control. The British partners in the first operating company are Rolls Royce (the aerospace giant), Lloyds and Midland Banks (two organisations with assets over $4.5 billion between them).

The UK operating company of Systems International has been first off the ground because Rolls Royce has supplied a readymade nucleus of talent. As far as machine services are initially concerned, the first branch of Systems International will take time on the triple 360-65 configuration at Rolls Royce's main computer centre until Systems International's first 360-65 is delivered to a new centre under construction at Kegworth, Derbyshire.

The Chief executive of the Systems International

COMING SOON



It won't be long before COMPUTER DEVELOPMENT takes the wraps off its small, sturdy and economical-to-operate new model. The manufacturer's suggested list price is low, and in fleet volumes it's ridiculous.

Before we unveil our product, it will be road-tested on our own track and then reworked until the first model is as reliable as the last.

When we present our product, there won't be a *bug* under the drape!

computer development

3001 South Daimler Street / Santa Ana, California 92705 / (714) 557-9720

Group of companies is Leonard Griffiths. A mathematician and aero-engine designer, he started development of systems and computer services for all aspects of Rolls Royce's business in '53. Since, the aerospace firm has probably built up the largest computer investment by an industrial user company in Europe with about 1,500 personnel on systems and computer services.

According to Griffiths, the group has no special commitment to any machine manufacturer, which is just as well, because the only name known to be definitely connected with operations in other countries is Inter G of France--an engineering consultancy in which the Dutch electronics giant Philips has a small stake.

JAPAN TAPS NEW HARDWARE VEINS

In a very different vein, Japanese research groups have made progress with a couple of neat hardware items. One of them that has been released onto the world market is described as the chemist's dream in automated analysis. From the Jeol Company's range of scientific equipment, its system runs a gamut of instruments (measuring nuclear magnetic resonance, mass spectrometry, infrared, ultra-violet and so forth) which are hooked via their individual peripheral processors to a central machine in a chemist's time-sharing system.

Samples for analysis are given to all the instruments simultaneously. Results from each are transferred to the central machine where the data is amassed until all the measurements have been acquired for an instantaneous chemical structure analysis of the compound.

The other work is an experimental time-sharing system in which laser communication has been used for two-way transmission between terminals and computer over a mile apart. For the trial the remote terminal accessed a data bank containing library information, and indulged in solving some simple games. Development has been done by a laboratory of the Industrial Science and Technology Agency along with engineers from the Matsushita Communications Engineering Company. A helium-neon gas laser was used and the developers of the system reckon it could solve a communications bottleneck on telephone channels in the congested area in the four or so miles radius of the heart of Tokyo.

AND TRIES TO CLOSE THE GAP

These developments are more than mere novelties, for name of the game to the Japanese industry is to "close the gap" between Japan and the United States by 1980. On sheer numbers of installations, the country is second only to the United States, but the real motive of the Ministry of International Trade and Industry is to ensure no gaps exist in the technology that will be the springboard for future international marketing campaigns. About one in four of Japan's 5,000-plus installations are imported.

At the beginning of the year the market was shared by IBM Japan 35%, Hitachi (affiliated with RCA) 13.8%, Fujitsu 13.6%, Nippon Electric (links with Honeywell) 11.5%, Univac 10.2%, Toshiba (links with GE) 3.7%, NCR Japan 3.2%, Oki (link with Univac) 3.2% and rest, including Mitsubishi, 5.8%. All of the Japanese manufacturers forecast increases over the next fiscal year varying from 30 to 50% in their output. In the meantime the Government agencies have several projects in hand for strengthening the industry, including a state-backed systems development and software house, and coordination of education courses at university and college levels. This follows backing already given to a consortium of manufacturers concentrating on electro-optical, electro-magnetic, and electro-mechanical peripherals.

BOB MAY DELAY WIMMIX PURCHASE

The Budget Bureau reportedly is considering whether to order a formal review of the Wimmix buy. If the review occurs, release of the final RFP would be delayed 12 to 18 months. Meanwhile, Deputy Defense Secretary Packard has told Pentagon dp managers that their planning for all upcoming computer buys must be updated and reapproved, if it isn't already current. But a DOD source says the Packard directive won't affect Wimmix or any other major systems now in the works.

BROOKS BROOKED ON EDP COMMITTEE

Despite Jack Brooks, a House Rules subcommittee headed by B. F. Sisk of California is likely to recommend establishing a joint committee to oversee the computerized information retrieval system proposed for Congress. Brooks wants to put the Library of Congress in charge. The Sisk group reportedly believes the joint committee would be more objective, carry more clout, and attract higher caliber personnel. If and when the joint committee is established, the dp industry may be given a hand in selecting its director.

FCC'S JOHNSON NEEDLES FCC

FCC ought to be asking itself "How can the (nation's communications) systems be made more useful to all users?" rather than "Why shouldn't established interests be permitted to protect monopoly markets and traditional market sharers?" said Commissioner Nick Johnson last month.

He added that this new policy could be expressed immediately, unlike others that can't be developed until the Commission's policy planning and information gathering capabilities are beefed up.

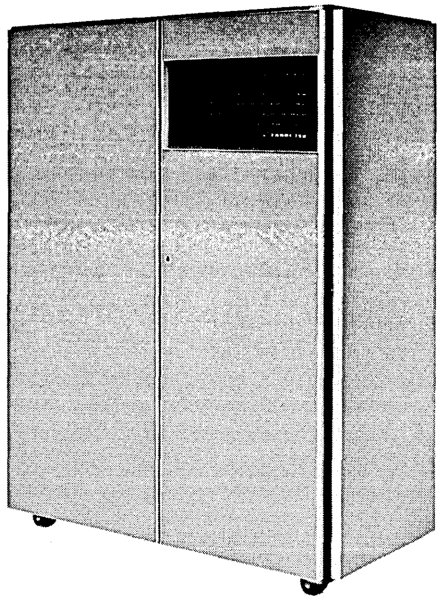
Johnson, featured speaker at last month's Brookings Institution seminar on "Computers, Communications, and the Public Interest" also thought "the Commission could indicate its willingness to use competition as a regulatory tool...'deregulation' is a fashionable word. But...there has to be some form of competition to replace it...Permitting small entrepreneurs to compete against multibillion-dollar monopolies will not be enough."

He implied that SRI, in its report on the computer inquiry, offered the wrong prescription for curbing the carrier's monopoly power. Instead of "harnessing allegedly predatory pricing behavior," said Johnson, "FCC should consider alternative industry structures that would eliminate the problem of monopoly power."

Also, "the Commission might also begin a separate legislative inquiry into all aspects of privacy."

But neither problem can be tackled until FCC policy makers get more in-house research staff and develop better liaison with outside sources of information. Johnson thought the Commission should establish regular conferences with groups to be affected by decisions; he mentioned computer communications as one conference subject. The meetings "must be something more than occasional oral arguments and written briefs...There should be opportunity for independent testing of positions, and for analysis by knowledgeable individuals whose only allegiance is to their own intellectual honesty."

How come we're plugging the IBM 360 series?



Because we've developed a big, fast add-on core memory system that lets IBM 360 users plug higher speed and increased storage capacity into their equipment! It's our new LCM 207 Large Core Memory, and it's in production now . . . a perfect plug-to-plug match for IBM models 360/50, 360/65, 360/67 and 360/75.

Cycle time is 2.5 microseconds, and capacity is from 5 million bits up to 20 million. And that translates into low cost-per-bit performance because of higher data throughput.

Storage capacity is 1 million bytes for the LCM 207-10, 2 million bytes for the LCM 207-20. Cabinet is 72 inches high, 60 inches wide, 27 inches deep.

Both models can be leased or purchased. Either way, Fabri-Tek can provide servicing on a nation-wide basis.

Call or write our local office. Our experienced application engineers are ready to help you find the solutions to your problems in the following areas: Main Memories ■ Buffer Memories ■ Scratch Pad Memories ■ CTR Refresher Memories ■ Peripheral Mass Memories ■ Mil-Spec Memories ■ Extension of Main Memory ■ Numerical Control.

See us at Booth 4800, Spring Joint Computer Conference

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CIRCLE 229 ON READER CARD

washington report

FIRM FIRMS UP SINGLE PHONE BILL

Shearson Hammill & Co. has worked out an accommodation with the telephone company (Jan. p. 165), under which it will receive a single bill each month for the services rendered by AT&T, Illinois Bell, and New York Bell; also, Shearson Hammill will deal with a single coordinator guarding all maintenance and system alteration problems. But the basic question remains--whether interstate private line service becomes intrastate when it utilizes terminals located in the same state as customer-provided multiplexing or switching equipment.

The phone company's agreement to appoint a coordinator implies an admission that Shearson Hammill is receiving a unitary service, despite the divison of regulatory responsibility. FCC, however, apparently isn't inclined to pursue the matter, even after Commissioner Kenneth Cox intervened earlier in the proceedings. Cox told Nicholas Costanza, Shearson Hammill's communications man, that Ma Bell's present definition of interstate and intrastate private line service is "not based upon specific tariff provisions . . . but upon Bell's own interpretation of law . . . "

If private line services like the one by Shearson Hammill were considered solely interstate, FCC's jurisdiction would be significantly increased; operators and users of t-s systems would have to deal with only one regulatory agency, instead of 51, and charges and specs would be standardized.

PRIOR FED APPROVAL URGED FOR CREDIT FILES

Credit bureaus and other consumer investigative agencies that computerize their files should be required to get prior federal approval, Prof. Alan Westin said last month.

Because computerization permits greater circulation and consolidation of data, he suggested that it creates a need for a "licensing-type procedure." The computerization plan should be considered at a public hearing "with full opportunity for spokesmen representing consumers, persons subject to data collection, or civil liberties interests, to appear before the (licensing) agency and comment." Westin also thought the regulatory agency should "make periodic audits and trials of computerized systems to test whether (approved) procedures were being followed."

He spoke before a subcommittee of the House Banking and Currency committee, which is considering HR 16340, a bill aimed at giving individuals greater control over the data that consumer investigative agencies collect about them. A related but weaker bill (S 823) has already passed the Senate.

In a related development the Federal Trade Commission has banned unsolicited mailing of credit cards after May 18.

CALO FOR WOLF

Eric Wolf, technical director of NAVCOSSACT for six years, has resigned—apparently because the job became overly administrative and didn't give him enough opportunity to work on information systems development, his specialty. Wolf expects to join a local systems company shortly. Carl Calo is now acting technical director of NAVCOSSACT; previously, he headed the agency's systems support department.

CAPITOL BRIEFS

Heinz Abersfeller has been restored to his former eminence as commissioner of GSA's federal supply service. He replaces Art Sampson, who became head of the agency's public building service . . . AT&T has proposed an amendment to its private line tariff that permits more sharing. The change is scheduled to become effective the 15th of this month.

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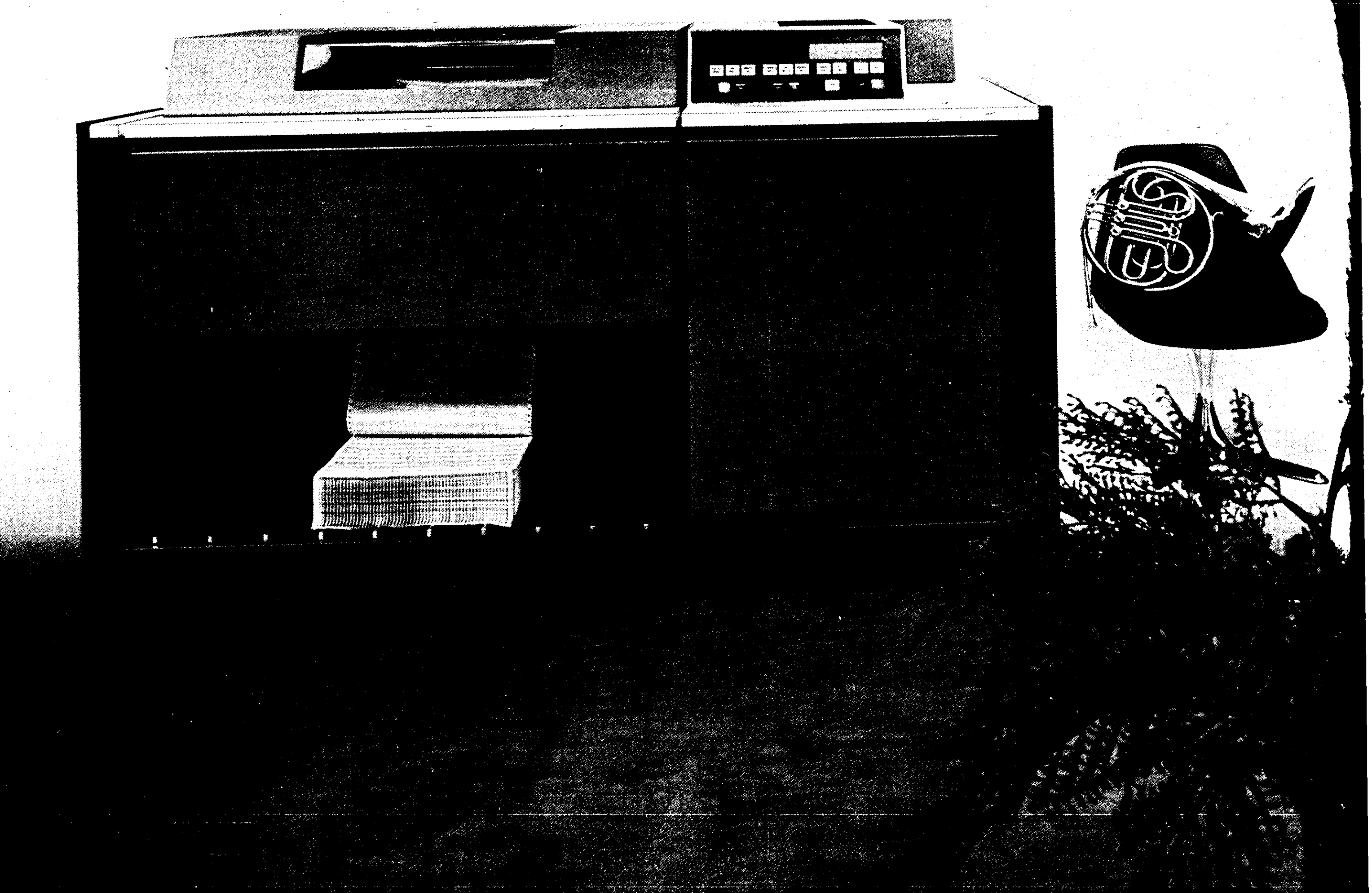

