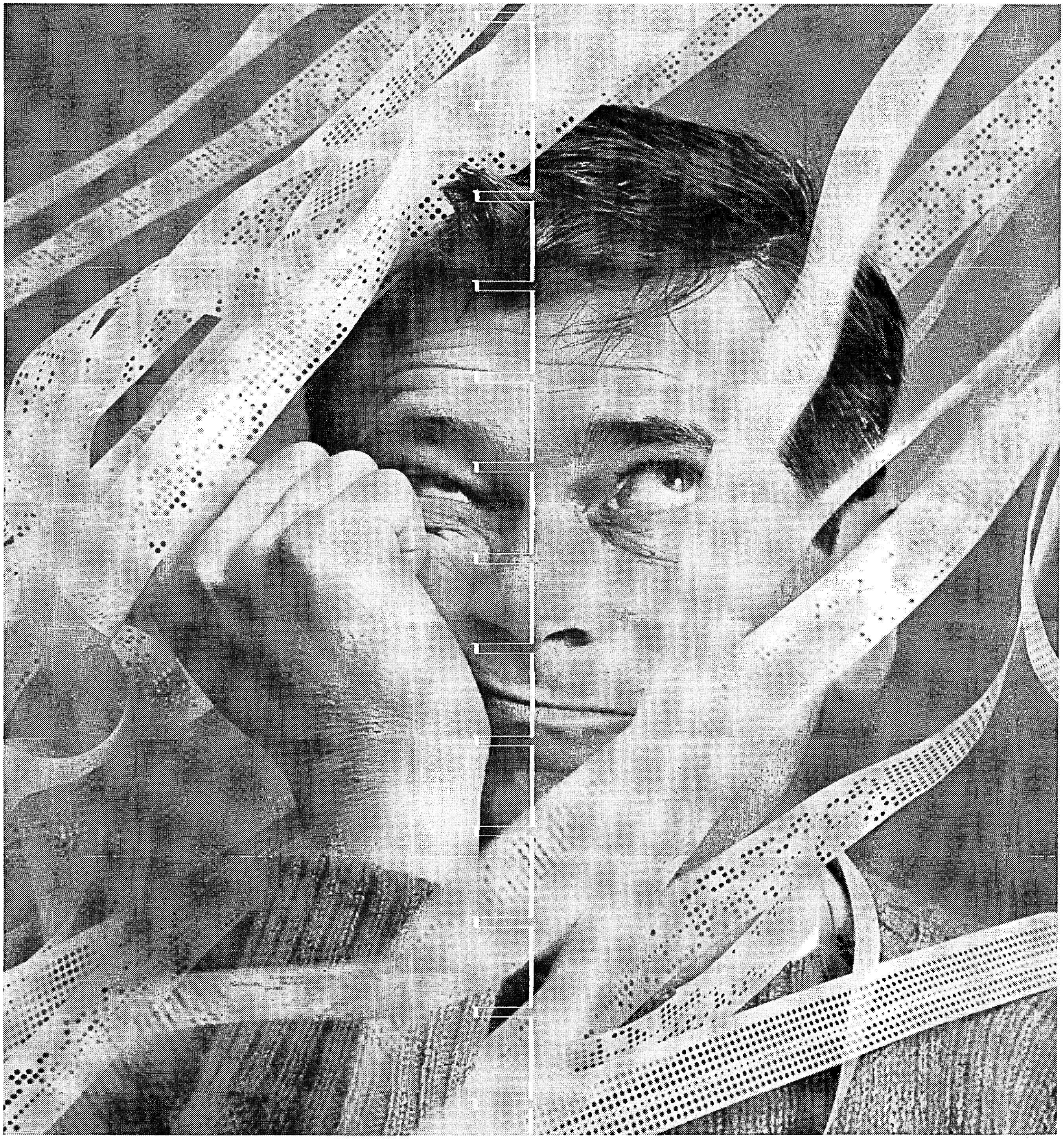
# DATAMATION®

65

*January*

AUTOMATED DISPLAYS



**Save it for parades. Now Ampex magnetic tape is faster, more accurate and costs less.**

And it's more efficient. One small Ampex CDR-1 tape cartridge stores as much data as 7000 feet of paper. And can be erased and used again. Paper tape systems are slow. The CDR-1—an incremental digital recorder—records 2400 bits of information per second. Plays back up to 3840 bits per second. Paper tape systems need operators. The CDR-1 is automatic. Paper tape systems make mistakes. With the CDR-1 mistakes are less than 1 in 10,000,000. And mistakes are spotted—the CDR-1 automatically verifies every bit of data it records. In short: Ampex has made all the benefits of magnetic tape available to manufacturers of systems incorporating other input/output devices. The CDR-1 is comparably priced, incomparably better. And available now for evaluation by manufacturers of systems designed for communications, factory data acquisition, data logging, machine tool control, computer input/output devices, and many other applications. For full details on the CDR-1, write Ampex Corporation, Redwood City, California.

AMPEX

CIRCLE 1 ON READER CARD

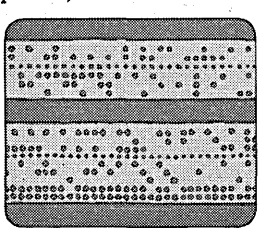
# WHICH PAGE PRINTER DO YOU NEED?

**With several new and different lines of Teletype send-receive and receive-only sets, how do you decide which is best for you? While they may seem alike at first glance, there are actually many differences.**

*4-row keyboard*

*Let's begin with the most obvious difference.* The Model 32 send-receive set has a 3-row keyboard, like the familiar Model 28, but the Model 33 and 35 have 4-row keyboards. Why the shift to a 4-row keyboard when the 3-row keyboard has been standard for many years? To avoid the shift! That is, to avoid the need to shift in order to type numbers and common punctuation marks. Besides saving strokes and cutting down on errors, the 4-row keyboard is familiar to any typist.

*Now, for the not so obvious differences.* The Model 32 page printer operates on the 5-level, 7.50 unit code, but the Models 33 and 35 handle an 8-level, 11-unit message and data code which conforms to the newly approved American Standard Code for information interchange. Both the 32 and 33 units are available with a friction feed platen. The Model 35 can have either a friction or sprocket feed platen, the latter for use with multiple-copy business forms.

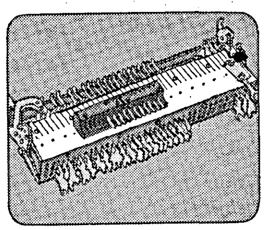


*5- and 8-level tape*

The Model 35 has the exclusive "stunt box" that can perform a wide variety of switching duties including "editing" incoming messages, as well as turning on and turning off unattended Teletype equipment. The Models 32 and 33 are equipped with a simplified "stunt box."

*What do these Teletype machines have in common?* Many things. They operate at 100 wpm; have pneumatic shock absorbers for smooth, quiet carriage return; all-steel clutches that engage at high, positive pressures to insure slip-free operation; and quieter nylon gears and pulleys that last longer and cut maintenance to a minimum.

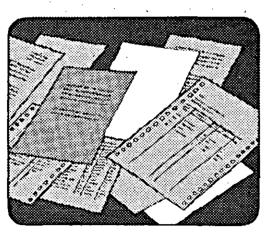
*What about optional features?* The Model 35 offers many modification kits to serve individual needs. Included are vertical tab, horizontal tab, page feed-out, and a variety of different width platens for printing on business forms.



*stunt box*

*Now, which machine should you use?* Though your specific needs have to be taken into consideration, the following will serve as a guide: Where the traffic ranges from normal to light, Models 32 and 33 are the most economical. The Model 35 is designed for handling a much larger volume of messages and data, as well as offering increased versatility for on-line and off-line communications.

*What are some typical applications?* This Teletype equipment is used to handle a variety of business needs, such as to link sales offices with customers, production plants with company headquarters, warehouses with distribution outlets, purchasing with outside suppliers.



*multiple-copy forms*

All business forms can be typed on this equipment, such as invoices, payroll checks, personnel records, sales orders, freight bills, tracers, and reservations. In addition, they can be used to gather information for sales reports, expense figures, production schedules, and account facts.

This kind of equipment is made for our Bell System, and others who require the utmost reliability at the lowest possible cost.

To obtain a new and informative brochure on the uses of the Model 32, 33, and 35 equipment, write: Teletype Corporation, Dept. 81A, 5555 Touhy Avenue, Skokie, Illinois 60078.

TELETYPE ®

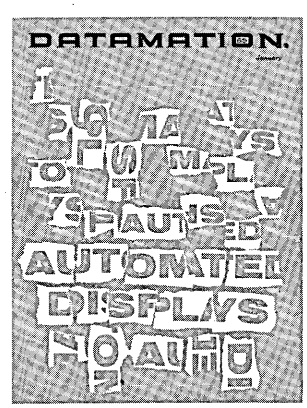
CIRCLE 5 ON READER CARD

DATAMATION 65 ®

january 1965

volume 11 number 1






automatic information processing for business industry & science

DATAMATION®
january 1965
volume 11 number 1

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THIS ISSUE — 57,034 COPIES

# RCA announces the world's computer series...

## RCA skills that helped blaze our trail into space make it possible. The new RCA Spectra 70 gives you the best management control for your computer dollar—without costly reprogramming Here's why:

**RCA** developed the world's largest first-generation computer. RCA started the second generation of computers in 1958 with the 501, first all-transistor computer. Now, a new space-age circuit makes possible the first true third-generation computer series—the RCA Spectra 70.

**First true third-generation computer series. Puts you in the 1970's now.**

The reason is the RCA Spectra 70's tiny *monolithic integrated* circuit. RCA space scientists gave it its high performance. One circuit replaces 15 transistors. Or a shoeboxful of tubes! The two larger computers of the RCA Spectra 70 series may have up to 8,000 circuits. Each is many circuit elements that give the pulses a shorter distance to go. *That means higher computer speed.* And RCA takes fewer steps to tie them into one circuit. *That means lower computer cost.* So the RCA Spectra 70 computer series gives you the best management control for your computer dollar. 1970 performance now. Another 1970 standard is the etched backplane wiring. So simple it makes bulky hand wiring obsolete. So precise its design is computer-controlled. The RCA way, we use a computer to make a computer.

**Dollar for dollar, gives you superior computer performance.**

Spell it s-p-e-e-d. The RCA Spectra 70 computes *and* remembers faster. Can finish a cycle in 300 nanoseconds. *(Billionths* of a second.) You'll find a faster interrupt, too. A special register lets you interrupt this computer's chores. Then returns it to its job, in no time at all. The RCA Spectra 70 has four processors and 40 peripheral units to meet the broadest range of your needs. And it grows with them. There is a special RCA reason why. *A standard interface.* Every unit connects with its Spectra 70 in the same way. In short, you get *tailored data processing.* Now and for the future. Behind it all is the tiny circuit. It raises speed. Lowers cost. Permits the RCA Spectra 70 to run cooler. Takes less space and power. And gives you greater reliability, easier maintenance.

# first true third-generation the RCA Spectra 70!

**Talks to other computers without costly reprogramming.**

That means *savings.* Because the RCA Spectra 70 speaks most computers' languages, it protects your program investment. You save on "software." Extend computer flexibility. With its new eight-bit-plus-parity language configuration, it meets latest industry standards. It trades instructions with the latest series announced. Saves your investment in other computers' output. RCA's own software makes the RCA Spectra 70's hardware work its *hardest.* Tailors performance to your needs. Extends range to its broadest limits. And no language barrier within the family. Its advanced communications, terminal devices and other units see to that. There's one language it doesn't speak. Words like costly *re*programming, *re*training, *re*investment. With the RCA Spectra 70, you can largely forget them.

**Build a total management information system at lowest possible cost.**

The RCA Spectra 70 has the total capability to meet your needs now *and* as you grow. The RCA Spectra 70's language capability lets you match its system to your current system. Lets you talk freely as you build, one RCA Spectra 70 unit to another. All the way, you get the best management control for your computer dollar. *And all this without costly reprogramming!*

Developed by RCA, a world leader in electronics, the RCA Spectra 70 is a total management information system. It can be analyst, planner, forecaster, designer, scheduler, controller, order processor, customers' man. It can keep you informed, free you to make the key decisions.

Let your RCA Spectra 70 representative show you how you can put this years-ahead system—these proven skills—to work for you.

RCA The Most Trusted Name in Electronics

Tmk(s)®

## NEW RCA SPECTRA 70

CIRCLE 9 ON READER CARD

# DATAMATION calendar

● The Univ. of Miami's School of Engineering has scheduled two workshops: Project Management with CPM and PERT, Feb. 22-26, and Methods of Operations Research, April 12-16.

● The fifth annual short course and symposium "Computers and Computer Application in Mining and Exploration" will be held March 15-19 at the Univ. of Arizona.

● A conference on "Applications of EDP for State and Local Government" will be help March 29-31 at the Univ. of Georgia, Athens, Ga. Co-sponsoring the conference with the University will be SDC.

● The Sixth Scandinavian DP Congress, AUTOMATION V65, will be held in Stockholm, Sweden, April 5-9. Included will be a computer exhibition.

● Los Angeles will be the site for the IEEE computer group conference on impact of batch-fabrication on future computers, March 2-4, 1965.

● The national automation conference will be held in San Francisco on March 8-10, 1965. For furthed information contact the American Bankers Assn. in New York.

● The fifth annual one-day technical symposium of the Washington chapter, ACM, will be conducted at the Marriott Motor Hotel in Washington, D.C., on April 15, 1965.

● The University of Alabama, Birmingham, will host the 10th annual dp confedence, April 20 and 21, 1965. The conference is sponsored annually by the certified public accountants, National Accountants Assn., DPMA, Univ. of Alabama, and Auburn Univ.

● The Mathematics Research Center, U.S. Army, of the Univ. of Wisconsin Madison, will sponsor a symposium on error in digital computation, April 26-28, 1965. The program will consist of invited addresses by leading research mathematicians from the U.S. and Europe, and will be concerned with theory and technique of error estimation and control in the numerical solution of mathematical problems of current importance.

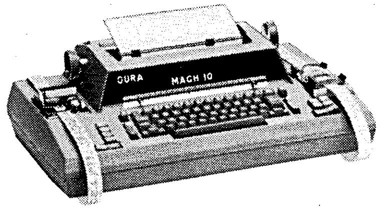

Before our Dura® Converter made the scene, our different data processing equipment had a communications block.

Now tab cards talk to tape. Tape back to cards. Tape to tape, too. And our Dura Converter does it faster—up to 20 characters per second.

To change code configurations takes me only seconds. I simply insert a pre-programmed plugboard.

Plugboards and wiring templates match 80 column cards and all known 5, 6, 7 and 8 channel tape codes including the new A.S.A. code.

To make your machines talk a common language, call your Dura representative or write: Dept. D12-15, Dura Business Machines, 32200 Stephenson Highway, Madison Heights, Michigan 48071.




**DURA**

BUSINESS MACHINES

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*Trademark Dura Corporation

SPEED • SIMPLICITY • VERSATILITY

CIRCLE 11 ON READER CARD

# letters

## more time-sharing

*Sir:*

"Introduction to Time-Sharing" by Glaser and Corbato (Nov., p. 24) is a generally good introduction to the philosophy of time-sharing. Two points were made, however, that seem questionable. First, in considering the case of the system being dormant with respect to the user, it is said: ". . . the system is constantly looking for some form of input from the user's console." This seems very wasteful from the system's point of view. Shouldn't the approach be just the reverse? That is, shouldn't the system do nothing for the user until the user's console sends a unique code to the system, which then automatically activates the user's program and memory?

A second statement: "Efficient hardware utilization is no longer the prime measure of effectiveness. The service given to each user is the criterion that must be paramount." This statement looks at the system only from the user's point of view. What about the seller of time? Since the cost of such a system will be astronomical, the system's owner must maximize the efficiency of the system; otherwise he will not survive. If, as you say, ". . . most computers of the future will be time-shared," then certainly the owners must make a profit; otherwise service bureaus and dp equipment renters might as well go out of business when time-sharing systems become common.

HARRY KERASTAS
*Farrington Manufacturing Company*
*Springfield, Virginia*

The authors' reply: "In a brief article covering such a broad area as time-shared computers, it is inevitable that there are misunderstandings. With regard to the first point, the phrase 'the system is constantly looking for some form of input' refers to the way that the user feels the system behaves. In fact, a well-designed system, by using either interrupt or polling logic, should look for messages terminated by one or more program-set 'break' characters; the input process thus requires an insignificant amount of attention since most of the time the processor is able to do other useful work.

"As to the second point, it should be obvious that service bureaus need only supply services for which there are customers willing to pay a fair price. Thus any astronomical costs (a presumption we do not agree with) will only imply corresponding astronomical profits for the enterpreneuring service bureau!"

## we goofed

*Sir:*

There seems to have been a gremlin at work in the November issue. In the panel discussion about time-sharing (p. 38), of which I was chairman, there was no mention that the article was an edited transcript of a session at the 19th National Conference of the Association for Computing Machinery held in Philadelphia on Aug. 25-27, 1964.

F. J. CORBATO
*Massachusetts Institute of Technology*
*Department of Electrical Engineering*
*Cambridge, Massachusetts*

**Our sincere apologies to you, other panelists, and the ACM for the oversight.**

## new hardware

*Sir:*

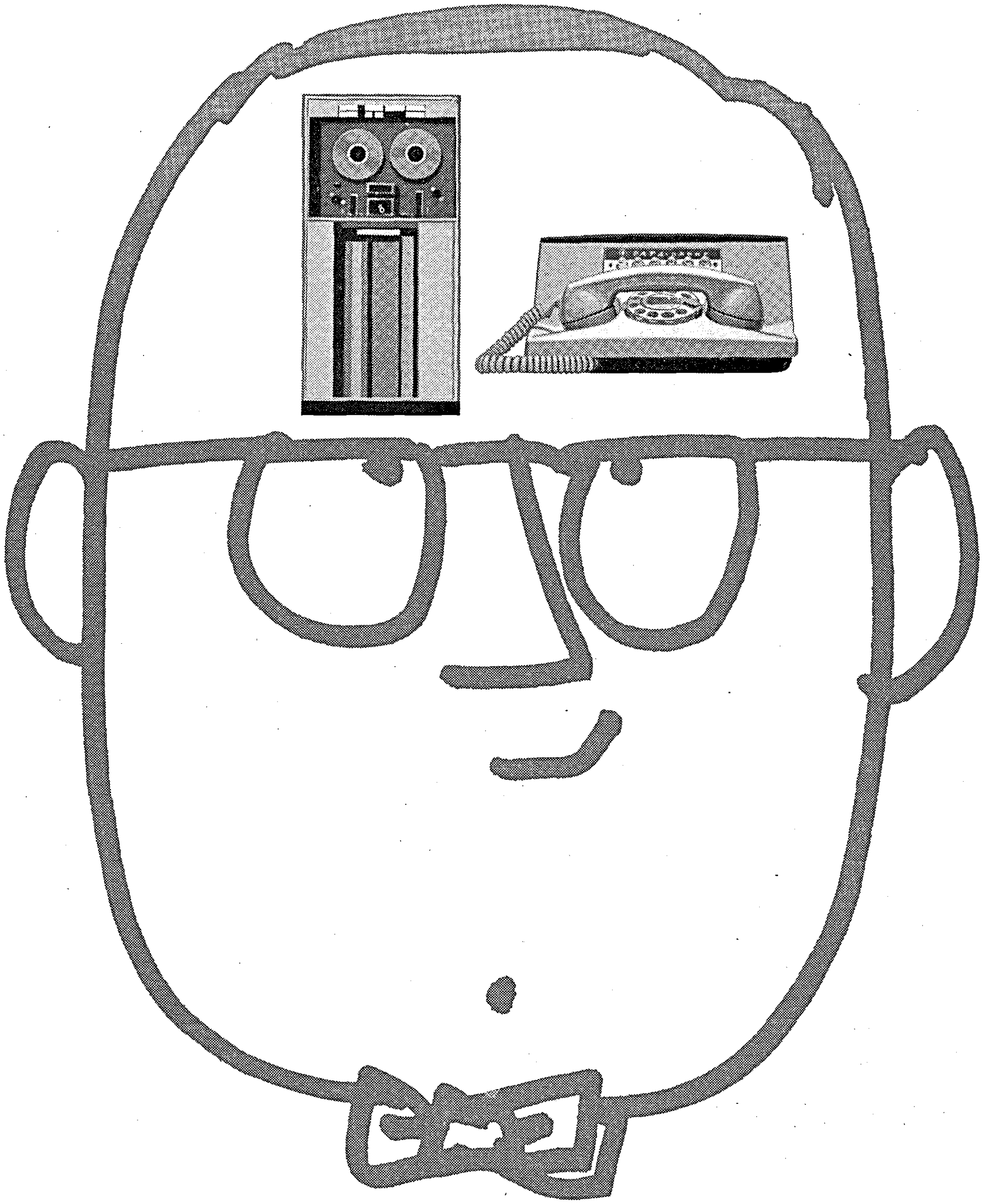
When we reopened our eyes to paragraph three of Editor's Readout (Oct. '64, p. 23) we were dismayed to find that the "magic time of two score years from now" was not quite magic enough to come out 1984.

Dismayed but undaunted, we straightaway initiated planning for STRETCH simulation of a generalized program for collating, tabulating, sorting, merging, translating, indexing . . . and generating a concordance of the blizzard of sales proposals made to DATAMATION for a dp system capable of solving $\frac{1984 - 1964}{20}$.

In the interim, we plan to don our beard and sandals and set about storing up adequate supplies of coffee, games, blackboards, and missed deadlines in preparation for an idyllic life of obsolescence in the hereafter, secure in the knowledge that our niche in History as the world's last working computer programmer is assured.

A. G. LYNN
*IBM Data Systems Division*
*Development Laboratory*
*Poughkeepsie, New York*

**Thanks for the gentle nudge. As a matter of fact, our dp system shows that $\frac{1984 - 1964}{20} = 1$. Now we're working on one that proves that $\frac{1984 - 1964}{20} = 2$.**



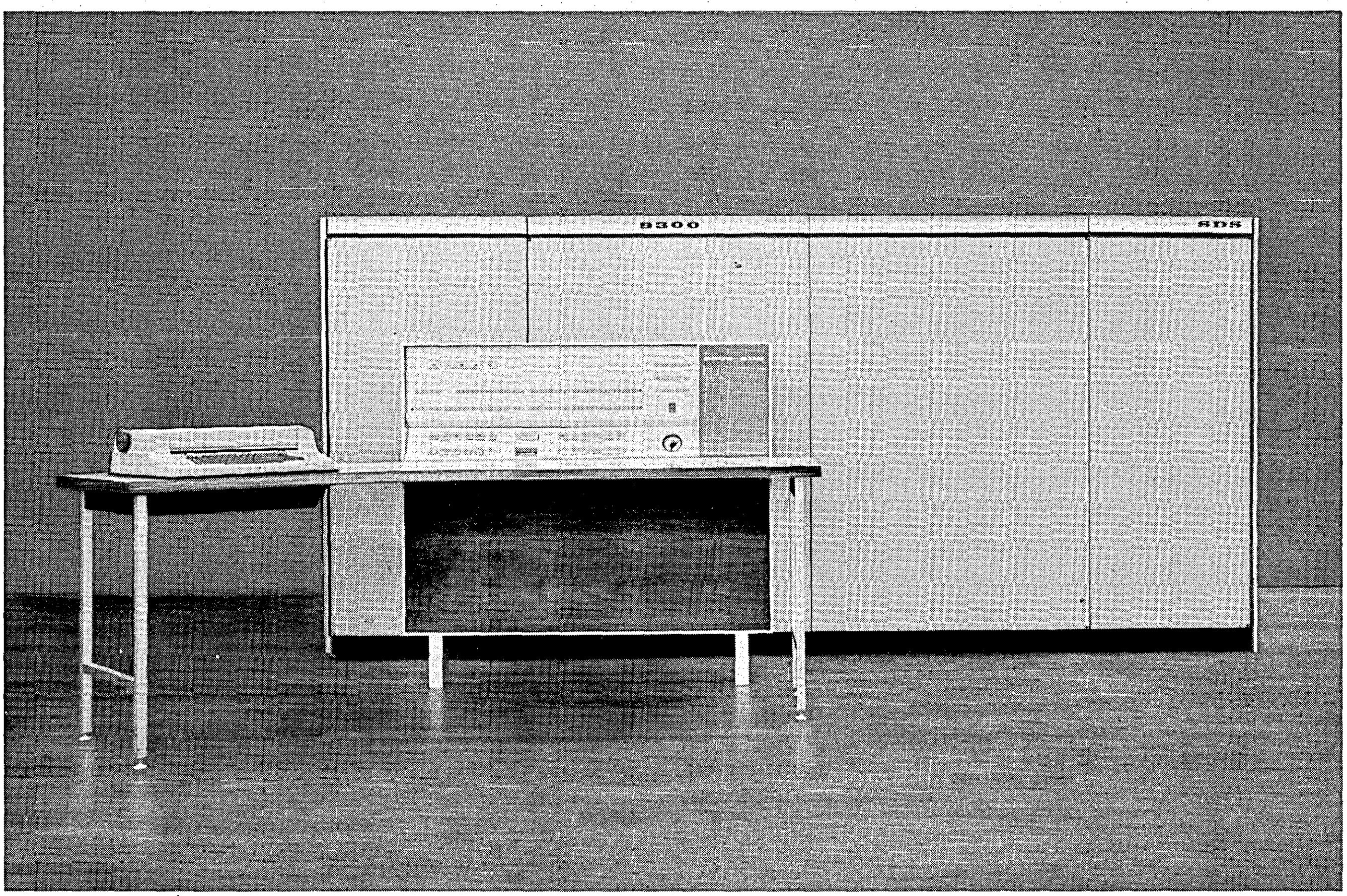

Whitney Darrow Jr.

CIRCLE 15 ON READER CARD

# If your application is real-time and you care about availability, reliability and cost...

# There is exactly one scientific/engineering digital computer you can buy...

# This one:




**Availability:** The SDS 9300 is here. It's running. It's real. It's in production. If you'd like to see one in operation yourself, come out to our plant and run your own problem on the 9300.

**Reliability:** How do *you* project reliability? Component count? The SDS 9300 has the lowest count of any machine in its class (up to five times less!).

**Cost:** The SDS 9300 costs less to buy and less to operate. You can have a complete 9300 system (8K memory, I/O, four tape stations, high speed printer, card reader and punch) for $360,000. You'd pay at least 20% more for a less powerful and flexible machine.

Do you have all the facts on the SDS 9300? A brochure awaits your inquiry.

SDS 9300 — $177,500 with 8,192 words of memory, Control Console, 6-bit Time Multiplexed Communication Channel, and Input/Output Typewriter.

Basic core memory of 4,096 words, expandable to 32,768 words, all directly addressable. One standard and as many optional buffered input/output channels as needed, all of which can operate simultaneously with computation.

Memory cycle time: 1.75 μsec

Execution times, including all accesses and indexing:

Fixed Point (24 bits plus a parity bit)

| | |
|---|---|
| 1.75 μsec | Add |
| 3.5 μsec | Double Precision Add |
| 7.0 μsec | Multiply |
| 5.25 μsec | Shift (24 positions) |

Floating Point
(39-bit fraction, 9-bit exponent)

| | |
|---|---|
| 14.0 μsec | Add |
| 12.25 μsec | Multiply |

**SDS** SCIENTIFIC DATA SYSTEMS 1649 Seventeenth Street, Santa Monica, Calif.

Sales offices in New York, Boston, Washington, Philadelphia, Pittsburgh, Huntsville, Orlando, Chicago, Houston, Albuquerque, San Francisco. Foreign representatives: Instronics, Ltd., Stittsville, Ontario; CECIS, Paris; F. Kanematsu, Tokyo; RACAL, Sydney.

CIRCLE 16 ON READER CARD

## RTISERS' INDEX







# BUSINESS & SCIENCE

SPECTRA 70 ANNOUNCEMENT
REACTION RANGES 360 DEGREES

Reaction to the Spectra 70 ranged about 360 degrees . . . from "Me Tooism" to "Greatest shot in the arm for the industry yet."

The latter pronouncement came from an old pro who feels that, for the first time in 10 years, we have a standard. He admires RCA for accepting the 360 as a standard, thinks the other manufacturers will have to follow suit. Another agreed: "This makes the 360 the industry de facto standard."

The general reaction was that this was a price, rather than technological, break. "About time," grumbled one user, "computers are overpriced." Several thought the announcement would force IBM to lower prices, though these will probably come in the way of increased speeds at the same price.

The compatibility of the 70 with the 360 raised more questions than it lifted hearts, though several liked the idea a lot. But most want to wait and see just how compatible the two are. Another noted that RCA was achieving compatibility at too low a level. He doubts that there will be much machine-language coding for either the 360 or 70, and notes the significance of RCA's copying only the unprivileged 360 instructions: it means that the operating systems, which use privileged instructions, may be quite different. But for true compatibility, the links between application programs and operating systems must be identical.

Some noted a weakness in the lower end of the line (70/15 and 70/25), with their "rather limited" instruction sets. One user wants to see RCA come out with something below the 45 in power and price as an option to 360/40's he now plans to install. The gap between the 15,25 . . . 45,55 suggests he may get his wish.

In general, the industry is waiting to see if RCA can deliver the software . . . and to see just how well the 70 can gobble up 360 programs.

GE CRACKS IBM-DOMINATED
AEROSPACE INDUSTRY

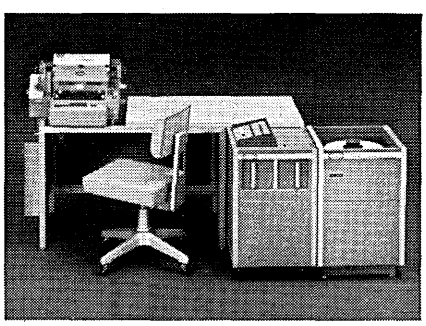
GE has a foot in the aerospace computer market with an order for a 625 at Northrop Corp., where it will replace a 7090. Eventually, in a move toward time-sharing and multiple vendors, Northrop will install twin 635's, wiping out some 20 processors at various divisions & depts. Thus the order may represent a very fat foot in the door for GE, which has already taken away prestige IBM accounts at Bell Labs and Project MAC.

ALWAC STORY ENDS
ON BITTER NOTE

A belated, sorry postscript to the ALWAC story came out of New York last month, where a Federal judge awarded over $200K to the Federal Reserve Board as the result of the non-delivery of an ALWAC 800.


*Continued on page 19*


## Computer player



The disc fits in the economical new FRIDEN 6018 Magnetic Disc File.

It's a random access memory unit designed to work with our low cost FRIDEN 6010 Electronic Computer.

The combination gives you the least expensive, and the only small scale computer system offering the speed and versatility of magnetic random access disc storage.

In milliseconds, it will retrieve data for invoicing, cost accounting, payroll—as many operations as you can store in 122,880 alphanumeric characters.

Total cost of computer and disc file (with discs and programming) comes to under $30,000.

We offer sales and service throughout the world. Just call your nearest Friden office. Or write to Friden, Inc., San Leandro, California.

Friden*

*A TRADEMARK OF FRIDEN, INC., A SUBSIDIARY OF THE SINGER COMPANY

CIRCLE 17 ON READER CARD



# "...I lik

# but

I felt
more and more
I was just repeating myself.
Not really learning much.
Not being pushed,
you know?

There was plenty to do.
I was busy.
It's just — I don't know —
it's like that old line
about a specialist
being someone
who knows more and more
about less and less.
That was me.
That was our whole group . . .

Everything was an emergency,
no one seemed to know
what was important —
they were too busy with
"emergencies."

*Interested Programmers and Eng*
*their resume, in confidence, to M*

151 NEEDHAM ST., I
NEWTON HIGHLANDS, MASS

Opportunities exist at other Honeywell Divisions. Ser

*Continued from page 17*

Defendant in the suit was the Wegematic Corp., which is the name of the corporate shell after the sale in 1958 of ALWAC Corp. to El-tronics. In Sept. '56, Logistics Research Inc. (later named ALWAC Corp.), signed a contract with the Federal Reserve Board to deliver an ALWAC 800 on or before July 1, '57 for some $250K. Thinking (negatively) ahead, the FRB included penalty clauses of $100/day for every day the system was late; and payment of the difference in costs between the 800 and whatever machine the FRB bought in case the 800 never arrived.

In October, '57, ALWAC – after sinking over $1½-million in the project – gave up. The FRB then acquired a 650 for around $450,000 . . . and proceeded to instigate legal action. In addition to the two kinds of penalty, the FRB asked for money spent programming the 800. Last month the decision, for $237,836, was handed down.

P.P.S. – Another 800 order, obtained from the Weather Bureau, also had been cancelled, but settled out of court for $2500. The unfinished 800 was shipped to Stockholm, where 20,000 man-hours were spent unsuccessfully trying to complete it.

## NEW USER MARKET FOR OEM PRODUCTS?

Data Products Corporation is moving into what it hopes will be a "mass custom" market for its OEM products. First of what may be a whole line is the 4620 printer. The last three numbers are no accident: the printer hooks up to a 1620 with the aid of a black box. Two 360 and 600 lpm models sell for $31K and $35K respectively, with lease prices ranging from $775-900/month. There's a 10% educational discount. DPC is dickering with RCA Service Co. to handle service, is looking at the 160 and a couple of other machines to hook new printers to.

