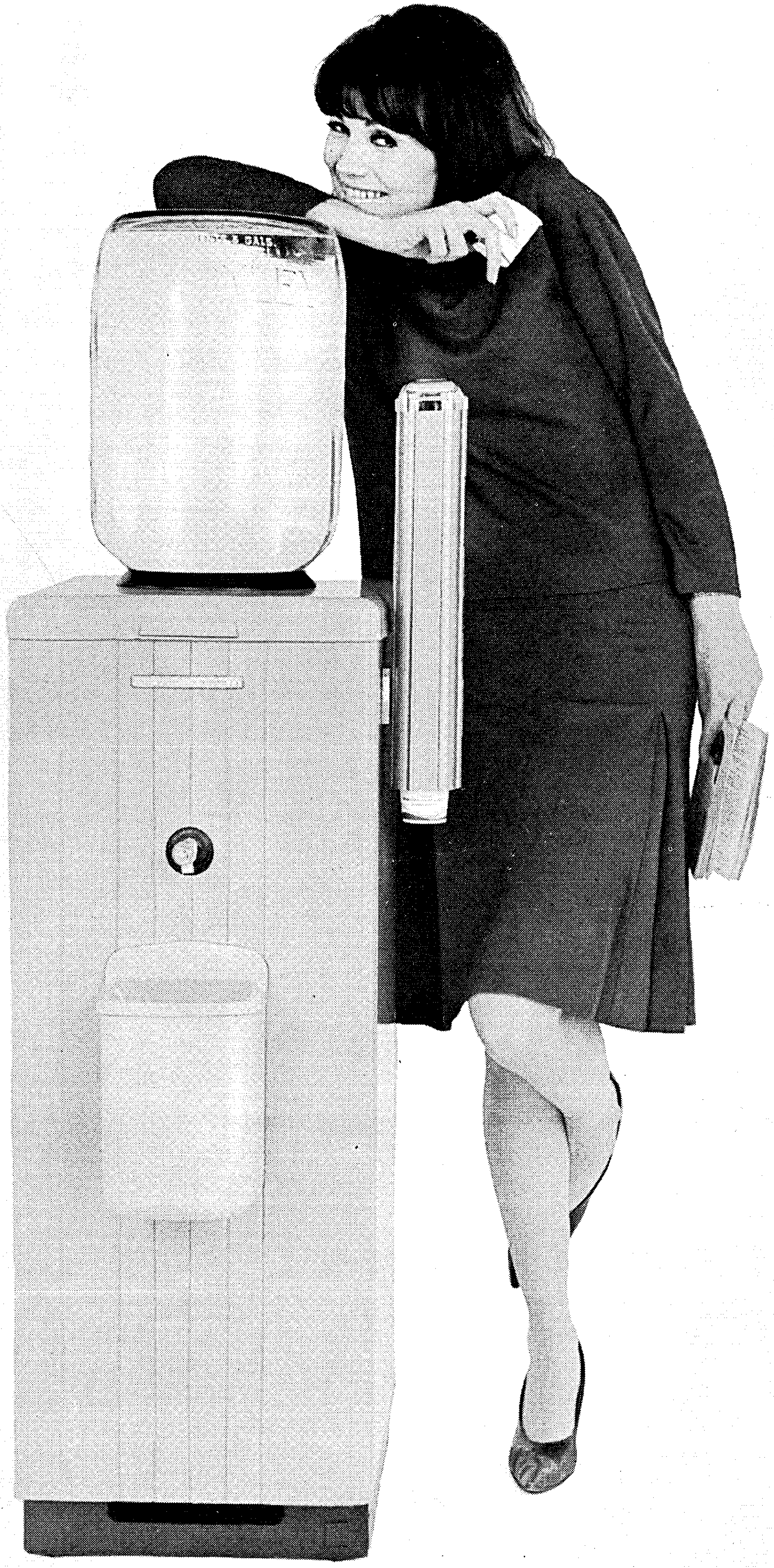
# DATAMATION

*October*

November 8, 9, 10



# Our optical reader can do anything your keypunch operators do.

## (Well, almost.)

It can't goof off at the water cooler. Or file its nails. Or eat lunch. But it *can* read. And gobble data at the rate of 2400 typewritten characters a second. And compute while it reads. And reduce errors from a keypunch operator's one in a thousand to an efficient one in a *hundred* thousand.

Our machine reads upper and lower case characters in intermixed, standard type fonts. Handles intermixed sizes and weights of paper, including carbon-backed sheets.

An ordinary computer program tells our reader what to do . . . to add, subtract, edit, check, and verify while it reads. Lets you forget format restrictions, leading and trailing zeros, skipped fields, and fixed record lengths. And our reader will not obsolete any of your present hardware because it speaks the same output language as your computer.

Our Electronic Retina Computing Reader can replace all—or almost all—of your keypunch operators. At least that's what it is doing for the Chicago Board of Education.

If you have a volume input application, it can do the same for you. Tell us your problem and we'll tell you how.

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CIRCLE 4 ON READER CARD

# PDP-8 computer family: approachable, friendly, personal. $4.75 to $150,000.

More than 500 scientists have one or another of the PDP-8 family computers in their laboratories. Physicists, chemists, life scientists, social scientists, mathematicians. For such a small family of machines, that's an enormous family of users.

There are good reasons, of course.

Scientists like to talk to each other. They like to exchange programs and ideas with other scientists — not accountants.

Then, too — scientists like to be able to change their minds. Family-of-8 computers are approachable, variable, easy to talk to, personal machines. They are easy to re-instruct halfway through an experiment, and they respond. For those who know how an investigation will begin — but not necessarily how it will end — they are ideal.

That's also why so many scientific instrument and systems makers build in one of the Family-of-8. That, and the proven reliability, and the price.

Lastly, there are PDP-8 type computers for almost all types of investigations and for greatly varying budgets. All use the same set of instructions. All use the extensive PDP-8 programs. When we say they are compatible machines, we don't just mean format compatibility. We mean programs. All programs. All instructions. Without exception and without modification.

---

It started with the PDP-8 itself, the most popular computer ever made for the scientific community. 4K memory, expandable. 12 bit word. 1.5 μsec cycle time. Fortran. Approachable. 30-day delivery of basic machines is now possible. $18,000. A ruggedized, portable version is also available, and, of course, expanded versions, too.

---

The new $10,000 PDP-8/S is a near cousin. We call it the SMALL-8 because of its compact size. But it has the same general purpose, same real-time on-line computation, same size memory, same size word, same instructions as the PDP-8. Same Fortran. Same everything, in fact, except physically smaller, slower (36 μsec add time), and less expensive.

---

The LINC-8 is an ingenious combination of two computers: the famous MIT inspired LINC, and the PDP-8. Two complete software packages. Built-in A to D conversion. Built-in oscilloscope display. Dual magnetic tape unit. Relay buffer. It is a completely integrated laboratory data handling system. $38,500.

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The DISPLAY-8 is a display terminal to large computers. It is the only standard display terminal with a built-in small computer as an integral part. The PDP-8 is the buffer to a large machine or a generator for the display when on its own. The DISPLAY-8 proves how easy it is to use small computers on the business end of time sharing. $55,000 to $150,000.

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And modules. DIGITAL is one of the world's leading suppliers of logic modules, each electrically, physically, and logically compatible with each other — and with each DIGITAL computer. For interfacing. Many scientists consider this an important reason for buying DIGITAL'S computers. Module prices start at $4.75.

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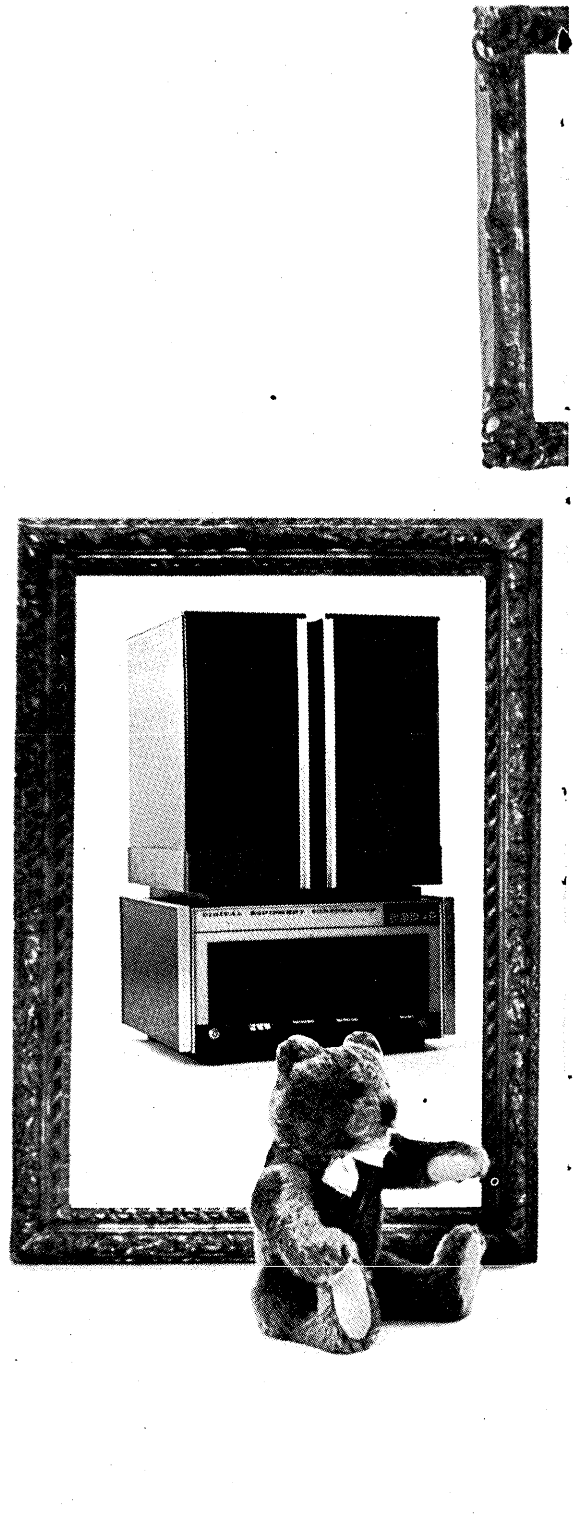
A 350-page handbook describes the 101 FLIP CHIP™ modules and what you do with them. A 500-page Small Computer Handbook contains a computer primer and full descriptions of the Family-of-8 computers. Write for either, or both.

And if you have bigger problems than these, we have bigger answers. PDP-9. PDP-9 Multianalyzer. And the soon-to-be-here PDP-10.



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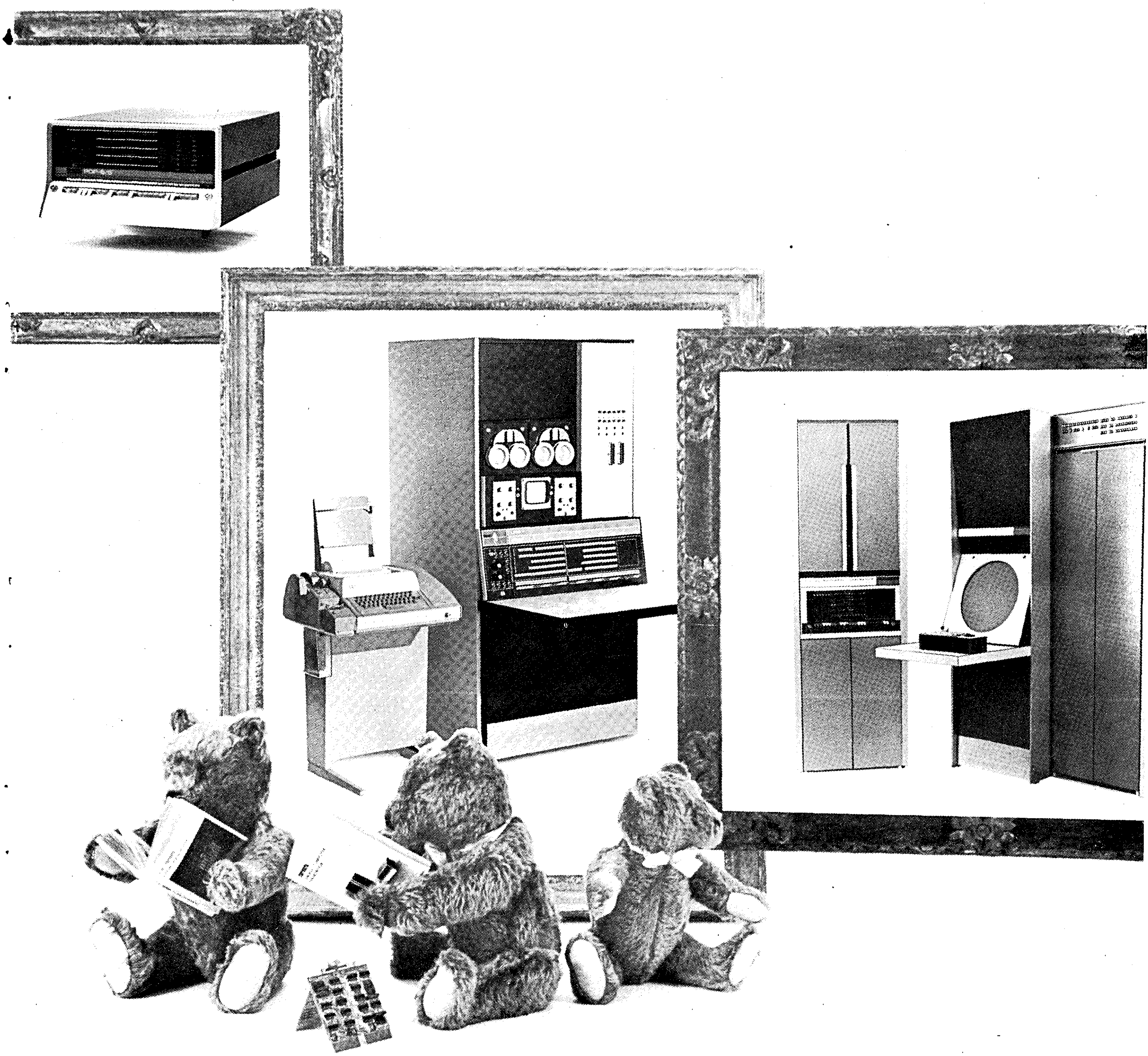

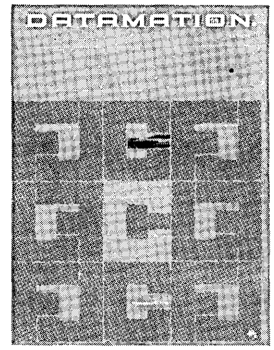


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volume 12 number 10

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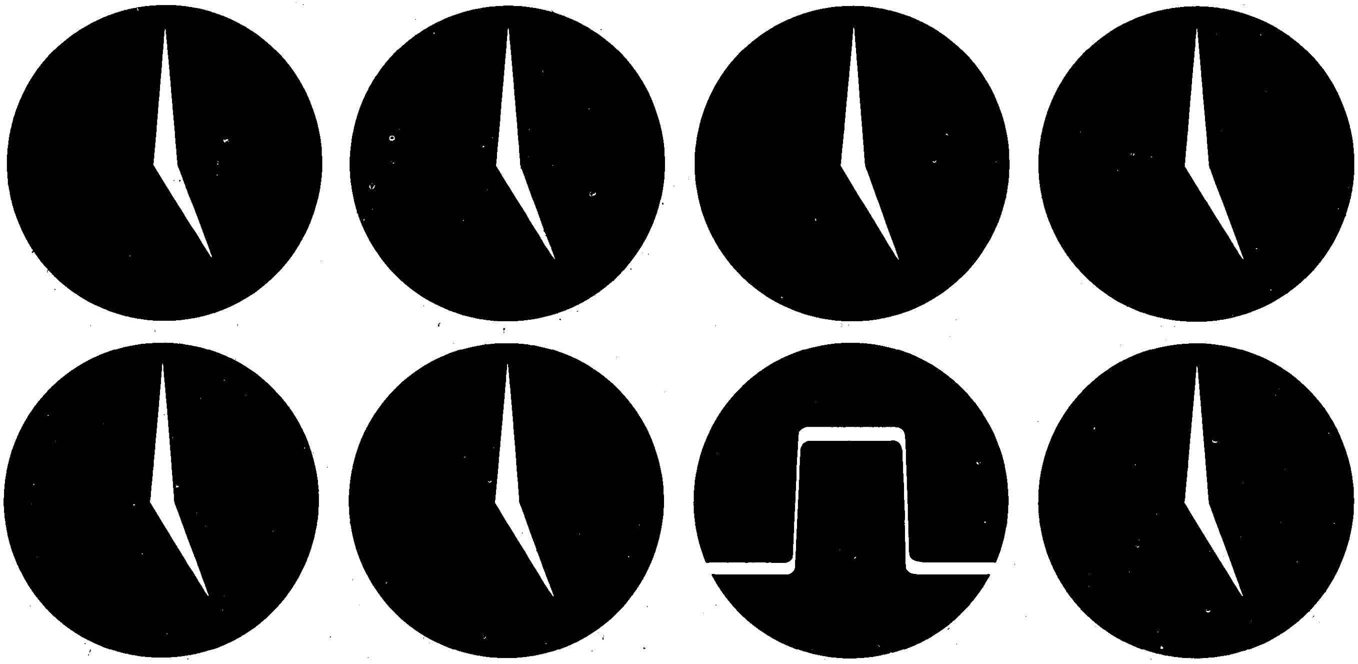
# A real-time, time-sharing systems computer



# and a way to measure volts on 5 nanosecond pulses-

## If you're in data acquisition, you can get either or both from Raytheon Computer.

Using a new disc-oriented, real-time monitor, the Raytheon 520 can simultaneously acquire and process real-time data, control a data system from up to 20 remote display-control stations and compile, assemble and execute FORTRAN IV and FLEXTRAN programs on a job or batch basis.

And the new NANOVERTER™ input device for high speed data systems includes a remarkable 5-nanosecond sampling device, and a 12-bit analog-to-digital converter for ± 2% accuracy at 45KC throughput.

With the monitor the 520 can respond to real-time interrupts, transfer data to core or disc via a direct memory access channel, transfer programs from disc to main memory and then shunt processed data to disc, magnetic tape, printer or other storage or output device.

The 520 monitor makes use of two unique features—direct memory access and dynamic memory protect including a memory map.

Direct memory access switches main memory in four microseconds between external devices—either peripheral equipment or another computer—without interrupting the 520 central processor.

Memory protect prevents inadvertent loss or output of stored real-time or batch processing data during interrupt program runs or job program compiling, assembly or execution. A special memory map keeps track of occupied and available memory locations in 2000-word segments and automatically assigns available memory to new programs.

Besides FORTRAN IV and FLEXTRAN, 520 software includes Real-Time FORTRAN IV. This separate and distinct processor is based on Raytheon's exclusive one-pass FORTRAN IV which is language compatible with the widely-used FORTRAN IV (version 13). Real-time FORTRAN IV simplifies the programmer's handling of real-time problems with features like RECURSIVE, PROTECT, CONNECT AND COUNT TIME Statements, and useful debugging aids like TRACE mode, Memory Map and DUMP.

The 520's one microsecond main memory boosts data acquisition word transfer rates to IMC. Besides the NANOVERTER, other real-time systems hardware includes the Multidevice Controller for interfacing as many as 512 external data systems devices and establishing up to 1024 levels of priority interrupt, and the unique Multiverter,™ which combines up to 96 channels of IC multiplexing, a 50-nanosecond sample and hold amplifier and analog-to-digital conversion in a single 5¼ inch chassis.

The Raytheon 520 is currently being specified and delivered for real-time and hybrid systems in the $100,000 class and up. Find out why by writing today for Data File C-132. Raytheon Computer, 2700 S. Fairview Street, Santa Ana, California, 92704.

RAYTHEON

*Trademark of the Raytheon Company for its data system.*

SEE RAYTHEON COMPUTER'S 5 NEW PRODUCTS AT FJCC, BOOTH 414-515

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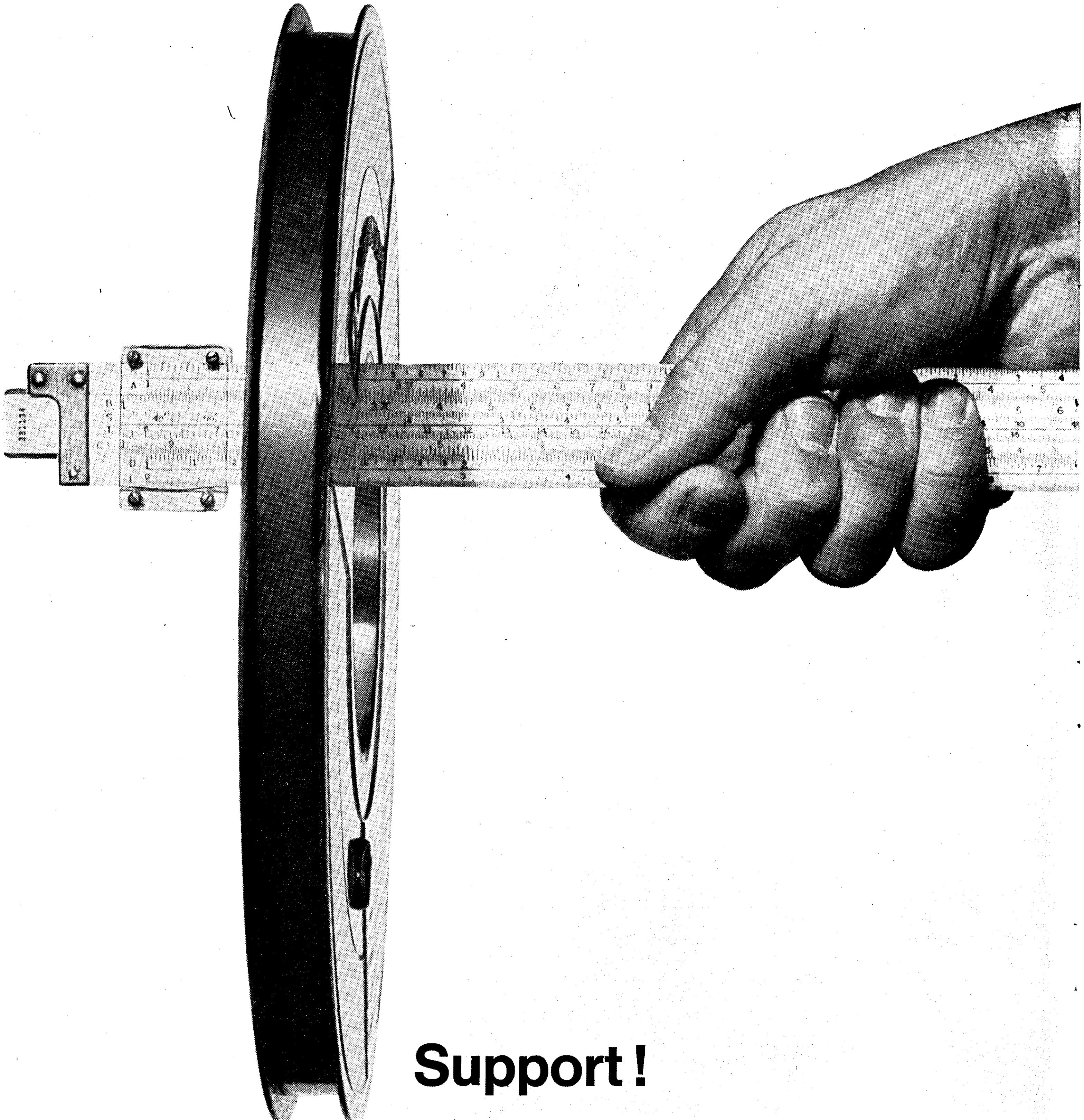

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october
1966
volume 12 number 10



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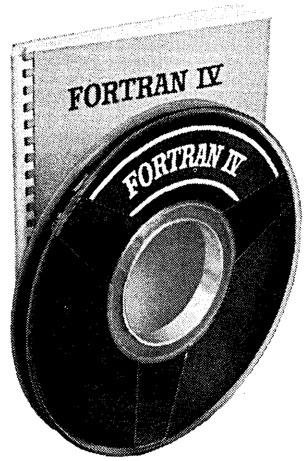
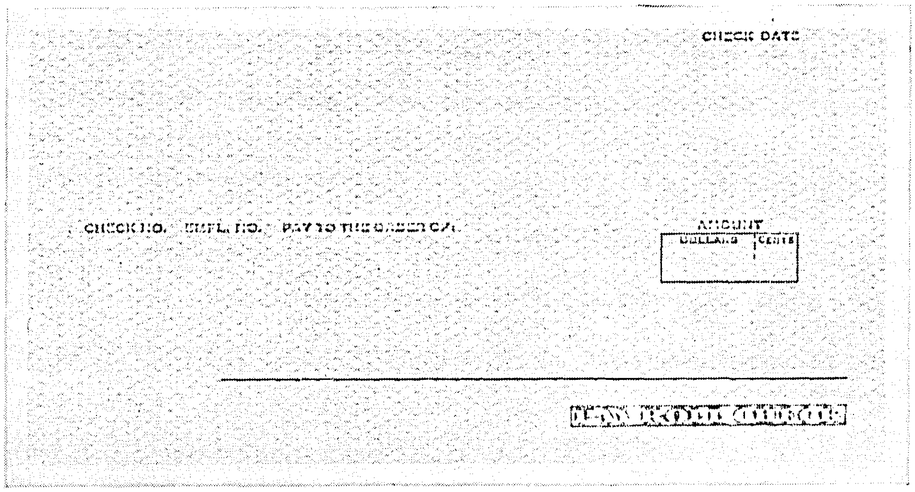

FORTRAN IV
FORTRAN IV

# calendar

| DATE | TITLE | LOCATION | SPONSORS |
|---|---|---|---|
| Oct. 27-28 | ECHO Meeting | American Hospital Assn.<br>Chicago, Ill. | Electronic<br>Computing<br>Hospital<br>Oriented |
| Oct. 31-<br>Nov. 3 | Users' Meeting | Vacation Village Hotel<br>West Mission Bay<br>San Diego, Calif. | UAIDE<br>Automatic<br>Information<br>Display<br>Equipment |
| Nov. 2-4 | Electronics Research<br>& Engineering Meeting | Sheraton-Boston Hotel<br>Boston, Mass. | IEEE<br>New England |
| Nov. 4-5 | Users' Meeting | Lawrence Radiation Labs.<br>Laboratory Auditorium<br>Berkeley, Calif. | DECUS<br>Digital<br>Equipment<br>Users Society |
| Nov. 7 | Workshop on User<br>Groups | Del Webb Town House<br>San Francisco, Calif. | ACM, JUG,<br>and CAP Assns. |
| Nov. 7-9 | Conference: Automatic<br>Support Systems | Colony Hotel<br>Clayton, Missouri | IEEE |
| Nov. 8-10 | Fall Joint Computer<br>Conference | Civic Center<br>San Francisco, Calif. | AFIPS |
| Nov. 14-17 | Course: Transmission,<br>Display of<br>Management<br>Information. $175. | Twin Bridges Marriott<br>Motor Hotel<br>Washington, D.C. | American Univ. |
| Nov. 15-17 | Symposium: Ship<br>Control Systems | Navy Marine Engineering<br>Laboratory<br>Anapolis, Md. | U. S. Navy |
| Nov. 15-18 | Users' Meeting | Americana Hotel<br>Miami Beach, Fla. | GUIDE<br>International |
| Nov. 17-18 | Conference:<br>Computers in<br>Humanistic Research | Texas A&M Univ.<br>College Station, Texas | IBM Corp. &<br>Texas A&M<br>Univ. |
| Nov. 28-30 | Users' Meeting | Jung Hotel<br>New Orleans, La. | COMMON |
| Dec. 5-6 | Users' Exchange<br>Meeting | Room 158<br>Matomic Bldg.<br>Washington, D.C. | Transportation<br>Planning<br>Computer<br>Users' Group |

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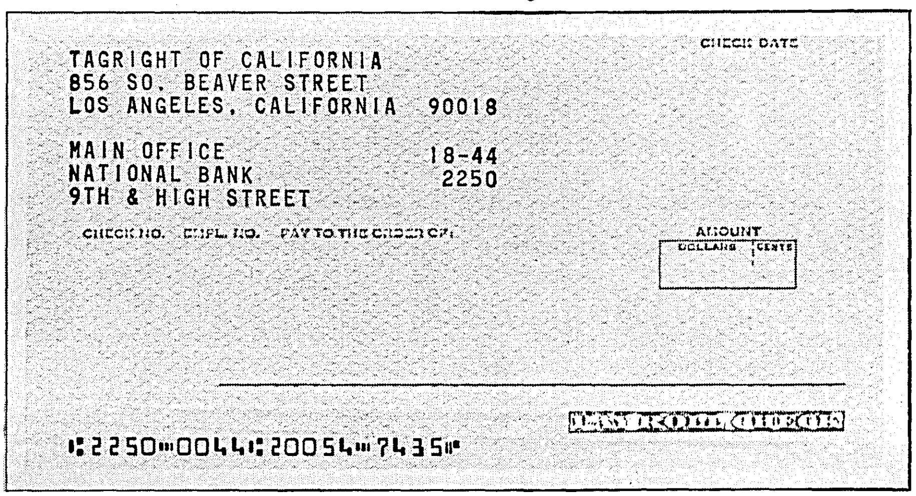


After

# Statement Service Co. Uses Addressograph® Methods

## to Increase Clerical Output 1/3
## to Save Valuable E.D.P. Machine Time
## to Reduce Form Costs

"The use of Addressograph methods has increased clerical productivity by at least one-third", reports Mr. Wylie Adams, President of Statement Service Co., Los Angeles. Their services include computation of earnings, writing checks, maintaining payroll records and tax reporting. Mr. Adams gets optimum performance from his electronic accounting machines because he uses an Addressograph machine. This Addressograph machine automatically imprints each client's name, address, the bank name, and MICR encodes bank and account numbers. Single continuous forms of blank checks are used for all clients, eliminating the need to change forms. The result? Major savings of labor and the cost of forms. And valuable E.D.P. machine time is saved, providing more earning power for the company. And Addressograph methods need only one easily trained operator. Increasing your E.D.P. output is a good reason to call your nearby Addressograph Representative (listed in the Yellow Pages). Or write Addressograph Multigraph Corporation, Department T-6640, 1200 Babbitt Road, Cleveland, Ohio 44117.

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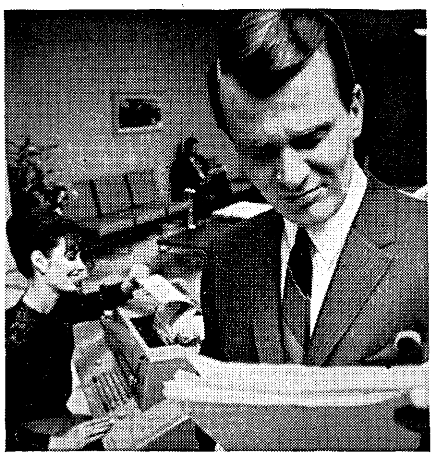


# HOW TO COLLECT, INTEGRATE AND DISTRIBUTE DATA

If any one symbol can represent the rapid changes of the "sizzling sixties," it's the computer. Data processing has won not only wide acceptance as a vital function of efficient business operations, but is growing more sophisticated with greater reliance on real-time operations.

In turn, this reliance on real-time processing has placed renewed emphasis on data communications. Data must be available quickly for management to make timely, accurate decisions. And, regardless how sophisticated your data system may be, Teletype sets remain the simplest, most reliable and least costly terminal equipment for collecting, integrating and distributing data.

The integration of communications within data processing systems has helped solve many business problems by:

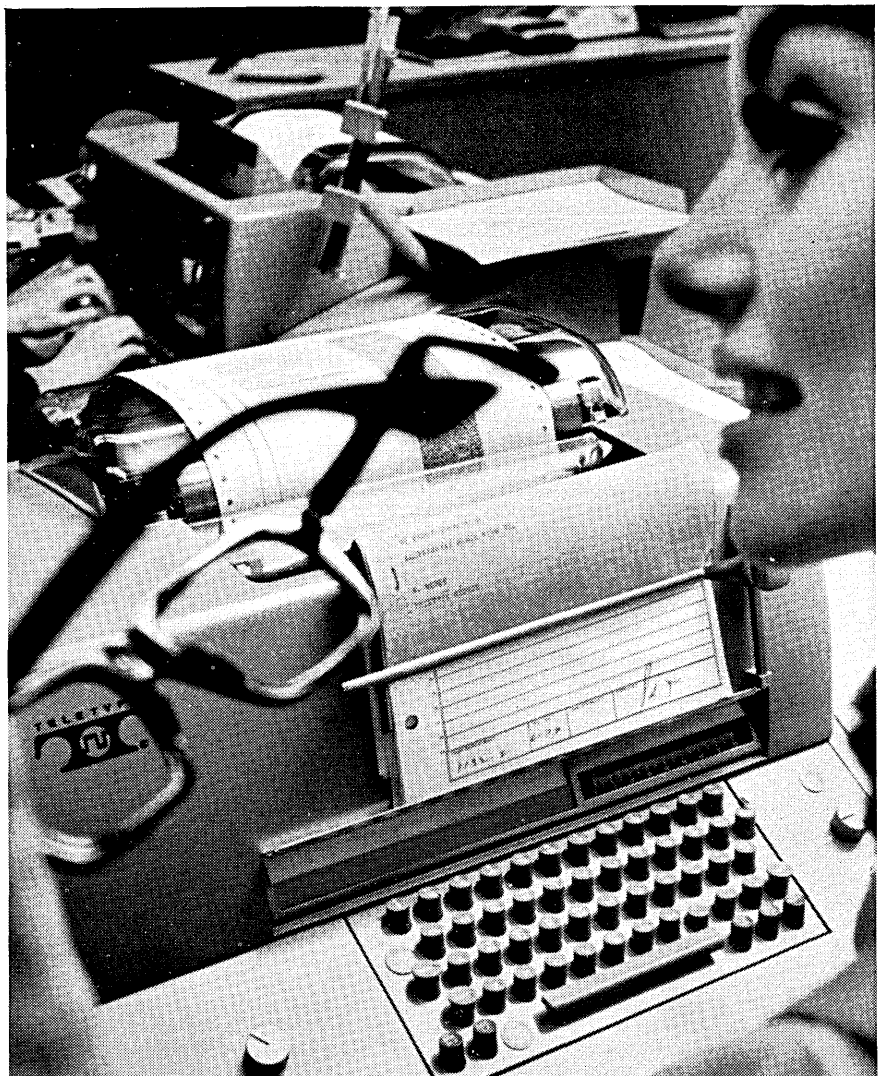
- Assuring management of adequate, timely information to make accurate decisions,
- Eliminating the costly errors caused by duplicated paperwork,
- Speeding distribution by cutting costly paperwork,
- Reducing customer complaints, and
- Enabling management to communicate quickly with remote computer centers.

**Getting data in time for decisions** Nothing can be as useless to you as information that arrives too late. Wrong decisions are made. Production is slowed. Deliveries are late. Customers are dissatisfied or lost. Yet, none of these situations need ever exist.

Using Teletype machines for communications within a data processing system, assures you of getting information where you need it — when you need it. You'll be able to make better informed, more timely decisions that could spell the difference between profit and loss.

This problem faced a New Jersey food processor, who had been receiving sales and inventory statistics by mail from its two branch offices. By the time these reports were processed, the information was too old to use in reaching important management decisions. The processor had Teletype ASR (automatic send-receive) sets installed at all three locations. Now, daily statistics are received in minutes and processed into up-to-date reports. This reduces inventory costs and enables the processor to close its books eight days earlier each month.

**Eliminating duplicate paperwork errors** How often do errors in order processing result in producing the wrong size or quantity? How often have prices been misquoted or customers lost due to incorrect shipments? These are typical problems



resulting from errors caused by duplicating data from one department to another. You can eliminate these situations with a system that speeds the handling and processing of data by including Teletype communications equipment.

Sales order information can be prepared on Teletype machines, reviewed, and transmitted directly to Teletype receiving sets in other departments. In addition to sending each department accurate information, Teletype sets can selectively "edit" this information. Thus, such data as order numbers can be sent to all departments, while cost data is directed only to accounting, billing and management departments.

This is what a metal products manufacturer did to cut order processing time 75 percent. By using Teletype ASR sets, minutes after an order comes in the data is sent to shipping and production departments—each receiving only the data it needs. A few of the resulting benefits include in-stock items shipped the same day, production orders scheduled three to seven days faster, overtime reduced, and errors greatly reduced.

**Moving inventory faster** Many companies are finding that profits are being eaten away by high inventory and distribution costs. They often find themselves having to justify a high inventory on the grounds it's needed to meet fluctuating customer requirements.

Yet, other companies have cut inventory costs while keeping a larger selection of stock on hand. They have learned that an effective data communications system eliminates inventory that stands idle waiting for slow-moving paperwork. By using Teletype equipment to link business machines with existing channels of communications, they are provided with instant, accurate data collection, integration, and distribution. Thus, they can handle a larger volume of business faster with more efficiency and less error.

Due to the rapid decay of critical radioactive pharmaceuticals, a national drug company had a serious inventory problem. To solve it, the firm had Teletype machines installed at all of its 26 branches to provide the necessary speed, efficiency and written verification required to plan production and delivery of these drugs. Now orders are instantly received by a Teletype set, and prepared, packaged and shipped almost immediately.

**Reducing customer complaints** Today, customer service is often the deciding factor in who gets the order. Yet, rapid expansion has greatly strained the capacities of many companies to properly service their customers. This is why computers and data communications have become so important in speeding the order processing, production and shipping operations. And, regardless of the distance, Teletype equipment plays an important role in the gathering and forwarding of information needed for fast service.

Many banks are relying on data communications equipment to improve the efficiency of their customer services. A midwestern bank uses a Teletype ASR set to transfer funds, to notify customers when loan payments are due, to speed transmittal of correspondence, and for many other related functions.

**Solving your communications problems** There are many other applications in which Teletype equipment helps improve business operations, such as using Teletype sets to link companies to a remote computer center on a time-sharing basis. You can see why Teletype equipment is made for the Bell System and others who require reliable, low cost communications.

Our brochure, "WHAT DATA COMMUNICATIONS CAN DO FOR YOU," further explains how an effective data communications system can cut your costs while building your profits. To obtain a copy, contact: Teletype Corporation, Dept. 81K, 5555 Touhy Avenue, Skokie, Illinois 60076.

TELETYPE ®

CIRCLE 12 ON READER CARD

# letters

### an operating olrt

*Sir:*

In the July issue (p. 83), you report Dick Brandon's comment that any on-line real-time systems planned for operation by 1970 must be in the first stages of implementation now. Your readers might be interested in knowing that American Motors' OLRT system was conceptualized in April 1963 and put on the air in October 1964.

I. STEPHAN BLOCH
*American Motors Corporation*
*Milwaukee, Wisconsin*

### sub-usec compacts

*Sir:*

In the August issue (p. 79), the SDS Sigma 2 computer was featured as the only machine in its competitive field to have a sub-usec cycle time. We take exception to that statement. The Advance 6130, mentioned in that group, has a 900-nanosecond cycle time—equal to that announced for the Sigma 2. This, however, is not the minimum time attainable.

J. O. PAIVINEN
*ASI Computer Division*
*Electro-Mechanical Research Inc.*
*Minneapolis, Minnesota*

**We stand corrected. The 6130 was featured in our May '66 issue, p. 61, and we should've known better.**

### management systems

*Sir:*

Robert V. Head's ill-tempered attack (August Forum, p. 124) on Professor John Dearden for his *Harvard Business Review* article (May/June '66) contributes little to the subject of real-time management information systems. While Professor Dearden's views were highly controversial, they were neither "crude" nor "grumpy."

Mr. Head seems to have a penchant for confusing noise with signal. One recalls that his excessive enthusiasm for the checkless society (March, p. 22, and May, p. 13) led him to feel that the views of the Messrs. Watson and Sarnoff represented unbiased support for his position on that subject.

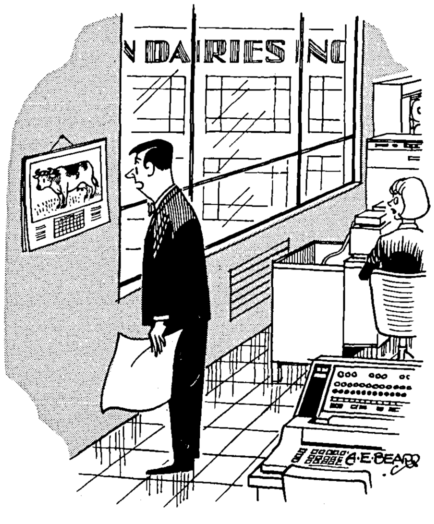
If DATAMATION feels it is publishing quality articles, it ought to have its Head examined.

CHARLES BLOCK
*Chase Manhattan Bank*
*New York, New York*

**Editor's Note: We feel that Mr. Head *did* contribute to the subject of real-time management information systems: he pointed out in a lively (not ill-tempered) fashion some of the inadequate and false definitions, straw men and questionable rhetorical techniques used by a critic of real-time MIS writing in the pages of a respected journal. Mr. Head, by the way, declines to comment on this latest jab by his friend at Chase Manhattan, thus hopefully ending what one observer has labelled the Block-Head debate.**

### the missing caption

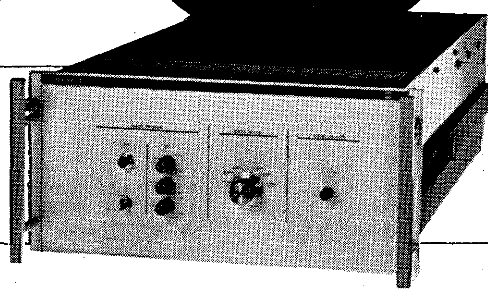
**Before we receive a torrent of letters from avocational caption writers, the editors of *Datamation* are reprinting the cartoon below, which appeared last month on p. 69 without its caption. We trust that the feelings of our Humor Editor and his followers are hereby salved.**



"What the hell's *that?*"

*Datamation* welcomes your correspondence concerning articles or items appearing in this magazine. Letters should be double spaced . . . and the briefer the better. We reserve the right to edit letters submitted to us.

# 4,800 /BPS



COLLINS' TE-216A-4D DATA MODEM *DOUBLES* THE SPEED ON YOUR EXISTING VOICE DATA LINE. AVAILABLE *NOW*

COMMUNICATION/COMPUTATION/CONTROL

Demonstrations of the new modem are being conducted in major cities. Write for date and place nearest you. Address communication to Manager, Data Equipment Sales, Collins Radio Company, Newport Beach, California 92663.

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# look ahead

MISERIES AT MARTIN

The big systems blues which have plagued IBM and CDC have hit GE's 600 series. Problems, including slow performance, excessive downtime, have caused the withdrawal (by Nov. 25) of three dual-processor 635's at the Martin Co. Uptime at one Martin 10-month-old installation has averaged only 70% and speed reportedly has been slower than the 7094. To blame: software complexity and overhead. But GE points out that three government 635's, all accepted, have been averaging 85, 92 & 99% uptime, with better times at other installations. Martin is in the throes of re-evaluating replacement gear, but we hear that 360/60-40 AST systems are on order at all three plants. Meanwhile, GE -- one of the few companies big enough to swallow such a disaster -- is moving "rapidly" to correct the problem.

NCR READIES
THIRD GENERATION ENTRY

NCR's new 615 series computers, we understand, will consist of the 615-100, 200 and 400. All will use rod memories and have 800-nsec cycle times, the 100 accessing one byte at a time, the 200 two bytes, the 400 four. Optional are 1401 and NCR 315 emulators. Instruction lengths are eight or four bytes; 63 index registers are in main memory; 256-character coding set. Some models will have integrated processor/ peripherals in one cabinet, obviating need for raised floors. Also new: CRAM clusters, 3,000-lpm printer, disc files.

The mod 100, with 8-16K bytes, is for batch processing with limited real-time applications. System rentals are from $1500-6K. The 200 has 32-256K bytes, is for business and scientific computation, real-time environments, has optional multiprogramming. Rentals range from $4-25K. The 400 is a time-sharing model, has 64-512K bytes, rents from $7-55K.

Software will include Fortran, assembly system, Neat Autocoder and exec system. Deliveries are slated to begin sometime in 1968.

PROPOSED TAX LAW
FURROWS FOREHEADS

Users and manufacturers alike are concerned about the proposed legislation that would remove the present 7% tax credit on capital expenditures, probably for 16 months. The Investment Incentive Tax Credit went into effect Jan. 1, 1962 -- leading computer manufacturers, among others, to point out to prospects that there was money to be saved by acting.

One point to consider in evaluating the possible effects of removing the credit: it doesn't apply to government and nonprofit organizations anyway.

A second area is lease vs. purchase. Here it might have some effect, because -- with the tax credit available -- there is a fair amount of money to be saved: 7% of the total price on an outright purchase. But there are two offsetting factors here. One is that the manufacturers are able to pass along

# COBOL/AUTOFLOW*
# Now Available!

## COBOL SOLVES HALF YOUR DOCUMENTATION PROBLEMS. WHAT ABOUT THE OTHER HALF?

Users are switching into COBOL because the language gives them more understandable code than assembly listings. This is a big step. It doesn't, however, do anything about the flowchart, the other fundamental piece of documentation required for a computer program.

Now, Applied Data Research proudly announces AUTOFLOW for IBM 360 COBOL Programs. This new ADR documentation system produces superior flowcharts directly from COBOL source language. This means that COBOL users can enjoy the same advantages of complete, accurate, up-to-date and economic flow charts which have proved so successful for assembly language users.

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If you are using COBOL, why wait to find out what COBOL/AUTOFLOW could do to save you money and increase the efficiency and control of your computer installation? Write today for detailed information on COBOL/AUTOFLOW or other AUTOFLOW Systems listed below.

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CIRCLE 16 ON READER CARD

# *Moving?*

If you're going to have a new business address, please fill out the form at the right now and return it to us. We'll make sure that DATAMATION keeps up with you. To save time, we need your old address, just as it's printed on the mailing label, (or the whole label is better yet) as well as your new address.

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Company
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**NEW AD**
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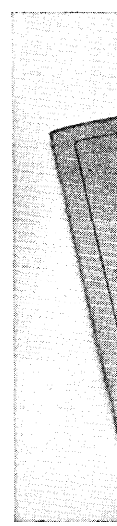

an intro

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# *define your terms, please*

Whatever your work in information processing, you'll communicate better with the help of this authoritative glossary.

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some of the tax saving to lease customers, although not all of it ... and especially not all of it in the first year, as could be elected by the customer with outright purchase. The second factor has to do with the typical behavior of users: often they like to get the machine on rent, try it out for several months before making a purchase decision. Under these conditions, there is so much more money to be saved by exercising the purchase option early that the tax benefit seems minor.

There is still another way of looking at the problem though -- and some medium-sized users may have this viewpoint. Suppose you want to buy a nice new tape system in the middle range ... for, say, $300K. But you've got an older model that still seems to be running even if it takes multiple shifts to do the job. The tax credit would come to $21K. But this is real money -- $40K of profits at present tax rates. If your company is making about 5% on sales, that's some $800K worth of extra widget sales to come out even ... and 16 months may not seem so long.

### TIME-SERIES ANALYSIS COMPUTER IN THE WORKS

For researchers in fields like biomed, geophysics and airframe testing, a time-series analysis computer is under development at Palo Alto, Calif. According to Time/Data Corp., the model 100 processor has wired programs that reportedly give it speeds comparable to such giants as the 7094, yet cost fractionally. Wired in are the basic algorithms of time-series analysis, such as spectral analysis, correlation, convolution, averaging, and histograms. The device can stand alone or work on-line to a general-purpose digital computer.

### OPEN-ENDED ASCII

SHARE members, with IBM support, are appealing to ASA to reject the revised ASCII code, which was approved by a 21-5 X3 vote last month. While the technical argument is over two symbols missing from the central 54 characters (different symbols must be used for logical OR and NOT than those in the 60-character-set PL/I compiler), the real gripe is that ASCII is communications-oriented and downgrades programmers' preferences. At this late date, ASA is not expected to turn thumbs down on the code, but the programming community can still offer amendments.