people

Five years "to pursue professional objectives of their own choosing" are being given to two IBM research aces, **Dr. Enrico Clementi** and **David DeWitt.** Dr. Clementi (San Jose, Calif., research division lab) has used the computer to determine atomic and molecular structures, and to simulate chemical reaction. DeWitt (components division lab) was one of the first workers in transistor development, including the one used in the 360, and integrated circuits for the System/3. Both will remain IBM consultants, as well as the 38th and 39th Fellows appointed under the IBM official program, which was initiated in 1963. . . . Two VIP's have come up with a new company, M&M Computer Industries, Inc., in Orange, Calif. **Jerald C. Murphy,** vice president, was founder and president of Digital Logic Corp., was also with Digital Equipment Corp., and was a space project systems designer at Jet Propulsion Lab. **Frederick J. McKee,** president, was formerly vp of operations at Bunker-Ramo Corp., and previously with ITT and Digital Industries. Their first product is a remote batch terminal. . . . A former director and executive vp of Ingersoll-Rand Co., **Edward J. Parish,** has joined Access Corp. as executive vp and chief operating officer. The Cincinnati info retrieval systems manufacturer also has a new vp/marketing operations manager, **Dean Willmann,** who comes from the corporate staff of IBM in Washington, D.C. . . . Information Systems Management Corp., the Richland, Wash., subsidiary of Western Operations, Inc., has a new president, **Gordon R. Douglas,** who comes from the parent San Francisco computer planning and management company, where he was responsible for a large scale development and installation project for the Federal National Mortgage Assn. At ISM, Douglas will oversee automation of systems and program design, coding and testing. Former president **D. C. McElroy** resigned to be an independent consultant. . . . Advanced Information Systems, Inc., Palo Alto, Calif., is a new company with a new president, **John J. Williams,** who was formerly director of military space programs for Philco-Ford. AIS is a systems house concentrating on high-speed digital data uses, and Williams has had wide experience with wideband data transmission systems. . . . Quantum Science Corp., which claims that its MAPTEK is the world's largest market research data base on technologies, particularly in the electronic industry, has rewarded **David H. Parks,** the man who completed its compilation, by making him head of the MAPTEK division as vp. The project took three years and $2 million. . . . Wellington Computer Systems, Inc., which recently took over all of Telemax Corp., has appointed **Philip W. Fellows** to be exec vp/gm there. Fellows was recruited from Univac, where he was manager of airlines programs—he was previously with Eastern Air Lines for 18 years. Telemax now has more than 2,500 subscribers to its on-line travel services. . . . High-echelon promotions at Applied Logic Corp. to fill the gap left by the departure of **Dr. Helmut M. Sassenfeld** (March People): **Martin T. Mobach,** previously in marketing, has become exec vp/gm of AL/COM services, now will direct general operations as well; **Adolph Futterweit** has been made development vp, and **Larry G. Settle,** operations vp. Mobach will now have to move to Princeton from Scarsdale. . . . **Lee F. Weiler** has been named president of Marketing Automation, Inc., which offers consulting and marketing services to the automation industry and is located at a place called Ramblewood Center in Morrestown, N.J. It is a subsidiary of Decision Dynamics, Inc. . . . **Gen. H. B. Manson,** who became president of Guidance Technology, Inc., upon re-


F. McKee


J. Williams


G. Douglas


E. Parish

tirement from the Air Force in January, has already resigned that Santa Monica, Calif., systems firm to emigrate to Florida. His post will be taken by **Charles M. Hollis**, who had been finance vp there since '68. . . . Raytheon has acquired the services of **John R. Allison**, now ex-president of Pepsi-Co Service Industries, as senior vp/-treasurer. Besides overseeing Raytheon's investment and financial relations, he will assist in its diversification program. He is a member of the Pacific Basin Economic Cooperation Council, and once served as a finance director for the U.S. government in Japan. He succeeds **Allen E. Reed**, who will continue as a vp and financial consultant until his retirement in June. . . . Two Divisions at Litton have new presidents: **James W. Sheridan** heads Monroe, which recently introduced a new line of MOS/LSI calculators, after being with that firm for 23 years during the less sophisticated days. **William C. Guyette** is president of the Advance Circuitry division, promoted from vp at the Springfield, Mo., plant. . . . **Lloyd C. Hubbard**, who as IBM systems manager was responsible for engineering and production of all data acquisition and control systems, has

been appointed president of newly formed (for specialized peripherals) Tracor Data Systems, Inc., in Austin, Tex. A 20-year IBMer, Hubbard was instrumental in installing its first computer system. . . . **Dr. Harvey Sobelman**, a linguistics expert (Harvard), and **Po Chiu Mar**, industrial management expert (MIT), have been made vp's at Advanced Computer Techniques Corp., N.Y.C. management and systems analysis firm. . . . KDI Corp., the organization that is assembling computer product companies for an overall capability in the industry, has appointed **John B. Owens**, 31, director of corporate development. He will also

be responsible for expansion. His background is definitely non-computer: he was previously president of Realsilk and American Hosiery Mills, Inc. (before 31?). . . . Step-ups at Timeshare Network Corp: **James L. Unger** has become president, succeeding **Lawrence D. Purcell,** who has gone on to be chairman of the board and president of Timeshare's holding company, Elektra Industries, Inc. **Tony Yates** becomes operating vp; only newcomer is **Robert Page,** now southwest region vp, from Honeywell's computer control division. TNC is based in Chicago. . . . GE's new business development operation at the communications systems division in Lynchburg, Va., has **Robert L. Casselberry** as manager. He will push GE's land communication operations. . . . **Gilbert R. H. Kennedy,** formerly director/exec vp/founder of Diebold Computer Leasing, has been named president/chief exec of Diversified Technologies, Inc., a Singer subsidiary in N.Y.C. . . . **W. F. (Bill) Sauers,** former vp at Autonetics (North American Rockwell), has taken the same post at Kratos, a computer peripherals firm in Pasadena. . . . Leasco has appointed **Robert De Stefano** to be exec vp of Response, its time-sharing division. He was an IBM Service Bureau veteran manager. **Robert R. Donaldson,** new marketing vp, was formerly with Xerox Data Systems and Bell & Howell. . . . In Dallas, three Texas Instrument men, **Philip Hudson, Tom Francis** and **Frank Bray** have gone over to be vp's at Computing & Educational Systems Co. . . . Ticket Reservation Systems, Inc., has named **Theodore W. Helweg,** former president of Cybercom Corp. and more recently special assistant in sales and services for Control Data, to be exec vp for Ticketron. . . . A new non-president is **Howard I. Jacobs,** who resigned from Micromation Technology Corp., accompanied by **William B. Grawe,** now non-vp. MTC recently relinquished its systems and services division to University Computing, and acquired LV Computer Systems, Inc. . . . **Thomas G. Paterson,** formerly director of corporate planning and systems development at RCA, has taken a vp post at Marcom, Inc., N.Y.C.-based management consulting organization, and will manage that company's Applied Systems Div. in L.A. Paterson advocates multimedia systems linking computers, television, audio and other electronic components into a single master operation. . . . **Dr. Hanan Rubin** has assumed the position of vp of corporate development and administration, and treasurer, of ZVR Systems, Inc., N.Y.C. software house which accepts only fixed-fee engagements. He came from Leasco Systems & Research Corp., where he was also vp. . . . Computer Sciences Canada, Ltd., has appointed a former Honeywell man (10 years) **Welton M. Richburg,** to be president. CSC, jointly owned by stateside CSC, Canadian Pacific and Canadian National Railways, is based in Toronto. Richburg was most recently a regional director in Honeywell's edp division. . . . **D. L. Hearn,** who has had more than 20 years of management and design experience in electronic systems, has been elected president of Tamar Electronics Industries, Inc., in Dallas. Tamar reported a substantial loss ($1.27 million) in 1969, which it partly blames on startup and production costs for new lines of computerized traffic control systems. . . . **John J. Bonness** has been appointed vp/gm of CSC Computer Services, Inc., the subsidiary set up to handle Great Southwest Corporation's controlling interest in Scientific Control Corp. Bonness has served with North American Aviation, Litton Industries and Automated Business Systems, has 30 years of edp experience to apply to SCC's reorganization. ■

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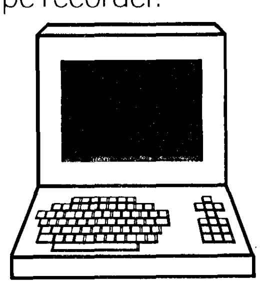

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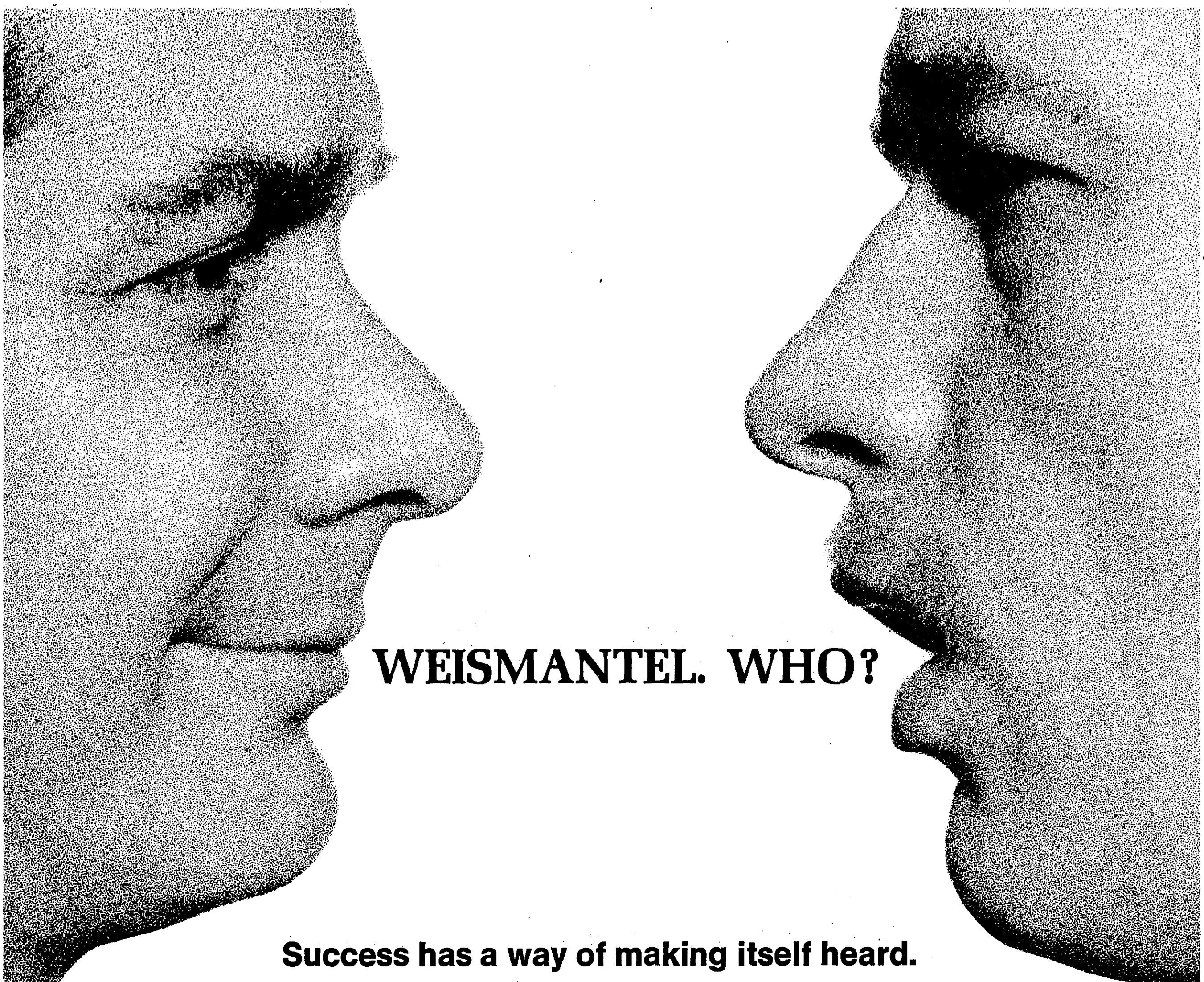

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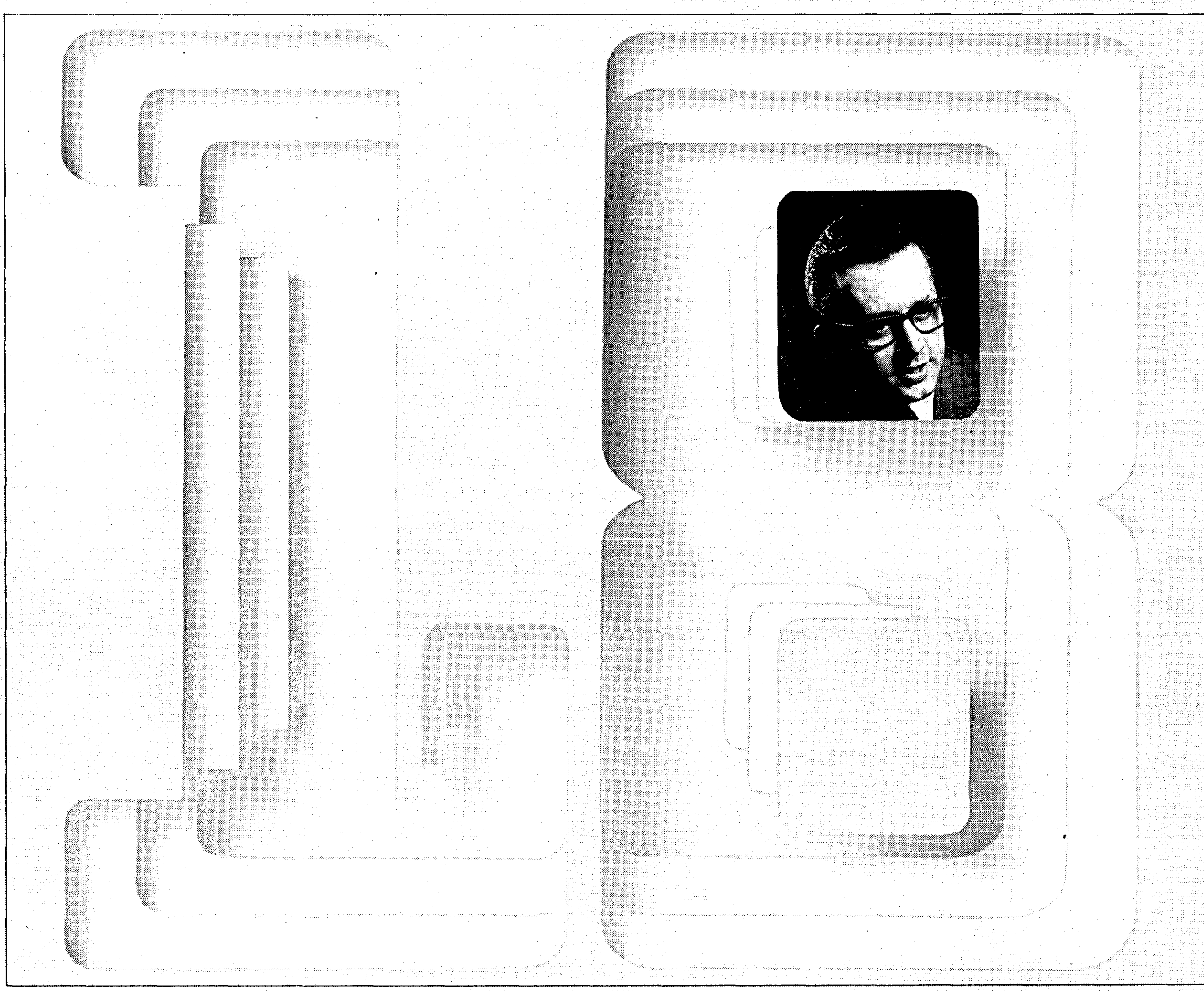

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CIRCLE 521 ON READER CARD

books

***Man-Machine Simulation Models: Psychosocial and Performance Interaction,* by Arthur I. Siegel and J. Jay Wolf. John Wiley & Sons, Inc., New York, 1969. 191 pp. $9.95.**

Simulation of engineering designs to establish optimum hardware configuration has been utilized for many years, especially in the aerospace industry. These simulations have rarely considered the man portion of the man-machine interface. Perhaps the importance of this concept has never been fully realized, although more probably it was ignored because the parameters describing human behavior are not readily ordered. However, the quantification of human performance has been the subject of much study by engineering psychologists for the past 10 to 20 years.