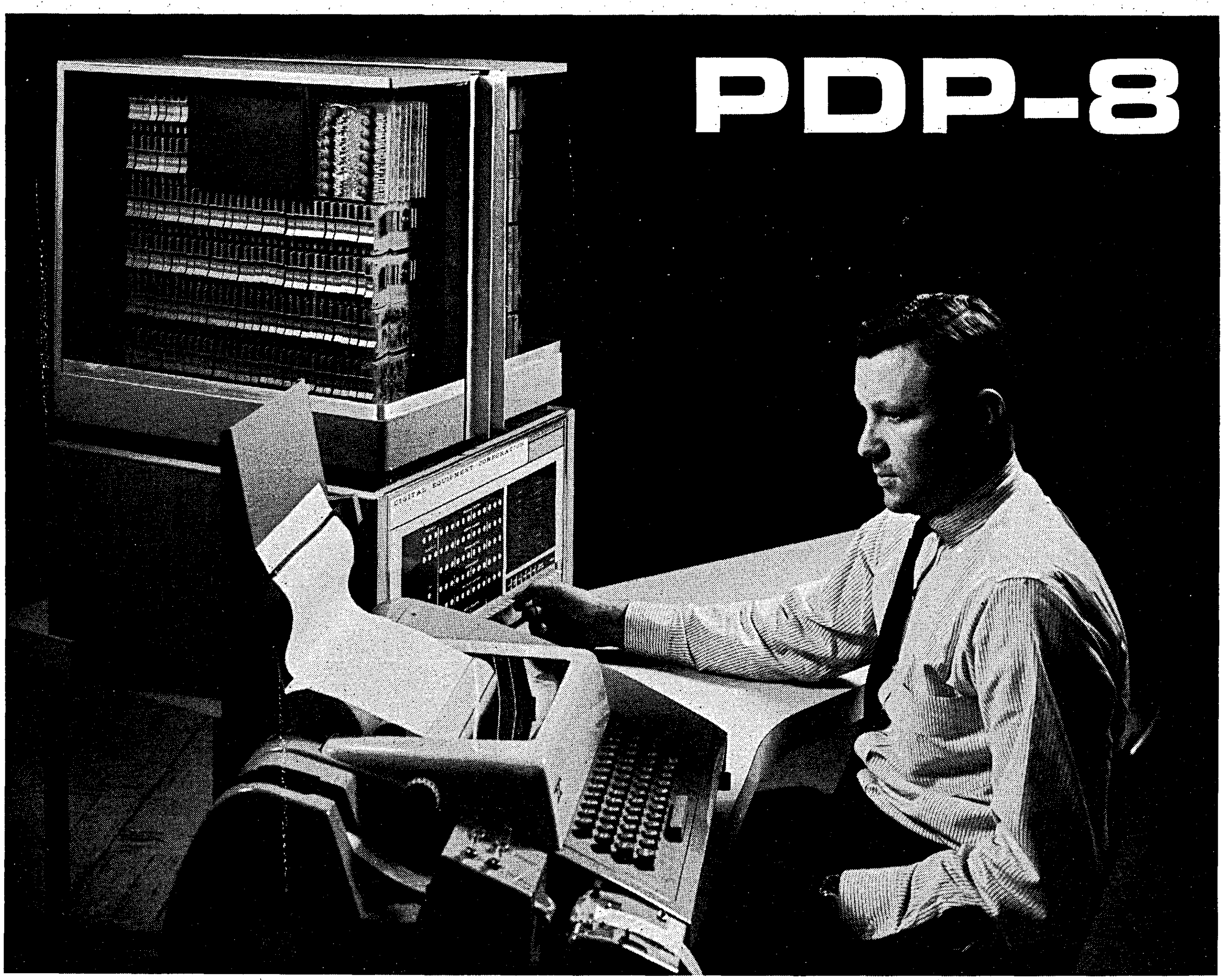
## IT'S $64-QUESTION TIME FOR COBOL COMMITTEE

NPL, lurking in the wings, has already cast its shadow on the stage, and the hook may be ready for COBOL, which has yet to achieve star status. ASA's X.3 is set to ask the X3.4 Programming Languages committee some pointed questions. Like "What are your objectives, and what is your timetable for achieving them? What is the current status of your work on COBOL? What are your plans for this language? And what do you intend to do about NPL?" It's no secret that standards insiders are dissatisfied with the progress of X3.4; they feel it lags considerably behind other groups, which have been busy turning out standards. And they feel that NPL, although far from finalized, is now a candidate for standardization. ECMA (European Computer Manufacturers Assoc.) has already formed a technical committee to study NPL.

## CONTROL DATA PRIMES PUMP IN JAPAN

C. Itoh Electronic Computing Service Co., Ltd. – Japanese distributor of Control Data gear – has ordered a pair of 3200's for delivery this year. One will go to Osaka in June (where it will replace a domestic machine), the other to Tokyo in October. The systems will be used for time sales, demonstration and for internal applications by parent company, C. Itoh, import-export house. Before the year is out, CIECSCO plans to order a 98K-core 3600 which may replace the G-20 now in use. Although Itoh has made no CDC sales yet, it has received a "substantial" number of inquiries about the 32, 36 and 6600's, and expects to close some orders this year.

*Continued on Page 87*




# THE $18,000 DIGITAL COMPUTER

**Central Processor** — registers, information handling elements and operator console in table-top cabinet or rack-mounted

**Integrated All-Silicon Circuits** — from Digital's popular new FLIP CHIP™ Module line

**1.6 μsec Cycle Time** — gives the PDP-8 an add time of 3.2 μsec for a maximum computation rate of 314,000 additions per second

**Fast Throughput** — with an input-output transfer rate of 625,000 words or 7½ million bits per second

**4096-Word Random Access Core Memory** — expandable to 32,768 words

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CIRCLE 18 ON READER CARD

# WASHINGTON REPORT

## UNIVAC SPECTACULAR DRAWS MIXED REVIEWS

A computer system with specs resembling something thought up by Cecil B. DeMille – as many as 25 processors, scores of I/O and memory attachments, a hundred-megacycle instruction rate, capable of 50 to 100 million instruction executions a second – was described, though not identified by name, in a paper presented by two Univac engineers at a recent symposium in Washington. Unfortunately, some hep observers put two and two together, and there are now some sadder but wiser souls at Univac-St. Paul.

It seems the sneak preview of a coming extravaganza was neither appreciated nor cleared by the U.S. Army, which was trying to maintain in a highly classified state development details of the mammoth computer system to be used in conjunction with the Nike-X anti-missile missile, a task undertaken by Univac under contract to Bell Telephone Labs.

Without breaching security, it can be reported the new system is a true multi-processor but without a master processing unit. All system units function asynchronously, both internally and externally, and as many programs can be handled simultaneously as there are processors. A full-boat system is described variously as stretching LARC's capability by 100, of being capable of producing in one hour calculations equivalent to 33 1107's in one month, or of making feasible the concept of a giant EDP power plant on tap as a public utility.

## TWELVE CITIES CONSIDERED FOR DP TRAINING PROGRAM

The Labor Dept., with one successful dp training program in Washington, D.C., under its belt, has hatched a plan to inaugurate similar programs in 12 other metropolitan areas. It awarded a $77,850 contract to the Institute of Computer Technology, Silver Spring, Md., for a survey of dp technician needs in a dozen large urban communities (yet to be designated) and for assistance in the development of training program content. The institute is a non-profit offshoot of Datatrol, Inc., recent acquisition of Control Data, and staffed largely with Datatrol people.

The firm recently concluded a highly successful dp training program for the Labor Dept., in which 34 unemployed students were sufficiently initiated in eight months' time into the arcane of computers to secure jobs as junior programmers and machine operators.

What headway dp training makes in the hinterland will depend largely on the financial backing that state and local governments grant it, for, after June 30, funds for such projects will be provided by the federal government only on a two-for-one matching basis. And, despite the hue and cry raised about obsolescent job skills and the need for retraining, only three states thus far have put their money where their mouth is, so far as computers are concerned.

*Continued on page 95*

# 4 WAYS TO IMPROVE MAGNETIC TAPE

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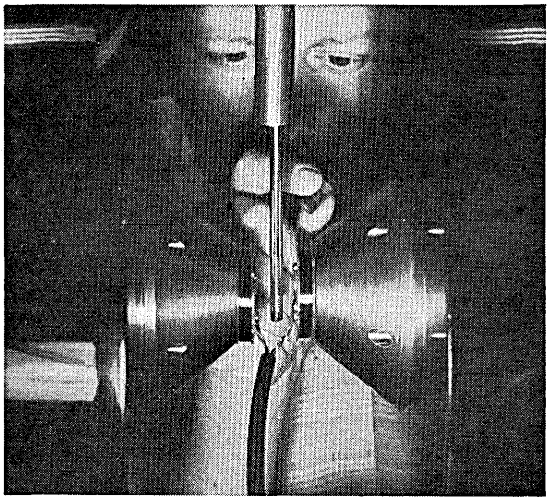

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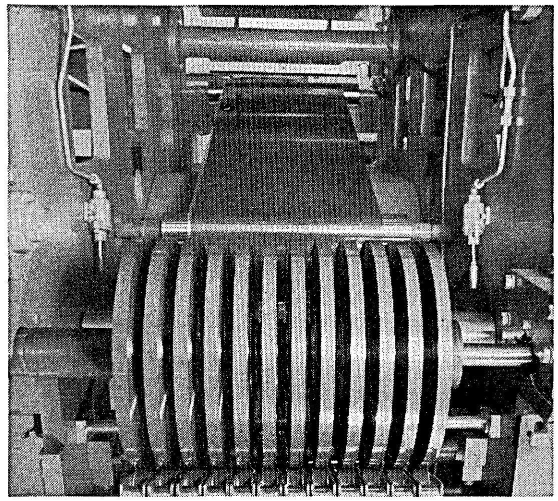

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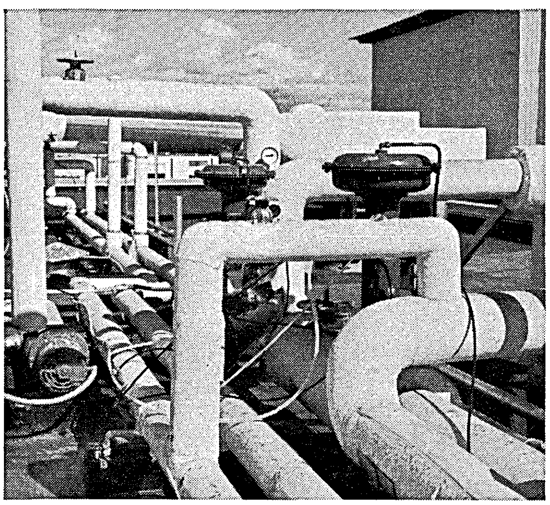

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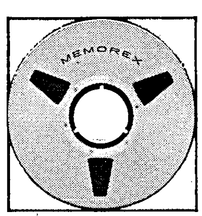

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**MEMOREX**

PRECISION MAGNETIC TAPE

CIRCLE 19 ON READER CARD

# EDITOR'S READOUT

## THAT WAS THE YEAR THAT WAS

Written as the old year sinks slowly into the west, this message will reach you with the new year already at your throats. It nevertheless seems fitting that we take a moment to look over our shoulder at 1964, and to ponder its significance.

What was supposed to be the year of the Tiger roared loud enough to warrant that title by the judges in this corner. According to Charles Adams & Associates, 45 new machines were introduced in '64.

The biggest announcement had to be the 360 . . . partly because it came from the company which dominates the industry, partly because it opened the Pandora's box of reprogramming ills. Thus IBM had to face the problem which had helped them keep their competition at bay for many years.

Honeywell anticipated the problem, and offered to "Liberate" 1401 users with a program to convert their programs to the 200. The offer was not ignored. IBM's own solution to the reprogramming problem is the "emulator"—using stored logic to liberate its own customers into the wide wide world of the 360.

Hoping to fence off some of these lush pastures for itself, RCA followed the 360 announcement by eight months, claiming 360 compatibility and offering some integrated circuitry at an initial price break. (See p. 17 for further discussion of the implications of the Spectra 70 announcement).

A lot of hot air was stirred by the issuance of the first copyright for a computer program, and one software firm was thus encouraged to announce a FORTRAN IV compiler for the 7000 series. But nobody knows yet how effective the copyright can be in protecting proprietary programs. We may find out in '65 or '66.

The biggest software news of the year, though, was the New Programming Language (out of SHARE and IBM), an attempt to offer both scientific and business programming features. Paened and panned, the language received a tremendous boost when RCA went the IBM route . . . seems destined to become a standard fixture on the information processing scene. But there's a tremendous investment in COBOL, which isn't dead yet.

Time-sharing continued to spread—like a warm air front or a tornado—depending on your point of view. IBM, cut off from the nation's leading T-S research project, announced its own time-sharing data center. Another big user—Bell Labs—went the same GE route as Project MAC, and more may follow.

The federal government worried fitfully about computers . . . and converted over $200-million worth to purchase. But the Brooks Bill—an attempt to centralize computer acquisition and management authority in the GSA—got lost in LBJ's last-minute drive for the Great Society . . . and Reelection. So did the Multer Bill, a bold attempt to handcuff banking's even bolder invasion of the service bureau business. The Clewlow Committee report was also waylaid.

It was quite a year. Next month we'll have a sneak preview of '65. In the meantime, batten the hatches, grab your hat, and hang on. It looks like another Lively One.

# A HISTORY OF AUTOMATED

by Dr. RUTH M. DAVIS

Man's compulsion to communicate is realized through the display of ideas, facts and feelings by means of sound, pictures, signals and symbology.

More and more has man come to rely on the display of information in his pursuit of progress . . . in war, space exploration, air travel, medicine, and education.

Traditionally one associates either visual or sound displays as the most useful means of communication of ideas, facts or emotions. This in effect delegates to a secondary role the other senses of touch, smell or taste as means of display. Reflection upon this development reveals that visual and acoustic displays based upon the senses of sight and hearing lend themselves more readily to reproduction and dissemination than do displays based upon the other senses. Further, it is most interesting to note that sounds, smells and tactile motions are quite conveniently and commonly simulated or represented by visual displays where the converse is not true. Hence, the emphasis in the remainder of this paper will be upon the history and improvement of visual displays.

Of the two primary means of display, that of vocal presentation is the one requiring merely the presence of man himself. As such, it can be considered as the basic or primitive display method. Its usefulness is dependent, unfortunately, on a standardization or common definition of the sound patterns generated among the participants of a vocal discussion. In contradistinction, visual displays—although requiring the presence of a display media such as the wall of a cave along with a scratching tool or a piece of paper accompanied by a marking device—can be much more effective than vocal displays, especially if the visual display is a representation of the information which is being conveyed. A picture of a lion attacking a cow can be an effective warning device to a person not understanding the sounds being uttered by the person conveying the information.

The measure of effectiveness of pictures versus words displayed either vocally or in writing was qualitatively introduced by that individual who first proclaimed that "a

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# DISPLAYS

picture is worth a thousand words." He, in effect, was attesting to the universality of pictures as a display device. The communication of facts or ideas many times, however, does not lend itself to pictorial representation. Plato's presentation of his philosophy or Einstein's presentation of his theory of relativity appears to demand a symbology other than pictures and other than vocal utterances of man. Imagine, for example, the difficulty of conveying the mathematical theory of relativity to a group of individuals without the use of a written medium; or similarly, the more commonly stated example of describing a spiral staircase without benefit of pictures.

It is small wonder, on the one hand, that improvement of display techniques and media has gone hand-in-hand with man's progress in every field of human endeavor. On the other hand, it is incredible to realize when one surveys the history of displays how disorganized, how spasmodic, even how serendipitiously has been the improvement of displays. The development of automated displays is worth considering as a case in point. It is only natural that automation, encompassing as it does most devices that reduce the amount of human effort necessary to do work, should also impact upon the display field; and, especially in those applications where automation has produced better information gathering, information processing and information retrieval devices.

Automation as a word was coined about 1935 by Delmar S. Harder, an employee of General Motors, although it was not widely publicized until more than a decade later.[1] A definition of automated displays is presently difficult to agree upon, even by specialists. The purpose of this review will be served well enough, however, if one accepts the simple definition that "an automated display is one either controlled and/or at least partially generated by an electronic computing device."

It is worth clarification at this point to note that under the above definition of automated displays their generation can be accomplished either by analog or by digital computers. Since the purpose of the author is to highlight the significant events in the history of automated displays, their means of generation will be of secondary importance. It will be acknowledged with candor, however, that due to the author's personal background, those computers discussed will be primarily digital.

## 'display' in 1822

Even though the calculating engine designed by Charles Babbage falls outside the allowable historical period of this article, it is worth discussing at this point for historical completeness, a bit about the mechanism for displaying results on Babbage's calculator of 1822. First of all, only numerical symbols were manipulated and produced. The calculating section of the computer consisted primarily of levers, wheels and rollers. The calculated numerical results were expressed in terms of wheel positions.

On the axle of each of the wheels which express the

[1] O'Brien, R., "Machines", Life Sciences Library, Time Inc.; N. Y.; 1964.

> calculated number [of the answer] . . . there is a . . . solid piece of metal [whose] . . . curved surface acts against the arm of a lever so as to raise that arm . . . to 10 different elevations . . . The opposite arm of the lever . . . puts in motion a solid arch . . . which carries 10 punches: each punch bearing on its face a raised character of a figure 1, 2, 3 . . . 9, 0 . . . This type sector [as it is called] will receive 10 different attitudes corresponding to the 10 figures . . . At a point over which the type sector is thus moved . . . is placed a frame in which is fixed a plate of copper. [A bent lever is then forcibly pressed upon the punch and] drives it against the force of the copper beneath and thus causes a sunken impression of the character upon the punch to be left upon the copper. If the copper be now shifted slightly . . . and the type sector be also shifted so as to bring another punch under the bent lever another character may be engraved upon the copper . . . The engraved plate of copper obtained in the manner above described is designed to be used as a mould from which a stereotyped plate may be cast.[2]

So it was that the first automatic calculator displayed its results on an on-line medium permitting an indefinite number of hard copies to be reproduced.

In 1946, just 124 years later, the numerical output of ENIAC was punched on cards and then reproduced as hard copy off-line by an IBM printer. During the period, 1946-1952, those computers either commercially available or individually designed for government use had as their most advanced primary output display devices teletype printers and electric typewriters, both serial-by-character devices. Gang printers were just developed which attained printing speeds of 100-200 characters a second. Such printing devices were, of course, intended by their designers to produce only textual and tabular information.

Ingenious programmers, however, even in this beginning period of computer usage, were already manipulating the inputs to these prosaic devices to produce graphical and even pictorial displays. Tedious and detailed programming permitted the alphanumeric or numeric output of the computer to be formatted on the printed page to produce geographical contours, nuclear density distributions, Christmas card designs and the like. The author, herself, during this period generated the common version of the famous Lincoln profile on an ordinary computer printer output simply using alphabetic characters for both facial outline and as fill to produce the mouth, eyes, hair and the like.

If historical reminiscing serves any purpose then, events during this period would seem to indicate that (1) automated output display devices were primarily suited for producing the numerical results of scientific calculations where such calculation was indeed the motivation for initial computer design, and that (2) dissatisfaction with such limitations on display devices was already evident and was being expressed through inventive programming techniques for bypassing display equipment limitations. Engineers were already tinkering with digital-to-analog converters to drive mechanical curve tracers from the computer in an on-line mode, and faster means of on-line printing were under investigation using photographic and cathode ray tube recording techniques.[3,4]

Perhaps the first interesting application of a cathode ray tube as a computer-operated display device was that associated with the ORDVAC at the Aberdeen Proving Ground, where it began operation in 1952. In this instance a CRT installed at the operator's console (also the programmer's console) maintained a continuous 1024-spot display, where each spot was associated with a storage memory location. When a particular memory location was accessed, the spot on the CRT associated with that location was illuminated. As a result, a programmer could sit and watch the execution of his program through the memory accessions performed. As an auxiliary aid to this visual display a computer monitoring receiver was connected through which frequency variation provided the programmer with a "sound picture" of the computer's action. The CRT with its sound accompaniment, served as an excellent display for debugging purposes since it immediately indicated when a program was in an improper loop through the continued successive illumination of the same set of spots, or the indication of the address at which the program "hung-up" through the maintained illumination of the last accessed memory location. The primary limitation on its continued usefulness was its dependency on relatively slow memory access so as to permit discernible changes in spot illumination on the CRT. It should be viewed, nevertheless, as a proper ancestor of the currrent generation of on-line aids to programmers commonly referred to under the aegis of on-line processing or time-shared compuer systems.

### the seven-year lag

Looking back now from the vantage point of 18 years of experience, it is easy to point out that display automation has consistently lagged behind computer automation. To be more precise, a "good" automated display of calculated results has not normally been achieved for from two to seven years after the successful automation of the processing in question. During the entirety of the first period of automated calculation (1946-1952), it was evident that graphical display of results of the scientific problems being tackled—primarily trajectory calculations, equations of nuclear physics, hydrodynamic problems and the like—would be of immense value. The programming of alphanumeric printing devices to achieve such graphical displays—although ingenious—could only be considered an interim solution.

Hence it was a milestone of tremendous import when the first cathode ray tube was linked to a computer so that its display generation circuitry could be controlled by computer programming, thus permitting the results of any calculation to be graphically portrayed. As is often the case in a rapidly developing technology, the same advance is made almost simultaneously by several groups. However, it appears that the first computer-driven CRT display was employed in 1951 at MIT. Two 16-inch scopes, one with visible screen and one feeding into a computer-controlled Fairchild camera, were utilized as part of the output equipment of the Whirlwind I computer.

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[2]Morrison, P. and Morrision, E., "Charles Babbage and his Calculating Engines: Selected Writings by Charles Babbage and Others" pp 199-202, Dover Publications, Inc., 1961.

[3]Fuller, H. W., "The Numeroscope," Annals of the Computation Laboratory of Harvard University, Vol. XVI, pp 238-247 (1948).

[4]Mansberg, H. P., "A New, Versatile Camera for the Cathode Ray Oscillograph", Oscillographer, Vol. 10, No. 4 pp 6-7 (Oct.-Dec., 1948).

The now rather famous group of engineers and programmers associated with this system tried many applications. Two are indicative and serve as interesting examples. The first is the "bouncing ball" problem, where the computer is programmed to solve the equation of motion of a ball started into motion at a given point with a given impetus and forced to impact on a given surface (e.g., a sidewalk). As the points along the ball's path are computed, they are transmitted to the display generator and the path of the ball is traced on the face of the cathode ray tube. The resultant display provides a graphic presentation of the calculated results and serves as an excellent check of the correctness of the program, for it is very obvious that a program error will be immediately evident through the generation of an improper path. The author used the particular "bouncing ball" problem in one of the first courses in advanced computer programming taught at the Univ. of Maryland in 1955 for the simple reason that a student error was immediately obvious and made the grading of that particular project extremely simple.

In the 1955 course, an electromechanical plotter was used (rather than a cathode ray tube), which serves to illustrate the diversity in graphical display devices afforded the customer within the short span of three years. It is a consensus of opinion (although not universal since documentation is sparse) that the first application of the CRT display device to a real problem also occurred at MIT in 1952. This problem is that of antenna design, where antenna patterns were generated on the CRT as an aid to checking out the design specifications. During this same period, Univ. of Illinois staff personnel were using the ILLIAC to drive a CRT display for the graphic solution of two-point boundary problems. At both MIT and the Univ. of Illinois, the importance of hard-copies of display results was recognized through the attachment of a camera to record the presentation on the CRT. It is interesting to note that this technique was the forerunner of those employed in many of the currently operating large-scale automated projection display systems.

## dispersal & growth

At this point in the discussion of the development of automated display systems, one must stop to philosophize just a bit. It now appears that 1954 must be considered as a year of decision or a turning point for both computer and automated display technology. From this point in time, a serial chronology of events is no longer possible. The original group of computer and display specialists previously concentrated in four or five centers now began to disperse, forming the nuclei of a continuously expanding set of specialist groups. In addition, and certainly as significant, was the realization and the demand that computers be applied to a much wider variety of tasks than the scientific problems to which their use had thus far been primarily directed.

The forward march in automated display technology fell in line behind that of computer technology. The use of displays was almost instantaneously advocated for the business world, for military commanders, for document storage and retrieval, for air traffic control, for real-time following of events, for map-making, for school room instruction, for medical diagnosis and the like. Schools of "specialists" sprang up in each of these application areas. Engineering designs, breadboard models and display brochures were produced faster than the consumers, the users, and the public could absorb them. The author has been unable to determine either a complete or a non-redundant method of characterizing displays to present their history in a coherent manner during the decade commencing in 1954. To provoke sympathy for this dilemma, the reader is referred to the latest, most comprehensive compendium of displays prepared by the Rome Air Development Command which contains some 900 pages of descriptive material on automated displays.[5]

Certainly one gross subdivision of displays is that of individual consoles and group displays. The individual console is designed for use by one to three individuals at a time while the group display is a large screen display intended for viewing and use by a minimum of four people at a given time.[6] Individual displays have been most successful, probably because of their correlation with the individual decision mode as opposed to the group decision mode, which is less understood and successfully applied.

The first individual display was, of course, the pioneering CRT at MIT in 1951. The first group display was that incorporated in the SAGE Air Defense System for which design was initiated in 1954. The number of individual displays now available is rampant.[5] They include cathode ray tube displays, charactron displays,[7] television consoles, film display devices under computer control, meters, electronic plotters, character display devices and printers. Group displays have not proliferated as rapidly as have individual displays due primarily to their cost, their more lengthy design and development cycle, and the complexities of their usage. Those now installed or under programmed development number less than 10. They include those of Stromberg-Carlson (now General Dynamics Corp.), Fensky, Frederick and Mills, Bunker-Ramo, ITT, Hughes A/C, Inc., Philco Corp., Aeronutronic Inc. (the latter two being divisions of Ford Motor Co.), NCR and Burroughs. Their users are all military commands and agencies and the experiences of the users thus far have not generally been happy.

## applications

The users of automated displays can perhaps be characterized in the following manner:

- Real-time following of events.
  Examples: process control, air-traffic control and system monitoring.
- Historical summary of events.
  Examples: graphs of events versus time, or a chronological tabular listing of items.
- Generation of specialized aids.
  Examples: maps generated from aerial photographs, and cloud pattern charts.
- Geographical displays.
  Examples: displays of enemy target locations or of population densities.
- Problem-solution aids.
  Examples: equation solution graphs a la Culler-Fried[8]

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[5]RADC, "Compendium of Visual Displays", Rome Air Development Center, AFSC, Griffiss AFB, N. Y., March 1964.

[6]Davis, Ruth M., "The Information Display Field as it Exists Today", Information Display Vol. 1, No. 1., October 1964.

[7]Darne Frances R., "Cathode Ray Tubes" Electronic Information Display Systems, Spartan Books, Inc., Washington, D. C.; 1963.

[8]Culler, G. J., Fried, B. D. Huff, R. W., Schrieffer, J. R., "The Use of On-Line Computing in the Solution of Scientific Problems," R. W. Research Labs, TRW, Inc., April 1962.

antenna pattern generations, and sketch pad techniques.[9]

- Program-debugging aids.
  Examples: Project MAC type output[10] or computer-generated flow charts.

Examining these applications brings out certain significant features of automated display. The first automated displays simply presented computer outputs to the viewer with the display completely under program control and with no user interaction possible. The first use of an automated display which permitted the user to exercise control over the information presented (and also to enter requests and information based on what was presented to him) occurred in the SAGE system. The significance of the introduction into this system of the light gun as a pointing device under the control of the display operator cannot be overemphasized. It was probably the one most important event which made possible the man-computer interaction deemed so essential at the present time. It occurred in 1952 utilizing the Whirlwind computer.

The first computer system with the capability of a true man-computer interaction (in terms of permitting a real dialogue to ensue between user and computer) was one developed by Ramo-Woodridge Corp., commencing around 1958 and informally referred to as "Subsystem I." Since that first system, the need for man-computer dialogue has been universally hailed and it has been again vigorously supported during the last two years. As a final philosophical comment, it is interesting to report that programming languages for display, or display languages as they are occasionally called, are beginning to appear, thus accentuating the rapidly-maturing field of automated displays. The first such language was actually developed for "Subsystem I", and the next several known to the author have just been finalized by MIT/Lincoln Lab personnel and the Datatrol Corp.

## development of geographical display

To conclude, it seems appropriate to pick one of the display applications and to discuss its history. In this instance, geographical displays will be chosen.[11] Geographical contours were first described in the SAGE System by the generation of line segments and geographical locations by dots accompanied by alphanumeric characters. This technique proved feasible only for small geographic areas having relatively straight boundaries, due to the tremendous amount of memory space needed to store the line segment data. As a result, other means were sought for superimposing geographical data on a display under program control.

The first method attempted was to design transparent overlays which could be fitted to the top of the display screen and though which the computer-generated data could be viewed. This was tried and discarded by the Navy in 1957 because (1) the selection of the geographical data set was not under program control, and (2) the problems of parallax between the transparent overplay and the display face were unresolvable. The next technique, also attempted in 1957-58, involved the overhead photographic superimposition of geographical data onto the display face from a roll of film mechanically manipulated under program control. In this case, a digital-to-analog-to-digital converter was attached to the computer and a set of geographical codes was supplied to the operator of the display console. When he inserted a particular code at the display console, several actions occurred. First, the computer generated display data for that particular geographic display; secondly, the display console supplied the geographic code to the digital-to-analog converter which decoded it to select the proper film frame on the roll of film and to project it on the display face simultaneously with the display of the computer generated data.

One disadvantage of this method was that if one wanted to mark on the display face by hand, one blocked out the projection on that part of the screen where the hand was between the projector and the screen. A second problem was that of registration of the projected display accurately on the screen by mechanical means. Parallax, of course, created another problem and the general problem of reliability of electro-mechanical devices was a deterrent factor. This technique, however, is still used in one military display system. Another, more recent, technique (1963-1964) still involves the use of a transportable film mechanism, where the correct film frame is selected under program control as described above. However, instead of an overhead projection of the geographical display onto the display screen, a rear port projection scheme is used.[12] A flying spot scanner performs a raster scan of the computer-selected film transparency. The light which passes through the transparency is amplified by a photomultiplier and is then used to control the intensity of the electron beam as it is writing the display on the CRT face. This latter beam then will be deflected in step with the flying spot scanner beam and a television-like picture will be produced on the display. The two displays—geographic and computer generated—will appear simultaneously superimposed through time-sharing of the tube face between the two types of display. The techniques thus discussed are, of course, utilized either by individual or group displays, using CRT's or charactrons anywhere in the system.

Another technique developed in the 1958-1960 era is that of maintaining geographical data on a set of slides, of superimposing the geographical data slide on one containing computer-generated data and, through optical techniques, presenting a composite display to the user.

This brief history of geographical data display was selected because of its extreme and over-riding importance to the military commander both for real operations and for training operations. It seems fitting, therefore, to conclude with a quote from a book on War Gaming written in 1897,[13] in which the author states that the training needed for large scale exercises "can be easily applied in the lecture-room with maps. . . . Using maps . . will shorten the time consumed by old methods in consulting tables and it will facilitiate the dry study of the exercise which discourages so many." It is probably not presumptuous to suppose that the author, General Verdy du Vernois, would be delighted with our automated displays of today. ■

[9]Sutherland, I. E., "Sketchpad: A Man-Machine Graphical Coumunication System," Lincoln Lab. Tech. Report, No. 296, 30 January 1963.

[10]Biggs, J. M. and Logcher, R. D., "Stress: A Problem-Oriented Language for Structural Engineering" MAC-TR-6, MIT, May 6, 1964.

[11]Davis, Ruth M., "Design and Program Planning for Automated Display Systems", American University Symposium Lecture Series, 1964.

[12]Mitchell, J., "Description of the System Design Laboratory Display Console" MITRE Corp. Tech. Memo. TM-03930/0000/00/0/00, 21 Feb. 1964.

[13]du Vernois, General Verdy, "War Gaming."

# ON-LINE PROGRAMMING

by ALBERT V. SHORTELL JR.

Although computer display consoles utilizing CRT's have received much attention in recent years, such display techniques were utilized from the very earliest days of the digital computer industry. A notable example is the Whirlwind I computer built at MIT in 1948 under the sponsorship of the Office of Naval Research to which display consoles using 16-inch CRT's were added shortly after the computer became operational in late 1950. Within the next three years Whirlwind's display capability was greatly increased with the addition of 25 such display consoles. Whirlwind formed the nucleus of the experimental "Cape Cod" system of air defense which led directly to the development and implementation of the SAGE air defense system. This historic computer, the nucleus of the nation's first "real-time" command and control system, is still operational in its 14th year.*

One modern application of this venerable machine has been directed toward the use of its display facilities to solve the major problem which has faced the computer industry from its infancy—the language barrier between man and computer. Tremendous sums of money have been expended by the industry and government in the development of software and, in particular, sophisticated compilers which attempt to solve the programming problem by moving the man one step further away from the computer. However, comparatively little attention has been given to the possibility of utilizing computer displays and light guns to improve man/machine communication in the solution of the programming problem. The primary reasons that such facilities have not been exploited until now have been the dearth of computers with adequate display capabilities and the cost of computer time. Widespread research efforts into display-aided programming will undoubtedly result from increased availability of lower priced display equipment and the development of time-sharing techniques.

## equipment configuration

The display-aided, on-line programming system described here utilizes the display facilities of the Whirlwind I. Whirlwind, a 16-bit, parallel vacuum tube computer, has, in addition to 6,144 words of core memory, 36,864 words of drum memory, paper tape input/output, card equipment and magnetic tape, a display system which consists of approximately 25 consoles and associated light guns. Displays composed of points, characters and vectors are generated by the use of the appropriate combination of input/output select instructions and record instructions. Light gun activation upon point displays may be programmed to cause the computer to respond by performing certain actions, thus providing a feedback mechanism for man-machine communication. While not utilized extensively in the present system, the display facilities also include display selection switches which enable one or more display lines at each console, permitting "simultaneous" selection of different displays at each console.