### KEEPING UP WITH KAP

Rumored to be doing $3-4 million of business, and in the black, is one-year-old Information Systems Co., an L.A. subsidiary of Lear Siegler. Heading the works is M.O. Kappler, ex-president of System Development Corp., who oversees a worldwide bodyshop operation and now is starting an on-line service bureau in L.A.

With a 4-disc 131K 360/40 due in December, Kap plans to go after medium-sized manufacturers. Through a terminal of their own choosing, they'll be able to develop a data base to generate marketing and accounting reports, perform materials and manufacturing control and engineering computation. First teleprocessing is due next February.

ISC also has a booming Far East Div., including 40-50 people in Saigon doing Pert and related project management work with a dual CDC 3100. A similar job, for another construction project, goes on in Bangkok with a single 3100.

### GOOD NEWS FOR UNIVAC: SPACE SALES NOW, LASER MEMORY MANANA

Starting with a 490 communications processor a couple of years ago, Univac penetration of the NASA Manned Spacecraft Center is leading to a total installation

*(Continued on page 159)*

# Just as we expected, Sigma 7 is 30% faster than we promised.

When we put the first Sigma 7 together, we found that its cycle time was 850 nanoseconds.

So why had we promised 1.2 microseconds?

Because we wanted to wait and be sure. And 1.2 microseconds is impressive enough.

So much for cycle time. Sigma 7 is an integrated system of hardware and software, and raw speed is a poor way to describe how fast it gets the jobs done.

Take input/output. Most computers have to take time to do it. Sigma 7 doesn't. It has two processors – one for computing, another for input/output.

Sigma 7 was designed from the beginning to do real-time on-line control, conversational time sharing, batch processing, and high-speed input/output all at the same time. With full protection for everybody. And every job done as fast as the user wants it done.

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So far we're keeping all our promises. Except the one about the cycle time.

Sorry about that.

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Scientific Data Systems, Santa Monica, California

CIRCLE 17 ON READER CARD

## LEARNING A TRADE

One of Bill Mauldin's great World War II cartoons shows a line of infantrymen slogging along past a soldier, on his knees in the mud, constructing a crude path. Looking down at this muddy wreck, one of the footsoldiers says, "At least you're learning a trade."

Pushing aside his template and his Go board temporarily to scan the recruitment ads in the *New York Times, Village Voice* or *Wall Street Journal,* today's programmer must feel a delicious sense of being wanted, of learning a trade which is in high demand.

The feeling may be short lived. Higher level languages have helped to shove aside the programmer as middleman in the problem solving circle, and time-sharing, when it gets here, may hasten that delightful day when T. C. Mits poses his prosaic problems directly to the computer in everyday English.

Programmers who expect to float effortlessly up into systems programming — and systems programmers who expect to stay there forever — may be disillusioned. As Ascher Opler points out (July, p. 105), systems programming, becoming increasingly complex, may leave mentally sluggish or lazy systems programmers behind. And as software costs skyrocket and hardware costs continue to collapse, it's natural to expect an attempt to find a way for hardware to take over some of the tasks now handled by software. Here's another frightening thought: the punks coming out of college today may know damn near as much as you do.

Lest these remarks trigger a wave of programmers leaping despondently from the tops of their Porsches, we'll hasten to add that there are solutions. You could go to real estate school. Or you can start to develop a sensible professional development plan.

There are books available. Most large universities offer graduate courses in information processing. Most of the software houses conduct short courses and seminars. Your local ACM chapter usually offers stimulating speakers, and DPMA chapters often sponsor reviews for the DPMA certificate exam, which is one way to find out how much (or little) you know. User group meetings may offer some brain-stretching sessions. The Joint Computer and DPMA Conference are possibilities, and DPMA has sponsored roving seminars on COBOL, may offer others. Soon a comprehensive programming correspondence course will be available.

While all of these can help you maintain a nodding acquaintance with the technology, there's no substitute for solid on-the-job experience. But you might ask yourself the question many employers ask as they review a resumé: Do I have seven years experience . . . or one year's experience seven times? What you may need is the solid foundation of edp theory which can help you translate today's experience into the ability to master new skills.

There are other considerations. Although you may now be performing more difficult and complex work than you were, say, five years ago, you may also have narrowed the scope of your skills. Or you may not have had a chance to develop skills in subtechnologies which have grown up around you. One way to look at it: are you ready to manage the full range of activities being conducted at the level at which you now work?

We hope it's clear that these remarks apply not only to the neophyte, but to the experienced professional as well. We know several experts of yesteryear who are experts no longer. And there's no assurance that today's expert will be one tomorrow.

And we hope that edp management is listening, too. The best way to attract and to keep top-level talent is to offer challenge and growth . . . the opportunity to *really* learn a trade.

**pushbutton math**

# THE AMTRAN SYSTEM

by LAWRENCE H. HOOD, JURIS REINFELDS, ROBERT N. SEITZ and PAUL L. CLEM, JR.

The advent of third-generation, time-sharing computer systems with on-line remote terminals makes it technically and economically feasible for human beings to communicate directly with computers in a conversational mode. At the same time, as the computer becomes directly accessible to Mr. Everyman, there is great incentive to develop interactive conversational-mode languages which lean heavily upon large disc file libraries of pre-designed procedures and which permit the user to converse with the computer in the natural language of his field. In view of this technical opportunity, it is not surprising that a number of new computer languages, designed specifically for conversation-mode programming, are now under active development in many parts of the country.

Several of the new conversational-mode languages consist of streamlined and simplified blends of FORTRAN and ALGOL. However, this approach does nothing to simplify the programming process for the professional, and, in addition, it encourages scientists and engineers to waste both their time and that of the computer on a programming task for which, in many cases, they may have neither the background nor the inclination. These considerations have led the authors to feel that another approach to this problem consists of the development of new highly-advanced computer languages compatible with the conversational mode and which conform as nearly as possible to the natural language of the scientific world. This article describes a system which represents an attempt at such an arrangement for scientific computation.

This system is called AMTRAN, for Automatic Mathematical Translation.[1] It is designed to permit the user to enter mathematical equations in their natural textbook format and to receive immediate graphical and alphanumeric displays of the results on a cathode ray scope and a typewriter. For example, a nonlinear differential equation such as

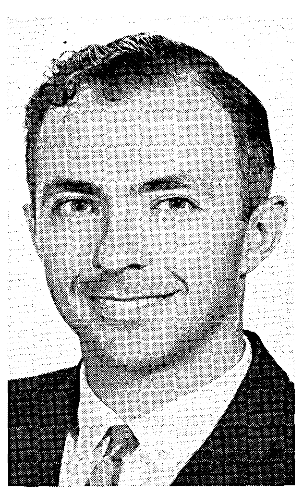
$$\frac{d^2 \text{Y}}{d \text{X}^2} = \text{Y}^3 + \text{Y EXP}(-\text{Y}) + 2\text{X}^2$$

can be entered as the series of slips

$d^2 \text{Y}/d\text{X}^2$ Y POWER 3 + Y EXP(−Y) + 2 X POWER 2.

and will be typed out by AMTRAN's special typewriter in the format shown in the original equation. This equation can be entered and solved within seconds to minutes, depending upon the speed of the computer. At the same time, the system also provides the flexibility required to enable an experienced programmer or a numerical analyst to solve problems of a nonroutine nature. Generally speaking, AMTRAN provides an order-of-magnitude improvement in convenience and turnaround time in mathematical problem solving.

The full AMTRAN system employs remote terminals (Fig. 1) which communicate with the computer over voice grade telephone lines. The terminals[2] consist of a large keyboard,



*Mr. Wood is a research physicist in the space sciences laboratory of NASA's George C. Marshall Space Flight Center. A principal contributor to the development of AMTRAN hardware, he holds a B.S. in electrical engineering and an M.S. in physics.*

[1] Seitz, R. N., "AMTRAN: Do-It-Yourself Computing", *Astronautics and Aeronautics*, June, 1965.
[2] Reinfelds, J., Seitz, R. N., Wood, L. H., and Ely, C. A., "AMTRAN Hardware-An Electronic Interface to Simplify and Speed Up Man Machine Communication", NASA Technical Memorandum X-553343, May 1966.

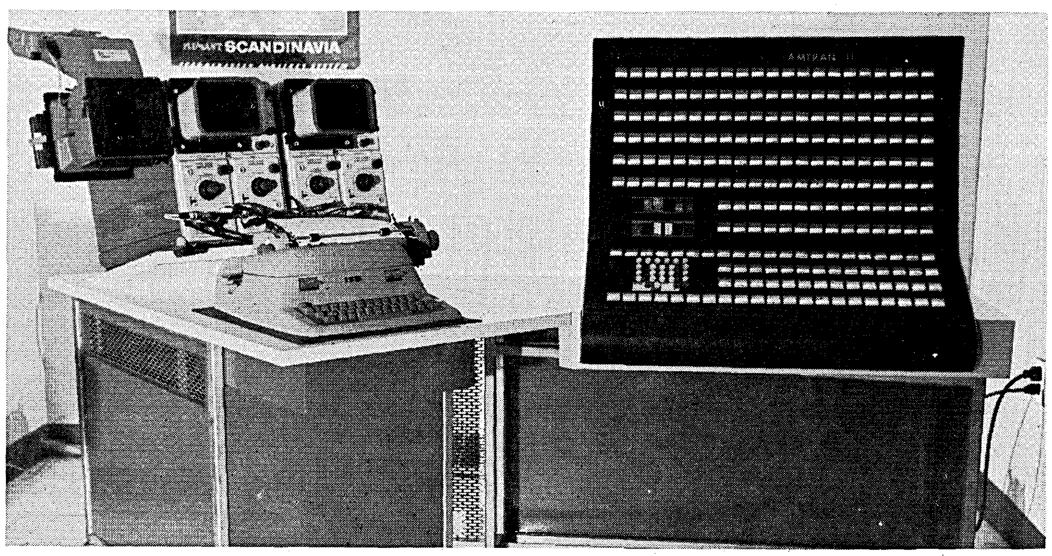



Fig. 1

two 5-inch cathode ray storage oscilloscopes for graphical and alphanumeric display, and a typewriter to provide a permanent record of displayed information, when this is desired. Of course, the usual plotting and printing capabilities can be used at a central location although these tend to be too bulky and expensive for desktop computer terminals. The typical cost of such a terminal runs $5,000 to $10,000, depending upon whether several terminals share a common multiplexer.

## general philosophy

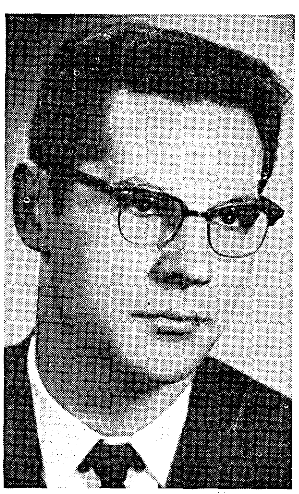
AMTRAN is a multi-level language. It can be used by the systems programmer at the level of bit manipulation or by the applied mathematician with no prior knowledge of computing, or by practitioners at any intermediate level. The system can be used in an on-line, conversational mode or in an off-line, batch-processing mode or in any combination of the two. The keyboards, cathode ray scopes and typewriters provide low-cost adjuncts to the usual card, printer, tape, and plotter attachments.

Three objectives have been of primary importance in the development of the AMTRAN system.

First, a scientist or an engineer with no background in computer techniques should be able to solve relatively straightforward mathematical problems with little or no instruction in the use of the AMTRAN system. For this purpose, the system has standard "convenience" operators in the language of classical mathematics, such as $\int, \frac{d}{dx}$, MINIMAX, etc., which suffice for a large fraction of the problems commonly encountered by the scientist or engineer.

Also, the AMTRAN language has been considerably streamlined to permit the user to "converse" with the computer in the natural language of mathematics. For example, the system provides automatic array arithmetic, automatic dynamic dimensioning of arrays, no declaration of variables, automatic assignment of working storage, implied multiplication, natural-English input and output, "picture" formatting, and other adjuncts to natural mathematics.

Second, the programmer and the more experienced user should be provided with the capability to construct their own programs and operators *at the keyboard* so that they can handle problems for which the standard set of operators is inadequate and so that they can take advantage of the extremely short turnaround times which are characteristic of conversation-mode programming. This requirement has been met by including ALGOL 60 programming capabilities with certain programming extensions—e.g., high-



***A former member of the AMTRAN development team, Dr. Reinfelds is currently with the computer sciences dept. of the Univ. of Georgia. He holds a Ph.D. in physics from the Univ. of Adelaide, and has done postdoctoral research at the Tait Institute of Mathematical Physics.***

level logical and transfer instructions, extensive list-processing and symbol manipulation capabilities, graphical input and output instructions, etc. Perhaps the most important feature is a simplified procedure-and-operator generation arrangement which permits the construction from the keyboard of general-purpose "super-instructions." These can then be stored in a disc-file library. This means that the programmer is not restricted to 30 to 40 basic FORTRAN-level instructions, but can, in effect, draw upon a repertoire of hundreds or thousands of general-purpose mathematical and logical procedures as building blocks for his programs.

Third, the system must be economically competitive with batch-processing systems in speed and storage. This requirement will be met through an incremental compiler.

## hardware configuration

As previously mentioned, a typical AMTRAN terminal consists of a large keyboard, one or two cathode ray scopes, a Polaroid camera for the scopes, and a special Selectric typewriter. A stylus or "electric pencil" will soon be available to enter graphical information to the computer.

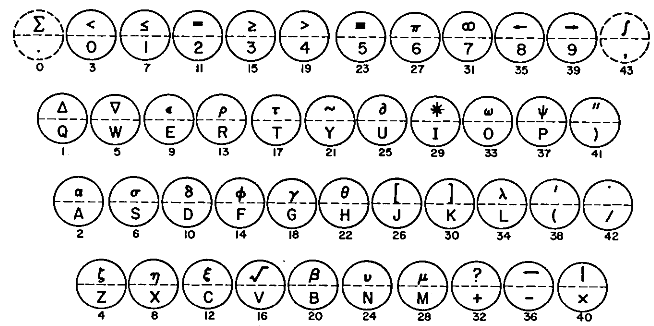
The keyboard has two classes of buttons: labeled buttons which are permanently programmed and unlabeled buttons which are "programmable" by the operator. Sufficient space is provided around the unlabeled pushbuttons so that the user may label them as he wishes on paper overlays provided for this purpose. Since the number of pushbuttons is necessarily limited, they are used primarily for the more common functions and operators, such as the +, SIN, and REPEAT operators, while mnemonic codes are used to call less commonly used operations such as the error function, or the Newton-Raphson method for solving differential equations.

Since the typewriter is used to call a great majority of operations, the question arises: Why use the keyboard at all? Briefly, when a typewriter is used to enter mathematical equations, entry becomes quite slow and prone to error. A conflict seems to arise in the user between the consideration of the problem and the mechanics of typing. On the other hand, the keyboard is relatively inexpensive, permits considerably faster entry than the typewriter, and provides important software advantages because it enters binary codes directly into the computer, bypassing the label-decoding process. Also, a special keyboard is quite desirable for certain special operations, such as those dealing with graphical displays. Most of the people who have used AMTRAN so far have preferred the keyboard-typewriter combination to the typewriter alone. Nevertheless, a typewriter can be used in lieu of the keyboard at some reduction in performance.

Because of the large number of buttons and instructions associated with the keyboard, a full set of instructions has been stored on the disc file and the user may display them any time. A GENERAL INSTRUCTIONS button has been provided on the keyboard to elicit a display of general instructions on the cathode ray scope and get the user started. Thereafter, the user can get specific instructions regarding the use of any particular button by pressing the TURN PAGE button, followed by the button in question. Thus, the system can explain itself in a self-teaching fashion to the novice user.

The typewriter, used to provide a permanent record of the program, has an 88-character set, which includes most of the Greek alphabet and a large complement of mathematical symbols (Fig. 2). The complete AMTRAN typewriter unit currently under development will have the

Fig. 2




KEY LAYOUT OF SPECIAL TYPE BAR SET FOR IBM I/O WRITER

ability to index the roller upward or downward independent of the carriage return so that mathematical equations may be typed out in the format in which they appear in a mathematics textbook. The typewriter is also used to type out data and results (augmented by the line printer) and, in addition, can serve as a plotter. The reverse indexing feature makes it possible for the typewriter to plot and label a curve in 30-40 seconds.

The stations used by the authors incorporate two scopes so that one scope can present alphanumeric information while the other retains "blackboard" graphical displays. The alphanumeric scope is used to print out instructions and error messages, and while it does not provide hard copy as does the typewriter, its writing speed is much greater. Therefore, it may be used to compose segments of the user's program before entry into the computer. Once the input has been checked, it is released to the computer, at which point a typeout occurs. This rapid writing rate has afforded unexpected benefits in the rapid printing of alphanumeric information in comparision to the slow typewriter. The 5-inch Tektronix storage scopes used for this purpose are inexpensive, afford high resolution, and require no internal buffering; consequently, they can be operated over ordinary voice-grade telephone circuits. (An improved 11-inch scope will be available early next year.) The attached Polaroid camera provides excellent high-contrast photos of the data displayed on the scope face. It would also be possible to employ an on-line plotter which would be shared by several stations. The plotter would provide accurate hard copy plots of any desired data.

*Dr. Seitz is employed by the computation laboratory at NASA's Marshall Space Flight Center in Huntsville, Ala. With prior experience in ion propulsion and plasma physics, he began working on the AMTRAN project in its early stages of development. He has a Ph.D. from Case Institute of Technology.*

The AMTRAN software can be implemented on almost any scientific computer of any reasonable size and speed, whether old or new.

## mode of operation

The user may elect to operate in a real-time mode in which instructions are executed as he enters them, or he may elect to operate in a suppressed-execution mode with execution occurring at some later time. However, in both cases, the list of entries made by the user is temporarily stored. If, at any time, the user wishes to permanently retain and assign a label to his list of operations, he may do this by entering CALL THIS, followed by the label. If he does not wish to retain a particular list of instructions, they are automatically erased when the RESET button is pressed.

Fig. 3

COMMON FUNCTIONS AND OPERATORS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DISPLAY ON SCOPE | [ | ] | \| (ABSOLUTE VALUE) | BACK-SPACE | ≠ | EDIT | * | ( | ) | ' | " |
| ERASE SCOPE | EXP | LN | LOG | NUMER-ATOR | Z | C | / | 7 | 8 | 9 | °/radians |
| TYPE | POWER | SQUARE | √ | SUPER-SCRIPT | Y | B | • (MULTIPLY) | 4 | 5 | 6 | $ln_{10}e$ |
| EXECUTE | ∫ | d | ∂ | SUB-SCRIPT | X | A | − | 1 | 2 | 3 | π |
| CALL THIS | REPEAT | LET | INVERT | RELEASE | ≤ | = | + | 0 | ×10? | • (DECIMAL POINT) | |
| RE-PROGRAM | MINIMUM | MAXIMUM | LOCATE ZEROES | | RESET | | | , | ; | CARRIAGE RETURN | CLEAR NUMBER |

The AMTRAN language has been extended beyond FORTRAN II in certain ways. The syntax has been streamlined and automated in an effort to eliminate as much human bookkeeping as possible and to retain only those operations necessary for mathematical definition and clarity. The simplifications are of value to the professional programmer and are necessary for the scientist or engineer if he is to converse with the computer in the language of mathematics.[3,4]

In AMTRAN, the dimensioning of a variable is carried out automatically when the variable is first defined. Thereafter, the computer, using dynamic memory allocation, keeps track of the dimensionality of variables as they are manipulated during computation.

Another feature is automatic array arithmetic. For example, if the user enters an equation such as ½AX, where A has previously been defined to be an individual number and x has been defined to be a one-dimensional array, the computer will calculate the individual number, ½A, and will then multiply this result by every number in the x array. This permits the user to deal more nearly with the constants and functions of applied mathematics (in addition to speeding up the execution of array operations).

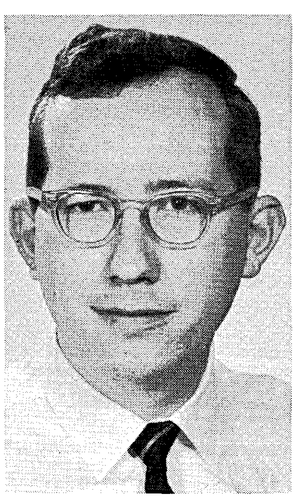
Perhaps the most important feature is the ability to rapidly and easily construct high-level instructions or operators which can then be embedded in other operators. These super-instructions are automatically compiled into object code. This "boot-strap programming" capability enables each user to construct high-level mathematical and logical instructions tailored to fit his own needs. Furthermore, these instructions are indistinguishable, as far as the user is concerned, from the intrinsic AMTRAN instruction set. For example, many of the instructions of FORTRAN and ALGOL can be simulated by console-programmed instructions in AMTRAN. A library of commonly-used instructions is available to all users. This operator or modular-programming approach also permits the user to build up and check out his program a block at a time.

Another feature will eventually consist of the ability to manipulate symbols with the same automatic dimensioning and automatic array operations which characterize the handling of data. These symbols consist not only of the alphanumeric and special characters but also, the basic operators and operands of the system, such as ∫, IF, GO, TO, etc.

Primitive symbol manipulation capabilities are present now. Fig. 3 shows the keyboard "island" which contains the most commonly used operands and operations. There is a number-entry group of buttons on the right-hand side and an elementary function group on the left with buttons in between which are also accessible to the user. A number of more commonly used classical analytical operators are present on the common-operator keyboard, such as ∫, ∂, *d;* and operators which invert functions, change variables, and locate the minima, maxima, and zeroes of functions. Two programmable buttons are also present on this keyboard island. Two standard-format data display operators, for the typewriter and the scope respectively, also appear on the common operator keyboard. Certain delimiting and housekeeping operations are represented on the keyboard by the BACKSPACE, RELEASE, AND START, RESET, period, comma, semicolon, and CARRIAGE RETURN buttons. The SUBSCRIPT operation is used to address the elements of arrays. The constants $\pi$, $\log_{10}{}^{e}$ and $\pi/180$ are also addressable from this keyboard island, as well as two blank buttons which the user can assign to his own commonly used programs or variable. (Many other "programmable" keys are available elsewhere on the keyboard.)

The following examples provide a quick look at some of the present capabilities. Fig. 4 is a photograph of the scope face showing the printout which occurs when the user solves a differential equation using the SOLVE operator. The user's first statement causes the printout of any instructions that may be present in the next subroutine which he is about to call (in this case, the SOLVE subroutine).

The second statement demonstrates the present procedure for solving a differential equation. When the SOLVE 1 button is pressed (or the mnemonic SOLVE1 is typed in from a teletype terminal), the computer selects the appropriate Runge-Kutta formula and begins the process of



*Mr. Clem is a programmer analyst at Computer Sciences Corp. in Huntsville, Ala. He was previously employed at Northrop/Huntsville where he was in systems programming. He has a B.S. in mathematics from Birmingham-Southern College.*

[3] Yntema, D.B., "The Software Problem", Group Report 1964-51, Lincoln Laboratories, MIT, Cambridge, Mass., Sept. 4, 1964.
[4] Sibley, E. H., "The Engineer's Assistant", MIT Summer Session Course in Computer-Aided Design, Cambridge, Mass., Aug. 1966.

solution. (Note that the SOLVE operator is a console programmed subroutine.)

The third instruction in Fig. 4 causes the scope display of the solution (Fig. 5). The solution-curve is automatically scaled with printed *x* and *y* scale factors, and with the origin optimally located to fully utilize the scope face. If we wish to retain a list of operations and to thereby construct a console program or operator, we proceed by entering:

RESET

(This operation resets the system so that it is ready for a new program list.)

ENTER PROGRAM

1. $\frac{2\ \text{AQ}}{\text{R}^2 - \text{A}^2}$
2. CALL THIS PHI.

Note the implied multiplication between A and Q. This is possible only because the keyboard bypasses the mnemonic label interpreter required for typewriter input. Since the keyboard inserts unique code numbers directly into the computer, potential confusion is avoided between A x Q and the (possible) mnemonic label AQ.

After the program has been stored under statement 2, the system automatically resets for the next program. Having generated a mathematical operator (which, incidentally, would compute the axial component of an electrostatic dipole field), let us now differentiate it, using the symbolic differentiation subroutine.

Fig. 4

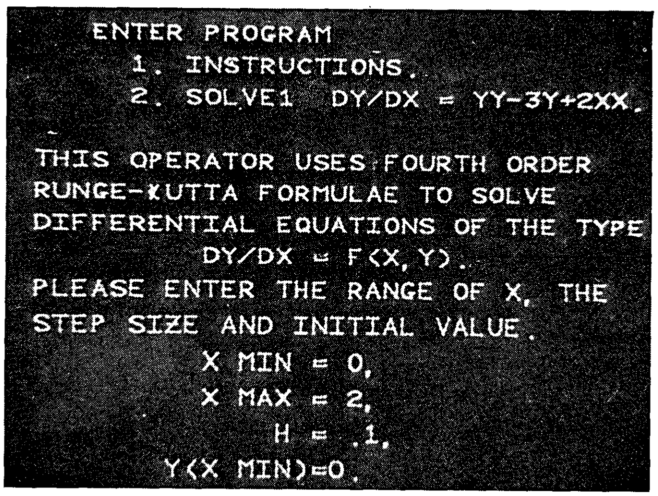
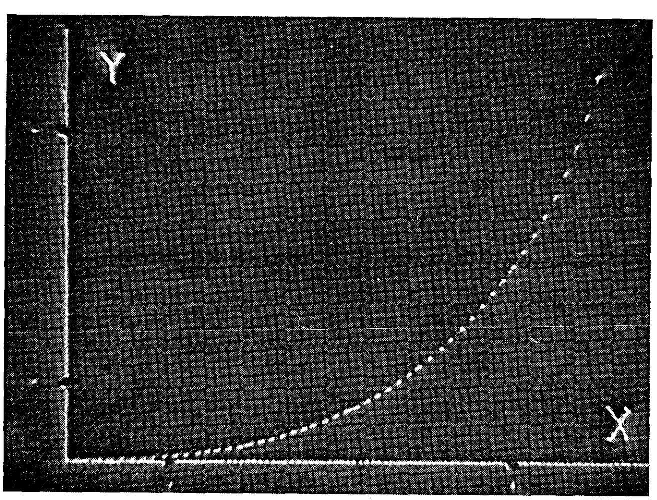



Fig. 5




ENTER PROGRAM

1. TYPE $\frac{d\ \text{PHI}}{d\ \text{Z}}$

$$\frac{d\ \text{PHI}}{d\ \text{Z}} = \frac{-2\ \text{AQ}\ (2x)}{(\text{A}^2 + x^2)^2}$$

This statement causes the computer to analytically differentiate the B expression and type out the partial derivative. (The computer automatically labels the derivative after differentiation.) The resulting formula for the partial derivative is an executable program which is temporarily retained by the computer and can be permanently stored by the user, if he so desires.

As an example of the latest version of AMTRAN, consider the following:

ENTER PROGRAM

1. TYPE-ON-SCOPE "PLEASE ENTER $\eta$ AND $\Phi$ (x) NOW."
2. FOR O $\geq$ (x) $\geq$ $\Phi$ MIN

$$\rho\ (x) = 1 - \overset{\eta}{\sqrt{\pi}}\ \text{EXP}\ \Phi\ (x) \int_0^{\sqrt{\Phi}} \text{EXP}\ (-\text{T}^2)d\text{T},$$

OTHERWISE, $\rho$ (x) = $\eta$ EXP ($-\Phi$ (x));
WHERE O $\leq$ T $\leq$ 3, 100 INTERVALS

3. CALL THIS RHO.

After the typewriter has typed ENTER PROGRAM, the statement 1 causes the message PLEASE ENTER $\eta$ AND $\Phi$ (x) NOW to appear on the cathode ray scope face.

The second statement causes the computer to divide the array $\Phi(x)$ into two parts: the portion which lies within the range o $\leq \Phi$ (x) $\leq \Phi_{MIN}$ and the portion which does not. The computer then carries out the indicated calculation on the two portions of the array $\Phi$ (x). The WHERE following $\rho(x)$ causes the "dummy" (local) variable T to be generated before the first part of statement 2 is executed—i.e., it puts the "o $\leq$ T′ $\leq$ 3, 100 INTERVALS" at the beginning of statement 2 rather than at the end. The third statement assigns the label RHO to the operator which we have just constructed.

This program illustrates several features of AMTRAN. First, in statement 2, since $\eta$ is not previously defined within the subroutine, the computer assigns to $\eta$ at execution time the value of the first operand which follows the RHO operator. These variables are dummy (local) variables and the data associated with them is automatically deleted at the end of a console program. Such variables are used for "working storage." On the other hand, $\rho(x)$ will remain after the subroutine has executed. Since $\eta$ appears only once in the subroutine, no working storage is provided for it by the computer. (This fact is determined by the computer during the initial entry of the code string.) The second variable, $\Phi(x)$, which appears in the subroutine is also undefined so the computer takes for its value the second operand (or sequence of operations) which follows the RHO operator. Since $\Phi$ (x) appears more than once in the subroutine, the computer automatically provides working storage for $\Phi(x)$, automatically dimensioning this storage area at execution time. For example, if the second operand were equivalent to a single number, the result for $\rho(x)$ would be a single number, whereas if the $\Phi(x)$ entry were a one-dimensional array, $\rho(x)$ would also be a one-dimensional array. (Of course, the user need not concern himself with this detailed system logic.)

Second, when $2\eta$ is calculated, it is calculated only once and the resulting number is multiplied by all of the numbers in the array EXP $\Phi(x)$.

Third, this operator contains the integral operator, which in turn, contains the forward difference operator. Thus, three levels of nested subroutines are embedded in the macroinstruction RHO. The operator RHO may itself be embedded in other programs and may be used as freely as the exponential subroutine.

Note the method of generating the independent variable x. Most commonly, for functions which can be defined by means of formulae, the construction of the function begins with the generation of X. However, when a function is known only in terms of tabulated values, these may be entered with the instruction SET. To later use the RHO operator, we might say DENSITY = RHO (1.05, Y).

## other conversational mode systems

The basic inspiration for AMTRAN was the Thompson-Ramo-Wooldridge on-line computer system originated by G. J. Culler and B. D. Fried[5] and later extended by Culler at the Univ. of California (Santa Barbara). The Culler-Fried system utilizes a 5-inch Tektronix storage scope, a typewriter keyboard, and another typewriter keyboard with specially-labeled operator keys. The system possesses the ability to handle complex numbers, two-dimensional arrays, vectors and matrices. It is designed to permit the console programming of operators or instructions and it also provides array arithmetic. It is very fast in execution. Although there are similarities between AMTRAN and the Culler-Fried systems, there are also sizable differences.

Another early conversational mode system consists of the RAND Corporation's highly-polished JOSS system,[6] which has formed the basis for the Burroughs INTERP system and the SDS CAL language. Four more recent conversational mode languages are QUIKTRAN (IBM's conversational-mode FORTRAN system), and the MAP,[7] RECKONER,[8] and COGO[9] systems. The RECKONER and MAP systems are quite similar to AMTRAN in their provision of a streamlined, applied-mathematics language for scientists and engineers. The COGO system is a problem-oriented language designed to accommodate civil engineering problems.

Two on-line batch-processing systems which use special high-speed compilers consist of the Klerer-May system[10] and Dartmouth's BASIC language.[11] The Klerer-May system is particularly strong in its emphasis upon natural mathematical formatting of its input and output. General Electric has implemented BASIC on a commercial basis.

AMTRAN differs from the preceding systems in various ways. It has been given certain features intended to facilitate future research in applied mathematics. It should be emphasized that AMTRAN is a full-scale ALGOL-type programming system and not a simplified language designed only for small computations or for a narrow range of problems.

Two restricted versions of AMTRAN are presently available which can be used on any IBM 1620 computer with floating point hardware and indirect addressing capabilities.

One version is intended for 1620's with 40,000 digits of core storage while the other is designed for 60,000 digit machines. No special equipment is needed except for the usual console typewriter and a card-reader punch. Copies of these 1620 programs are available from the authors upon request.[12,13]

Although these restricted versions are designed for small core machines, they possess considerable power. Virtually all of the capabilities of the 1620 version of FORTRAN II are present, in addition to automatic array arithmetic multi-level programming of operators, rudimentary symbol manipulation capability, the ALGOL IF test, subscripted subscripts, and above all, the ability to deal with straightforward problems at approximately the level of classical mathematical analysis. Through an encoding arrangement, this system can store up to 50 console programs or subroutines and can accommodate matrices or two-dimensional arrays up to 25 x 25. (When small desk-top computers become economically feasible, a 4-8,000 word edition of AMTRAN could combine the mathematical power of a digital computer with the simplicity and convenience of a slide rule.)

A more elaborate system utilizing one of the special terminals described in this article has been implemented on IBM 1620 mod II computer with a disc file.

Although the writers have had very favorable experience with keyboards and visual displays, considerable effort has been expended in rendering AMTRAN compatible with typewriter and teletype input and output, since the latter are cheaper than full-scale AMTRAN terminals.

An extended version written in ALGOL 60 is currently under development in collaboration with the Burroughs Corporation.* This time-sharing AMTRAN incremental-compiler will act like a single program in the multi-processing B5000 or the faster (800-nanosecond cycle time) B6000 computers.

Finally, the Brown Engineering Co. is presently developing an AMTRAN incremental compiler for the IBM 1130 computer.

## conclusion

An effort has been made in the development of AMTRAN to develop a broad-based programming system which spans the spectrum from a streamlined machine language for the professional programmer to the highest level mathematical operations (for the scientist or engineer).

In addition to the writing of an incremental compiler, future plans call for effort in the areas of symbol manipulation, automatic numerical analysis, and the introduction of new simplified basic programming operations. It is hoped that these improvements, particularly in the symbol manipulation area, will improve the programming check-out and debugging rates beyond their present values. Turn-around times are presently running 5% to 10% of the batch processing rates.

An interesting result of our demonstrations has been the response of scientists and engineers to the system. The reaction is invariably "Where can I get one of these?" There is no doubt that a market exists for a conversational-mode computer system which speaks the natural language of mathematics as nearly as possible, and which relieves the user of all those programming and analytical bookkeeping operations which can be prescribed in "cookbook" terms. Of course, incorporating the procedures of classical and numerical analysis into an on-line computer system is a formidable task. Nevertheless, we hope AMTRAN will provide a first step toward everyday use of an automatic mathematical system for on-line computation. ■

5 Fried, B. D., "STL On-Line Computer: Vol-General Description". Report 9824-6001-RU-000, TRW/Space Technology Laboratories, El Segundo, Calif., December 1965.

6 Shaw, J. C., "JOSS: A Designer's View of an Experimental On-Line Computing System". *Proceedings, Fall Joint Computer Conference, 1964,* p. 455.

7 Kaplow, R., S. Strong, J. Brackett, *MAP, A System for On-Line Mathematical Analysis,* MIT Press, Cambridge, Mass., January 1966.

8 Stowe, A. N., R. A. Wiesen, D. B. Yntema and J. W. Forgie, "The Lincoln Reckoner: An Operation-Oriented, On-Line Facility with Distributed Control", *Proceedings, Fall Joint Computer Conference,* Boston, 1966.

9 Roos, D., and C. L. Miller, "The Internal Structure of COGO-90". M.I.T., Research Report R64-5, February 1964.

*This differs from the Burroughs INTERP system.

10 Klerer, M. and J. May, "A User Oriented Programming Language", *The Computer Journal,* Vol. 8, No. 2, July 1965.

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12 Albert, M. A., P. L. Clem, Jr., L. A. Flenker, C. A. Ely, J. Reinfelds, R. N. Seitz and L. H. Wood, "The AMTRAN Sampler Instruction Manual", NASA Technical Memorandum X-53342, July 1966.

13 Buntyn, T. A., P. L. Clem, Jr., M. D. Cox, M. E. Dyer, C. A. Ely, L. A. Flenker, W. D. Hoelscher, V. C. Lillard, J. Reinfelds, R. N. Seitz, M. R. Sparks and L. H. Wood, "AMTRAN Sample Demonstrator", Computation Laboratory, George C. Marshall Space Flight Center, Huntsville, Alabama July 1966.

# PERPETUAL USER STUDIES

## prerequisite for information management

by LAUREN B. DOYLE

The magnitude and complexity of technical information flow in the United States is nowhere more evident than the level of federal government, with its numerous super-large libraries and information handling networks. Because of this, the urge to propose a government-sponsored centralized technical information service is as recurrent as the stirrings of a troubled conscience. Various studies of this possibility have been undertaken, and as often as not the recommendation has been against establishing such a service. Considerable conservative sentiment exists, and few expect the establishment of any centralization of information handling similar in size and scope to that in the U.S.S.R.; nevertheless, it appears that centralization of some sort is unavoidable.

In regard to this question, as to many other abiding questions in the information field, much talk has occurred without clarifying how a decision is to be made. This is not the fault of the discussants, and of course the issue must be discussed. The fault is not even in the complexity of the national information flow picture. The fault is that there is not nearly enough "information about information." The nation's goods and services economy is far better understood than its information economy, and even the metabolism of the human body is better known and understood than the metabolism of information in modern civilization. Bits and pieces of the information transfer and utilization scene are often brought into sharp focus by conscientious studies, but under present conditions it is hard to describe adequately any large portion of the total picture.

When it comes to making decisions such as whether or not to have centralized information management, or decisions about the degree and kind of centralization (if that route is taken), we literally do not know enough to have confidence. There are occasional glimmerings of concern about the dearth of such knowledge. For example, in a report[1] to the National Science Foundation entitled "Centralization and Documentation," Giuliano of Arthur D. Little, Inc., points out: "Many of the proposals for major changes tending toward the development of large centralized systems do not appear to be based on sufficient quantitative data to justify investments of the magnitude contemplated."

A thesis can be built that if something is to be centralized and if large investments are to be made therein, it might best be a *massive and concerted program to gather, summarize, and distribute data on the dynamics of national use of technical information.* This thesis argues that if beneficial control of information transfer is possible, then the first step in achieving control is the collection of information about information at a level of detail and volume of almanac proportions. This reservoir of information would be both the context for decision making and, with rapid updating, the feedback element that a good control system needs. A strong possibility is that if this massive information-gathering program were undertaken successfully, the need for "management"—control from the top—may not appear; distribution of summarized material to the numerous people (in and out of governmental activities) who now make decisions about information handling may permit local control that would be more satisfactory than centralized control.

### designing for the user

There is a part of the total information flow picture that we might call "the technical document system," in which authors put useful information and/or discussion in a form that can be directed flexibly to a large audience, scattered widely in time and space. In this communication system, in which information can be stored and tapped at will, the accent is on the convenience of the user. This is appropriate beyond measure; it is hard to imagine how a rapidly progressing technology would be possible unless users have freedom to program their own inputs. Most users may not approach their optimum in exercising this latitude; nevertheless, if the user doesn't know when, why, and how he needs information, it is hard to contend that anyone else knows either.

Many information specialists seem to deny this by presenting themselves as critics or spokesmen in relation to the user. The user's critics want to change him—an unrealistic objective, even when "change" means "educate." The user's spokesmen are even worse, adopting an idealized model of the user in an unconscious attempt to simplify the information problem. An oftheard example of the latter process is the admonition: "What users want is *information,* not documents." Really? I wonder who knows that much about what "the user" wants.

Of course, criticism can be constructive, and descriptions of the user can be accurate. The point being made here is that, under conditions of fragmentary information about users, value-laden or idealized pictures of the user compete with and even drown out those sketched perceptively from experience and available information. Moreover, the possibility of great diversity in user needs can be uncomfortable to system planners. But in the absence of sufficient information, system designers are free to adopt a conception of user needs that conforms to ideals of system efficiency or economy; it requires only a minor shifting of mental gears thereafter to expect the user himself to conform.

Many have seen that these ills are subject to a direct remedy: increase what is known about the user. But recent user studies—though many of them have been enlightening—are isolated fragments of a very large mosaic. We note that senior people in the information field have been saying, lately, that technical information should be considered a "national resource." From this it would require no great stretch of logic to conclude that user behavior data ought to be the fundamental stock of knowledge

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[1] Available through the Clearinghouse for Federal Scientific and Technical Information, United States Department of Commerce.

on which information system and policy decisions are based just as traffic and driver behavior data are relied upon in determining legislation relating to highways.

For readers who already agree with this view, it remains only to postulate that we need information far more complete and far more representative of the cross-section of technical information users than current studies give us.

Earlier the thesis was offered that the first step in achieving management and/or control of information on a national scale should be a massive information-gathering program, and the qualification was just added that emphasis be on user behavior data. To consider the user's key position in the "technical document system," one might think of communication between author and user as derivative from that between a speaker and a listener. The speaking-listening relationship can be thought of as the basic mode of human communication. If communication involves the written word only, the relationship changes to writing-reading, much closer to the relationship of author and user, but still not identical.

To provide a sound framework within which to examine the user, it would seem prudent to begin with an understanding of the role of the user within the information system. One view is that the user, like the reader in the writer-reader relationship, does nothing more complicated than read what the author has written. This, however, would overlook the fact that actual reading of documents is seldom studied in user studies; stress instead is placed on interaction between the user and "the literature," meaning the entire mass of documented material in the user's field and the means of access to it. The "user" function thus appears to be defined in terms of his motivations and actions in *selecting* material, and rarely in terms of his use of it. Ultimately, it may be standard in a user study to give the reading process (or, more broadly, the using process) as much importance as the searching and selecting process, but the case now is that these studies seem impelled to treat the non-reading aspects of user behavior.

The non-reading aspects of user behavior get emphasis because of their greater immediate significance in information-system operation. But there is a more fundamental reason why they are significant. The author-reader relationship is a one-to-one interaction in the case of written correspondence, whereas the author-user relationship is—from the user's viewpoint—a many-to-one interaction in searching and selection. The process of searching, say, an index to ten thousand documents is that of converting a relationship between the user and many thousands of *potential* authors to one between the user and perhaps one or several authors to whom the user wants to be exposed. The burden of this process is primarily on the shoulders of the user, and this is the price he pays for being free to program his own information input.

It is this selection function that distinguishes the author-user relationship in the communication model we have been considering. The Weinberg report[2] sets forth this function as follows: ". . . The information chain operates like a switching system. The ultimate aim is to connect the user, quickly and efficiently, to the proper information and to only the proper information. But perfectly precise switching is neither possible nor desirable. One cannot define in advance exactly what information is proper; the switching system must always allow for some browsing in neighboring areas. Moreover the capacity of the user to absorb information limits the system . . ."

The author, of course, can and often does take part in the operation of "the switching system." Through his mailing list and his selection of publication outlet he may partially determine his user population. But the final choice—to use or not to use—resides with the user, who is his own best authority on the information he needs, if not on how to get it.

It may now be more evident why monitoring of user behavior that is both perennial and widespread can eventually bring a kind of information control not previously known. This information gathering—which we can think of as a "perpetual user study"—could come to constitute a democratic control system with the user as the electorate. The user, however, would not vote in the usual sense, but more in the manner of the refugees from East Berlin who "voted with their feet."

Eventually, another and possibly more important kind of controlling effect should arise: feedback. Changes in user behavior patterns, detectable wherever monitoring is fairly continual, can be analyzed as responses to introduction of new facilities or to changes in policy. In this age of fast-changing horizons of technology, so many new methods and machines are becoming available to use in information access that choosing among them—or even knowing about them—is an unmanageable task. Nationwide monitoring of user behavior, however, would lead to wide advertisement of technological mutations showing unusual utilization or popularity.

## user complexity and fallibility

At least two important difficulties are seen in a user-governed control system: (1) the user's complex behavior in searching and selecting information, and the impossibility of making a complete record of all pertinent interactions of the user with access mechanisms; (2) the user's fallibility, especially his limited understanding of how best to approach the information store (or even how to use the information he acquires).

Surely the first goal of the "user census" is to know the typical user and his range of variation in behavior. The requirement for a continual user study on the scale we're talking about is generally to observe as much as possible within some budgetary limitation. This probably entails representative in-depth studies of a very small number of users, in addition to some data on all users. Though the census may be shallow of the total user population, it will furnish a sounder basis than we now have for deciding where to focus in-depth studies. People using in-depth study results in determining policies affecting information assimilation would by this token be assured that the situations investigated were indeed representative.

In general, microscopic scrutiny can be brought to bear on any portion of the nation's information use pattern, with full understanding of what kind of user situation is being observed and how much of it is typical. As we know from the history of science, the first tasks in establishing a new realm of scientific inquiry is organization of what is known; when the large amount of user data are tabulated in summary form, a portrait of the user population will emerge that will become the foundation for a more securely analytical phase of the "zoology of the user."

The fallibility of the user, the other difficulty we are considering, is probably a matter of more practical concern than is user complexity. A great part of the problem is something we touched on earlier: attitudes toward the user. Some writers about use of information facilities believe that information system personnel know best about almost anything having to do with information access, and advocate requiring those who would aspire to be technical information users to be educated "from the ground up" in use of access facilities. One does not want to be in the position of being against education, of course. But

[2] *Science, Government, and Information.* Report on the President's Science Advisory Committee (Alvin M. Weinberg, chairman). Washington, D. C., G.P.O., January 10, 1963, 52 pp.

the benefits of education or re-education are limited, especially in an age of specialization. The user, after all, is not expected to know as much as the information specialist about information access—so by that criterion he will always be somewhat fallible.

The preoccupation with the inadequacies of the user, and the consequent criticism (some of it open and much of it thinly disguised), would not be an auspicious mood in which to begin scientific inquiry about information use. A more neutral way of seeing the user would be helpful. His situation must be seen in its over-all context, not just in relation to information access.

He is getting paid to do his job (as is the information specialist), and his most influential critic is his boss—who is *also* a user—and so on up the line. The user does more than merely retrieve information: he rules technology.

Even those who feel more kindly and respectful toward the user may still have unrealistic expectations of him. Some of the recommendations of the Weinberg report (op. cit.) seemed to paraphrase a larger sentiment of those times: "Ask not what the system can do for you; ask what you can do for the system!" It seems to me, though, that—except during times of widely understood emergency—telling people to accept more responsibility is the easiest but least effective approach to a social or organizational problem.

## collecting information about the user

User behavior data can be and should be collected painlessly. Monitoring need not be watching or even interviewing. To choose an obvious case, everything a user does with an on-line computerized literature search facility can be recorded automatically without strain or even awareness on the part of the user. Experience with time-shared computers has turned up many frustrating difficulties, but sensitivity to having one's acts recorded has not been one of them.

In a conventional technical library, monitoring would be less automatic, but can still be painless. Closed-circuit TV, transducers, photocells, magnetic actuators, and even lasers or low-strength X-ray devices can be used in common library situations. (If the reader feels incredulous about the more bizarre of these sensors, he might consider the wide variety of uses such devices have in industry.) One ought not to feel concerned that this array of user-watching equipment will create a "big brother" atmosphere; even in banks and supermarkets, where its purposes are less noble, it causes little stress.

The great bulk of data collection on information usage might consist of nothing more than pooling records of the type that some libraries keep anyway. As pointed out earlier, the data about users en masse may not need to be particularly detailed, and the expensive equipment can be reserved for in-depth studies. Precedents in other areas of government-sponsored information gathering give grounds for optimism, and the final compilation of user data would probably be as faceless and unjudging as the U.S. Census.

I list below a number of "burning questions," which people have wondered about and argued about without, really, great progress having been made toward answering them:

1. What percentage of references placed before a user leads to his ordering or procuring a document and/or further information? What is this percentage with respect to KWIC indexes, citation indexes, standard bibliographies, monographs, abstract journals, citations in journals and reports, and on-line computerized searches? This is an example of a particularly difficult study—one whose results could be misinterpreted even under the best of conditions. Without background data on a specified (and hopefully standard) population of users, however, it would be reckless to claim that a given study is generalizable beyond the group involved in that study. It is granted that most user studies are not intended to be representative of the "user universe," and are frankly geared to a special field or special user class. Unfortunately, since this sort of thing is all that is available today, people are bound to generalize from it. What else can they do?

2. How do reference publications based on computer output fare in comparison to manually produced reference publications? What is the effect of post-editing? The question of computer vs. manual output is going to become more "burning" as time goes on, and the answers more confusing as the variety of computer outputs increases. Dependable answers are quite important in this area because they will help us reach a more effective man-machine balance.