As systems became more complex, and man was called upon to assume an interactive role with computers in the decision-making process, human factors specialists were pressed to provide more meaningful data. It has now become essential that human performance parameters be expressed in a form adaptable for inclusion in a computer simulation program, in proper conjunction with hardware parameters, to achieve the optimum man-machine relationship for system design.

While some success has been attained in the quantification of human performance in the psychomotor area, little success has been realized in the field of psychosocial parameters. Consequently the interaction of psychosocial and performance elements of human behavior rarely has been included in system simulations, leaving a large area of system success essentially unanalyzed.

Arthur Siegel and Jay Wolf have proposed an approach to the quantification of the psychosocial-performance interaction that appears to have both the logic to satisfy engineers and the behavioral analysis to satisfy the psychologists.

The first three chapters of the book introduce and develop the basis for the construction of a model for computer simulation of the psychosocial-performance interaction. This model is suitable for the simulation of single or dual operator participation. In common with other digital simulation models, it incorporates the essential hardware components of a system. However, it is unique in its inclusion of both psychomotor and psychosocial parameters, especially time-induced stress, proficiency, operator morale, team decision-making and cohesiveness. Its success in the quantification of psychosocial efficiency and orientation enables this model to provide a valid indication of total system effectiveness.

One of the most difficult parameters to express in mathematical terms is stress. The Siegel-Wolf model does treat stress quantitatively and, further, is responsive to current psychological theory which suggests that stress, up to a limit, can act as an organizing agent. The quantitative definition of the stress function in the model is the ratio of how much work is left to be done to the amount of time available in which to do it. The stress threshold is defined in terms of data available from experimental studies, and the model provides for recognition of the operator's breaking point.

The model is evaluated against data obtained empirically from the experimental evaluation of four man-machine systems. Siegel and Wolf concluded that the model demonstrated considerable ability to yield "results which will help in making decisions regarding the potential of a given man-machine combination." From the data presented, it appears that the model does have the potential for simulating the interaction of the selected psychosocial and performance processes.

In chapter four, the authors present basic psychological background material for their second digital man-machine simulation model, which pertains to group performance. Unlike the two-man model, which was concerned with variables relating to short missions, the group model is designed to predict qualities of larger man-machine systems over greater time spans. Emphasis is placed on six basic qualities: system efficiency as a function of crew size and mission time; crew morale and cohesiveness during the mission; time devoted to equipment repairs; manpower time shortages by type of personnel as a function of crew size; proficiency of crew members; and man-hour loadings and overtime.

The factors treated were selected from those which social psychologists determined to be most influential in their effect on the performance of an individual who is part of a closed social group. The model requires, as source data, an analysis of the equipment in the system, the mission to be simulated, and the characteristics of the staff which will man the system. This analysis identifies the tasks re-

quired for mission performance, and these tasks are introduced into the program for sequential simulation of crew performance.

The computer is used for several calculations before the actual simulation is begun. For example, the minimum crew size is determined, and crew composition is fixed. Thereafter, simulation of crew operation is achieved by means of arithmetic operations on those tasks identified in the source data for the program, or from simulated equipment failures randomly generated in proportion to a specified failure rate associated with the subsystems. The simulation involved the time needed to perform the task, the group performance efficiency, and the adequacy of the simulated performance. It is concluded when the crew size, initially selected as minimum, has reached the size which eliminates the requirement for overtime work. The output of the simulation program is recorded on magnetic tapes which can then be printed and analyzed. The fifth chapter presents a detailed discussion of the model and its features, keyed to a flow chart which provides a variety of illustrations of techniques applicable in general model building.

The concluding chapters of the book are devoted to sensitivity testing of the group simulation model to illustrate its internal consistency, followed by a description of the results of applying the model to an actual navy system to determine its predictive validity. For the sensitivity test, Siegel and Wolf conceived an underwater craft whose mission required long-term isolated alerts at stationary submerged positions. The operating parameters of five working stations were defined and several simulation runs were made, one of which was used as a standard. The results obtained in the major categories (crew efficiency, productive time, and number of failures) were clearly shown to be logical and in accord with group dynamics theory.

The purpose of comparing an analytical model to an actual system is to test the model's prediction validity. Using actual data available during the real system planning stage, the model was run through a typical simulated mission and the results compared with actual system mission data. The predictions and observations compared very favorably, and most differences were not of such magnitude as to render the predictions ineffective.

Siegel and Wolf properly conclude that digital simulation can provide answers to questions that must be resolved early in the development of a

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books . . .

large man-machine system. The inherent variability of humans and their inconsistent behavior make deterministic prediction of behavior unrealistic. The more reasonable approach appears to be that of computer models which allow for variable and even erratic behavior. Continued progress of digital simulation of human behavior will depend upon further developments in the related areas of theoretical psychology, mathematical representation, and and computer programming methods. The present state of the art is well represented in the authors' work, and use of their models during system design will be a useful tool to systems managers in achieving total system effectiveness.

—JOSEPH STAHL

book briefs

(For further information on the books listed here, please write directly to the publisher mentioned.)

***A Guide for Software Documentation*, prepared by Dorothy Walsh, Inter-ACT Corp., 1345 Ave. of the Americas, New York, N.Y. 1969. 160 pp. $16.50.**

This book contains 14 basic computer program system models that span the full range of software documentation. Point-by-point instructions enable readers to proceed systematically in the preparation of any computer software and application manuals. The book may also be used in the creation of documentation standards. When the models are used properly, readers of documents based on them should be assured of completeness of content and logical development of information, as well as the use of aids such as a guide to reading a typical document and a complete table of contents.

***Digital Computer Programming*, by Peter A. Stark, The Macmillan Co., 866 Third Ave., New York, N.Y. 1967. 525 pp. $9.95.**

Designed for the beginning student, this text emphasizes applications to problems rather than the intricacies of particular computer languages. Three basic types of languages are covered: machine language, symbolic assembly language, and problem-oriented language. A major feature of this textbook is the variety of examples, which are completely worked out and include computer printouts and results. Thus the effect of each program instruction is immediately shown. The arrangement of the material permits several possible approaches to teaching.

***Computer Evaluation of Mathematical Functions*, by C. T. Fike, Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. 1969. 227 pp. $10.50.**

This is a guide to the mathematical techniques employed for coding the computer programs required to evaluate such transcendental functions as sin x and log x. Content includes error in function evaluation computations, square-root and cube-root evaluation, reduction of argument range, polynomial evaluation and approximation, rational-function evaluation, minimax polynomial and rational approximations, Chebyshev polynomials and series, and asymptotic approximations.

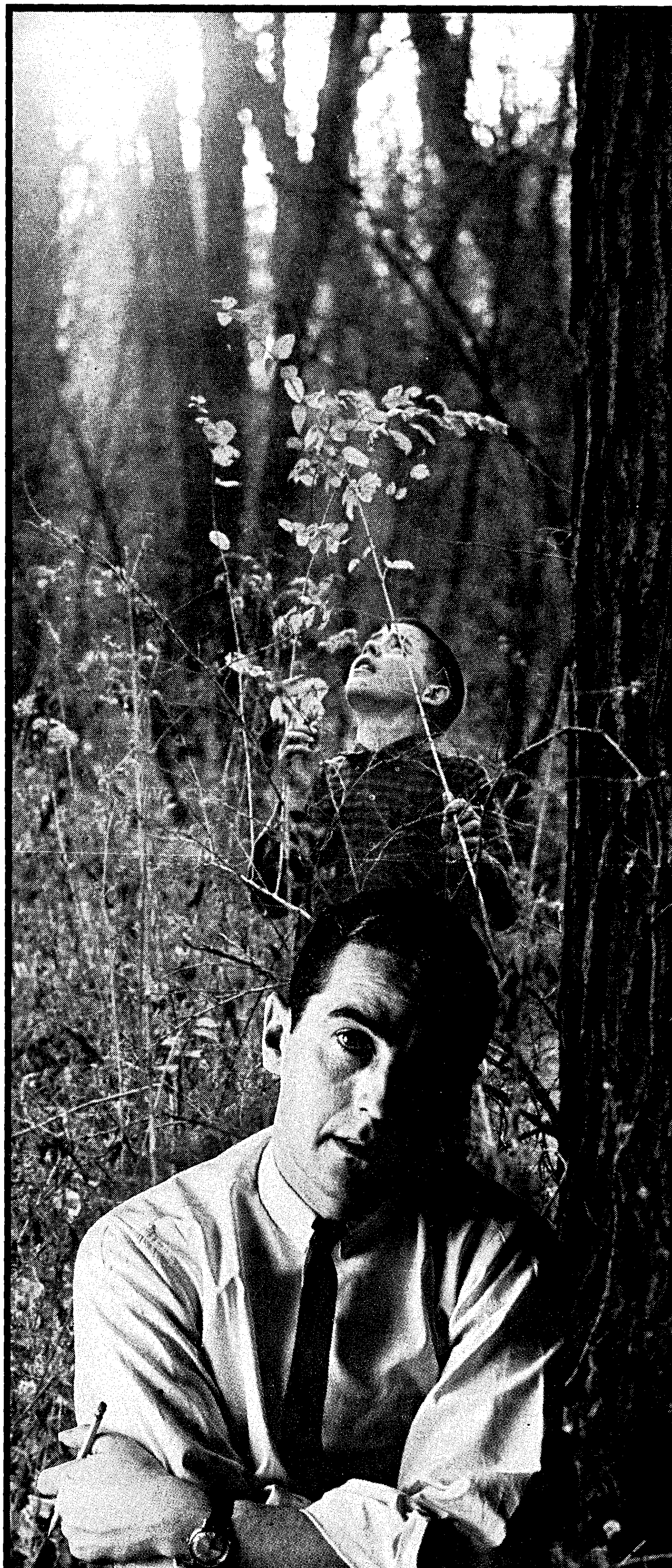
***Management Techniques Through Systems*, by Leslie H. Matthies. Systemation, Inc., Box 730, Colorado Springs, Colo. 1969. 107 pp. $4.95.**

This simple, little (5" x 8") book provides 1-2-3 techniques for the management of systems. It includes subjects such as motivation, administrative training, and using time effectively.

***The Market for Computerized Composition*, by John W. Seybold. Computer Section, Printing Industries of America, Washington, D.C. 1968. 175 pp. $15. (Order from PIA Computer Section, 5223 River Rd., Washington, D.C. 20016.)**

Addressing itself primarily to printers and typesetters, this book also looks at the application of high-speed composition in computer centers that produce voluminous printouts. It cites a Government Printing Office study on the use of an electronic composing system, which purports to cut costs by as much as 40%. "As an example," it states, "20,000 copies of an 800-page computer printout job would cost $11,305 more to print and bind than it would if made only 480 pages—a reduction of 40 percent in number of pages. . . ." Along with a reduction in bulk, which brings with it savings in the cost of distribution, the system also enhances quality and readability.

Chapters cover composition systems, cost factors, programs and programming, the markets, and anticipated developments. The appendix consists of a list of computerized typesetting installations as of the end of 1968, samples of typographic style and quality produced by photocomp systems, and a bibliography. The book itself was produced on a Fototronic crt.



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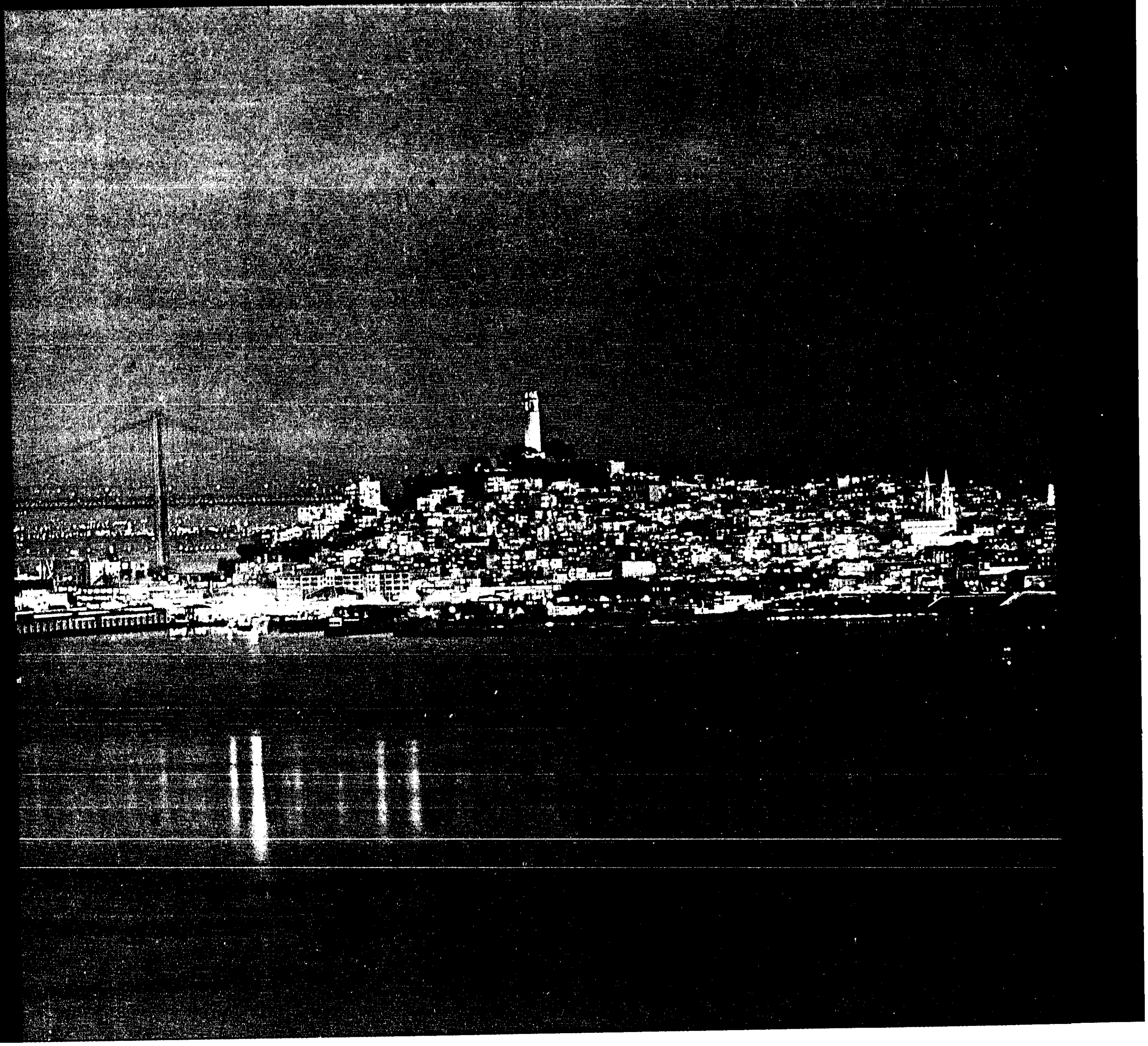