Utilizing these display facilities, the on-line, real-time programming system provides a capability for defining the instructions comprising a computer program and displaying the results of executing these instructions. This latter feature is extremely powerful since it permits combining the program definition and debugging phases. It is this feature which is largely responsible for the substantial reductions in programming time which have been indicated using this system.

## programming procedure

The initial model of the on-line, real-time programming system includes only the features essential to demonstrate its feasibility. However, the incorporation of such features as selection of any desired computer operation code, macro instructions, and multiplexed servicing of several programmers is entirely feasible and requires no technological breakthroughs. For example, the Whirlwind I has enough display consoles and adequate storage capacity to serve up to 25 programmers in real-time.

The present model of the system operates only with the Whirlwind I order code and serves one programmer seated at a display console. The nucleus of the system is the display of the order code and functional instructions (Fig. 1, see page 30).

In Fig. 1, the order code is presented in the two columns in the upper left hand corner, while the eight octal digits (1, 2, 3, 4, 5, 6, 7, 0) and functional instructions (LOC, ACC, CON, DATA, DISP and END) are displayed in the upper right hand corner. Displayed in the lower right hand corner are the last 10 instructions and/or data words entered into the system and the storage locations at which they have been entered. Also displayed in the case of computer instructions is the contents of the accumulator after its execution and, for the last instruction, the contents of the B-register (right hand extension of the accumulator) after execution. The program writing process

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* Moved from MIT in 1960, Whirlwind I is now at the firm's headquarters, under a lease contract with the ONR.

involves the selection, by means of the light gun, of the appropriate sequence of instructions and data words. The system displays each instruction as it is coded and, in addition, displays the contents of the accumulator and B-register resulting from the execution of all instructions with the exception of input/output and transfer instructions.

In order to enter an instruction, the point displayed to the right of the desired operation code is initiated with the light gun. Following this, the address portion of the instruction is entered by initiating four octal digits in sequence from the octal-digit display in the upper right hand portion of the scope. The operation code and each octal digit are displayed as they are entered. If an error occurs in selecting the wrong operation code, this can be corrected by activating the proper operation code, provided that the last octal digit of the address has not been entered. If all digits of the address have been entered prior to discovery of the error, correction can be made by resetting the location counter as described below. As each new instruction is entered, the previously coded instructions are shifted up one line and a maximum of the last 10 instructions and/or data words coded are displayed.

Normally, the location counter is set to $40_8$ at the beginning of any routine due to a Whirlwind programming convention. As each instruction or data word is entered, the location counter is incremented by one. To reset the location counter to a different address at any time, the point to the right of the "LOC" function code display is activated, and then the four octal digits of the desired address are entered in the same manner as for an instruction address.

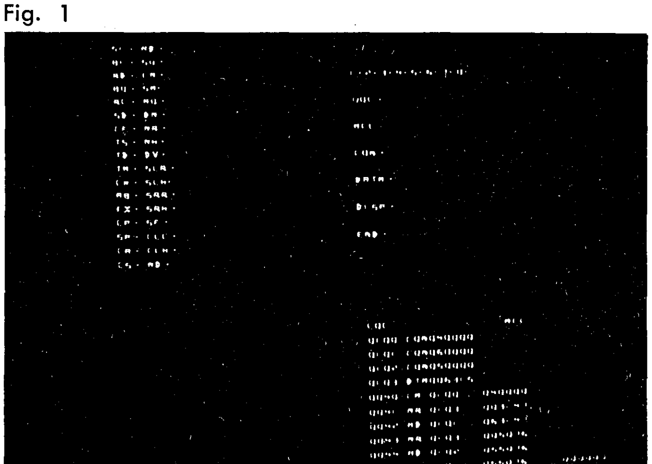
To enter a constant or a data word, light gun action is taken upon the "CON" or "DATA" functional instructions; respectively. The six octal digits (sign and five magnitude digits) comprising the constant or data word are then entered in the same manner as for an instruction address.

Provision is included for changing the contents of the accumulator by activating upon the "ACC" function code and then entering, by means of the light gun, the six (octal)-digit number to be inserted in the accumulator. An examine feature is also provided which displays the contents of the desired memory cell on the display scope in octal form. This feature is enabled by activating upon the "DISP" function code, followed by light gun activation of the four (octal)-digit address of the desired location.

Displayed in Fig. 1 is a simple example which involves the evaluation of the equation

$y = ax^2 + bx + c$ for $x = 0.1$

Fig. 1



where

$a = 0.5$ (0.40000 octal)
$b = 0.75$ (0.60000 octal)
$c = 0.625$ (0.50000 octal)
$x = 0.1$ (0.06315 octal)

The answer is

$y = 0.705$ (0.55076 octal).

When a programmer has coded his program and is satisfied with the test results displayed during this process, he may obtain a paper tape punch-out of his program by activating with the light gun the "END" function code. Activation of this function causes all previous coding to be written on magnetic tape for off-line punching of paper tape. Core memory locations reserved for program storage are then cleared and the display of previous coding is erased. Present paper tape output has a format which consists of mnemonic instruction codes and octal addresses, and is therefore acceptable for input to the Comprehensive System II Conversion Program, the Whirlwind assembly program. A binary paper tape could be produced at this point as an additional option, but this function has not been implemented in the present model of the programming system.

To operate his program by itself, the programmer instructs the computer operator to start over at location 40. This enables him to cycle his program on the computer and to verify that correct operation has been achieved. If he finds errors in the program as a result of this cycling, he can instruct the operator to return control to the real-time programming system. He then may proceed by means of the light gun to take corrective action. After being completely satisfied with the checkout of the program, he may then produce a Flexowriter-coded (alphanumeric) tape by activating the "END" function code. Alternatively, he may request the computer operator to generate a binary paper tape using an independent utility program.

## results

Use of the on-line, real-time programming system during the past several months has indicated that significant improvements in programmer productivity may be realized. These improvements are due not only to the reduced turnaround time inherent in any on-line system, but also in large part to the concurrent display of the results of executing each instruction as it is coded. This latter feature enables the programmer to debug and correct errors as he codes, and increases productivity by reducing the number of debugging runs. Such improvements in programmer productivity apply only to the coding and debugging phases of the problem and, of course, do not affect the analysis portion of the programming task. Comparisons between programmer productivity rates using this system and conventional programming procedures are heavily dependent on individual ability. However, the opinion of most users is that their own productivity has been increased by at least an order of magnitude.

On the basis of results to date, continued effort in developing a more elaborate on-line, real-time programming system appears to be extremely desirable. Future improvements may include such features as the following:

1. Selection of instruction repertoires for most of the commercially available computers.
2. Extension of instructions to include symbolic and relative addressing.
3. Incorporation of macro instructions for the selected computers.
4. Provision for servicing up to a maximum of 25 programmers on a multiplexed basis.
5. Implementation of problem-oriented languages such as FORTRAN, JOVIAL, and COBOL. ■

displays for command-control

# THE ICONORAMA SYSTEM

by GEORGE W. N. SCHMIDT

The mission of the North American Air Defense Command is to defend the continental United States, Canada and Alaska from enemy air attack. To accomplish this, both the U.S. and Canada contribute the men and materiel which constitute the resources under control of CINCNORAD, who operates this far-flung organization from his headquarters in Colorado Springs, Colo. The central focal point for military operation of this international command is the Combat Operations Center (COC) on Ent Air Force Base in Colorado Springs. To this center funnels the data collected by many sensor sytems.

The sensor systems involved are the surveillance radars of the Distant Early Warning system, Mid-Canada line, and SAGE system as well as the Ballistic Missile Early Warning System with sites in Alaska, Greenland and England. Early in the history of the center (1956-57), it was realized that manual techniques for plotting data from the then existing sensors were adequate for that time but with the advent of supersonic aircraft and ballistic missiles, a requirement existed for reducing the reaction time of the total system.

Radar data is basically formalized; i.e., it consists of range, range rate, azimuth, elevation and time which can be derived from the signal and formatted in a routine manner. This is an application which defines the classic operation for which electronic computers are well suited. With appropriate criterion measures such as flight plans, statistically established thresholds, geographic and time dependent limits, the large quantities of data can be filtered in such a way as to limit the data transmitted to human decision makers to a reasonable level. This collec-

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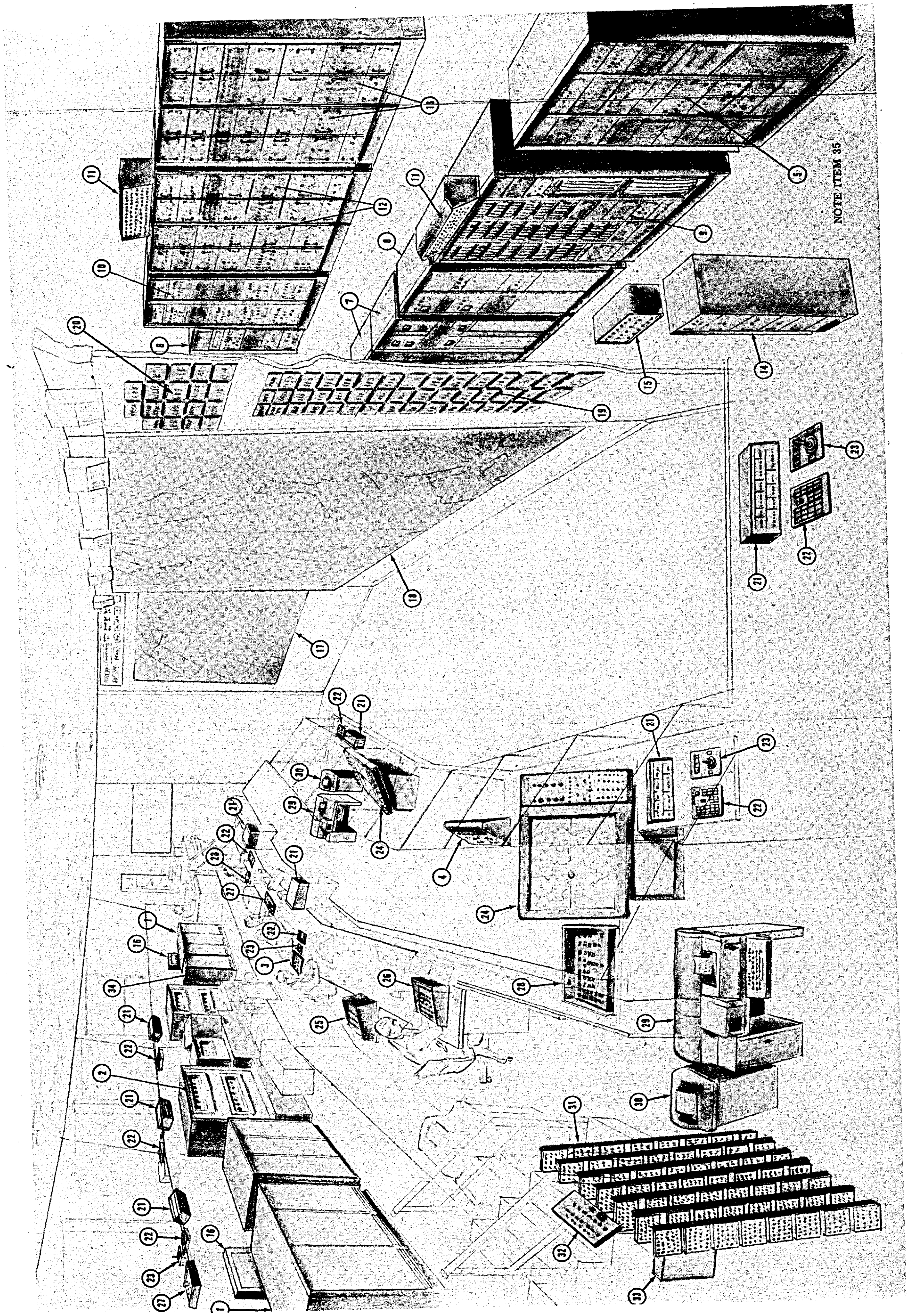

NOTE ITEM 35

## LEGEND FOR NORAD EQUIPMENT LAYOUT

*(at left)*

1. Projector Electronic Cabinets
2. Projector Array
3. C&LC Availability Control Panel
4. Operator's Console
5. Dead Reckoning, E T C & Alert Status Cabinet
6. Symbol Generator Cabinet
7. Power Supply Cabinet
8. Register & Drum Distributor Cabinet
9. Drum & Drum Control Cabinet
10. Sector Memory Cabinet
11. Monitor Panel
12. Reader Control-Decoder Memory, Message Unit, and Category & Limit Control Cabinet
13. Reader Control & Decoder Memory Cabinet
14. Status Board Control Cabinet
15. Alarm Panel
16. Junction Boxes
17. Launch Display Screen
18. Impact and Airbreathing Display Screen
19. Weapon Status Board
20. Alert Status Board
21. Readout Consoles
22. Readout Keyboards
23. Elapsed Time Computer Control Units
24. Tracing Boards
25. Alert Status Keyboard
26. Weapon Status Keyboard
27. Remote Projector Control Console
28. SAC Message Composer Keyboard
29. Message Composer
30. Message Printout
31. Cable Junction Block
32. Readout Console Monitor Panel
33. Powel Panel
34. Elapsed Time Computer Cabinet
35. 24 RT28 Teletype Units (not shown)

tion site filtering also serves to limit the communications facilities support required by limiting the traffic density on the communications lines.

### data presentation considerations

Having progressed to this point, the question of how to best present the data to the user had to be faced. By this time, SAGE centers had had some experience with large board displays as well as consoles. Experience with the large board technique used in SAGE, to be generous, had not resulted in wholehearted acceptance on the part of the user. The large board techniques for command and control systems had reached the concept stage, and experimental hardware was being developed but no operational installation was yet in existence to be evaluated. Into this dismal picture came a relatively new organization, Fenske, Fedrick and Miller, with their ICONORAMA system (FF & M was subsequently bought up by Ling-Temco-Vought, Inc., so that all subsequent references will be to the ICONORAMA system). The basic concept was one of converting the digital data to servo system control signals which would drive a scribe across an opaque coated glass slide. The scribe would remove the coating and the result would be projected upon the large display area. The entire plan appeared feasible, reasonable and economical, so the go-ahead was given.

### teletype data

The data which is displayed is both large-scale geographic and tabular. It reflects that air activity over or approaching the North American Continent, which is of special interest to NORAD. The data transmitted over teletype consists of the following:

1. *Surveillance messages* which contain: classification, i.e., unknown, hostile, friendly, or special; track ID; other actions, i.e., track termination, etc.; GEOREF (geographical reference) coordinates; time; course; number of objects in the group; altitude; speed; weapons committed and kills.
2. NUSUM (nuclear summary) *messages* which contain: NUSUM designator; division designator; time; hostile strength; weapons committed; kills.
3. *Status messages* which update the Defense Weapons Status Board with the current Fighter, BOMARC and ADA units status.

Subsequently, with the activation of BMEWS, an additional ICONORAMA installation has become operational; it displays, in conjunction with the original display, pertinent launch and impact data for missiles.

### aircraft threat messages

Returning to the aircraft threat, messages containing the data are received on standard teletype perforators. The peforated tapes are used to enter the data in the Reader Control Unit where the messages are checked for correct format. Those messages which pass the format checks are passed to the Decoder Memory Unit where the data is converted from serial form for transmission to parallel form for temporary or buffer storage. If a format error is detected, the entire message is printed out on a Message Unit Page Printer for operator review and possible correction. If correctable, the message is manually entered into the Decoder Memory Unit and processed.

The Decoder Selector and Category Availability Unit obtains the classification data and the first character of the GEOREF coordinates from the Decoder Memory Unit. This data determines the configuration of the switching within the Main Matrix and thereby the routing of the data to the Drum Input Register for temporary storage until required on the drum. Message data is also sent to the Category and Limit Control and Sector Memory for entry into the display system.

The drum and drum control circuits perform the following system logic functions: storing all messages; locating previous tracks; selecting and transferring the old GEOREF data to the appropriate Category and Limit Control if an update message is received; updating data in the related Magnetic Drum Location; effectively detecting processable messages and rejecting "none suitable" messages. When an update message on a track comes in, the update is accomplished by only erasing and replacing those segments of the update which have changed.

### iconorama display screen

The ICONORAMA display screen is divided into two sectors to provide two approximately square plotting areas. Each sector has an independent bank of projectors to display the data. The GEOREF data passed to the Category and Limit Control Unit determines the sector in which the data will be plotted—i.e., etched and projected. The data is also converted to analog voltages which are the driving force for the plotting projectors to determine the $x$ and $y$ coordinates displacement.

The Category and Limit Control-generated analog voltages are transmitted to the appropriate Sector Memory Unit. This unit is a transient storage. The voltages are held only long enough to permit the track display signals to be generated and integrate from the old to the new GEOREFS. The unit also sequentially controls the operation of the plotting projectors, if required. The Sector Memory Unit signals are input to the electronic control equipment associated with the plotting projectors. This equipment uses the voltages, controls calibration functions, and provides for automatic switching of the projector lamps in case of lamp failure.

The end results of the plotting projector functions are the dynamic traces representing the flight paths of aircraft of interest under surveillance by the sensors. To identify the track or plot, $x$ and $y$ voltages are provided by a symbol generator to the Sector Memory to place the identifying code symbols beside the tracks. The plotting projectors plot the symbols.

## manual intervention

In addition to the standard real-time processing of track data, it is possible by manual intervention from various positions on the command dais to determine for any track the time to go from its present position to any desired location. This computation is actually a dead reckoning based upon the currently recorded speed of the aircraft and the great circle distance between the present position and the selected location. The data is entered by the operator from his console by means of a keyboard and joystick. The keyboard enters the track designation, and the joystick positions a spot of light upon the display screen at the desired location. As the screen is divided into two sectors, separate spotting projectors are used for each sector. After the spot is positioned, a button on the joystick is used to start the computation and request its display at the console. The solution, in hours and minutes, appears on a counter on the console. The maximum time which can appear as a solution is 10 hours and 59 minutes. Larger elapsed time cause a readout of SATURATED.

There is a possibility that under operational situations, a queuing problem may occur. With eight locations from which elapsed-time computations can be requested, and approximately three seconds per computation, the logic has been set up on a sequential order of arrival basis.

The controls of the elapsed-time computer can be used with the spotting projectors as pointers to call attention of other command party members to items of special interest.

The readout consoles with their associated keyboards are used to furnish additional information relating to tracks displayed on the large screen. In the surveillance area, reference to a plotted track by classification, region track designator, GEOREF, time, course, number of objects, altitude, speed, weapons committed, kills and other actions can be obtained. NUSUM data relating to region, time, number of hostile objects, weapons committed and total kills can be called for. Specific data relative to region fighters, region surface-to-air missiles, and unit status is also available to the operator. Each of the eight consoles operates independently under normal procedures; however, it is possible under any readout console to force an identical readout to appear at any other readout console on a one-at-a-time basis.

## control consoles

There are two control consoles. These consoles permit selection of special background material and the control of categories of information presented. They are located at the Controller and the Director of the COC positions.

Subsequent to the installation of this system for use in support of the air defense operations of NORAD, the Ballistic Missile Early Warning System was developed, assigned to NORAD and became operational. Launch and impact position information are generated by BMEWS. It was felt that this information could be of importance to the decision process. As the installation of ICONORAMA was well along and there was no available space for another large board display, it was decided to superimpose the BMEWS impact data display upon the existing ICONORAMA aircraft threat displays.

## major problems

The major problems met in integrating the BMEWS display with the existing ICONORAMA at that time were the following. The original contract called for no supporting documentation in the form of manuals because the contractor was to furnish the trained maintenance personnel and whatever circuit diagrams they needed to accomplish their work. Effectively, the NORAD system was one of a kind. The BMEWS system furnished impact points and a confidence figure so that an ellipse representing the area wherein the missile might fall with the given confidence could be drawn. This required a new computer to drive the plotting projectors for BMEWS. The optical systems for the BMEWS system had to be aligned and distortions due to parallax compensated for.

Finally, during the initial phases of the system checkout problems arose in the slide change mechanism. In order to meet this problem, the BMEWS projector slide change mechanisms were modified and the display subsystem of BMEWS was made operational in time to meet the operational date of the Thule BMEWS site.

Other problems which have arisen and been solved include the hardness of the opaque emulsion on the glass slides. For some time there were cases where the emulsion was extremely hard and the stylus could not remove the emulsion from the slide. These hard spots would cause discontinuities in tracks, characters and ellipses. Changes in the quality control procedures by the contractors were able to practically eliminate this problem. As styli wore and the point became more blunt, there was a tendency for them to pick up emulsion and broaden the etched lines considerably beyond the limits established in the acceptance tests. Harder and more uniform styli with the improved quality control of the emulsions corrected this problem. A major criticism of the system appears to be that, for the system to be used effectively, the ambient light conditions in the environment require an appreciable night adaptation on the part of people working in the area.

The system has been in operation for over four years. In that time, the Space Detection and Tracking System (SPADATS) has been added to the NORAD inventory. This has created problems as there is data which should be made available to the NORAD staff on large displays. This has been attempted with varying degrees of success dependent upon the orbital parameters of the satellite on display.

Based upon evaluations accomplished under AFSC cognizance in support of military command and control, it was recommended that techniques other than those used in the NORAD ICONORAMA system be used in the Cheyenne Mountain Complex Command Post displays. ■

# GRAPHIC DATA PROCESSING

**system 360 peripheral**

by IRVING ABZUG

During the most recent Fall Joint Computer Conference, IBM introduced graphic data processing equipment which adds to the flexibility of IBM System/360 by making it possible for man and machine to exchange graphic information at electronic speeds. Designed to help engineers, designers and businessmen work directly with graphics—charts, curves, sketches and drawings, the new system allows the user to communicate with a computer in almost the same way he talks with his colleagues. The instantaneous handling of graphic information in a computer-controlled system will reduce the time gap between the birth of an idea and its execution.

The main elements of the system include: a System/360 processor; visual display consoles with electronic "light pen" and vector graphics capability; a 35mm film recorder for output of computer-generated graphic information; and a 35mm film scanner which permits computer-directed "reading" of graphic images recorded on microfilm. The scanner converts these images to digital form for further processing by System/360 (models 30 through 70 with a minimum of 64K core) or for storage in peripheral discs, drums or tapes.

The graphic data processing system offers new capabilities in computer-aided design, development of engineering drawings or preparation of statistical business graphs under computer control. It can be used in a variety of information-handling activities which are basic to business, science and industry. These include:

COMPUTER-AIDED DESIGN, for dynamically solving design problems that are common to industries such as electronics, manufacturing or aerospace; or for modifying existing product drawings already stored on microfilm or within a data processing complex.

GRAPHIC FILE MAINTENANCE, for updating and maintaining microfilm files of blueprints and working drawings, construction plans or public utility distribution network drawings.

GRAPHIC DATA REDUCTION, for conversion of graphically recorded information, such as electrocardiograms, into digital form for computer processing.

GRAPHIC DOCUMENTATION, for recording business statistics represented in graphs and charts on film while making information available for computer processing.

HIGH SPEED RECORDING, for transferring to film, at rates up to 20,000 lines a minute, information stored on magnetic tape.

The units that compose the graphic data processing system are the IBM 2250 display console, the 2280 film recorder, the 2281 film scanner, and the 2282 film recorder /scanner which can perform either function. Each of the units can be used independently.

A variety of programming routines will be available to users of the graphic data processing system. Programming support, under operating System/360, will consist of:

—an IOCS for one or more model 2250 displays;
—problem-oriented routines which provide the 2250 and the film recorder with the facility for defining grids, scaling coordinates, plotting lines and labeling graphs;
—problem-oriented routines to scan film input and to simulate the IBM 1403 printer on film output; and
—an IOCS which enables information to flow between System/360 and the 2280, 2281 and 2282.

## the display

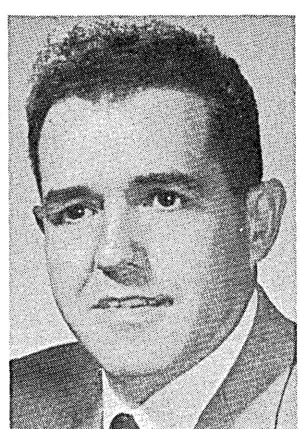
Tables, graphs, engineering drawings, messages and charts can be generated on the display's 21-inch cathode ray tube. Images of this information are generated by a computer program which positions and deflects the CRT's electron beam to any of the 1,024 by 1,024 addressable grid points on the 12-inch-square display area. These images consist of points and line segments; the latter can be of any length or orientation. By proper combination, the display can produce lines, arcs, circles or more complex geometric figures, and an unlimited variety of graphic symbols.

A vector generator permits the display of straight lines of any length and direction between any two addressable points by merely specifying the end points of the desired vector.

The vector display time is variable depending on length, ranging from 16.8 microseconds for short vectors to 100 microseconds for a long vector—a full-screen deflection of 1,023 raster units, or 1,024 points in the X or Y axis on the 12-inch square display area. Identification of a point or a vector requires four eight-bit characters of storage. An alphanumeric character, which requires one eight-bit character of storage, can be displayed in 15 microseconds. The regeneration rate of the displayed image is not fixed and varies with the size of the image.

A character generator permits display of alphanumeric characters in two sizes at any of either 1,715 or 3,848 addressable positions. The fixed standard character set contains 63 characters. The character generator decoding matrix will convert the input character code to a series of vector strokes which form a character.

The 2250 display unit is available in two models. The model 1 has a self-contained control unit, while the model 2 attaches to a separate control unit which can drive up to eight displays. The multiple display control unit—the IBM 2840—contains buffer storage for 8,192 alphanumeric characters of information, a character generator and multiplexing circuitry. The 2840 can be expanded to 16,384 characters. Each buffered character in the 2840 is available at a 2.1 microsecond rate. Up to eight control units can be linked to either a multiplexor or selector channel of System/360. The length of time required to



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## GRAPHIC DATA PROCESSING . . .

display a full buffer's storage depends on the length of the vectors and the amount of the buffer allocated to the particular 2250.

When using multiple displays, the buffer storage featue provides the display unit with a local buffer which can store images for regeneration purposes. The use of a buffer allows the display unit to operate concurrently with the computer system, freeing the main storage for other purposes. Data is transferred between the buffer and central processor unit under program control. The portion of buffer storage to be used for any attached display unit is program assignable and can be varied under program control. Each display unit can be independently operated. When using multiple displays, it is possible to generate different images simultaneously on each display.

Since an image is transferred only once from main memory to the buffer, there are savings in storage cycles and channel time. The buffer also is used to enter messages from the alphanumeric keyboard.

Three manual input devices are available with the display—the alphanumeric keyboard, a program function keyboard and a light pen. They provide dynamic interaction between a user and the computer-controlled graphic data processing system.

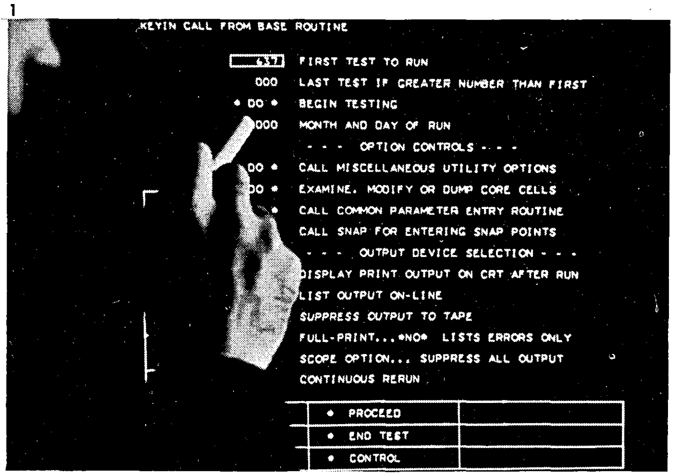
The alphanumeric keyboard can be used for editing or composing messages to be generated by the display. As the message is composed, it is displayed for verification and then is transferred on demand to the computer's main memory. A symbol called a "cursor" appears on the screen to identify the location at which the next character of information from the keyboard will be displayed.

The program function keyboard contains 32 keys, 32 indicator lights and interchangeable plastic overlays. Each key's function is program-defined and is identified by a coded overlay which fits directly over the keyboard. Eight overlay code-sensing switches enable the program to determine the function called for by the overlay. A subroutine associated with the overlay code and the function key selected indicates to the computer what action should be taken on the displayed image on the CRT.

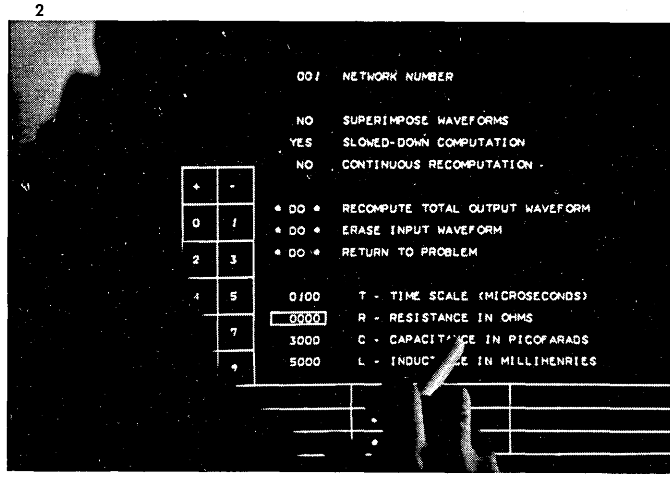
The light pen enables the user to communicate with the computer by merely pointing the device on the display screen. The light-sensitive element in the pen generates a signal when the pen is positioned on a section of the image. The light pen's response is transmitted to the computer which relates the identified section of the image to its equivalent digital representation in memory. The

1. With light pen, engineer indicates sequence of steps to be executed.
2. Displayed then is a subprogram enabling retrieval of electrical circuit from computer.
3. Under computer control, a schematic of circuit on which engineer is working is displayed.
4. Engineer has drawn input wave form at left; values of various circuit elements appear in center. Based on these, computer determines characteristics of the output wave form, displayed at right. To redesign circuit, engineer can change value of its elements by pointing light pen at vector arrows (shown) and computer adjusts values by predetermined increments.

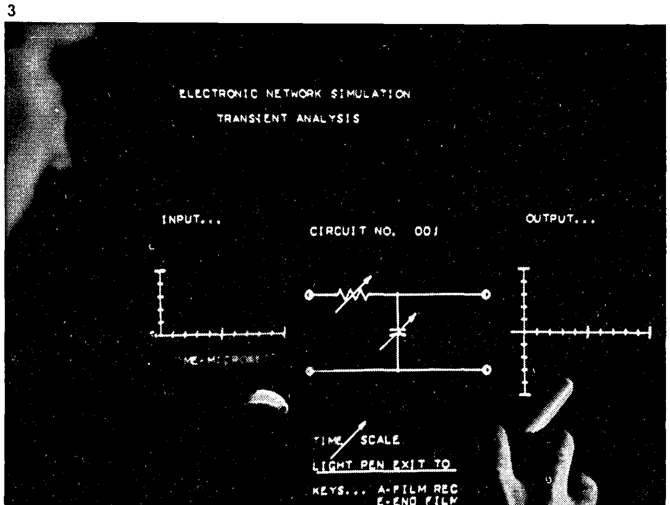
1



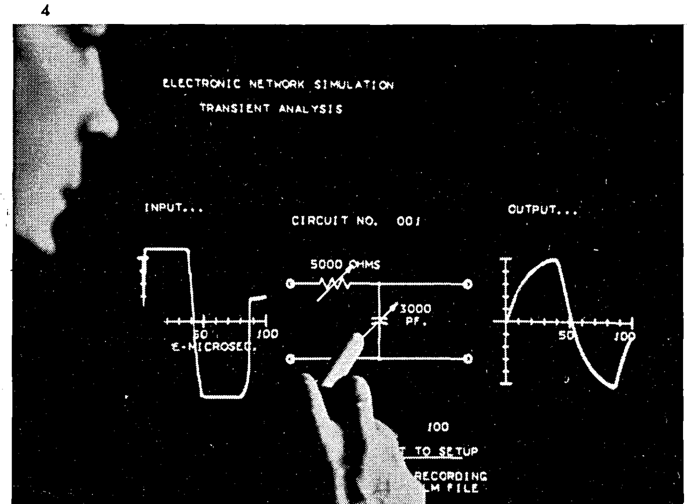

2




3




4



selected portion of the image then can be modified under control of the user's programs stored in the computer.

By appropriate keyboard action and programming, the light pen can be used to create, add, delete or re-arrange displayed data. The light pen or program function keys, or both, can be used to reduce, enlarge, move, rotate, or animate displayed images. Grids can be defined, coordinates scaled, lines plotted and graphs labeled.

## the film recorder

Graphic and alphanumeric information is recorded on unsprocketed 35mm film. Digital and analog circuitry directs the motion of an electron beam across the face of a high precision CRT in the film recorder. The beam's light is projected on to the unexposed, silver-emulsion film used to record images. The exposed film may be developed in the recorder or be moved directly to the take-up cassette for off-line developing. The microfilm reproduction of the image can be viewed on the recorder's rear-projection screen prior to entering the cassette.

The film transport includes film cassettes, electromechanical components which move the film through the recorder and vacuum columns for film buffering. Each cassette can hold a 400-foot reel of film supplied on daylight-loading spools; threading of the film is automatic.