3. What forms of literature search figure most prominently in user behavior? Search for unique items of information not requiring context? Exhaustive searches for all pertinent material on a topic? Searches for anything on a given topic? Searches for *the* document in a given field? Browsing in which no definite information need is in mind? Browsing for problem-solving purposes where one fulfilled searching step leads to the next step?

4. Is there any relationship between a user's productivity and his literature access habits? Notice that this is one kind of study where results could be very misleading under now-existing conditions of not having adequate data and not being able to judge representativeness.

5. To what extent do typical users prefer "social" information access forays (professional meetings, telephone calls, visits, correspondence) over the essentially non-social chores of library searches or use of subscriptions to journals and reference publications? The ramifications of the user's humanity and gregariousness in access to information are little understood at present, but may be among the most important factors we need to understand.

One could go on and on listing questions of this kind. These questions are aired repeatedly among information specialists and interested bystanders, often quite emotionally. Yet the answers to the questions are tentative and do not inspire confidence; we don't have the apparatus to observe and describe users representatively and conclusively. As a result, the voices of those who might see reality in spite of lack of appropriate data are lost in the competitive shouting of user critics, user spokesmen, dogmatists, vested interests, promoters, and well-meaning but ignorant authorities in neighboring fields. Those isolated workers who have tried to be scientific are to be complimented, but their efforts are too puny in relation to what is required.

## conclusion

One hears increasingly that technical information is a "national resource." We must come to know more about the use of this resource. If knowledge of information use is to be truly representative, we must begin by defining a national user population. If knowledge of the user is to be kept current as information access techniques and systems change, we must monitor the user population perpetually. Then, in the context of the trends brought to light, we may evolve a decision-making apparatus that will eventually be as self-regulatory as our economic system itself. As in the case of the economy, only where it is not truly self-regulatory need we apply centralized controls. ■

# PRODUCTIVE GRAPHIC DATA PROCESSING

**success at huntsville**

by WILLIAM J. QUIRK

At Boeing-Huntsville, we were faced with a unique computing problem that was placing an inordinate drain on time, engineers and facilities. We thought the solution time could be vastly speeded up by the use of a graphics system; thus in 1965 we installed an IBM graphic system linked to 7044 and 7094 computers. The new approach has been applied to two of our chief missions. One is the reduction of raw flight data that we receive from telemetry stations after a missile shot. The second is the simulation of data in advance of a launch.

In the first instance, the moment-by-moment flight of a bird is transmitted from launch until impact by telemetry back to ground stations. The result is a digitized tape containing thousands of information bits for each of 20 to 50 flight parameters. This tape must be reduced to tabular form, analyzed and then converted into curves that will describe pictorially the actual flight path of the missile. But the number of telemetry receiving stations involved on each flight, the effects of static, and inherent errors of transmission and reception add a confusing number of extraneous bits that must be eliminated by judicious editing and replaced by hours of iterative deduction on the computer. Thus our engineers are confronted with a mass of data, some wholly irrelevant, some erroneous, and several information gaps with a wide variety of variables that must be explored, tested and discarded or accepted purely by engineering intuition and trial and error.

Traditionally, each flight curve was constructed from computer outputs, then translated back into digital inputs and fed back to the computer to see if the curve was the correct one. This constant conversion and need for run and rerun, plus off-line recording to obtain graphic output, added to computer turnaround time and meant that each flight reduction problem took up to three weeks. But with the use of a graphics system, we now do the same operation in minutes.

### changes during processing

The difference lies in the new capabilities of graphics; changes and decisions can be made at any time during the run. This is the real time-saving factor for us.

In essence, the graphic mode enables us to display the digital flight data as a curve. If the curve needs alteration or adjustment at any point along the run, we can make these changes by throwing out incorrect information and adding new variables that help form the correct curve.

We had, of course, been aware of the potential in graphics for some time, but when we first thought of applying it to some of our solution needs, we anticipated a great number of programming difficulties. But happily, this wasn't the case. Our analysis programs were already written and we simply added graphic interfaces to them by supplying macros for display, plot, record, plus all the standard macros IBM had provided.

In the graphics system we got from IBM, there are some 30 basic macros to generate orders to channels for computer, function keys, light pen, alphanumeric keyboard and display tube. Typical macros would order the display tube to draw a vector or a point, draw characters, set counters, turn the tracking cross on and off and reposition it. In addition, there are other macros that form the calling sequences for subroutines. These enable the programmer to simply initiate the order for a specific function—such as draw a circle—and the subroutine, already built into the macro, would generate every order to draw each vector that would go to make up the circle. The programmer simply provides the center of the circle and the radius as an addition to the macro.

There are also subroutines to draw grids on the display tube and all the programmer must add is the amount of screen he wishes to be taken up by the grid. This appears as an option for the engineer to select based upon the specific problem being run.

To these, we added our own macros to alert the programmer to the fact that an attention had occurred, or to wait for a forthcoming attention.

In essence, we were simply adding on to our existing programs some wishful thinking in the form of displays we would want if they were available. And we found that we could make them available.

Thus, we were able to shrink the lengthy computer complexities of flight data reduction to a matter of minutes instead of weeks. The solution begins by reading both the tape and the program disc into the computer. A request is then made for the tape to be mounted on the tape drive and the program loaded into core.

Initialization occurs as the Alpine system shifts to a conversational mode by asking the engineer at the display console which parameter he wants to look at. The engineer replies by sensing with his light pen one of the 20 or more parameters, e.g., thrust and time, he wishes.

The routine then goes to the tape and records it on microfilm. Once again the dialogue between engineer and computer resumes as the program says, on the cathode ray tube, that the entire graph is on microfilm and then asks what segment the engineer wishes displayed.

The engineer again uses the light pen to select the desired segment and the program then creates the necessary orders to draw that segment on the CRT. At this point, the engineer can edit the segment, with both light pen and function keys—eliminating extraneous bits, filling in gaps and removing obvious errors. From this point he proceeds to call for each of the other segments of editing. Thus far, all functions have been performed by the IBM 7044. But now, curve fitting of information on the tape is necessary and this requires an analysis program rather than the display control program used to this point.

A function key alerts the proper macro that requests the analysis program stored in the 7094. At the same time, a background program, already running on the 7094

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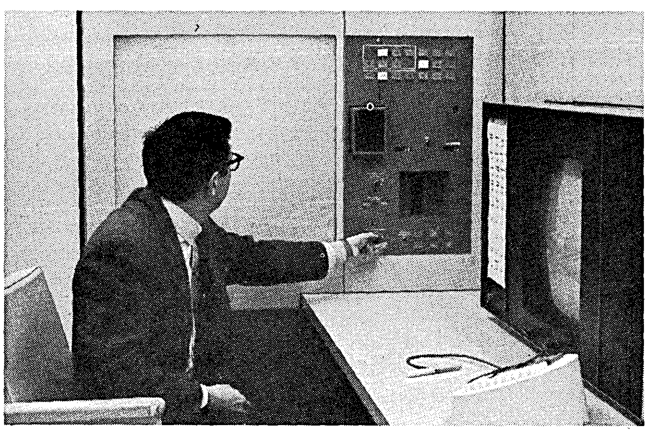
for a totally different problem, is checkpointed and the graphic analysis program is loaded in its stead.

When the analysis program has completed its curve fitting function it notifies the display control program and the engineer to this effect and stores the information on its disc file. A call for the curve drawn by analysis brings it forth on the CRT. Now, the engineer's judgment and intuition come into play. He can accept the curve, if it looks right or, if not happy with it, he can change it. To do this, he may weight some of the coefficients by adding or subtracting variables—again an iterative problem solved by engineering judgment. The changes are analyzed and a new curve drawn and displayed. If the engineer is now satisfied he can call for the curve, and the digital data from which it was built, to be recorded on micro-film, or printed out by the 1403. Then he moves on to the next variable, until all flight parameters are reduced. Total elapsed time—one engineer approximately 40 minutes, as opposed to the three or four engineers taking two to three weeks for the same problem using our old system of a computer without a graphic capability.

From flight data reduction, it was a simple step for our engineers to program the system for flight simulation. In this instance flight curves must be constructed in advance to take advantage of launch windows that in some instances are only minutes wide, to tell the range safety officer at every second in time where the debris from a possible destruct will land, and to provide tracking stations with advance data so that the target may be acquired and tracked through every moment of flight. These trajectories also involve thousands of information bits for each parameter of the flight path and required the same amount of engineeering time and computer use and turnaround as flight data reduction. This too has been speeded up to the point where minutes instead of weeks are needed for the solution.



### present and future effects

What graphics has made possible is to free the engineer from drudgery, from those hibernation periods that data processing forced on him. Now it is possible to utilize people as well as machines efficiently. Eventually, the scope of the graphics revolution may go even beyond our wildest imaginings. Twenty years ago, when we first started using computing on a large scale, we were solving problems we already knew how to solve but didn't have time to do by hand calculation. The space program, for example, was not possible until these machines could be brought into the picture. But now we have reached the point where conventional ways of using the machine have reached a plateau. Graphics will remove that restraint so that we can concentrate on engineering thought and its documentation.

I can illustrate this with some examples of pure engineering thought now being applied at Boeing-Huntsville. In addition to flight simulation and flight data reduction, we are using the graphics mode in a GPSS system for logistics planning of Saturn V launchings. With this program we can translate digital inputs into blocks on the CRT, assign flow lines to them and make changes at any point along the way. The topology for any flow chart can even be created without digital inputs and the computer will then provide the input table. Production lines, logistic designs and all other topology problems we have found, can be solved far more quickly by graphics, since on-line errors can be corrected immediately. Again, the big time saving is in reducing computer turnaround and engineering brain hibernation.

There is little doubt, based on our experience, that the iterative areas pay off quickest, but we are not limited to these. Often, we don't even know what type of analysis we want to perform on a given problem until we see it in graphic form. In that sense, what we have the computer doing is showing the way toward the programming needed.

Problems of configuration are particularly applicable to the graphics mode. By freeing the engineer from the sheer mechanics of computing and allowing him to question, in his own language, the possibilities of design, his creative horizons are greatly expanded.

We have learned that even the draftsman and the artist may benefit from the graphics computer. The creation of an isometric drawing, for example, used to take us three to four hours and after it was finished it was not always right. But it is now possible to work out on the CRT all the perspectives possible in a matter of minutes and enable our artist to choose the one that works best. Then, his three or four hour rendering will be correct the first time.

One day, we may see the largest use of graphics in the still relatively unexplored area of management sciences. We find that graphics can provide us with more up-to-date information for management planning. Decisions such as "Should we bid on a new contract?" and "How much should we bid?" can be made far more accurately and swiftly than with the present generation of computers, due to the instant read-out possible with graphics.

Until now we have been developing methods and techniques. But we have learned enough to start applying them across the board, in every area, wherever we are doing computing. Graphics has spurred us on to attempt the solution of future problems that today have no solutions, because the problems have not yet been fully perceived. One area is the conversion of the CRT into a true stereoscope. Using four prisms we salvaged from World War II tank periscopes, George Monnig, one of our physicists, is designing a three-dimensional system that will project images on the CRT in stereoscopic perspective. At the moment, we have a program for the creation of a safe with a door that swings wide to reveal the yawning depths of its interior. Soon, such a stereo system with the capability of solving depth-of-field problems will be needed for the rendezvous and docking solutions required by the Apollo and its associated Lunar Excursion Module. Without such a stereo capability, no true simulation of a lunar mission is possible.

What we have here is the new generation of computers, that can right now be effectively harnessed to productive use on a variety of problems. The only true new generation is in the graphics mode—everything else has been just more of the same. Graphics, however, is the first step toward really efficient man-machine communication. ■

# CREDIT CHECKING BY COMPUTER

**random access okays the charge**

by WILLIAM COLE

When an individual applies for credit—for a bank loan, department store charge account, oil company credit card or the like—he realizes that usually some sort of credit investigation will take place. For obvious reasons, both the individual applicant and the credit grantor are desirous that this credit investigation take place quickly and efficiently.

This article will describe how a credit investigation can be accomplished quickly and efficiently by means of a random access computer.

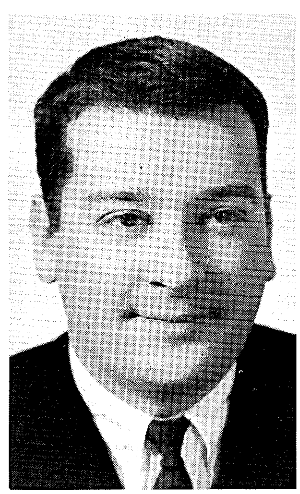
The investigation which follows an application for credit usually takes one of three forms: a direct check, credit scoring or use of an outside agency.

If the credit grantor uses the direct check method, he telephones the place of employment and credit references listed on the application to verify the information the applicant has revealed. Disadvantage of this method is that the credit grantor usually is limited in obtaining information which the applicant desires to divulge, and few applicants will list as a reference someone who can report a bad credit history. Direct checking also is expensive and time consuming.

Credit scoring is a method whereby certain point values are given for positive factors such as the applicant owning his home or holding the same job for several years and subtracted for negative factors such as derogatory credit experience or low income. In most instances, the applicant's "score" must reach a specified level if his application is to be given further favorable consideration.

A third method of obtaining information needed to evaluate a credit application—the one most used—is to forward the application to a credit bureau which checks out references and supplies any additional data that might be in the files on the applicant. This method, too, can be costly and time consuming. Additionally, because Americans are tending more and more to range over entire market areas for their shopping, there are limitations created by time and economics on the amount of information a credit grantor can obtain from what normally is thought of as a credit bureau. Such bureaus generally operate within definite geographical limits, maintaining credit records only on transactions occurring in their own areas. Information is interchanged among bureaus, but this often takes weeks and costs are high.

Primarily, the credit grantor needs three types of information to properly evaluate the credit application before him. These include any derogatory experience—slow pay, repossession, etc.—that previous credit grantors have had with the applicant; amount of credit the applicant currently has outstanding to determine whether additional credit might over-extend his ability to repay; and signifi-



*Mr. Cole is vice president in charge of systems development for Credit Data Corp., Los Angeles, Calif. Previously with the IBM Corp., he majored in business administration at Michigan State University.*

cant historical data showing how extension of credit has been treated in the past.

### variety of services

Different approaches toward furnishing credit information have been developed, some utilizing electronic data processing equipment and some limited in the type of service they offer.

One such service limits its operations to the check-cashing field. Derogatory information, including that pertaining to persons who have records of cashing bad checks, is stored in computers and retrieved quickly when interrogated on behalf of subscribing merchants. Primary identifier used in this system is a driver's license.

Another computerized system gathers only derogatory information and was specifically designed to serve mail order companies which sell books or phonograph records. Files are oriented by address only, a limiting identifier because of the ease with which addresses can be changed.

Other firms have announced plans for use of electronic data processing equipment for check verification or other forms of limited credit checking but as of this writing have not begun actual operation.

Normal credit bureaus, as discussed above, furnish derogatory, current and historical data to credit grantors.

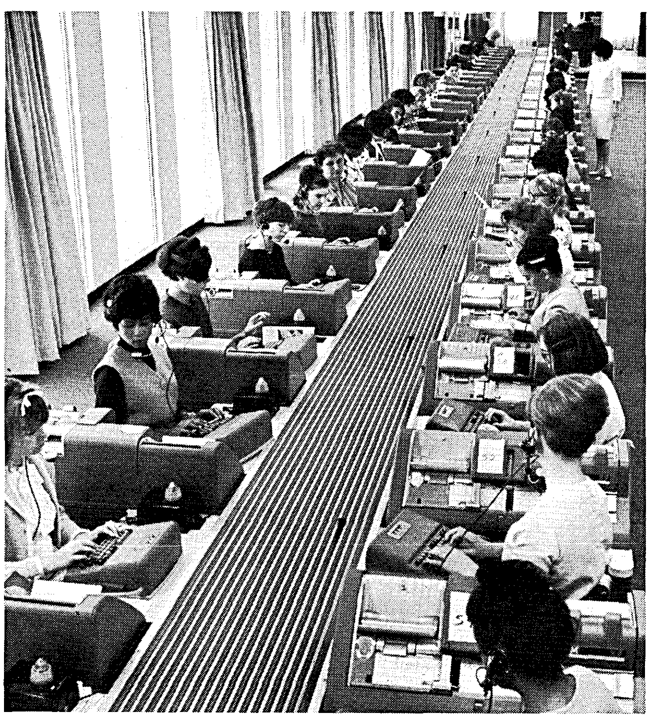
cdc CREDIT DATA CORPORATION 680 WILSHIRE PLACE -- LOS ANGELES

30-200 ROBERTSON WILLIAM J MARY 3-30-66
01212 WILSHIRE LA DOUGLAS 386-32-1362

CURRENT ADDRESS CHECKS FILE EMPLOYMENT - DOUGLAS

| INDUSTRY | CODE | FILE DATE | TYPE | AMOUNT | MO'S | RATING OR COMMENT | DATE RATED |
|---|---|---|---|---|---|---|---|
| BANK | 15-310 | 02-62 | AUTO | $1500 TO $2000 | 24 | EARLY PAY | 03-63 |
| FINANCE | 24-109 | 03-64 | PERSONAL | UNDER $250 | 06 | OPEN ACCT | 03-64 |
| RETAIL | 41-053 | 06-65 | CHG ACCT | $250 TO $500 | 10 | OPEN ACCT | 06-65 |
| OIL | 30-600 | 08-65 | CHG ACCT | | 01 | INQUIRY | 08-65 |
| S & L | 18-052 | 08-64 | REAL EST | $20000 TO $40000 | 30 | OPEN ACCT | 09-64 |

*** SAMPLE WRITTEN REPORT ***-



Mechanical filing, however, slows issuance of reports, and each bureau generally has in its files only that portion of an individual's credit record involving transactions which occurred in the bureau's service area. This area normally is limited to a single city or community within a trading area. For example, in the Greater Los Angeles trading market which comprises portions of four counties, there are more than 30 credit bureaus, any of which might have bits and pieces of a credit applicant's entire credit record or file. It is distinctly advantageous to offer regional service so a person's complete credit record will be in one central file.

The approach taken by Credit Data Corp. to serve banks, finance companies, retailers and other businesses which make consumer loans or sell on credit has been to "pool" the derogatory, current and historical credit experience data from the files of individual subscribers throughout an entire marketing region. This is stored in a random access computer system for quick retrieval when needed.

This system, first of its type in the nation, went on the air in September '65 to serve the 3,000 square mile Greater Los Angeles trading area which covers portions of four counties with a population of nearly 10 million persons. Since then, the service region has been expanded to cover the bulk of the southern California population. Meantime, CDC's semi-automated regional credit reporting system in San Francisco is being converted so that the entire state of California will be covered by early next year. Similar conversion of files is taking place in the Detroit CDC office, which by mid-1967 will become the hub of a vast midwest service region covering the "strip city" beginning to emerge from Buffalo, N.Y., to and beyond Chicago.

More than a year of working experience has proven the practicability of such systems to meet the needs of credit grantors.

Major elements of the Credit Data Corp. system are a telephone communications network with an automatic call distributor, a high-speed document conveyor and an IBM 1410 storage and retrieval system.

Credit information about individuals from throughout the megalopolis that comprises most of southern California is stored in the central file computer. A subscriber needing any individual credit record can obtain it within 90 seconds via telephone. For those subscribers not requiring the speed of telephone service, a night operation generates written file reports for delivery the following morning.

### the subscribing public

Subscribers include all major banks and oil companies in the service area, as well as many retailers, finance companies, mortgage lenders and other businesses offering credit.

A telephone request for information is initiated when the subscriber dials a local number assigned to his area. The call is automatically routed by foreign exchange lines to the automatic call distributor at the CDC center. The call distributor selects an available operator and completes the connection, or stores the call until an operator is available. Output from the call distributor also provides a continuous visual display so supervisors know at all times the volume of telephone traffic and can make necessary adjustments in manpower to handle incoming calls.

The CDC operator who receives the subscriber request is seated at a standard keypunch machine alongside the document conveyor. The operator punches into the inquiry card the identification data and transaction data provided by the subscriber, then sends the card to the computer room via the conveyor.

Once inside the computer room, the inquiry is read into the computer, which scans the credit file and prints all pertinent information on a form. This is returned to

WITH ALL THE DIGITAL COMPUTERS AVAILABLE TODAY—

# WHY IN THE WORLD DID EAI ADD THE 8400 TO THE LIST?

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## We didn't want a computer that could do everything. We wanted a system a scientist could do everything with.

*Simulation, experimental design studies, engineering model building—these are computer-aided creative processes. They place great demands on the designer and the computer that assists him. The EAI 8400 and its simulation software is the first computer a designer can really consider a partner. He can talk to it, ask questions about his simulation model, demand the highest performance. He can require that all his own mistakes be found and forgiven, with error-free behavior on the part of the computer.*
*The creative design engineer—the man who has devised a mathematical model of a new design and wants to experiment with it —needs to be close to the machine at run-time. He needs to modify the program and data during the run. He can't afford to be hampered by operating details such as octal conversions and symbol searches. He needs the simplicity—and the sophistication—of the 8400.*

SM Service Mark of Electronic Associates, Inc.

The prime focus for the 8400 system is man: the design engineer, the experimentalist, the simulation engineer. The system was designed to respond to his needs in every way. This concept of usability calls for an economy of means and effort to yield a high throughput.

It starts with the problem of how to give a powerful, expensive complex machine to one person — aid him as he searches for an undefined number of answers through a trial-and-error process and still provide computer services for others. Moreover — provide this usability and an economical cost/performance ratio.

Scientific laboratory computation is not all creative and experimental. There will always be a significant amount of straight processing — assemblies, FORTRAN compilations, data sorting, report generation. The 8400 was designed to do these jobs while fully meeting the requirements of the simulation engineer.

The 8400 multiprogrammed system provides real interactive control and conversation for the designer. It lets him have as much think time as he wants. Batch processing goes on as background work, soaking up all the machine time he doesn't use. In fact, he is unaware that it is taking place.

Why is the EAI 8400 the best digital computer for simulation? Look at features like these:

## High Operational Speed

The EAI 8400 has the speed performance of some giant machines that cost 4 to 5 times as much. As for machines in its own price class, the 8400 is 1½ times as fast!

First there is raw speed—minimum execution times for each machine function. Memory access: 1.75 μsec. Typical floating point multiplication of two 32-bit data words: 7.35 μsec. That's fast.

Then there is the speed-up due to shorter sequences for doing a given job. This comes from the very large set of instructions and options. One group of floating-point instructions automatically performs mode conversions between fixed and floating-point numbers with no additional time penalty. Sixty-three decision commands reduce tests to one or at most two steps. There's direct addressing of every bit in core. Indexing with the accumulator, as well as 6 other high-speed registers. And most valuable of all, a 56-bit push-down store (the SAVE register) which will accept the contents of all the arithmetic registers just prior to any arithmetic instruction at a cost measured in nanoseconds! All these are important hardware features that mean speed.

But for real-time simulation something more is needed. The entire software system must be designed for very short computer response time. The 8400 FORTRAN generates code that speeds the execution of entire programs. The object code is optimized for minimum execution time—just as well as a top programmer could do it for a large, complex program. For tough problems, such as a hybrid computer program where tight coding is needed, assembly code may be freely intermixed with FORTRAN statements.

The 8400 Monitor system has a master scheduler and priority interrupt handler which direct the multiprogram schedule in the computer. But for quickest response, the monitor permits the user to assign a priority above the multiprogram priority list.

Finally, to help the programmer design for real-time constraints, the compiler and assembler both contain pseudo-operations for estimating and adjusting the execution time of segments of code by as little as several microseconds.

## On-Line Access To The Model

The EAI 8400 brings the design engineer close to his program—that is, to his model—not just close to the computer itself. He need not be concerned with machine operating details, yet he still has direct access in symbolic fashion to many details of his program. To do this, the 8400 has the hardware features for interactive control: mass memory devices, remote typewriter stations and CRT display systems with the latest options of light pens, vector mode, and special operating features.

Above all, the entire software system is geared to the interactive mode of operation. This includes the IOCS, the multiprogramming schedules of the monitor, the language processors, and the special conversational-mode systems HYTRAN℠ and SPECTRE. The HYTRAN Operations Interpreter is a JOSS-based mathematical processor with numerous extensions to provide control of the linkage and analog computer in a hybrid system. The SPECTRE on-line assembly system, based on DDT, is a full symbolic assembler. In fact, it is a disassembler—which means it will create a symbolic listing from a program in core. SPECTRE permits you to modify a program in core, assemble and insert new code segments, run a trace, and execute a program section to a breakpoint.

## Economic Computer Utilization Through Multiprogramming

It is obviously inefficient to tie up such a powerful system for fast, short runs. Yet it is necessary for the user to sit and think between runs. How is this conflict overcome?

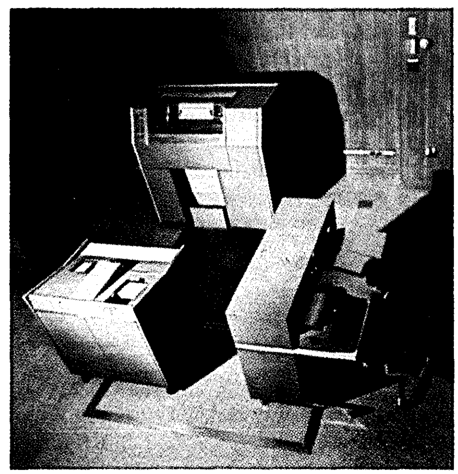
Only by multiprogramming. Only with a monitor designed for this kind of interaction. Only with a system that can assign the full resources of the computer to a single user for a short period, and can respond at any time to real-time interrupts and still do batch processing on a queue of jobs. Only with the 8400.

This multi-user mode takes several forms. In a hybrid system the 8400 is usually assigned one top priority job (the hybrid programs) to which it applies full power whenever and for however long it is needed. Other interactive processes have next priority. And the job queue is the "background" that uses the remainder of the system time.

Thus, the 8400 gives you high run-time speeds . . . effective, rapid, on-line interaction of the investigator with his model . . . and economic utilization of the system with no charge for "think time." This, we believe, is exactly what the man interested in simulation and scientific computation is looking for in a digital computer system.

# Our goal is more than just to manufacture computers... It's problem-solving through simulation.

The EAI 8400 Digital Computing System is an expression of this aim.



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Electronic Associates is in the computer business because we believe in simulation.

You've known us for a long time as the leader in analog simulation. We are now the only company that's strong in all three: analog, hybrid and digital computer systems.

We have grown in the three disciplines as we sought to improve the art of simulation. The culmination in digital systems is the 8400. And this system is designed for use in a powerful new hybrid, the EAI 8900.

We have lived and breathed simulation for 14 years, working with thousands of design people through all the trials, errors, headaches and successes of innumerable simulations.

This experience is embodied in both the hardware and software of the 8400.

The rapid acceptance of this medium-scale system marks it as the most popular digital computer ever designed for simulation, and several are already in full operation here and abroad.

We and the 8400 speak a problem-oriented language. If you're not sure of how to handle your particular scientific simulation requirements, come in and talk to us at one of our five computation centers. We'd like to help you discover the power of computer-aided design.

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## Write For Brochure

What you've read is only part of the story. For the rest, let us send you the detailed technical description of the EAI 8400 design. We've given deep thought to the rationale of every detail. You'll see "reason why" for everything we've put into the EAI 8400. You'll understand why it's being called the "hottest" digital computer on the market today—and "the computer that has everything." Send to Dept. 302 for your copy today.

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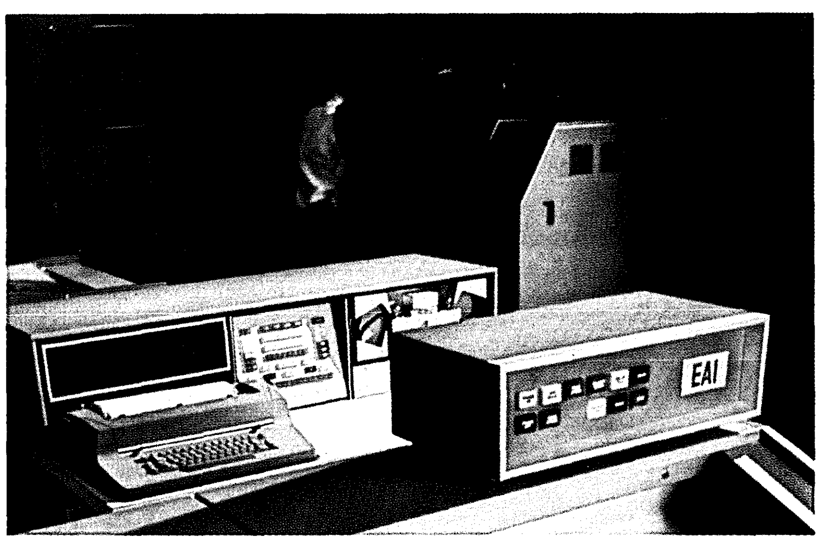

the operator, who completes the process by reading the data over the telephone to the subscriber. On an individual inquiry, it takes only 90 seconds for the entire process from the time the subscriber dials until he has the requested record. When multiple inquiries are made, the time for him to receive each record is reduced to about one minute.

CDC's random storage media consists of two IBM 2302 model 2 disc files. Present storage capacity of the system is 468 million characters, which provides room for the credit histories of approximately 15 million persons. By early next year, histories of nearly nine million persons will be in storage and instantly available. The credit records are compacted in a unique and proprietory fashion.

When the inquiry card created by the operator is fed into the card reader, the processor scans the identification data and attempts to match up information stored on one or more disc file tracks with the identification. The contents of any match with the file data are printed out and returned to the operator for reading to the subscriber.

Identification data furnished by the subscriber includes name of the credit applicant, spouse's name, address, previous address, employment and, when available, social security number. The computer verifies those elements of the identification with which it has obtained a match in the file, then prints out the file data, which consists of a list of transactions on file for the subject. For each transaction there is shown an industry designation, subscriber branch code, file data, type of transaction, amount in dollars, terms in months or years, a rating and a date last rated.

For purposes of personal identification a worse system than name and address would be difficult to devise. Names are replete with redundancy, multiple spellings and endless nickname variations. Addresses, particularly in California, are not constant since one out of every three residents of the state moves each year. Names and addresses, however, are the only identifiers that occur universally in the records of credit grantors. Therefore, of necessity, they are the primary search argument of CDC's retrieval program.

Routines in the program check for alternate spelling and alternate given names, and search all addresses given at time of inquiry. Employment and social security numbers are used as secondary identifiers.

Through the use of such routines, a very acceptable mismatch rate, in the order of one part in 10,000, is obtained.

## the central file

Data stored in CDC's central file is obtained from the files of subscribers throughout the service region and consists of positive and negative credit experience they have had with individual customers. In addition, pertinent data affecting credit standing is taken from public records.

CDC bears all file building expense. Consumer credit experience records stored on index or ledger cards are microfilmed, necessary information is keypunched from microfilm readers and the information is entered into the random access files. If the subscriber's own files are stored on magnetic tape, special programs are written to extract the needed data and read it into the central file.

Before the southern California system went on the air 13 months ago, CDC teams gathered millions of consumer credit experience records from the files of more than 3,000 subscribing companies and branches. Since the system has become operational, additional millions of subscriber records have been gathered and stored in the central file.

Once a subscriber starts using the service, he is required to report ongoing credit experience regularly. Likewise, new public record information is entered into the file daily. Inquiries are noted in the file at the time a subscriber requests information about a credit applicant. This inquiry notation is replaced with the appropriate data when the subscriber notifies CDC that the application has been approved or rejected.

Subscribers who have their own credit files computerized, at least some in each industry grouping, furnish CDC with magnetic tapes on a daily or weekly basis. These are fed into the CDC computer to update the central credit file with the subscribers' new accounts and any delinquencies that have occurred since the last reporting. Some subscribers send in reports on a daily basis according to their accounting cycle. Subscribers without computers report new accounts and delinquencies on special forms furnished by CDC or on their own forms. Pertinent public record information is entered into the central file on the second business day after it has been filed in the courts. Included in the public record information gathered for the file are such items as notices of bankruptcies, chattel mortgages, mechanic's liens, federal and state tax liens and defaults on first trust deeds.

In this manner, the central file is continually kept up to date.

At the time the CDC system started a year ago the service area included the Greater Los Angeles trading market, which covers the population majorities of four southern California counties—Los Angeles, Orange, Riverside and San Bernardino.

Since then, service has started to the Greater San Diego area and to Santa Barbara and Ventura counties, so that the service region now covers the bulk of the southern California population. Subscribers in distant areas dial local telephone numbers to request information, with their calls automatically routed via long distance lines to the automatic call distributor in the Los Angeles computer center.

## a statewide system

For the past three years, CDC has been operating its semi-mechanized credit system for the San Francisco Bay Area and the data in this file is presently being converted for inclusion in the computer file in Los Angeles. At the completion of this conversion, early in 1967, a communications processor in San Francisco will link that office with the file in Los Angeles. Extension of service to cities of California's Central Valley—linking them via long distance telephone lines to the computer subcenter in San Francisco—will complete the system and permit credit grantors in any part of California to obtain credit information from one statewide random access central file.

At the present state of the art, it is feasible to serve cities as far as 400 miles from a computer center or subcenter. Thus, a relatively small number of interconnected regional systems similar to that operating and being expanded in California can provide rapid access to credit information from any point in the United States.

Credit grantors and the credit-using public, alike, are benefitting from the new breed of regional computerized credit systems.

Credit grantors are able to quickly and inexpensively obtain the information they need to evaluate applications —information from throughout a vast area that formerly was not accessible or prohibitively expensive to obtain.

Because of the speed and accuracy with which this data reaches the credit grantor, legitimate users of credit car get almost immediate approval of needed loans or pı chases, rather than having to wait for days or weeks frequently was the case before the advent of mo electronic data processing in credit reporting.

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Look for the announcement of a new family of Stromberg-Carlson Compatible Equipment at the Fall Joint Computer Conference, November 8-10. Here's a system that turns computer output into readable text at electronic speeds and makes it readily available to anyone who needs current information. No costly communications installations needed, either. Investigate Micromation—see if it doesn't let you break through to substantial savings.

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CIRCLE 19 ON READER CARD

# THE TEXT90 SYSTEM

by V. S. MERCER,
F. E. FRANKLIN and R. A. LOWENSTEIN

Preparation of today's technical publication demands that the documentation keep abreast of product development and engineering efforts. When technical achievements are announced, the documentation must be available, too. With the advent of System/360, technical publications groups at IBM were confronted with the problem of providing complete, accurate and comprehensible documentation, and providing this at the time of system announcement. Ultimately, this problem was reduced by a computer-assisted system known as TEXT90. TEXT90 speeds the basic documentation effort by allowing publications groups to incorporate changes with ease. Thus the finished product is timely as well as technically accurate.

Historically, editors and writers have had to compile a master manuscript which is retyped several times until final approval of the document; it is then typed in final form and submitted to the printer. Each major change of substance requires alteration of all copy following it. Even if a single paragraph were to be added to a manual, an entire page, not only the added paragraph, would have to be retyped, proofread, and corrected again. Or, for example, if the name of a product were changed at the last minute, much of the manual would have to be redone and rechecked.

Because incorporating change into printed matter has been a continuing problem in almost all publishing operations, widespread attention is being given to systems that incorporate changes automatically, thus reducing repetitive clerical tasks, such as proofreading. TEXT90 is one such system.

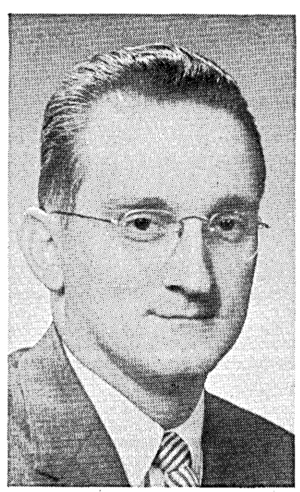
In essence, TEXT90 creates a master record of a manuscript that can be processed by a computer. This master record can then be altered rapidly, no matter how much the change may alter the subsequent version. Moreover, machine processing permits us to produce updated manuscripts for writers' or editors' use at computer printer speeds.

TEXT90 also includes subprograms which enable us to produce page proofs suitable for photo offset reproduction. Other TEXT90 features are hyphenation and justification routines, routines that organize copy into single and double-column page layouts, and routines that select and display subject headings. Space requested for illustrations is reserved by TEXT90 throughout subsequent alterations to the editorial matter surrounding the space.

A special type font with both upper and lower case letters, as well as 68 special characters, was created and assembled into a chain for the 1403 printer so that final copy would resemble typed copy. However, unlike standard publishing type, the TEXT90 characters are each of equal width, a compromise that is not difficult to accept in publishing of manuals. If the compromise were unacceptable, the computer printout could be used until the manuscript had final approval. Then the master record could be converted into input to an automatic photocomposition machine.

The TEXT90 program has helped us produce over 60 manuals running up to 500 pages in length. It can be obtained from IBM* for use by other organizations with similar problems and similar equipment. Interest, however, should not stop here, for we do not regard TEXT90 as an ultimate solution, but rather as a successful demonstration of how data processing can aid editorial effort.

We designed TEXT90 for implementation on the 7090



*Manager of the group that implemented TEXT90, Mr. Mercer also led the implementation of IBM's 7070/74 Autochart, an automatic flowcharting program. Employed at IBM's Development Div., Poughkeepsi N.Y., he holds a BS in electri engineering from Drexel I tute of Technology.*

* useful only for 7090 or 7094 systems.

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CIRCLE 20 ON READER CARD

and 1401. The larger machine performs text manipulation while the 1401 processes all new entries to the records and supervises the printing at about 230 lines a minute.

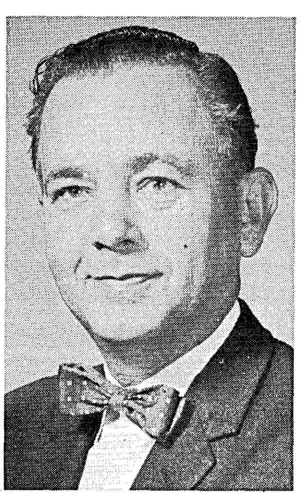
Input to TEXT90 is punched cards. The card punch operator's job is much the same as that of a typist's, the only difference being that the deck of cards is not the finished product, but rather the input to a computing device. Special codes are required to control text format. These special codes can be learned within two to three days by an editorial typist who, with a few weeks of experience, can punch manuscripts almost as quickly as they can be typed.

### free form punches

The TEXT90 language uses a free-form concept. Unlike most punching operations, where certain punches must be placed in certain card columns, the codes and text of the TEXT90 language can be punched anywhere within the 80 columns. Words and codes can even be split between the end of one card and the beginning of the next. As little as one word or code can appear on a single card.

For a 60-page, double-spaced manuscript to be produced in double-column format, approximately nine hours' punching is required (including special code entry): eight hours for initial copy entry and one for subsequent copy change and/or corrections following document printout. Total machine time to process the 60-page manuscript is about 30 minutes on the 1401—10 minutes for prescan (input error detection) and 20 minutes printing—and nine minutes on the 7090. Editorial time to mark manuscripts prior to punching is approximately one hour for the initial manuscript and eight hours for proofreading and copy reading later editions. Such documentation speeds buy time that can be secured in no other way. For IBM, it has saved an average of one month in the writing and publishing of each manual.

Initially, the TEXT90 system creates two magnetic tapes. One, called a print tape, contains the text of the document in the format specified by the control codes. This tape is listed on a 1403 printer equipped with the special upper and lower case print chain. If upper and lower case facilities are not necessary, the document can be printed with any standard upper-case chain; upper case is used for all letters, and blanks are left for special characters not available.

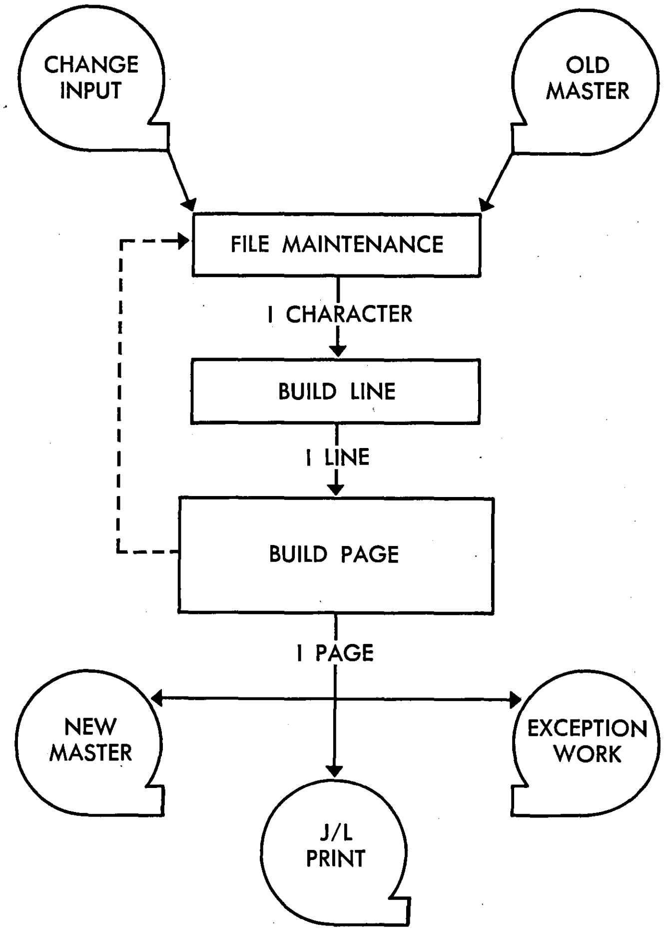


*Mr. Franklin is a staff programmer with the System Development Div. of IBM. Formerly in the Research Div., he managed a program support group in simulation and language translation. He has a BS in electrical engineering from Louisiana Polytechnic Institute.*

The other tape produced by TEXT90 is the master tape. In addition to text, it contains control codes that specify the document's format. The master tape is used when the document is changed (updated), using punched cards containing special codes to indicate copy deletions, additions, and revisions and to move the text and codes stored on this tape. This update routine produces a new master and a new print tape.

Changes can be made in one line of the document without affecting the contents of the next. The program automatically repositions the text within paragraphs and pages to compensate for additions or deletions. Then when changes are made, only the changed lines need be proofread. Because of this capability, TEXT90 output can be updated, checked, possibly updated again, run in final offset reproduction form and taken to a printer in the same day.

Fig. 1 TEXT90 General Flow




The 7090 was selected because it was the most conveniently available large computer. Core storage requirements are 32K, which must be available at all times because line construction is done character by character and virtually all the routines are resident as the line is developed. Also, as a page is developed, the entire page is kept in storage.

The portion of TEXT90 performed on the 7090 consists of three sections. Functionally, they are:

1. File maintenance
2. Build-a-line
3. Build-a-page

Fig. 1 shows the general flow of these three elements.

During the original processing of a document, the new input is all that is required; because there is no old master, the file maintenance section is bypassed. During an now you can.....

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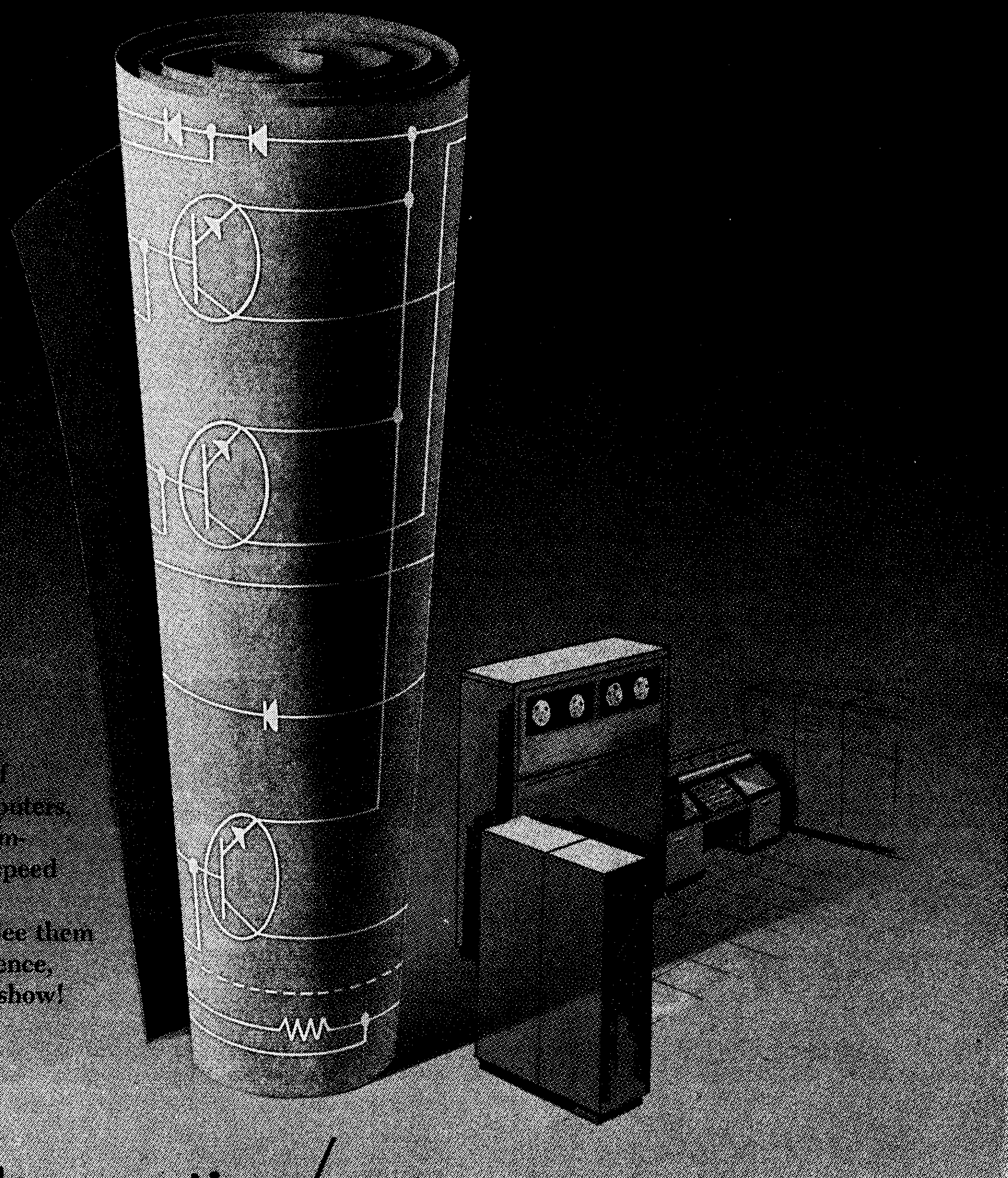

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CIRCLE 21 ON READER CARD

update run, the file maintenance section makes the changes, insertions, and deletions indicated by certain codes on the old master. This is a typical file maintenance routine. As updated copy is passed by the maintenance routines, the next section exercises the copy-character routine to build a line.

### build-a-line

This section analyzes each character so that as soon as the end of a word is reached (recognized by a blank space) and the number of characters designated for the column width has also been reached, the routine stores the line in a line buffer. If, however, the point is reached where we are putting copy into format, lines are hyphenated and justified before passing them to the line buffer.

The program for the 7090 consists of three parts linked together for operation under the IBSYS monitor. All elements of this system, except the hyphenation routine, were created especially for TEXT90. The hyphenation routine was originally written for the 1620 typesetting program and was subsequently rewritten for the 7090.

Justification is accomplished by inserting extra blanks in each text line until the line is filled out to the set length. We alternate this process on succeeding lines to reduce the possibility of "rivers" of white space within blocks of text. TEXT90 hyphenates a word at the end of a line when the line cannot be adequately justified through the insertion of blank spaces between words. Hyphenation, like justification, can be turned off and on by insertion of appropriate alter codes.

In TEXT90, an algorithm and an exception dictionary are used to hyphenate words. The exception dictionary is a listing of words frequently found to be incorrectly hyphenated by the algorithm. If the word to be hyphenated is not in the table listing, then the program resorts to logical analysis of the word by a set of rules for syllabification.