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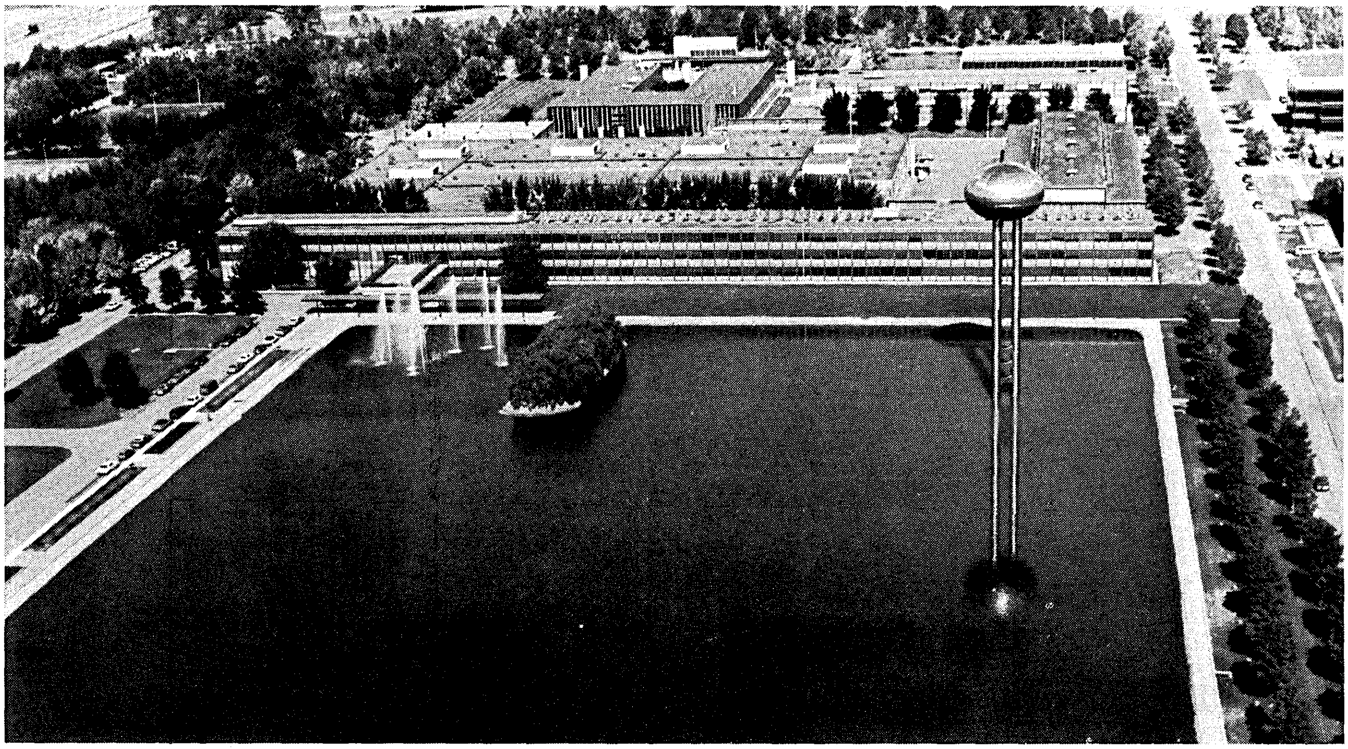

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the forum

The Forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

THE COMING NUMERICAL CRISIS IN COMPUTING

Maybe the "consumerism" movement should turn its attention now to the computer industry. Or maybe what the industry needs is its own private consumerism movement. There's certainly plenty of scope for such a movement. Take the question of numerical accuracy as one, important example.

Now everybody knows computers are good at "number crunching." It's one of the fundamental myths of computing. That's right, I said "myth," because, while computers are fast, all right, they're not always accurate. And the accuracy of numerical results is a problem that's plagued computer users from the very beginning.

Notice I'm not talking about precision. You can't expect 18-bit accuracy from a 16-bit machine. But it does seem reasonable to expect 12-bit accuracy from such a machine, especially as the result of a relatively simple calculation.

We've all heard horror stories on this general theme. Like the trigonometric subroutine that was heavily used for years at one installation till they did some benchmark tests in picking a new computer and accidentally found it gave completely spurious results for some values of its argument. Or the bug in the floating-point multiplication algorithm permanently wired into the hardware of one popular computer. Or the study that was done to find the most accurate linear equation solver, which concluded they were all lousy.

Such stories have always been with us, but it seems to me recently they've been rising to a crescendo of outrage. We could even commission Ralph Nader to write a book about it, called "Inaccurate At Any Argument."

Now maybe the manufacturers' numerical subroutines and wired algorithms haven't been getting any less accurate over the years, and it's just that more people are using them and finding errors. But this is all the more reason for the industry to take some positive action to ease what might eventually be called "The Numerical Crisis in Computing."

Well, all right, what can be done? Do we need some standards? A testing lab? A manufacturer's accuracy oath? A new committee? Some more litigation? Or what?

Elsewhere (*SIGPLAN Notices*, October, 1969) I've called for long overdue action to establish an American National Standard for Numeric Conversions in Programming Languages. But that's just a tiny part of the problem. Besides, setting the standards is relatively easy. It's determining how well the products meet the standards that's hard.

Dick Canning (in *EDP Analyzer*, December, 1969) has called for volunteer efforts to tackle a whole host of pressing problems, including the software certification problem. He suggests an independent software certification lab might be set up along the lines of the Underwriters' Laboratory.

I think this is a good idea, but I also think certification of all commercially available software is just too big a job for any one group. So what I'm calling for is an independent, nonprofit, Numerical Certification Laboratory, supported by competitive pressures, like the Underwriters' Laboratory, from fees for testing manufacturers' products. In this case, the testing would determine that the products meet minimum standards for numeric accuracy. Of course, until algorithm-proving techniques advance tremendously, it would be understood that such certification could not guarantee complete accuracy for all arguments, any more than a UL label guarantees complete safety under all conditions.

Where can we look for leadership in establishing a Numerical Certification Laboratory? From user groups? Professional groups? Industry groups? The government?

The computer users' groups have been grappling with this problem for years without appreciably denting it. Depending as they do on part-time volunteers, they lack the resources to tackle a job of this magnitude. And the professional groups face the same situation. After all, what would you estimate to be the cost of certifying that the typical scientific subroutine package meets some minimum standards for numeric accuracy? To do a good job of this is often more costly than the manufacturer's original testing—which is one reason why it's needed.

We can't expect the Business Equipment Manufacturers' Association to take the lead in this either. There's no profit in it for the computer manufacturers, so long as they can all avoid it together. Besides, BEMA has just shot its all too meagre wad—and it has the same funding problems as the UN—moving from New York to Washington.

So that leaves the federal government, and here's where I suppose I'll lose at least some of my readers, but what else is there? The user and professional groups are too poor and the manufacturers are too short-sighted. Besides, only the government can supply the initial economic pressure needed to make the hardware and software vendors pay the high cost of numeric certification, by making it a federal information processing standard that no hardware or software product can be brought into the federal inventory without such certification.

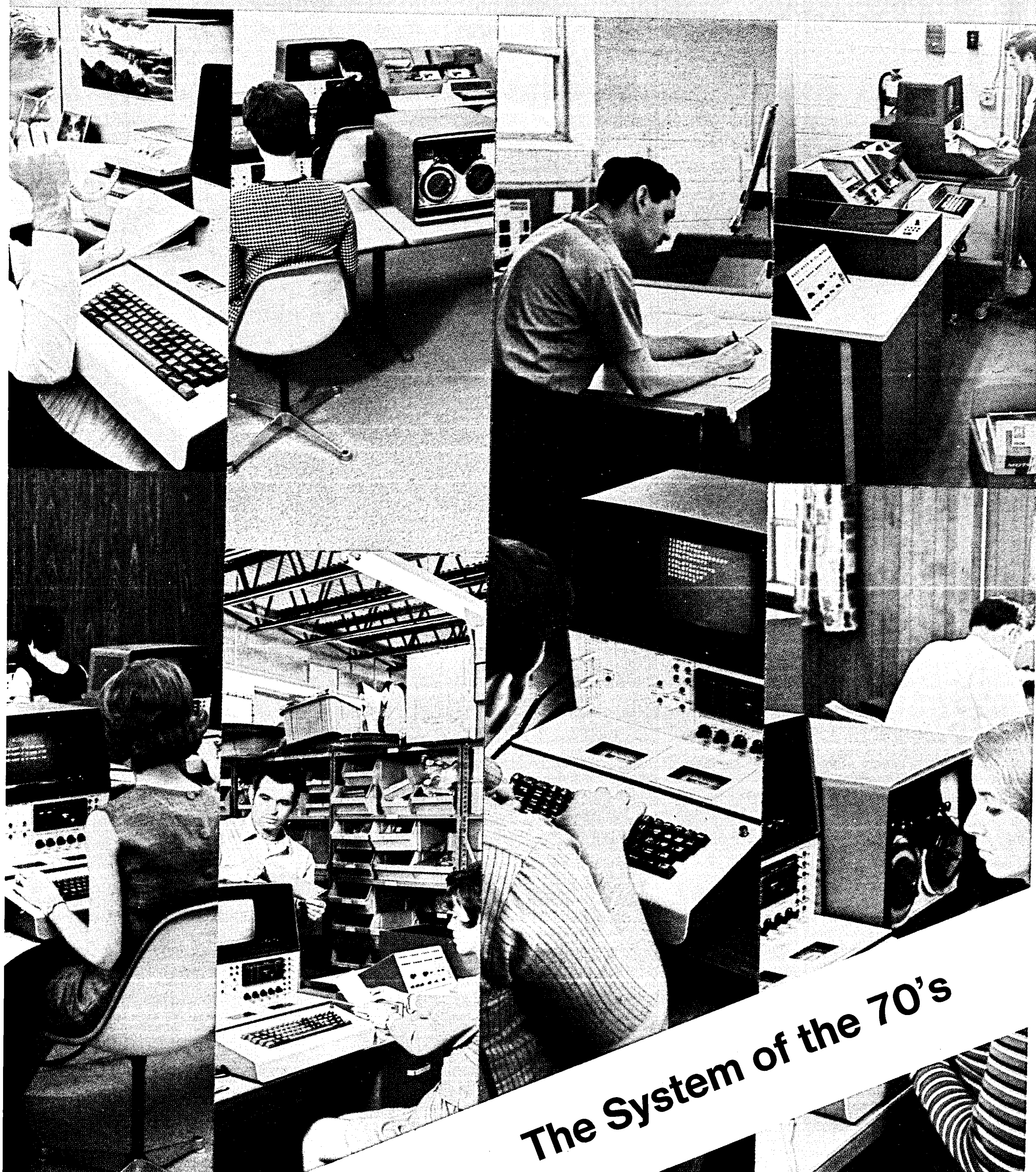
If you're still with me, you may be wondering how you can help advance this cause. Should you write your Congressman? Herb Grosch? Ralph Nader? The Secretary of Commerce? Your local IBM salesman?

Let me confess I don't have a brilliant, detailed plan of action, and I'm not even personally concerned with the problem since I'm primarily interested in nonnuemric computation. But I do have at least a tentative plan of action, and you can help.

Send me your numeric horror stories, care of this magazine, documented as thoroughly as possible and commenting on the chaos caused, and I'll see that your stories are used as ammunition in the battle to establish a Numerical Certification Laboratory. Maybe we can get the Computer Science and Engineering Board of the National Academy of Science to recommend this to the Commerce Department, and maybe we can convince Commerce Secretary Stans to ask Congress for some money, and maybe . . .

—CHRISTOPHER J. SHAW

VIATRON



The System of the 70's

The System of the 70's-
THE NEW REALITY

- Mass production—you can buy a System 21 terminal for as little as $1,872.
- Multimedia terminals produce tape, cartridge, card and on-line input.
- Microprocessors let you perform many computer functions off-line.
- Zero-defect computer tape input system lets you record data anywhere—without environmental controls.
- Black and white, and color video displays provide fill-in-the-blanks formatting so anyone can prepare and verify computer input.
- Desk-top printing robots prepare formatted hard copies from tape, card, cartridge or computer input.
- Batch-transmission and unattended operation features allow automatic polling of remote locations.
- Low-cost VIATAPE Banks provide digital filing systems with automatic search and retrieval—can be used anywhere.
- Under-$5,000, general-purpose, 4-K, terminal-oriented computer provides low cost processing power wherever it's needed; 8-K version sells for under $10,000.
- LSI/MOS reliability.

Distributed Data Processing

AND ITS SIGNIFICANCE

The applications detailed on the next few pages would not be practical if it weren't for Distributed Data Processing, the new technology developed by VIATRON.

Present-day data management systems are oriented to the giant central processing unit in the computer room. This orientation has precluded using computer logic for everyday data communications, management and processing.

The new technology has created data stations and computers that everyone can use. That can be placed in any environment. And, that you can afford to put on every desk where data originates or is used. With this new technology you can build systems that parallel — rather than divert — the channels through which information must flow to make decisions and keep records.

These new systems are something that people can touch, see and work with to handle the problems that are on their desks.

Distributed Data Processing

Distributed Data Processing, as the name implies, distributes computer logic to those places where it is needed instead of trying to funnel everything through a remote computer room.

Data is processed as it is gathered through the use of logically programmed System 21 terminals. Inexpensive System 21 computers add the middle management dimension to the system, freeing the central processing unit for the big jobs it was designed to do.