Images to be recorded, including curves and circles, are made up of a series, or combination, of straight lines which are formed within a 4,096-by-4,096 coordinate grid. The computer program provides the X- and Y- coordinate positioning values which control the CRT deflection system. Also associated with each coordinate is a control bit which specifies whether the electron beam should be turned "on" or "off," while the deflection system is sweeping from the starting point to the end point of the line or vector. The time required to generate a line is a function of its length; it varies from 102 to 408 microseconds. The program specifies one of two line densities, normal and light. The latter can be used for grid background and dimension lines. The program also can specify one of two line widths—nominally 0.00075-inch and 0.0018 inch.

The recorder also uses the character generator of the control unit. In this case, the character generator enables alphanumeric characters and graphic symbols to be generated at an average rate of 40,000 a second. The character generator decodes each character and automatically converts it to a series of strokes which form the graphic character.

Three character sizes are available. Spacing between characters is automatic or programmable. Up to 150 lines, each containing up to 204 characters can be recorded within the total 1.2-inch square image. The character generator provides 63 different alphabetic and numeric characters and symbols.

Strokes can be used to produce any type of characters. In this mode, the program provides a series of strokes to form a character. Each stroke occupies one character of storage and is defined by its end points on an 8-by-8-point matrix. Strokes can be recorded at a four-microsecond rate.

After each image is completed, an instruction is issued to advance the film. There are four selectable film-advance distances to accommodate different image formats and applications. The exposed film is moved into a vacuum-column storage loop which can hold up to 32 inches of film. From there, the film is fed to the film processing station for developing, fixing and rinsing. After moving through an air-drying station, the film is immediately available for viewing on the rear-projection screen or for storage in a cassette. The film is processed at the rate of 40 inches per minute.

After the first image has been exposed, it can be processed and projected within 48 seconds. Projected film images are magnified 19 times actual size, thus providing a 22.8-inch-square projection from a 1.2-inch-square image. The operator can control the motion of the film at the projection station.

## the film scanner

This unit scans microfilm images and transmits them, in digital form, to a computer. It can convert 35mm negative images—light lines on a dark background—directly into digital data.

The scanner utilizes the same techniques for handling vectors and strokes as the recorder. For a scan vector, light from a CRT electron beam—the same one that is used by the recorder—is directed along two paths: one through the film to a photomultiplier tube and the other directly to another photomultiplier. By comparing the amount of light passing through the film with the light intensity of the CRT beam, the scanner's circuitry can determine whether a strike has occurred. A strike is a response which is above a preset level of light intensity set by the computer program. The response to a scan vector is digitized into 16 parts. A response bit is obtained for each part encountering a strike. Scan vectors can be repeated at the rate of one every 102 microseconds.

The light intensity level can be preset to any of 63 increments which represent the range between zero and the maximum light transmission level of the film. Once the information has been converted to digital form, it can be modified, stored permanently or updated by the computer under control of a user's program.

Image registration within the film gate may be program-or manually-controlled. Film frames may be scanned for reference data and then moved forward or backward by programmed increment of 0.012-inch to establish proper registration. The operator accomplishes manual registration by using a built-in scan image view screen and manual controls for film movement.

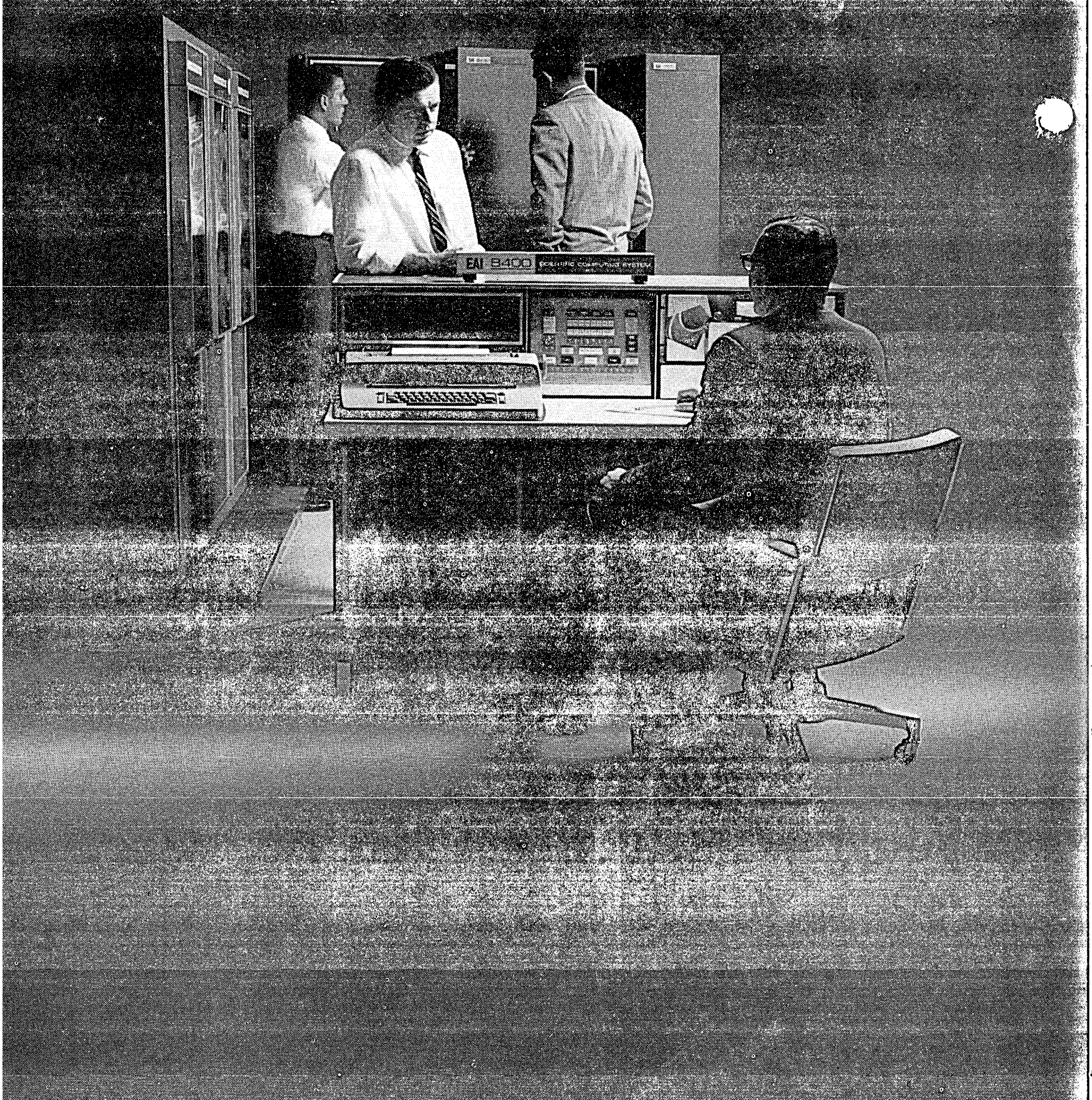
A variety of programmed scanning techniques can be used. Among them are raster scanning and edge following.

Raster scanning can be used in searching, automatic film registration and many general image retrieval jobs. With this technique, the image is examined by parallel beam sweeps. The data acquired is then correlated and analyzed by the central processor. A raster can be generated that covers any area of an image to a fineness, or precision, pre-set by the computer program. A rapid, coarse search can be made until a part of the image is encountered, and then the scanner program can switch to a slower fine-scan pattern which prepares response data for the central processor.

Edge following employs a variable vector probe which can be directed to move along a boundary between two selectable levels of image density. The probe can be programmed to report its position periodically, or to report a minor or major change of direction. This technique is useful in detailing topological boundaries.

The power of the film scanner will be enhanced as scanning techniques grow in sophistication. Because of the wide range of jobs and applications which can be addressed by this equipment, it was decided not to constrain the scanning techniques available to the user by fixing them within the equipment. Rather, the techniques were left completely flexible and under control of the user's program.

Graphic data processing enables a user to become an integral part of a data processing complex. The new techniques allow direct man-machine exchange of graphic information, and make possible instantaneous intervention to provide an optimum combination of human judgment, computer speed, and accuracy. ■



# Dear Mr. President:

I am worried about my country. We have so much poverty and unemployment in the midst of plenty, and indications are that poverty and unemployment will increase even as plenty will also.

As a practitioner in the computer field, I have occasional twinges of conscience about my role in the process whereby computers displace persons who are then unable to make a decent living. I have these twinges of conscience even though I see some (not all, mind you) of these computers doing things better, faster, more accurately, more everything than any person could do. Up until a few years ago, most of my colleagues, my professional organizations, my employees, their customers and their government sponsors were silently certain that computers would be largely a blessing and cause only temporary human dislocations. We thought that our society was competent enough to realize the promise of advanced technology. Today, many of us are not so sure. I'd like to tell you exactly why I myself have doubts.

When an intellectually honest and competent scientist finds in his work that his deliberate actions lead to undesired or unexpected results, he re-examines the assumptions that guided his actions. This is sensible, even in fields outside of science, because actions based on erroneous assumptions are likely to be wrong and almost certain to be irrelevant.

The task of finding a valid set of assumptions in science is often difficult: it is especially hard when the current set of assumptions has worked for so many years that one has gotten to depend on them as "eternal" truths. The physicists' commitment to Newton's "Laws" of Motion is a case in point. Physicists resisted adopting Einstein's formulations even though the assumptions of Newton did not hold in certain situations. But when progress in science is more important than the preservation of beliefs in assumptions that no longer hold (however politically sensitive the questioning of these beliefs may be in the scientific community), then the assumptions are discarded and promising alternatives are devised and tested.

I am not an economist. Yet, I can observe that our economic attitudes and actions have resulted in the unexpected and undesirable consequences of increasing poverty and unemployment in the midst of increasing plenty. So, in this sensible spirit of science, I have tried to uncover and examine the assumptions that constitute the rationale for the well-intentioned War on Poverty and for other legislation in the economic field. Congress and the Administration are doing what they are doing (tax-cuts, education, training and retraining, and public works programs) because they believe that these measures will raise the purchasing power of the heads of American households and of American industry to a sufficiently high level that American industry will then have to employ most of the labor force (appropriately trained and geographically located) together with its machines (however many, productive and versatile) in order to produce and distribute what Americans and others will need, want, and then be able to

***The founder and former president of the Computer Control Co. Inc., Dr. Fein is currently an independent consultant at Palo Alto, Calif. At Raytheon, 13 years ago, he led a team that designed and built RAYDAC, one of the first large-scale computers. He is also a constructive critic of the work of his colleagues, professional societies, and the world at large.***

# "Usually it takes months to get a computer system going. Ours was running six weeks after they rolled it in."

"We'd heard discouraging reports of computers that didn't begin to show promised results for a year after being installed. That wasn't true with our NCR 315. Six weeks after it arrived, it was turning out a heavy load of sales statistics, stock turnover and inventory reports besides doing all kinds of other corporate data processing. That was just the beginning. It's been processing about 500,000 invoice items a month. And we're still exploring new applications. One obvious and welcome benefit is: we've shortened the time gap between the accumulation and the final evaluation of sales data. That means money in the bank for us. The 315 is more than earning its keep by saving time, increasing sales information, and thus increasing our control over our own business. Unusual? I'd call it essential." Joseph A. Grazier, President, American Radiator & Standard Sanitary Corporation, New York City.

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buy. I understand that most economists in the U. S. share this belief. Not only do Congress, The Administration, and the economists believe that at the moment we have in the labor force about as many persons as we need to fulfill demand, even taking into account computers, automation, and technical advancements, but that this will continue to be so for at least the next 20 years. So why worry?

It is generally admitted that many persons are not yet adequately educated and trained and that some of them are not yet in the geographic areas where good jobs are available. To meet these recognized deficiencies, Congress is acting: we have programs to educate and train people to prepare them for jobs, and programs to move these people to appropriate areas. If we consider that a 3.5% unemployment rate is tantamount to full employment, then a succinct, explicit statement of this conventional assumption is:

> At this moment, and for the next 20 years or so, the demand for products and services, including public works, education, urban renewal, household goods, etc., can be met only if we employ at least 96.5% of an appropriately trained and geographically well placed labor force and utilize a substantial fraction of our computers and machines to conceive, develop, produce and distribute these goods and services.

Defenders of this conventional assumption hold that computers, automation, and the like are but another form of advancing technology and that, as in the past, advancing technology brings with it a net gain—not a net loss—in requirements for human labor to fulfill an ever increasing demand.

I myself should like to believe that this assumption is still valid. But the economic implications of adopting this assumption (or any other, for that matter) are so vital and so crucial that we shouldn't accept as evidence for its validity what amounts to hope that what was valid in the past will be valid in the future. In order to shed light on the validity of this assumption, we must have the following:

(1) An estimate of demand—i.e., a list of those goods and services that will probably be demanded and could be paid for, in the future, year by year, for 10 years, starting in 1965;

(2) A statement of the size, composition, and productivity of the labor force together with computers and machines in each of these 10 years;

(3) A prediction based on (1) and (2) that gives for each of the 10 years, 1965-1974, the number of persons in the labor force and the fraction of the future machine capacity, that will be utilized to meet the predicted demand of (1).

If such estimates based on relevant and accurate data were available, particularly (3), then they would serve to determine the degree of confidence one could have in this assumption, or in any other proposed assumption.

For instance, a few people have proposed what might be considered a counterassumption:

> At this moment, and in the future, the demand for products and services, including public works, education, urban renewal, household goods, etc., can be met by employing an ever decreasing percentage of an appropriately trained and geographically well placed labor force and utilizing a substantial fraction of an ever increasing number and variety of increasingly productive computers and machines to conceive, develop, produce and distribute these goods and services.

Defenders of this counterassumption insist that machines are already so numerous, productive, versatile, and reliable, that any realistic future demands could be met by largely utilizing such machines together with a relatively small fraction of the labor force. The remainder of the population could be freed to undertake legitimate preoccupations of their own choice. Prediction (3) could serve to indicate what degree of confidence we might have in this counterassumption.

Doubts must be raised about the adequacy and relevance of tax-cuts, training programs, the War on Poverty legislation, etc., until convincing evidence is given for believing the validity of the conventional assumption rather than that of the counterassumption. And the best kind of evidence I can now imagine is to have (1), (2), and (3).

I realize that (1), (2), and (3) may be extremely difficult to obtain. Nevertheless, I cannot be persuaded that the difficulty of obtaining them diminishes by one iota the absolute necessity of our having them if the Congress and the Administration are to act rationally, relevantly, and prudently.

I am aware that Title I of the Manpower, Development, and Training Act of 1962, as Amended (42 U.S.C. 2571-2620) states "It is therefore the purpose of this act to require the Federal government to appraise the manpower requirements and resources of the Nation and to develop and apply the information and methods needed to deal with the problems of unemployment resulting from automation and technological change and other types of persistent unemployment."

But the Secretary of Labor, to whom Congress assigned this task under this law, has been unable to gather such data and evidence, not because he refuses to, but because the economists in the Department of Labor and in the universities don't know how to—apparently the state-of-the-art of developing and applying these methods and information is not yet sufficiently advanced.

Mr. President, I therefore suggest that you set up a task force to do the admittedly difficult task of first developing the means of estimating and then applying these means to estimate (1), (2), and (3) and thereby to find the answers to the most important economic questions of our time: Do we or don't we have millions more people in the labor force than we need to fulfill demand? Will we or won't we have tens of millions more people in the labor force than we need to fulfill future demand?

Respectfully yours,
Louis Fein

*P. S.* Let's assume that at this moment we do have as many persons as we can use to fulfill demand and that the legislation of the War on Poverty and other measures are relevant. Isn't it plausible that U. S. science and technology is advancing at a sufficiently great rate that at some instant soon we will have just one more person than we need, then two more, then 10 more, then thousands more, then 3.5 million more, then tens of millions more . . . ? Is it not imperative that we start right now seeking alternative viable economic policies for coping with such contingent conditions—instead of gambling that the roof won't fall in? There is so much to lose by being unprepared for such an eventuality—and so much to be gained by being ready for it. ■

# THE LARGE SCIENTIFIC JOB SHOP

**preparing for the change**

by L. I. PRESS

Although the purposes of the variety of installations that can be lumped under the heading "scientific job shop" are diverse, a possible path of evolution can now be perceived. In considering this predicted change of approach, our remarks will be confined to the framework of existing or announced equipment.

The urge to change present practices springs from two sources: changes in installation goals and the relaxing of constraints on current shops.

The compelling goals of computing installations have always been that they process as many jobs as possible during a period of time and that response to the user be rapid. It is a rare shop which these requirements have not kept operating at a level close to the constraints imposed by hardware and systems limitations.

The pressures on capacity are constantly increasing for a variety of reasons. As service improves, the user is able to submit more work in a day and get on to new projects sooner. The increased load may be alleviated by a greater tendency to pursue projects in a serial fashion; however, as programmer efficiency grows (regardless of the source of this growth) aggregate demands upon the shop will grow.

It is implicit in the foregoing that there be sufficient new work for the computer. I feel that it is a safe generalization that the backlog is constantly growing as a result of innovation in the recognition of computable problems, the dropping cost of computation, relaxation of hardware limitations, growing numbers of computer knowledgeable persons, growing educational requirements, reformulation of approach to previous applications, etc. The net effect for many shops is a dramatic mismatch between today's capacity and tomorrow's, or even today's requirements—a mismatch that shows no sign of yielding.

Given that capacity pressure exists, what constrains the computing shop?

Constraints may exist in both hardware and systems areas. Attention has been given to both fronts. Hardware and systems have pushed each other through several different approaches (the term evolution would imply a more orderly progression than has been observed). Manual loading of decks and paper tape has given way to various sequentially oriented operating systems, with the availability of magnetic tape. Asynchronous channel operation and attendant multiprogramming oriented systems have appeared.

More recently we see a variety of systems built around configurations where two or more computers communicate, either through common storage devices or direct access to main memory. In all of these developments hardware and systems approaches have developed in consort and at commensurate rates.

As we scan the equipment of today, however, the constraint in this dimension appears to be receding at a rapidly accelerating pace. Mass random memories have under-

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gone capacity growths of several hundred times; main memories are now described in $k^2$ rather than $k$ and nanoseconds rather than microseconds. CPU operations require nanoseconds and are performed by several autonomous units operating in parallel. It is nearly incidental that conventional I/O devices perhaps double in speed because real-time devices, graphic devices, image processing equipment, etc. for both local and remote operations are becoming available (along with the complementary communications capability).

This type of relatively sudden order-of-magnitude relaxation of hardware constraints dictates the need for innovation in the systems area. Systems design might progress in the following way at a large installation which does indeed foresee a need for grossly expanded capacity.

## selecting a processor

One course of action is the addition of units similar in nature to those in use. While possibly offering some short-run relief, this approach is undersirable for two major reasons:

1. The anticipated computing load would require so many such machines as to be untenable from an economic or operational standpoint.
2. A large class of problems exists which cannot be solved on these machines.

A second, more suitable solution is the use of one very large computer. With the most powerful computer available, the installation will be able to process virtually any computer-soluble problem.

The economic limitations of the smaller machines are obviated by the fact that the capacity of a computer grows considerably faster than its cost. New machines will compute in the range of 100 times the speed of machines currently in use and have available more than 100 times the core storage capacity, yet cost only about three times as much.

The fact that capacity increases of several orders of magnitude are represented by the processor implies that the method of operation must be different than with current systems. It is no longer sufficient to consider the processor as an autonomous device being given jobs by operators with the aid of peripheral computers. Extrapolating from current practice, some 100 to 150 operators and peripheral machines would be required to service such a processor.

## monitor operations

A more efficient mechanism must be found as the interface device between the processor and the persons who are solving problems. The mechanism must be capable of assembling programs and data from a variety of sources into easily handled job "packets" for the main processor and, after processing, present the results to the problem solver. In addition, scheduling the activity of the processor must be handled. Since an inordinate number of operators would be required to provide these monitor functions in the conventional manner, alternatives must be considered. Two approaches seem feasible.

1. Usurp a small portion of the processor's time and storage and allow it to fulfill the monitor function.
2. Introduce a second, less powerful, computer into the configuration and delegate these tasks to it.

Several factors will influence the relative economy of these alternatives.

The nonlinear speed-cost relationship indicates that the first approach is superior from a time standpoint; however, the relatively high cost of the main memory of the main processor pulls toward the second. In the specific installation, the nature of the job mix and of input/output media will determine monitor time and storage requirements and hence the placement of the monitor functions. A diverse array of input/output devices and operational modes would indicate large storage requirements and therefore favor the secondary computer approach. A preponderance of relatively long jobs with straightforward input/output would favor the stand-alone configuration.

The key point is that definition of the monitor functions is independent of their implementation and their residence. Thus we may discuss the system in terms of these functions as provided by independent entities, noting that the choice must be made in view of the particular installation.

## user interface devices & storage

In addition to the monitor functions associated with bridging the gap between the processor and user, we must consider the form of information at this interface. The 100–150 card read/punches and printers which would be required using current media are clearly intolerable from an operational or economic standpoint. Some other basic information storage media must become part of the system, meeting the following basic requirements:

1. Massive capacity—to match the literally unbounded information capacity of cards, tapes and printed output.
2. Portability—to provide ability to easily remove or add selective increments of storage related to specific projects.
3. Random accessibility—to allow the monitor system to assemble jobs from the entire program/data store and to allow demand display of output.

Several currently announced devices meet these requirements. They have sufficient capacity to allow users to maintain private program/data files to which the monitor machine may have direct access. The basic storage medium is generally portable in units of several million characters to allow for exceptional requirements.

In addition to program/data storage, the mass random file may serve as high volume output media. A variety of display consoles and printers on the monitor machine will allow for selective examination and processing of output, thereby eliminating the extrapolated printing requirements.

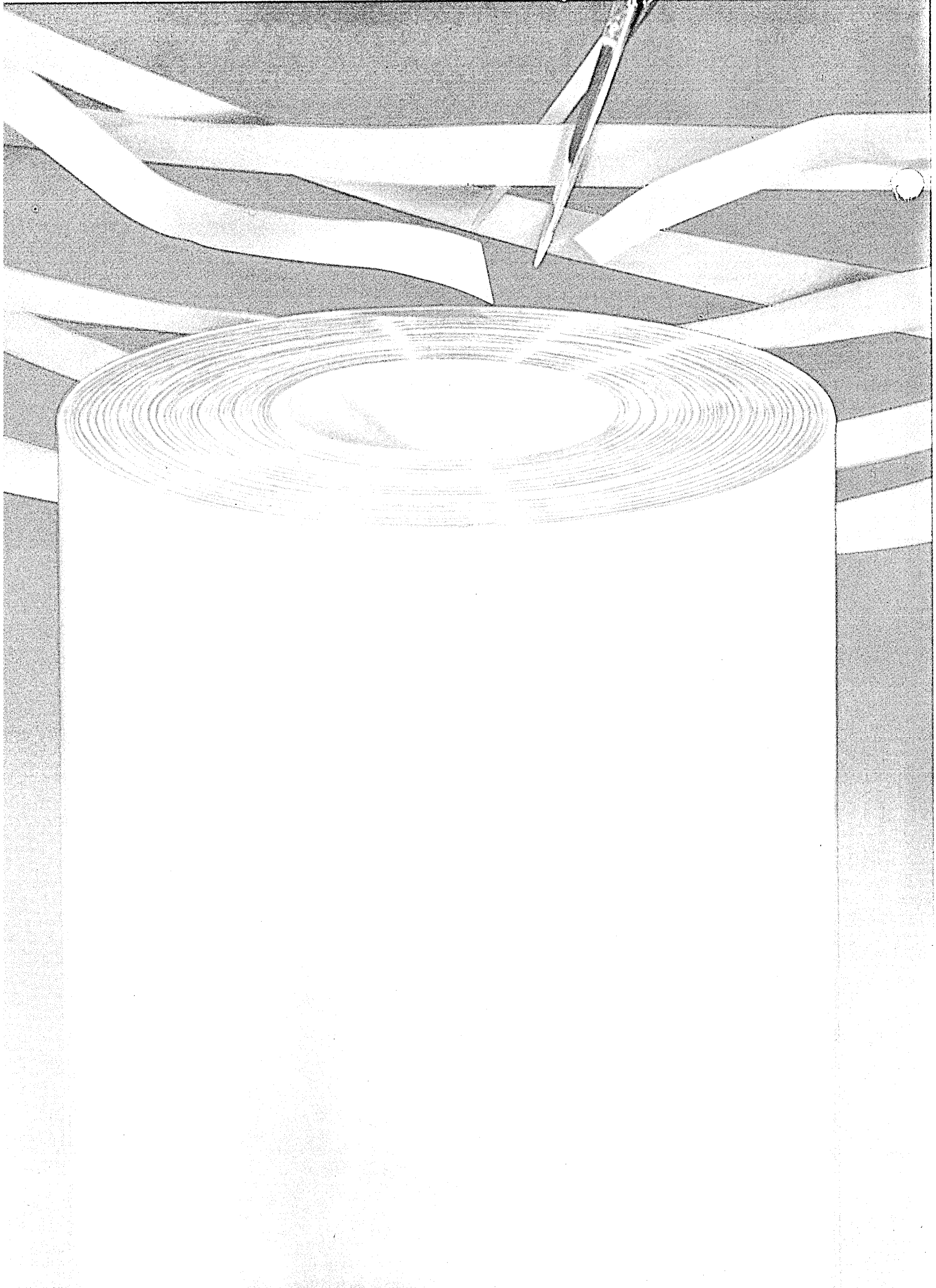
## buffer & problem storage

A final major functional requirement must be met if the processor is to be used efficiently. A buffer of staging area for jobs that are waiting to be processed and for recently produced output should be provided between the processor and monitor. This staging area will allow the monitor and processor to work asynchronously, eliminating the possibility of periods of time when one must wait for the other (interlocking). The characteristics necessary for this "inventory" store are:

1. Random accessibility to allow the monitor to present jobs to the processor in any order and to reschedule jobs dynamically.
2. Sufficient capacity to hold several pending jobs and output strings to allow continuous operation.
3. Extremely high transfer rates to feed the main processor in a manner which is commensurate with its speed (120-170 times today's tape and disc files).

This requirement is fulfilled by currently available large core storage units which allow the processor and monitor machines common access to several million words of addressable core storage.

It is apparent that the large core storage unit will provide for greatly enhanced system throughput by cushioning the interdependence of the monitor and processor and by providing a reasonable input/output rate for the latter. Perhaps a greater contribution of the bulk storage device than efficient processing of normal jobs is that it will allow great breakthroughs in the flexibility of the



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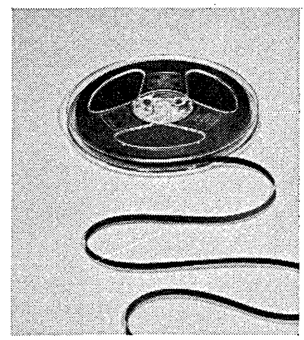

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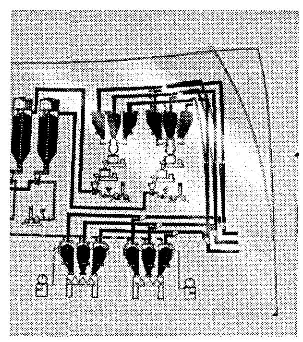

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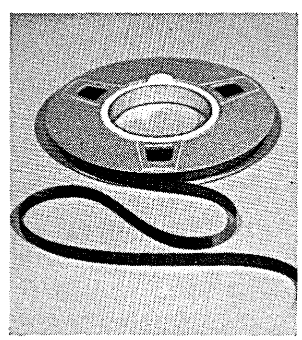

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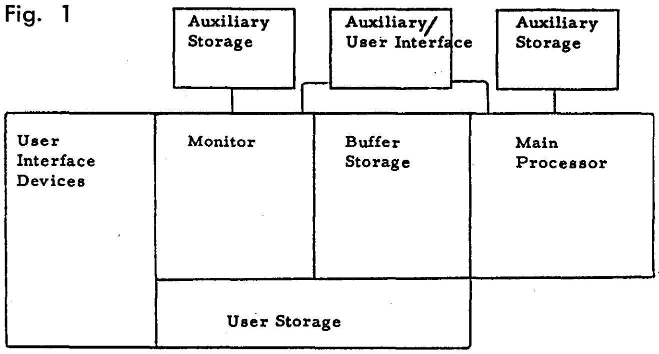
approach taken in the formulation of both usual and exceptional problems.

With about 100 times the addressable core storage of the machines currently in use, problems which today are insoluble, computationally uneconomical, or handled in a cumbersome and time-consuming manner will be processed efficiently. If one considers the ability of a computer with storage capacity of this magnitude to store entire (non-segmented) programs and process very large increments of data internally, problems which are unthinkable by today's standards are solved in a straightforward manner and today's 24-hour-long jobs are run in minutes and seconds. This broadening of the vistas of computability is perhaps the most important contribution of the large core storage unit.

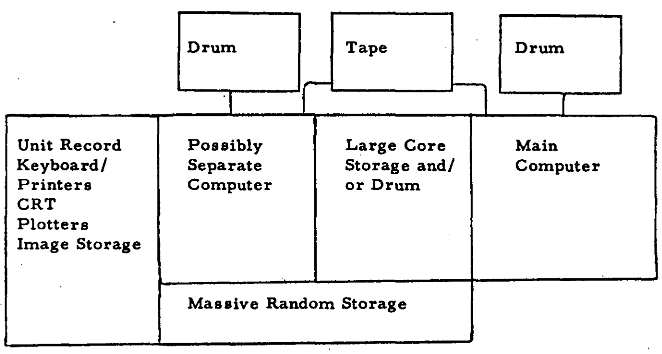
## auxiliary storage

The problem-solving capability of the main processor may be further enhanced by a third level of storage, probably a high speed drum. Such units provide several times the bulk store capacity with very high transfer rates. They will serve as a most useful adjunct during the solving of very large problems where voluminous intermediate

Fig. 1




FUNCTIONAL DIAGRAM




POSSIBLE HARDWARE

results and data must be stored. In addition to broadening the problem solving capability of the processor, drums will provide storage space for special system control programs, programming language processor, e.g. FORTRAN, etc. This latter function may be performed by a disc file in the case of the multiple processor installation.

Both the auxiliary and buffer storage requirements will be affected by the nature of the installation requirements—i.e., the job mix. If relatively few long duration jobs are processed and input/output requirements are either low or of necessity from other than buffer storage, an electromechanical device may suffice entirely as buffer storage. A compromise to be evaluated is a relatively small core storage unit, augmented by, say, a drum, for the buffer function. In addition, the processor may be required to have direct access to tape as part of its auxiliary storage for certain jobs.

Even if this last condition is not the case, the relatively small cost of making the tape units of the monitor machine available to the processor via either manual switching, programmed switching or pooling and the flexibility of degraded operation of the processor alone makes this desirable. If the monitor functions are provided by the stand-alone configuration, the foregoing access to tape is free. The five major functional units—processor, monitor, buffer and problem storage, user interface devices and storage, and auxiliary storage—are illustrated in Fig. 1.

## implementation

The fact that some of the hardware discussed is several years from delivery, and that extensive planning and preparation are necessary to implement such a system, indicate the desirability of evolution to the complete system. The flexibility provided during evolutionary stages is a key point in favor of the performance of the monitor and processing functions by separate computers. The evolution might progress in three stages:

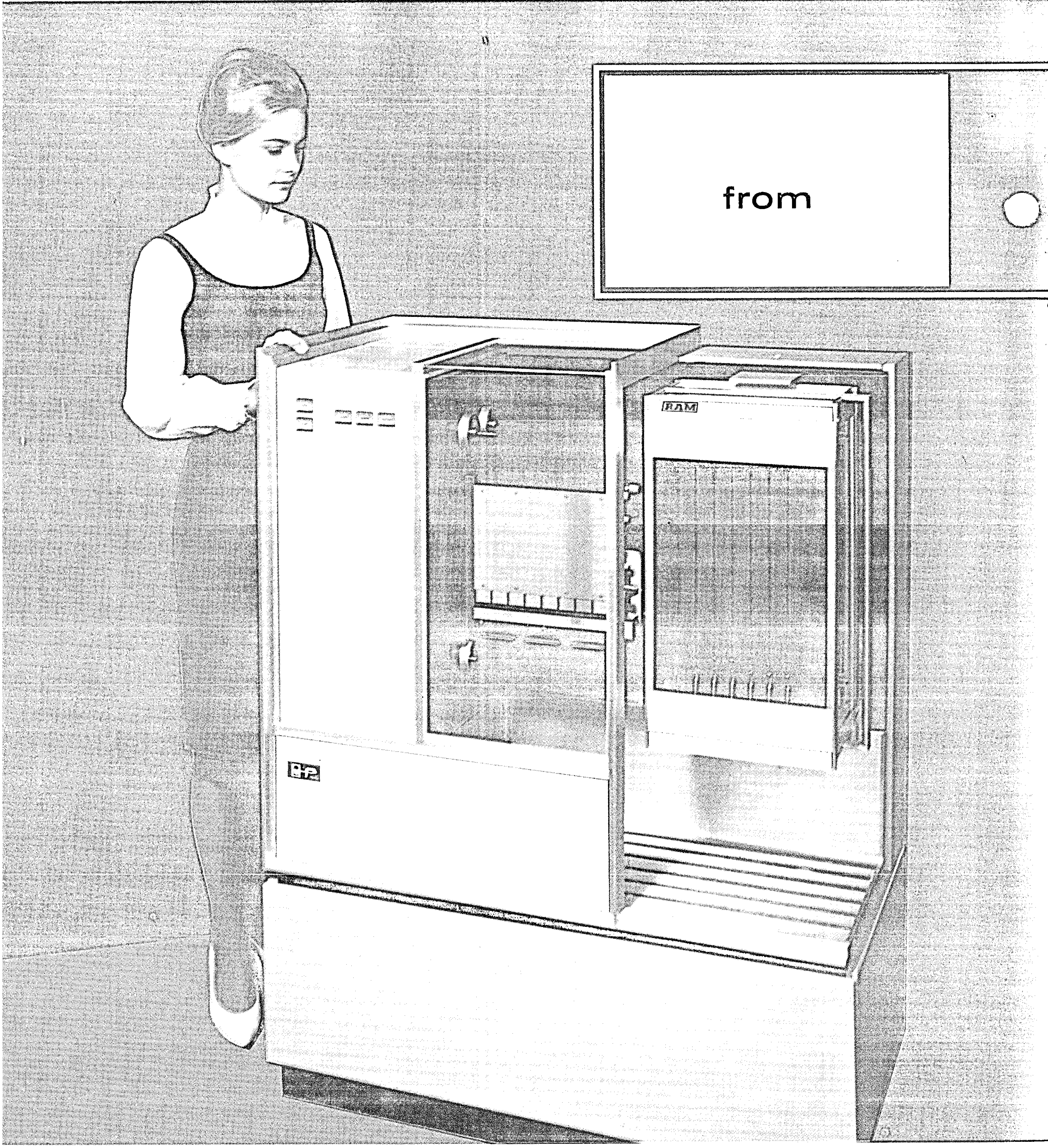
**Phase I**—Installation of a relatively small computer, which will eventually serve as the system monitor. This early installation will immediately be able to absorb a portion (or perhaps all) of the current computing load and therefore help pay its own way. In addition, it will be a necessary tool in the planning and implementation of the monitor programs. If it is compatible with the main processor, installation personnel can obtain experience of even wider value. The configuration should be specified as nearly as possible as a subset of that planned for the final monitor machine, particularly if all or part is to be purchased; however, the interim role as a "conventional" processor must be considered.