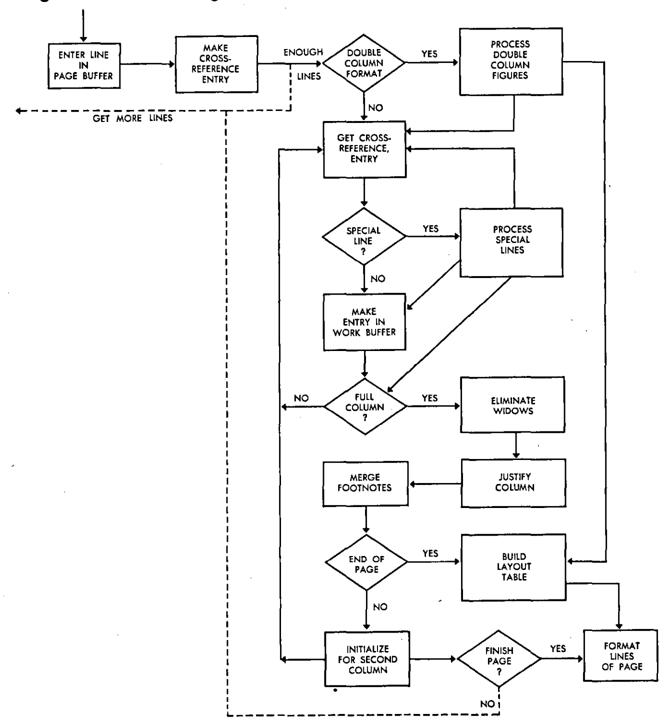
When lines are passed to the line buffer, the program makes an entry in a cross-reference table and checks to see if enough lines have been accumulated to create a page. So that the page layout routine need not re-analyze individual lines during the format sequence, the cross-reference table contains information about the line such as indentation required, line length, or special handling requirements such as placement of footnote lines.

Many page layouts are possible. One layout, similar to galley proofs and containing line numbers for easy reference, is used during the early manipulations of the copy. Later, as headings and illustrations are added along with footnotes, the page layout routine generates a format to meet the page requirements of the finished manual (see Fig. 2), retaining line references so that changes can be made until the final printing run.

### build-a-page

The page layout routine constructs the page by combining elements from three work buffers. These are for double-column figures, for footnotes, and for normal lines. As a routine begins, each entry of the cross reference table is analyzed to find any lines that require special processing.

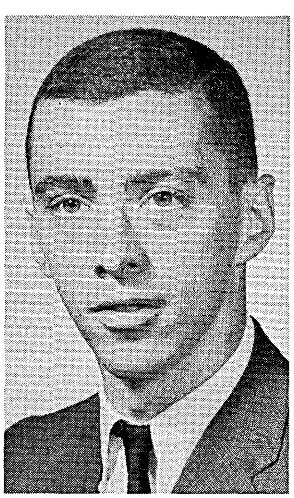
Fig. 2 Build-a-Page Section of TEXT90




Such lines include: a new page request, the first line of a double-column figure, a footnote, a skipped line, the first line of an illustration or table. The address of the cross reference entries for all other lines is stored in a work buffer. At the same time, a check is made to see if the column is full. When the column is completed, widows are eliminated and when necessary, the column is expanded to bring it to the desired depth. This is done by repeating some of the existing skips.

At this point, in single-column pages, the format is completed. For double-column pages, completion of the first column sets a switch and the routine is repeated for the second column. When the layout of the page is complete, the entire page is written out on both the new master record tape and on the tape which is passed to the 1401 for printing.

Special lines handled by TEXT90 routines include a hierarchy of subject headings to lead off and identify segments of the publication, running titles, folio lines at the bottom of the page, and page numbers. Codes punched along with the titles indicate both case of the characters and placement of the titles. Page numbering and placement are automatic. An additional 1400-word routine for the 7090 permits the user to extract and list by line and page number any previously specified words and phrases contained in the copy. This is done by a scan which compares given words with those in the text. Although this requires an additional pass during a post processor phase, it pro-



***Before joining IBM's System Development Div., where he now manages a programming publications group, Mr. Lowenstein was a business writer with Prentice-Hall. He has a BA in economics from Rutgers Univ., and an MS from Columbia Univ.'s Graduate School of Business.***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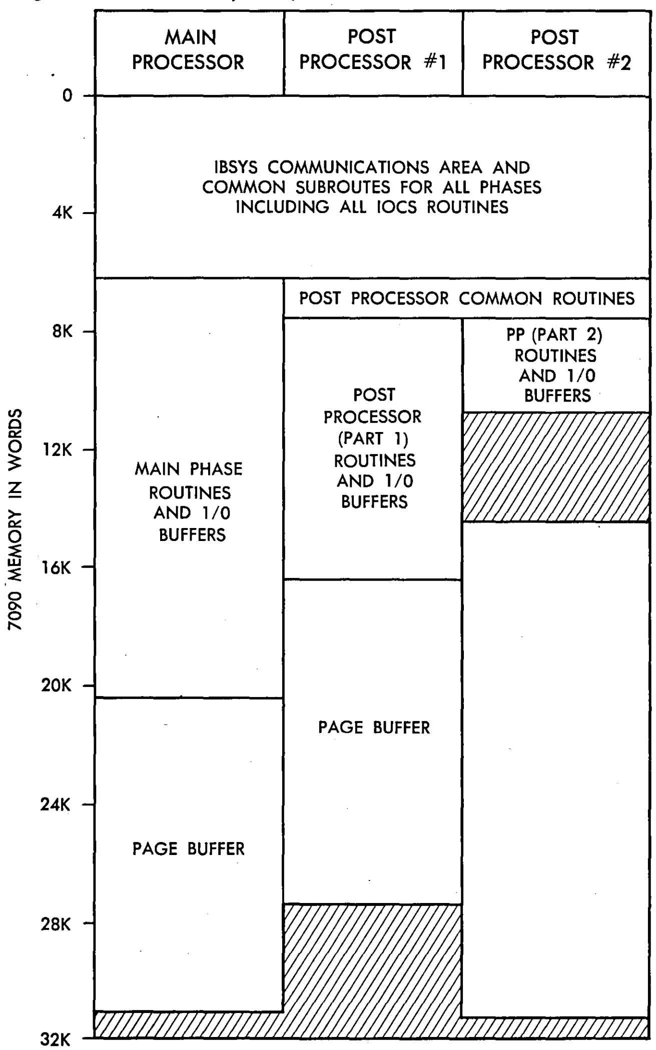
ceeds at tape speed because it is the only processing being done.

Core storage allocation for the entire 7090 portion of TEXT90 is illustrated in the memory map, Fig. 3. The 1401

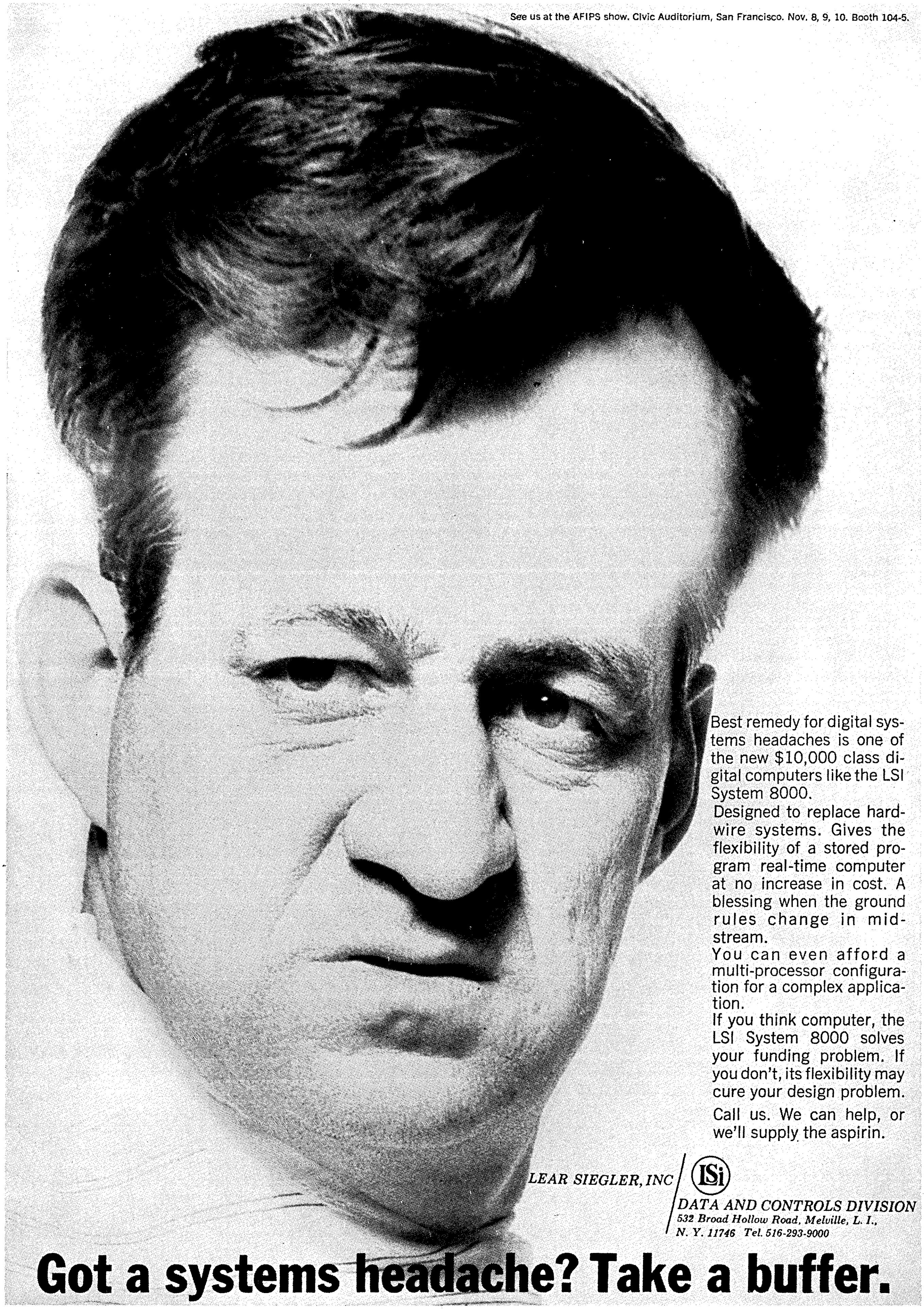
Fig. 3 7090 Memory Map for TEXT90




phase of the TEXT90 includes a prescan procedure that checks the card input and converts it to card image on tape and a printer program. Each of these programs requires 4K.

Because we do not regard TEXT90 in its present form as the ultimate solution, additional investigation is being done to further improve its assistance to IBM publishing requirements. An Administrative Terminal System, previously announced by IBM for use by customers, is being used as alternate input to TEXT90 on an experimental basis in Poughkeepsie. Terminals are located within the writing sections so that initial input and updating use ATS to create documents on disc file. This disc file can then be converted to TEXT90 input format.

The cost of operating with the TEXT90 system is higher than for conventional methods. In addition to the continuing programming support for the system, we make full-time use of the 7090 and 1401 computers. The fact is, however, that the cost is more than justified by the ability to deliver publications quickly and accurately, thereby supporting IBM's marketing objectives. Furthermore, we are gaining valuable experience that will help us develop better systems for the future. ■




CIRCLE 23 ON READER CARD

# A PUT-LIST FOR ENHANCED COMMUNICATION

by SAM A. and ANNE H. ROSENFELD

Science is breeding a new child—the analysis of technical language. Consider the psycholinguistic origins and implications, for example, of the "put" construction whereby three new nouns may be formed by combining the particles "in," "out," and "through" with the verb "put." The resultant nouns "input," "output," and "throughput" (or its variant "thruput") have received rapid and widespread acceptance by the technical community. Such thorough incorporation of a new *construction*, and not merely of a new *term*, indicates to us the existence of a technico-linguistic gap requiring closure by additional terms of similar construction.

In this paper, therefore, we propose 13 new "put-terms," whose subsequent appearance, if any, in both technical journals and in conference presentations we will study and report at a later date.

The first group of put-terms follows the precise construction of the original three terms (i.e., particle + put), and, like them, pertains to data processing systems. Let us consider a significant element of a dp system—its "memory." Instead of borrowing from the humanities this weak term, redolent of Aristotle and Proust, let us choose, rather, from the language of everyman. What could be more natural than to call that store of information containing what has been put away the AWAY-PUT? Similarly, the term "delay circuit," so outmodedly verbose, could be far more crisply and naturally replaced by OFF-PUT, an unforgettable noun to anyone who has ever put off until tomorrow what was unpalatable today. Following the same simple linguistic transformations, the integration of information is obviously TOGETHER-PUT, while intelligence processing might best be described as ONTO-PUT.

The effectiveness of the total process of information dissemination and communication, ACROSS-PUT, depends heavily, in dp systems, upon the manner of presentation to the user. Ultimately, the human makes the decisions, usually based upon the FORTH-PUT (a far more discreet term than the exhibitionistic "display"). Occasionally the problems of scheduling result in UPON-PUT, in which one user takes over another's time. On those rare days when analysts are called upon to give presentations of their work, they have been known to so dazzle their audience with their intellectual elegance and personal charm as to result in a thorough OVER-PUT.

The group of put-terms mentioned above is sufficiently close in form to the original three terms to be assured of rapid assimilation into the technical vocabulary. The next group, while possibly slower to gain acceptance due to its looser put-construction, nonetheless has much to recommend it. First, the all-important field of microminiaturization obviously needs a more miniature and far less syllabic term as its descriptor; we propose LILLI-PUT, a name simply and swiftly said. In both LILLI-PUT and more conventionally sized circuits, one commonly finds many feedback loops providing for stability by error detection and correction. Programming loops are also commonly found which might well share the same term as feedback loops: STAY-PUT.

As we move further from the orthodox put-list, several terms arise for consideration, among them SHOT-PUT (trackball data), and that Teutonic borrowing KA-PUT, meaning specifically a short circuit, but, by extension, catastrophic failure of any system.

In conclusion, in view of the importance of improved communications among communications personnel, we encourage other authors to use this DOWN-PUT as a guide to improve the technical lexicon. ■

***Mr. Rosenfeld, on leave of absence from the Mitre Corp., where he has been a systems analyst since 1962, is currently in the Psychology Dept. of Harvard Univ. Anne Rosenfeld is a science writer-editor at the Neurosciences Research Program of MIT.***

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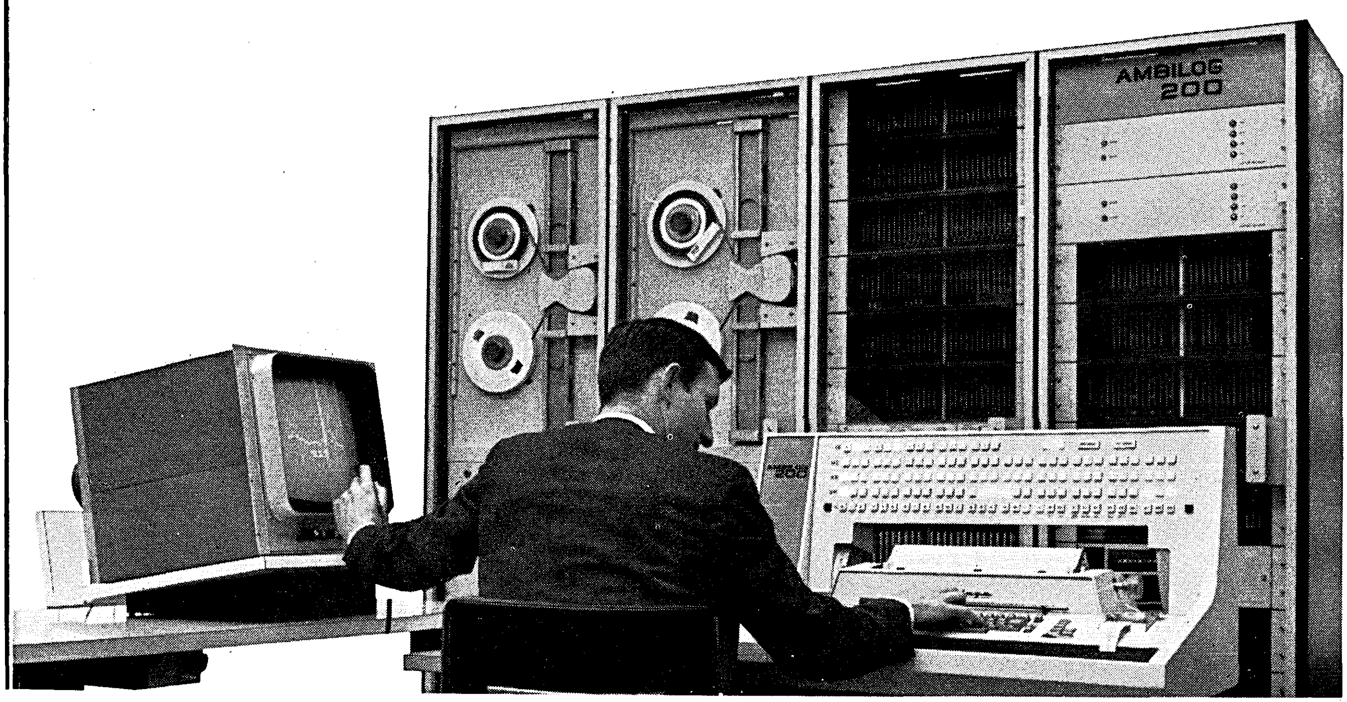



CIRCLE 24 ON READER CARD

# PRECISION MAGNETIC TAPE

**under the coating**

by JOHN M. RICCI

More than one million miles of precision magnetic computer tape are being consumed each year by more than 20,000 computers now in operation in the U.S. In another five years tape-devouring computer installations are expected to increase to more than 70,000—even allowing for a 30% retirement of outdated equipment.

This year it is estimated that more than $110 million will be spent for precision magnetic tape in an effort to keep up with a mounting wave of information—doubling every seven to ten years.

Precision magnetic tape has provided and will continue for some time to provide the best combination of economy, accuracy and speed for the processing and storage of information. About half of the U. S. computers now in service, and an increasing percentage of the new machines being installed, are equipped with magnetic tape drives. Most of these tape-oriented computers today receive information from punched cards in sequential order. Since most business data processing is also sequential, tape consumption is expected to remain closely linked to the number and size of computer installations.

Storage cost of information on precision magnetic tape has been estimated at one-tenth of a cent per bit. Inherent economic advantages of tape also include the ability to erase and reuse it many times. Tape also offers a very high storage density. Current 7-channel, ½-inch-wide, precision tapes have typical packing densities of 800 bits per inch. On a 2400-foot reel this provides a capacity for approximately 160 million bits. Packing densities of 4,000 and then 8,000 bits per inch are being predicted within four to seven years.

Wide frequency and dynamic range are coupled with magnetic tape's low inherent distortion characteristics. Signal storage in magnetic form lends itself to automatic data reduction, and makes possible immediate playback of the information. To top it all, precision magnetic tape is easy to transport and to store.

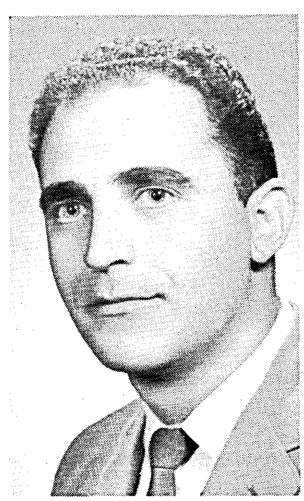
Typical edp systems today perform more than 150,000 operations per second employing eight small tape drives with a punched card input and a printer. This compares with an all-punch-card system of 10 years ago that performed a thousand operations per second. By 1972, a typical system is expected to have about 12 tape drives on-line capable of handling 15,000,000 characters at a speed of 4,000,000 operations per second, resulting in a corresponding increase in tape use.

Nearly all of the precision magnetic recording tape made today uses a base, or substrate, of polyester film. For convenience, precision tape is usually defined to include audio tape. With about 20 U.S. manufacturers currently making magnetic tape, only eight (until recently) produced a precision tape to the exacting requirements of the computer market. In all it is estimated by industry sources that well over 10 million pounds of polyester film will be converted to precision magnetic recording tape during this year.

Sales of precision tape, estimated at over $110 million in 1965, are expected, by computer and tape industry experts, to exceed $250 million by 1970. With only minor exceptions this precision tape will be made of polyester film. Other tape bases are generally ignored by the precision tape market because of the availability of tough and durable polyester film.

Steel wire, oddly enough, was the original magnetic recording media used in voice recorders as early as 1898 in Denmark. Steel tape continues in use for some special applications which demand extremely high heat resistance and dimensional stability. Next in line historically is the coated-paper tape patented in 1928 that initiated the development of the modern tape recording. Around 1944 paper was in general supplanted by cellulose acetate film as a magnetic tape base. Both polyvinyl chloride and cellulose acetate films, however, lacked the necessary strength and dimensional stability required for reliable computer tape, although both are still employed satisfactorily in most audio tape applications.

Polyethylene terphthalate polyester film has dominated the field as the precision magnetic tape base material for at least ten years. Because of its basic strength and economy it is confidently expected to grow with the edp industry. Other plastic film materials continue to be evaluated for computer use as they are made commercially available. One such, the new polyimide film, has been employed in specialty uses requiring resistance to high temperatures. The very high cost of the film, at least for the



*Mr. Ricci is West Coast sales supervisor for film and sheet products, Celanese Plastics Co. Joining Celanese as a project engineer in the plastics research and development laboratory, he later became technical marketing representative at Newark, N.J., headquarters. He has a BS in chemistry from Seton Hall Univ. and has been employed by Westinghouse Electric Corp. and Standard Packaging Corp.*

present, prevents its widespread use as a precision magnetic tape base.

### precision magnetic tape—what is it?

The modern precision computer tape is typically a half-inch wide strip of coated polyester film 2400 feet long that is wound on a 10½-inch O.D. reel. It can store 800 bits of magnetic information per inch on each of seven or more channels as the tape moves across a read/write head at 112.5 inches per second.

Viewed closely and in profile, a standard computer tape is seen to consist of a polyester film base 1.42 mil thick (0.00142 inches) and a magnetic oxide coating on one side that is about 400 microinches thick (0.000400 inches).

The magnetic coating is composed of a dispersion of ferromagnetic oxide (usually gamma ferric oxide—$Fe_2O_3$) with thermosetting binders, lubricants, electrically conductive additives, dispersing agents and solvents. It is coated onto master rolls of polyester film to one side of which has been applied a primer coat approximately one micron thick (0.000039 inches) to assure a strong bond between base and coating. The coated film passes through a strong magnetic field to orient the magnetic particles before it is dried and slit to standard computer tape widths.

The magnetic coating is not permitted to vary in thickness by more than about 15 microinches (0.000015 inches) and the coated tape must hold to a tolerance of less than 25 microinches (0.000025 inches) over its entire length. In addition, each finished reel of computer tape is tested 100% for electronic defects. This means the whole tape is written at the proper packing density (e.g. 556 or 800 bits per inch) and then played back. A single defect in the tape that causes a permanent drop in strength of the signal below 50% of its original level when it is played back (called a dropout) is considered cause for automatic rejection of that tape for computer use.

As the tape passes over the head, any tape defect may lift the tape from the head—causing a drastic signal drop. It takes only a gap of 140 micro-inches (0.000140 inches) between tape and the read/write head, for example, to cause a dropout or loss of signal at 800 bpi. It follows that—discounting the boundary air layer between head and tape—a tape surface defect of 140 micro-inches height would result in tape lift causing a dropout. Suppose we magnify the ½-inch wide 2400-ft. roll of tape 1000 times —in length and width—until it is a 42-foot-wide highway some 455 miles long. Then the surface defect that caused a tape dropout at 800 bpi would have been enlarged to the size of a pebble of approximately one tenth of an inch in diameter in the road surface.

Care and maintenance of computer tape is the one item for which the computer user has full responsibility. Normally the maintenance and repair of computers and peripheral equipment is performed by the manufacturer's customer service engineers. It has been estimated that a tape defect resulting in a serious information loss may cost as much as $500, or more, in computer time to correct. It is obvious that with such ultrasensitive equipment extreme care must be taken in order to reduce costly dropouts in the tape.

However, tape is also one of the few key parts of a modern computer involved in a strictly mechanical system. And mechanical operation immediately brings with it the associated difficulties of wear, tear, friction, alignment, environment and so forth. As the carrier for the magnetic tape coating, the tape base bears the full brunt of all this mechanical wear, tear and stress. And, as we have seen, even microscopic deviations in these critical mechanical dimensional factors can cause a dropout or malfunction.

The physical characteristics of the tape base thus play as important a role in the tape's performance as magnetic characteristics of the oxide coating. In normal computer operation the typical half-mile-long reel of tape moves back and forth across the read/write head, around driving and braking capstans, through pulleys and guide flanges, and then onto take-up reels. This occurs at speeds ranging from about 6 to 20 miles per hour (100 to 350 inches per second). To find a particular bit of data or instruction on the tape, it frequently comes to a full stop and starts off in the reverse direction. The start-stop time of a conventional tape system currently is of the order of 5 milliseconds, or less.

With the weight of the reel behind it, these sudden stops and reversals produce excessively high stresses in the tape. The ultimate tensile strength of the tape thus obviously has to exceed the greatest stress that the drive mechanism can deal out. But, just as important, the tape should not stretch or elongate beyond the point that would cause signal distortion. The tensile yield strength of a material is defined as the first stress level on a stress-strain curve at which there occurs a marked increase in strain without an increase in stress. In essence, tensile yield strength measures the stress required to make a material exceed its elastic limit and begin to stretch permanently. Since permanent stretch in the tape can distort or destroy the signal fidelity and the tape alignment, the tape's tensile yield strength is a major factor. Another way of evaluating tape stretch as it relates to performance is to measure the amount of stress required to produce a 5% elongation in the film—which is known as the F-5 value. This method is used since it has been determined that computer tape can withstand 5% elastic stretch without adversely affecting signal fidelity. A typical value for this stress measurement on a one-mil polyester film is about 16,000 pounds per square inch. Low residual elongation of the tape during heavy operating or storage stresses also helps to prevent signal loss during playback.

Additionally, a high resistance to tear initiation is displayed by polyester film in comparison with other film base materials. This tear resistance ensures against tape breaks under constant handling.

Dimensional stability is one of the essential physical characteristics of any tape base. This means that there should be no significant change in size or shape of the tape either temporarily or permanently under temperature and humidity variations. Swelling or shrinking of the tape base can cause lateral shifting of the channels away from the read/write head, possibly resulting in crosstalk and garbled or weak signals on some channels. Transverse expansion of the tape beyond width tolerances forces it to ride up on tape guides. This ruffles the edges, which, in turn, yields poor head contact. Shrinkage or expansion can also produce "cupping" of the tape so that it makes only partial contact with the read/write head, again causing crosstalk, dropouts and garbled signals. A tape that shrinks below the width tolerance, on the other hand, tends to weave back and forth laterally across the read/write head and thus reduce signal strength.

The way the base film is fabricated also affects its performance in precision tape use. Major trouble spots are surface dirt, contaminants, and gels which are caused by improperly dispersed polymer that forms nodules on the surface of the film. Polyester and other plastic films tend to accumulate a static charge during processing which promptly attracts all airborne dirt, dust, smoke, lint and fine contaminants within reach to the film surface. Electrically conductive additives are therefore incorporated in the magnetic oxide coating to dissipate or eliminate static charge on the finished magnetic tape supplied to

the computer user.

Carefully controlled film extrusion and orientation is employed to maintain optimum gauge, or thickness, uniformity in the manufacture of polyester film. This can be particularly critical in the transverse film direction. Poor gauge uniformity in the base film produces coating irregularities, such as a wedge-shaped section, which yields uneven signal fidelity across the tape.

Improper handling of the base film in storage and fabrication can also produce wrinkles, cross-buckles, stretch-lanes and beaded edges which interfere with the critical performance of computer tape.

Each of these factors, then—tensile strength, dimensional stability, and uniformity—plays a vital role in the performance of the tape and the ultimate electronic system. Maximum values in each of these factors is mandatory for precision magnetic tape applications. In actual use, the uniform maintenance of a high level of performance from reel to reel is equally important to the operation of the system.

## how do magnetic tape bases compare?

Polyester film clearly dominates the field today in the precision magnetic tape market. Its pre-eminence in this area is derived from its superiority in property characteristics in comparison with other film base materials. Cellulose acetate and rigid (non-plasticized) polyvinyl chloride plastic film materials offer the only real economic competition to polyester, at present. However, neither material comes near to challenging polyester in the precision magnetic tape market.

Cellulose acetate film, for example, is a popular base for audio tape. But for the more demanding use in precision magnetic tape, it lacks the high values of tensile strength, dimensional stability and tear initiation resistance that are now required. Polyester film is between two to three times stronger (in tensile strength) than cellulose acetate film—it is thirteen times more stable dimensionally, three times more resistant to tear initiation, and about ten times more resistant to cupping and curling.

When cellulose acetate tape breaks, however, it breaks cleanly with a minimum of stretch out, or elongation. This has the advantage for audio tape of minimizing sound distortion when the tape is spliced back together.

A film made of rigid polyvinyl chloride plastic is used to an appreciable extent in Europe as a base for audio recording tape. Its tensile strength is slightly lower than that of cellulose acetate, and still falls far short of the exceptional strength of polyester film. Rigid polyvinyl chloride film is clean breaking, but does not age as well as acetate.

As far as price goes, though, rigid polyvinyl chloride and cellulose acetate win hands down. On an area yield basis (that is, in cost per square inch), gauge for gauge, polyester film costs about twice as much as either of the other two films. Physical properties, of course, make the significant difference, carrying polyester into another class entirely. Because of these superior properties, polyester film is employed exclusively in the manufacture of precision magnetic tape for computers, video and instrumentation, despite its premium price.

Of course, better area yields can be obtained with polyester if a thinner polyester film is used that matches heavier gauge competitive films in strength. The thinner gauge film also saves weight and storage space; consequently, polyester film is seen as a major competitor in the audio tape market, too.

Although in a class by itself for use as precision tape, polyester film can be graded into different types. Three kinds of polyester film for magnetic tape emerge on a closer look. Fabrication technique and physical properties are the basis for the distinctions. The three types of polyester film are sometimes referred to as "tensilized," "balanced," and "balanced/tensilized."

Tensilized polyester film is oriented or stretched in both directions but preferentially with the length—known as machine direction (MD)—of the film as it is manufactured. The result is a higher tensile strength in the machine direction.

Stretching orients the long-chain molecules in the direction of stretch from an original random distribution and results in higher strength.

A typical tensilized polyester film has a tensile strength of 40,000 psi in the machine direction, but only 25,000 psi across the width or transverse direction.

Balanced polyester film, as its name implies, has nearly equal strength in each direction. This biaxially stretched film provides roughly comparable tensile strength—approximately 25,000 psi—in both directions.

Balanced/tensilized polyester film strikes a middle ground in tensile strength and at the same time maintains its balance. A balanced strength of about 30,000 psi—a value between the upper and lower figures for tensilized film—is achieved in both machine and transverse directions for this new polyester film.

Tensile break strength and tensile yield strength for all three types of polyester film are compared in Table 1 in both machine and transverse directions. Tensile test data

Table I—TYPICAL TENSILE STRENGTH PROPERTIES OF MAGNETIC RECORDING TAPE BASE FILMS

| | Pounds Per Square Inch | | | |
|---|---|---|---|---|
| | TENSILE BREAK STRENGTH | | TENSILE YIELD STRENGTH | |
| BASE FILM | LENGTH* DIRECTION | WIDTH** DIRECTION | LENGTH* DIRECTION | WIDTH** DIRECTION |
| Balanced/Tensilized Polyester | 30,000 | 30,000 | 16,000 | 16,000 |
| Balanced Polyester | 25,000 | 25,000 | 14,000 | 14,000 |
| Tensilized Polyester | 40,000 | 25,000 | 22,000 | 13,000 |
| Cellulose Acetate | 10,000 | 10,000 | 9,000 | 9,000 |
| Rigid Polyvinyl Chloride | 8,000 | 8,000 | 7,000 | 7,000 |

TEST METHOD: ASTM D 882-61T

*Commonly referred to as "Machine Direction" (MD) in the tape industry.

**Commonly referred to as "Transverse Direction" (TD) in the tape industry.

are also supplied for one-mil films of cellulose acetate and rigid polyvinyl chloride for further comparsion. As can be readily seen, any one of the polyester films has the decisive edge in strength that means greater reliability under the shock impact of computer operation.

Anisotropy, or the imbalance of properties in different directions, produces further significant differences in these polyester films. Thus the tensilized film also displays unbalanced dimensional stability in machine and transverse directions.* As a result, at various temperature and humidity conditions the tensilized film expands or contracts more in one direction than in the other. The unbalanced tensilized film, or the tape made from it, has a tendency to cup or distort as the temperature and humidity change. A comparison of the dimensional characteristics of the three types of polyester film, including coefficients of linear thermal and hygroscopic expansion, moisture absorption,

*In a magnetic tape evaluation conducted by the U. S. Army Electronics Research and Development Laboratory, results conclusively demonstrated that tensilized polyester film was considerably lacking in dimensional stability when compared to other magnetic tape base films.

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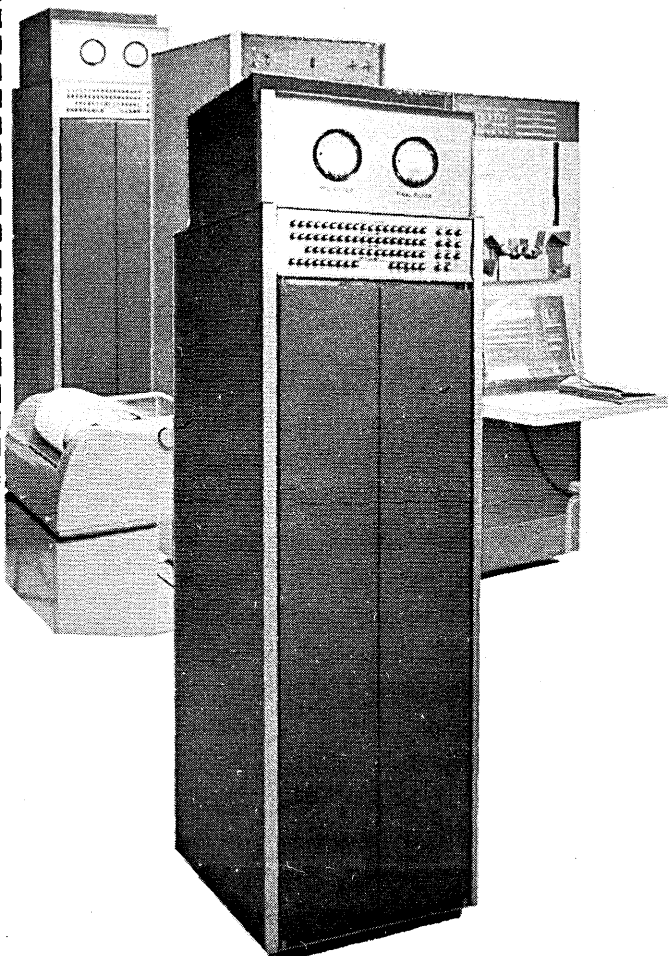

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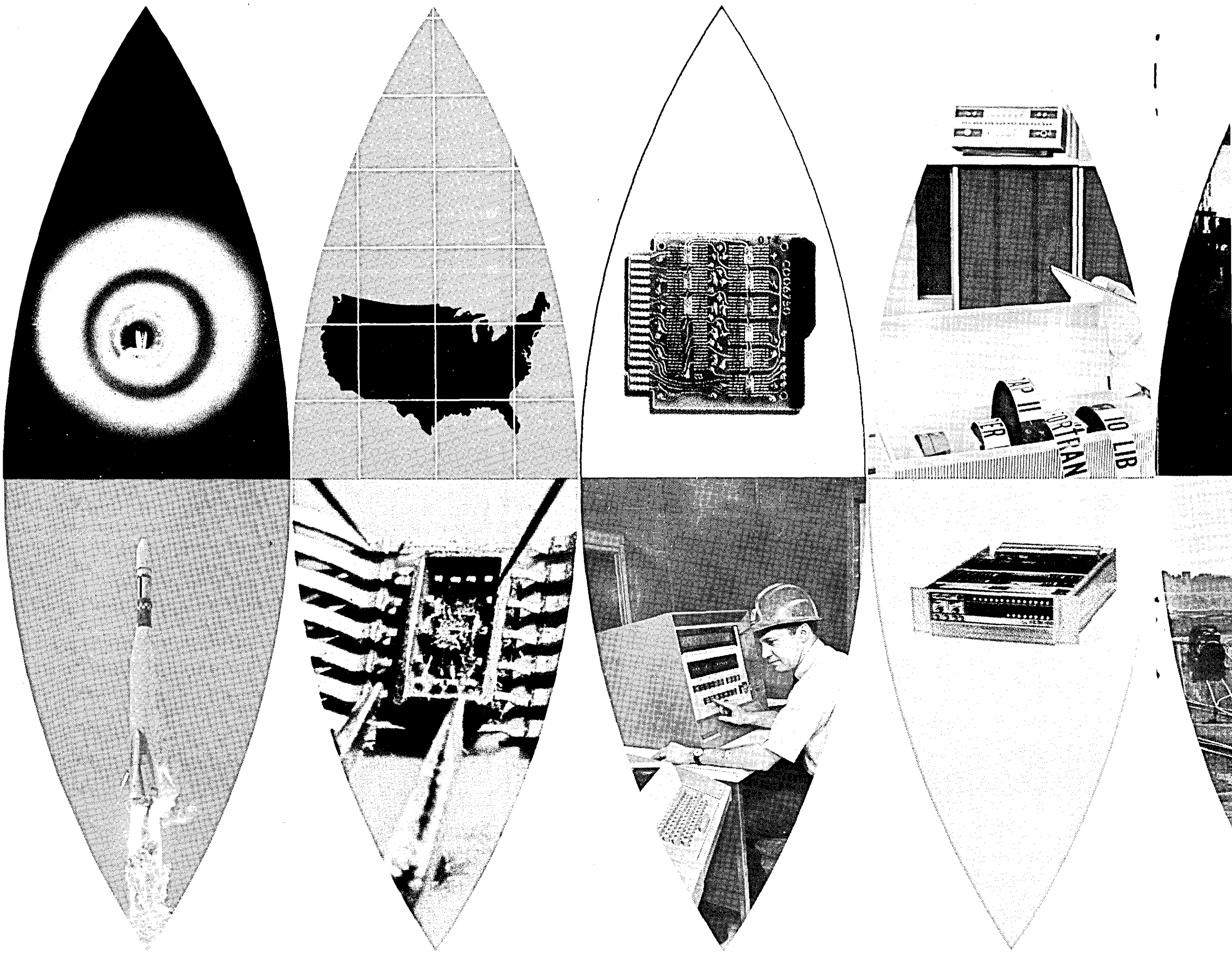

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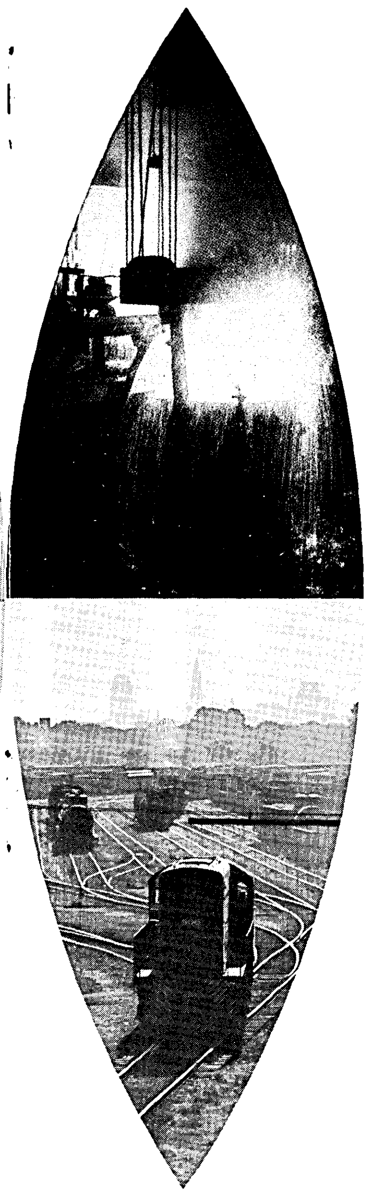

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and thermal and hygroscopic shrinkage is shown in Table 2.

Resistance to tearing, and particularly the initiation of a tear, is a property of significant practical importance in the use of magnetic tapes. The anisotropy of the tensilized film adversely affects its tear initiation resistance as compared to the balanced films. The balanced/tensilized type attains typical tear initiation strengths of 2.5 pounds —as compared to a typical 1.0 pound value for tensilized film. Data on tear initiation resistance was generated by employing the Graves test method (ASTM D 1004-61) on nominal one mil samples.

Table 2—TYPICAL VALUES FOR DIMENSIONAL STABILITY OF POLYESTER FILMS

| Property | Coefficient of Thermal Expansion | | Thermal Shrinkage: 30 min. at 105°C | | Thermal Shrinkage: 30 min. at 150°C | | Coefficient of Hygroscopic Expansion | | Hygroscopic Shrinkage: 0%RH to 90% RH to 0%RH | | Moisture Absorption: 24 Hrs Water Immersion at 23 C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | in/in/F | | % | | % | | in/in/%RH | | % | | % |
| Film Direction | Length* | Width** | Length* | Width** | Length* | Width** | Length* | Width** | Length* | Width** | — |
| Base Film | | | | | | | | | | | |
| Balanced/Tensilized Polyester | $1.1 \times 10^{-5}$ | $1.1 \times 10^{-5}$ | 0.6 | 0.5 | 1.2 | 1.5 | $1.1 \times 10^{-5}$ | $1.1 \times 10^{-5}$ | 0 | 0 | $< 0.6$ |
| Balanced Polyester | $1.5 \times 10^{-5}$ | $1.5 \times 10^{-5}$ | 0.7 | 0.6 | 2.0 | 2.2 | $1.1 \times 10^{-5}$ | $1.1 \times 10^{-5}$ | 0 | 0 | $< 0.6$ |
| Tensilized Polyester | $3.3 \times 10^{-5}$ | $3.0 \times 10^{-5}$ | 2.0 | 1.4 | 9.0 | 8.5 | $2.2 \times 10^{-6}$ | $1.4 \times 10^{-5}$ | 0 | 0 | $< 0.6$ |

*Commonly referred to as "Machine Direction" (MD) in the tape industry
**Commonly referred to as "Transverse Direction" (TD) in the tape industry

As has been indicated, significant differences in the quality of polyester films stem from the conditions under which the film is fabricated.

Another major advantage of the balanced/tensilized polyester film is that the gauge uniformity is held to a tolerance of ± 5% of the mean gauge. No other polyester film currently is manufactured to conform to this stringent tolerance. Magnetic tape manufacturers, it will be recalled, hold their coatings to extremely close tolerances, and it thus becomes apparent that a consistently uniform tape is dependent to a large extent on the uniformity of the base film.

Attention to the holding of close tolerances is maintained throughout film and tape production. For example, something as simple as the control of the width of the tape can have a decided effect on its performance in a high-speed computing system. A tape that is less than the specified width by as little as 0.002 of an inch is free to begin to wander up and down between the tape guides. As a result the narrow tape crosses the read/write head at different angles at different times. This slight change in the angular tape-to-head relationship can cause an error or dropout when the reading head is not positioned exactly over the data track. The prevention of the difficulty is in the carefully controlled slitting of the coated master rolls of film into narrow tapes.

Dirt, or extraneous particles of matter, is one of the major causes of failure, or dropout, in precision magnetic tapes. Impurities in the tape itself, such as gels, airborne dust, and self dirt (e.g. shedding of the oxide coating) cause dropouts. To avoid contamination of the tape with these error-producing particles, extreme care is taken in both the manufacture of the film base and the magnetic tape.

Elaborate safeguards, similar to those used in hospital surgeries and in the production of extremely sensitive missile guidance instruments, are now part of the normal practice in precision magnetic tape manufacture. At the most modern facilities for production of polyester film in the U. S., installed recently by Celanese Plastics Company at Greer, South Carolina, this "white room" approach is extended back to include even basic raw materials, for example. Celanese makes a balanced/tensilized film under the trade name of Celanar polyester film.

Each shipment of film is accompanied by a temperature flag that indicates whether it has been subjected to potentially harmful temperature extremes en route.

For highly critical applications, such as computer and instrumentation tape, an impact recorder may be included to report any shock damage suffered in transit. This precaution is important because impact damage to the shipped film often does not show up until the defective film is on the user's production line.

Similar precautions are taken at each level of manufacture of precision magnetic tape. When it is turned over to the user, computer tape is normally 100% error free. To preserve this ultra-purity in actual use, most computer rooms are kept almost antiseptically clean as compared to the standards applied to conventional office maintenance.

### the big dropout problem

Now, why all this elaborate cleanliness ritual for the sake of a few specks of dust? Is the tape and the data processing system so sensitive that it can be upset by a wayward airborne particle? Unfortunately, with modern digital computing systems it takes only one mote of dust, as small as 140 millionths of an inch in height, to cause a temporary or permanent tape malfunction. This error can be compounded many times when tape is wound on reels and the pressure of layer upon layer produces indentations in the surface of succeeding layers of tape.

Digital data in binary code is generally recorded above the magnetic saturation level in the form of sharp, discrete pulses that occupy only a microscopic space on the tape surface. At current packing densities of 800 bits per inch, a dropout, or 50% signal reduction, will result from a piece of embedded dirt projecting only 140 millionths of an inch above the surface of the tape. The introduction of one such error can be cumulative throughout the whole computer program, and render it useless.

Modern instrumentation tape recording is also highly sensitive to tape dropouts. Instrumentation tape like audio tape, employs analog recording methods in which a continuously varied signal is recorded below the magnetic saturation level. Here a dropout interrupts a small portion of a wave pattern without affecting the data that comes after it on the tape. However, a speck of dust will as easily produce an increase in modulation noise and a decrease in short wavelength response in addition to causing dropouts. As a case in point, a bump of less than 10 millionths of an inch can cause a 50% signal reduction at a recorded wavelength of 100 millionths of an inch. Again, this introduces significant error into the data reduction and processing system.

Returning to computer tape, higher bit-packing densities only increase the need for more and more stringent quality control and maintenance practices. The tenfold increase in packing density envisaged by 1972 to accommodate the growing mound of data in less space, tends to accentuate this formidable dropout problem.

An attempt at classification of dropouts has brought to light three distinct types:

1. *Permanent dropouts* result from an imperfection of the tape base or the magnetic coating during its manufacture. This built-in dropout is not removed by cycling and registers as a dropout in the initial 100% tape testing.
2. *Temporary dropouts* result from the bits of dust and airborne particles lightly stuck to the tape surface that fall off during normal machine cycling.
3. *Embedded dropouts,* like raisins in a cookie, are formed when temporary dropouts are made permanent by sticking them firmly into the tape coating.

The embedded dropout is by far the biggest problem source in computer tape care. And "self dirt" is the major source of embedded dropouts. Self dirt is commonly produced by oxide shedding in which chips of magnetic oxide break away from the coating surface. The oxide chips then accumulate on tape heads and guides where they are eventually dislodged and redeposited onto the tape surface. A contaminated film base, to which the coating can not be firmly bound, can be another source of oxide shedding and redeposition.

Slitting debris is another form of self dirt. It is produced by microscopic chips and burrs left on the edges of the tape by improper slitting of the tape. The chips or burrs are frequently dislodged by normal computer operation. The buildup of electrostatic charge on the tape tends to attract all small charged particles to it. Most plastic films subjected to friction will accumulate enough of an electrostatic charge to create a problem. A thin film of oil or grease deposited on the tape by direct handling or improper care has much the same "flypaper" effect.

But, whatever the cause, temporary and embedded dropouts are essentially cumulative and self-propagating. In the normal wear process, foreign particles and self-dirt both serve to grind out more abrasive particles. After the first embedded dropout is formed, more and more tend to form in rapid succession.

Tape performance is more clearly tied to this embedded material than to the wearing away of the oxide coating itself. Self dirt and embedded dropouts have a number of origins. The list includes degree of roughness of the tape surface and its coefficient of friction, degree of smoothness of the tape edge, adhesive strength of the magnetic coating and the softening temperature of the binding resin as well as the speed, temperature, humidity, and tension at which the tape operates.

Physical distortion of the tape by folding, stretching, crimping, etc., is the second most common origin of dropouts or tape malfunction. The main source of trouble is in improper winding of tape reels. High speed tape drives produce side-to-side flutter as a result of air inclusion while the tape is being rewound onto the reel. After storage in this offset position the tape unwinds from the reel at a skewed angle on its next pass across the read/write head.