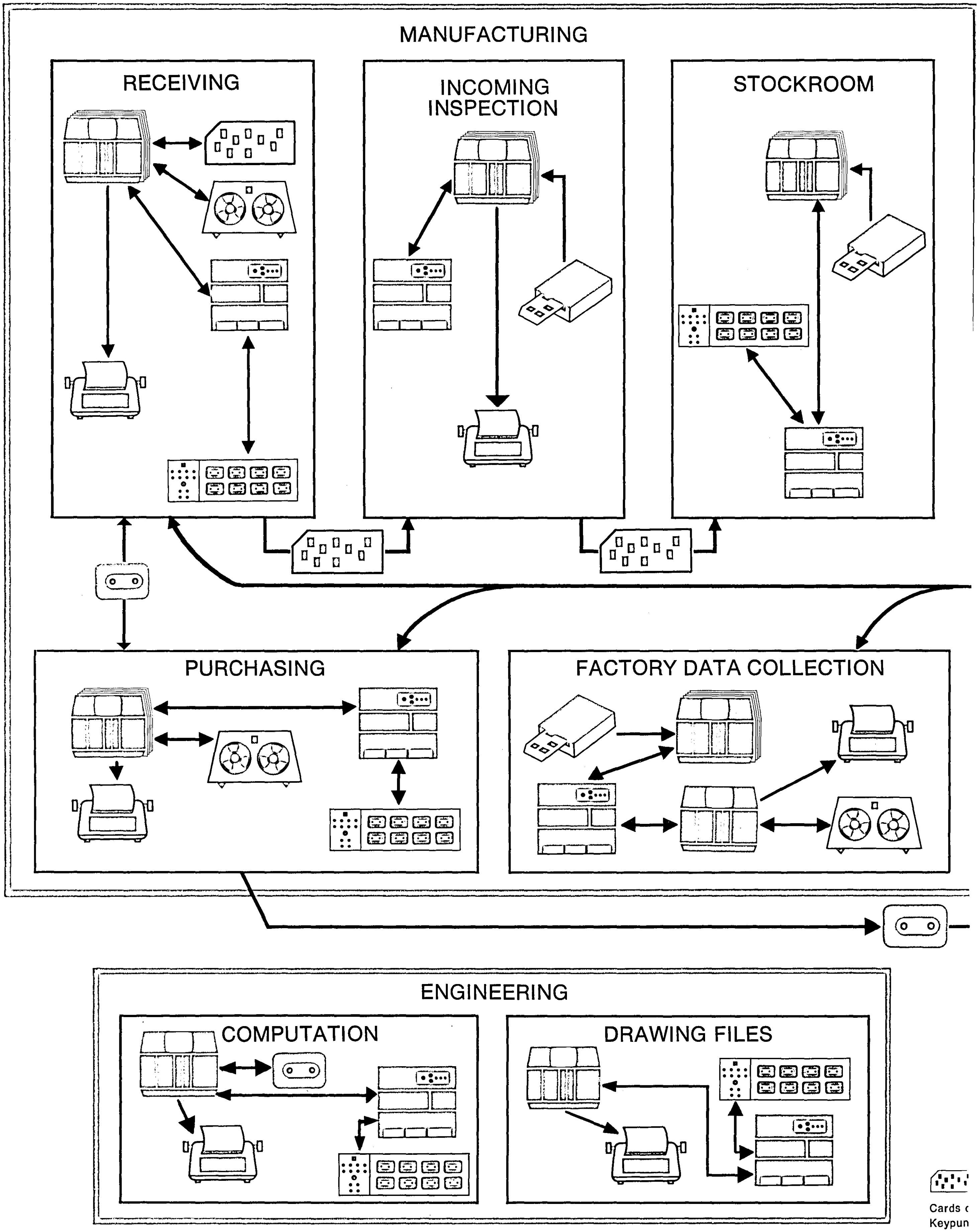
The hierarchial approach of Distributed Data Processing is completely flexible. Like a human organization it can be built a part at a time — organized to reflect the characteristics of a particular business.

You can start today.

Your VIATRON dealer can show you how you can build the Systems of the 70's today. He has a staff of highly-trained and experienced systems analysts who can show you how System 21 can not only cut your data processing costs but produce an immediate, measurable return on investment.

So why wait until tomorrow? Look at the specific applications suggested here, study the detailed descriptions of the components and configurations made possible by the new technology and then give your dealer a call.

Where you need



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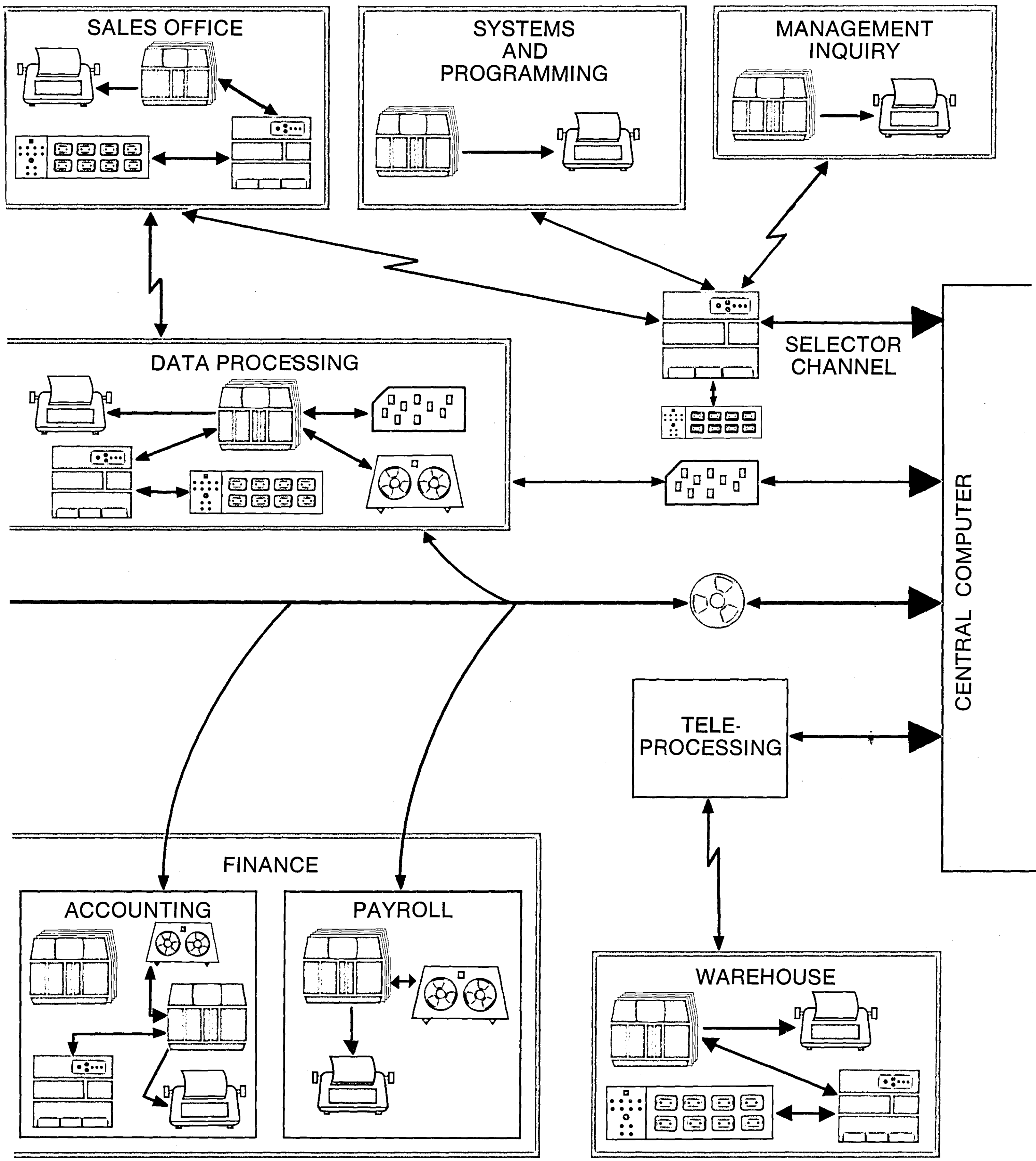
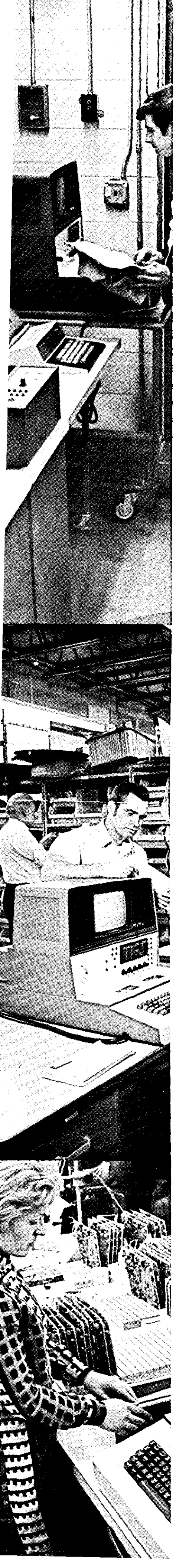
System 21 in the 70's





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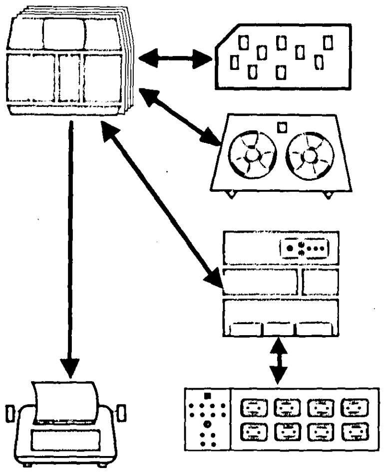


The receiving system of the 70's

The man on the receiving dock is faced with feast or famine. Either there are no trucks coming in or all the docks are filled and other trucks are waiting their turn.

Today's receiving problems

In periods of feast, receiving dock personnel are a harried lot. They must match the truckers' shipping papers to copies of purchase orders sent to them by the purchasing department.

One truck may contain material that is covered by many purchase orders.

Part numbers on the purchase order must be checked against the received material. The quantity ordered must be checked against the quantity stated on the shipping papers which in turn must be checked against the actual quantity received.

Getting the job done

Even if everything is in order, the job isn't done. Paper work has to be generated to notify purchasing and accounts payable. Partial shipments require additional paper work. Finally a travel card must be prepared before the material can be moved. All this time things are beginning to back up. And, if receiving personnel try to work faster, errors increase.

There are several possible solutions. Add more receiving docks and more people. Attempt to schedule the arrival of vendor trucks. Or, reduce the amount of work required to receive material.

The benefits to you

System 21 reduces work load and errors by automatically matching shipping papers and purchase orders, by generating travel cards, and by automatically producing the data required for accounts payable and purchasing.

The incoming inspection system of the 70's

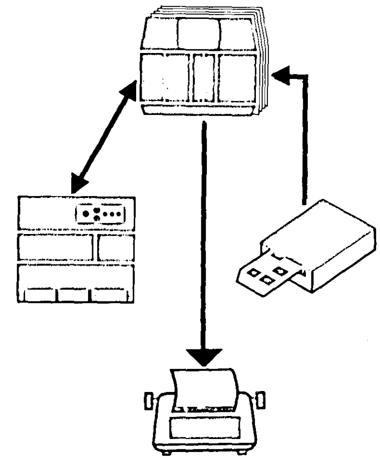
Incoming Inspection has the responsibility for testing material received from vendors to make sure that it meets the specifications required by manufacturing. Each of the thousands of different parts received has its own test procedures. Finding the correct test procedure, performing the necessary mathematical calculations, and determining what to do next requires most of the inspector's time. This limits the amount of material he can inspec and therefore raises the cost of inspection.

Cutting control costs

The 2150 Incoming Inspection System performs those routine tasks for the inspector.

All procedures are recorded on VIATAPE. The prope one is selected by the computer upon entry of part numbe from the travel card.

INCOMING INSPECTION



Sampling methods

In tests using statistical sampling procedures, th inspector enters the part number and the quantity receivec The 2150 specifies test lot size, tells the inspector ho to select samples, and leads him through the test.

If a part fails, the computer notifies the inspector an prints out a rejection notice for the purchasing depar ment on the printing robot.

If calculations are required, test data is entered throug the keyboard by the inspector. Results are displayed o the terminal.

Printed results

As the computer is leading the inspector through th procedure, it is also generating a VIATAPE recording c each test. Test history reports are generated by the com puter and printed for quality assurance engineers.

Failure rates by part number and vendor, shortcoming of the testing procedures, and adherence of the inspectc to the procedures are easy to check.

New test procedures can be installed instantly by di tributing new VIATAPES to replace the out-dated prc cedures.

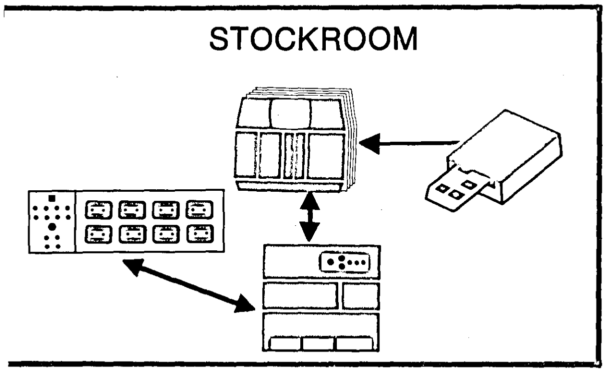
The stockroom system of the 70's

Stockrooms simply cannot justify the use of expensive da processing systems to keep track of inventories. Wha needed is a low-cost, easy-to-operate system that involv a minimum amount of work.

Verified transaction records

VIATRON provides a system that allows simple transa tion entry with verification, immediate updating of balanc inquiry processing and automatic reordering.

Incoming stock is posted by reading the punched tra card that accompanies it. The stock clerk then adds t transaction code and storage location. The travel card



aved for use in subsequent transactions, such as file ıquiry and inventory withdrawals.

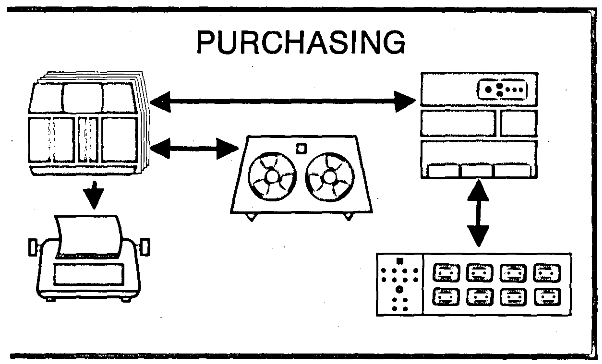
'he job to be done

The 2150 is dedicated to performing four stockroom ınctions:

1. File update: receipts and withdrawals.
2. File inquiry.
3. Reordering.
4. Inventory reporting.

/ork load reduction

Stockroom paper work is eliminated. Real time operaons are made possible without adding a teleprocessing ont end to the central computer. At the same time, the ›ad on the central computer is reduced since it is no ›nger used to handle day-to-day stockroom inventory roblems.



ľhe purchasing ›ystem of the 70's

ystem 21 allows purchasing agents to remain in complete ɔntrol of all data for which they are responsible—control hich extends from the keying of input to the automatic reparation of purchase orders and transaction tapes to ɜ used by other departments.

ontrol of paper

All decision-making is left to the purchasing agent. Sys›m 21 is simply a tool which helps control the massive ɔw of paper work associated with the purchasing operaɔn. It files and reports data, and it frees the purchasing ȝent to do the job he was hired for—make decisions hich save you money.

perations sequence

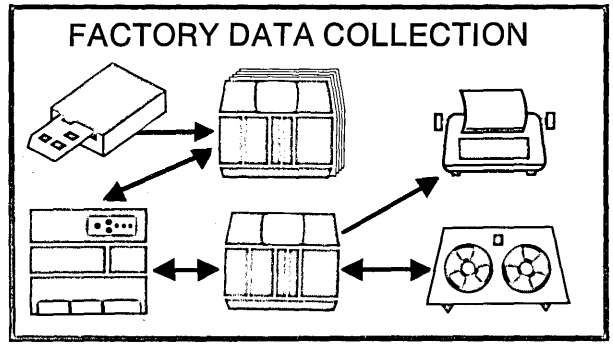
The operation begins with the receipt of material reɹests. Departments, like manufacturing, having a large ımber of requests may submit them on VIATAPES preɹred on their own System 21 units. Other requests may ɜ submitted on paper forms.

In the purchasing department a System 21 robot lists I material requests received on VIATAPE producing ultiple copies for distribution to all purchasing agents.

Each agent takes the list and selects the items for which ɜ is responsible. To those items he adds the vendor code, ıipping instructions, payment terms, billing instructions, quisition number and other needed information.

Purchase order presentation

The list is then given to a System 21 operator who prepares the purchase order. She enters the vendor code and the additional information required. Fixed vendor data is extracted from the vendor file stored on VIATAPE. The 2150 computer inserts the appropriate control characters to format the printout. Upon command from the operator the entire purchase order is printed.