**Phase II**—At this stage a processing machine will be introduced into the configuration. Though due to delivery and planning requirements it will not be the ultimate, it should be able to further relieve the installation computing load while providing for further evolution. If the stand-alone approach has been decided upon, the original machine may now be dropped and the monitor programs tailored to the processor-monitor.

In either case, the buffer storage, user storage, and user interface devices should all be introduced at this point. Systems programming and checkout may now proceed as necessary for the final complex. Users may begin to plan and program problems which make use of the large core and auxiliary storage. More important, they will begin operating and formulating problems in terms of the mass data store, selective output concept and new user interface devices. This latter activity will provide operating experience and user requirements which will be "fed back" for the final detailed planning and implementation of the third phase.

**Phase III**—Primary equipment changes will be the installation of the final processor and user interface devices. The installation will now be at its full computational power. As stated previously, planning and delivery constraints have delayed the processor installation to this point (probably three to four years). The final specification of user interface devices has been postponed to this point for different reasons. First, the relatively short time from announcement to first deliveries of such equipment indicates that much of what will be installed is yet to appear in the market place. Second, the Phase II operating experience will have its greatest impact upon this portion of the system, and finally, the relatively low cost of such devices allows more "hands on" implementation and requires less advance planning. ■

FOR POTTER INSTRUMENT CIRCLE 24 →

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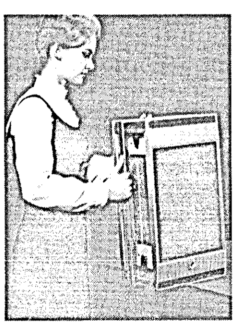
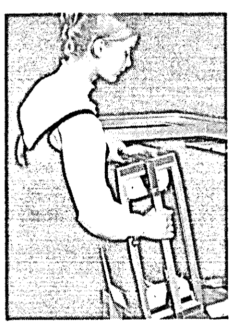
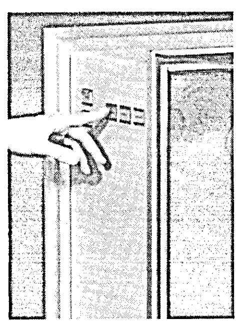


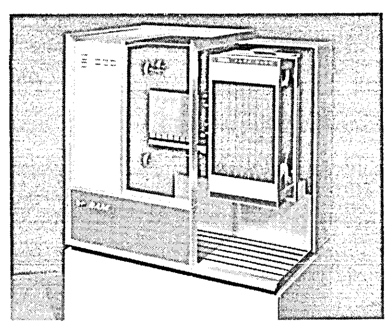
operator selects proper Tape Pack



latches Tape Pack into RAM



touches start button



loading completed automatically, capacity infinitely expandable.

# the *RAM*® a completely new concept in random access memory

## TWICE AS FAST
## DOUBLE THE CAPACITY
## COMPLETE DATA SECURITY
## LOWEST PRICED UNIT AVAILABLE TODAY

A random access memory unit that costs *less* than competitive equipment is news in itself. But when you add to it doubled bit capacity, immediate check-read-after-write capability, and complete data security, you begin to realize what new — *new from Potter* — really means.

The RAM* is a fast access, infinitely-expandable cartridge-loaded memory device. Its revolutionary new drive system permits using high density magnetic tape loops in random access memory applications for the first time. Still another revolutionary development — a read-after-write head — permits a complete write and check read operation in less than 90 milliseconds. The fastest available!

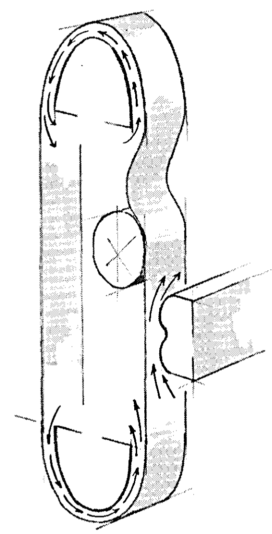
Potter's unique Tape Pack cartridge is another feature that really sets the RAM apart. Tape Pack cartridges need no more special handling consideration than a briefcase. Even if a cartridge is accidentally dropped to the floor, data remains secure. And because critically fabricated disks are eliminated, Tape Packs are less than half the cost of disk packs.

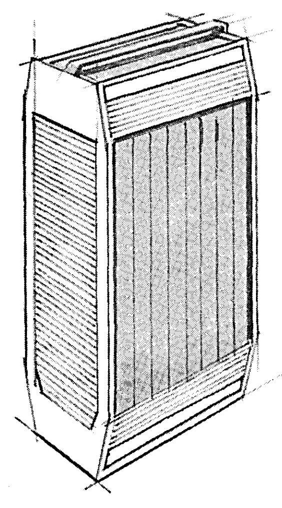
But these are just the highlights of this remarkable breakthrough in random access memory equipment. Get the full details on the new Potter RAM for yourself. Write or wire Potter today.

*Registered trademark of Potter Instrument Company, Inc.

### FLEXIBLE TAPE LOOP STORAGE MEDIUM

tape loops float over stationary bearings on cushions of air . . . "fly" past write/read head without making physical contact. Years of trouble-free operation are assured.





### UNIQUE TAPE PACK CARTRIDGES

rugged plexiglass and aluminum cartridges protect tape during both storage and operation. Dirt, dust and contamination are sealed out.

## SUMMARY SPECIFICATIONS

| | |
|---|---|
| On Line Capacity (millions) . . . | 50.2 bits |
| Average Head Positioning Time . . . | 62.5 ms |
| Average Latency Time . . . . . . | 25.0 ms |
| Average Access Time . . . . . . | 87.5 ms |
| Check Read Delay . . . . . . . | 0.3 ms |
| Check Read-After-Write Cycle Time . | 87.8 ms |
| Data Transfer Rate (Bits) . . . . | 600 kc/s |

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INSTRUMENT CO., INC.
*151 Sunnyside Blvd., Plainview, N.Y. (11803) 516-OV-1-3200*
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THE LEADER IN EDP EQUIPMENT

# ADAMS' COMPUTER CHARACTERISTICS

**new format**
**new hardware**

by DAVID E. WEISBERG*

With 1964 behind us, it is perhaps appropriate to sit back and take a brief look at what has happened during the past year. It surely was not dull as far as the computer industry was concerned. Over 45 general-purpose computers were announced during the year, increasing emphasis was placed on integrated product lines with a large degree of flexibility in developing various configurations, computers oriented to multiple on-line users mounted in popularity, and small high-speed computers selling at less than $30,000 appeared on the scene.

To keep pace with the dynamic aspects of the computer industry, we at Adams Associates decided to make some changes in the format of the *Computer Characteristics Quarterly.* As the reader can see from the entries below, which are the additions to Section I of the December issue, these changes place more emphasis on the storage capabilities of the systems. During the past year there has been a clear trend toward increasing the significance of peripheral equipment in relation to central processing units when configuring evaluating computer systems.

Consequently the type of memory is not mentioned unless it is other than magnetic core, and the number of addresses in each instruction has been eliminated because it is considered to be of marginal value due to the rather complicated internal logic of many new machines. Likewise, since the maximum number of magnetic tape units is virtually always greater than what anyone would reasonably use, especially as mass storage units become more popular, it too has been deleted.

The major addition to the *Quarterly* is detailed information on disc and drum memory units; average access time (including latency), transfer rate, and capacity per individual unit. One can expect that most manufacturers will connect as many mass storage units to their computers as a customer desires, although this can sometimes be quite expensive. To save space, we have also assumed that software is now available or will be when new machines are delivered, and that the business compiler is COBOL and the scientific compiler is FORTRAN with no differentiation made between the various dialects of each.

These changes, we feel, will meet with the approval of the many subscribers to the *Computer Characteristics Quarterly* and enhance the value of the publication to them and others who use it. ■

## SECTION 1

| | *Monthly Rental* Typical Range | *First Delivery* Month and Year | *Processor Speed* Complete Add Time in Microseconds | Storage Cycle Time in Microseconds | *Internal Storage* Capacity in Thousand Words | Word Size | *Magnetic Tape* Thousands of Characters per Second | Buffering | Read Forward and Reverse | *Disc Storage* Capacity per Unit | Access Time in Milliseconds | Thousands of Characters per Second | *Drum Storage* Capacity per Unit | Access Time in Milliseconds | Thousands of Characters per Second | *Peripheral Devices* Cards per Minute In—Out | Paper Tape Characters per Second In—Out | Printer Lines per Minute | Off-line Equipment | *Other Features* Program Interrupt | Index Registers | Indirect Addressing | Floating-point Arith. | Memory Protection | Byte. Manipulation | Console Typewriter | *Software* Algebraic Compiler | Business Compiler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PHILCO 2000 Model 213** | $78,000 | 9/65 | .55$^{C}$ | 1.15 | 32-2000$^{E}$ | 56b | 90-240 | MRWC | √ | 83.2 M$^{K}$ | 140 | 1000 | 16 M | 17 | 2000 | 2000$^{M}$<br>100 | 1000<br>60 | 900<br>300 | 1000 | √ | 8 | √ | √$^{U}$ | √ | √ | I/O | √$^{Y}$ | √ |
| **CONTROL DATA 3800** | $50,000<br>(45-80) | 1/66 | .8$^{C}$ | .8 | 32-262 | 48b | 30-120$^{G}$ | MRWC | √ | 33 M | 187 | 83 | 4 M | 17 | 2000 | 1200<br>250 | 1000<br>110 | 500<br>1000 | 3200 | √ | 6 | √ | √$^{U}$ | √ | √ | √ | √ | √$^{Z}$ |
| **EAI 8400** | $10,000$^{A}$<br>(5-25) | 3/65 | 2.75$^{C}$ | 2$^{D}$ | 4-64 | 32b | 15-96 | MRWC | √ | — | — | — | — | — | — | 800$^{M}$<br>300 | 500<br>110 | 600$^{P}$ | — | √ | 7 | √ | √$^{U}$ | √ | √ | √ | √ | — |
| **IBM 360 Model 20** | $1,700<br>(1.2-3.6) | 5/66 | ?$^{C}$ | 3.6 | 4-16$^{E}$ | 1a | — | — | — | — | — | — | — | — | — | 1000<br>500 | —<br>— | 350$^{P}$<br>600 | — | — | √$^{S}$ | — | — | — | √ | — | — | √$^{Z}$ |

PHILCO 2000 Model 213: C. Instruction look-ahead (four-level) and asynchronous, overlapped core banks allow increased internal speed. D. Multi-processor system permits four main processors to access large common core storage simultaneously. M. 600 cpm reader and 200 cpm punch available. U. Double-precision, floating point included. Y. ALTAC (FORTRAN II-type compiler in addition to FORTRAN IV.

CONTROL DATA 3800: C. Overlapped core banks and look-ahead feature allow increased speed. G. See CDC 3600. U. Double-precision floating point included. Z. Compatible with 3600 software now operational.

EAI 8400: A. No rental prices announced. Prices derived from purchase price. C. Applies to fixed and floating-point arithmetic. D. Overlapped core banks allow increased internal speed. 16 word fast memory available. M. 200 cpm reader and 100 cpm punch available. P. 132 columns. 300 lpm printer available. CRT display and light pen available. U. Double precision included.

IBM 360 Model 20: C. Add time is for four digits. E. Each character is eight bits or two decimal digits. P. Up to 750 lpm possible for numeric information. S. Eight general registers used as accumulators or index registers. Z. Report Generator.

*Mr. Weisberg is a senior staff member of Adams Associates, and editor of that firm's well known and widely used "Computer Characteristics Quarterly," available for $10 a year from Adams Associates, 142 The Great Road, Bedford, Mass.

# PIECEWORK PROGRAMMING

**The price is right**

by WILLIAM ROLPH

"It all started when I was still inside the corporate shell," Hank Watson, vice president of Data Processing Systems,* said. "When I told the management what kind of salaries should be paid to attract the people who could do the job right, they said that would upset the wage structure of the whole company."

Two years after breaking out of the shell, Watson now presides amiably over the sales activities of an unusual programming services operation that has attracted 24 major clients, just concluded a $400,000 fiscal year, established a new method for measuring and rewarding the efforts of analysts and programmers, and given competitors fits by setting firm prices for finished programs based on the number of instructions delivered.

The company now operates from two offices. One is in North Hollywood, Calif., and managed by H. V. Nichols, president and co-founder with Watson. The other is on the Stanford Univ. campus and is headed by John V. Erck. Watson flies back and forth, handling sales for both.

Both offices stick strictly to their business-applications knitting, leaving scientific programming and the mysterious delights of compiler building to other firms.

"We often get requests for these services," Watson says, "and are glad to pass them on to people we know who can do a good job."

When it comes to business applications, though, DPS is ready to go. They have lost only one bid so far, and Watson attributes this record to the company's pricing policy. The main feature of this policy is that a customer pays by the instruction instead of by the hour or over-all job.

"Of course, we'll give them a price in the conventional

*Bill Rolph is a free-lance writer and editor who has been on the fringes of the computer world for 10 years. He and partner Dick Salzberg prepare advertising, public relations and technical material for manufacturers and users.*

*Now a wholly-owned subsidiary of Informatics, Inc.

way if they want it," Watson says. "But we always add that the other method has never failed to produce big savings. That seems to be enough to convince them."

The ability to establish a price-per-instruction schedule is a product of the combined experience of founders Watson and Nichols. Nichols is the money man, having some 24 years experience as treasurer or controller for several major corporations. Watson, already an old hand in the CPC and 601 days, has invested 26 years in data processing and was dp manager for General Controls, Rocketdyne, and several others.

Although prices are quoted by the instruction, this includes the whole spectrum of activity involved in coming up with the finished program: logic detailing, testing, compiling, debugging, and full documentation.

Prices are computed by taking into consideration the type and configuration of equipment to be used and what software is involved. Records are kept in a form similar to a manufacturing job card and these are made available to the client as verification of the work done.

Being able to predict costs, of course, is a neat trick and is really the result of long experience applied to close analysis of the records.

"I can tell you, for example," Watson says, "that one of our pragrammers working on a tape 1401 job will produce 12 instructions per hour or roughly 100 per day. This is close enough for me to make an accurate estimate of what we should charge."

An equally important ingredient of the DPS plan is that the same figures are used to allocate incentive pay to the programmers. They get a base salary, to smooth out the peaks and valleys of being paid by the job, and a quarterly bonus reflecting their efficiency.

So how do they make out?

Watson says: "They do 35 to 40 per cent better than inside the corporate shell."

### the goodwill problem

Customer relations is a delicate subject with programming firms. Since they regularly serve as an extension of the customer's staff, they are more akin to consultants than to companies with a product for sale on a take-it-or-leave-it basis. They must be prepared to exit quietly when the job at hand is done, leaving everything in good order for the regular troops.

This situation inevitably has some effect on how the outside group operates.

In programming methods, for example, DPS leaves the choice of symbolic languages to the customer. They will, of course, offer suggestions based on what the client has been doing and the nature of the job. But the client must make the final decision.

In documentation, the effect of this in-and-out condition is especially strong. The paperwork is meticulous, complete, and — perhaps most unusual — understandable to noncomputer people.

It gets done in this way.

A project manager is appointed by DPS with over-all responsibility. His first job is to screen the customer's specifications, relate them to DPS standards, and resolve all questions in regard to the dimensions of the project and the procedures to be followed.

When agreement is reached on these matters, the work is divided among the members of a team. A typical task might require one man for each of these categories: writing a flow text, coding, documentation, compiling, and testing.

The flow text becomes the basis of other documentation, as well as the initial outline of the project. It consists of a plain-English list of statements covering all processing and is preceded by a simple summary of what is to be done. This list is most thorough and, like the rest of the documentation, is delivered with the program. For a sample job, it would be followed by a list of switches and halts, card layouts, disc layouts, report layouts, operating instructions, sample output, cross reference list and autocoder listing.

Anyone familiar with the customer's business, computerman or not, can follow and understand the flow text. Since it can be edited like a manuscript to reflect changes, then retyped, it doesn't suffer the typical fate of a flow chart in gathering mysterious shorthand notations made by people who don't seem to be with us any more.

This extensive documentation—especially the flow text—thus offers a way around the "crutch problem," well-known to users of outside programming outfits. The customer presumably has everything he needs for maintenance and updating of a program.

### around the corner

There are major changes in store for the company now, applying their measuring and pricing techniques to a broader area.

The first change is in the nature of the work sought and the sort of people DPS will be recruiting. So far, the company has handled logic detailing, based on the client's existing systems analysis, and the actual programming. Now, however, Watson feels that there really is a new generation of computers that will force a drastic reworking of many companies' systems and standards. The primary characteristic producing this effect is the ready availability of mass random-access storage at relatively low cost. A second cause is faster and more flexible input-output equipment.

The plan is for the company to tool up and meet the predicted demand by acquiring experienced executives along industry lines. These new people, in conjunction with the present staff, will form teams able to back up a step in the information-handling process and establish new systems and procedures to fit the changed situation.

Second big change at DPS will be in the scope of services offered. Expansion in this area includes the acquisition of a 64K IBM 360, now on order and expected in July, '66. It will be housed in the North Hollywood office.

It will be used to supply computer time to customers who don't have one, to handle overloads, to prove out programs prepared for clients, and for programming research. It is this last enterprise that is closest to Watson's heart. His opinion is that various businesses have basically similar functions, close enough that general-purpose programs can be prepared and, when slightly modified, fit a specific company's needs. He agrees that these functions are only similar—not identical—and that management has varying goals and dreams for their separate objectives. Nevertheless, he sees business applications packaged in modular fashion as widely adaptable.

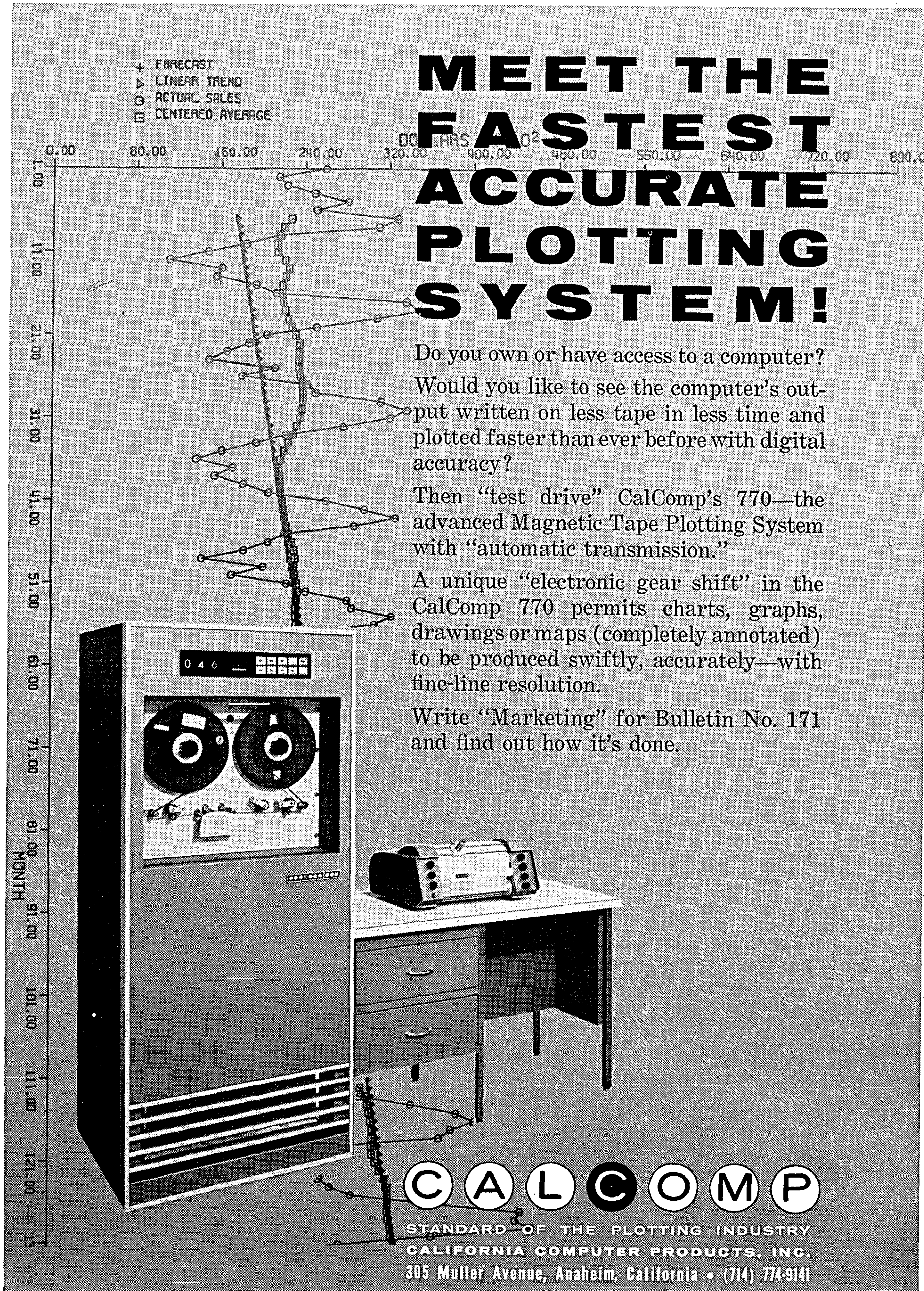
"They ought to be like ready-made suits of clothes," he says. "Everybody will have to be measured for cuffs, of course, and most of them will need the sleeves altered, but there's no point in starting all over again every time for all these essentially standard applications."

Watson also has an answer to the question of when corporations will adopt a professional data processing structure to handle their own work inside.

"The idea will never be sold from within," he says. "The proper organizational structure will be established by outside professionals and finally accepted by corporate management. Then it will be adapted and maintained—after acceptance of principles developed outside."

Watson clearly intends to be one of those who do the developing.

He doesn't want to get back into the shell. ■




CIRCLE 26 ON READER CARD

# DIGI-COMP USER REPORT

by Karen Ann Schneider

I admit that my "toy" computer, Digi-Comp I, fascinates me. Although frankly when my mother gave it to me for my birthday I was not too impressed. My parents are the conscientious type. They are always giving us these little deals that are supposed to make studying fun, or sugar coat the pill, or something, but seldom do. My brother, who is two years ahead of me in the tenth grade, said you won't be able to assemble a working digital computer, let alone program anything. Realizing his ulterior motives, that he wanted it for himself, I said please don't trouble yourself, I am sure I will get along all right. After all, there are directions.

My Digi-Comp I is made of polystyrene plastic, rectangular in shape and about twelve inches by five by four. I keep it on my dressing table in my room. It is red and white, and there is something neat about the way it looks. The parts such as the clock, logic rods, logic tubes, clock tubes, read-out and flip-flops teach computer functions. It is a compete mechanical equivalent of an electronic computer which exposes the fascinating work of the operations hidden within the circuits of an electronic brain.

I followed the directions in the construction guide, which has detailed pictures. The parts are all numbered and no glue or tools are required. There are 16 diagrammed steps to assembling it and then you are ready to check it out, and that is when I began to get fascinated with it really.

The instruction manual explains what a computer really is, and then after you have checked out your computer you get into programming and experiments. The riddles and games are fun, but I am more interested now in figuring out my own experiments.

### problems solved

One of the problems that I had the most fun with was the logic riddle, "Guess the Number." In this problem, I asked my friend to guess a number between zero and seven. And with three questions, I guessed or rather computed the number she had picked. The three questions were: 1) Is the number even? The answer was no. 2) Is the number 0, 1, 2 or 3? Again, the answer was no. 3) Add 10 and divide the result by 6. Is the remainder 0, 1, 2, or 3? The answer was yes.

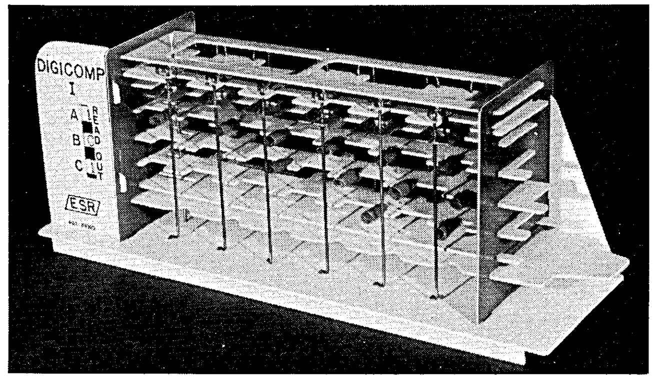
The first step was to program the machine according to the chart in the manual. On Slide A, I put the logic rods on 1 (true), 2 (false) and the clock tubes on 1 and 2. On Side B, the logic rods went on 3 (true), 4 (false), 5 (true) and 6 (false). The clock tubes were placed on 3 and 4. On the C Slide, the logics went on 3 (false), 4 (false), 5 (true) and 6 (false). One clock tube went on 5 and the other on 6.

Step Two was to make sure that the clock was out all the way to the right in the active position. With the manual tabs of the flip-flops, my next step was to enter the answers to the three questions into the Front Panel, by entering a 1 if the answer was yes and 0 if the answer was no. Then I cycled the clock once and the number my friend had picked appeared on the Front Panel in the binary system. The last step to the problem was to transfer the number from binary to decimal. The number turned out to be 5.

Another more useful problem was that of the binary counter, which is used in nearly all digital computers.

As in all the other problems, the first step is to program the machine. On Slide A, the logic rods went on 1 (true), 2 (false), 3 (true), 4 (true), 5 (true) and 6 (true). The clock tubes went on 1 and 2. On Slide B, the logics went on 3 (true), 4 (false), 5 (true) and 6 (true), and the clocks on 3 and 4. On Slide C, I placed the logic tubes on 5 (true) and 6 (false) and the clock tubes on 5 and 6.

Next, I made sure the clock was in the active position and entered 0 for the three flip-flops. As I cycled the clock slowly, the computer counted in the binary system. It was




extremely easy to convert to the decimal system by means of Front Panel Card I, which gave the decimal equals of the binary numbers.

I also got increased status when I took my Digi-Comp I to my math class one day. My teacher was quite thrilled with it. It tied in with our studying binary arithmetic, which is really the language of computers. I told him I thought he ought to recommend the use of Digi-Comp I in all math classes throughout the school system, and he said he couldn't agree with me more.

I was looking at my Digi-Comp last night before I went to bed and I thought, why is it so fascinating to me? Maybe because there is something magical about it; with it you can see logic done before your eyes, where before logic was done inside people's heads and therefore invisible to the naked eye.

Then I thought no, it is because it is a part of my world, which is the world of tomorrow. I was playing a record that I love. Dizzy Gillespie. And I thought these things are all a part of a new different life; no one knows what it will be like, terrible or beautiful or both, and that is why I am fascinated. ■

***Miss Schneider is a freshman at Bridgewater-Raritan High School in Bridgewater Township, N.J., and a system analyst specializing in the operation of the child-scale computer described in the April Datamation, p. 98. She reads at least one book per week, currently a Dickens novel, and last year worked on the school yearbook staff, and is the daughter of a plant superintendent for a plastics firm.***

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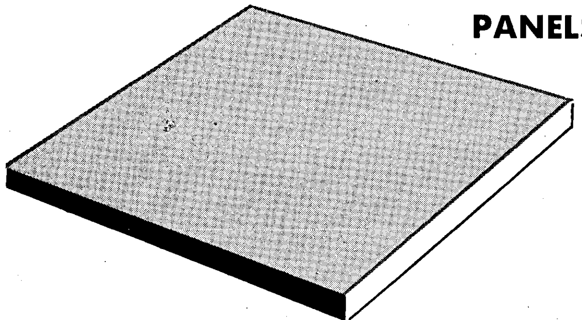

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Panels available from elevated flooring manufacturers vary considerably in terms of abrasion and indentation resistance.

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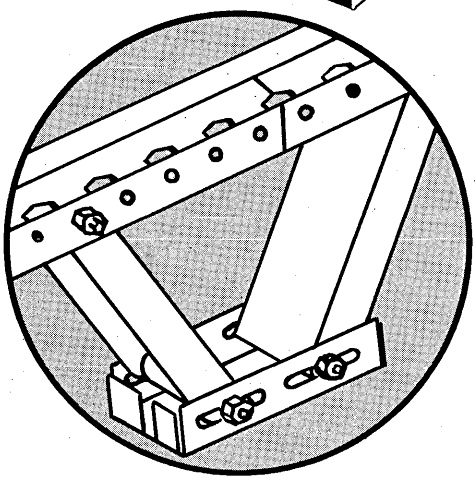
STRATO-FLOOR panels, of course, are non-conductive and light-weight and are available in plain colors or mottled patterns.



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For maximum strength, minimum deflection, the STRATO-FLOOR sub-structure features the patented STRATO-TRI-JACK, which utilizes the strength of the triangle in its design.

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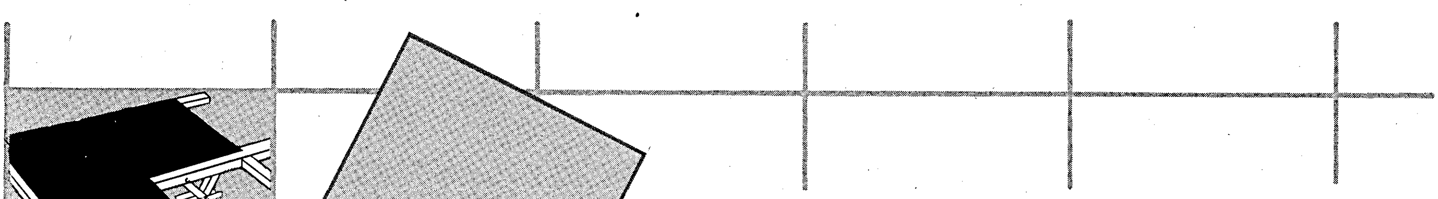
*This is important.* Before you contract for elevated flooring—get full details about STRATO-FLOOR. Write us for further information and the name of your STRATO-FLOOR distributor.



**STRATO-FLOOR, INCORPORATED**

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CIRCLE 27 ON READER CARD

# THE VIDEOFILE SYSTEM

The Videofile information retrieval system is a completely automated micro-filing system which stores documents on magnetic video tape and provides automatic access and much flexibility in updating. Introduced by Ampex Corp. in August of this year, the Videofile system is reportedly the first micro-filing system with the flexibility necessary for high-speed automatic handling of documents in large, active files.

Television and television tape recording are the methods by which the Videofile system acquires and stores material. Magnetic video tape is the microstorage medium on which television images of document pages are recorded.

In any large, active storage system, requirements such as fast automatic access, flexibility in updating and compression of stored data are always of prime importance. Before the Videofile system, no system met all three requirements.

First, the Videofile system provides fast, automatic access. It can respond to a request for information through a keyboard, punched cards from a computer or other input methods. The requestor may see a file, page by page, on a television screen or receive printed copies of documents seconds after making the request. File users may be located in various parts of a building or even hundreds of miles away. A document is immediately available to any number of requestors.

The Videofile system provides complete flexibility in deleting, replacing or relocating file entries without disturbing other material. In most micro-storage systems, total system flexibility is the sacrifice that must be made to reduce bulk. For instance, a system making use of reeled microfilm as a storage medium would compress material, but it would be impossible to expand a reel of film to include new files or replace obsolete entries without reshooting and reprocessing a complete reel. With the Videofile system, an individual document page may be deleted, added, replaced or relocated without recopying the reel of magnetic tape.