Tape folds result largely from a lack of constant winding tension on the tape reels. A momentary change in tension during wind-up causes the tape to slip during accelerated windup and fold on itself. This yields a horizontal crease as a permanent source of error. Longitudinal creases can be caused by guides or rollers that are badly out of line in the tape handling system.

Accidental damage is usually caused by human error in handling and storage of computer tape. Such simple things as dropping a tape reel and threading tape improperly in the machine can cause folds or creases in the tape. Holding the tape through the reel flange holes can also introduce appreciable tape errors. When tape is rewound and single layers stand out from the side of the roll, they are subject to nicks, tears and scratches that permanently damage the tape.

Although precision tape manufacturers have published precise and voluminous instructions for the care and handling of computer and instrumentation tape, the precautions they suggest bear constant repetition. Table 3 is a listing of the most common sources of dropouts. Suggestions on how the computer operator can minimize these tape problems are listed in Table 4. ■

Table 3—Major Causes of Computer Tape Dropouts

| *This Dropout Cause* . . . is | indicated by this . . . *Tape Condition* |
|---|---|
| 1. Oxide coating wear, flake-off, etc. | Flakes of magnetic oxide coating embedded in tape after collecting on tape guides or read/write heads. |
| 2. Defective read/write head, or tape guides | Oxide loss or shedding, Surface scratching |
| 3. Delaminating magnetic oxide coating | Oxide loss or shedding |
| 4. Foreign particles, dust, dirt, etc. | Bumps or imprinting on successive layers of tape |
| 5. End-of-reel tabs | Bumps or impression on underlying layers of tape |
| 6. Fast rewind | Folded edge produced when a tape layer protrudes and is bent back by reel flange. |
| 7. Faulty machine operation | Surface scuff marks imprinted by pinch roller |
| 8. Improper storage or transportation conditions | Crimps or wrinkles |
| 9. Loose reel winding, improper tape wind-up tension | Pleats or wrinkles across tape |
| 10. Faulty slitting | Edge flake re-deposit |
| 11. Failure to normalize to computer ambient environment | Wrinkles and cinching |
| 12. Misaligned drive mechanism | Stretched edges, nicks and burrs produced by reel flange |

Table 4—Precautions for Handling and Storage of Precision Magnetic Tape

1. Store tape reels in dustproof sealed bags; stack on edge in original carton and maintain at regulated temperature and humidity conditions suggested by manufacturer.
2. Handle with care by picking up reel at hub, not flange, keeping fingers off working surface of tape, fastening tape end so that it is not exposed; load take-up reel as manufacturer suggests, without folding tape leader or leaving it outside reel.
3. Establish rigid maintenance check adopting manufacturer's recommendations for periodic checking of tapes and tape reels for contamination; cleaning of read/write head, braking and driving capstans and pulleys; and adjusting of rewind mechanisms according to manufacturer's specifications.
4. Rewind tapes in long-term storage at least once a year to relieve built-up internal stresses.
5. Maintain thermal equilibrium of tape and computer environment by placing stored tape in operating ambient condition for at least six hours before use.

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CIRCLE 29 ON READER CARD

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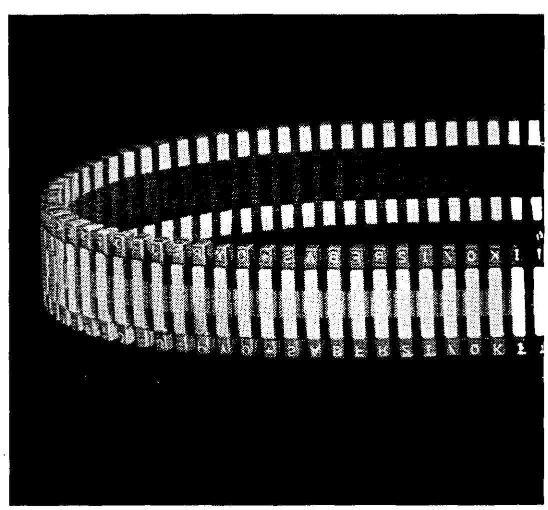

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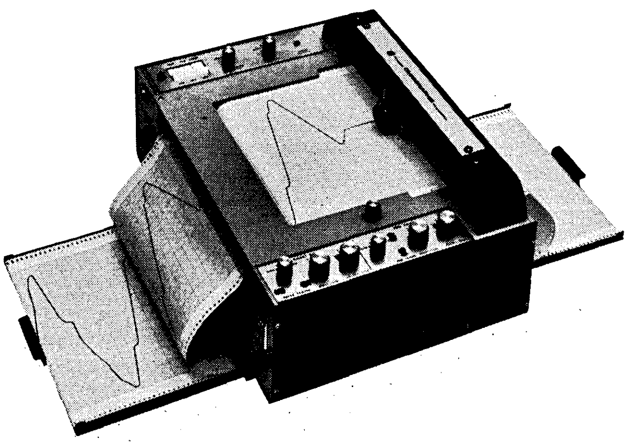

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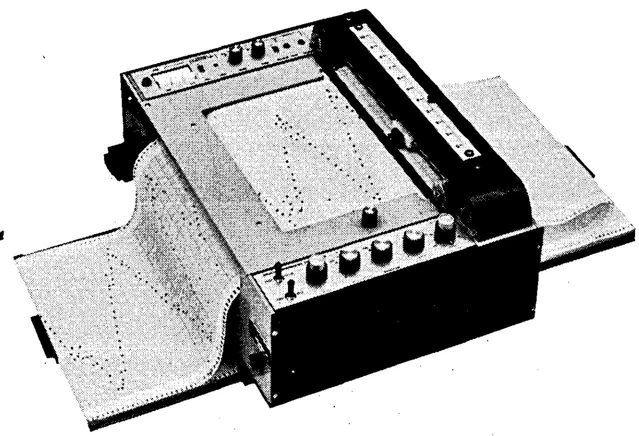

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CIRCLE 84 ON READER CARD

# BYPASSING PROFESSIONAL PROGRAMMERS

**a user-oriented system**

by BENSON H. SCHEFF

A truly effective computer-directed data processing system is one that can be programmed rapidly and efficiently by the intended user. However, most data processing systems, and the languages developed for use with them, implicitly require that the user be trained as a computer programmer. Contrary to the system programmers' general conception, the user may not readily adopt programmers' conventions for his task. A problem-oriented data processing system is not automatically a user-oriented system, and may present a severe obstacle to the non-programming-oriented user. In the case of automatic test equipment, the user is a test engineer who thoroughly understands testing techniques and the functional operation of his equipment. To prepare programs which direct the operation of his tests on the automatic test equipment, the test engineer needs a programming system which he can understand and use easily.

## the ate system

An automatic test equipment (ATE) system consists of a configuration of programmable devices which apply stimuli to, and obtain measurements from, electronic units under test (UUT's). The testing process is designed to determine the operational condition of the UUT. The programming task consists of translating the procedures for testing a UUT into a program which conducts the equipment test.

The ideal test equipment programmer should be capable of understanding complex logical sequences of both hardware and programming processes. He should be able not only to devise the test specifications and assist in the debugging of the unit being tested, but, because the testing procedures are controlled by the test program, also must be capable of writing and checking out the computer program.

In practice, few people have the necessary combination of programming and engineering training and experience. In many applications, the broad differences in technologies between test engineering and computer programming make it more efficient to train test engineers in the rudiments of programming techniques than to teach programmers the intricacies of equipment checkout. The problem, then, is one of developing a programming system which can be readily used by a non-programming-oriented test engineer to prepare and check out his test program. Such a programming system not only expedites the process of obtaining operational test programs, but reduces the overall cost of test programming. A user-oriented programming system consisting of a compiler and simulator was developed for the Depot-Installed Maintenance Automatic Test Equipment (DIMATE) system.[1]

DIMATE, a computer-controlled test system, was designed and built for the U. S. Army Electronics Command, Fort Monmouth, New Jersey, to test and check out a wide variety of electronic and electrical communications equipment in real-time.

The DIMATE System consists of a complex of stimuli and measuring devices. Adapter cables connect the test points on the UUT to connector panels on DIMATE. Stimuli are routed to these connector panels and the responses of the UUT presented at these connector panels are measured.

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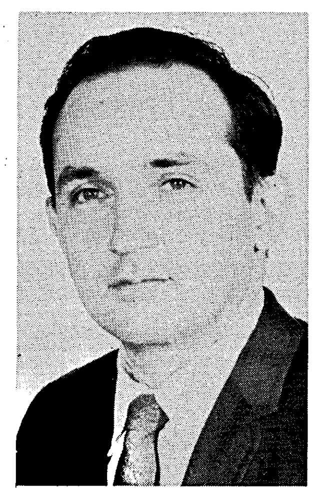


*Previously with RCA Aerospace Systems Div., Mr. Scheff was the project engineer for the development of a compiler and simulator program for an Automatic Test Equipment System (DIMATE). He is currently responsible for the programming aids being developed for an aerospace computer at Raytheon Co., Missile Systems Div. He received a BA in math from Oberlin College and an MA in mathematical statistics from Columbia Univ.*

[1]Contact DA-36-049-SC-90583

# BYPASSING PROFESSIONAL PROGRAMMERS

**a user-oriented system**

by BENSON H. SCHEFF

A truly effective computer-directed data processing system is one that can be programmed rapidly and efficiently by the intended user. However, most data processing systems, and the languages developed for use with them, implicitly require that the user be trained as a computer programmer. Contrary to the system programmers' general conception, the user may not readily adopt programmers' conventions for his task. A problem-oriented data processing system is not automatically a user-oriented system, and may present a severe obstacle to the non-programming-oriented user. In the case of automatic test equipment, the user is a test engineer who thoroughly understands testing techniques and the functional operation of his equipment. To prepare programs which direct the operation of his tests on the automatic test equipment, the test engineer needs a programming system which he can understand and use easily.

## the ate system

An automatic test equipment (ATE) system consists of a configuration of programmable devices which apply stimuli to, and obtain measurements from, electronic units under test (UUT's). The testing process is designed to determine the operational condition of the UUT. The programming task consists of translating the procedures for testing a UUT into a program which conducts the equipment test.

The ideal test equipment programmer should be capable of understanding complex logical sequences of both hardware and programming processes. He should be able not only to devise the test specifications and assist in the debugging of the unit being tested, but, because the testing procedures are controlled by the test program, also must be capable of writing and checking out the computer program.

In practice, few people have the necessary combination of programming and engineering training and experience. In many applications, the broad differences in technologies between test engineering and computer programming make it more efficient to train test engineers in the rudiments of programming techniques than to teach programmers the intricacies of equipment checkout. The problem, then, is one of developing a programming system which can be readily used by a non-programming-oriented test engineer to prepare and check out his test program. Such a programming system not only expedites the process of obtaining operational test programs, but reduces the overall cost of test programming. A user-oriented programming system consisting of a compiler and simulator was developed for the Depot-Installed Maintenance Automatic Test Equipment (DIMATE) system.[1]

DIMATE, a computer-controlled test system, was designed and built for the U. S. Army Electronics Command, Fort Monmouth, New Jersey, to test and check out a wide variety of electronic and electrical communications equipment in real-time.

The DIMATE System consists of a complex of stimuli and measuring devices. Adapter cables connect the test points on the UUT to connector panels on DIMATE. Stimuli are routed to these connector panels and the responses of the UUT presented at these connector panels are measured.

The DIMATE System consists of the following six subsystems:

1. *Computer/Controller Subsystem*
   The computer/controller subsystem contains a general-purpose digital computer and a system controller. The digital computer makes logical decisions and performs computations. The controller controls the operation of the switching subsystem and the input and output devices.
2. *Stimulus Subsystem*
   The stimulus subsystem generates the basic voltage

***Previously with RCA Aerospace Systems Div., Mr. Scheff was the project engineer for the development of a compiler and simulator program for an Automatic Test Equipment System (DIMATE). He is currently responsible for the programming aids being developed for an aerospace computer at Raytheon Co., Missile Systems Div. He received a BA in math from Oberlin College and an MA in mathematical statistics from Columbia Univ.***

[1]Contact DA-36-049-SC-90583

# A thousand words

**To get the whole picture about how our media conversion systems can save you computer time (which means money) you'll have to read most of the following thousand-or-so words. It'll be worth your while.**

*Our premise:* The work of translating punched-card or punched-tape data into the kind of electronic information your computer can understand is too often done on a peripheral computer which really ought to be doing better things. And in some instances, the main frame itself is being used for this time-consuming chore.

*Our solution: Do your media conversion off-line.* Our paper tape-to-magnetic tape and punched card-to-tape systems were designed specifically for this one job. By putting your data on magnetic tape and feeding it to your computer in this pre-formatted fashion, you increase your data input rate so dramatically that you may effect main frame time savings *as high as 50%.*

**Increase your main frame data input rate by a factor of 120!**

**Your punched card or paper tape direct input rate to the central processor is, at best, 1,000 cps; typical magnetic tape input rate is *90,000 to 120,000 cps.* You can see that it makes sense to put your raw data onto magnetic tape with an off-line media conversion system.**

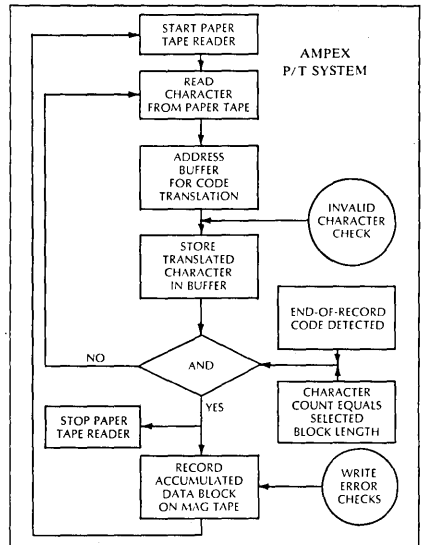
*The systems:* We make three basic media conversion systems; one (P/T) handles paper tape-to-magnetic tape; the second (C/T) converts data from punched cards at speeds of 800 or 1500 cards per minute; the third MCS "COMBO" combines the abilities of both the C/T and P/T, alternately handling punched paper tapes and punched cards.

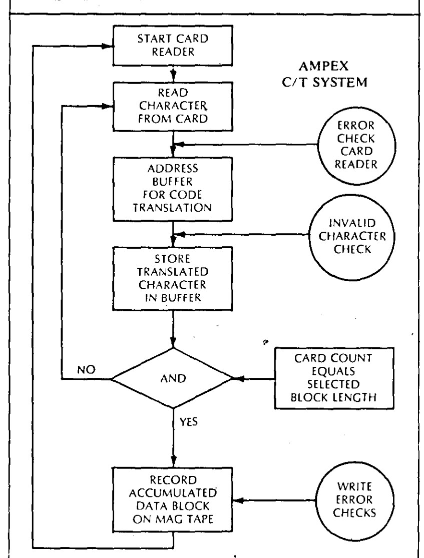
*How they operate:* Our media conversion systems are adaptable to any form of punched tape or card input. The P/T system accepts 5-, 6-, 7-, or 8-level paper tape in virtually any code. The paper tape reader handles 1000 characters per second, yet it *stops between characters* to let the magnetic tape unit record an accumulated data block.

The C/T systems read 51- or 80-column punched cards in column binary or Hollerith code. Cards are read column-by-column by a photodiode read scheme.

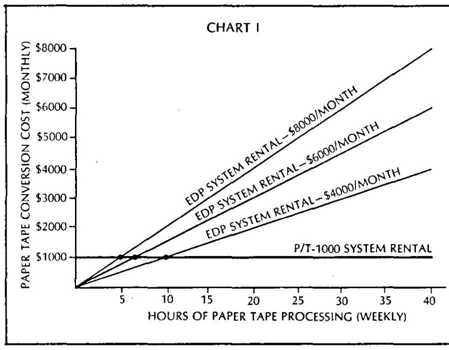
The *outputs* from the P/T or C/T units are identical: data blocks written on magnetic tape according to the desired length and packing density, in either 7- or 9-channel magnetic tape format. **And every single data block is completely free of conversion errors.**

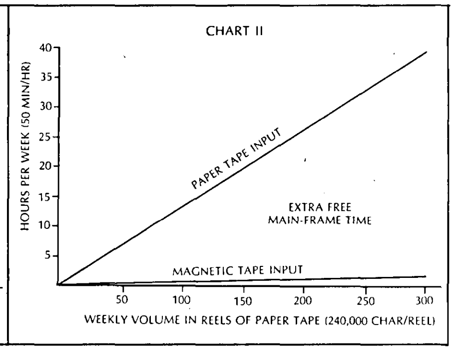
A series of built-in checks during conversion assure you that no main frame computer time will be wasted on erroneous input information. The following sequential operation charts demonstrate how each step of the conversion is carefully checked:



**If you are doing data conversion on your computer, compare the savings possible by doing it on an Ampex media conversion system.**




The time and money savings you can expect from an Ampex media conversion system are difficult to project on an across-the-board basis because of many variables, but if you study the charts above you can get fairly good "ball park" ideas.

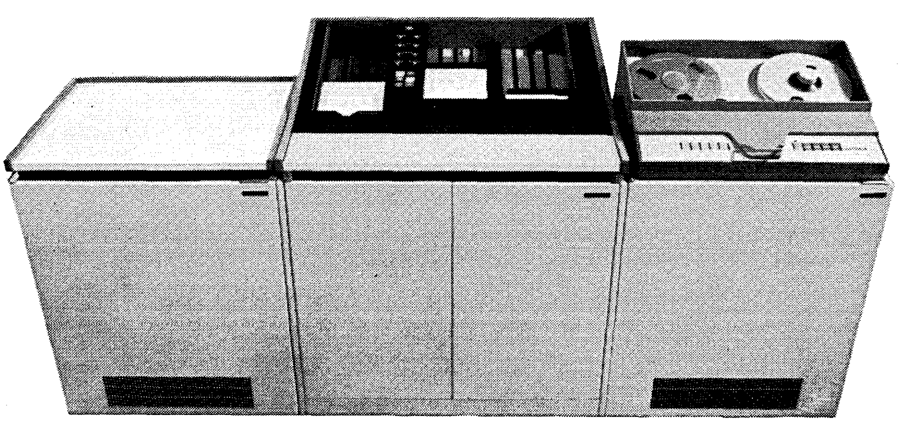
*Chart I* illustrates paper tape-to-magnetic tape conversion costs for three different computer systems. It is based on weekly processing volume in hours, and costs of this processing are shown in relation to the per-month cost of the system. We have also charted the approximate monthly rental cost of our P/T 1000 system. You can see that the break-even points are where the lines intersect.

If your computer costs are not shown, it will be simple for you to interpolate its monthly cost and find your own approximate break-even point.

*Chart II* compares the main frame time required to input raw data from paper tape with the time required to input the same volume of data from magnetic tape. It is easy to translate time saved into dollars. The time and dollar savings illustrated in these charts for the P/T system are similar for the C/T system.

We will be glad to study your current procedure and demonstrate what our media conversion system could mean to you in savings of time and money. Just drop us a note.

# are worth one picture



*Lease or purchase:* Low cost lease plans and a very attractive lease-purchase option plan fit the financial circumstances of many users. They permit you to begin using this money-saving system without tying up capital.

If you want to purchase your system, the prices are as follows: the P/T system, $26,800; C/T systems range from $28,900 to $39,500, depending on the card speed you want; MCS "COMBO" system sells from $50,600 to $58,000, again depending on card speed desired.

We realize that data conversion, as we are performing it with the Ampex P/T and C/T systems, is a fairly recent development and that there are many more details you will want to know before you can put them to work for you. We will be glad to send you (or bring you, if you wish) complete descriptive literature on our systems. Please fill out the coupon below and mail it to Ampex Corporation, 401 Broadway, Redwood City, California 94063.

Gentlemen: I am interested in details about data conversion to magnetic tape from ☐ punched tape ☐ punched cards ☐ both media.

Please send appropriate information. ☐ Have salesman contact me. ☐ My telephone number is:________

NAME________

COMPANY________

ADDRESS________

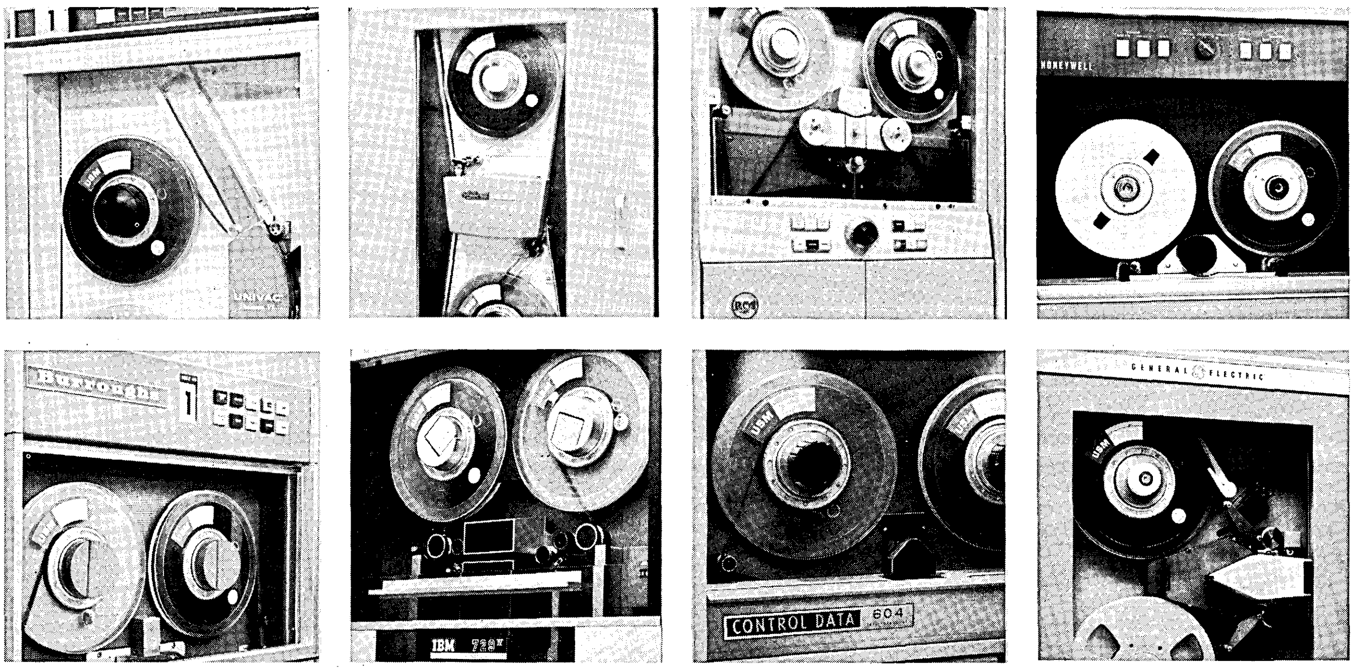
CITY________

STATE________ZIP________

**AMPEX**

CIRCLE 31 ON READER CARD

# First cost of digital computer tape? Forget it!




# The real cost is the price-per-pass.

And on that basis, U.S. Tape with exclusive Duramil 7 may well be the lowest priced tape on the market today!

Duramil 7 makes possible the manufacture of computer tape with superior abrasion resistance and oxide adhesion . . . excellent scratch resistance. Coupled with **8+8 Total Surface Testing*** — a forward step in truly error-free tape certification — U.S. Tape with Duramil 7 records and maintains your data pass after pass after pass after pass. More passes, you'll find, than any other tape you can buy.

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CIRCLE 32 ON READER CARD

levels, sinewaves, and pulses for use in stimulating a UUT. The basic stimuli can be mixed to generate complex waveforms.

3. *Measurement Subsystem*
   The measurement subsystem measures the response from the UUT, compares the response against programmed limits and converts the measurement to digital data. The basic parameters that may be measured are voltage, frequency, time interval, power, resistance, and impedance.
4. *Switching Subsystem*
   The switching subsystem selects and routes stimuli, responses and measurements, to the programmed assemblies within the stimulus and measurement subsystems. The switching functions include:
   (1) Stimuli selection.
   (2) Routing the selected stimuli to synthesize complex stimuli.
   (3) Routing the synthesized stimuli to the UUT.
   (4) Selecting measurement functions and ranges.
   (5) Selecting UUT responses.
   (6) Routing measurement data.
5. *Control and Display Subsystem*
   The control and display subsystem provides the primary interface between the operator and the remainder of the system. This subsystem permits the operator to exercise overall control. The control and display subsystem also displays test results and measurement data to the operator.
6. *Power Supply Subsystem*
   The power supply subsystem distributes primary power and converts primary power to the required dc voltage levels for the operating assemblies.

The DIMATE programming system permits engineering users with various technical skill levels to generate accurate test programs and debug them quickly. The compiler allows the test engineer to write the program directly in a language that he understands, automatically converting his specification to the operational system's digital code. The simulator permits the engineer to verify (i.e., debug) his test program prior to validation (operational checkout) on the test system with a UUT. The first DIMATE system[2] is in operation at Tobyhanna Army Depot, Tobyhanna, Pa.

The purpose of this article is to demonstrate a user-oriented programming system using the automatic test equipment system, DIMATE. From a programming viewpoint, more sophisticated compilers and simulators have been written; however, the effectiveness of these DIMATE programming aids lies in their simplicity, permitting them to be used successfully without an extensive learning process on the part of the user.

The process by which DIMATE programs are generated, verified, and validated is shown in Fig. 1. The source language deck describing the equipment test procedures is keypunched directly from coding sheets prepared by the test engineer. The test program is translated to the operational machine code by the compiler which operates on the RCA-301 computer. The object deck produced by the compiler on the RCA-301 can either be exercised on the simulator program or used on the DIMATE system.

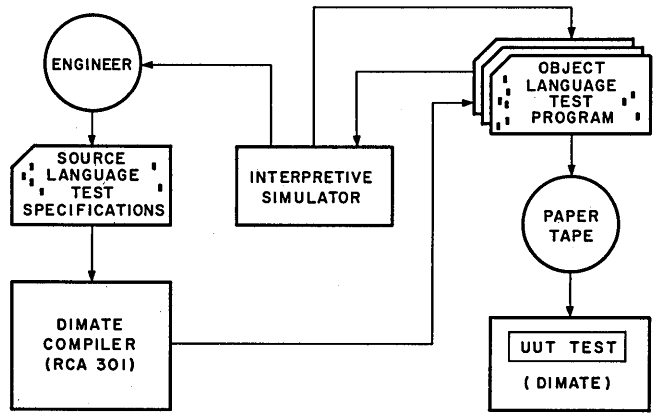
The DIMATE user can be any one of three types of individuals:

1. Military test engineers at the depot responsible for developing test procedures for the equipment being serviced
2. Test design engineers who participated in the development of the automatic test equipment
3. Test technicians.

These personnel not only differ in their relative technical skill for testing electronic equipment, but, because computer training was not prerequisite, may differ greatly in their programming abilities.

For these reasons, the language used to specify the equipment test programs is of critical importance. The compiler source language must permit the engineer to program his test specification directly. Unfamiliar notation, terminology, or syntax will cause the test engineer difficulties in relating the compiler's source language to his

Fig. 1 DIMATE Programming Aids System




test specification. As a consequence, either an explicit or implicit translation process from the user's ideas to the test program vocabulary must ensue. If programmers must be employed to code the engineer's test specifications, communication difficulties are likely to arise between the engineer and the programmer.

Therefore, the compiler's source language must accommodate the various skill levels, engineering and programming, of the DIMATE user so that both the highly skilled engineer and the relatively unskilled test technician can write test programs. If this is accomplished, the number of potential users of the compiler is increased, and the amount of training required to use the compiler by even the skilled test engineer is reduced.

## compiler source language and format

These goals were achieved for DIMATE by developing a compiler input language consisting of engineering expressions arranged in a tabular format. Because the tabular structure provides a framework into which test parameters can be inserted, procedures are stated simply. Programming conventions are implicit in the structure of the table and the test engineer programs his requirements in a format and vocabulary which appears natural to him. The compiler vocabulary and format provide a basic language structure oriented towards the user's background and his associated task requirements without forcing him to rely upon unfamiliar terms. By not requiring specialized programming notation, engineer-to-engineer communication is facilitated and the test program in compiler source language becomes final user documentation.

The compiler language functions can be considered to be divided into three groups: a basic group of test functions for the relatively untrained user and two groups of functions which require, respectively, greater programming skill or engineering knowledge to use properly. These latter groups of compiler functions act as an "overlay" and are not required to perform the basic equipment tests.

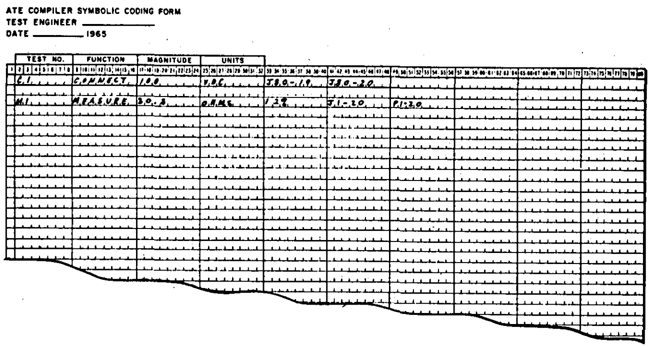
The relatively unskilled user is expected to use only the

[2]The compiler and simulator programs have been in operation since mid '65.

basic test processes to write his test program. He needs to:

1. connect and disconnect stimulus and measuring devices
2. establish proper time delays
3. generate stimulus signals and perform measurements
4. evaluate measured values against specified limits

Fig. 2 Basic program format on sample coding sheet



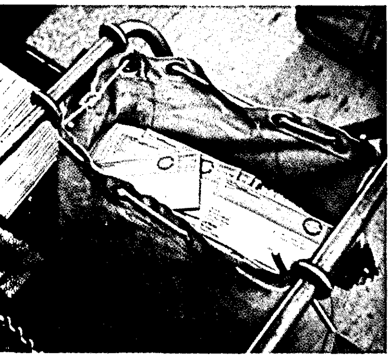

5. branch based upon the results of a measured comparison
6. print the measurement results.

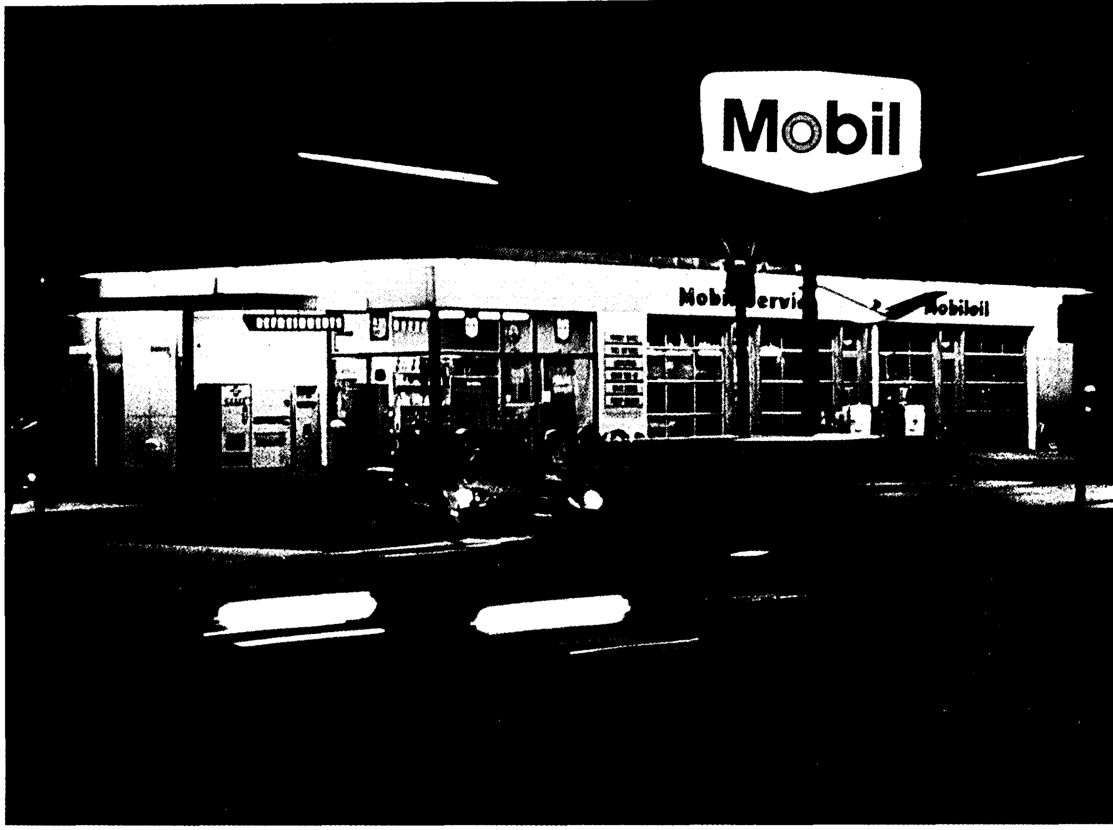
The compiler statements for these functions form the primary language used to specify DIMATE test operations. This primary language is comprehensive and permits all output stimulus signals and input measurements to be selected. Each statement defines the selected stimulus to be applied to the UUT, the selected measurement to be performed, and the DIMATE connection points.

The more skilled user who is interested in programming his test more efficiently can use internal program branching and subroutine linkages. Internal test program control is achieved by the programmer through conditional jumps based upon the state of internal program indicators. The compiler language permits both open and closed subroutines. Any section of the program can be defined by the programmer as an open subroutine while predefined computational subroutines allow arithmetic functions of either a single measurement or several measurements to be evaluated.

The highly skilled user can intentionally violate the DIMATE system rules by making direct reference to each of the stimulus and measurement subsystems. This feature is considered beyond the capability of the normal user, because coding in machine language of the DIMATE computer requires skill in applying both engineering and programming techniques.

The complete compiler language consists of 24 function words. Associated with these function words is information which further defines the function such as units of magnitude, statements to be printed, and connection point identification. The function words and their meanings are listed in Table I. The test specifications are keypunched on cards to form the compiler's source deck. For operational convenience, each function is completely described on one 80-column card. The standard tabular form for the card is exhibited in Fig. 2. The test number field permits the test designer to identify the compiler statement by a test number reference or a symbolic tag while the function field contains the compiler function. The remain-

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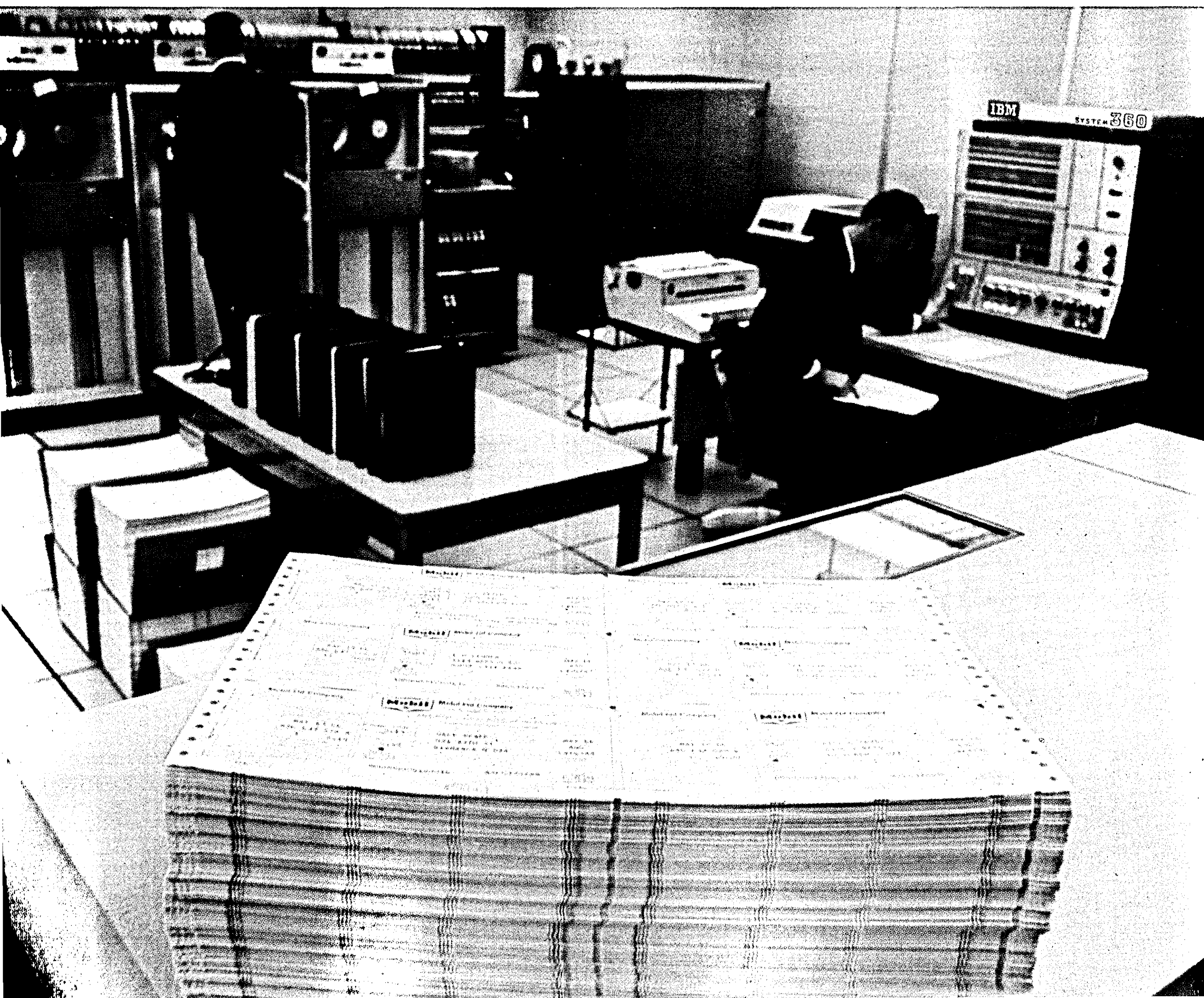
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It is a Model 30 that went in last March at the regional credit card center in Kansas City. In just two weeks it was out-performing a more expensive IBM 1460.

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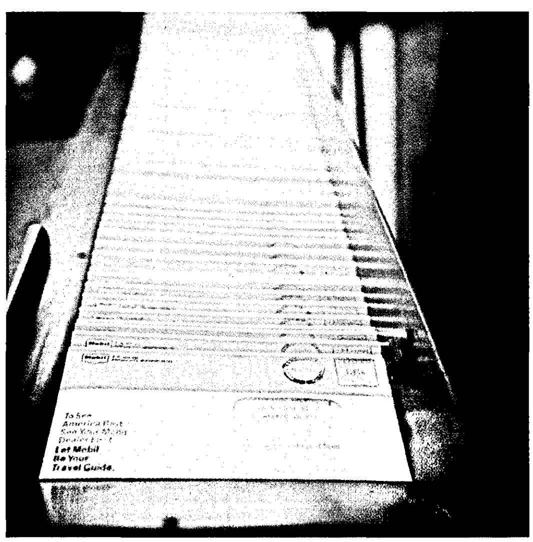

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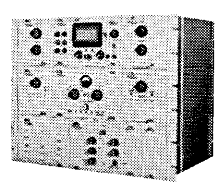

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CIRCLE 35 ON READER CARD

ing fields contain modifiers, arguments, or DIMATE connection point numbers[3] according to the requirements of each individual function. Modifiers are the units of measurement and magnitude which further define the task of a particular function while the arguments are the values which are used.

The test designer can write his test specification using only the basic test functions (Group 1 in Table I). Because those functions which activate the stimulus and measurement devices form the basic framework for any

Table 1: DIMATE Compiler Functions

| Group | Function | Meaning |
|---|---|---|
| 1 | CONNECT | Applies stimulus to UUT |
| 1 | DISCONNECT | Disconnects a stimulus from UUT |
| 1 | MEASURE | Measures a response from UUT |
| 1 | *MEASURE | Sets up to measure a response from UUT |
| 1 | MONITOR | Continuously measures a response from UUT |
| 1 | WAIT | Specifies a time interrupt period |
| 1 | DELAY | Causes a delay prior to measuring |
| 1 | TRIGGER | Starts external time delay period and a measure |
| 1 | PRINT | Prints a message |
| 1 | MESSAGE | Defines a message |
| 1 | PAUSE | Stops for manual intervention |
| 1 | GO TO | Conditionally or unconditionally changes the program sequence |
| | HALT | System reset |
| 2 | SET | Sets a program indicator |
| 2 | RESET | Resets a program indicator |
| 2 | CHECK | Checks a program indicator |
| 2 | CALISUB | Calls a predefined subroutine |
| 2 | SAVEMV | Saves the last measured value |
| 2 | NAME | Creates a named location |
| 2 | ENTER | Enters a subroutine |
| 2 | LEAVE | Leaves a subroutine |
| 3 | ASSEMBLE | Permits DIMATE instructions to be used directly |
| 3 | COMPILE | Permits use of compiler functions |
| 3 | END | Terminates the compilation |

test, the associated compiler language statements provide important use of the basic language structure. The operations performed by these functions are briefly described in the following paragraphs.

### function operations

The CONNECT function selects all DIMATE assemblies required to generate a particular stimulus and scales them to the specified values after which the stimulus is connected to the designated UUT connection points. The DISCONNECT function performs the associated disconnect operations. For the MEASURE function, the compiler selects the measuring device defined by the statement's arguments, automatically programs a standard delay, and gives the measure command. If tolerance limits are stated, the compiler sets the object program to perform the necessary comparisons after the measurement. This standard delay allows both the stimuli selected since the last measurement, and the devices selected for this measurement, to settle. To accommodate special UUT requirements, the engineer

[3] In addition to the object test program in DIMATE machine code, the compiler will produce a From-To wiring list based on the connection point information. This list contains the information necessary to produce the test cables between DIMATE and the UUT.


U.S. Case patent numbers are 3074546, 3138250, D196987. Foreign patents secured in principal countries. Other patents applied for.

# 5 cases fit where 4 did before.

# If you store 204,387 reels of tape, this new case saves you one mile of shelf.

That's not just arithmetic, either. For a big tape user, we could be talking about saving a new building, or at least a new wing. Certainly we're talking about an awful lot of shelf.

The best tape storage case in the industry is now thinner. Five-sixteenths of an inch thinner. And this is a complete case. It has a bottom and a top. It keeps out dust, moisture, other contaminants. Not only from the tape, but from the reel flanges. The case supports the reel where it should be supported . . . at the aluminum hub, not the plastic rim.

Then, there are the things we didn't change. The unique locking device is still there, still patented, still fully enclosed within itself to keep wear particles away from the tape. When you turn the handle, you can still hear the click that locks it and read the word "lock" when you do. (Oh, we did change the handle a bit. Larger. Easier to grip.)

For people who are choosey, there's no protection that equals this case — now thinner than ever before.

Tell your tape supplier to deliver on a Data Packaging reel — the one with the ring of color around the hub — locked in the new, slim storage case. Tell him you need the space.

**Data Packaging Reels and Cases**

205 Broadway, Cambridge, Massachusetts

CIRCLE 36 ON READER CARD

is able to program his own delay. Overriding the standard delay is needed to ensure that a minimum time delay has elapsed or to measure, say, an instantaneous peak. By using the MEASURE function, he can connect the measuring device bypassing the standard delay. The WAIT and DELAY functions allow a time delay to be specified directly.

For these functions, test statements in compiler format look identical to an English statement with connective words removed and some unnecessary descriptive words eliminated. Statement 1 of Fig. 2 connects a 100-volt dc stimulus source to DIMATE test points J80-19 and J80-12. Statement 2 of Fig. 2 measures 30.0 ohms with a tolerance of 12% between points DIMATE J1-20 and P1-20.

On the coding sheets, the test engineer only lists pertinent data, according to the following syntax rules.

1. The primary signal characteristic follows the function designation; the name of the signal is placed in the units field while the value of the signal is placed in the magnitude field.

**Table 2: Stimulus Statements**

| Stimulus | Units |
|---|---|
| 1. Internal Power Supply | VIPS, VAC IPS |
| 2. Relay Supply | V Relay |
| 3. Primary Power (AC) | VPRI, VP1, VP3 |
| 4. Filament Supply (AC) | VFIL |
| 5. Standard Frequency | KCS, MCS |
| 6. Switches (AF/DC) | SWITCH |
| 7. Signal Ground | SIG GND |
| 8. Chassis Ground | CHAS GND |
| 9. DC Voltage | VDC |
| 10. Power Load | OHMS, ROHMS, MOHMS |
| 11. Sine Wave Signal (CW) | VRMS, MVRMS, UVRMS |
| 12. Modulation | KC, MC, KCPS, MCPS, MCF |
| 13. Audio Power | WATTS, W |
| 14. Pulse Train | PPS, (KPS, MPS) VPP, DELAY SQUARE |
| 15. Local Oscillator | LOS |

**Table 3: Measurement Statements**

| Measurements | Units |
|---|---|
| 1. Ac Voltage | |
| A. RMS | VAC, TVAC |
| B. RF | VRF |
| C. Peak-to-Peak | VPP |
| 2. Dc Voltage | VDC, TVDC |
| 3. Dc Resistance | OHMS, KOHMS, MOHMS |
| 4. Impedance | ZOHM, KZOHM |
| 5. Average Power | W, MW |
| 6. Frequency | |
| A. Frequency | KCPS, TKCPS, MCPS |
| B. Frequency Ratio | TO: 1, TTO: 1 |
| 7. Time | |
| A. Time Interval | MSEC, TMSEC |
| B. Interval Ratio | CNTS, TCNTS |
| 8. Frequency Modulation | |
| A. Frequency Modulation | FMF |
| B. Frequency Deviation | KDEV |
| 9. Amplitude Modulation | |
| A. Frequency Modulation | KAMF |
| B. Percent Amplitude Modulation | AMM |
| C. FM Modulation Amplitude | FMMA |
| 10. Single Sideband | |
| A. Frequency Modulation | SBMF |
| B. Sideband Ratio | SBR |
| 11. Open | OPEN |
| 12. Short | SHORT |

2. Secondary signal characteristics (including tolerance specifications for measurements) follow the primary signal characteristics.
3. Test point designations follow the modifiers used to define secondary signal characteristics.
4. All information is placed in consecutive fields.

The specific stimulus and measurements which may be programmed are given in Tables 2 and 3, and are associated with the UNITS mnemonics. There are some obvious advantages to using this fixed syntax. The chief advantage to the user is that the same arguments are used by the CONNECT and DISCONNECT function to define the same stimulus units, and that the arguments used for the MEASURE function have the same meaning when used for the

**Fig. 3 Typical compiler statements for programmable power supplies.**

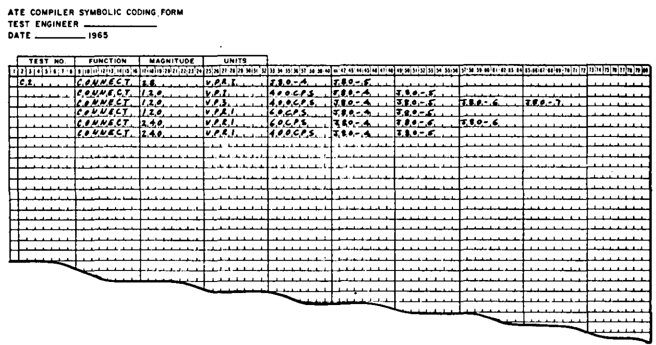


**Fig. 4 Sample printout of source program listing**

```
        COMPILE VALIDATE9075                                          0001
        PRINT      C. HUGHES TEST PROGRAM, UUT NO. 9075.              0002
T001    CONNECT 6.3     VFIL    400CPS  J10-1   J10-2                 0003
        CONNECT 120     VP3     400CPS  J10-3   J10-4   J10-5  J10-6  0004
        MEASURE 250     VDC     25      J10-7   J10-8                 0005
        GOTO    -       AP001   A002                                  0006
        PRINT      VOLTAGE TOO HIGH.                                  0007
        HALT                                                          0008
P001    PRINT      VOLTAGE TOO LOW.                                   0009
T002    CONNECT 45      VRMS    100CPS  ------- J10-9                 0010
        PRINT      CONNECT DC/AC PROBE TO  J10-10. PRESS PROCEED.     0011
        PAUSE                                                         0012
        *MEASURE1,5     VRF     -,5     A                             0013
        CONNECT C       SWITCH  J10-11  J10-12  -------               0014
        MEASURE                                                       0015
        GOTO    -       -       A003                                  0016
        PRINT   (MSG1)*                                               0017
T003    DISCONN 45      VRMS    100CPS  ------- J10-9                 0018
        DELAY   2       SEC     J10-13                                0019
        CONNECT 5.0     VDC     J10-14  J10-6                         0020
        TRIGGER                                                       0021
        MEASURE 0       KOHMS   .01     J10-15  J10-16                0022
******  LOWER LIMIT IS OUT OF RANGE                                   0022
        GOTO    -       A-      A004                                  0023
        PRINT   (MSG1)*                                               0024
T004    DISCONN C       SWITCH                                        0025
        CONNECT 2.0     VRMS    5KC     -1009   J10/                  0026
******  ATTEN OUTPUT AT A13J14, CHECK PRINT MESSAGE                   0026
        DELAY   20      MSEC                                          0027
        MEASURE 1       KOHMS   .01     J10-15  J10-16                0028
        GOTO    -       P005    P004                                  0029
        HALT                                                          0030
P004    PRINT      END OF PROGRAM                                     0031
        HALT                                                          0032
MSG1    MESSAGE    TEST OUT OF TOLERANCE.                             0033
        END     9075                    1       1                     0034
```

* MEASURE function. Different rules do not have to be followed by the user to perform the same basic test operations.