The factory data collection system of the 70's

The key to production control is knowing what's happening on the floor. What jobs have been completed. What jobs are being worked on. What jobs are on schedule. What jobs are behind.

Until now, scheduling of production has been hampered by the lack of timely input.

Data collection at its source

Most of the data collection and feedback equipment that has been tested on a factory floor to date has been unsuccessful for several reasons. It has been difficult to use, too expensive, too delicate for the factory environment. System 21 offers an excellent solution for factory data collection. It overcomes all the problems listed above—it is easy to use, it is very inexpensive, and it is designed to operate in a factory environment.

The unit card reader enables production workers to pick up job numbers, part numbers and other data from the travel card that accompanies jobs through the production cycle.

The information you need

Upon completion of a particular job, the travel card is read into the System 21 terminal and displayed on the video. Variable information, such as employee number, quantity produced, and quantity scrapped, is entered through the keyboard. After visual verification, the data is transmitted to a 2150 computer.

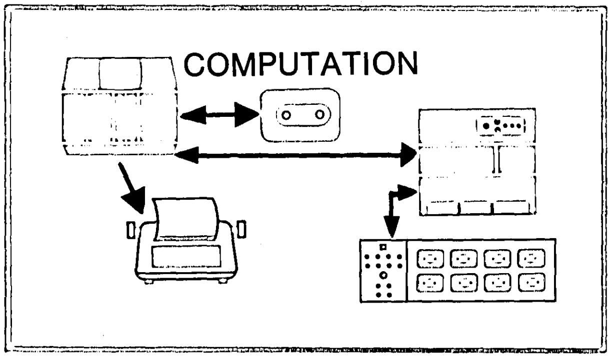
System flexibility

An advantage of the VIATRON System 21 is that it allows each terminal to operate independently. In the event of a system failure, each terminal can be placed in a standby mode—there's no need for a backup system.

The foreman or operator would follow the usual procedure, but instead of sending data to the computer, he would record it on VIATAPE. When the system is restored, the data stored on VIATAPE is batch transferred to the 2150. The computer then edits all the transactions on a batch basis and responds to the transmitting terminal, telling the operator which entries must be corrected.

Keeping on schedule

The VIATAPE recorder that's part of the terminal also serves to record both the data on the travel card and the data entered on each job so the foreman has a complete transaction record at the end of the day. This enables him to check the completed jobs against schedules issued to him by production control.



The engineering computation system of the 70's

The engineer is faced with a constant need for computation. Slide rules are inaccurate and slow, centralized computers are inaccessible, time sharing is too expensive.

A personalized computer

The answer is his own computer that is fast, accurate, and less costly than time-sharing. The answer is a System 21 computer.

It has a powerful instruction set. Triple word precision arithmetic—up to 48 bits long. Inexpensive mass storage. Input/output 10 times the speed of paper tape, and the ability to support multiple System 21 terminals located throughout the engineering department. With video displays, hard copy, and tape storage capabilities.

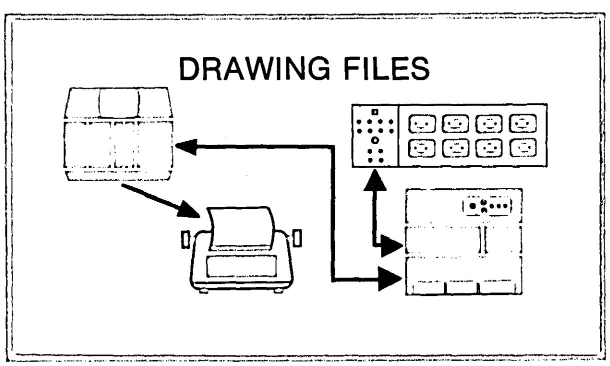
Program preparation

The engineer prepares his source program at a System 21 terminal operating in an off-line mode and records it on VIATAPE. When the program is complete, the engineer inputs his program to the 2150 computer where it is compiled and assembled to produce an object program VIATAPE.

Data output

To execute a program, the object VIATAPE is loaded into core and the engineer uses his terminal in an interactive mode to input data and receive output on his display or on VIATAPE.

If hard copy is desired, a System 21 printing robot can be interfaced with the terminal to produce completely formatted reports and graphs.



The drafting records control system of the 70's

It's a fact that duplicate drawings are constantly being created in the drafting departments of most businesses. Why? Because it's easier, and faster, to create a new drawing than to find an old one. Cross index filing systems are almost impossible to maintain manually. Consequently, drawings are usually filed by drawing number or date sequence that has no relationship to the part. This filing system results in duplicate drawings and the assignment of new part numbers to items that are already used in the business. So, the drawing file grows and costs mount—for filing space, for drafting labor, and for duplicate inventories resulting from the same part being assigned multiple part numbers.

Save by cutting out duplication

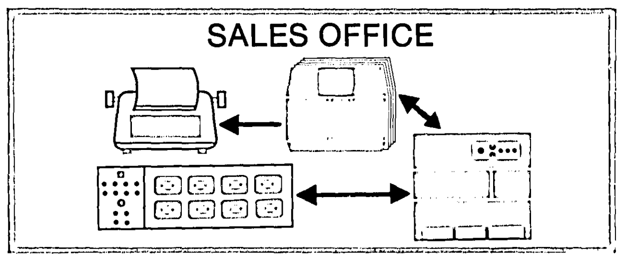
System 21 solves these problems and lowers costs with a 2150 computer and System 21 terminals. Drawing numbers and commodity codes are recorded and cross-indexed on VIATAPES.

To review drawings of stainless steel bolts, for example, the draftsman or designer keys in the appropriate commodity code and the computer retrieves drawing numbers and descriptions for all existing bolt drawings. The draftsman then pulls the selected drawings to see if one is appropriate.

All-around filing system

System 21 is also used to store where-used files so that an engineer can quickly measure the impact of proposed design changes.

Keeping track of engineering change notices is also simplified with System 21. A periodic listing of impending engineering changes sorted by their effective dates is an automatic by-product of the system.



The sales inquiry and order system of the 70's

Sales orders and inquiries originate in the field—not in the home office. But information must get back to the home office, accurately and quickly. Therefore, the sales inquiry and order system must be data entry and communication oriented.

Speeding up the data flow

System 21 provides both capabilities at affordable prices. A VIATRON 2150 computer with a bank of VIATAPES and with System 21 terminals is a powerful order entry and communication system. The VIATAPES contain customer names, shipping addresses, billing addresses and other fixed data.

Handling purchase orders

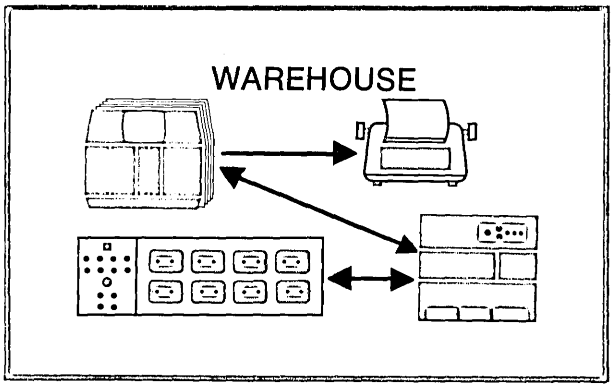
As purchase orders are received, a clerk at one of the terminals keys the customer identification and the variable data from the order. The 2150 automatically searches the VIATAPES to obtain fixed customer and product data and then generates on the printing robot a written confirmation statement for the customer. A transaction record for each order is stored on VIATAPE.

Ease of communications

At the end of the day, the order records are batch transmitted to the home office over standard telephone lines. The orders are received by the home office computer or by a System 21 terminal with a zero-defect computer-compatible tape recorder.

Inquiry response

Customer inquiries would be handled by System 21 terminals equipped with communication adapters. When an inquiry is received, the salesman or sales clerk dials the home office computer and enters the appropriate inquiry. The response is immediately displayed on his terminal.



The warehouse inventory system of the 70's

The critical data management problem in a warehouse is keeping the information system current with the physical system. All records and files should reflect actual inventory.

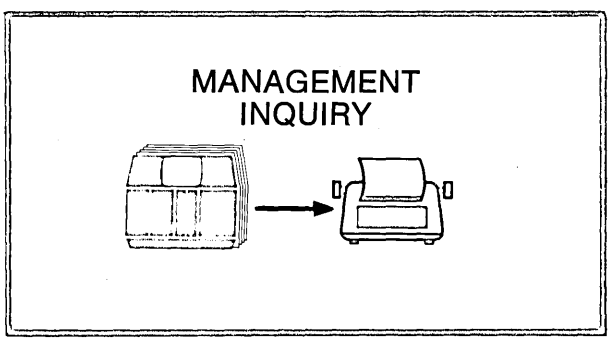
Keeping up with inventory turnover

When the information system falls behind the physical system, additional inventories must be carried in order to avoid out-of-stock conditions.

Easy-to-use System 21 terminals allow warehousemen and stock clerks to record transactions when and where they happen.

Input flexibility

Transaction records stored on VIATAPE are collected periodically from each terminal and converted to either punched cards or computer-compatible tape for processing by the central computer. If the warehouse is located on the same premises as the computer center, the magnetic tape or cards can simply be hand carried to the computer. If the warehouse is in a remote location, a System 21 terminal is equipped with communication capabilities so that it can transmit the day's transactions back to the computer center using standard telephone lines.



Corporate management system of the 70's

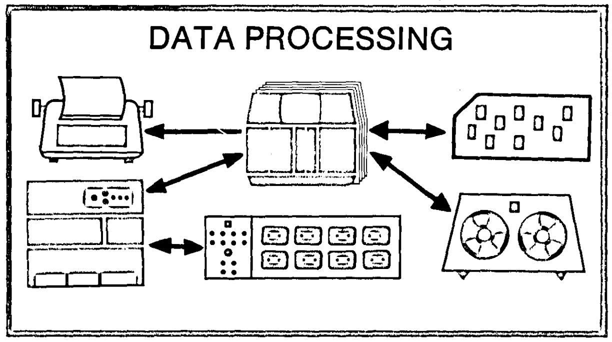
There's a lot of information about sales, production, project status, budget performance, and financial statements in the corporate data base—information that is needed by top management to make daily business decisions.

System 21—the same system that helped create the data base, and keeps it up-to-date—gives managers immediate access to all information. The same information that first-line management is using—not watered-down or disguised summary reports prepared when it's too late to take effective action.

Getting data where it's needed

System 21 terminals can be placed on the desk of every manager giving them a direct line to the corporate data base. Better yet, the terminal may be placed on the secretary's desk and a remote display placed on the manager's desk. Now she initiates computer inquiries just as she would a phone call, and the responses appear on the manager's display in color. If hard copy is needed, it can be produced automatically on the secretary's typewriter.

System 21 helps take the guesswork out of decision-making. It's the modern management tool—the standard of the 70's.



Data processing in the 70's

THE OPERATIONS LIBRARY

The security and integrity of data stored on tape and disk volumes is of vital concern to the management of corporations using data processing equipment. The task of cataloging and controlling the distribution of such volumes is monumental. It requires 100% accuracy. If the wrong tape or disk is used for a particular processing task, the consequences are catastrophic.

More for your money

A 2111 data management terminal with printing robot and unit card reader is a low-cost, highly effective tool for preventing such a catastrophe.

The unit card reader reads fixed data such as serial number and volume number from a library card. The keyboard lets the library clerk enter the borrower's name, due date and other variables.

Updating card files

The printing robot creates labels and volume assignment and inventory lists. The card reader/punch adapter is used to produce new library cards.

THE SYSTEM 21 ROOM

In the modern counterpart of the tab room, System 21 saves you money, time and noise in your key entry and media conversion operations.

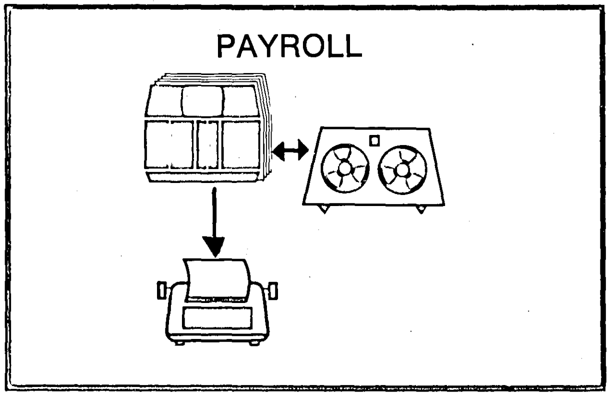
Faster data throughput

The 2111 terminal performs all the functions of the keypunch and key verifier, offering you more throughput, visual verification, key verification and error-free recording on VIATAPE. With System 21 you can produce error-free computer-compatible tapes and punched cards automatically.

Support for the central system

In addition, System 21 performs the functions needed to support a total data processing system. The 2150 computer with a bank of VIATAPES is used to duplicate format and program tapes needed throughout the corporation. A 2111 is used to pool VIATAPES from remote terminals on to error-free, computer-compatible tape. The printing robot is used to generate reports from VIATAPES prepared at remote locations. The 2111 and the unit card reader are used to convert readable documents to VIATAPE, cards, or computer-compatible tape.

Financial systems of the 70's

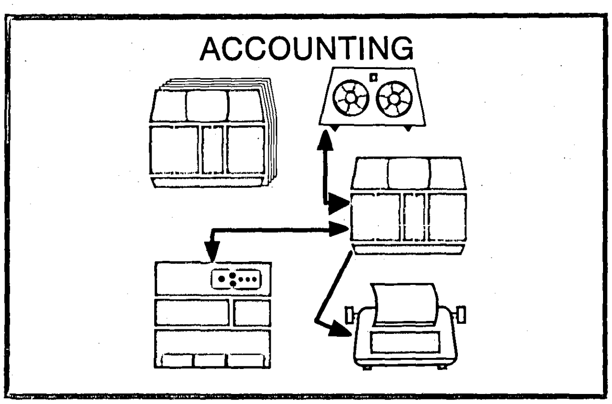


PAYROLL
When you think of payroll, you think of your weekly check. But issuing checks is a routine job for today's computers. The problem facing the payroll department is how to keep the information in the computer up to date so that checks are issued correctly.

The old way
In the 60's this meant filling out form sheets for changes in employee records such as address, pay rates, number of dependents, and department. The form sheets were then sent to the keypunch center for punching and key verification, then to the tab room for sorting. Unfortunately, this multiple handling of the data caused errors and delays in updating the computer files. Result—inaccurate checks.

A system for today
But, now it's the 70's and System 21 has changed all that. No more form sheets, no more keypunch, nor key verification, no more tab room—no more delays.

Using System 21 data management stations in the payroll department, changes are entered and visually verified by a payroll clerk who understands the information — not by a keypunch operator who doesn't. Data is then recorded on computer-compatible tape ready for processing by the computer.

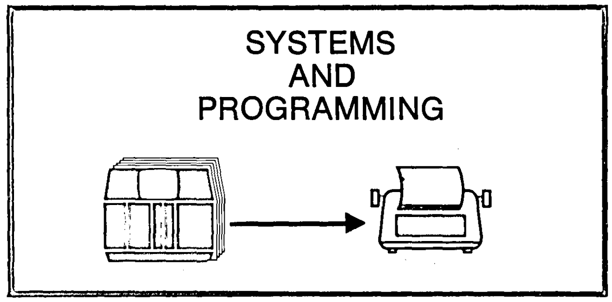


ACCOUNTING
Each accounting entry must be prepared by an accountant, coded by a clerk, keypunched, key verified, sorted, and finally sent to the computer.