Although the Videofile system is custom engineered to a specific application, it makes use of off-the-shelf components. A basic system consists of a Videotape television recorder with built-in electronic editing capabilities, a television camera, an indexing unit, television receiver and/or electrostatic printer.

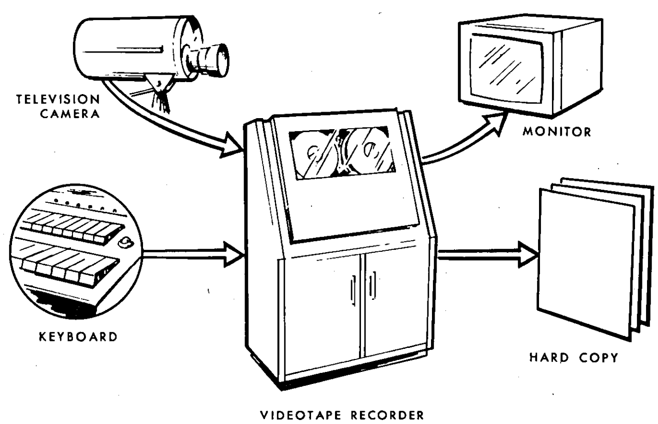
Precise access to individual file entries is made possible by an electronic editor and the Editec time element control system. Editec and the electronic editor work together to make possible push-button location of each individual item of information recorded on video tape.

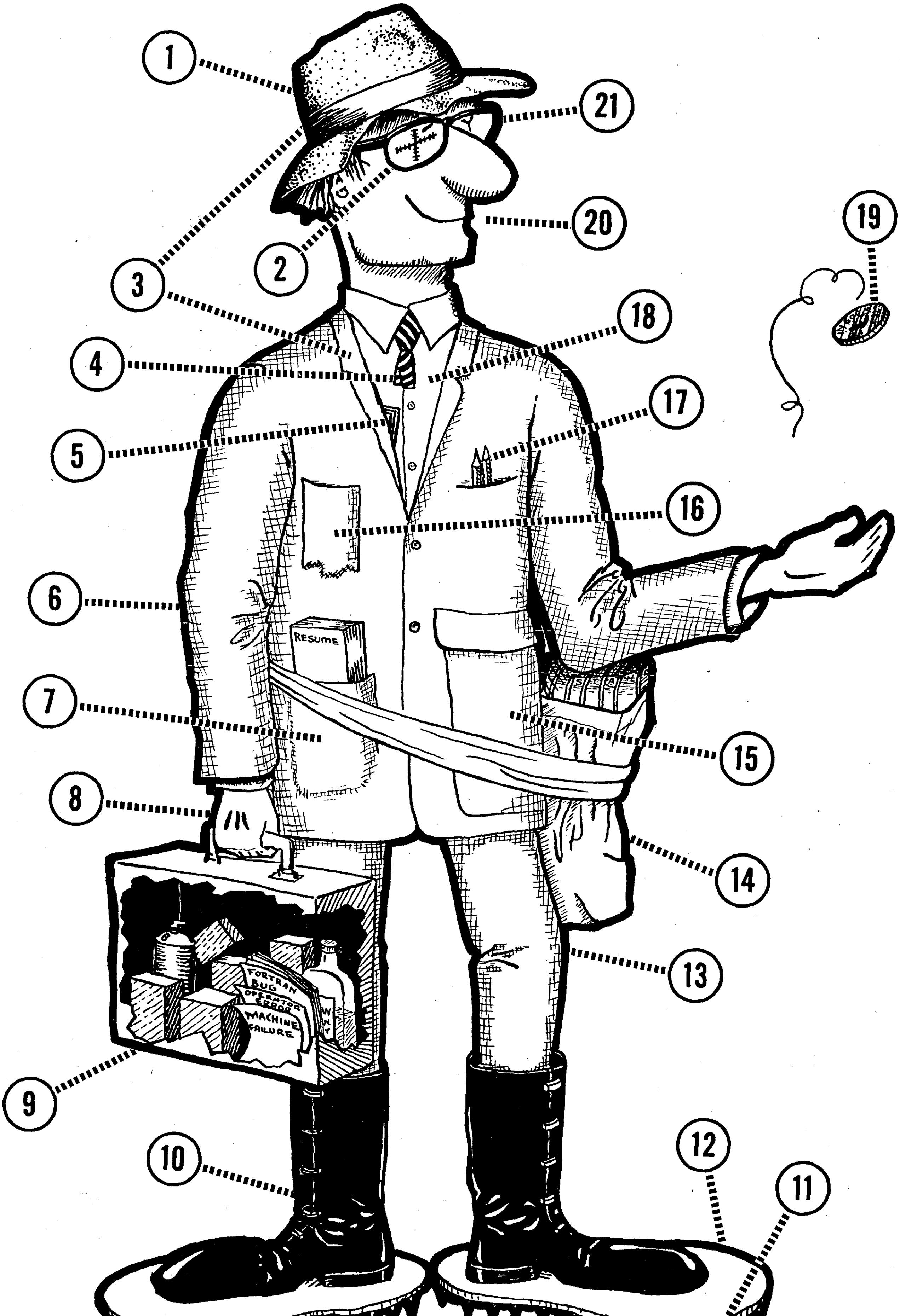
The first Videofile system will be delivered to NASA's George C. Marshall Space Flight Center, Huntsville, Alabama, next spring. It will be used for filing and automatically retrieving technical reports of components tests and reliability data for use by NASA centers and prime contractors located throughout the U.S. Storage of more than 250,000 document pages on each 14-inch reel of standard video tape will be possible. Users at a variety of locations will have immediate and simultaneous access to any part of the file.

The Videofile system will be the key element in NASA's PRINCE reference library and will be divided into two sections: a master file and a reference file. There are two Videotape recorders in the master file section, one for input and storage and the other for copying. Each page of a report is televised and simultaneously recorded on video tape on the storage recorder. Copies of the master tape are then made on the copy recorder and sent to the reference section where they are placed in a ready position on the third recorder.

As each document is recorded on the master recorder, an address is recorded on an auxiliary track of the video tape. For automatic retrieval of documents at the reference section, a specific address, corresponding to the desired document, is fed into the Videofile system. The document's position on the tape is automatically found and an image of each page is sent to a buffer storage unit, which permits an electrostatic printer to produce a printed copy of each page. Eventually, NASA expects to have many stations throughout the nation equipped for direct access to the PRINCE reference files. ■

BASIC VIDEOFILE SYSTEM

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RESUME
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FORTRAN BUG
OPERATOR ERROR
MACHINE FAILURE
9
10
12
11

# THE WELL-DRESSED PROGRAMMER

1) Hat to cover hair pulled out in frustration.
2) Calibrations on lenses for sizing up secretaries.
3) Ivy-League-styled narrow lapels and mind.
4) Short tie to prevent entanglement in card-reading machinery.
5) Self-addressed job offers for mailing at salary review time.
6) Alcohol-resistant suit.
7) Handy resume pocket.
8) Glove for preventing Coffee Cup Callus.
9) Attaché case containing professional supplies:
   a. Upper lip stiffener (spray can),
   b. Package of rubberized points for stretching,
   c. Fifth of 110-proof inspiration,
   d. Knits for picking,
   e. Fifteen (15) stock excuses, e.g.,
      "It's machine failure."
      "It's the programming system."
      "It's operator error."
   f. Condiments for inclusion in programs:
      1 quart of flexibility,
      1 gross of modular designs,
      2 gross of open ends.
10) Boots so won't get cold feet.
11) Hobnails to prevent slipping on schedules.
12) Wide soles for thin ice.
13) Pants to plan by seat of.
14) Pillow to help absorb staff shake-ups.
15) Large pocket for the Big Picture.
16) Bottomless pocket for keeping maintenance requests.
17) Pencils with no lead, which will not write documentation.
18) Plasticized shirt so won't lose same on contracts.
19) Coin to aid key-decision making.
20) Confident expression for scheduling meetings.
21) Rose colored glasses to look at customer complaints with.

# WORLD REPORT

NEW TARGET: TAB INSTALLATIONS

Big Brother's Mod 20 announcement sent shudders down the European spines of France's Machines BULL and Britain's International Computers & Tabulators (ICT). In recent weeks, hordes of executives from north, south and west have been flown to Mod 20's birthplace, IBM's new Boeblingen labs near Stuttgart, Germany, for demonstrations. Viewers had no doubt but that the new Multi-Function Card Machine, a 360 peripheral, is the bait for some 8,000 non-IBM tab installations. Biggest inroads are expected in Britain where Numero Uno takes only 40% of the computer mart, about 20% of punched cards. Comparable figures for Germany: 90% all around; for France: 70% computers, 50% tabs.

(There's talk in the U.S. that Univac has a competing device in the pipeline.)

Most of those non-IBM installations in the U.K. "belong" to ICT, which is heavily involved with punched-card installations. Theoretically, if the latter can convert its tab installations to computers it could rival IBM in Europe. Whether Basil de Ferranti will be able to provide this leadership and whether the firm can produce the hardware to accomplish this remain to be seen.

THE ISRAELI SCENE

Israel's first IBM 360 (a Mod 40) is scheduled for delivery to the government DP center in April. One of the three largest in the country, the center already has three IBM tab systems plus a 1401, and is now taking delivery of a second 1401 with six tape drives.

The two largest centers are the Ministry of Defense with two Philco 1000's and two 2000's, and the Weizmann Institute of Science with a CDC 1604 and two large Golem systems of their own making. Although IBM has 60% of the market, NCR and Elliott have made many key sales, including an NCR 315 with two CRAM units to the Income Tax Authority, an Elliott 803 installed and a 503 on order to one of the technical universities. The Hebrew University at Jerusalem is due for delivery of an IBM 7044 this year. Total systems in Israel: 20.

COMPUTERS & BRITISH POLITICS

Labour Parliamentarian Mrs. Shirley Williams gave notice recently that she will ask the Government if "the Treasury will publish comparative evaluations made of the IBM System/360 and the ICT 1900 compatible series." Her Majesty's Treasury, pinnacle of Britain's civil service Establishment, has veto power over almost all the central government computer purchases. Computer recommendations come from its Technical Support Unit, which follows a tightly-guarded policy. Publication of its evaluations would be a complete "volte-face" of traditional civil service practice.

With a new Labour administration, elected on a modernization and technology ticket, the local computer industry is a red-hot political potato. Committed to boosting national technical prowess, central government departments have received word to buy British, assist

*Continued on page 62*

*Continued from page 61*

NEW & UPCOMING

a sagging industry. Local pundits forecast further aid from a new Ministry of Technology with big civil research contracts on software and an acceleration of government investment in computers.

Developed in the U.K. by an NCR team is Language H, an English-language commercial language claimed to be less ambitious than COBOL, machine-independent, and said to be compilable on small machines . . . News of a one-megabuck Atlas 3 project was released at the dedication of Manchester Univ.'s "Ferranti Computer Lab." Anomaly of the situation is that the Atlas project was hived off to ICT in '63 when Ferranti sold its dp interests. But ICT has access to current Ferranti technical know-how. With a mixed bag of five Atlas 1 and 2's being debugged in the field now, some eyebrows are raised here . . . Rumblings from the NCR-Elliott Automation partnership indicate that long-awaited hardware is on the way. Rumored to be equipment in the $200K class, it should slot between the 503 and 803 without obsoleting current shelf items, which are old but still selling well. Elliott and NCR marketing forces have sold 160 and 40 803's, respectively. Current production is four per month. Production of the $300K 503 runs at two/month.

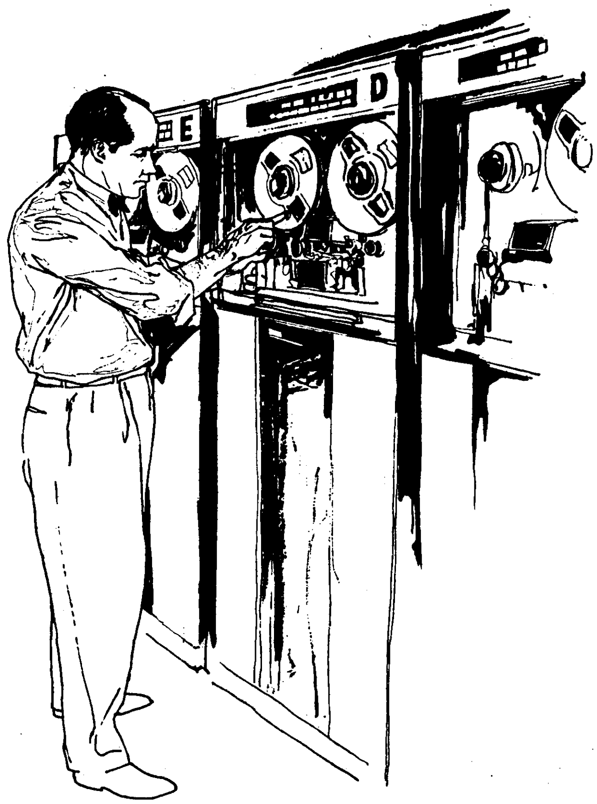
GROWTH & HESITANCY IN HOLLAND

The teeny Dutch firm of Electrologica NV, which specializes in scientific machines, opened a new plant last month. Old timers by computer life expectancy charts, the firm has steered Europe's ALGOL along more than most.

The neighboring electrical giant, Philips NV, still hovers on the brink of entering the market. As major components supplier through its subsidiaries across Europe, Philips has resisted entry apart from special communications gear and military applications. While industry chit-chat says the day is at hand for a decision, the Dutch giant remains silent.

ODDS & ENDS

By April's end, British European Airways starts operations with Europe's largest real-time, commercial dp system, comprising twin Univac 490's costing $7.5 million. Twin Univac 418 communications processors are also scheduled for NASA's London end . . . Honeywell also notched up a communications-oriented order with three 200's for British Railways to do "wagon" inventory control. If successful, another dozen orders could roll in for similar work . . . Following the recent launching of the 1900 series, ICT made a complete management overhaul, the third in as many years. New managing director Basil de Ferranti has a well-earned reputation for toughness when the chips are down. Following three mergers in five years, ICT still has two men for most jobs. The remedy could be swift. The backlog for 1900's is now over $36 million, following announcement of the 100th order . . . English Electric-Leo picked up its first Australian KDF-6 order from a major oil company. Within days, a second "down under" contract followed. Adding these to a recent South African sale, EE-Leo had a million-dollar Merry-export Christmas. Both EE-Leo and ICT, under existing agreements with RCA, can manufacture the new Spectra 70 line. Hitachi (in Japan) is reportedly "very interested" in getting production rights, as Siemens & Halske (Germany) recently did.



# What's so important about the conductivity of computer tape?

## in a word: Static!

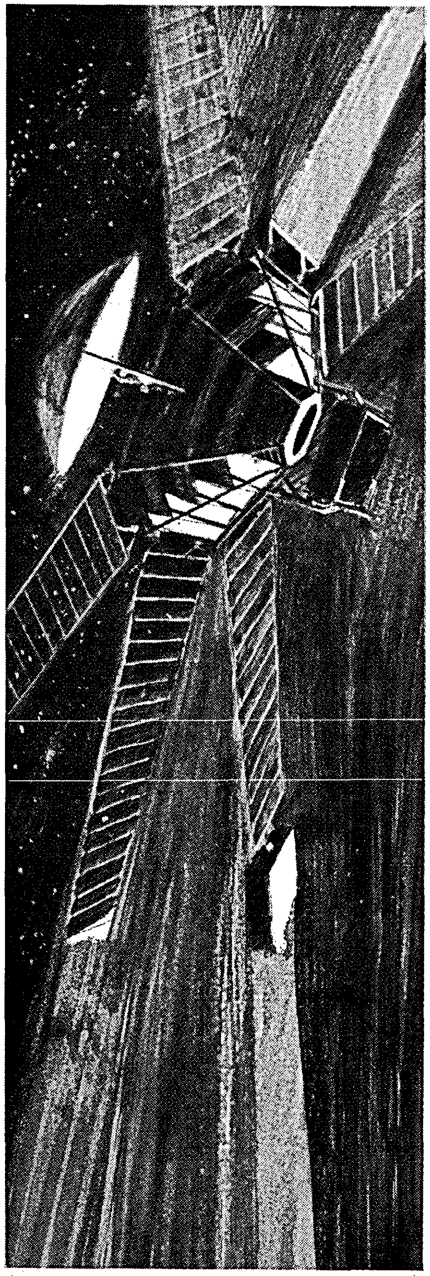
At least, MAC Panel thinks it's important. Simply because a tape with high conductivity bleeds off, or absorbs, static charges built-up by friction. And this static is a problem. It prevents uniformity of the tape's motion inside the vacuum columns — too much static and the tape will actually adhere to the sides of the column. Static affects the lateral conformance of the reel wind. And, static attracts drop-out causing dust — even in the most rigidly controlled atmospheric conditions. ■ High speed transports . . . polyester base materials . . . all contribute to static build-up. So you see, highly conductive tape is important. And from coating formulation to final packaging, MAC Panel's Computer Tape is tested to assure maximum conductivity. In fact, ten times better than current military specifications. ■ Sounds simple, but it's the result of extremely critical quality control in manufacturing. And, it's one more reason why MAC Panel Computer Tape gives you assured performance . . . ask your MAC Panel representative for some of the other reasons.

**MAC PANEL COMPANY** MAC PANEL **High Point, North Carolina**

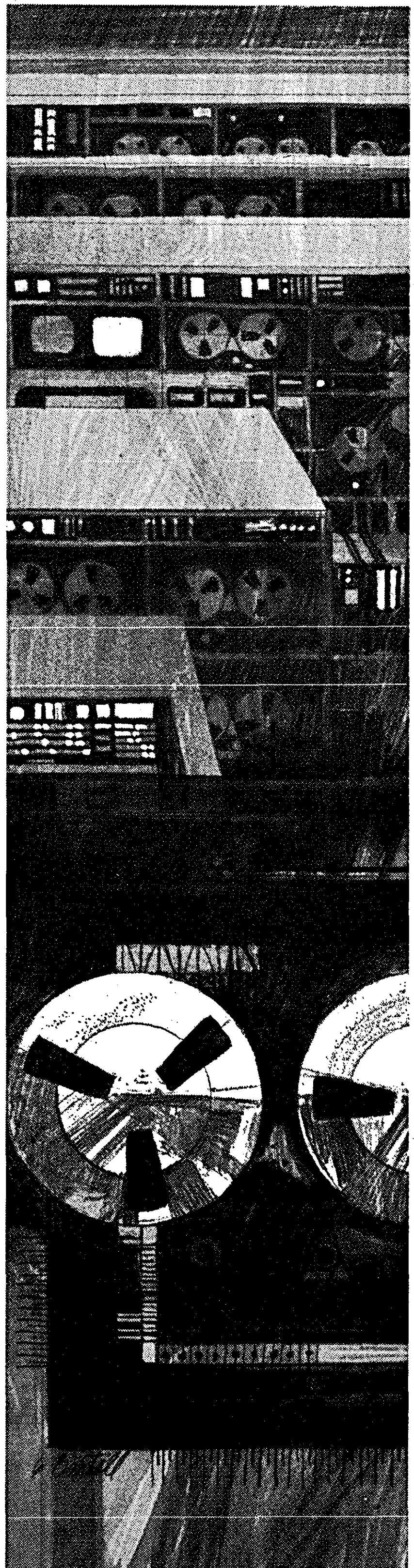
Representatives Throughout the World

CIRCLE 30 ON READER CARD

# What goes on out there...



# Depends on what goes on in here and...



# Mesa software makes it go

Your problem, let's say, is automatic checkout. Or data acquisition. Or some other real-time situation. Who can provide the best software package? Mesa.

In Sacramento, there's a major new test facility for the Saturn S-IVB stage of Apollo. Who performed software system design and computer programming for the ground instrumentation system? Mesa.

The software package exceeds 30,000 instructions. Special flexibility of the executive provides for several hours of set-up, calibration, and ambient testing prior to the actual data acquisition phase. In the data acquisition mode, the executive provides for monitoring 1 or more of 380 different measurements at a maximum instantaneous rate of 20kc. The data acquisition programs are supported by library programs, programs for automatic assignment of system elements to route measurement signals through the system, and programs for post-test reduction of collected data.

That's a very brief sample. Other current real-time projects include software for Mariner automatic checkout, and telemetry data acquisition at the Mississippi test facility. Because of Mesa's consulting work in hardware design and system engineering as well as programming, Mesa does more to optimize system performance. Take a contract that called for programming alone. Mesa debugged the hardware, too — at no extra cost.

Isn't this the kind of team you want? Find out how Mesa Does More For You (MDMFY). Write for your MDMFY report. Client Services Headquarters, 1833 East 17th Street, Santa Ana, California 92701. Or call Mesa in Inglewood, Los Angeles, Santa Ana, Washington D.C. or Huntsville.

**MESA SCIENTIFIC CORPORATION**

CIRCLE 31 ON READER CARD

# NEWS BRIEFS

## INDIANA UNIV. RELEASES SPEEDED-UP FORTRAN

Indiana Univ. has released a FORTRAN II compiler for the 7090 series which is said to compile programs on the 709 from 10 to 100 times as fast as IBM's FORTRAN under FMS II. Called FASTRAN, the system includes all of the FORTRAN language, including Hollerith literals, double precision, complex and Boolean arithmetic, and source language debugging. Greatest speed advantages are on short programs.

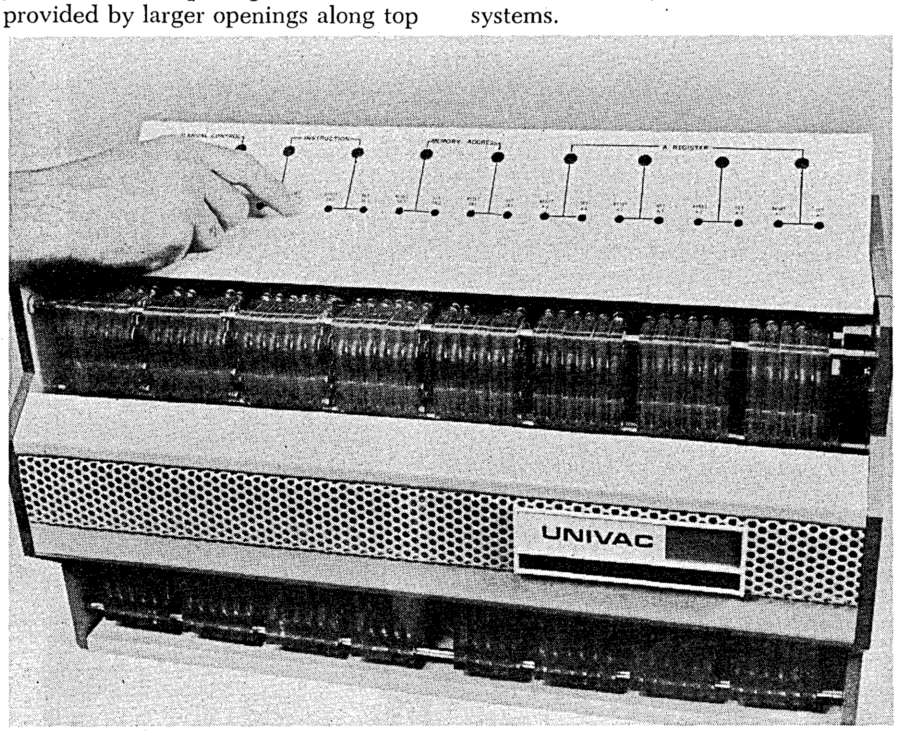
An in-core compiler which generates about 10% less object code than FORTRAN, FASTRAN has object program compilation times which are generally slightly longer than those of FORTRAN. The software system uses one scratch tape in compiling long programs, binary output is completely acceptable to the FMS-II BSS loader. The success of FASTRAN—now being examined by some 10 universities—led to its availability through SHARE as UI-FAST.

## AIR-OPERATED COMPUTER ANNOUNCED BY UNIVAC

Univac has announced an experimental general-purpose digital computer that uses air flowing through a network of plastic channels and elements to perform basic functions of an electronic computer: memory, arithmetic, control, and I/O. This model has four instructions and four four-bit words of memory.

No moving parts are involved. Programming and operating instructions are fed into the fluid computer by covering appropriate openings in the panel board, shown below, creating pressure changes in the elements adjacent to the openings. Readout is provided by larger openings along top of the panel board. A register indicator counts up to 16 in binary.

Fluid-operated systems are no competition for most electronic systems, particularly in speed, but the fluid circuit's reported low cost, reliability under extreme environmental pressures, and immunity to radiation and electromagnetic interference may be attractive features to some industrial, military, and space operations. Univac expects that techniques of the fluid computer will be used in peripheral equipment, tab and bookkeeping machines, printers, and control systems.




## FEDERAL GOVERNMENT SEEKS EXPERIENCED EDP FOLK

Without taking a written test, qualified computerites can get a job with the federal government as a programmer, systems analyst, or computer operator. Pay scale ranges from $6,050, to $10,250 (GS-7 through 12). All the positions are said to be in the Washington, D.C., area.

Those interested should consult Announcement No. 348, which carries details of experience requirements and is available from many post offices, as well as from the U.S. Civil Service Commission, Washington, D.C. 20415.

## CONTROL DATA ADDS TWO, CREATES 6000 SERIES

In the most inauspicious announcement to date, Control Data Corp. ended the year with word on the super-duper-scale 6800, which has an add time of 75 nanoseconds. It joins the 6600 and a new 6400 to form the 6000 series. There's upward compatibility. Prices range from one to "several" megabucks, and rental from $25-150K. And all three feature a central processor and 10 peripheral and control processors, all within the mainframe. The following specs apply:

| | 6400 | 6800 |
|---|---|---|
| Memory | 32-128K | 128K |
| Major cycle | 1 usec | 0.25 usec |
| Minor cycle | 0.1 usec | 0.025 usec |
| Floating add | 1.1 usec | 0.1 usec |
| Floating multiply | 5.6 usec | 0.25 usec |
| Delivery | 12 months | 1967 |

## MICROFILM I.R. SYSTEM DEVELOPED FOR MILITARY

A microfilm information storage and retrieval system with an updating capability has been developed for the military by General Precision's Aerospace Group, Pleasantville, N.Y. The PARD (Precision Annotated Retrieval Display) system stores up to 100 microfilm images on an aperture card, and can select and retrieve a card within six seconds.

Enlarged images displayed on a screen can be coded to show that updated data is available; the document with that code is then retrieved and the information mixed electronically with the original document. Storage capacity is up to 500,000 documents on 5,000 cards, with modular expansion possible.

### PRINTING PATENT AWARDED TO GE COMPUTER DEPT.

A patent for a high-speed printing technique has been granted to T. M. Berry of GE's Computer Dept. The Berry process uses ferromagnetography, a technique of printing on paper from a latent image magnetized onto a metal sheet or drum. Magnetic iron particles applied to the image are transferred to the paper during the printing process.

Unlike electrostatic printing, used in office copiers, the image is not destroyed each time a print is made from the negative. The process thus makes possible unlimited copies, and the latent image can be stored for future use.

### FIRST AMBILOG 200 GOES TO CALTECH

Adage Inc., Cambridge, Mass., has delivered the first AMBILOG 200 hybrid computer to the Kresge Seismological Laboratory of the California Institute of Technology in Pasadena. Using AMBILOG's advanced techniques of waveform pattern recognition, such as digital filtering, Caltech scientists will conduct research on distinguishing underground nuclear explosions from other seismic events.

The Caltech computer accommodates 32 channels of analog input signals and has output capacity for 32 channels of analog output data, with A-D and D-A conversion equipment. The 2 usec core memory has a 4K-word capacity. A mag tape unit which records at a 96 KC character rate is included.

CIRCLE 148 ON READER CARD

### SYSTEM/360 COMPATIBLES UPPED TO SEVENTEEN

In addition to the 1401, 1440 and 1460, 14 more currently installed IBM computer systems are now compatible with System/360. They include the

1410, 7010, 7044, 7070, 7074, 7080, 7090, 7094, 7094II, and 709. Compatibility features for these systems couple read-only storage with programming systems techniques, a procedure known as emulation. This permits the addition of a complete instruction set—representing the currently installed system—to the organization of a particular 360 configuration.

Performance will range from a minimum of one-half the overall system speed of the 7080, when its programs are emulated on the 360/62, to up to twice the speed of the 1410, when its programs are emulated on the 360/50. The new emulators rent for $600 to $700 a month and cost from $25,000 to $29,400. Delivery of the first emulator is scheduled for late '65.

## IBM DEVELOPS SOLID-STATE SCANNER

An experimental solid-state optical scanning device which converts images into electrical signals has been developed by IBM. The dime-sized Scanistor is made of silicon and is sensitive to both ordinary light and near infrared radiation.

Scanistor's predecessors, such as electric-eye photocells in cameras, require many specially arranged cells to detect a pattern of light and a corresponding number of output amplifiers to transmit it. In contrast, the IBM device provides on a single output wire an analog voltage that represents both the amount and position of light shining on its surface.

In reading punched cards or tape, or printed documents, the image may be moved past the Scanistor to provide a complete scan of the image area. To scan a stationary image, a moving mirror can be used to reflect the image, line by line, onto a Scanistor, or several Scanistors can be mounted side-by-side and their outputs combined into one picture.

● An electronic system which enables petroleum companies to automatically determine the amount of gasoline being dispensed at service stations has been developed by Motorola. In the system, impulse transmitters are installed on each pump at the service station. The impulses, each representing a gallon of gasoline, are added up and stored in core memory. When the central console automatically dials the station, the stored information is sent back through telephone equipment. The information, including station identification number, time interrogated, and number of gallons, is fed to an electric typewriter and punched on tape, station by station. Up to 150 stations can be polled in an hour. The sending-receiving equipment at the outlet costs about $1200; telephone charges, including Dataphone, are $10 to $20 a month; and automatic typewriter, tape punches, and telephone dialing equipment go for under $10,000.

CIRCLE 149 ON READER CARD

● The Computer Personnel Research Group will hold its third Annual Conference on June 17 and 18 at Washington Univ., St. Louis, Mo. A call for papers has been issued, with abstracts and summaries in quadruplicate to be submitted by March 1 to Prof. Malcolm Gotterer, 120 Boucke Building, Pennsylvania State Univ., University Park, Pa. 16802.

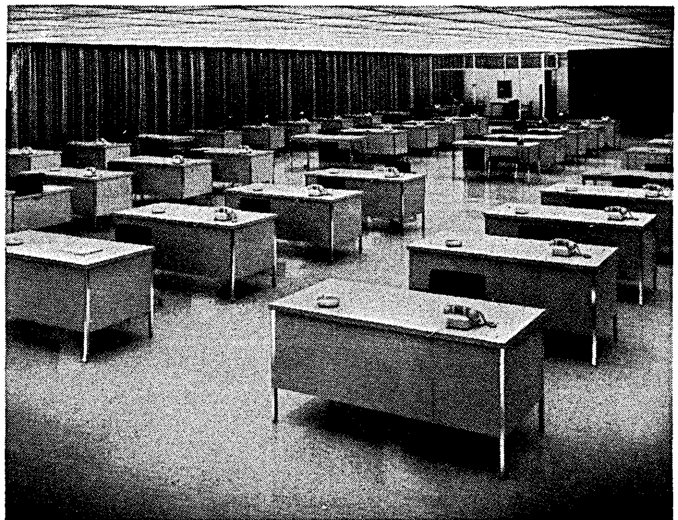
● "Delivery of the 1000th desk-top analog computer"—a PACE TR-48—has been made by Electronic Associates, Inc., West Long Branch, N.J. The TR-48 joined the TR-10 at the Indiana University School of Medicine, Indianapolis. It will initially be used for simulation and on-line data reduction.

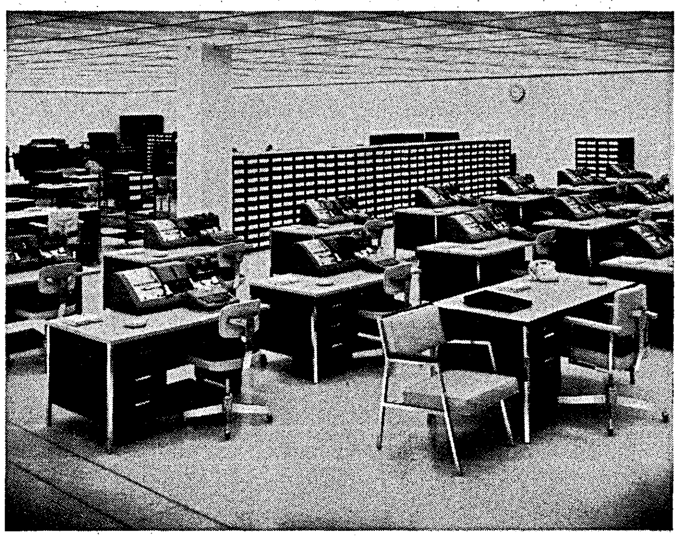
● Computer Control Company's hardware and technology is being made available to Bunker-Ramo on a worldwide basis as a result of a recent agreement between the two companies. The arrangement will permit Bunker-Ramo to market a broader line of computer systems, the first of which will be the BR335.

● Software firm Informatics Inc. is offering a standard warranty for digital computer programs. The warranty assures purchasers of fixed-price programs that Informatics will correct all errors which result in failure of the program to perform according to approved specifications. Such errors must be reported within three months after the purchaser has given final acceptance of the program.