The ease with which a test engineer can associate the source language statements with test functions can be illustrated using, as an example, the slightly more complicated compiler statements needed to connect primary power. In DIMATE, primary power can be generated at 28 volts dc, 12 volts ac, and 240 volts ac, with either of the ac sources being generated at 60 cycles or 400 cycles. The 120 volts ac at 400 cycles may be either one-phase or three-phase: the one-phase source may have two test points specified. Although the signal is not specified solely by the units and magnitude parameters, the compiler source language statements can be formed directly from the English stimulus description, as is shown in Fig. 3. Fig. 3 lists the six possible primary power statements.

Fig. 4 illustrates a representative test program. The meaning of each source language statement in that program is explained in Table 4. The sequence numbers in the righthand column are determined by the compiler. Besides detecting clerical coding errors, the compiler compares the information presented in this source program against the specified characteristics of the DIMATE system. Because the compiler cannot outguess the intentions of the test designer, errors are classified as either positive (always wrong) or possible (may be an error in some situations). The indicators in the left-hand margin of the source language printout distinguish between positive (*) and possible (#) errors detected by the compiler.

Table 4: Explanation of statements in UUT 9075 program (Fig. 4)

| Sequence Number | Statement | Meaning |
|---|---|---|
| 1 | | Identifies subsequent statement as compiler functions. |
| 2 | | Causes specified message to be printed. |
| 3 | T001 | Connect 6.3 volt 60 c.p.s. stimulus (AC filament power) across UUT terminals J10-1 and J10-2. |
| 4 | | Connect 120 volt 400 c.p.s. stimulus (3-phase, WYE connected AC power) to terminals J10-3, J10-4, J10-5, and J10-6. |
| 5 | | Measure DC volts, upper limit 275 volts, lower limit 225 volts between terminals J10-7 and J10-8. |
| 6 | | Transfer program control to locations as follows: next statement (if HIGH condition), P001 (if LOW condition), or 002 (if GO condition) as a result of measure statement 5. (A dash in any of these fields transfer program control to the next location). Set indicator "A" if HIGH or LOW. |
| 7 | | Causes specified message to be printed. |
| 8 | | Halts program and removes all stimulus. |
| 9 | | Causes specified message to be printed. |
| 10 | T002 | Connect 45 volts RMS 100 c.p.s stimulus to an unnamed terminal with return at terminal J10-9. |
| 11 | | Causes specified message to be printed. |
| 12 | | Stops test program until proceed button is pushed. |
| 13 | | Set up but do not execute anticipated measurement of 1.5 volts RF but not less than 1.0 volt RF in a frequency range > 25 Kc. |
| 14 | | Connect terminals J10-11 and J10-12 together by means of AF/DC switch "C". |
| 15 | | Execute last measure statement (set up in statement 13) |
| 16 | | Transfer program control to locations: next statement (HIGH or LOW) or 003 (GO) depending on results of measure statement 15. Set indicator "B" if LOW. |
| 17 | | Print contents of (MSG1) message, statement 33. |
| 18 | T003 | Remove stimulus applied in statement T002, (statement 10) |
| 19 | | Set up 2-second delay to be triggered by signal from J10-3. |
| 20 | | Connect 5-volt DC stimulus between terminals J10-14 and J10-6. |
| 21 | | Execute delay programmed in statement 19. (Signal trigger from J10-13). |
| 22 | | Measure 0 ohms ± 10 ohms (wrong range chosen). |
| 23 | | Transfer program control to "HIGH" "LOW" or "GO" locations depending on result of measure statement 22. Set indicator "A" if HIGH or LOW. |
| 24 | | Prints message stated in location MSG1 (statement 33). |
| 25 | T004 | Disconnect "C" switch applied in statement 14. |
| 26 | | Connect 2 volts RMS 5 Kc stimulus attenuated 10 decibels to terminal J10. |
| 27 | | 20 millisecond delay. |
| 28 | | Measure ohms resistance between terminals J10-15 and J10-16, upper limit 1010 ohms, lower limit 990 ohms. |
| 29 | | Transfer program control to "HIGH", "LOW", or "GO" locations depending on result of measure statement 28. |
| 30 | | Halts program and removes all stimulus. |
| 31 | P004 | Prints specified message. |
| 32 | | Halts program and removes all stimulus. |
| 33 | MSG1 | Prints message, requested elsewhere in program. |
| 34 | | Tells compiler that there are no more cards in UUT 9075 program. |

## program debugging

Debugging an equipment test program presents problems which are considerably more complex than those normally encountered by computer programmers. The interaction of program and hardware in automatic equipment testing does not allow debugging problems to be simply categorized. For example, suppose a test engineer received a NO-GO indication while checking a GO branch of a test program with a supposedly operational UUT connected to the automatic test equipment. (A GO path performs a qualification test required to certify that the UUT is performing within operational limits.) Obviously, an error exists somewhere. If the UUT developed a malfunction, the NO-GO indication would be valid. If not, then the cause of that response could be any one of the following:

1. The automatic test equipment system may not be operating correctly
2. A device in the system may have different operating specifications than were expected by the test programmer (engineer)
3. The programmers who wrote the compiler program may have misinterpreted the automatic test system capabilities
4. A compiler program may contain an error
5. The test program may be incorrect

These possibilities must be systematically checked. However, some practical factors compound the complete debugging of the test program in its operational environment.

First, little time is available on the test equipment system. Generally, time cannot be made available to exhaustively check each branch in a typical UUT test program, especially if specific program errors must be isolated. The prime use of the automatic test system is expended in operational UUT testing and the lack of equipment availability time precludes thorough program debugging.

Second, all stimulus signal sequences cannot be guarded. The test program has control of the stimulus and switching subsystems. Consequently, as the result of incorrect test program coding, legitimate stimuli coding could be generated in a sequence which causes a catastrophic failure of the UUT.

Third, it may be impossible to check every NO-GO path in a test program by generating specific errors. Furthermore, generating certain errors to force a NO-GO path may result in destroying the UUT. Even if an equipment malfunction is generated under known conditions, it may have too wide a range of effects to be controlled to the precise level required to predict the specific program branches which will as a consequence be executed.

A user-oriented programming system, to be completely effective, must give the test engineer as much assistance in debugging his test programs as it does in writing them. The natural choice would be a program which simulates the characteristics of the test equipment system. Having such a simulation program, the engineer could verify the correctness of the test program prior to executing it on an automatic test system, reducing significantly the amount of on-line program debugging needed. The entire debugging process is expedited since the simulator can contain a multiplicity of debugging procedures not otherwise available.

Simulation programs, although widely used in other real-time systems, have not been generally accepted for use with automatic checkout systems. The reason for their disfavor appears to be that a sufficiently comprehensive simulation program is extremely difficult to develop and, because it requires a substantial amount of programming effort, is considerably expensive. These arguments are true, but when one carefully analyzes all factors, he will find that the cost of developing a thorough simulation program is more than offset by the initial and accrued savings and reduced risk.

First, the development cost of a simulation program represents only a small fraction of the total cost of the test equipment system. Second, debugging for the most part becomes an off-line operation with the result that the availability of the test system is increased and the unit cost of UUT testing is reduced. For test systems such as DIMATE, the savings accrued over a long period of time can be substantial. Third, off-line debugging not only maximizes the operational availability of the prime equipment, but permits program debugging to be accomplished in a comparatively "unhurried atmosphere." Fourth, repairing any inadvertently damaged UUT's adds to the repair shop workload and diverts costly spare parts.

### simulation program

The simulation program developed for DIMATE provides a reference for the entire system; i.e., compiler, test program, and the DIMATE equipment. Debugging the object programs produced by the compiler establishes a measure of confidence in the compiler. Hence, verifying a test program on the simulator also certifies the compiler's processing. Because the simulation program represents the specified test system's characteristics, any problems which arise on a verified test program during validation can be easily isolated and reconciled.

In the DIMATE system, the simulation program is the primary verification tool for the test engineer. It (1) checks the legality of the compiler output, (2) checks the compatibility between stimulus and measurement programming and DIMATE functions, (3) performs programmed arithmetic functions, (4) allows the results of each test to be predetermined (either by a numeric value or by a HIGH, LOW, GO indicator), (5) performs various trace routines, (6) performs various types of memory dumps.

The level of simulation is sufficiently thorough to remove the need for validating, on the DIMATE system, any NO-GO path which has been previously verified. To ensure consistency between the simulator and the test system, only the basic GO path of the test program needs to be validated.

### benefits

The intrinsic value of a programming system is realized when it is designed to fulfill the needs of the user. The ever-increasing application of computer-directed systems, both in defense and industry, where the user is not trained as a skilled programmer emphasizes the value of programming aids. The field of automatic test equipment is only one example.

Programming aids which are based on techniques and vocabulary which the user can relate to his background mark a significant step toward practical user-oriented programming systems. A simple processing system which is specifically tailored to a user's background can be more effective than a very elegant and powerful processing system. In the case of DIMATE, the compiler with its user-oriented source language and tabular format has made it possible for non-programming-oriented test engineers to write their test programs without undergoing an intensive education process. The long range benefits become apparent when one considers for a moment the normal turnover of personnel during a five-year period. Without these aids, the task of teaching programmers the intricacies of testing a wide variety of equipment on a complex test system would be large. With the aids and minimal indoctrination, an electronic test engineer can almost immediately write test programs.

Assuming proper training an engineer can write a UUT program in compiler language in about 40% of the time in which a computer programmer (and engineer) would require using only assembly language. Assembly language permitted a reduction in UUT coding time of 90% when compared with direct machine language coding.

For the DIMATE I system, each UUT required on the average 650 tests. However, the number of tests could vary from 1000 tests needed to comprehensively self-check a complex unit, to 65 tests needed for a simple device. Junior electronics personnel with a high school background were, after a few days indoctrination and training, able to code approximately 20 tests an hour in compiler language. Significantly, longer training would have been required to enable them to reach the corresponding figures of 12 tests an hour using only assembly language or 1.2 tests an hour using only machine language.

The compiler language provides indirect benefits which are most helpful in the test program debugging process. (1) The user-oriented source language permits engineers who did not participate in writing the test program to be of immediate assistance during program checkout. (2) The tabular format for the source language simplifies the compiler design; consequently, little time is needed to analyze the compiler's processing when compiler errors are suspected.

For complex equipment systems where available time is premium and a large number of programs must be prepared and updated on a continuing basis, the simulator becomes an integral part of a user-oriented programming system. The advantages to be derived in time savings and risk of damage more than offset the cost of developing a comprehensive simulation program.

### summary

The DIMATE programming system is a user-oriented system because it:

1. Reduces the time and cost of test programming
2. Minimizes the specialized training needed to prepare test programs
3. Improves overall information flow
4. Eliminates retraining required by the user for new ATE systems

These goals were accomplished by:

1. Decreasing the engineering skill level required to write test programs
2. Removing computer programmers from the UUT programming loop
3. Reducing engineering training time
4. Decreasing the time required to prepare and check out UUT programs
5. Facilitating emendations to existing UUT test programs
6. Permitting engineer-to-engineer communication on the engineering level
7. Using the UUT test program coding input
   a. as the test program specification
   b. as final test design documentation ■

# URBAN PLANNERS AND INFORMATION

**conference report**

The announcement for the fourth annual conference on Urban Planning Information Systems and Programs, held late in August at the Univ. of California, Berkeley, declared that it would "bring together planning professionals and computer specialists for a critical appraisal of existing automated information systems and an exploration of new techniques and emerging technological developments." This statement was broad enough to constitute a wide spectrum of appeal, yet formal enough to suggest academic trappings and the scholarly atmosphere. By and large, performance met the promise. It is surprising and comforting what can be tucked comfortably in the shadow of such words as "planning," "computer specialists" and "automated information system."

It also became apparent as the meeting progressed that our urban planning friends are as much in need of a discipline as are we information/computer specialists. How else does one explain the co-existence on a single program of such presentations as the esoteric Role of Models in Setting Values (learnedly done by Claude Gruen), and the prosaism of A Federated Statewide Information System by Robert Donati? Donati, incidentally, strongly suggested that Lockheed is yet to be heard from in the local-government information processing field.

The agenda *did* reflect an attempt at unity. Yet how can one structure the amorphous activities of urban planning and computers? The attempt at Berkeley was made by arranging program topics on the basis of computer use: data systems, models, simulation, hardware, education, and geophysical location. Perhaps it served as well or better than any other. It did reflect the enormous range of phenomena which are being marshalled to do battle with the problems of urban information and its hand-maiden, computer specialization.

### the opening triad

Chronologically, the meeting started Friday morning with a triad of panels on (1) data systems, (2) information systems and (3) intelligence systems. As an ordering device for panel formation, such categorizing has much to be said for it. As a valid analytic classification, it is open to question, as the successive panel presentations showed. Joel Kibbee's panel led off for the data systems session. Santa Clara County's Logic, Lockheed's Federated System, Los Angeles' APOF and New York's Systems Design for the planning function were in turn discussed or exposed by their representatives.

Several conclusions of significance emerged: the old "integrated data bank" has serious conceptual defects as well as inherent maintenance problems; the assumption that increased rationality in the decisional process will evolve spontaneously from an increase in valid, quantified data is open to serious question; the average local-government official, political or administrative, must be made more knowledgeable about computerized data systems; a computerized data system package must be linked to a computerized analytical package and to organizational change; academic explorations of urban phenomenon using the concepts of the economist are intellectually titillating and pragmatically mercurial; and as a society we are moving rapidly towards the accumulation of socio-economic data with which to identify more precisely the environment in which local government operates.

Friday afternoon consumed the second of the triad, "Information Systems for State and Local Governments chaired by Leslie Carbert, chief, California State Office of Planning. Carbert introduced the subject by reflecting that future state and local governmental administration will move toward a greater concern for information and its aggregation to aid in the decision-making processes. To move in this direction, governmental information flows must be integrated into a single process which both determines informational needs and provides for their generation. The issues here are not academic, Carbert contends, but involve significant decisional processes which will profoundly influence the character and quality of our citizenry.

Donald Foley followed with a demonstration of how analysis of census data can reveal the character of metropolitan growth in California. Apparently an analytic software package (UC's Statpac) is as important as source data in generating such extrapolations.

Robert Kokat, IBM, explored the ability to reflect the economic characteristics of a multi-state region. The means for such a projection was a socio-economic model which reflected the relationship of varying expenditures and their effect on employment. The U.S. Office of Economic Opportunity picked up the bill and IBM housed the study. The model can apparently be used in any large metropolitan area concerned with alternate programs designed to optimize the economic benefits of alternative expenditures. The salient point is that computers, models, and economic theory can be brought to bear on regional problems, which are economic in symptom and social in origin.

Richard Siegel of the California State Planning Office completed session with a discussion of his experiences in studying the informational needs of New York. His conclusions are that people who are designing information systems need to consort with the people who bear the responsibility for the activities—not a novel idea, but a refreshing one. The urban management system will yield to rationalization when the information specialist becomes an essential, governing, team member. Furthermore, the lack of an adequate management information system appears as a major obstacle to the more effective use of the theory of the firm in ordering governmental decisions through such devices as planning and programatic budgeting.

### enter time-sharing

Time-sharing and its kin, real-time processing, provided a most interesting Saturday morning. Of particular interest to the soothsayers of local government and the computer were the observations of Robert E. Fagen of Computer Communications Inc., Los Angeles. His view is that the rapid reductions in costs growing out of third-generation hardware and improved communications will make the power of the computer available to local governments of all sizes. His cost analysis provided impressive evidence for this view. The argument would have been more impressive, however, if comparative costs for small separate computers had been included. The same assumptions for cost reduction through technology for large computers need to be applied to the future cost patterns of smaller equipment.

Two other points which Fagen made: (1) the successful use of remote terminals and real-time data handling is primarily a software problem with a current no-man's land of responsibility between the manufacturer and the user for its development; and (2) because the most inflexible cost of remote input systems is communication distance, the future will see urban government computer users satellited around numerous central facilities rather than many such users tied into a sharply limited number of giant computer utility systems. Could be.

The Saturday luncheon provided an all too short diversion on information processing and political realities as seen by John T. Knox, a perceptive Assemblyman from California's 11th District. The dreams of computer scientists for monolithic systems serving unified geographic areas are incompatible with the realities of home rule, Knox believes. Rather, the future use of computers in local and state governments is to be found in the concept of federated information systems. Local governments will join such systems as benefits from such a union are demonstrated and as less efficient, special-purpose governmental agencies are eliminated. The state's job is one of outlining the major subsystems in the federation and providing policy and fiscal guidance for the creation of logical regional areas that are unified through compatible, operating information systems.

Regional agencies may come, but in Knox's view the solution of basic urban problems must start with better information that is computer-based and planning oriented. With such an approach, the definition and solution of urban problems on a regional basis are possible without violence to a political basic—*viz.*, home rule. Urban computer and information issues thus become and are social issues, a fact we in urban information systems need to recall and recognize more often than just at annual conferences on the subject.

### gaming & simulation

Saturday afternoon was Gaming and Simulation Day at the auditorium. Two professors (Richard Duke of Michigan State Univ. and Alan Feldt of Cornell) and a consultant (Robert Barringer of Arthur D. Little Inc.) provided an intellectually stimulating, if not pragmatic, session. Barringer aptly dubbed "simulation" as "like love—it can be discussed and participated in without a precise definition." His nine reasons for building a model justified the activity. Duke turned a bit abstract in discussing his METRO project, a metropolitan planning game played by three elements of a community: planning, city councilmen, and investors in a community. Feldt gussied up a training model by calling his exercise "heuristic gaming" and brought it into perspective by assigning it the acronym CLUG (community land use game).

Despite these interesting presentations, I left the session still wondering about the basic issue: are such exercises justified because they (a) serve as a training device, (b) constitute a prediction process, or (c) provide high entertainment for intellectuals who dignify game-playing by wearing academic cloth?

Saturday evening explored how computers could be used in "planning education" (apparently assuming the terms suffer no inconsistency). The discussion rose above the panel title, however, and faced some rather basic problems related to academic life and the computer. Andrei Rogers of UC's City and Regional Planning Dept.

suggested that computers should be presented to the student as (1) a processor of data, (2) a problem-solving facility, and (3) as an educational resource. The fundamental issue apparently is how—considering the press of contending academic interests for the student's limited time—computer exposure should be secured: through elective courses, integral parts of curriculum, or self-taught, student enrichment? Professor Duke suggested that a further factor was the need for a faculty retread in computers, but he faltered in suggesting ways to bell *that* cat.

A particularly pertinent point, suggested by Duke, was the growing need to generate and store urban data within the computer laboratory so that the planning student can experience the richness of computer-processed data exploration without leaving the laboratory. The real value of his research and collection of data for METRO may well be the student's use of urban data on computer tape, rather than actual training in urban processes by participating in the game itself.

Edgar Horwood (Urban Data Center, Washington U.) combined perceptive observation with a light touch of humor by suggesting seven "syndromes" which characterize our educational efforts to blend computer technology into the education of future planners. These included the vogue syndrome (drop by and tell us about it), the gadget syndrome (we can't give you course credit for learning, but you should volunteer), the frill syndrome (an elective course available on an optional basis), and the get-off-my-back syndrome (take a short course from the computer manufacturer—it isn't an academic subject anyway).

Barclay Jones (Dept. of City and Regional Planning, Cornell U.) took a somewhat different, if not new, tact. He suggested that the computer should permeate the urban planning curriculum, rather than be a discreet portion of it. Whether computer education for the urban planner is an academic problem, a syndrome, or an ingestion problem, Clark Rogers (Grad School of Public and International Affairs, Pittsburgh U.) supplied a measure of its market value in urban planning employment: students with planning degrees start at $6-8400 a year; students with a specialty in computer utilization to supplement their planning degrees start at $9-12,000! Perhaps our educational institutions cannot agree on what is to be taught about computers or how, but apparently there are very real rewards for students who acquire these skills.

### land parcel information

The conference closed with a panel session on the Theory and Application of Geographical Information Retrieval, which readily translates to, "How do you code land parcel information so the computer can store and retrieve it?" The simplicity of the idea is matched, apparently, with its difficulty in application. The problem is in part one of how to identify and locate the individual parcel. It could be solved by a Cartesian product system, but we neither deal nor think of land parcels that way. Legal descriptions would fill computer memory beyond a computer salesman's dream, and a system of street or situs addresses as the basis for indexing leaves something to be desired.

Into this complex of problems, there is tied the Bureau of Census accumulation of data by census tract and, in

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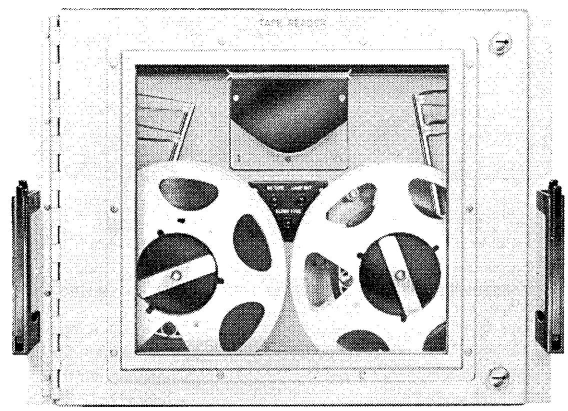

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some instances, by block, which must be fitted into or related to the land parcel file. The critical issue appears to be one not so much relating computer processes to land parcel designation systems as it is a recognition that the individual land parcel designation will become the foundation for our future urban information systems. Moreover, such systems will deal increasingly with data reflecting the many socio-economic factors which spell out the path of our urban civilization and our efforts to channel it. The subject deserved the excellent treatment it received.

In a follow-up business meeting, attendees formalized the group which has sponsored and supported this and previous urban data conferences. The result was a new society, The Urban and Regional Systems Assn. Edgar Horwood was elected president, Andrei Rogers and Clark Rogers, vice presidents. Six regional representatives were also designated. Editor of the proposed newsletter is Herman Burkman. The constitutional guide for the association is patterned after the Regional Science Assn.

The very existence of such a permanent organization suggests the ground swell of interest and concern for the problems of local government information processing. It also raises a question of where one finds an equivalent group concerned with information processing for urban government short-range planning and day-to-day operations. Urban planning information systems are not synonymous with urban informational and decisional systems. One wishes that the association formed to consider the problems of planning information processing could have been explicitly enlarged to encompass the total range of urban information processing problems. Certainly, the urban phenomenon itself reflects no such artificial segregation of its information into "planning and other." Perhaps the new association's broader title reflects a shift towards concern for *all* urban informational systems.

In summary, the conference was designed by city planners for city planners and their computerized fringe. There is rationale in such a limitation, but one cannot help wondering whether the urban planner can study himself without including the interests and perception of his contemporaries—police, fire, and recreation, to mention a few. Further, only one speaker took the management viewpoint of urban informational systems. Does urban planning exist as unity and in the abstract? Or does it find its wellsprings in the urban, human condition, which urban planning assays to do something about but which is best revealed through all local government activities?

Clearly, urban planning as a process and as a focus for academic effort finds the computer—with its approach, its technology, and its promise—very attractive and elusive. DP is taken seriously by those associated with planning, but not so seriously as to disrupt their dogma. Yet only as the paradigms of urban planning are changed through computer use will computers have become important in fact to planners. Several more annual institutes will have to pass before their agendas will reveal, by their very tissue, that this congenial marriage of discipline and technique has taken place.

WILLIAM H. MITCHEL
Manager, Project SOGAMMIS
School of Public Administration
Univ. of Southern California

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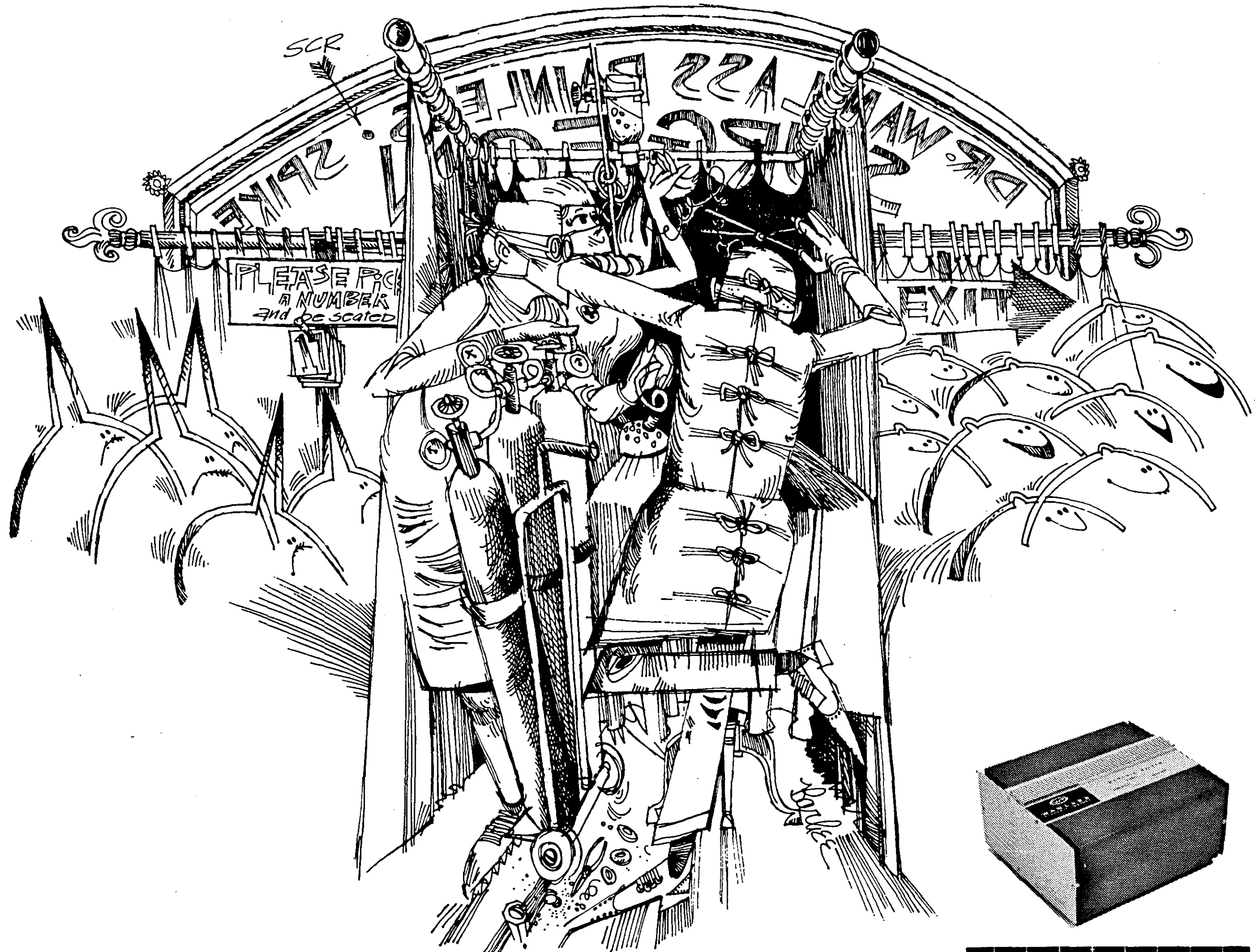


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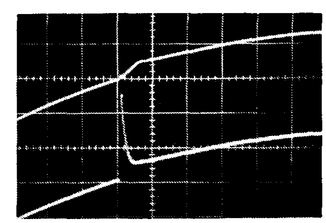

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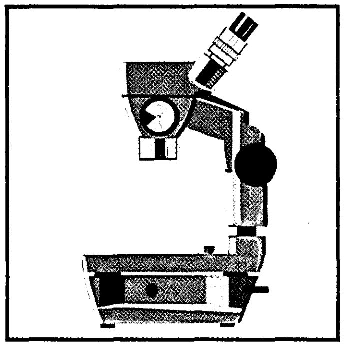
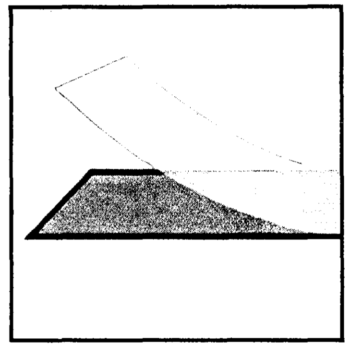


## 1953 3M PRODUCES FIRST ERROR-FREE TAPE

In 1953, 3M helped develop the modern age of data processing by successfully producing the first error-free computer tape capable of 100 bits-per-inch density. Like all 3M computer tapes that have followed, it provided a clean, stable base and coating, with consistently dependable magnetic and physical qualities.



## 1957 3M DEVELOPS SANDWICH TAPE

The demand for more rapid access time, through faster transport speeds, required a tape that could withstand high speed tension and wear. To meet this need, 3M introduced sandwich tape. This featured a micro-thin plastic coating over the recording surface to prevent rub-off and protect transport heads against wear.

## 19
HEAVY

In 19
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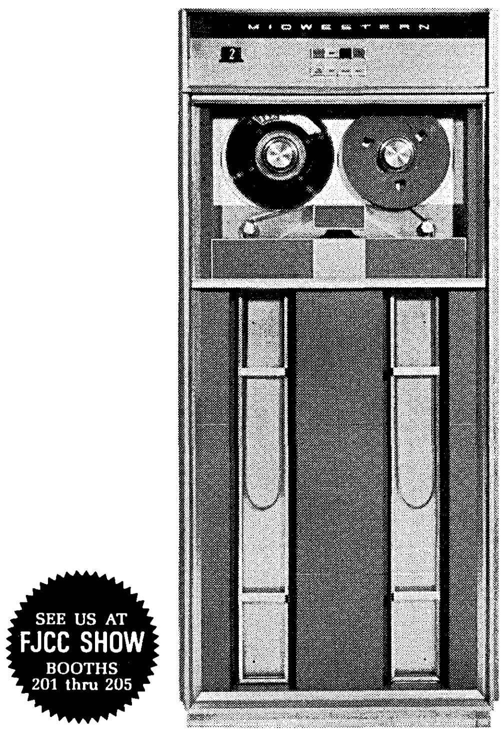
# NOW
# A MAGNETIC TAPE TRANSPORT READY FOR ON-LINE OPERATION




End high leasing costs forever with Midwestern's M4700 series digital tape transports. Designed as **direct** replacements for primary leased transports, the M4700 is ready immediately to become a part of your on-line operation. No conversion is necessary. The I-0 connectors are exactly the same. So are the 3-phase power connectors. And the control electronics are completely compatible. Just slide it in place and plug it in. The M4700 is ready to start saving your company thousands of dollars per year.

You can own an M4700 outright for approximately the cost of 16 months' leasing. The M4700 is a refinement of Midwestern's M4000 that has earned acclaim for its compatibility and superior reliability throughout the O.E.M. market. Exclusive features include Midwestern's lightning-quick, but feather-light pneumatic tape drive and proven reliability at speeds to 150 ips.

For complete information on the M4700, (including names of companies who have made the change already) write or call Digital Tape Products Division, P. O. Box 1526, Tulsa, Oklahoma 74101. Our phone number is 918-627-1116.

**MIDWESTERN INSTRUMENTS**
SUBSIDIARY OF THE TELEX CORPORATION
41st AND SHERIDAN RD / TULSA, OKLAHOMA / 918 627-1111
TWX 918-627-6030 / TELEX 049-589 / P O BOX 1526 74101

THE MIDWESTERN
**M4700**

CIRCLE 46 ON READER CARD

# THE CHAIRMAN'S WELCOME

**by R. GEORGE GLASER**

Attendees at the 1966 Fall Joint Computer Conference will be treated to an outstanding technical program, a keynote session of unusual quality and interest, a luncheon address by a prominent legislator, an exhibition of the latest developments in information-processing equipment, and the traditional array of JCC social events. To round out what promises to be a busy week, a full day of technical sessions will be held by AFIPS sponsoring societies.

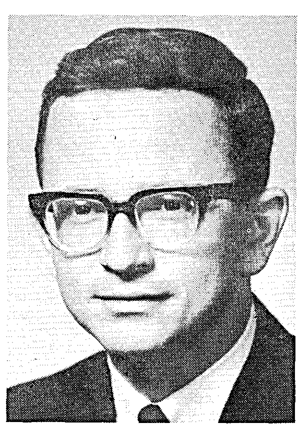
Gerald Phillippe, chairman of the board, General Electric Co., will keynote the opening session on Tuesday, Nov. 8. Mr. Phillippe will discuss the "Impact of Computers on a Technical Society" from the standpoint of a businessman. The subject then will be discussed as viewed by an educator (Professor Patrick Suppes, Stanford Univ.), a banker/consultant (Harry M. Runyan), and a teaching psychiatrist (Dr. Ulric Neisser, Univ. of Pennsylvania). We expect this session to raise controversial issues, to provoke thoughtful discussion, and to make us, as professionals in the information processing industry, just a little uneasy.

The technical program is the heart of any conference; but in the technical program for the 1966 FJCC the topics and speakers are exceptionally noteworthy. Dr. William Davidow, technical program chairman, gives more details in pages that follow.

The conference luncheon, at noon on Wednesday, Nov. 9, will be highlighted by an address by Congressman Jack Brooks (Democrat—Texas). Congressman Brooks is the author of the Brooks Bill, an important (and controversial) piece of legislation dealing with the acquisition and use of computers in the federal government. Congressman Brooks has been mentioned frequently in the editorial and feature pages of DATAMATION. We believe his address will be interesting to all taxpayers, whether suppliers or users of data processing equipment.

Following the Congressman's address, the Harry Goode Memorial Award will be presented by AFIPS to J. Presper Eckert and John W. Mauchly for their "pioneering contributions to automatic computing." Known primarily for their participation in the design and construction of the ENIAC, the world's first all-electronic computer, both men have a long history of professional contributions to the industry.

*Mr. Glaser*



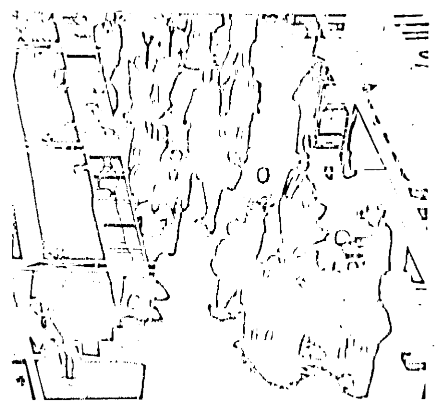
Over 100 exhibitors will occupy nearly 350 booths to make this the largest exhibition of information processing equipment ever held. A number of product introductions are anticipated; several exhibitors will feature hands-on use of time-sharing equipment. The lounges in the exhibit area will be turned over to the arts—with interesting results.

The opening session, theatres, and all technical sessions except those on analog computing will be held in the San Francisco Civic Auditorium. Exhibits will be in Brooks Hall, immediately adjacent to the auditorium. The luncheon, reception, all committee meetings and analog computing technical sessions will be held in the Jack Tar Hotel, conference headquarters.

Because Tuesday, Nov. 8, the opening day of the conference, is an election day, the traditional conference reception (cocktail party) will be held on Wednesday evening. Exhibits will remain open until 8 p.m. on Tuesday; on Wednesday, 10-6; and on Thursday, 10-5. We urge you to arrange for, and cast, your absentee ballot in your local area before leaving for San Francisco.

One major innovation in registration procedures is the introduction of one-day registration. Fees will be one-half of those for three-day registrants but will not include a copy of the conference proceedings. We hope that this innovation will encourage heavy local attendance.

The conference steering committee set out to arrange a great conference; we hope you will agree that we were successful. ■



# CONFERENCE PARTICULARS

Elegant and rigid, San Francisco is a city with an opulent traditionalist shell and bursting insides; a city where new ideas and technologies are not assimilated without a struggle. And nowhere are the contrasts more evident than in her transportation systems. The cable cars struggling up the hills are legendary; so are the boat tours of the bay from the Wharf. The street cars—not so famous, but rarely seen elsewhere—are side-swiped in the streets by ubiquitous taxis. A computer-controlled rapid transit district, now testing its first four miles, will be the most advanced in the world, and mocks the hulk of an unfinished freeway recently discarded by truth-and-beauty taxpayers.

The '66 Fall Joint Computer Conference will add its own vehicle to the foray—a shuttle bus will service the conference between the Civic Center (hq of the FJCC—just slightly younger than the '06 quake), and the Jack Tar Hotel. Sponsored by AFIPS members—Assn. for Computing Machinery, IEEE Computing Group, American Documentation Institute, Simulation Councils, Inc., and the Assn. for Machine Translation and Computational Linguistics—the conference is expected to draw 4,000 computerites to the City-by-the-Bay.

Over 100 companies will be exhibiting in Brooks Hall at the Civic Center, and the exhibits will be open to all paid registrants from noon to 8 on Tuesday; on Wednesday from 10-6; and on Thursday, 10-5.

Highlighting the conference, the technical program will include 72 papers (over 200 authors) in 23 sessions. Emphasis will be on the impact of computers in various fields (including music), and, of course, time-sharing.

The keynote speech at the opening session (9:30 a.m., Tuesday) will be given by Gerald Phillippe, chairman of the board of GE. His topic will be, "The Impact of Computers on a Technical Society." A "real" session, the keynote will also include "Prospects for Computers in Education," by Patrick Suppes; "Is There a Computer Revolution?" by Ulric Nesser; and "Which Way the Computer Revolution?" by Harry Runyan.

Three discussion sessions, on error analysis, multi- access management, and computer-oriented data analysis, will be among the regular sessions. For these sessions, preprints of the material to be discussed will be available two weeks before the conference. Copies include all three sessions, cost $1 each and may be obtained by sending name, address and check or money order to Dee Tozer Advertising, 517 E. Bayshore, Redwood City, Calif. Copies will also be available by filling out an "action card" to the found in the pre-conference program being mailed to members of the AFIPS organizations.

New this year to the conference will be a workshop on the complement of man/computer interactions, an evening program scheduled for Tuesday.

Advance registration for the conference will be Monday, Nov. 7, at the Jack Tar and Hilton Hotels. A pre-conference cocktail party will be Monday night at Jack Tar's Gas Buggy Room. The registration schedule will continue for all three days—a new feature—8:30-5 through Thursday.

The conference luncheon will be on Wednesday (and because of election day, so will the conference reception). The luncheon address will be given by Congressman Jack Brooks of Texas, author of the Brooks Bill, passed last spring and dealing with federal government acquisition and use of dp equipment. Congressman Brooks will speak on the impact of computer technology in the federal government.

A special vocational program for students is also a new feature of this year's FJCC. Experts in the industry will speak to over 1200 students in the three days of the conference, emphasizing edp as a vocation. The presentations will be augmented by demonstrations on computers.

Movies on computer sciences will be shown in two rooms (Cinema #1 and #2) in the Civic Center, the schedules running simultaneously for the three days.

For the ladies, a special program is offering tours of Ghirardelli Square, Chinatown, a Japanese tea garden, and the Paul Masson Champagne Cellars in Saratoga.

If there's any time between scheduled and non-scheduled discusssions, the city itself will provide many diversions: "Other Suns, Other Worlds" will be showing in Golden Gate Park's Morrison Planetarium; the California Palace of the Legion of Honor will be hosting "The Age of Rembrandt," containing 106 Dutch masterpieces. In the nightclubs: Arthur Lyman will be at Basin Street West; Vikki Carr will sing in The Fairmont's Venetian Room; and La Parisienne Revue will continue its long run at Bimbo's 365.

The closing night of the conference will also have a performance of "The Marriage of Figaro" at the San Francisco Opera, only one city block from the Civic Auditorium. And at the 85th annual San Francisco Art Institute (doors are open until 10 p.m.) there will be an exhibit by printmakers John Ihle and Gordon Cook. ■

# THE EXHIBITORS

| EXHIBITOR | BOOTH |
|---|---|
| Academic Press, Inc. | 122 |
| Adage, Inc. | 228, 230; 327, 329 |
| Addison-Wesley Publishing Co., Inc. | 418 |
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| Benson-Lehner Corporation | 827, 829, 831 |
| Bryant Computer Products Div., Ex-Cell-O Corp. | 733, 735, 737 |
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| Computer Design Publishing Corporation | 912 |
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| John Wiley & Sons, Inc. | 1029 |
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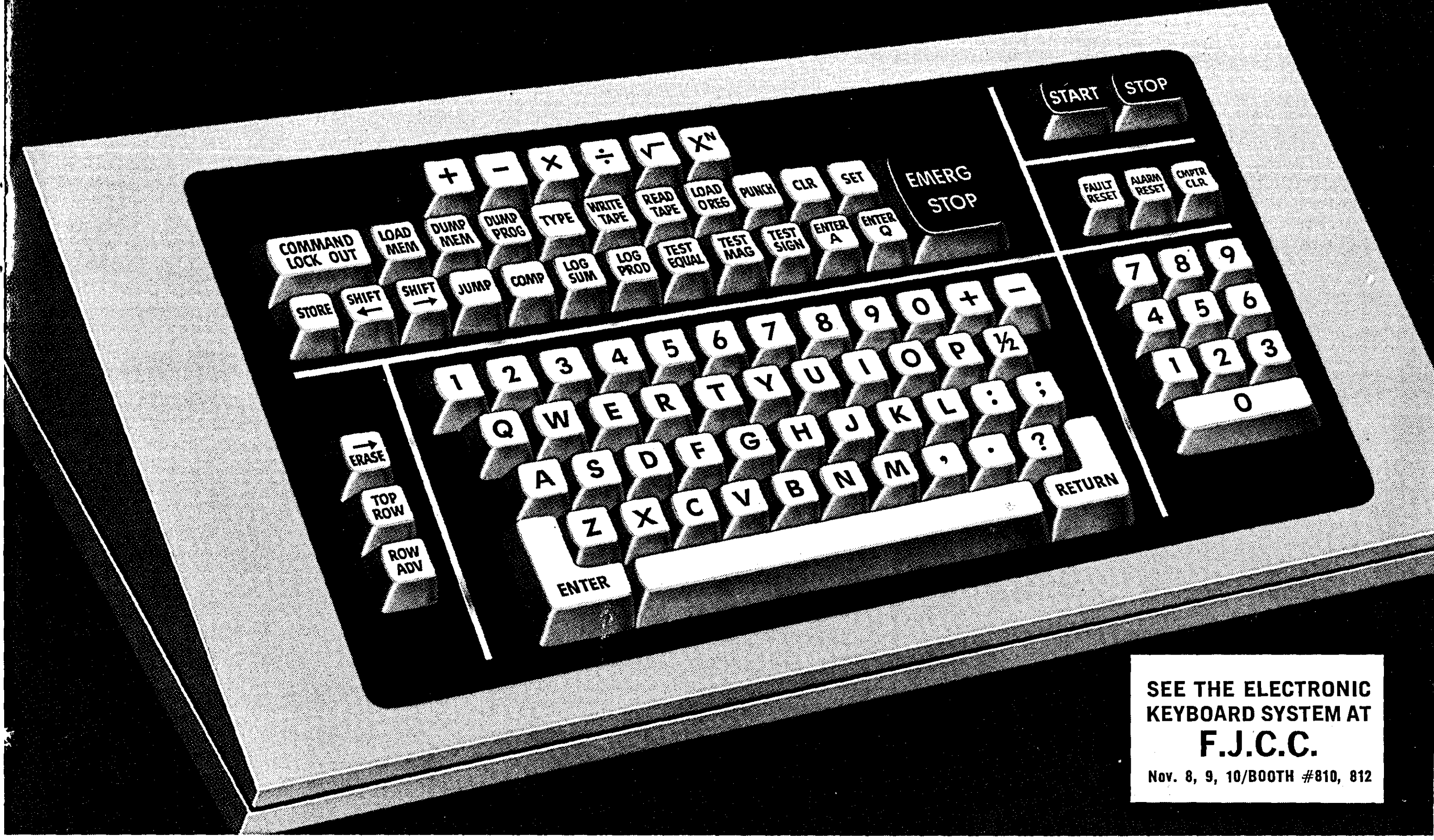
| Zeltex, Inc. | 1016, 1018 |

# NEW TEC-LITE
# ELECTRONIC KEYBOARD SYSTEM...




**SEE THE ELECTRONIC KEYBOARD SYSTEM AT**
**F.J.C.C.**
**Nov. 8, 9, 10/BOOTH #810, 812**

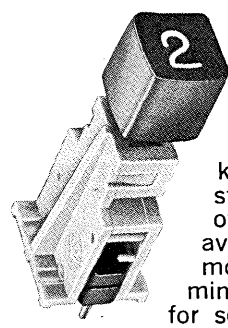
## *NOW YOU CAN HAVE A COMPLETELY UNINHIBITED KEYBOARD SYSTEM... CUSTOM DESIGNED for FUNCTION AND STYLE*

**Far cry from conventional keyboards!** Here's a completely new, completely flexible data entry and control device which can be incorporated into any computer or industrial control system.

The new TEC-LITE Electronic Keyboard System can generate any code up to eight levels or more and, in addition, provide command controls and indicators on the keyboard console itself. Key and control arrangement is determined by your requirements.

Compact, simple . . . fast. The new TEC-LITE Electronic Keyboard System features pulse or momentary key switches virtually identical in feel and action to electric typewriter keys. Pulse switches *make and break* on the *downstroke.* Typing speed can be as fast as the operator's normal typing ability. No mechanical linkage to cause jam-ups or noise.

When custom designed, the new TEC-LITE Electronic Keyboard System is built for your particular system, both electrically and mechanically. Its keys can be styled to complement your console design. From stock you can select standard typewriter or 10-key keyboards compatible with popular computer languages. Keyboards can be mounted in desk tops, rack mounted or be portable.



**Key to the TEC-LITE Electronic Keyboard System** is this snap action SPDT pulse or momentary switch which virtually duplicates the feel and travel of electric typewriter key action. Two key styles are standard . . . special styles, including most button designs offered on electric typewriters, are available. The molded plastic body mounts on .750 x .780 centers, minimum. Standard terminals provide for solder-mounting on printed circuit boards or solder-plated, quick-connect types, with other terminals also available. Switch life is 1,000,000 operations, minimum. Operating force is 2.5 (±.5) ounces, with other pressures optional. Button travel is 5/32″ and the switch will withstand a 50-pound downward force.

Write for complete information about the versatile TEC-LITE Electronic Keyboard System and individual Keyboard Switches.

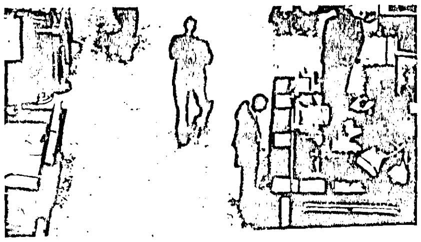
TEC LITE
INDICATING DEVICES

| INDICATORS & SWITCHES | DATA·PANEL DISPLAY SYSTEMS | +536.27 DIGITAL READOUTS | ELECTRONIC KEYBOARD SYSTEMS |
|---|---|---|---|

# Transistor Electronics Corporation

Box 6191 • Minneapolis, Minnesota 55424 • Phone (612) 941-1100

CIRCLE 48 ON READER CARD



# PRODUCT PREVIEW

**AUTO-TROL CORP.**
**Arvada, Colorado**

The model 3700 Series Two and Three Coordinate Graphic Digitizer has output to a 500 cps mag tape recorder, and an 18-key keyboard for

direct manual entry of variable data. X-Y or X-Y-Z coordinates are recorded onto 7-channel IBM-compatible tape in operator-wired BCD format. Used with the Opti-Track X-Y, this system is suited for curve tracing including contour lines and strip charts.