No duplication of input
System 21 eliminates this multiple preparation cycle and its inherent delays by permitting the clerk who understands the data to record it directly on error-free VIATAPE. Transactions are entered through the System 21 keyboard using the fill-in-the-blanks technique which displays all format words and keyed data on the System 21 screen. After visually verifying her entry, the clerk records the transaction record on VIATAPE.

The VIATAPES are then automatically converted to punched cards or computer-compatible tape for processing by the computer.

On-line calculations
System 21 computers provide computational capability for the many calculations required in accounting. For example: the 2150 computer can calculate return on investment, perform cash flow analyses, compute depreciation schedules, or determine interest payments. Results of these and other calculations are displayed on the System 21 terminal and printed by the printing robot when hard copy is desired.



Programming in the 70's

Getting computer time is the programmer's biggest problem. System 21 terminals bring the computer room to the programmer's desk by giving him direct access to a large computer through the 2150's selector channel interface.

Program preparation and editing is done without tying up the central computer. When the programmer is satisfied with his source program, he initiates remote job entry through the 2150 to the central computer where an on-line debugging system permits compilation and testing of the program.

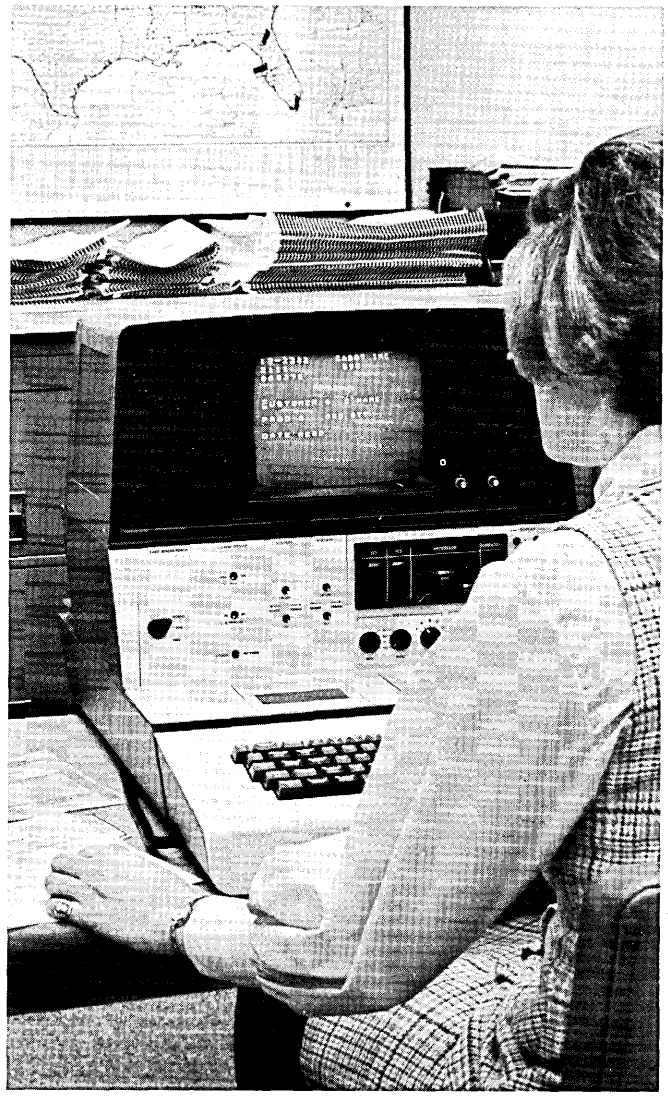
He obtains current listings using his System 21 printing robot. His programs can be stored on VIATAPE cartridges in his own desk drawer. There are no cards to carry around or drop. No source data to be clobbered by an operations error. And, no time lost waiting for keypunching and machine shots.

The applications for the system of the 70's are limited only by your imagination

Advertising Media Analysis
Traffic Control
Security Systems
Law Enforcement
Retail Sales Systems
Medical Records Systems
Personnel Records Systems
Teaching Aids
Cost Analysis
Estimating
Insurance Planning
Hospital Billing Systems
Income Tax Collection
Service Bureau Communications
Utility Billing Systems
Brokerage Record Maintenance
Ticket and Reservation Systems
Mail Order Processing
Dispatching
Mail Order List Maintenance
Subscription Processing
Educational Records
Voting List Maintenance

SYSTEM 21-The hardware of the 70's

The 2111 Microprocessor



The 2111 Microprocessor is an LSI/MOS component which provides the storage and control logic functions for the expanded System 21 data management station—a desk-top station capable of performing the many routine batch processing tasks which currently overburden your central computer.

The 1024 12-bit word Read-Only Memory houses hard-wired microprograms equivalent to a general-purpose computer's software. The microprograms initiate automatic input and output operations and interpret data entry, reformatting, editing, error correction, visual and key verification, tape searching, and peripheral control programs.

The 2111 also provides a 400-character dynamic storage which is divided into five directly accessible areas.

The Read Record holds previously processed data output from the microprocessor.

The Write Record is used for data entry and processing. As data is output to a tape or data channel, the contents of the Write Record are transferred to the Read Record.

The Master Record displays fixed information and format words which assist the operator in data entry and processing.

Control Records 1 and 2 contain program control functional specifications referenced by the microprocessor.

FUNCTIONAL CAPABILITIES

Microprocessor functions can be controlled either manually through the keyboard and control panel or automatically by the microprocessor control record. The control characters recognized by the microprocessor are listed below:

- U — the keyboard is set in the upper shift position
- L — the keyboard is set in the lower shift position
- D — the field from the Read Record is duplicated into the selected record
- M — the field from the Master Record is duplicated into the selected record
- S — the cursor is skipped to the beginning of the next field
- Z — the numeric field thus identified is right-justified through the insertion of leading zeroes
- I — the next record is input immediately without output of the record currently being processed
- O — the record currently being processed is output immediately
- R — the output sequence specified by the OUTPUT OPTIONS rotary is initiated immediately. If options are OFF, the microprocessor is halted.
- C — selected fields are compared in accordance with program functions currently being executed
- NUMERICS — reformatting functions are initiated in response to numeric specifications

HIGHLIGHTS

Automatic input/output under program control — provides true batch processing for: record updating, key verification, and tape search. After a record is input from the selected tape or data channel, the cursor is returned to position one. If Program Control is "ON", automatic interpretation of the control program begins; otherwise, the cursor remains in position one—awaiting operating action. As soon as the record is completely processed, it is output to the selected tape or data channel.

Reformatting within record and field — records are reformatted on a character-by-character basis. Fields and data within fields can be rearranged and eliminated as desired. A single character can be copied into as many positions as desired thus providing the ability to duplicate fields. This is especially useful when source data is presented in an order quite different from that expected by a receiving computer or when there is little room for blanks between fields — thus making visual verification almost impossible. Computer output can be reformatted for terminal operations. Data recorded on VIATAPE or computer-compatible tape can be rearranged for listing by the printing robot.

Tape search — makes it possible to retrieve a specific record or series of records. A search argument is entered into the Master Record in those positions where it is expected to appear in the records on the file being searched. File records are read into the Write Record and the microprocessor initiates a compare operation.

When a match is encountered, the record can be processed and output to a selected tape or data channel. Alternately, unmatched items may also be sent to a selected channel. Search operations can be performed on multiple fields or on the entire record.

Character deletion and insertion — the DELETE and INSERT keys provide powerful error correction capabilities. Extraneous characters can be deleted and missing characters inserted. Resultant contraction and expansion of fields can be performed under program control. Shifting of characters occurs to the right of the cursor except in left-zero fields, where it occurs to the left.

Key verification — insures the accuracy of previously keyed data. After a record is read into the Master Record, the operator re-keys the original data into the Write Record. The microprocessor compares each character as it is entered and locks the keyboard if there is a discrepancy. The operator can then correct the data in either record. The operator cannot proceed beyond the point of error until a correction resulting in an equal compare is made.

Tape validation — in all operations involving VIATAPE or computer-compatible tape, the validation feature can be used to guarantee error-free data transfer to and from tape. When the VALIDATE switch is "ON", the microprocessor checks the validity of each read and write operation. If a data error is detected during input, the microprocessor will re-read the record. If the error is detected again, the CHANNEL ERROR and OPERATOR ERROR indicators will light and the read operation will be halted.

During output, after a record has been written, the tape will be backspaced and the record will be read back into the microprocessor, where it will be compared to the original record which still resides there (read-after-write check). If an error is detected, the record will be rewritten and rechecked. After three attempts have been made to validate a record, the failing area of the tape is spaced over, and the record is written in the next good area.

OPTIONAL CAPABILITIES

Automatic input options — permit the operator to select one of the following input sequences:

1. load new format with its associated program record from tape channel 1
2. load new format with two associated program records from tape channel 1
3. batch-transfer of records from a selected input channel to a selected output channel (required for unattended batch communication)
4. load Master Record from the selected input channel (required for batch reformatting)

Automatic output options — permit the operator to select a combination of tape and/or data channels for automatic output:

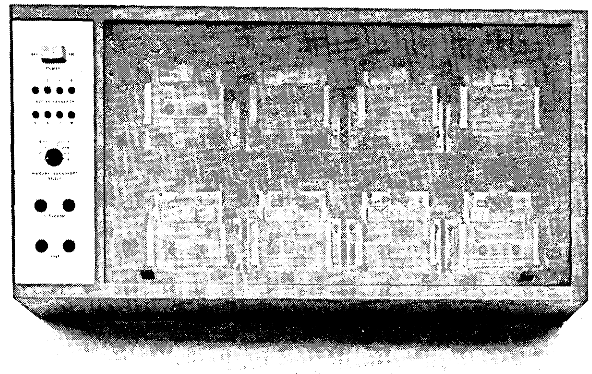
1. to data channel 1, and tape channel 2
2. to data channel 1, and data channel 2
3. to data channel 1, data channel 2, and tape channel 2

Field and character selection — provides two additional cursor movement keys: POSITION SELECT, and FIELD SELECT. The POSITION SELECT key provides immediate access to any position in the record. The FIELD SELECT key provides immediate access to the first nine fields specified in the active control record.

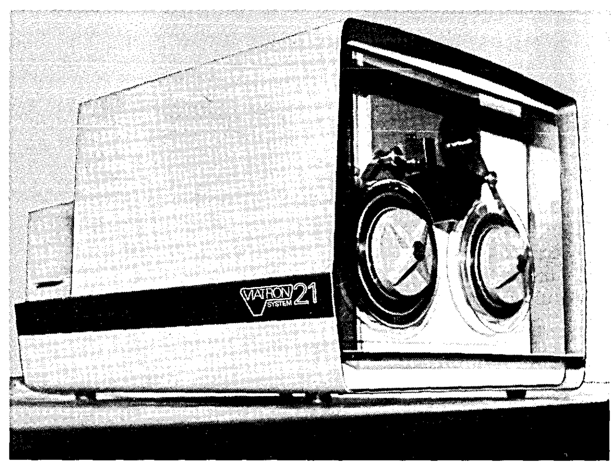
Short record feature — allows the user to input or output a record that is less than 80 characters to any device attached to a data channel. Used in a communication environment, the short record adapter provides minimum transmission time. The microprocessor that is equipped with the short record feature will employ a line feed or carriage return symbol (specified by user) to signify end of record. In an input transmission when the microprocessor detects the line feed or carriage return symbol, it automatically fills the remaining positions of that record with blanks. In an output transmission, when the microprocessor detects a line feed or carriage return, the trailing blanks are stripped from the record.

VIATAPE Bank and Controller

The VIATAPE Bank and Controller provide the 2140 and 2150 computers with over one million bytes of on-line storage. The storage medium is the VIATAPE cartridge. VIATAPE cartridge recorders are mounted in banks of eight; each controller is capable of supporting up to four such banks. The controller and its associated banks are interfaced to the computer through the 2140/2150 wideband channel. The computer can address each recorder individually and can initiate both read and write operations. The VIATAPE bank control panel indicates which VIATAPE cartridge is being referenced by the current operation. Tape and operational characteristics are identical to those of the VIATAPE cartridge recorder.



Computer-Compatible Tape Recorder



Computer tapes are designed to work in environments where temperature, humidity and dust levels are carefully controlled. However, computer tape is being used on non-computer devices such as key-to-tape machines. When these devices are moved out from the computer room the results are not really surprising. Computer tape does not function reliably outside antiseptic environments.

VIATRON's zero-defect, computer-compatible tape system, is designed to operate outside the computer room—in the factory, the warehouse, the boiler room—with the same reliability that you expect and receive from your computer's tape drives.

How did VIATRON do it? Simple. The tape hardware records each individual character five times. The probability that at least three of the characters are correct is very high. Application of a simple majority logic test ensures the accuracy of the data read from the tape. This error detection and correction technique reduces errors caused by dirt, temperature and humidity to one in ten million. On tapes using single character recording techniques, there is nothing to check the character against. You never know if the character is recorded correctly or not.

Technical specifications

The System 21 computer-compatible tape recorder uses the ASCII code to comply with U. S. Government specifications on information interchange. Three models are available: 9-track, 800 bpi; 7-track, 556 bpi; and 7-track, 800 bpi.

Input/output and code conversion processing are provided through free software packages which perform the data checking that ensures zero-defect computer input. Packages currently available are written in COBOL, FORTRAN IV, and BAL. Pooling, blocking and editing capabilities are available with the FORTRAN and COBOL versions which are used as stand-alone programs. The BAL version, which also performs blocking, is available both as a stand-alone program and as a callable subroutine.

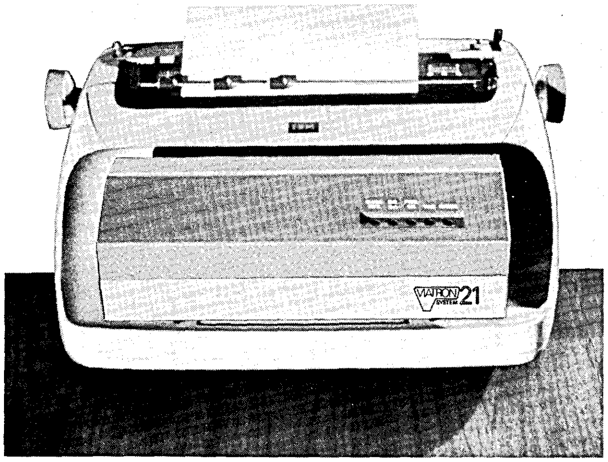
Card Reader/ Punch Adapter

The Model 6001 Card Reader/Punch Adapter provides the System 21 microprocessor with a cable interface to the IBM 029 Keypunch. The adapter operates in three modes. In the READ mode, cards are read into the microprocessor from the 029. Conversely, in the PUNCH mode, data from the microprocessor is sent to the 029 for the punching of cards. In the DISENGAGE mode, the 029 can be operated as a keypunch independently of the microprocessor. The adapter is normally used for batch conversion of VIATAPE to punched cards, or vice versa.

The punch time for an 80-character record is 4.5 seconds.

A record transfer buffer (Feature 601) permits input operations to be performed on the microprocessor during the punch cycle.