● The 74-year reign of square corners is over. All IBM general-purpose punched cards are being shipped with round corners, unless otherwise specified. Round-corner cards, introduced a year ago by IBM,

# We go farther than the DP department





## *Steelcase/Datacase can furnish every office—beautifully!*

■These offices of the New York State Electric & Gas Corporation at Etna, N. Y., are excellent examples. For its general and executive offices, the utility chose Steelcase desks, chairs and tables...for its DP department, compatibly-styled Datacase auxiliary units. Because all Steelcase/Datacase units are completely coordinated in design, color and function, the entire office complex has a look of unity that will retain its freshness for years. Equally important, this sturdily constructed equipment is as efficient as it is attractive. Your local Steelcase/Datacase dealer offers you this same broad choice. And, he delivers, installs and services quickly, knowledgeably. Call him, he's in the Yellow Pages. Or, write Dept. E. Steelcase Inc., Grand Rapids, Michigan; Los Angeles, California; Canadian Steelcase Co., Ltd., Don Mills, Ontario.

**DATACASE®/BY STEELCASE**

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**CIRCLE 35 ON READER CARD**

now reportedly account for two-thirds of the company's general-purpose card volume.

● Raytheon Computer, Santa Ana, Calif., has decreased the price of the 3856-word memory 250 from $32,400 to $23,500 and added a FORTRAN II compiler. The configuration includes an I/O typewriter with paper tape punch. A 250 with a 2320-word memory is available for $22,000. Also, accessory items now include a new digital graph recorder for producing 29½-inch graphs. Cost: $9500.

● Four years after its first computer delivery, NCR has hit the 1000 mark with the installation of an NCR 315 system at Fidelity Mutual Life Insurance Co., Dayton, O. The 315 will process insurance records for the company.

● IBM is setting up a time-sharing service through which a New York-based 7040 can be used simultaneously by up to 40 problem solvers at different locations. The user will communicate through a 1050 in his company, and it is claimed he'll never have to restart again. Contract is either for 25 hours/month for $325 or 75 hours/month for $760. The 1050 rents for $128 and costs $6,170. The center will make use of IBM's QUICKTRAN time-sharing software package.

● More than 100 computerized typesetting systems are in use or on order, according to a recent survey by Composition Information Service, Los Angeles, Calif. Systems leading in installations and orders are Mergenthaler Linasec (35) and IBM 1620 (25).

● Management control technique, PERT/COST, is now being implemented on the Univac 1107 system and will be available for the 1108.

● Retaining but two computer centers, RCA last month sold its Washington D.C., center to CEIR Inc. While no price was announced, the 501 and 301 systems were said to be valued originally at one megabuck. This gives CEIR two centers in the D.C. area, and RCA has a Wall St. office in New York City and a center at Cherry Hill, N.J.

● American Can Co. has begun operation of an automatic message relay system linking more than 100 company plants and offices. The relay center, in Oak Brook, Ill., uses an IBM 7740, is expected to handle over 1½-million messages a year, save over $200K annually.

● A computer science institute for college teachers of engineering, math, and the physical sciences will be held at the Univ. of Missouri at Rolla, June 7 to July 30. Sponsored by the National Science Foundation, the institute will offer instruction on the numerical and statistical methods of digital and analog computing. Inquiries and applications should be addressed to Prof. Ralph Lee, director of the UM institute. Application deadline: February 15.

● Prospective 360-users have a new toy to behold. Currently running on the IBM 1440/60, and being developed for the System/360, is software that handles up to 40 on-line typewriter terminals. It is capable of speeding the preparation and revision of ordinary text material, such as technical manuals and proposals, enables use of a typewriter as a desk calcula tor, as well as message transmission from one to any other on-line terminal. It is currently being used for program assembly and writing on tape, subsequently to be compiled on another machine.

The 1440/60 version of the program will be available in the second quarter of '65.

● Florida State Univ. has tied in to an IBM computer system at Yorktown Heights, N.Y., to experiment with possible uses of the computer as a teaching aid on all grade levels. In the project, the computer will send course instruction which is based upon a student's performance in previous lessons. The student will respond through an on-line typewriter.

● Two more of those giant 6600's from Control Data Corp. have been ordered. The super-scale hardware goes this year to New York Univ.'s Courant Institute of Mathematical Sciences, and will be used to develop computer methods for applied math and math physics, through numerical and non-numerical techniques. Another system has been purchased by Kirtland AFB, Alburquerque, N.M., for nuclear blast studies.

● A 7.4-megabuck contract for seven display systems to be used in the automatic pre-launch checkout of the Saturn V vehicle has been awarded by NASA to Sanders Assoc. Inc., Nashua, N.H. Each system is capable of driving from two to 20 display consoles 54 consoles are specified initially) and includes data conversion equipment that provides hard copy, slide reference and closed circuit TV capabilities. Installations will be at Cape Kennedy and Huntsville.

● In the software field, Computer Control has announced FORTRAN IV for the DDP-116, NCR reportedly will soon have FORTRAN II and IV for the 315, and Univac has implemented APT III on its 1107 and 1108 computers.

● Third NASA contract to Computer Applications Inc., New York City, is a three-year, one-megabuck deal for "computing services" at Goddard Space Flight Center, Greenbelt, Md.

● A contract for a nationwide 30,000-mile communications system has been awarded to Western Union by the Travelers Insurance Co. for use with the latter's centralized dp system. Most of that distance will be accommodated by WU's new transcontinental microwave network. Installation begins this month, is slated for completion by the end of '66, by which time the firm's field offices will be linked to the computer center in Hartford, Conn.

● Univac has opened its fourth punched-card manufacturing facility, the third in the last two years. The plant at Tiffin, Ohio, has an initial capacity of 30 million cards weekly.

● Three independent hospitals have joined in a cooperative venture to share a central computer for what might be termed a "real-time" accounting operation. Central hardware is an IBM 1440 with disc file. Additionally, each hospital has at the check-in desk a 1050 teleprocessing terminal which is used to produce patient billing when he checks out. And at such stations as the pharmacy, X-ray, and examination labs, 1001's are used to transmit chargeable expenses to the central computer. The three hospitals are the Memorial, the Delaware, and the Wilmington General in Wilmington, Del.

● An optical scanner to process its flight tickets and auditor's coupons has been purchased by United Air Lines from Recognition Equipment Inc., Dallas.

## people IN DATAMATION

■ Planning Research has branched out into the field of numerical control and has appointed L. Ray Reeves director, assisted by Francis J. Garvis. Both were formerly with Univac Div. of Sperry Rand.

■ Robert D. Holland has been named executive vp of CEIR, Inc., Wash., D.C. He succeeds George W. Dick, who has been elected president of CEIR's American Research Bureau.

■ The Board of Directors of Epso, Inc., Westwood, Mass., has elected Samuel J. Davy president. He replaces John H. Beedle, who resigned in May.

■ Don D. Bushnell has left SDC and taken up residence at the Brooks Foundation, Santa Monica, Calif.

■ John D. Gast will head a European field office for the United Research Services, Burlingame, Calif. He will lead a group of URS systems engineers and programmers engaged in designing and programming Army command and control systems.

■ Jules Mersel has been appointed director, Synthetic Intelligence Systems of Informatics, Inc., Sherman Oaks, Calif. He will explore the application of computer processing of natural language.

■ A. R. Wilde has been appointed manager of systems programming services for Univac Div. of Sperry Rand Corp. He was formerly with International Computers & Tabulators.

■ James N. Cast is the new chief of computer development at Telemetrics, Inc., Santa Ana, Calif. He has been with the company since 1963.

■ Arthur P. Stern was named director of Western Technical Center Operations of Bunker-Ramo Corp. at Canoga Park, Calif. and Dr. Harry Letaw, Jr. was appointed director of the eastern operations at Silver Spring, Md.

■ Thomas W. Martin has been appointed Manager of Applications Programming for Scientific Data Systems, Inc., Santa Monica, Calif.

# NEW PRODUCTS

### line printer
Models 1931, 32, and 33 have speeds up to 1,350 lpm with 96, 120, or 160 character positions to the line. INTERNATIONAL COMPUTERS AND TABULATORS LTD., London, S.W. 15, England. For information:

CIRCLE 200 ON READER CARD

### hybrid interface equipment
The HI Series permits fully integrated operation of any of six SDS computers with most general-purpose analog computers. The series includes the basic HI 21, which serves as a junction box between digital computer and other system units and provides power supply isolation between digital and analog computers; HI 31 D-A and HI 41 A-D conversion controls, both for up to 128 channels, which operate with integrated circuit converters, sample-and-hold amplifiers, and multiplexers. Software includes SDS hybrid programming library. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For information:

CIRCLE 201 ON READER CARD

### lister-printer
Series N models have outputs from four to 32 columns at speeds to 40 lines/second. The rotary-drum printers can be numeric or alphanumeric, and a replaceable code wheel allows changing of input codes. DI/AN CONTROLS INC., Boston, Mass. For information:

CIRCLE 202 ON READER CARD

### computer tape reels
Aluminum reels feature a precision center aperture, shock-resistant flanges, and colored facing rings. A 10½-inch size is now available, 8½-inch after Mar. 1. MEMOREX CORP., Santa Clara, Calif. For information:

CIRCLE 203 ON READER CARD

### planning aid
With Planalog, management network planning technique, a program is planned on an aluminum channel board which has parallel plastic gauges to represent activities to be performed simultaneously. Each gauge is beveled to provide five faces for a description of the activity and four lines of information about it. Edge of board is unit-scaled for time readings. Thin steel fence modules placed across channels separate sets of activities. PLANALOG INC,. Philadelphia, Pa. For information:

CIRCLE 204 ON READER CARD

### disc file
Model dp/f-5022 is offered in capacities ranging from 8-32 million characters on a full complement of 16 discs, with up to 128 million characters in special configurations. A logic unit providing simple interface is included. DATA PRODUCTS CORP., Culver City, Calif. For information:

CIRCLE 205 ON READER CARD

### process computer
Designed for process use, the model 97600A has a 1.75 usec core memory cycle time. Options available are a high speed arithmetic unit and wired-in double precision circuitry.The system is compatible with the 97600 and includes a FORTRAN II compiler. FOXBORO CO., Foxboro, Mass. For information:

CIRCLE 206 ON READER CARD

### tape transport
The incremental MT-SW tape transport records 300 characters/second on mag tape, with bit positioning ac-

## PRODUCT OF THE MONTH

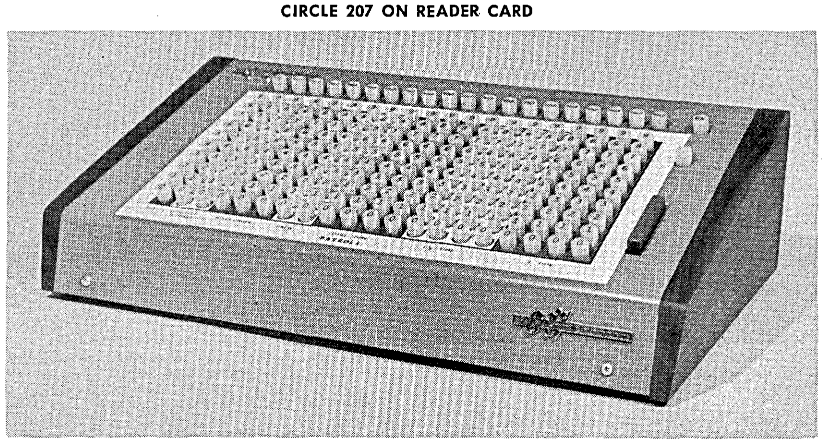
A solid-state, source data gathering unit has the name, C-DEK (Computer Data Entry Keyboard). Applications include labor data gathering, automatic weight recording, store ordering, and inventory control. Among attachments available are a card and/or badge reader, adding machine (for hard-copy output or to produce control totals), timeclock, and typewriter (for alphanumeric printout). Output can be on paper tape, punched cards, mag tape—or unit can go on-line.

Visual verification of data before input is accomplished with keys that light up when depressed; only one light in each column is allowed to be on at any one time. Use of a record bar then inputs all information at once.

Changing applications requires replacement of a program card, a process said to be easier than changing panels on an accounting machine. The card modifies keyboard format and the required output sequence.

In a catalog order entry application, orders from outlying locations enter the C-DEK via paper tape; the internal logic checks completeness of item information (color, size, etc.) before order is accepted; and output paper tape is transmitted to warehouse where orders are filled. COLORADO INSTRUMENTS INC., Broomfield, Colo. For information:

CIRCLE 207 ON READER CARD



curacy of ±0.0005 inch. Packing density is 200 or 556 bpi; tape speed is 7.5 ips. A single capstan tape drive is used for tape motion control. POTTER INSTRUMENT CO., Plainview, N.Y. 11803. For information:

CIRCLE 208 ON READER CARD

### tape punches

Series 500 rack mounted tape punches have synchronous operation up to 50 cps, asynchronous, up to 30 cps. Standard tape accommodated is 1, ⅞, or 11/16 inch. Tape feed mechanism consists of a positive one character/cycle reciprocating rotating ratchet wheel and solenoid controlled interposer. ROYAL MC BEE CORP., INDUSTRIAL PRODUCTS DIV., Hartford., Conn. 06106. For information:

CIRCLE 209 ON READER CARD

### data acquisition and control system

Designed to record and measure a wide variety of data as it is generated in a plant or laboratory, the 1800 can gather information at up to 8 million bps. Features include a single-disc storage cartridge capable of storing 512K words, and pluggable circuitry packages. The 1800 can be linked to 360's and can be equipped to perform functions of many analog controllers. The CPU is available with memory cycle times of 2 or 4 usec combined with four 32K word memories. IBM DATA PROCESSING DIV., White Plains, N.Y. For information:

CIRCLE 210 ON READER CARD

### report covers

Covers, for binding unburst continuous tab reports, are available in 125, 200, and 290-lb. stock weights. Cover stocks are 8½ or 11 inches deep and have 14 widths, from 8½ to 18-15/16 inches. AMERICAN CARBON PAPER CORP., Chicago, Ill., and TARA CARBON PAPER CORP., Chamblee, Ga. For information:

CIRCLE 211 ON READER CARD

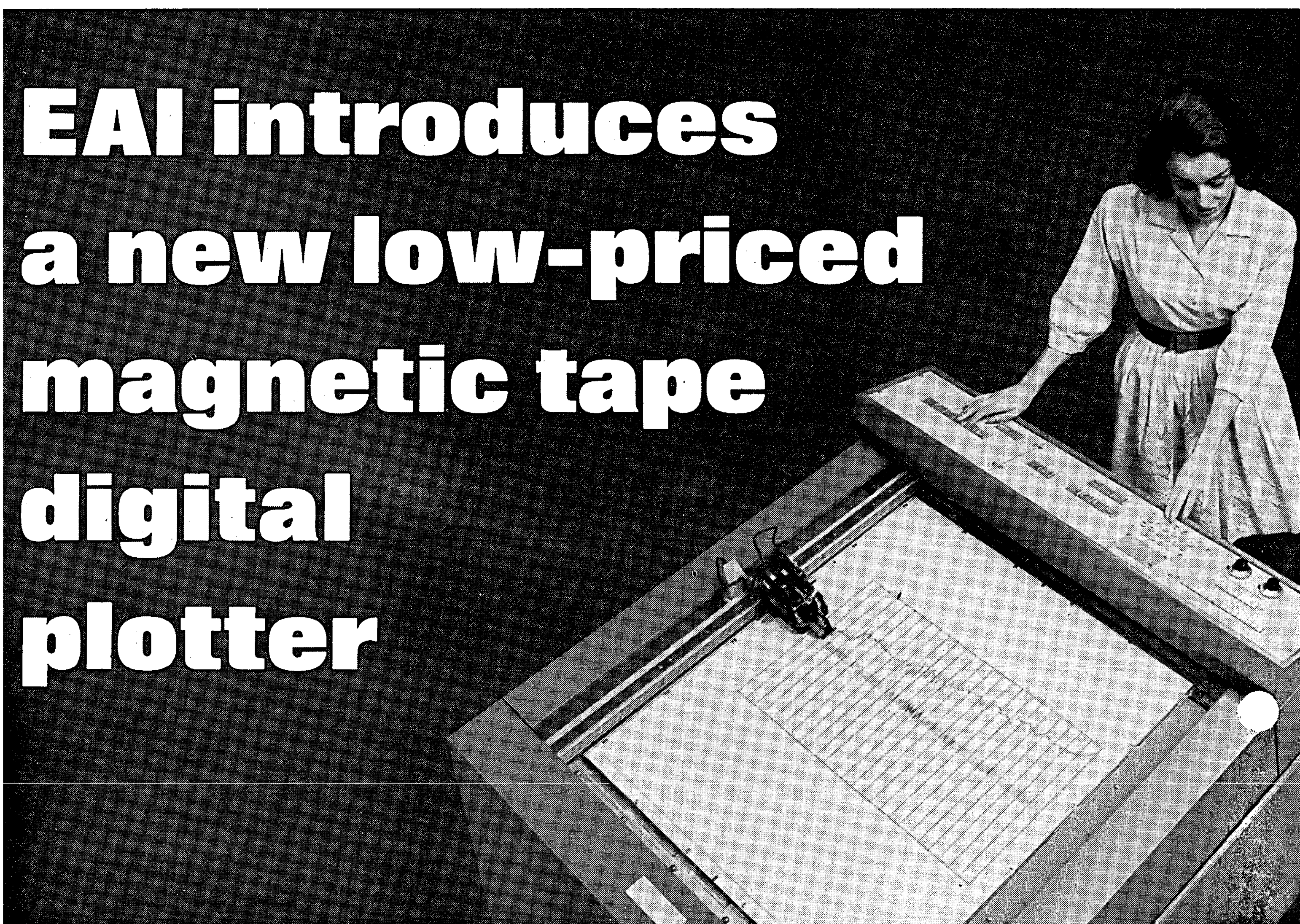
### readout device

The Series 360 rear-projection readout device displays a 2-inch-high character for legibility up to 50 feet away. Each unit can display up to 12 different messages. Individual 360 units can be grouped into a multi-unit assembly with continuous viewing screen, known as Series 370. INDUSTRIAL ELECTRONIC ENGINEERS, INC., Van Nuys, Calif. For information:

CIRCLE 212 ON READER CARD

### data transmission terminal

Kleinschmidt Model 321 combines a high-speed typewriter, photoelectric reader, and tape punch—each with a



speed range of 60-400 words/minute. Printer type drum has 64 characters. SCM CORP., New York, N.Y. 10022. For information:
CIRCLE 213 ON READER CARD

### remote control switches

Switches connected to all or selected dp machines in an installation permit mass turn-on or -off from one control station. AUTOMATIC SWITCH CO., Florham Park, N.J. For information:
CIRCLE 214 ON READER CARD

### program package

CART (Computerized Automatic Rating Technique) is designed for use with the Honeywell 200 and 2200 in trucking operations. The package applies proper freight rates to shipments and transmits rate bills to the terminals responsible for final delivery of shipments. HONEYWELL EDP, Wellesley Hills, Mass. 02181. For information:
CIRCLE 215 ON READER CARD

### seismic communications

The Seismic Communications Unit allows communication between ASI 6020 and 6040 computers and analog seismic systems. Input system has a 64-channel multiplexer, sample and hold unit, A-D converter, and supplementary logic. Output system includes D-A converter, 24 sample and hold amplifiers, and control logic. ADVANCED SCIENTIFIC INSTRUMENTS, Minneapolis, Minn. For information:
CIRCLE 216 ON READER CARD

### microfilm reader printer

Designed for engineering and newspaper applications, the F1824 will accept 16-70 mm microfilm roll, aperture card, film jacket or film sheet. Repro print time is 35 seconds. Reader can magnify image to 14 times on screen. SPERRY RAND CORP. REMINGTON OFFICE SYSTEMS, DIV., New York, N.Y. 10017. For information:
CIRCLE 217 ON READER CARD

### militarized printer

In parallel mode, the HSP-3604 can print up to 10 lps in a 26-column format with 64 characters. Serial, character-at-a-time printing allows minimum speed of 10 characters/second; average speed for a typical message is 80 characters/second. Features are a drum using 13 elastomeric torsion bearing print hammers, and paper advance system which acts only during paper feed cycle. POTTER INSTRUMENT CO., Plainview, N.Y. For information:
CIRCLE 218 ON READER CARD

### printing calculator

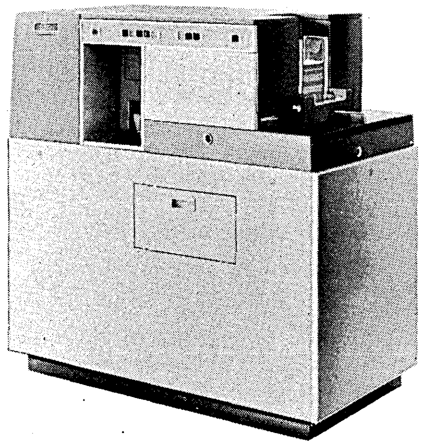
The Epic 2000 is an electronic unit that can be programmed for repetitive operations, and produces hardcopy output. Uses include invoicing, interpolation, and root extraction. Add

time is four msec, and multiplication: 0.3 seconds. LITTON INDUSTRIES, MONROE INTERNATIONAL, Orange, N.J. For information:

CIRCLE 219 ON READER CARD

### card punch

With maximum speed of 350 cpm, the 1921 punches into 80-column cards, one row at a time, at a 960-position (12 x 80) punch station. Input hop-



per capacity is about 1000 cards. INTERNATIONAL COMPUTERS AND TABULATORS LTD., London, S.W. 15, England. For information:

CIRCLE 220 ON READER CARD

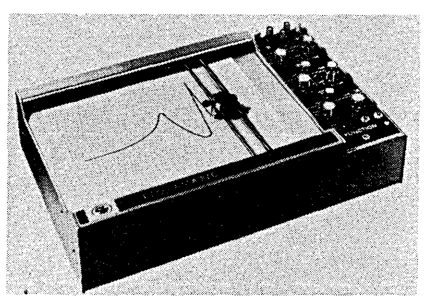
### analog computer

The small kit-form 650 is designed for use in simulation, problem solving and teaching in mathematics, electronic design development, and computer training. Included are seven operational amplifiers, two with differential input. POLYTECHNIC INDUSTRIES, TESLA RESEARCH FOUNDATION, Phoenix, Ariz. For information:

CIRCLE 221 ON READER CARD

### analog x-y plotters

The Plotamatic 820 (11 x 17 inches) and 620 (8½ x 11 inches) feature full scale accuracies of 0.2% and repeatability of 0.1%. Three input ranges are 0.1, 1, and 10 v/inch, continuously



variable between fixed ranges 0.1 to 1, 1 to 10, and 10 to 100 v/inch. DATA EQUIPMENT CO., Santa Ana, Calif. For information:

CIRCLE 222 ON READER CARD

# NEW LITERATURE

**RANDOM ACCESS STORAGE:** 18-page general information manual describes modular dp/f-5022 DISCfILE system. Included are details of application information as well as major design features, access and capacity specifications, system operation and interfacing considerations. DATA PRODUCTS CORP., Culver City, Calif. For copy:

CIRCLE 100 ON READER CARD

**ANALOG-HYBRID COMPUTER:** Six-page brochure describes model Ci-5000 analog computer which is a 100-volt analog computer system capable of handling up to 416 100-volt operational amplifiers. COMCOR INC., Anaheim, Calif. For copy:

CRICLE 101 ON READER CARD

**DISPLAY SYSTEM:** Teleregister's 200 series (including models 211, 212, and 203) are outlined. Features, storage and control, interfacing, and operation are explained. THE BUNKER-RAMO CORPORATION, Stamford, Conn. For copy:

CIRCLE 102 ON READER CARD

**PAPER TAPE COMPONENTS:** 20-page catalog describes and illustrates paper tape perforators, readers, accessories, one- and two-way data communication systems and typing systems. TALLY CORPORATION, Seattle, Wash. For copy:

CIRCLE 103 ON READER CARD

**SUPPLEMENT TO STANDARD EDP REPORT:** Brochure includes sample excerpts from the supplement, which contains a definitive analysis of the H-2200 system as well as an updated report on the H-200. Particular emphasis is placed on performance, pricing and degree of compatibility with existing computers such as the IBM 1401/1410. AUERBACH CORP., Philadelphia, Pa. For copy:

CIRCLE 104 ON READER CARD

**MILITARY COMPATIBLES:** Programs prepared on commercial computers can now operate military and aerospace computers. Eight-page brochure outlines benefits, standard software and compatibility features of the GE-600 series. GENERAL ELECTRIC CO., COMPUTER DEPT., Phoenix, Ariz. For copy:

CIRCLE 105 ON READER CARD

**CONFERENCE PROCEEDINGS:** The Computing and DP Society of Canada has published the proceedings of the Fourth Conference held in Ottawa.

"...I l

but

I felt
more and more
I was just repeating myself.
Not really learning much.
Not being pushed,
you know?

There was plenty to do.
I was busy.
It's just — I don't know —
it's like that old line
about a specialist
being someone
who knows more and more
about less and less.
That was me.
That was our whole group . . .

Everything was an emergency,
no one seemed to know
what was important —
they were too busy with
"emergencies."

*Interested Programmers*
*their resume, in confide*

151 NEEDH
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# ADVERTISERS' INDEX

## NEW LITERATURE

Included are several papers covering a wide range of current and future computing and dp applications. Price: $5. SECRETARY, THE COMPUTING & DP SOCIETY OF CANADA, 20 Spadina Rd., Toronto, Ontario.

**INFINITE ACCESS FLOOR:** Eight-page brochure contains general description, drawings, tile selection chart, and architectural specifications. TATE ENGINEERING, INC., Baltimore, Md. For copy:
CIRCLE 106 ON READER CARD

**FIRE & SMOKE PROTECTION:** Brochure shows various ways of providing early warning and best protection of dp and computer equipment. Typical applications are illustrated. PYROTRONICS, Union, N. J. For copy:
CIRCLE 107 ON READER CARD

**CARD PUNCH:** Four-page booklet describes how a desk-model bookkeeping machine and datacoupler automate the preparation of punched-card input. THE NATIONAL CASH REGISTER CO., Dayton, Ohio. For copy:
CIRCLE 108 ON READER CARD

**STORED PROGRAM SIGNAL PROCESSOR:** Programming of the AMBILOG 200 and areas of application are discussed. Subsystem including ambilogical section, the system control, the core memory, the typewriter/punched tape, and the magnetic tape are described. ADAGE, INC., Cambridge, Mass. For copy:
CIRCLE 109 ON READER CARD

**PLOTTER COMPUTERS:** Three brochures describe the Z 64 Graphomat, a tape or card controlled transistorized plotter with board sizes 21x23", 48x56", or 6x12'; Z 25 small computer system; and, Z 23 program-controlled scientific computer. ZUSE KG Bad Hersfeld, West Germany. For copies:
CIRCLE 110 ON READER CARD

**RANDOM ACCESS STORAGE:** Eight-page brochure describes the RAM device, including cartridge loading, principles of operation, performance characteristics, and specifications. POTTER INSTRUMENT CO., INC., Plainview, N. Y. For copy:
CIRCLE 111 ON READER CARD

**DATA CODER:** 12-page catalog lists and describes accessories for punched and magnetic tapes and edge-punched cards. Prices included. ROBINS DATA DEVICES INC., Flushing, N.Y. For copy:
CIRCLE 112 ON READER CARD

## NEW LITERATURE

**CORE MEMORIES:** Eight-page brochure lists features including I/O signals and gives detailed specifications for front-access coincidence current core memories. COMPUTER CONTROL CO., Framingham, Mass. For copy:

CIRCLE 113 ON READER CARD

**TAPE TRANSPORT:** Presents details of TM-11 single-capstan drive tape unit, with speeds up to 120 ips, in seven or nine-track formats. AMPEX CORP., Redwood City, Calif. For copy:

CIRCLE 114 ON READER CARD

**RECORD/REPRODUCE:** Describes system for recording and/reproducing IRIG-compatible tapes in conventional fashion while simultaneously repetitively scanning them with one of several interchangeable scanning headwheels. S. HIMMELSTEIN AND CO., Chicago, Ill. For copy:

CIRCLE 115 ON READER CARD

**HYBRID COMPUTERS:** Eight-pager describes SDS/Beckman systems, including analog, digital and interface subsystems, and standard software. BECKMAN INSTRUMENTS, INC., Computer Operations, Richmond, Calif. For copy:

CIRCLE 116 ON READER CARD

**RETAILING EDP:** 16-page booklet describes approach which enables retailers to utilize the services of an NCR dp center for processing original-entry transactions into detailed merchandise reports. Illustrations include typical merchandise inventory report, tax liability report, customer statements, profit and loss, and balance sheet. THE NATIONAL CASH REGISTER CO., Dayton, Ohio. For copy:

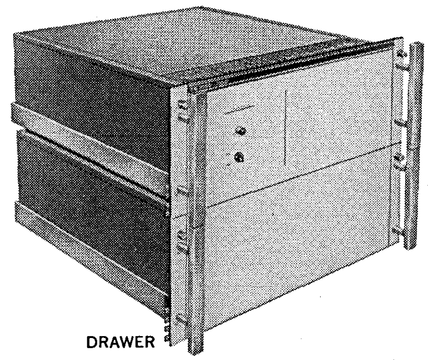
CIRCLE 117 ON READER CARD

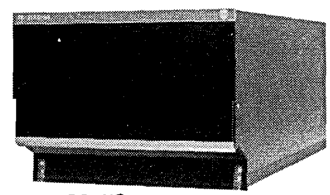
**THE ABC'S OF ADP:** Booklet offers elementary discussion of unit records, edp, hardware, programmed instructions, software, personnel, management and adp and gives selected references for source material. Single copies are free; quantity lots—$.15 ea. DATA PROCESSING MANAGEMENT ASSN., Park Ridge, Ill. For copy:

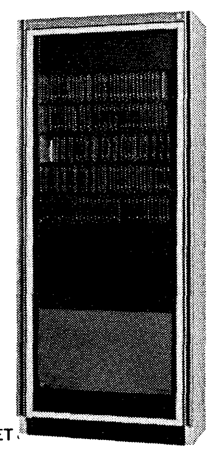
CIRCLE 118 ON READER CARD

# Announcing a new line of adaptive microminiature modems with rates up to 6,000 bits per second!

Available in three types: Drawer, cabinet or airborne. They're small; for example, the single drawer type is only 22½″ x 17½″ x 8¾″. They employ Kineplex® techniques, operate on a 3 kc bandwidth over HF and wireline. Data rates can be controlled externally. Computer-assisted design techniques have reduced prices dramatically. If you have large amounts of data to move between computers or from remote sources to computers, contact us today.


DRAWER


AIRBORNE


CABINET

COMMUNICATION / COMPUTATION / CONTROL

COLLINS

COLLINS RADIO COMPANY, Information Science Center, 19700 Jamboree Road, Newport Beach, California, phone 714-549-2911 • International, Dallas

CIRCLE 41 ON READER CARD

## NEW LITERATURE

**APPLICATION PACKAGE:** 12-page brochure describes package tailored for electrical contractors, including cost estimating and payroll programs for the LGP-30 desk-sized computer. Included are descriptions and photographs of the LGP-30, peripheral equipment, and printouts for both cost estimating and payroll. For copy:
CIRCLE 119 ON READER CARD

**COMPUTER TELETYPE INTERFACE:** Four-page bulletin explains theory of operation and gives operational and physical specifications of unit which allows a PDP computer to communicate with up to 64 Teletypes of different data rates, unit codes, and signal levels. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:
CIRCLE 120 ON READER CARD

**DISC FILE:** Technical article gives detailed description of access times, capacity, speeds, formatting of Series 4000 disc files. BRYANT COMPUTER PRODUCTS, Walled Lake, Mich. For copy:
CIRCLE 121 ON READER CARD

*Continued from page 19*

SOVIETS HAVE BIG PLANS FOR LITTLE MACHINES

Take the total computing capability of the entire U.S. (estimated at some $10^{16}$ operations per year) and that's how much power the Russians are aiming at for one application: nationwide economic planning and control. The Soviets have set up a commission for the Introduction of Computers in the National Economy, according to Prof. Edward A. Feigenbaum of Stanford's Computer Science Div.

Planned is the collection and processing of data from local firms by the Minsk 2, a solid-state, medium-scale machine. At regional levels will be computers capable of 1-2 million operations per second, and the central configuration will run 5-10 million ops/sec, says Feigenbaum, who recently returned from a month's visit to Soviet computer centers.

ANOTHER TEST FOR STANDARDS COMPATIBILITY

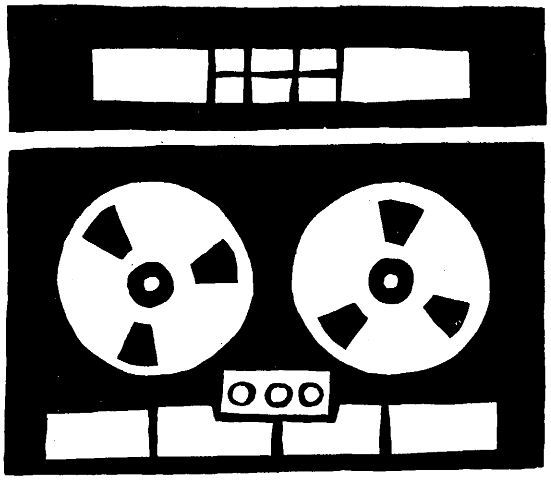
ASCII aficionados are crying foul over what they feel is the mad rush of the EIA (Electronic Industries Assoc.) to establish the RS 244 code as a standard for numerically controlled machine tools. RS 244, it seems, is incompatible wih ASCII – already accepted as the standard for communications equipment over which RS 244 might someday flow.