CIRCLE 126 ON READER CARD

**COMPUTER DIVISION**
**ELECTRO-MECHANICAL RESEARCH INC.**
**Minneapolis, Minnesota**

The hardware debut of the previously-announced Advance 6130 computer is being held. An integrated-circuit machine, it has a cycle time of 0.9 usec and an add time of 1.8 usec. Word length is 16 bits plus parity and memory protect bits, and memory capacity is 4K to 32K words of core.

CIRCLE 127 ON READER CARD

**CONRAC DIVISION**
**GIANNINI CONTROLS CORP.**
**Glendora, California**

Being demonstrated is the model CDF alphanumeric display, an X-Y random scan CRT device for computer output. The unit accepts X and Y input signals (typically 0 to 6 volts) and, through its own deflection amplifiers and yokes, positions the electron beam on the CRT face. It also has a digital blanking amplifier for the Z axis, along with high and low voltage power supplies and regulation. Retrace time for a 90° deflection at approximately 15 KV is 50 usec.

CIRCLE 128 ON READER CARD

**CYBETRONICS INC.**
**Waltham, Massachusetts**

The Monitron is a computer configuration monitoring system that operates on-line. Consisting of input stations mounted on the processor and peripherals, it is said to generate system utilization reports. These reports enable a user to get daily studies of a processor's run time, idle time, job set up and tear down, scheduled and unscheduled maintenance, and scheduled vs. actual workload correlations. The reason for system downtime—machine, component, software or operator—is also indicated.

CIRCLE 129 ON READER CARD

**DECISION CONTROL INC.**
**Newport Beach, California**

The VersaStore core memory system operates at 2 usec with full or half cycle capabilities, with full read, modify and write capability. Available in 16K increments, it goes up to 64K with 36- or 72-bit words. The integrated-circuit system is available in 19- or 24-inch standard rack mounts.

CIRCLE 130 ON READER CARD

**ELECTRONIC MEMORIES INC.**
**Hawthorne, California**

A ruggedized unit, the Severe Environmental Memory System 5 (SEMS 5) has a maximum speed of 700 nanoseconds for an access and a cycle time of 2 usec. It consumes less than 60 watts at maximum speed, 10 watts on standby. Operating temperature range is −55° to +85°C. The system is available with capacities of 256 to 16K, from eight to 32 bits. It is a 3-wire coincident-current unit.

CIRCLE 131 ON READER CARD

**FAIRCHILD MEMORY PRODUCTS**
**Mountain View, California**

Two memory systems being shown are the Pacer and the Microcell. The latter is a scratchpad system with a capacity of 8,192 bits and a read-only cycle time of 50 nanoseconds. The Pacer, on the other hand, has a maximum core capacity of 2.4 million bits—up to 32K words of 12 to 72 bits each. It has a complete cycle time of 800 nsec and an access time from 250 to 400 nsec.

CIRCLE 132 ON READER CARD

**FERROXCUBE CORP. OF AMERICA**
**Saugerties, New York**

Being shown are the FX-22 coincident-current core memory system and an all-glass-bonded read/write head. The latter is a 7-track unit that is said to have a life expectancy five times that of all-metal or epoxy-bonded heads. The absence of organic material in the recording surface is said to be another advantage. The core memory system has a 4-usec cycle time and capacities to 512 (8-bit) words. The cores have voltage margins of ±10% and operating temperature range of 0° to 50°C.

CIRCLE 133 ON READER CARD

**GENERAL COMPUTERS INC.**
**Los Angeles, California**

The model 200 is a card-programmed diode function generator. Functions are composed of 11 contiguous line segments; units may be ganged to provide any greater number of line segments. Operating with a .1% programming accuracy, the unit provides for the programming of a start point, central slope, 10 pairs of breakpoint-slope values, central slope increase, function increase, and a start point decrease—all on one card. Standard input range is ±100 volts, output power is ±100 volts at up to 35 ma, and phase shift is less than 1° at 1000 cps.

CIRCLE 134 ON READER CARD

### GEO-SPACE CORPORATION
**Houston, Texas**

The DP-203 digital CRT plotter is being introduced. The on-line unit, which features a CRT camera for hardcopy output, plots at 2 usec/bit (500KC) and is said to have an accuracy of ±½ bit vertical and horizontal positioning. The CRT dot intensity can be varied to produce up to 32 levels of gradation. Maximum image size plotted is 40 x 60 inches. Interfaces available include IBM's 360's and 1130 and the CDC 3000 and 6000 series.

CIRCLE 135 ON READER CARD

### INFORMATION DISPLAYS INC.
**Mount Vernon, New York**

For on-line computer-aided design applications, the CM 10093 CRT display system features character and vector generation, program control of size intensity and line structure, and a lightpen. It displays points and characters in two sizes plus subscripts and superscripts, and vectors in two line structures (dash and solid). Available are three brightness ranges plus blinking. On the exhibit floor, it will be driven by a DDP-116, but interfaces for other computers are also available.

CIRCLE 136 ON READER CARD

### MAGNE-HEAD DIVISION GENERAL INSTRUMENT CORP.
**Hawthorne, California**

A line of small-scale head-per-track disc memories is being shown. They reportedly were designed to facilitate maintenance, head placement, and bearing change in the field. Storage capacities are up to 10 million bits, and data rates to 1.5 MC. At that speed, average access times are as low as 8 msec.

CIRCLE 137 ON READER CARD

### MIDWESTERN INSTRUMENTS, INC.
**Tulsa, Oklahoma**

A new series of digital magnetic tape transports for on-line operation with medium and high performance computers will be announced. The Series/M4700 is an offshoot of the M4000 Tape Transport introduced in '65.

CIRCLE 138 ON READER CARD

### NORTH ATLANTIC INDUSTRIES INC.
**Plainview, New York**

The model 537 is a digital-to-resolver or digital-to-synchro converter with circuits mounted on three cards. It accepts an 11-bit digital input and has a no-load output accuracy of 0.1°. Conversion time is less than 1 millisecond. With a resolver/synchro output of 11.8 volts, line-line, it has applications in industrial control and machine tool environments.

CIRCLE 139 ON READER CARD

### POTTER INSTRUMENT CO. INC.
**Plainview, New York**

Paper tape gear from Facit AB of Stockholm, Sweden, will be shown under a new marketing agreement. Shown will be tape readers, spoolers, and punches. The PE 1000 reads and winds at 500 or 1000 cps, and accommodates 5, 6, 7 or 8-track tapes. The PE 1500 punch operates at 150 cps, also on 5- to 8-track tapes.

CIRCLE 155 ON READER CARD

### RAYTHEON COMPUTER
**Santa Ana, California**

The model 300 memory systems, using the 2½D organization, have a cycle time of 900 nanoseconds using 30-mil cores. This is reportedly reducible to 0.6 usec with 20-mil cores. Standard modules are 8K with word lengths up to 112 bits, and 16K with lengths to 56 bits. With a read-restore or clear-write cycle completed in 0.9 usec, the access time is 0.3 usec. A third mode of operation is split cycle, in which read timing occurs normally, but writing is withheld until a write command is generated after the contents of the data register have been modified.

CIRCLE 156 ON READER CARD

### SOROBAN ENGINEERING INC.
**Melbourne, Florida**

Being shown is an Autodin Subscriber Terminal which consists of a central control unit, card reader, and card punch. The expandable system will also accommodate line printers, tape punches and readers, and mag tape modules.

CIRCLE 157 ON READER CARD

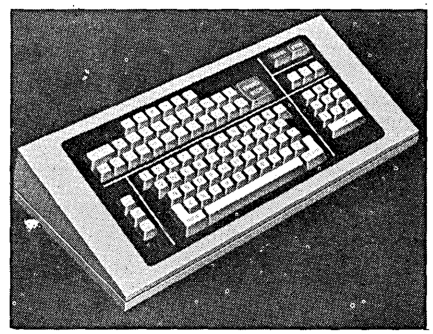
### TALLY CORPORATION
**Seattle, Washington**

A punched card transmission terminal that operates at 80 columns/second over dial-up phone lines is being shown. It is for use with the System 311 data communications terminal. Off-line, it can be used for card to paper tape conversion. Error detection/correction during transmission is standard. Also new is the System 800 paper tape verifier and duplicator. It automatically verifies or duplicates tapes or verifies two tapes and punches a third. Operating at 120 cps, it runs with 1- to 8-channel tapes in any code structure. Options include parity check and blank and/or delete skip.

CIRCLE 158 ON READER CARD

### TRANSISTOR ELECTRONICS CORP.
**Minneapolis, Minnesota**

An electronic keyboard system, for computer and industrial control applications, comes in various configurations, including one similar to a 10-key adding machine. With switches



similar in feel and travel to electric typewriters, all switching action occurs on the downstroke. The unit will accommodate any code up to eight levels, including ASCII, IBM octal, and 8-level teletype. Space is available for additional control switches, indicators, etc.

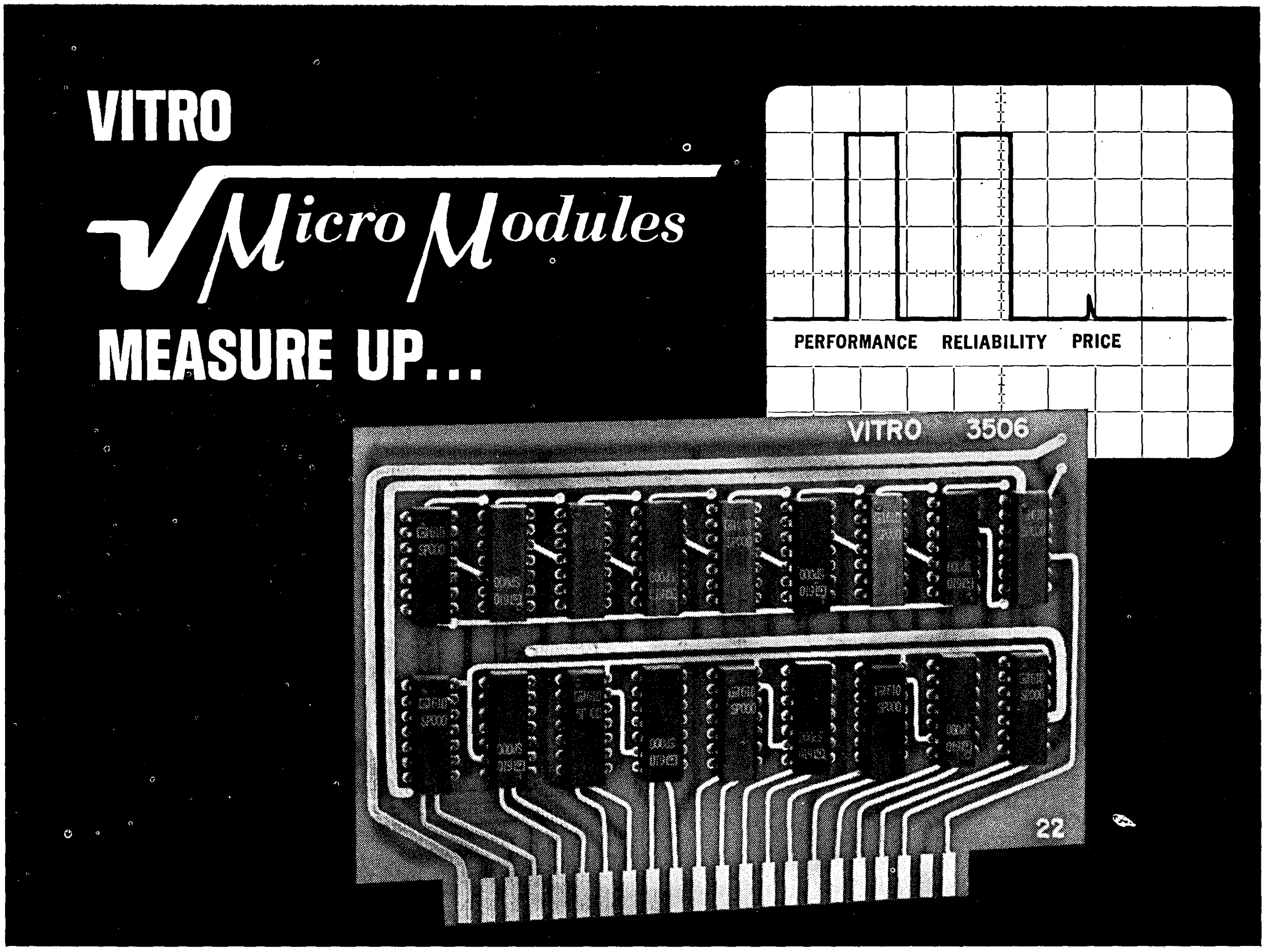
CIRCLE 159 ON READER CARD

### WYLE LABORATORIES
**El Segundo, California**

Such programming techniques as branching, looping, and conditional transfer can be performed on the firm's scientific calculator. The model WSS-10 consists of the basic WS-02 electronic calculator, the punched card

programmer, and these additions: patchboard programmer consisting of 16 32-step program modules, 10 24-digit storage registers (with provisions to add 16 more), and an auxiliary keyboard that permits manual addressing and access to different start locations for the patchboard programmer. ■

CIRCLE 160 ON READER CARD




# TO PROVIDE a microcircuit systems approach adaptable to breadboarding, small quantity and production runs

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- **boards designed to meet MIL- and NASA standards**
- **boards keyed to assure proper mounting**
- **dual in-line packages easily replaced for ease of maintenance**
- **off-the-shelf delivery**

The Vitro microcircuit systems approach is directly adaptable to a broad range of requirements. Whether the application be for breadboarding, one-of-a-kind units or total production runs, Vitro Micromodules are designed to provide the systems engineer with a low-cost, flexible, building-block approach to designing an integrated-circuit system.

The logic implementation on all Vitro boards has been standardized for positive NAND logical functions at a voltage swing from 0 to +3 volts. The diode-transistor logic devices employed have individual circuit speeds up to 10 MHZ, and equipment speeds above 5 MHZ. These circuit boards can be provided as directly off-the-shelf logic, with standardized performance to simplify a logic design application, or can be custom-built according to customer specifications. High density packaging is utilized providing up to 18 removable microcircuits on a single card. Ease of maintenance is assured since all dual in-line circuit packages can be easily removed and replaced in the field. To further simplify maintenance, Vitro-supplied chassis configurations are constructed of standard components assembled on a building block principle.

For further information on the complete line of Vitro microcircuits, mounting hardware, card files, wiring accessories, and power supplies, contact the Micromodule Sales Department, VITRO ELECTRONICS, 919 Jesup-Blair Drive, Silver Spring, Maryland 20910, Phone No. (301) 585-1000.

**Vitro ELECTRONICS** A Division of Vitro Corporation of America
Producers of **NEMS-CLARKE** Equipment V-23

CIRCLE 49 ON READER CARD

# THE TECHNICAL PROGRAM

by DR. WILLIAM H. DAVIDOW

The technical program of the '66 FJCC has been planned to present new and significant developments in the computer field, expose the attendee to basic material in areas of technology affecting his work, focus attention on some interesting applications of computers, and present a few of the issues facing the industry.

Three Discussion Sessions, similar to the ones presented at the '65 FJCC, are planned. Summaries of the sessions' participants' work, insights, and opinions will be made available to conference attendees two weeks before the conference at a nominal cost. In at least two of the three cases, the discussion-type format has been used as a way to present material which is so new that papers are not available. Attendees are encouraged to request these summaries, prepare for the sessions, and participate actively.

A workshop is planned to enable participants who are interested in graphics to meet, exchange ideas, and discuss new concepts. This should provide an opportunity to obtain up-to-date information on developments, and should do much to alleviate the "publication delay."

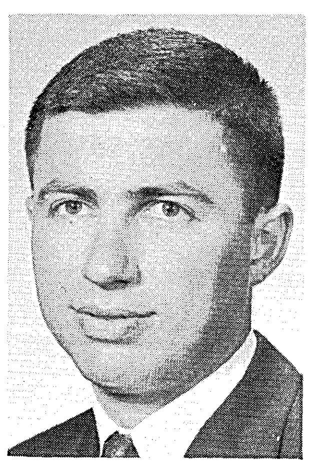
The program committee strongly felt that all excellent manuscripts submitted to the conference should be published. To this end, a special session was created in which papers of high quality will be presented; these papers did not fit well into the topic-oriented sessions, but their inclusion will improve the quality of the conference and increase its breadth.

Four sessions deal principally with hardware technologies. The session chairmen have done an exceptional job of bringing new developments and ideas from the laboratory to the conference floor. Men with authority and insight will be speaking about developments that will shape future trends in the industry.

Several sessions deal with the application of computers in diverse fields such as music, publishing, government, and numerical analysis. Attendees should find these informative, stimulating and, at times, amusing.

The program committee organized a number of sessions dealing with different aspects of time-sharing. The committee has attempted to present an overview of this significant advance in which the problems that should be run in a time-sharing environment, the processor and software design, remote terminals, communication lines, and the man-machine interface could be discussed in a coherent fashion. The session, "Some Communication Aspects of Time-Sharing Systems," is one of the first public discussions of the communication problem facing time-sharing.

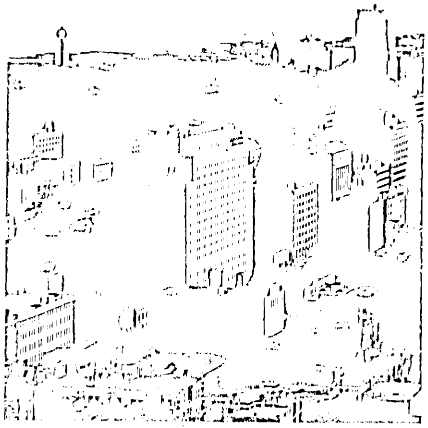
*Dr. Davidow*



Three sessions have been planned on hybrid and analog computation. The members with interest in these fields have done an enthusiastic and excellent job of organizing the material.

While a considerable number of sessions contain material about programming and programming techniques, two of these—on "Natural Language Processing" and "Advances in Programming Languages"—will be of special interest to software specialists. These resulted from the judicious selection of a large number of papers.

It is the program committee's hope that the '66 FJCC will be a stimulating, memorable, and enjoyable experience. The energy and enthusiastic efforts of approximately 200 authors, session chairmen, panelists, and referees have gone into organizing the technical program. If their efforts can be used to estimate the quality of a conference, the technical program of the FJCC should be of interest to all. ■



# THE SESSIONS

Tuesday, 1:00 p.m.
Larkin

**Computers and Publishing**

Chairman:
William R. Nugent
Inforonics Corporation
Maynard, Massachusetts

Early applications of computers in publishing were frequently characterized by eccentric typography, bizarre hyphenations, and outrageous page costs. This *wunderkind* of Gutenberg and Babbage, initially more profligate than prodigy, has matured, broadened, and prospered. "Computer typesetting" describes only a fraction of the diffuse applications; the role of the computer in publishing and its system configuration have changed; the end products of publishing are being modified to take advantage of new possibilities; and not least, a more economic rationale of application has produced profits.

This session will explore these changes. The tone of the session will be that of disclosure of new and significant methods and applications. In a sharply competitive field like publishing, there exists a Gresham's Law of disclosure, expressed as a strong tendency among the innovators to husband new techniques and keep their best papers in the vault. We are, therefore, fortunate to have in this session some of the most progressive innovators in the field who have agreed to describe their techniques in depth.

Newspapers have been leading users of computers in publishing, and a few of them have made telling advances in programs and systems. Such users have often spurned manufacturers' canned programs and standard configurations in favor of in-house programming and eclectic systems. While this approach has hazards, the session will point out two outstanding examples of success.

Brereton E. Nebel will describe a multiprogrammed tele-processing system in operation at the *Los Angeles Times*. Using twin 360/30's, the system services local and remote stations in a variety of time-shared tasks and can survive the demise of one central processor. Mr. Nebel is manager of Advanced Systems Programming at the *Times* and was previously active in systems programming at Litton and IBM.

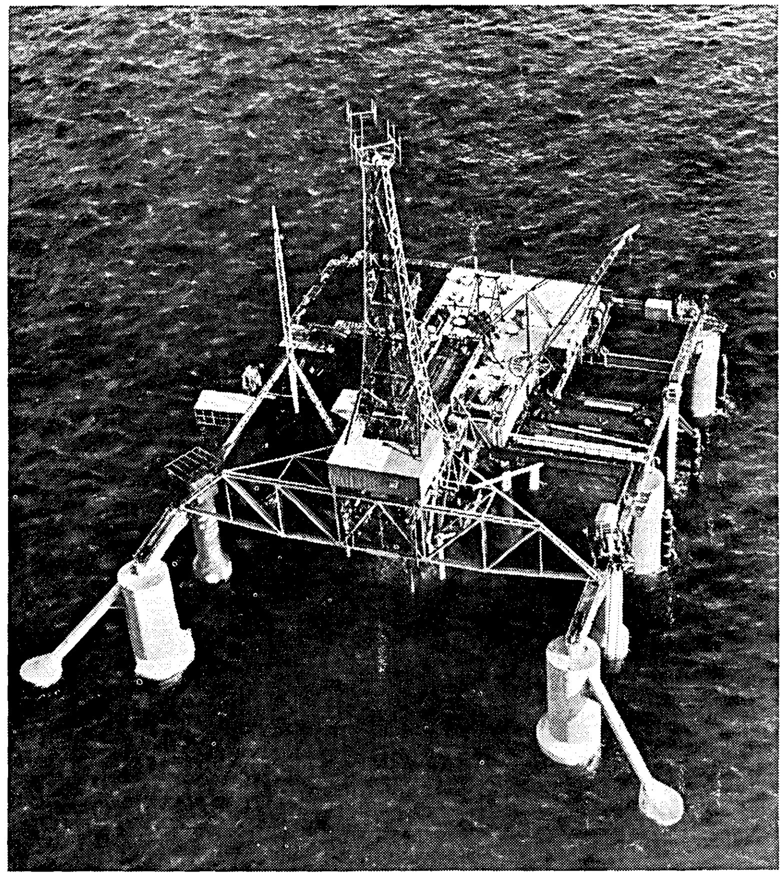
John H. Perry, Jr. invents his own machines and systems when the state of the art does not meet his needs or expectations, which, one gathers, is frequently: his inventions range from submarines to photocomposing machines. Perry Publications, Inc., publishes 27 Florida newspapers, as well as magazines, books, and commercial printing, and is considered to be the most fully automated graphic arts and publishing organization. Mr. Perry will describe his system and discuss the economics of print readers and computers.

One of the surprising effects of publishing on hardware has been the triumphant return of the special-purpose computer. Although special-purpose machines are often considered an atavism in this age of the $10,000 general-purpose machine, a recent *Composition Information Services* survey showed special-purpose computers to hold somewhat less than half of the computer typesetting market. The statistics change daily, however, and as the price of the general-purpose machine is dropping, the required sophistication of programs, wired or written, is rising. That the special-purpose computers are competing so well is a tribute to the ingenuity of their logical designers. Constantine J. Makris, head of the Computer Development section of Mergenthaler Linotype, will describe how he has approached the problem of page composition logic in the design of a special-purpose computer.

Our sampling of technical papers is of U.S. origin. However, much significant work is being done in Europe that is not generally heard of until a particular machine is imported or licensed. To counter such provincialism, we will hear a survey and progress report of work in Britain and Europe by C. J. Duncan and James C. Dolby. Mr. Duncan is the director of the Computer Typesetting Research Project at the Univ. of Newcastle-upon-Tyne and is widely known for his penetrating surveys, often published in the *Penrose Annual*. Dr. Dolby returns from a year's study at Newcastle and was previously active in automatic syllabification studies at Lockheed.

The computer typesetting of straight text matter was slow to impress many compositors or scientific publishers, since the composition of a novel, for example, was not especially difficult, and there were many places in Europe and rural U.S. where inexpensive composition of fair quality could be obtained. The difficult problems, where page costs were 10 to 20 times higher, were in the composition of display formulae, chemical structures, and tabular matter. Joseph H. Kuney and his staff at the American Chemical Society have developed an operational system for the composition of complex scientific material which he will describe. Mr. Kuney is director of Publications Research and director of Business Operations at American Chemical Society.

The combination of computers and phototypesetting has enabled new techniques of composition to be developed that do not imitate human compositors, but rather make use of the calculating ability of the computer to precisely position data of many differing forms and fonts. One goal has been fully automatic page makeup including graphics, text, running heads, page numbers, etc.; and the consequent elimination of cutting and strip-



ping of partial components. George Z. Kunkel of the Central Intelligence Agency has developed a page composition program which will be described in detail. The system uses Mr. Kunkel's unique variable set size justification method that avoids both hyphenation and letter-spacing (see DATAMATION April '65, p. 42).

A Multiprogrammed Teleprocessing System for Computer Typesetting, by B. E. Nebel.

Integrated Automation in Newspaper and Book Production, by John H. Perry, Jr.

A Special-Purpose Computer for High-Speed Page Composition, by Constantine J. Makris.

Publishing Automation in Britain and Europe: A Survey and Progress Report, by C. J. Duncan and J. L. Dolby.

Computerized Typesetting of Complex Scientific Material, by J. H. Kuney, B. G. Lazorchak, S. W. Walcavich, and Don Sherman.

A Computer-Assisted Page Composition System, by George Z. Kunkel.

Tuesday, 1:00 p.m.
Polk

### Integrated Electronics and the Future of Computers

Chairman:
James B. Angell
Stanford University
Stanford, California

The rapidly growing ability within the electronics industry to fabricate large-scale integrated electronic structures promises to substantially alter the ground rules for optimizing the design, structure, cost, and flexibility of future generations of electronic data processing systems. This session has been organized to provide:

1) an introduction to the field of integrated electronics and how rapidly it has changed and is still changing,
2) a look at expected future costs of such structures,
3) a discussion of how the "economics" of future computers may be affected by this trend; in particular, how integrated electronics may affect the utilization of computers via the trade-off of software simplification for increased hardware, and
4) consideration of how the channels of communication between computer fabricators and their component suppliers may be affected.

The session's first two papers, prepared by two of integrated electronics' most renowned and qualified spokesmen, will present the most salient factors which have been responsible for the remarkable advances made and still coming in this field. It will be shown that the present status of commercially feasible integrated electronic structures, which is exemplified by perhaps 100 electronic digital components fabricated and interconnected as one small unit, has already taken us well beyond the cost and reliability limits achievable with discrete components of former years. It will also be shown that this present status is nowhere near the ultimate limit, insofar as cost, number of components per structure, or reliability is concerned, and that substantial advances are imminent.

The third and fourth papers will develop the following line of reasoning. If future computers, built using integrated electronics, employ the same principles of organization and usage (the same architecture) as are found with traditional computers at present, the impact of the new electronics technology will be slight indeed, because the electronics portion of most present-day large-scale computing systems does not represent a large portion of the overall cost of the service provided by that system. Thus, in order to exploit integrated electronics to its fullest potential, new forms of computer architecture, no longer based on the careful minimization of the number of electronic functions but rather on minimizing the overall cost of using a computing facility, will be developed. The prospect of improving the coupling between humans and computers through the use of far more versatile and complicated electronics now becomes a reality.

The final paper is concerned with a new challenge that has never before risen to anywhere near this extent in the electronics field. As integrated structures become more complicated and capable of performing far more sophisticated functions than could be achieved before in a single, irreducible structure, the problem of specifying and testing these structures grows rapidly. These problems become particularly acute when the system designers, who specify the desired functions of integrated structures, are physically or organizationally remote from the semiconductor fabricators. Various possibilities for establishing working channels of communication between these two groups, who have traditionally been rather separate and coupled mainly by component specification sheets, are considered in the final paper.

The scheduling of these five papers has been planned to allow 45 minutes of informal discussion among the speakers, and between the speakers and the audience, before the close of the session.

Technological Foundations and Future Directions of Large-Scale Integrated Electronics, by Richard L. Petritz.

A Look At Future Costs of Large Integrated Arrays, by Robert N. Noyce.

Effects of Large Arrays on Machine Organization and Hardware/Software Trade-Offs, by L. C. Hobbs.

A Prospectus on Integrated Electronics and Computer Architecture, by Michael J. Flynn.

The System/Semiconductor Interface with Complex Integrated Circuits, by Wendell B. Sander.

Tuesday, 1:00 p.m.
Main Auditorium

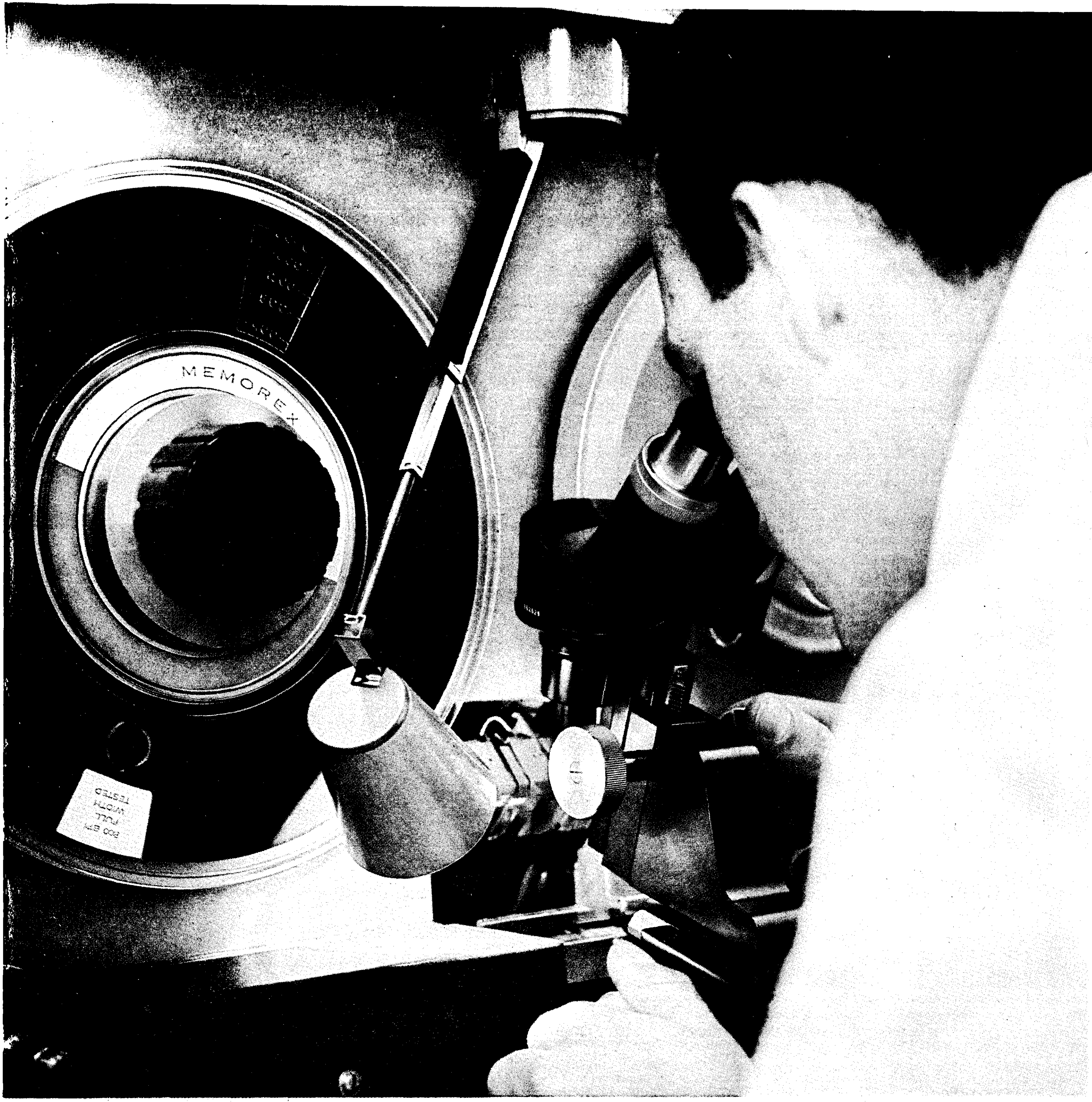
### Time-Sharing Processors and Executive Systems

Chairman:
Gene M. Amdahl
IBM Corporation
San Jose, California

The rapid growth of interest and achievement in time-sharing necessitates increased reporting on the status of current developments in this field. This session concentrates on the central computing system's hardware and software facilities for real-time, multi-user operation. The hardware considerations for responsive utilization and flexible configuration, the monitor system for fast and efficient control, the debugging techniques for program checkout, and conversational compilation and execution for program generation will be covered to provide an overview of time-sharing in the central computing system.

The hardware characteristics will be described of a system which is capable of achieving real-time response while operating in a multiprogramming, multiprocessing, space-sharing and time-sharing environment. The delineation of the problems and the philosophical considerations employed in their solution will be expanded upon for priority interrupts, duration of uninterruptible intervals, red tape time, system integrity, space-sharing, memory protection and recursive and reëntrant routines.

The monitor program characteris-

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tics for real-time control will be described, including simulation studies of scheduling algorithms. In the design planning it is essential that the monitor program employ an appropriate policy for scheduling the work to be done in order that the system resources may be efficiently utilized for greater responsiveness. In a complex system the advantages and disadvantages of particular scheduling methods become apparent only after the system performance has been extensively studied. Results of simulation studies permitting more fully informed choice of algorithms will be given.

The debugging techniques which are capable of supporting on-line computer usage will be surveyed. The development of system software for this function is becoming increasingly important for effective utilization of time-shared computers. Various aspects of the appearance to the user of such debugging systems, as well as their implementation, will be discussed. Both assembly language and higher level language debugging facilities are examined, and annotated examples of debugging sessions intended to impart a feeling for the capabilities of current systems are included.

A conversational system for incremental compilation and execution, which will be described, provides a highly interactive environment in which a number of languages have been implemented. This system operates under a time-sharing monitor and considers the flexibility and complexity encountered under real-time, multi-user conditions. The philosophy, implementation and implications of such a system will be described in view of the goals of a conversational interface, multiple language capability, user-oriented program debugging and reëntrant characteristics of compiled user programs.

The SDS Sigma 7, A Real-Time Time-Sharing Computer, by Myron J. Mendelson and A. W. England.

Performance of a Monitor for a Real-Time Control System, by Erna S. Hoover, and Barry J. Eckart.

On-Line Debugging Techniques: A Survey, by Thomas G. Evans, and D. Lucille Darley.

A Conversational System for Incremental Compilation and Execution in a Time-Sharing Environment, by James L. Ryan, Richard L. Crandall, and Marion C. Medwedeff.

Tuesday, 1:00 p.m.
International Room,
Jack Tar Hotel

## Hybrid Computers and Random Variables

Chairman:
A. C. Soudack
University of British Columbia
Vancouver, British Columbia

To date, the major use of the hybrid computer has been in solving deterministic problems. Since the vast potential of the hybrid machine is virtually untapped, we decided to have a session investigating the potential of the hybrid computer in another broad field, that of non-deterministic, or random variable type problems. Since there has been little publicized work on which to build a format, the session is self-contained and the following topics will be discussed.

1. The generation of random variables by the digital end of the hybrid computer. This needs no elaboration, since one obviously needs a random variable to simulate a non-deterministic problem.

2. Errors in hybrid loops. A great deal has been said about errors inherent in analog computation. But how about unforseen errors, both deterministic and non-deterministic, that might arise in a complex hybrid system due to interfacing and data conversion? This topic should be of interest to all hybrid computer users.

3. Applications. Monte Carlo, or random walk, problems always pose interesting questions, and have interesting applications. The solution of parabolic and elliptic partial differential equations using random walk methods will be presented. In contrast to the first topic, we have the analog end of the machine generating the random data. Professor G. A. Korn and his ASTRAC II, a special purpose ultra-high speed analog computer have been working on the forefront of this field.

4. Applications of random search methods in control system optimization. A most important topic of current interest, treated by the hybrid computer.

A General Method for Producing Random Variables in a Computer, by Dr. George Marsaglia.

A Unified Approach to Deterministic and Random Errors in Hybrid Loops, by Dr. J. J. Vidal.

Hybrid Computer Solutions of Partial Differential Equations by Monte Carlo Methods, by Dr. W. D. Little.

Parameter Optimization by Random Search Using Hybrid Computer Techniques, by G. A. Bekey, A. E. Sabroff and M. H. Gran.

Tuesday, 3:45 p.m.
Larkin

## For and Against Time-Sharing

Chairman:
Harry D. Huskey
University of California
Berkeley, California

Professor David Evans will set the stage by explaining why the sudden interest in time-sharing. He will describe those technical developments that make it feasible to have individual on-line computing. However, there are still problems which are not particularly suitable for solution on time-sharing systems. These will be described by Professor Abe Taub. Following this a pioneer in on-line computing, Dr. J.C.R. Licklider, will describe areas in which time-sharing systems have been used advantageously. Finally, the colorful Herb Grosch will discuss on-line information retrieval systems.

The session will be in two parts: a formal presentation followed by a discussion period. Each speaker will present his material in turn, and the audience will be encouraged to ask questions. After the formal presentations, the group of panel speakers will answer the questions.

To many people on-line computing (and implied time-sharing) is the most significant recent development in computers. Others are much less optimistic. Perhaps the enthusiasm is premature; it may take more effort than originally estimated in order to have usable time-sharing systems. Or perhaps existing systems already provide much more than batch processing systems can hope to provide!

The presentations and discussion are expected to bring out the relative importance of mass stores, trade-offs between large bulk core memories and sophisticated drum swapping systems, significant logical features which make re-entrant programs more efficient, and memory access priority schemes which substantially improve overall performance. Important char-

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CIRCLE 51 ON READER CARD

acteristics of computer languages for on-line systems will be discussed.

What is the relative importance of a language being "fail-safe" versus being concise and efficient? How much standardization should there be? What about "custom" systems that the user can modify and adapt to his personal taste? Are we coming closer to having significant building blocks which will permit the next generation of users to attempt larger problems, which could not be solved if the individual had to start from the beginning at the machine lanuage level?

Is Dr. Bush's super-desk almost here not as a self-contained library-information retrieval and processing systems, but as a terminal on a large central library and super-computer? Where will we be five years from now, ten years from now?

What is Time-Sharing? by David Evans.
Problems Which Should Not Be Run on Time-Sharing Systems, by Abe Taub.
Problems Best Solved on Time-Sharing Systems, by J.C.R. Licklider.

Tuesday, 3:45 p.m.
Main Auditorium

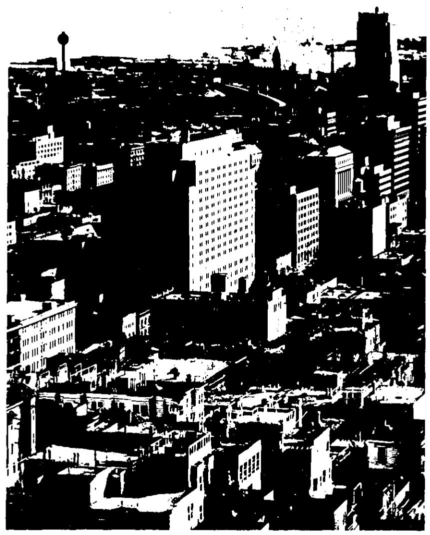
**Engineering Design by Man/Computer Interaction**

Chairman:
Thurber J. Moffett
Lockheed-California Company
Burbank, California

Academic, industrial and government interests alike are heavily involved in every phase of converting the present state of man-computer technology into usable and available systems. No longer in doubt is the coming widespread introduction of such systems for engineering design and related activity. Engineering managers have passed the point of questioning the "ifs" and "whys" and are becoming ever more concerned with the "whens." Competitive positions are beginning to be related to how soon particular companies can gear to design by man-computer interaction using the large multiconsole time-shared systems now envisioned. How such systems are to be developed and introduced into the engineering environment is, in itself, developing into one of the most challenging efforts ever to be put to the computer and engineering managerial communities.

In this mounting fervor, the areas requiring attention and getting it are evolving an impressive array of possibilities and alternatives. The field is now too comprehensive for any technical session to do more than single out a relatively few items for concentrated attention. The selections for this session were made recognizing the present state of engineering management thinking and consequently favoring near-term utility.

The first paper concerns a typical time-shared, on-line design of electronic circuits and associated display technique, accompanied by a teletype display demonstration from Project MAC at MIT. The second discusses an operational system which time-shares multiple graphic consoles with provisions for running independent



applications. Next, more of the extensive work underway at Lincoln Laboratory is presented with a description of an ultrasonic transmitting device to relate 3-D position information to a computer. The last two papers describe an experimental system for assisting the draftsman to translate circuit schematics into precise drawings for circuit fabrication, and an experimental system for reducing interconnections between separately packaged multipurpose logic elements in integrated circuits.

A Parametric Graphical Display Technique for On-Line Use, by M. L. Dertouzos and H. L. Graham.
A System for Time-Sharing Graphic Consoles, by J. R. Kennedy.
The Lincoln Wand, by Lawrence G. Roberts.
Using a Graphic Data Processing System to Design Artwork for Manufacturing Hybrid Integrated Circuits, by J. S. Koford, P. R. Strickland, G. A. Sporzynski and E. M. Hubacher.
Automated Logic Design Techniques Applicable to Integrated Circuit Technology, by A. B. DeAndrade, B. J. Crawford, M. T. McMahon and R. Waxman.

Tuesday, 3:45 p.m.
Polk

**Computers in Music**

Chairman:
Heinz Von Foerster
University of Illinois
Urbana, Illinois

TACK TACK TACK . . . BOING . . . WROOOOOM . . . . WHAMMY . . . . are words not listed in Webster's Unabridged International Dictionary, although they are popular and legitimate onomatopoetic representations of familiar sounds. Are these sounds music?

A century ago this question would have been unanimously answered in the negative. Today, however, we have to be more cautious. Does this imply that today we are less sure of our judgments or, perhaps, have suffered a loss in acuity of audition from the permanent exposure to a noisy environment? Why is it that today a sizable number of people are willing to even pay admission to a concert which to an audience of two generations ago would offer cacophony rather than symphony?

The causes for this change in attitude are easily understood by a brief glance at the trends in the evolution of western music beginning with Pythagoras and terminating—open-ended—with the theories and experiments of those gentlemen who so kindly consented to present their ideas and results during this session. What are these trends?

They are most clearly understood in information theoretical terms—namely, as a gradual reduction of redundancy in works of music or, expressed differently, as a continuous increase of complexity in sound and composition, and hence an increase in the amount of auditory information transmitted during a given interval of time. Redundancy reduction has been achieved over the last two millenia by a steady abolishment of constraints on three levels: specificity of wave forms (sounds), selection of frequencies (scales), and rules of synchronism and succession (composition).

With the invention of new musical instruments through the centuries, and with their integration into an orchestra which originally consisted only of lyre and flute, musical sound acquired at the turn of our century the grandiose richness, depth and variety of dimensions unthinkable a thousand or two thousand years ago. The Pythagorean seven-tone scale based on "pure" frequency intervals with ratios 2/1, 3/2 and 5/4 (corresponding, of course, to the second, third, and fifth harmonics) was found to be an "open" tonal system; i.e., ever new frequencies are generated if a tone, other than the fundamental, is taken as the start of a new Pythagorean scale. Consequently it was replaced in the 17th century by the "well tempered" scale of equal intervals with ratio $12\sqrt{2/1}$, which for the first time, offered musicians a "closed" tonal system, the 12-tone scale.

With this new scale, transition from key to key is smoothly accomplished, and earlier constraints regarding harmony and melody have been abolished. Wagner, Richard Strauss and Stravinsky made full use of this possibility, but it was Hauer and Schönberg who recognized the crucial features of the well tempered 12-tone scale—namely, the equivalence of tones within a chord, and the invariance of ratios against translation in pitch. With this observation they opened new possibilities for the composer and further removed constraints regarding synchronism and succession.

Is it possible to push these generalizations even further? The answer is clearly "Yes." One may challenge the validity of constraints in sound by a given set of musical instruments; one may challenge the validity of the constraints given by a scale that divides the octave into precisely 12 intervals. The number 12 has nothing to offer to make it preferable over any other number, except that the 12-tone scale happens to give good approximations for the Pythagorean intervals 3/2 and 5/4. However, it can be shown that an 18-tone scale gives much better approximations for these intervals. Accepting the possibilities of extensions in sounds and scales, how does one determine the new rules of synchronism and succession?

It is at this point, where the complexity of the problem appears to go out of hand, that computers come to our aid, not merely as ancillary tools but as essential components in the complex process of generating auditory signals that fulfill a variety of new principles of a generalized aesthetics and are not restricted to conventional methods of sound generation by a given set of musical instruments.

The session "Computers in Music" will focus on three aspects in the use of computers in generating music. First, hardware and software for implementing the generation of sounds will be discussed under the heading *Programs and Systems.* Second, the versatility of digital computers in exploring rules of succession and synchronism will be demonstrated in the section, *Composition.* Finally, the ticklish problem of judgment entering perception—i.e., what is "beautiful" and what is "ugly" or, to put it again into information theoretical terms: how we distinguish between signal and noise will be taken up in the final section, *Aesthetics.*

Simulation Models for Transient Musical Instrument Tones, by Dr. James W. Beauchamp.

The Computer as Orchestra, by Dr. Arthur Roberts.

Computer Generation of Music in Real-Time, by Dr. David Freeman.

Graphical Scores, by Dr. Max Mathews.

Operations on Waveforms, by Dr. J. K. Randall.

Composing Music with a Computer, by Dr. Lejaren Hiller.

Control of Consonance and Dissonance, by Dr. Max Mathews.

The Problem of Imperfection in Computer Music, by Dr. Gerald Strang.

Wednesday, 9:30 a.m.
El Dorado Room
Jack Tar Hotel

## Error Analysis in Analog and Hybrid Computation

Chairman:
Robert Vichnevetsky
Electronic Associates, Inc.
Princeton, New Jersey

Since the introduction of analog computers as general-purpose tools for the simulation of dynamic systems (i.e. systems described by sets of initial value differential equations), the subject of error analysis and error prediction in their operation has been a subject of significant interest. More recently, hybrid and digital techniques have enlarged significantly the scope of analog computation, and, by increasing the scope of what can be done in simulation, as well as the complexity of what simulation problems are being solved, have introduced new types of errors and new problems in error analysis.

In approaching the general problem of error analysis and error prediction, it should be emphasized that it is, by its very nature, a qualitative problem. By this we mean that to understand the potential and limitations of computer simulation, it is necessary to formulate concepts regarding overall behavior of errors, rather than being able to predict in each specific case, what the exact value of the errors will be as a function of solution time. Obviously, the latter would be quite useful and even desirable.

But in view of the multiplicity of sources of elementary errors in a single simulation, and of the uncertainty attached to the value of these elementary errors, one can at best hope to be able to predict the order of magnitude and the time-propagation properties of the total accumulated errors in the computer solutions.

Basically, analyzing errors in the simulation of a dynamic system is similar to analyzing the response of the system itself to small perturbations. A study of those perturbations themselves (a microscopic study of computing elements and algorithms) and the study of their effect on the computed solution (a perturbation or variation of analysis, in the calculus sense) are two main aspects of error analysis.

A classic paper, stressing the variational aspect of error analysis in ana-

log computers was published in 1953 by Miller and Murray. Later papers by Meissinger and Nelson developed the same ideas in a somewhat more practical fashion.

Assuming an electronic computer is programmed to produce a solution to the initial value problem described by the differential equations:

$$\frac{dx}{dt} = f(x) \qquad (1)$$

(where both x and f are column vectors) it can easily be shown that the errors in the solution will respond to the perturbation form of these equations, namely;

$$\frac{de}{dt} = \frac{\partial f}{\partial x} \cdot e + \epsilon \qquad (2)$$

Where $e$ is the vector of errors in the solution, $\epsilon$ is the vector of elementary errors resulting from a non ideal implementation of the system's differential equations, and $\frac{\partial f}{\partial x}$ is the Jacobian matrix, or matrix of partial derivatives of $f$ with respect to $x$. A classical way to analyze the effect of specific sources of errors on the solution accuracy is by the introduction of parameter influence functions or sensitivity functions. This approach was essentially that taken by Meissinger.