If the micoprocessor sends a character code other than one of the 64 valid Hollerith codes, a question mark (?) will be punched by the 029. Space insertion (Feature 603) replaces all such question marks with space characters.



Printing Robot

The Model 6002 Printing Robot is a solenoid-operated device which rests on the keyboard of the IBM Selectric® typewriter (13 or 15 inch carriage). The Selectric® is driven at the rate of 12 characters per second. The printing robot may be removed at any time to permit normal typing operations.

The robot may operate in one of three modes: List, Execute A, or Execute B. In List Mode, records are printed one per line followed by an automatic carriage return. Spaces may be automatically inserted in the line, when needed, through use of a tab matrix on the microprocessor control panel. In Execute A mode the robot recognizes the following control characters: backspace, tab, index, and carriage return. The print line can extend to the maximum width of the carriage. The 64 printable characters include upper case alphabetics, numerics, and special characters. Execute B mode operates identically to the A mode and also permits printing of lower case alphabetic characters.

The record transfer buffer (Feature 601) provides the microprocessor with the ability to support simultaneous robot and input operations. This permits the printing of a record while the next record is being entered from the keyboard, from tape, or from another data channel peripheral.

Batch printing of a VIATAPE cartridge or computer-compatible tape is possible through use of the automatic input and automatic output options.

Communication Adapter

The Communication Adapter is used in conjunction with a System 21 terminal to allow for transmission of data over standard, voice-grade telephone lines. The adapter provides a standard EIA RS-232-C interface to a Bell System Dataset®, or its equivalent, for performing half-duplex, asynchronous data communication operations. The adapter uses an 8-level, 11-unit ASCII transmission code for compatability with virtually all types of communications equipment.

Even parity is transmitted in the eighth bit position of each character. Parity errors occurring in the transmission are detected by the receiving microprocessor and a question mark is displayed in place of the erroneous character. The question mark remains a part of the record until corrected.

The following table lists speed characteristics and associated modems for each model.

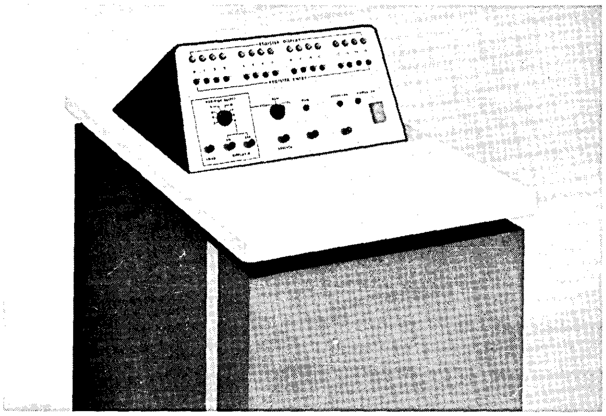
Adapter Model	Speed (Baud Rate)	Associated Modem
6003	110 or 247.	VIATRON 605, Bell 103A2, or equivalent, or acoustic coupler (Feature 606).
6004	600 or 1200	VIATRON 607, Bell 202C or 202D or equivalent.
6005	Any speed up to 1200	To 300 baud, VIATRON 605, Bell 103A2, or equivalent. From 300 to 1200 baud, VIATRON 607, Bell 202C or 202D or equivalent.

The adapter control panel provides for selection of transmission speed and mode (attended or unattended).

Unit Card Reader

The Model 6008 Unit Card Reader provides the System 21 terminal with the ability to read 80-column punched cards, fed manually, one card at a time. The unit card reader reads Hollerith characters, translates them to ASCII through a data channel, and transmits them to the microprocessor. It is designed for those applications where some or all of the data for a transaction has been previously punched in card form.

General-Purpose Computers



MODEL 2140

The VIATRON Model 2140 is an LSI/MOS Central Processing Unit with a 4096 16-bit word core memory. It offers extensive computational and data manipulation capabilities through 85 powerful instructions.

Arithmetic operations may be single, double or even triple precision using general purpose registers (accumulators) which are available to the programmer. Computational routines may therefore be easily programmed for the simplest or the most complex business or scientific calculations. Load, Store, Move and Test instructions may also be performed in all three registers and may be byte or word oriented.

Software available with the 2140 will be upwards compatible with future VIATRON computers. The software includes a Basic FORTRAN compiler, an assembler, a math subroutine library and utility programs for manipulating data from System 21 Data Management Terminals. In addition, a language for communicating with multiple data management terminals is available in DDL-1 (Distributed Data Language). This gives the user a powerful systems capability by supplying software control of terminals.

The input/output capability is accomplished through an Automatic Polling Controller, which allows the attachment of up to 8 System 21 Data Management Terminals, and a wideband high speed data channel, which may be used for data communications and computer peripherals. System 21 terminals may, of course, be configured to support any of the terminal peripherals in the System 21 product line, adding extensive data input, data storage, data display, and data printout capabilities to the Model 2140 computer.

An operator's control panel, designed for simplicity of operation, is located at desk height on the Model 2140. It allows access to all machine registers for display or for direct storage from the panel.

MODEL 2150

The Model 2150 expands the capability of VIATRON's general-purpose computers to serve more terminals and a wider variety of applications.

More Memory 8192 16-bit words of core memory are standard on the Model 2150, twice the core capacity of the Model 2140. Larger, more complex programs and more on-line data storage are available to the programmer and to the user.

More System 21 Terminals Three Automatic Polling Controllers are standard on the Model 2150, permitting the attachment of up to 24 System 21 Data Management Terminals. With more memory and more terminals, the Model 2150 is ideal for use in large data input centers, in private wire communications networks for message switching, for data transmission to computer centers, and a host of other terminal oriented application areas.

More Software A FORTRAN IV Compiler is standard on the Model 2150, bringing to the engineer, the scientist, and the mathematician a language which is both familiar and easy to use. For the engineer, or group of engineers, who has been concerned by the high cost and inflexibility of commercial time sharing services, or who has been unable to gain access to his centralized batch processing computer, the Model 2150 offers a cost saving, efficient alternative. Put the computer where the problems are for maximum accessibility and utility.

Specifications

- **Type of Circuitry for CPU:** LSI/MOS
- **Memory:** Magnetic Core
- **Memory Capacity:** 2140: 4096 words
  2150: 8192 words
- **Word Length:** 16 bits (Byte addressable)
- **Memory Cycle Time:** 2 microseconds
- **Index Registers:** 3
- **General-Purpose Registers:** 6
- **Register Length:** 16 bits
- **Interrupt Levels:** 2140: 2
  2150: 4
- **Input/Output:** Automatic Polling Controller
  2140: 8 channels for attaching System 21 Terminals
  2150: 24 channels for attaching System 21 Terminals
  High-Speed Data Channel
- **Data Format:** 8 bit byte — ASCII
  16 bit word
  Arithmetic: 8, 16, 32, or 48 bit numbers
  Positive Numbers: sign and magnitude
  Negative Numbers: 2's complement
- **Instruction Formats:**

Short(S)

0 5	6 7	8 15
6 Bits Op Code	2 Bits Index	8 Bits Relative Address

Extended(E)

0 5	6 7	8 15	16 31
6 Bits Op Code	2 Bits Index	8 Bits Op Code Modifier	16 Bits Address

- **Addressing Modes:**
  Short Format Instructions: 256 Locations relative to Program Counter, and Indexable
  Extended Format Instructions: Direct (Full Memory) Indirect, and Indexable
- **Instructions:**

Arithmetic:	12	Shift:	13
Logic:	9	Modify Memory:	1
Load:	13	I/O:	1
Store:	13	Operate:	12
Branch:	11		—
		Total	85

- **Software**

2140	2150
Assembler	Assembler
Distributed Data Language—1	Distributed Data Language—1
Basic FORTRAN	FORTRAN IV
Subroutine Library	Subroutine Library
Utility Library	Utility Library

- **Power Requirements:** 115 VAC, 60 cycle, 350 watts

price list

Model Number	Feature Code	Description	Purchase Price

2101 — **MICROPROCESSOR** — $960
- 512-word, Read-Only Memory
- 400-character Read/Write Memory
- Two Tape Channels
- Automatic Skip
- Automatic Duplication
- Automatic Left Zero Fill
- Automatic Upper and Lower Shift Control
- Automatic Output to selected data or tape channel

101 — **AUTOMATIC MULTIPLE INPUT feature** — $432
- One record from Selected Channel or medium
- One master and one control record from Tape Channel #1

102 — **AUTOMATIC MULTIPLE OUTPUT feature** — $192
- To Data Channel 1 and Tape Channel 2
- To Data Channels 1 and 2
- To Data Channels 1 and 2, plus Tape Channel 2 feature

103 — **SHORT RECORD feature** — $480
- Automatic input or output of a record less than 80 characters.
- A "carriage return" character is used to designate end of record.

106 — **SHORT RECORD feature** — $480
- Automatic input or output of a record less than 80 characters.
- A "line feed" character is used to designate end of record.

2111 — **MICROPROCESSOR** — $1728
- 1024-word, Read-Only Memory
- 400-character Read/Write Memory
- Two Tape Channels
- Automatic Skip
- Automatic Duplication
- Automatic Left Zero Fill
- Automatic Upper and Lower Shift
- Automatic Output to selected data or tape channel
- Automatic Input from selected data or tape channel
- Automatic Tape Search
- Automatic Tape Validation
- Editing, Automatic Reformatting
- Key Verification

102 — **AUTOMATIC MULTIPLE OUTPUT feature** — $192
- To Data Channel 1 and Tape Channel 2
- To Data Channels 1 and 2
- To Data Channels 1 and 2, plus Tape Channel 2

103 — **SHORT RECORD feature** — $480
- Automatic input or output of a record less than 80 characters.
- A "carriage return" character is used to designate end of record.

104 — **AUTOMATIC MULTIPLE INPUT feature** — $432
- One master and one control record from Tape Channel 1
- One master and two control records from Tape Channel 1
- Automatic Input from selected data or tape channel, followed by Automatic Output to selected data or tape channel.
- Automatic Input from selected data or tape channel to master record, followed by automatic selection of the record area indicated by the Status Record switch.

105 — **FIELD AND POSITION SELECT feature** — $240
- Direct Access to selected field or character position

106 — **SHORT RECORD feature** — $480
- Automatic input or output of a record less than 80 characters.
- A "line feed" character is used to designate end of record.

2140 — **GENERAL PURPOSE COMPUTER** — $4752
- CPU—4K words of core memory
- 16-bit words
- 8 Input/Output channels for local or remote attachment of System 21 Data Management Terminals
- Wideband Communications channel
- Software, Utility subroutines, Assembler, and MACRO languages

2150 — **GENERAL PURPOSE COMPUTER** — $9552
- CPU—8K words of core memory
- 16-bit words
- Hardware Multiply and Divide
- 24 Input/Output channels for local or remote attachment of System 21 Data Management Terminals
- Wideband Communications channel
- Software, Utility subroutines, FORTRAN compiler, Assembler, and MACRO languages

3001 — **VIDEO DISPLAY SUBSYSTEM** — $240
- Allows the attachment of several types of video displays to a microprocessor

301 — **BLACK & WHITE VIDEO DISPLAY** — $384
- 320-character display, divided into four 80-character records
- Suppression or display of any or all records
- Cursor in operational record
- Interleaving capability of Write and Master records (No charge for first Black & White Video Display when Feature 304 is not ordered.)

302 — **RECORD SUPPRESS feature** — $96
- Permanent suppression of any combination of 80-character records on local or remote displays

303 — **SELECTED DATA DISPLAY feature** — $192
- Allows selective distribution of data to local or remote displays

304 — **COLOR VIDEO DISPLAY** — $1248
- Requires Selected Data Display feature 303
- 320-character display, divided into four 80-character records
- Suppression or display of any or all records
- Cursor in operational record
- Interleaving capability of Write and Master Records
- Control characters for 8 Data and 8 Background Colors

305 — **BLACK & WHITE RF MODULATOR** — $96
- Connection for up to 12 RF displays. Displays may be VIATRON Displays (Feature Code 306) or any commercial television display
- Up to two RF Modulators may be connected to Microprocessor

306 — **BLACK & WHITE RF VIDEO DISPLAY** — $384

KEYBOARDS
(prices include Parallel Data Channel at $48)

4001 — **KEYBOARD** — $288
- Standard typewriter characters
- Standard card punch characters
- Microprocessor control characters
- Communications control characters

4002 — **KEYBOARD** — $624
- Standard typewriter characters
- Standard card punch characters
- Microprocessor control characters
- Communications control characters
- 40-character card reader

4099 — **KEYBOARD** — $192
- Microprocessor control characters

TAPE RECORDERS

5001 — **VIATAPE CARTRIDGE RECORDER** — $192
- Capstan-free tape recorder using magnetic tape cartridges
- 7-level ASCII code
- Bit read/write rate of 1250 bps

5002 — **COMPUTER-COMPATIBLE TAPE RECORDER** — $2880
- 9-track, 800 bpi
- 6-inch minireels of computer-compatible tape
- 2200 cps synchronous read/write rate

5003 — **COMPUTER-COMPATIBLE TAPE RECORDER** — $2880
- 7-track, 556 bpi
- 6-inch minireels of computer-compatible tape
- 2200 cps synchronous read/write rate

501 — **800 BPI DENSITY feature** — N/C

502 — **SPACE INSERTION feature** — N/C
- In write mode invalid characters are replaced by space characters instead of a question mark character.

DATA CHANNEL ATTACHMENTS
(prices include Serial Data Channel at $48)

6001 — **CARD READER/ PUNCH ADAPTER** — $1776
- Transmit any of the card punch's standard 64 characters
- Punches an 80-character record in 4.5 seconds
- Card punch may be disengaged and operated independently

601 — **RECORD TRANSFER BUFFER** — $864
- 80-character buffer permitting simultaneous microprocessor operation and card punch operation

602 — **BUFFER SHORT RECORD feature** — $96
- For Buffered Units Only
- Fixed-length short record
- Program card is set up with a skip field. Card is released as soon as skip is detected

603 — **SPACE INSERTION feature** — $144
- In punch mode, adapter spaces over an illegal character instead of punching a question mark

6002 — **PRINTING ROBOT** — $1200
- For IBM Selectric®, 13" Carriage
- Includes Format Control
- Printing speed of 12 cps
- Easily removed for normal typewriter operation
- Automatic backspace, tab, carriage return, and index by code detection in data stream
- Three print modes for straight line or formatted printing
- Upper and lower case

601 — **RECORD TRANSFER BUFFER** — $864
- 80-character buffer permitting simultaneous microprocessor operation and printing robot operation

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6003 — **COMMUNICATIONS ADAPTER** — $528
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- Asynchronous communication in half-duplex mode
- 7-level, ASCII code, record synchronization, optional parity check, 15-second time out

604 — **UNATTENDED OPERATION feature** — $240

605 — **MODEM 110-247 BAUD** — $480

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- Includes modem

6004 — **COMMUNICATIONS ADAPTER** — $528
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- 202 C/D-Compatible
- Asynchronous communication in half-duplex mode
- 7-level, ASCII code, record synchronization, optional parity check, 15-second time out

604 — **UNATTENDED OPERATION feature** — $240

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6005 — **COMMUNICATIONS ADAPTER** — $1008
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- 7-level ASCII code, record synchronization, optional parity check, 15-second time out

6006 — **FOREIGN DEVICE ATTACHMENT** — $864
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- Parallel transfers to and from foreign device

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