The incompatibility can be licked by additional conversion equipment (at additional costs), but systems-oriented users dislike the idea of continual conversion overhead . . . fear the precedence which might lead to a different standard for each process industry.

A ballot on RS 244 is slated to go out this month to "Ipsy-dipsy" (the 15-man Information Processing Systems Standards Board). It will take three nay's to defeat RS 244, which will probably bow to federal government and professional society opposition.

RUMORS AND RAW RANDOM DATA

The next DPMA Certificate Exam has attracted nearly 700 applications so far. Only 2500 had taken it up to now . . . Look for the announcement soon from RCA of the commercial availability of laminated ferrite memory planes. RCA's Jan Rajchman guesses the cost will be less than half of cores. Capacities of $10^7$ bits are expected; more than that requires more powerful sense amplifiers . . . A recent visitor to Russia noted on the desk of a top Soviet computer specialist a copy of the preliminary SHARE/IBM NPL report. It was stamped "For Internal Use Only." . . . Indiana U. has installed a CDC 3600/8090 system including 10 tapes, two printers, card reader and punch. The system will be converted to a direct-coupled 3600/3400 this spring, and will include a 64K shared memory, disc, drum and tapes. Remote stations and real-time systems will be added in the fall. . . . One man guesses that IBM is investing 1000 man-years in 360 software - 200 each for COBOL and FORTRAN, 600 on NPL . . . People interested in participating in an IEEE-sponsored workshop on Command & Control programming languages should send name, address and pertinent experience to Dr. Theodore Singer, Mitre Corp., Box 208, Bedford, Mass. . . . Control Data is demonstrating on-line use of remote consoles with 6600 in L.A. . . . GE has replaced the Capacitrix on its 415 with a hardware/software approach to 1401 compatibility . . . SDS may rack up $4-million in profits this year, will spend close to 8 megabucks on development in '65, expects its product labor costs to be reduced to 1% within two years.



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or simply *preserve* it □?

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- Operations Research
- Systems Design and Engineering
- Systems Analysis
- Computer Programming
- Software Design
- Applied Mathematics and Statistics

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**Arizona Research Center**
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# FREE Data Processing Opportunities Bulletin

***Shows the positions you could have in the field of Data Processing.***

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# NCR TOTAL EDP SYSTEMS

Programming Research
Sales Assistance
Customer Programming Support
Systems Analysis

Current expansion and future planning in the EDP area have created the following opportunities for qualified personnel who are ready to take a step forward in their career now, or within the next several months.

## Programming Research

College education plus two years or more programming experience with magnetic tape systems. Challenging opportunity in new and diverse problems in the commercial, industrial, and scientific areas.

## Sales Assistance

Education in the business, scientific, or engineering areas is desired with 2 years' experience in the EDP field. Long range interest in the sales area is essential.

## Customer Programming Support

Two years' experience is required in programming and related systems analysis with medium to large scale magnetic tape systems. Proficiency in the area of customer contact is essential. A college degree is desired but not demanded.

Other available opportunities exist in the area of SYSTEMS ANALYSIS.

These positions are in Dayton, Ohio and offer professionally rewarding challenges with a computer manufacturer in a growth position. Confidential inquiries may be addressed to:

**T. F. WADE, Technical Placement**
**The National Cash Register Company**
**Main & K Streets, Dayton 9, Ohio**

*An Equal Opportunity Employer*

CIRCLE 91 ON READER CARD

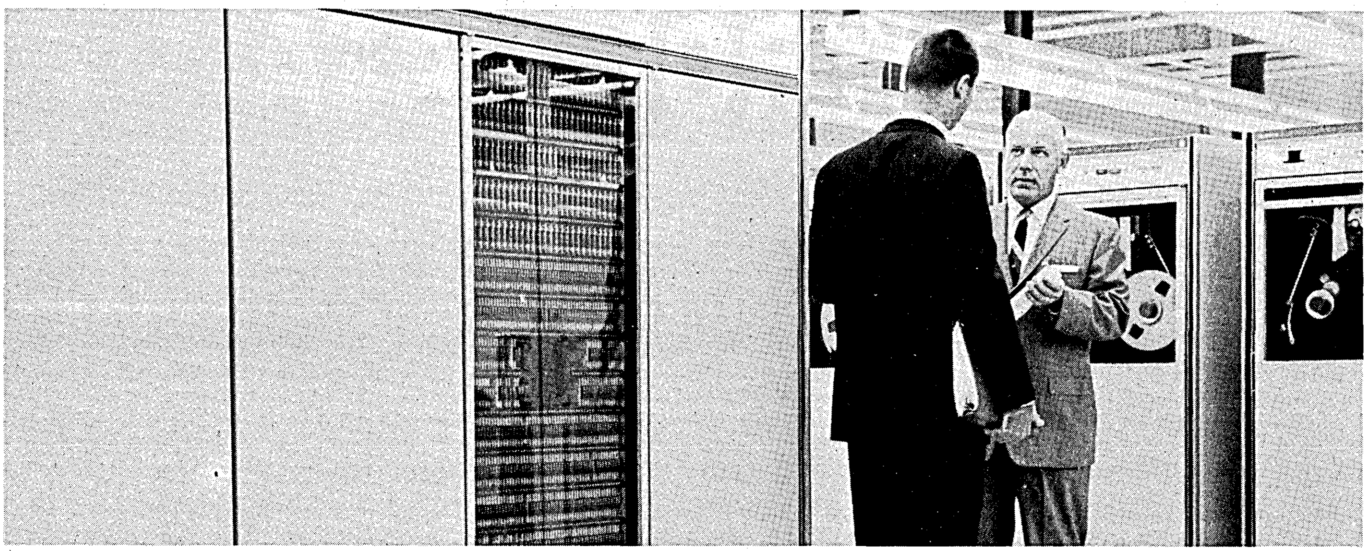
## IN PRAISE OF COMPUTERS

*(Without the computer,* Incaparina, *a life saving food for children, would not have been* calculated for *another lifetime.)—Advt.*

For rose cheeked children I lay down my guilt,
And bring you laurel for your metal brow;
The wasted crust, the brimming cup half spilt,
Are less than stone upon the conscience now;
For innocents who hold the world in debt,
Their hunger staring out at helpless skies,
Are seined like fish in your mathematic net,
And life washed back to half extinguished eyes.
I am aware your masters are wise men,
No pulse in you to race at praise or gift,
I follow instinct and not reason when
I bless your circuitry for being *swift.*

*Bessie F. Collins*

# EXTEND YOUR CAREER EXTEND YO



## Help us extend our capabilities

A large-scale expansion in computer and data systems development at Collins has opened many ground-floor opportunities for hardware and hardware-oriented people. Positions are in Cedar Rapids, Iowa, Dallas, Texas, and Newport Beach, California.

### SENIOR TECHNICAL ADVISOR

A BSEE degree is required, as well as 10 years' experience in design and development of digital hardware, including circuits, memory, logic and systems, and packaging. He must be hardware-oriented but also have programming experience and knowledge. He will serve on the senior technical staff to the assistant vice president and director of the Data Systems Engineering Division to advise in all aspects of computer hardware and system design and development.

### DIAGNOSTIC PROGRAMMERS

These men will have a BSEE degree and possibly a master's degree, as well as 2 years' minimum experience in writing factory and/or field diagnostic programs for digital computer hardware. Vast knowledge of digital equipment organization is necessary. These men will write diagnostic programs for factory test and for field maintenance of digital equipment. They will formulate factory and field test philosophy and procedures.

### DIGITAL CIRCUIT DESIGNERS

At least 2 years' experience in development of high-speed digital logic circuits is required, as is a BSEE degree. Work includes development of state-of-the-art, high-speed, digital logic circuits. Applications of these and microelectronic circuits to digital functions and equipment, coping with interface problems including interconnects, transmission lines, terminations, etc. are involved.

### MICROPROGRAMMERS

A degree in electrical engineering or mathematics is preferred. These men should have one or more years' experience in (1) logic design, particularly arithmetic and control units and/or (2) machine language computer programming. These positions involve development of stored logic routines for advanced microprogrammed computers which execute complete, comprehensive instruction including fixed and floating point operations.

### MEMORY DESIGN ENGINEERS

A BSEE degree is necessary with a master's degree desirable, along with 2-8 years' experience in core memory design and/or solid state circuit design. This includes participation in the design, specification, development and test of memory arrays and electronics for high-speed core memories.

### LOGIC DESIGNERS

At least 3 years' continuous experience in computer logic design is required, as well as a BSEE degree. The area of endeavor includes the design and development of digital computer equipment.

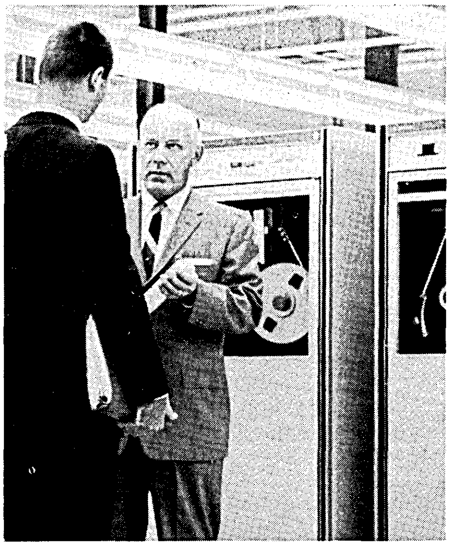
Send complete resume to one of the following at Collins Radio Company:

L. R. Nuss
Cedar Rapids, Iowa

H. C. O'Reilly
Dallas, Texas

P. Chamberlin
P. O. Box C
Information Science Center
Newport Beach, California

CIRCLE 93 ON READER CARD



### APPLICATIONS ENGINEER (DIGITAL)

This man will have a BSEE degree or preferably an MSEE. His experience will include a broad background of 6-10 years in digital hardware design and applications engineering. He also will have some programming knowledge and experience. The work area includes the analysis of communication, computation and control systems to determine the most economical arrangement of hardware that meets both customer and Company technical requirements. He will determine requirements of and write design specifications for new hardware. Experience in program management, including system liaison and co-ordination, will be advantageous.

### SCIENTIFIC PROGRAMMERS

These men will have at least a BSEE or equivalent degree, but preferably a post graduate degree. They will have at least 3 years' experience in scientific and/or real-time programming on large-scale computers. Area of work will entail knowledge of engineering mathematics and physics.

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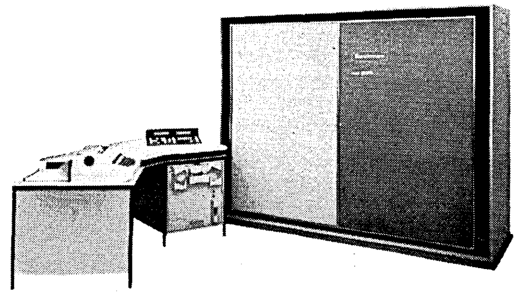
# THIS IS A BLOCK...



## . . . a building block, that is.

Designed to serve as the nerve center of major analog, digital and telemetry information systems, this important building block, better known as the Beckman 420 computer has received exceptional customer acceptance. But—this building block is now a year old and we are ready for something new. That is where you come in! We realize that significant developments in computer technology don't happen by accident and therefore, we are interested in becoming acquainted with inventive and well-trained men capable of making individual contributions in the following areas:

### SOFTWARE DEVELOPMENT

A key opening exists in this area for a senior man capable of directing the activities of programming specialists and developing unique software for a major class computer and large computer controlled data acquisition systems. An advanced degree is desired, together with seven or more years of experience, including contributions involving computer controlled information systems. Thorough knowledge of compilers, assemblers, executive programs and diagnostics is required.

### COMPUTER DEVELOPMENT

We have an immediate opening for a senior Computer Development Engineer to assume a key role in a digital computer design group. Candidates should have had responsibilities in a significant computer development program including experience in programming, logical design, machine organization and peripherals. Advanced training is preferred, together with evidence of the ability to make indivdual technical contributions.

### SYSTEMS DEVELOPMENT

Several openings now exist for senior men with advanced training in physics or electronics and several years of experience in the development phases of large computer controlled information systems. A detailed knowledge of analog, digital and telemetry hardware is required, although the prime responsibility rests in the development of major systems proposal efforts. The men we are seeking should combine a high degree of igenuity with a desire to make significant individual technical contributions.

If your training and technical interests are compatible with our immediate requirements, we would definitely like to hear from you and invite you to contact Mr. R. C. Wise or Mr. T. K. Williams immediately.

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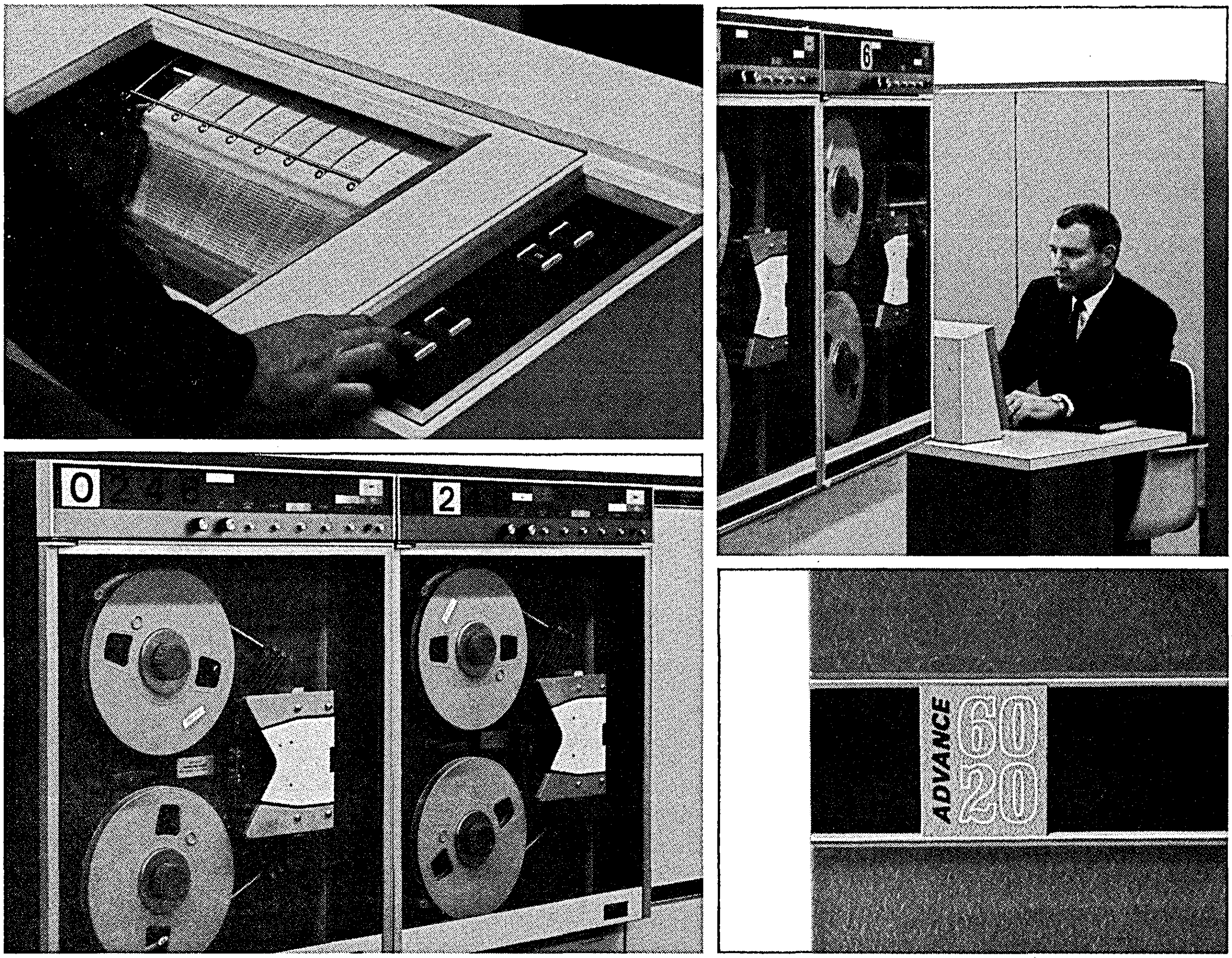


**From ASI's continuing program of new product development**

# This computer offers more productivity per dollar than any in its class–the ASI 6020

Compare the computing systems offered in the low cost scientific and on-line systems range. Other computers offer some important features, but only the *ADVANCE* Series 6020 from ASI offers *all* of the features required to best satisfy your needs. Consider the complete instruction repertoire with rapid execution times such as—add 3.8 microseconds, double precision add 12 microseconds.

Three index registers and successive indirect addressing simplify programming operations. ☐ Multilevel interrupts are provided for control requirements—real time, data communication, etc. ☐ The Programmed Instructions feature allows special subroutines to be handled as hardware instructions. ☐ Input/output rate of 180,000 words per second per channel. ☐ A memory with a 1.9 microsecond cycle time which is directly addressable to 32,768 24-bit words. ☐ One pass FORTRAN II and one pass symbolic assembler allow for complete batch processing without operator intervention. ☐ Low purchase price of $73,500 for the central processor, $79,500 for basic system including typewriter, paper tape and buffered input/output channels. ☐ As is true with all computers in ASI's *ADVANCE* Series, the 6020 is packaged to offer a versatile and completely modular method of installing the system to meet your exact needs.

We would like to tell you more about the 6020 and ASI's Customer Support Program which helps you get the most out of your computers. In addition, you may wish information on the larger member of the *ADVANCE* Series, the high performance 6040 Computer. Contact an ASI representative today.

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**ADVANCED SCIENTIFIC INSTRUMENTS**

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*Continued from page 21 . . .*

**FEDERAL COMPUTER STUDY DUE FOR RELEASE**

Resting on the desk of BuBudget director Kermit Gordon, at long last, is a finished draft of a comprehensive report on computer management policies and practices of federal agencies. The top-level advisory committee, chaired by ex-Georgia Congressman Robert Ramspeck, has been wrangling over the report for some months, held its last meeting early in December. Barring any major last-minute changes by Gordon, it's expected to go to the President and Congress early this year. Betting is that the report will be blandish in its findings and recommendations, with distinct differences of opinion regarding the conduct of government computer operations artfully buried in the prose.

**U.S. DELAYS JUMBO SYSTEMS FOR FRANCE**

Export licenses have been requested and are being held up for the shipment to France of two gee-whiz computer systems (valued at between 10-20 megabucks), which would presumably be employed in analyzing and processing information relating to nuclear tests. Hardware is reportedly STRETCH-like or in high end of 360-s, plus a new and large CDC system. U.S. decision awaits rereading of the Partial Nuclear Test Ban treaty to see if delivery of the system could be construed as contributing to the proliferation of nuclear arms.

If so, such usage might run counter to the language of the treaty, which prohibits in broad terms any action tending to encourage nuclear testing in the atmosphere. It could also run counter to standard U.S. policy of discouraging efforts by other nations to join in the nuclear arms race. Government spokesmen were at pains to make the point that the delay was not aimed at France per se, and that the same thing might happen to any other nation, but this rationale isn't likely to convince General DeGaulle that he hasn't once more been put upon by Uncle Sam.

**CSC LEFT AT ALTAR BY DOC. INC.**

The planned acquisition of Documentation Inc., Washington, D.C. information retrieval specialists, by Computer Science Corp., El Segundo, Calif., came a cropper at the last minute when Doc. Inc. chairman Mortimer Taube and president Eugene Miller cast their ballots against the deal. Three other Doc. Inc. directors voted to accept the CSC offer of a one-for-three exchange of stock, but a bare 3-2 acquiescence wasn't enough for the El Segundoites who would have to contend with the nay-sayers as stockholders and ranking divisional officers.

Reportedly, disenchantment of Taube and Miller stemmed from doubts about CSC's financial stability, the fear that Doc. Inc. people would be replaced by Californians and the possibility that a major Doc. Inc. contract with NASA would be jeopardized by a merger with CSC. The latter's purchase of ITT's Communication Systems and Intelcom divisions remains alive, however, leaving CSC within spitting distance of being a $17-million corporation.

# DATAMATION FEATURE INDEX—July-Dec. '64

## JULY

**Performance Measurement p. 24-30**

Two articles highlight the need for measurement in two critical areas: systems and software. Robert L. Patrick classifies installations by their environment, required response and applications, and attempts to ease the task of measuring system performance. Ascher Opler discusses factors that affect software performance, the influence of computer size and modularity, measurable characteristics of compilers, ground rules for testing relative software performance, and separation of software and hardware characteristics.

**The New Programming Language p. 31**
by Daniel D. McCracken

Article outlines the origin of NPL, compares it to existing languages, gives features and examples of NPL capabilities, and guesses at its future.

**Testing Real-Time Systems, Part I p. 42**
by Robert V. Head

First of two-part article covers development and management of test procedures, including programs, equipment subsystems, and combinations of equipment and software. Identified are characteristics of real-time systems that both fortify the need for preconversion testing and make such testing harder to carry out.

**Evolution of the Programming System p. 51**
by Mark Halpern

Paving the way for the creation of a new programming system (see Dec. '64, p. 39), the author challenges the generally-accepted notion of steady progress in their development . . . classifies the compiler as an application (not a programming) language . . . expresses unorthodox conclusions about the direction such evolution should take.

**Non-Linear Programming p. 55**
by Robert E. Singer

A primer for programmers and users, this article differentiates between linear and non-linear programming. It covers practicable techniques for NLP, classifying them as analytical, direct search, and gradient search techniques. Also discussed are suggested problem-solving methods with analog computers.

## AUGUST

**Programming Languages p. 24-40**

Four articles cover various aspects of FORTRAN and COBOL. W. P. Heising comments on FORTRAN compatibility and what standards can and cannot be accomplished. Henry Oswald presents a FORTRAN language characteristic/compiler comparison matrix of 16 compilers. Stanley M. Naftaly discusses the construction of a COBOL questionnaire which assists a prospective user in evaluating compiler systems. M. D. Fimple, a user, cites his experience in selecting FORTRAN over COBOL for business dp.

**Centralizing Computer Studies p. 41**

One topic discussed at the '63 RAND Symposium was the idea of establishing a National Computer Institute. Its possible functions, sources of financial support, and operational staffing were aired and, at the close, about half of the participants favored establishing such an institute.

**Testing Real-Time Systems, Part II p. 54**
by Robert V. Head

The conclusion of this two-part article covers the levels of testing, ranging from a simulation of the environment to acceptance testing, with particular emphasis on the application programs.

## SEPTEMBER

**Computing Abroad p. 24-31**

Three articles describe industry and user activities in Australia, Japan, and South Africa. An anonymous correspondent says of Australia: "It seems fairly certain that the exciting new concept of time-shared user-on-line information processing will be quickly accepted and the 'number factory' phase bypassed." Joseph C. Berston and Ken Imada report on such difficulties in Japan as the limited market crowded by competing manufacturers, reluctance of industry to invest R & D funds, and offer year-by-year installation figures. Virginia E. Marting describes the market in South Africa, sales activities, and applications, concluding that greater pay-offs are evident in the engineering and mining industry than in business dp.

**The Mechanized Library p. 32**
by L. H. Martin

Describes elements of a document storage system that applies photographic media, optical and electronic techniques for library applications. Elements of the system have operated successfully in a laboratory environment but have not been field tested.

**Optical Handling of Checks p. 39**
by Walter Dietrich

A pilot system for automatic postal check handling in Germany is designed to handle some 22,000 accounts and a volume of 40,000 documents a day. Author details elements of the optical scanning system which, if successful, would one day handle some two million accounts and three million documents each day.

## OCTOBER

**Digital Simulation and Modelling p. 25**
by G. B. Hawthorne, Jr.

Tutorial paper covers examples, techniques and classification of simulations, applicability and feasibility of simulation studies, and advantages and dangers.

**Elections & Computer Projections p. 30**
by Dr. Jack Moshman

Covers procedures followed to project election results on the basis of early returns, within limits posed by the state of the computing art, statistical theory, and the behavioral sciences. Describes selection of key precincts, concepts of the voter model, and base line projections.

**U and the Machine p. 38**
by Christopher J. Shaw

A graphic parable on the concept of implicit programming, one of six basic ways of changing the operation of system software to make the system more responsive to a user's changing requirements.

**Computer-Generated Coding p. 59**
by James R. Ziegler

BEST, designed for business edp, is a method for generating the detailed coding for program input with an NCR 315. Includes steps in the program production, and sample application.

## NOVEMBER

**Time-Sharing p. 24-54**

Four articles on this topic begin with a discussion by E. L. Glaser and F. J. Corbato on the more meaningful aspects of this still-embryonic method of distributing computer capability. Jules I. Schwartz, in the first of his two-part article, describes the SDC time-sharing system; the scenario of a filmed report on the JOSS system at the RAND Corp. is also presented. Edited is a panel discussion on time-sharing held at the '64 national ACM conference in Philadelphia. And finally, a description of one of the latest time-shared computers, the PDP-6 by Digital Equipment Corp.

## DECEMBER

**Information Retrieval p. 24-33**

Three articles on I.R. include a discussion by Gary R. Martins on the scant progress experienced by the field, but which has generated many technical papers, and a rundown of current research activities. An application report by Charles J. Austin describes the MEDLARS system at the National Library of Medicine. Joseph Becker reports on a photochromic micro-image system by NCR, a high-density document storage medium with high-resolution capabilities.

**XPOP: A Command & Control Programming System p. 39**
by Mark Halpern

Description of a meta-language processor which may change the terms of current arguments, pro and con, about the standardization of C & C programming languages.

**The SDC Time-Sharing System — Part 2 p. 54**
by Jules I. Schwartz

The concluding installment enumerates service routines available in the system, applications being run, and the future outlook for this mode of operation.

**The shock waves of sudden stops and eddy currents around slow vehicles are elements of traffic flow studied by IBM**

There's a variety of mathematical problems at IBM. For example, mathematical models, using concepts from various subjects such as fluid mechanics, are being applied to the study of vehicular traffic flow. The variational calculus is used to study high-frequency vibrations in crystals. Non-linear free boundary problems have been solved for dipping electrical connections into a hot solder bath.

Applied Mathematics at IBM is an intriguing area in which mathematical theory and new applications often develop out of the same problem. The problems may range from structural mechanics to solid state physics and electrocardiogram research.

There are many opportunities for interdisciplinary study in science and engineering, management and operations research, or computing and programming. For a broader scope of problems to solve, write to Manager of Employment, Dept.701A,IBM Corporate Headquarters, Armonk, New York 10504.

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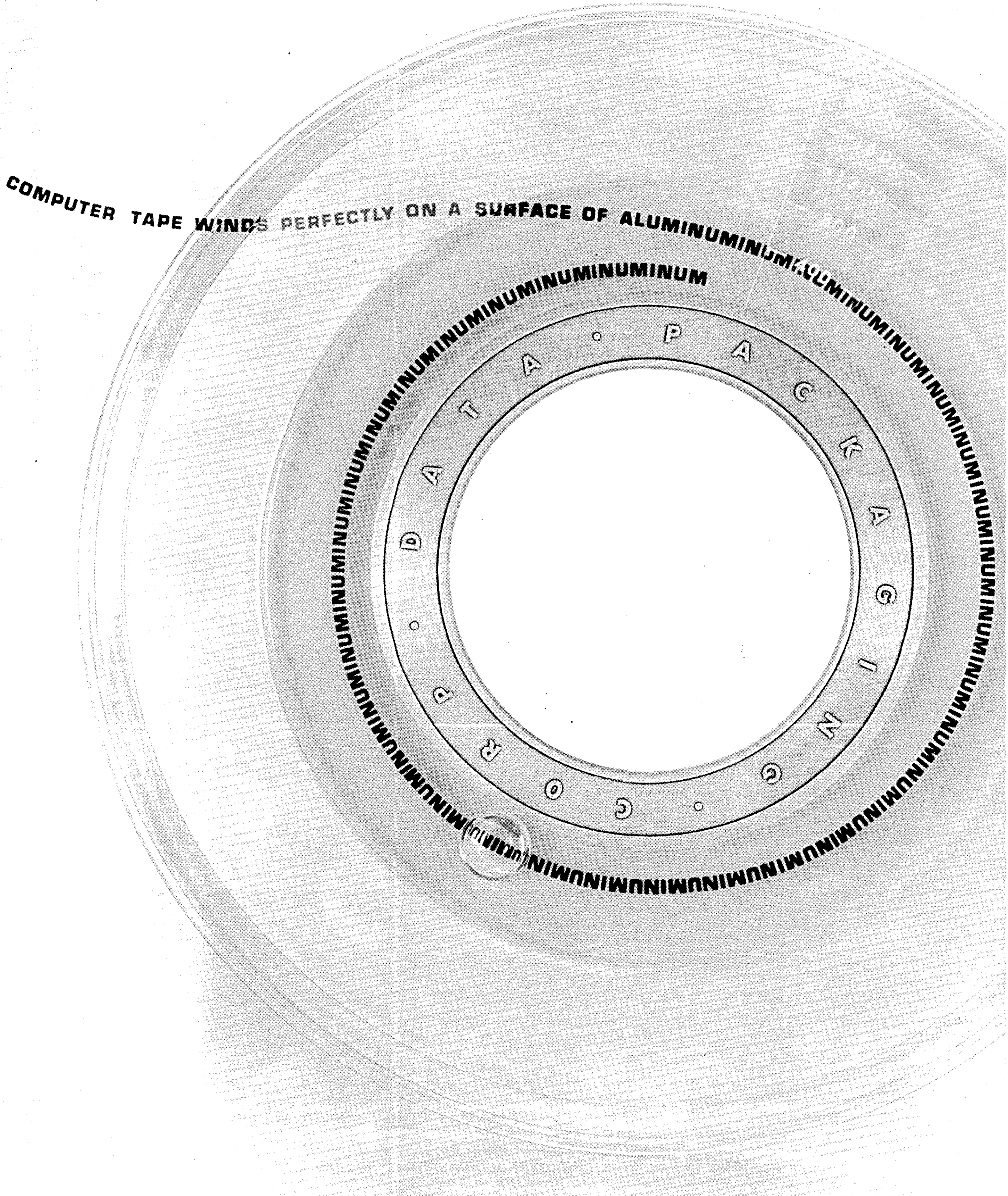
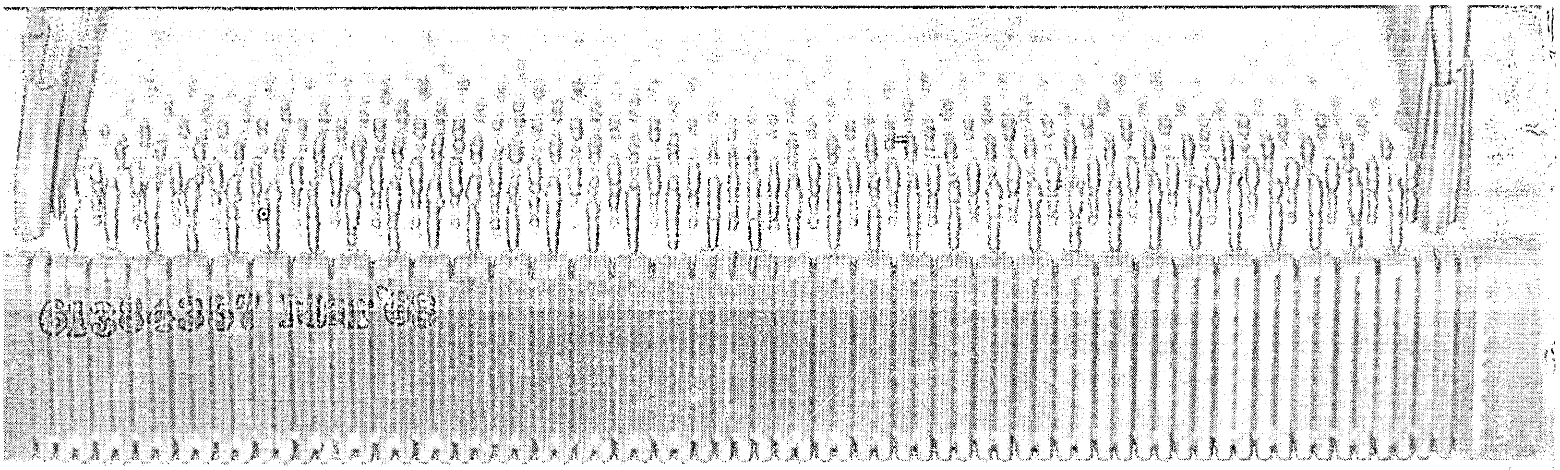

COMPUTER TAPE WINDS PERFECTLY ON A SURFACE OF ALUMINUM
DATA PACKAGING CORP

# Do you remember what it used to cost to buy a stack of memories?



Last year, we took a look at the price of memory stacks.

And we didn't like what we saw.

Frankly, they were too darned expensive.

Ours. And everybody else's.

This was our problem. If we wanted people to be able to buy memory stacks from us for less than it would cost to make their own, we had to drop our prices.

But how?

We could do it easily enough if we eliminated some of the checks we give our cores. (Ours are the only ones that are 100% tested three times before they get into one of our memory systems.)

Or if we cut back on research. (We spend more money on memory research than anyone else in the business.)

There was a third way. A hard way. We could find a better, more economical method of making the cores themselves.

So we worked on it. And finally, along with our Dutch uncle, Philips, we came up with a method that's so secret we can't tell you a thing about it. Except that it makes cores that are much more reliable. Even with our triple testing, we get far fewer rejects. Which makes planes and stacks cheaper.

As a result, in 1964, we lowered the price of memory stacks by 65%.

If you're in the memory business, you ought to remember 1964.

That's the year the cost of living went up.

And your cost of remembering came down.

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