It is interesting to note the parallelism between the tools used here, and those being used in different fields such as systems and control theory.

An approach to the problem of determining error sensitivity functions is to achieve this automatically on a fast-repetitive computer, as is suggested in the paper by Korn.

The application of sensitivity method to specifically hybrid problems has been done by Karolus in the case of the solution of partial differential equations.

The microscopic aspect of error analysis, or analysis of elementary errors, has received particular attention recently with the introduction of hybrid and digital processes in simulation. To that respect, the paper to be presented by Gilliland will emphasize one way of performing that analysis: spectral error analysis of discreet processes provides a description in the frequency domain well known to control engineers.

Along similar lines, Bekey will present an application of sensitivity techniques to the effect of sampling rate.

The discussions which are expected to take place will undoubtedly benefit the theoreticians in giving them fresh problems to ponder, and the users in giving them a better understanding of what tools are available to them to analyze their error problems.

**Interrelation of Error Analysis, Sensitivity Analysis and Parameters Identification, by Hans F. Meissinger.**

**Automated Computing—Error Studies in Hybrid Computation, by Granino A. Korn.**

**Error Analysis of Hybrid Field Simulations, by Walter J. Karplus.**

**The Analysis of Errors Due to Sampling Rate Variations, by George A. Bekey.**

**Error Analysis of Hybrid Computer Loops, by Elmer G. Gilbert.**

**Spectral Analysis of Hybrid Subroutines, by Max C. Gilliland.**

Wednesday, 9:00 a.m.
Polk

## Computer Memories

Chairman:
Jan A. Rajchman
RCA Laboratories
Princeton, New Jersey

Rapid addressable access to large amounts of information is the key to universal programmable data processing. In the relatively short history of electronic computers the demands for greater storage capacity and higher speed have been constant and, regardless of the progress achieved, still further demands were and are being made. Some reasons for this are: the use of higher order languages, the attack of more ambitious problems, time-sharing and, generally, the more convenient use of computers to ever-growing applications.

At the center of the hierarchy of storage devices is the computer's internal random access memory; therefore, it is not surprising that substantial and continuing efforts in research, development, production methods and usage are devoted to it. The state of the memory art and a realistic appraisal of the often optimistic promises from the laboratories is always of great concern to the computer community. The subject is featured in this conference as it was in most past conferences and will be in many future ones.

The core memory remains the mainstay of the art; its speed and capacity are constantly increasing and its cost decreasing. As in any mature business, economic factors are becoming the subject of a detailed art; this is reflected in the first paper in the session. Thin magnetic film memories are emerging from the laboratory into the factory and the next three papers show how well the long-standing promise of high speed and batch fabrication economy is being realized. All-semiconductor memories are becoming an economic feasibility due to the phenomenal success of integrated circuits and are likely to provide a good scratchpad in the near future. This is the subject of the next paper. An interesting approach to economic large capacity memories is the notion of random access to blocks of serially accessed bits. The last paper illustrates the progress of this approach with sonic scanning of strain-sensitive magnetic materials.

The session gives a good but only a partial panorama of the field, which is very broad. Among the important approaches not included are the monolithic ferrite memory, work on the constantly-changing superconductive memories, the popular read-only memories, content addressable or associative memories which are still in the laboratory, and early attempts in the area of optical memories.

**A Cost/Performance Analysis of Integrated Circuit Core Memories, by Dana W. Moore.**

**A 200-Nanosecond Thin-Film Main Memory System, by S. A. Meddaugh and K. L. Pearson.**

**A Rotationally Switched Rod Memory with a 100-Nanosecond Cycle Time, by Bruce A. Kaufman, Paul B. Ellinger, and H. J. Kuno.**

**A 500-Nanosecond Main Computer Memory Utilizing Plated Wire Elements, by Jas. P. McCallister and Carlos F. Chong.**

**A High-Speed Integrated Circuit Scratchpad Memory, by D. E. Murray, E. C. Garth, and I. Catt.**

**Sonic Film Memory, by H. Weinstein, L. Onyshkevych, K. Karstad, and R. Shahbender.**

Wednesday, 9:00 a.m.
Main Auditorium

## Management of Multi-Access Systems

Chairman:
Richard G. Mills
Massachusetts Institute of Technology
Cambridge, Massachusetts

In the current flurry of activity in hardware design and system and application-software development for large, multi-access time-sharing systems, it is easy to overlook the problems of control and management of the resources these systems provide. To do so would be a serious mistake; the issues of multi-access system management are inseparable from the more obvious technical considerations influencing system design.

After all, the proof of multi-access system technology will lie in its routine, day-to-day use. In the cold world of practical application, considerations such as economics, business practices and even politics, will have important effects, both on the overall system design and details of its implementation, and on the functional appearance and utility of the system as viewed by its users.

In this session the entire constellation of such issues as computer service as a resource; the economics of computation; control, including metering, accounting, billing and auditing problems; pricing structures; services offered, and a host of others, are

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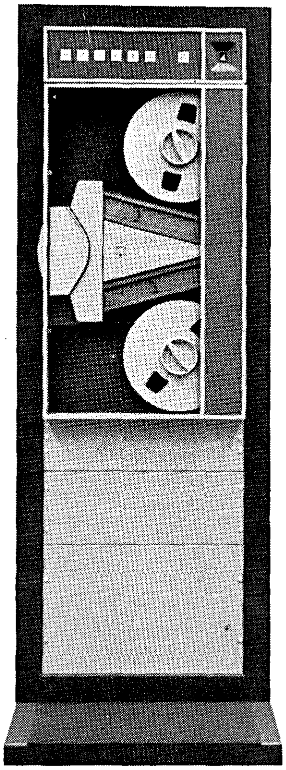

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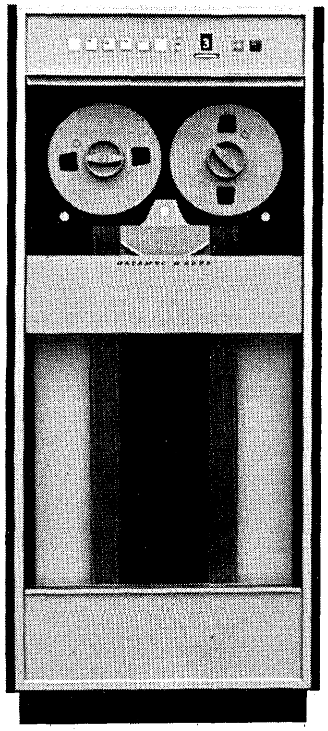

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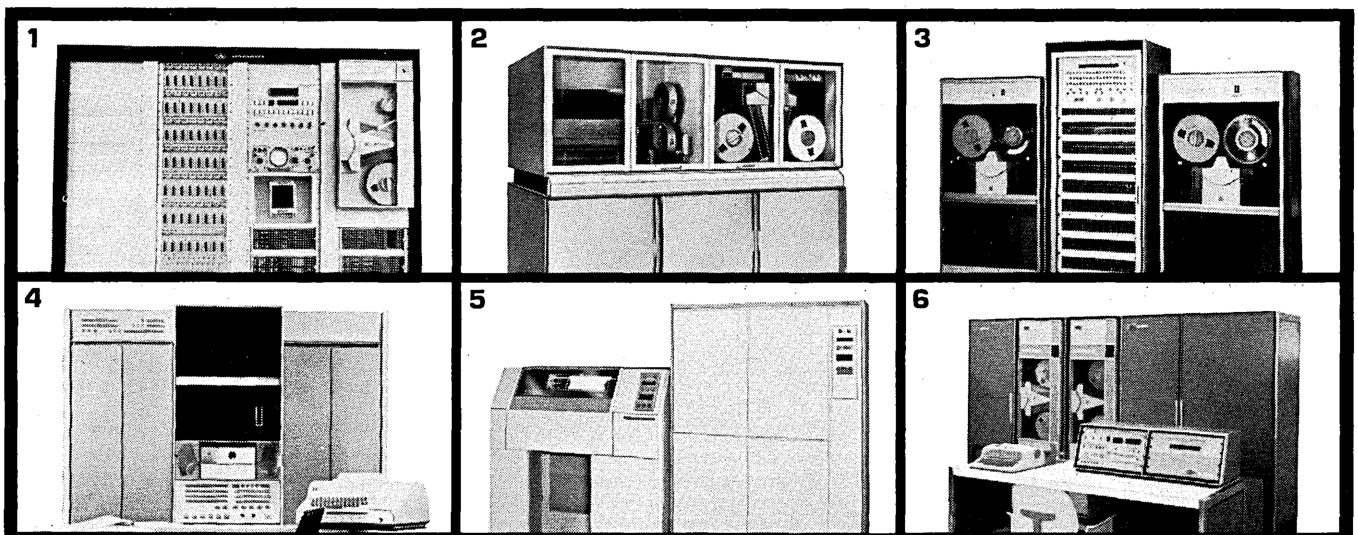


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* *Sorry there's space for so few pictures. If you'd like a lot more names, contact Tom.*

CIRCLE 53 ON READER CARD

somewhat loosely heaped together and assigned the label "management problems." If there is a theme threading the positions of all the panelists, it is that one should not expect the tried-and-true business practices of the past to be suitable for controlling the new kind of resource which a multi-access system represents.

Most of those who use the currently-available systems for either business or scientific problem solving have found that time-sharing offers much more than convenient access to a computer. Even at this early stage it has been repeatedly demonstrated that the real potential of these systems can be realized only by treating them as a new kind of tool—basically different from a batch-processing computer—for solving the problems at hand. New kinds of problems become approachable, and new approaches become appropriate. Old problem formulations are often profitably replaced by substantially different ones which exploit the new capabilities. Extrapolating from experience of this kind, it is reasonable to suppose that the coming generation of systems will permit—and demand—even further innovation.

Just as imagination and innovation are called for in multi-access system applications, so also in their management. Different computational resources are available; different management issues arise, and different policies and practices are in order.

As an illustration, consider the fundamental issue of accounting for system use. The machine organization and system configuration required for large, general-purpose time-sharing systems are naturally amenable to much more detailed and precise usage metering than are those of conventional computer systems. Time-sharing system supervisory programs must have highly detailed, precise metering for control of system operation, and system accounting and billing sub-systems can simply "tap off" as much of this information they can use. As a result, the bill that a user receives at the end of the month may be quite extraordinary by present standards. It may show separate charges for perhaps a half-dozen distinguishable "system resources," including processor use (down to the microsecond), core-memory occupancy (in "world-microseconds"), plus complete details of the use of secondary storage, peripheral devices, and so on. The old standard billing unit for computer use, the "system-hour," can and should be discarded, but the appurtenant problems are numerous.

Other management issues surround the question of what the operator of a multi-access system, either as a private enterprise or as the internal computer-service facility of an organization, offers to his "market," and what obligations he assumes when a customer signs up for service. An illustrative key issue is that of file system safety.

A user tends to place his trust, however misguided, in the safety of the available file system, regardless of disclaimers and despite objections of the management. By doing so, he, in some sense, forces an unsolicited obligation on the system proprietor to the extent that a user who loses a file has a moral and possibly even a legal

basis for claiming damages. This phenomenon (it was actually observed at an early stage in the development of CTSS at Project MAC) at least suggests that the file-system component of a service offering had better be based on a thoroughly safe system implementation. Anything less is likely either to be considered unusable by the system users, or worse, to be used as though it is perfectly safe with the consequent inevitable calamity.

A "fairly safe" file system is like a "fairly safe" airplane; the value of its contents is usually high enough to force a decision not to use it at all rather than risk a malfunction.

The foregoing attempts to convey an indication of the large and ill-defined territory encompassed by the session title. Written questions from the audience will be accepted for discussion.

The panelists offer a large and varied experience with one phase or another of multi-access system management. All draw from general backgrounds of participation in development of advances in the technology of computer systems and their applications.

Panelists:
John H. Weil, General Electric Co.
Charles W. Adams, Adams Associates, Inc.
Thomas J. O'Rourke, Tymshare, Inc.
Richard G. Mills, Chairman; Massachusetts Institute of Technology.
Lee Garbrick, C-E-I-R, Inc.

Wednesday, 9:00 a.m.
Larkin

### Natural Language Processing

Chairman:
Dr. H. R. J. Grosch
General Electric Co.
Santa Barbara, California

More and more attention is being devoted to the levels of man-machine interaction on which prescribed formats are unrewarding. At the tactical level, such vast assortments of formats may be required by a rapidly evolving context that programmers or console operators cannot catch up. And at the strategic level, system requests typically lead to still other system requests; only the earliest requests are predictable, and the value of mechanization depends almost entirely on freedom from format.

Programming languages attempt to cut away the richness and ambiguity of natural language. Carried too far, this skeletonizing repels human users, and even programmers; many dialects have their origins in a wistful yearning for Victorian velvet and tassels in the Danish modern or Bauhaus environment of the ACM.

Session efforts are now being reported at facing up to the difficulties of full or fairly full natural English. Sixteen years of primitive machine translation and ambitious information retrieval have taught us all caution, but real progress is being made. Three rather vigorous ideas, DEACON, CAINT and SYNTHEX, will be described at the FJCC; all are question-answering, all face the semantic challenge frankly, and each contributes differently. One emphasizes structuring data to reflect the preferences of the user, one concentrates on the instructional possibilities, and one breaks down or normalizes the input material for easier analysis.

These papers plus an introductory one on the general problem were selected from more than a dozen submitted. The amount of interest is not yet anywhere near that in time-sharing, but it grows at a healthy rate—unlike the latter! I would guess that genuine operational systems, albeit only in a few very carefully selected applications areas, are only about two years away.

English for the Computer, by Frederick

There will be no "program conversion" item to budget for when Burroughs B 5500 users move up to the new, more powerful B 6500. Their present programs will run on the B 6500 —even if the configuration is different—as efficiently as if they had been written *for* their new computer.

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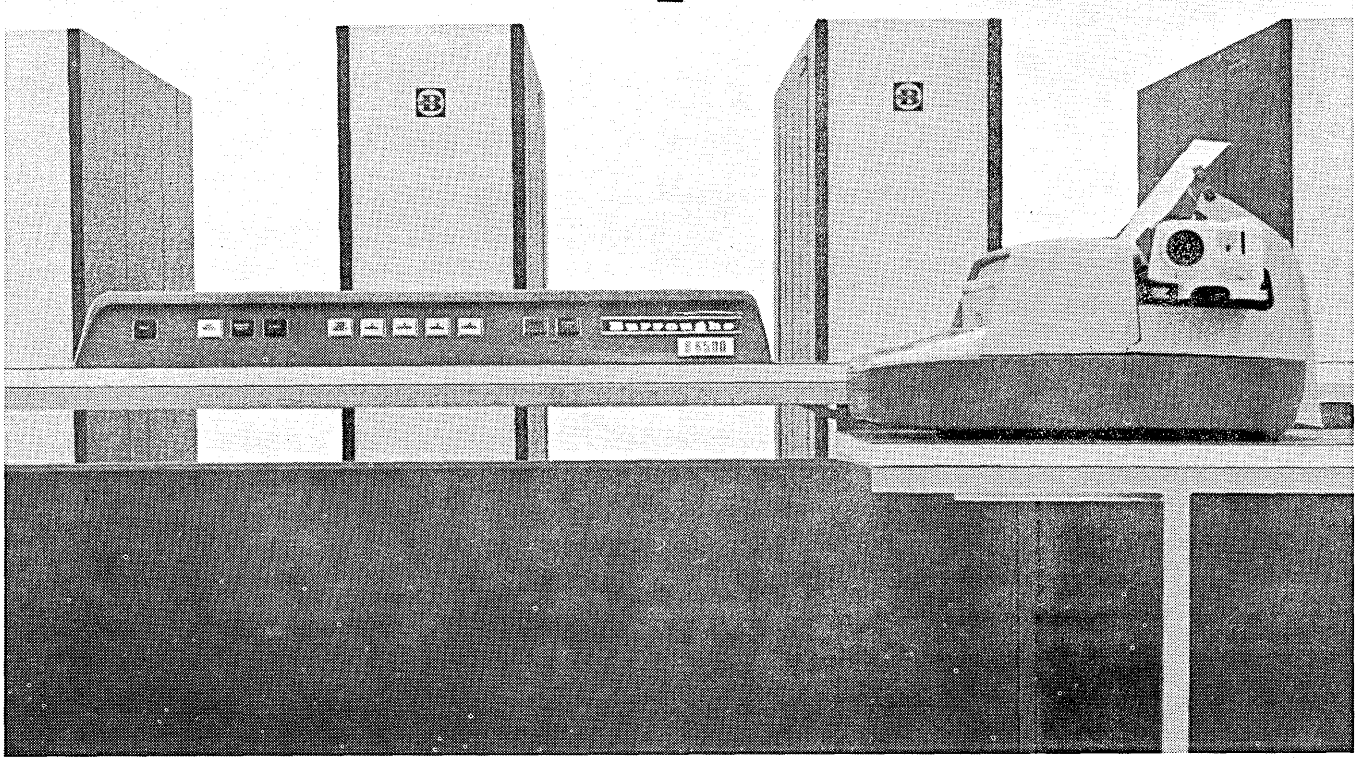


CIRCLE 54 ON READER CARD

B. Thompson.

DEACON: Direct English Access and Control, by James Z. Craig, Susan C. Berezner, Homer C. Carney, and Christopher R. Longyear.

Computer-Aided Interrogation, by Charles T. Meadow, and Douglas W. Waugh.

An Approach Toward Answering English Questions From Text, by R. F. Simmons, J. F. Burger, and R. E. Long.

Wednesday, November 9

2:30 p.m.

Larkin

### Impact of Computers In Government: Federal, State & Local

Chairman:

Norman J. Ream

Center for Computer Sciences & Technology

U.S. Department of Commerce

National Bureau of Standards

Washington, D. C.

This session will deal with the interaction between computers and government service on the federal, state and local levels. The federal government pioneered in the use of electronic digital computers which had been initially developed to meet military requirements. In the Bureau of the Budget's Report to the President on the Management of Automatic Data Processing in the Federal Government (Senate Document 15, March 4, 1965) Kermit Gordon said:

No single technological advance in recent years has contributed more to effectiveness and efficiency in Government operations than the development of electronic data processing equipment . . . Furthermore, the computer is becoming increasingly useful to managers in solving complex problems involving interrelated types of information. The most notable of these have been in military areas and in supply management, but the use of computers to support advanced management techniques is becoming common in a broad range of governmental activity. Based on results achieved to date, this latter type of use of computers holds a potential of outstanding importance in the public service.

In addition, there is the largely untapped area of integrating related information systems that cross organizational lines.

Accordingly, it seems reasonable to assume that the impressive advantages to the Government already achieved through automatic data processing are but stepping stones to the future.

The session will have one paper dealing with organizational staffing and procedural changes arising out of the application of a computer to a large-scale clerical operation at the federal level. This operation in the Treasury Dept. has had ramifications throughout the Federal Reserve System on the banking operations of the nation. Additional papers in the session will deal with problems of designing computer-based information systems to meet the needs of state, county and local government organizations.

Although present employment of the computer in the federal government exceeds in costs and variety of tasks performed the use of these systems in state and local government, the possibility for future development of beneficial uses in state, county and local government are challenging and demanding, and call for the employment of the best talents available.

President Johnson recently emphasized in a memorandum of June 28, 1966 to the heads of all departments, "I want the head of every federal agency to explore and apply all possible means to use the electronic computer to do a better job and to manage computer activity at the lowest possible cost." In this same letter he said, "I want every agency head to give thorough study to new ways in which the electronic computer might be used to provide better service to the public, improve agency performance and reduce costs."

This session will not attempt to cover all of the tasks which computers are performing at the four governmental levels. It will attempt to report some progress, identify some problems, and raise some issues which warrant study and discussion.

The Check Payment and Reconciliation Program of the U.S. Treasury: Present Status and Future Prospects, by George F. Stickney.

Problems of Information Systems in State Governments, by Dennis G. Price.

The Impact of Computers on Local and Regional Government, by Herbert H. Isaacs.

An Information System for the Los Angeles Police Department, by L. Farr and L. B. McCabe.

Implementing Computer and Information Technology Into the Urban Security (Police) Functions, by Richard B. Hoffman.

Wednesday, 2:30 p.m.

Main Auditorium

### Some Communications Aspects of Time-Sharing Systems

Chairman:

Paul Baran

The RAND Corporation

Santa Monica, California

As the cost of central processing decreases, the communications components of the time-shared system increases in importance. Communications techniques and costs become of key concern to the computer system designer.

Because of the relative unfamiliarity of communications to the computer community, the session opens with a tutorial review, followed by a paper describing the user's wants from the communications supplier. Next, a paper describing some experiments using new data communications techniques is presented. This leads to a tutorial description of how elementary telephone queuing theory may be simply applied to the design of message switching systems. Lastly, a paper is scheduled describing a communications network proposed to tie together existing computers.

A Review of Some of the Real-World Problems in Establishing Data Communications Between Users and the Computer, by L. A. Hittell.

The Users' Requirements for Data Communications in a Management Information System, by Donald J. Dantine.

Experiments Using High-Speed Communications Between Computers, by Henry McDonald.

Wednesday, 2:30

Polk

### Scientific Applications of On-Line Systems

Chairman:

L. H. Amaya

Lockheed Missiles & Space Co.

Sunnyvale, California

This session is devoted to the broad scope of scientific applications with emphasis on real-time, on-line systems designed for the direct use of the problem solver.

A perpetual objective in our profession is to minimize the communication and manual processes required from the point in time of the scientists' problem statement to the computer solution of the problem. Direct computer access through terminals is an advancement toward the objective. Also, as on-line, time-sharing computer hardware systems develop more sophisticated multiple user access capabilities, new software is being developed to further the objective.

The formal papers to be presented may be thought of as a natural extension of problem oriented languages in the realm of present day hardware. The authors refer to their work as on-line mathematical analysis, operation oriented on-line with distributed control, and user-oriented. In their oral presentations the authors will deviate from their published papers as appropriate to bring you the current status of their work. Each speaker will orient his presentation toward the utilization of the system from the users' problem solution standpoint rather than emphasize the hardware and software aspects. At least one presentation will utilize a motion picture (in real-time, of course) to show a user solving a problem on a terminal of the time-shared system.

Following each paper a member of the panel will give a critique of the paper and forecast the impact of the authors' work. The panel will consist of Dr. Charles R. DeCarlo, IBM Corp; Francis V. Wagner, Informatics, Inc.; and Dr. William H. Wattenburg, Berkeley Scientific Laboratories. In conclusion, a featured speaker, Dr. Charles DeCarlo, will summarize the session and prophesy the future of computing in the scientific field.

The Lincoln Reckoner: An Operation-Oriented On-Line Facility with Distributed Control, by Dr. Arthur N. Stowe, Dr. Raymond A. Wiesen, Dr. Douwe B. Yntema, and James W. Forgie.

Telsim, A User-Oriented Language for Simulating Continuous Systems at a Remote Terminal, by K. J. Busch.

Man-Machine Communication in On-Line Mathematical Analysis, by Dr. R. Kaplow, Dr. J. Brackett, and Dr. S. Strong.

Thursday, 9:00 a.m.

Main Auditorium

### The Man-Machine Interface

Chairman:

Sidney Fernbach

Lawrence Radiation Laboratory

Livermore, California

The man-machine interface is a very important item in a time-sharing system. At present many keyboards, cathode ray tube displays, light pens, printers, card readers, and even small computers are being designed and manufactured for use as remote stations. What is it that may be necessary or desirable as such a station? Is it the same for all users? In an attempt to answer questions such as these and get some understanding of what educators, physical scientists, medical scientists, and engineers think of currently available systems, a panel discussion will be held with a representative of each of the above mentioned disciplines participating. A summary of this discussion along with predictions for the future will provide the conclusion to this session.

Despite the fact that technology involved in computer components has made remarkable strides in the past 20 years, comparatively little has gone into the improvement of input-output equipment. Even though display tubes and keyboards have been associated with computers from the very early days, they provide substantially the same capability today as then. Is there something new that may replace these? In a search for possible stations of the future, we are presenting two papers, one on an electroluminescent screen and the other concerning a plasma display panel which is inherently digital in nature. Perhaps these will displace or supplement the tube with which we are now familiar. We expect to hear the advantages and disadvantages of these devices for man's interface with the computer. These papers will be presented first, so that our panel members may be in a position to comment on them.

Recent Progress on a High Resolution Meshless Direct-View Storage Tube, by Norman H. Lehrer and Richard D. Ketchpel.

The Plasma Display Panel—A Digitally Addressable Display with Inherent Memory, by D. L. Bitzer and H. G. Slattow.

Thursday, 9:00 a.m.

Larkin

### High Quality Papers of General Interest

Chairman:

Rex Rice

Fairchild Research Laboratories

Palo Alto, California

Three outstanding papers on independent topics have been chosen from the many good papers submitted to the conference. The authors have been asked to talk *about* their subjects rather than merely duplicating the material published in the proceedings. Each presentation together with audience participation will occupy about 45 minutes. A 15-minute break will occur to allow audiences to change.

The first paper, discussing automatic value exchange, examines in some detail what the authors feel is an inevitable trend. The concept of automatic credit transfer has been around for some time and is not new. The authors, however, assert that all the necessary technology required now exists, and describe many of the underlying concepts and requirements in some detail. They have provided an interesting package for study. The audience will find this presentation provocative and are invited to share their opinions, both agreement and disagreement, in the question period.

The next presentation, "Real-Time Recognition of Handprinted Text," describes a scheme already in operation which allows an on-line computer user to hand print text naturally and then have it recognized accurately. A film showing the operations, together with comments about experiences using the system, should provide interesting material for system users and designers. Some of the difficulties and areas yet to be explored will also be discussed.

The third paper describes the Basic Hytran Simulation System for programming the EAI 8400 digital computer; it is a digital simulation-oriented subset of the EAI total systems approach to software aids for hybrid simulation. The basic aim of BHSL is to provide a problem-oriented vehicle for the representation (description) of continuous dynamic systems that can be modelled by sets of ordinary differential and/or difference equations in one or more independent variables. The language includes an interesting set of command-control statements which allow the simulation analyst (programmer) to exercise control over the solution of equations representing his problem. The system depends on FORTRAN IV for its sophisticated procedural coding.

A System for Automatic Value Exchange, by Vern E. Hakola and Sherman C. Blumenthal.

Real-Time Recognition of Handprinted Text, by Gabriel F. Groner.

Basic Hytran Simulation Language (BHSL), by Jon C. Strauss.

Thursday, 9:00 a.m.

Polk

### Selected Applications Using Numerical Analysis

Chairman:

R. W. Hamming

Bell Telephone Laboratories

Murray Hill, New Jersey

Numerical analysis and statistics lack glamour and are generally regarded as dull fields as compared with multiprogramming, multiprocessing, real-time, remote consoles, visual displays, etc. And while the selection of one particular machine over others may be based on some of the above features, often the economic justification for the machine itself lies in applications which depend centrally on numerical analysis and statistics.

Both numerical analysis and statistics are old fields with large, well-developed bodies of knowledge that have been organized in standard texts and courses, and thus they require a long, hard apprenticeship as compared to most other computer fields. It is a mistake, however, to suppose that they are complete and frozen; as the tutorial paper on the Fast Fourier Series methods shows, significant new developments are still occurring which take previously important but impossible problems and make them very practical.

The Use of Semi-Recursive Polynomials in the Design of Numerical Filters with Applications in Processing Missile Flight-Test Data, by C. B. Stallings.

Fast Fourier Transforms — For Fun and Profit, by W. M. Gentleman and G. Sande.

Programs for the Computer Analysis of Finite Groups, by Harold V. McIntosh.

Thursday, 1:30 p.m.

Larkin

### Technologies and Systems for Ultra-High Capacity Storage

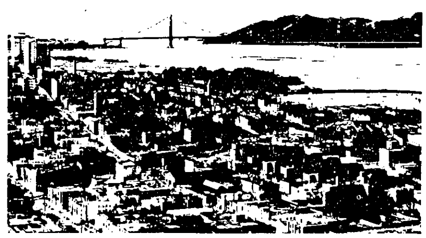
Chairman:

J. D. Kuehler

IBM Corporation

White Plains, New York

The scientific community has been aware of the capabilities of high energy optical and electron optical transducers and the storage capacity potential of photographic materials for many years. The slow development of these exciting technologies has been largely due to a lack of real need for systems capable of storing and retrieving data in the capacity range of $10^{11}$ to $10^{12}$ bits. Now the rapid growth of time-sharing systems, and the requirement for massive data banks under full machine control from remote terminals, are creating a need for these huge mass stores. Based on this need, industry is experimenting with photo material as the best candidate for a storage medium to achieve orders-of-magnitude cost reduction per bit of storage while main-



taining direct on-line accessibility to date. The record/read head becomes the laser or the electron beam. The magnetic mechanism is replaced with schlierenoptics, back-scattered electrons or modulated light. A description of these technologies and a discussion of their potential is the intent of this session.

The paper by H. R. Kerby and J. D. Kuehler describing a trillion-bit storage system sets the stage for this session. Direct electron beam recording on a photo material, on-line chemical development of silver film, CRT readout using air slider bearings for precision film registration, and many other new technologies have been taken from the laboratory and integrated into this complex device. The technologies of this system will be discussed in detail.

Dr. G. C. Higgins and R. L. Lamberts will describe a "System of Recording Digital Data on Photographic Film Using Superimposed Grating Patterns." Using this system, each bit is recorded as the image of a small diffraction grating. As many as eight simultaneous bits can be recorded by superimposing the exposures of grating images of different spacings. The information can be read out by using the photographic image as a diffraction grating and reading the first-order line photoelectrically. Each frequency in the image will produce its own first-order line. Resolution of photo materials today is no longer the key limiting factor when using high areal bit densities. Practical problems such as mechanical tolerances of access mechanisms, dust, dirt, and material imperfections are more serious limitations. The system of recording and read-out to be described in this paper circumvents many of these difficulties.

Sterling P. Newberry has been pioneering in the use of new technologies for many years. At the Wescon conference of 1958, the author proposed a class of electron optical memories of very high storage density. His new paper shows a continuation of his explorations. He will describe an electron optical analogy of the "fly's eye lens" which could allow the use of a memory surface small enough to remain permanently enclosed in a vacuum chamber with a minimum of mechanical access motion.

Dr. C. H. Becker will show another facet of the use of these new technologies. This system utilizes signal modulated coherent laser radiation in a rotating optical system to create and detect (record and reproduce) binary information elements in two dimensions through diffraction-limited evaporation of a special storage medium. Information is stored in a helical line pattern of 1 micrometer bits, providing 600,000 bits per line (unit record) at a packing density of 745 million bits per square inch, with a total capacity of $8.8 \times 10^{10}$ bits per UNICON memory (100 foot reel, 16mm unidensity film). Information retrieval of the UNICON Computer Mass Memory takes place instantaneously during storage, as well as by means of secondary readout. Rates of storage and retrieval are in the megabits per second range.

In summation, the papers in this session promise to stretch the imagination of the listener and show a path toward future systems that we believe will be followed by the industry as the needs continue to develop.

The Unicon Computer Mass Memory System, by C. H. Becker.

An Electron Optical Technique for Large Capacity Random Access Memories, by Sterling P. Newberry.

A System of Recording Digital Data on Photographic Film Using Superimposed Grating Patterns, by R. L.

Lamberts and G. C. Higgins.
A Photo-Digital Mass Storage System, by J. D. Kuehler and H. R. Kerby.

Thursday, 1:30 p.m.
Polk

**Computer-Oriented Data Analysis**

Chairman:
Geoffrey H. Ball
Stanford Research Institute
Menlo Park, California

The availability of digital computers with on-line displays and other capabilities for man-machine interaction makes *qualitatively* different data analysis techniques possible. This session, which should be of interest to experimental workers in all fields of the physical and social sciences, as well as to those developing new data analysis techniques will examine the significance of computers for data analysis in papers dealing with:

1. Data analysis vis-a-vis statistics —as it has been and likely to be.
2. A working computer program for preparing *n*-dimensional histograms from empirical multivariate data and for calculating some information theoretic measures of the amount of difference between different probability distributions.
3. A progress report on an on-line system for the analysis of data from biological experiments—a system now being implemented at the California Institute of Technology.
4. A progress report on an interactive computer system with graphical display for the analysis of multivariate data—a system now being implemented at Stanford Research Institute.

Each paper will be discussed by the other panel members and the audience after its presentation. (The papers providing progress reports of new computer data analysis systems will not be published in the Proceedings due to the recentness of the work.) A final 30-minute period for discussion between panel and audience will allow general comments and questions.

The goals of computer-oriented data analysis are flexibility in viewpoint and facilities, convenience and rapidity in the exploration and description of the data, and sufficient simplicity in the final result of the analysis to allow communication of those results.

The trends in computer-oriented data analysis are toward:

1. More man-machine interaction that allows: a) Examination of the intermediate results so that later analysis can be based on results up to that time; b) Obtaining immediate response to a need for analysis using a particular technique; and c) Investigation of many alternative working hypotheses.
2. Using a CRT to display intermediate results in graphical form rapidly without burdening the operator/analyst with reams of hard copy.
3. The use of new and special-purpose devices for input and output —e.g., light pens.
4. The development of high-level languages oriented toward data analysis.

Major problems in computer-oriented data analyses are:

1. Specifying and presenting the complex (multi-variate) relationships found in the data. This includes: a) Organizing the data so as to minimize the combinatorial growth of complexity of these interrelationships, and b) Human factors problems related to organizing the data analysis so that fundamental human limits for information absorption are not exceeded.
2. Developing new techniques

(both hardware and software) for graphical display.

3. Relating analytic results to models or conceptual viewpoints of the "real world."

Current computer facilities can compute, display and interact in ways that surpass our understanding of how to use them. This technological progress requires re-evaluating our approach to data analysis. With an interactive computer the short time between specification of analysis and the return of the completed analysis makes possible more intelligent choice and sequencing of the analysis techniques that are applied to the data. The convenience and the rapidity with which it is possible to proceed around the deductive-inductive loop should thus be more nearly matched to the ability of an analyst to remember why he wanted to perform a particular analysis in the first place. It seems that the encouragement provided by avoidance of computational tedium should cause a person to analyze his data in much more detail and consequently to do more than simply confirm or deny a particular prior hypothesis. It should allow us to see more clearly how we know what we know.

Data Analysis and Statistics: Principles and Practice, by J. W. Tukey and M. B. Wilk.

Automatic Off-Line Multivariate Data Analysis, by G. S. Sebestyen.

A Data Analysis System for Biological Research, by D. G. Keehn and P. Lockemann.

On-Line Pattern Recognition Using a Man-Computer Display Facility, by D. J. Hall.

**Panelists:**

H. P. Friedman, IBM Corp.

D. C. Engelbart, Stanford Research Institute.

O. Selfridge, Lincoln Laboratories.

Thursday, 1:30

Main Auditorium

### Advances in Programming Languages

Chairman:

W. C. McGee

IBM Corporation

Palo Alto, California

This session is devoted to reports on new and significant developments in programming languages. The presentations will be grouped in a way that emphasizes a number of identifiable trends in languages, and at the same time permits comparison of different approaches to common problems.

One trend illustrated by this session is toward more comprehensive programming languages. Two such languages form the subject matter for two of the papers. Both languages provide facility for manipulating complex data structures, but by quite different approaches. In one approach, a list processing facility has been added to a more "conventional" language, whereas in the other, a language has been augmented by some of the more conventional language features. Both approaches represent significant contributions in themselves.

Another trend is that toward shifting to the programmer more and more of the responsibility for specifying the language he writes in, together of course, with the machinery for processing the language. One paper will describe methods for enriching an existing language by adding new syntactic features to the language and new procedures to the compiler. A second paper describes a system which places the task of language and processor specification completely in the hands of the user, thus expediting the development of experimental languages.

Giving the programmer more responsibility for the language he uses is, in a sense, an admission of the impossibility of designing a truly acceptable universal language. The two trends alluded to above thus tend to diverge, and an opportunity is afforded here to contrast these trends.

The two remaining papers illustrate the continuing need for programming languages to reflect new hardware organization and new programming and software concepts. One of these papers deals with the problem of specifying parallel processes in a program, a problem growing out of the development of multicomputer systems and multi-tasking software. The other paper discusses the pros and cons (mostly pros) of using natural language in computer programming. Both subjects are relatively new and lacking in experimental data, so much of what the speakers say will necessarily be of a theoretical nature.

A Processor-Building System for Experimental Programming Languages, by Terrence W. Pratt and Robert K. Lindsay.

The Introduction of Definitional Facilities Into Higher Level Programming Languages, by T. E. Cheatham, Jr.

Foundations of the Case for Natural Language Programming, by Mark Halpern.

Explicit Parallel Processing Description and Control in Programs for Multi- and Uni-Processor Computers, by J. A. Gosden.

The LISP 2 Programming Language and System, by Paul Abrahams, Michael I. Levin, Lowell Haekinson, Robert Saunders, Clark Weissman, Stanley L. Kameny, Jeffrey A. Barnett, Erwin Book and Donna Firth.

A Language for Associative Data Handling in PL/I, by George G. Dodd.

Thursday, 1:30 p.m.

International Room,

Jack Tar Hotel

### Hybrid Applications and Techniques

Chairman:

Walter Brunner

Electronics Associates, Inc.

Princeton, New Jersey

The theme of this session is the application of the unique high-speed predictive display capability of analog and hybrid computers in engineering design.

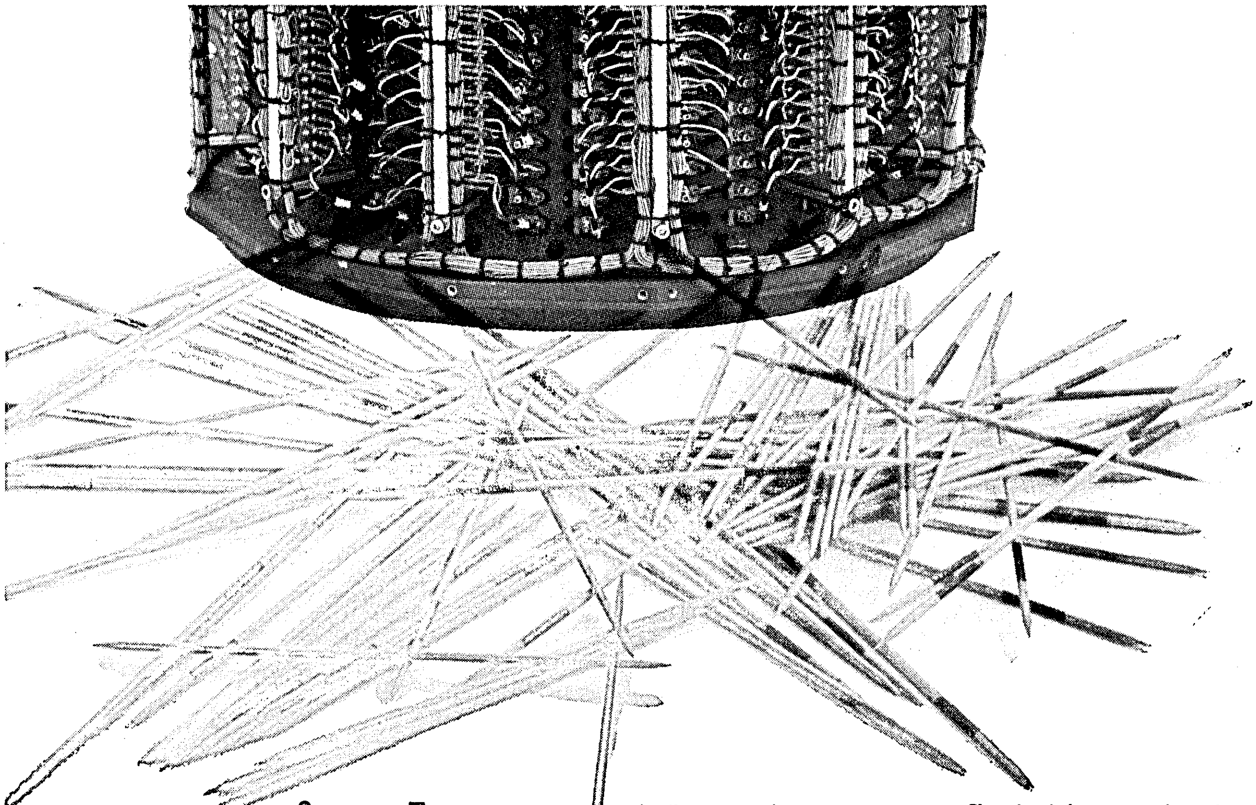
Analog and hybrid computers now operate in compressed time, while digital computers have new capabilities for real-time operation. Compressed time operation now makes it possible to conduct effective, economical feasibility evaluation of more complex dynamic physical systems in less time.

Papers in this session are directed toward aerospace and nuclear engineering application. However, the techniques in which they deal, such as sensitivity analysis, high-speed iteration, and multiplexing operations have application far beyond these fields.

The emphasis of the session is on hybrid simulation techniques and the benefits derived from the utilization of a hybrid system. The speakers will direct their comments to:

1. System programming: assignments, program checkout, readout, display, etc.
2. Analytical techniques: mathematical manipulation, iteration schemes, convergence, integration algorithms, error analysis. etc.

Hybrid simulation of nuclear reactors, aerospace, and control systems provide a framework for the discussions illustrating such achievements as a 100:1 reduction in costs, 1000:1 decrease in computer time, improved displays for optimum man-machine



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interaction, and improved accuracy in comparison to digital computer methods presently available.

Simulation, the development and use of models for the study of ideas, systems, and situations, has been an integral part of the synthesis and analysis phases of science and engineering for many years. The analog computer, because of the one-to-one relationship between computer model (program) and system model, is the main tool used to assist the engineer in simulation. Recent software developments have enhanced the utilization of the digital computer in simulating systems defined by ordinary differential equations.

The hybrid computer, an intetrated analog digital linkage system, appeared in the late 1950's as an answer to the requirements for simulation of high performance aircraft and space vehicles. It extends the computational capability available to scientific workers by combining the inherent high speed, flexibility, and excellent man-machine interaction of the analog computer with the stored program, precision, and memory of the digital computer.

Early efforts in hybrid computation were directed primarily towards the definition, design, and checkout of hardware and software. In many instances the delay in getting the "homemade" hybrid system operational exceeded the time available for obtaining information from the simulation which established the original need for the hybrid computer.

With the experience gained over the past few years, and the availability of completely "packaged" hybrid systems as a commercial product, the

scientist and engineer requiring a hybrid system for simulation can direct his attention and effort to sophisticated techniques, methods, and analysis in optimal control, non-linear partial differential equations, and stochastic problems for a variety of problems in aerospace mission analysis, fast nuclear reactors, and the life sciences.

Comparison of perturbation techniques (calculus of variations, maximum principle, steepest descent) and their computer mechanization, timesharing of analog components for economical solution of sets of non-linear partial differential equations, and eigenvalue search techniques are some of the specific activities in this field.

As a result, hybrid simulation will be found on the frontier of all areas of modern technology, and associated with it will be the elite of the men of science and engineering who are developing the system of tomorrow's world.

Hybrid Computers in the Analysis of Feedback Control Systems, by C. K. Sanathanan, J. C. Carter, L. T. Bryant, and L. W. Amiot.

A Hybrid Computer Solution of the cocurrent Flow Heat Exchanger Sturm-Liouville Problem, by Lawrence T. Bryant, Lawrence W. Amiot, and Ralph P. Stein.

A General Purpose Analog Translation Trajectory Program for Orbiting and Reentry Vehicles, by Arthur I. Rubin and Lloyd Shepps.

Near Earth Satellite Long-Term Orbital Stability Program (On the Hybrid Analog Computer), by J. Stricker and W. Miessner.

Trajectory Optimization Using Fast-Time Repetitive Computation, by J. S. Raby and R. Wingrove. ■

# THE SOFTWARE EMPHASIS

by ROBERT T. BAUST

The October issue of the Computer Characteristics Quarterly includes in Section I the six newly-announced computers listed below. Only one new family, the Univac 9000 series, made its long-awaited debut with the announcement of the 9200 and 9300 models and a promise of more to come. The remaining four new arrivals are expected additions to previously-announced families.

These six bring to a total of only nine the number of new computers announced thus far this year. From this it seems clear that the manufacturers have slowed down their hardware expansion and are concentrating on firming up their current product lines into fairly well-planned families. Moreover, software commitments are placing a mounting burden on expansion plans as software is taking on a competitive role of increasing importance. The cost of software development is already approaching hardware cost as a major factor in the price of a system.

Hence more and more manufacturers, almost in self defense, are developing and supplying standardized software packages. It appears that in each price range a "standard" set of system software is being offered. Even executive or monitor systems are becoming stereotyped. In fact, it seems that a single monitor is no longer adequate; now families of monitors — basic, real-time, time-sharing, to name but a few — are becoming commonplace.

All this emphasis on packaged programs cannot help but cause many to wonder, in the light of increasing diversity of applications, how much the customer may be paying in the long run for unwanted software and unneeded generality. ■

* Mr. Baust is editor of "Computer Characteristics Quarterly," published by Charles W. Adams Associates, 575 Technology Square, Cambridge, Mass. 02139. The publication is available from that firm for $10 a year. Adams Associates also holds the copyright to this tabulation.

## SECTION I

| | *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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BURROUGHS B6500** | $30,000<br>(25-80) | 1/68 | .4[C] | .6 | 16-106[E] | 48b | 9-144 | MR WC | | 24 M[K] | 20 | 514 | — | — | — | 1400[M]<br>300 | 1000[N]<br>100 | 1040[P]<br>815 | — | √ | √[S] | √[T] | √[U] | √ | √ | √ | √[Y] | √ |

C. Instruction look-ahead allows increased internal speed. E. Thin film memory. K. 12M and 96M character disc files, and 36M and 108M character disc files with access times of 40ms and 60 ms, respectively, also available. 800 cpm reader and 100 cpm punch available. Two card readers maximum. P. 715 lpm printer available, all printers with 132 print positions optional, four printers maximum. S, T. All addressing relative to Program Reference Table. U. Double-precision floating point available. ALGOL in addition to FORTRAN.

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| **UNIVAC 9300** | $3,600[A]<br>(1.7-9.3) | 9/67 | 52 | .6 | 8-32 | 1a[F] | 34 | MR WC | √ | — | — | — | — | — | — | 600[M]<br>200 | —<br>— | 1200[P]<br>600 | 1001 | √ | √[S] | — | — | — | √ | — | √ | √ |

Reductions available with 5-year lease. F. Eight-bit characters or bytes. M. Can be increased to 2000 cpm by using 1001 card controller on-line. 75 cpm punch also available. P. Rate depends on the number of characters in the type bar. S. Up to 8 general purpose registers may be used as index registers.

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| **SCIENTIFIC DATA SIGMA 2** | $1,800<br>(1.5-7.5) | 1/67 | 2.25 | .9 | 4-65 | 16b | 15-60 | MR WC | √ | — | — | — | 750 K[L] | 17 | 90 | 800[M]<br>300 | 300<br>120 | 1000[P]<br>800 | — | √[R] | 2 | √ | — | √ | — | √ | √ | — |

L, M, P. See SDS SIGMA 7. R. Up to 132 levels.

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| **UNIVAC 9200** | $1,200[A]<br>(1-2.5) | 6/67 | 104 | 1.2 | 8-16 | 1a[F] | — | — | — | — | — | — | — | — | — | 400[M]<br>200 | —<br>— | 500[P]<br>250 | 1001 | √ | √[S] | — | — | — | √ | — | — | — |

A, F, M, P, S. See UNIVAC 9300.

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| **DIGITAL EQUIPMENT PDP-9** | $1,000[A]<br>(8-1.8) | 8/66 | 2 | 1 | 8-32[E] | 18b | 15-60[G] | MR WC | √ | — | — | — | 262 K[L] | 8.6 | 96 | 100<br>100 | 300<br>50 | 600 | — | √[R] | 0[S] | √ | — | √ | — | √ | √ | — |

A. No rental prices announced. Prices derived from purchase price and do not include cost of magnetic tape units. E. In 8K increments. G, L, S. See PDP-7.
R. One interrupt standard, extended priority interrupt system optional.

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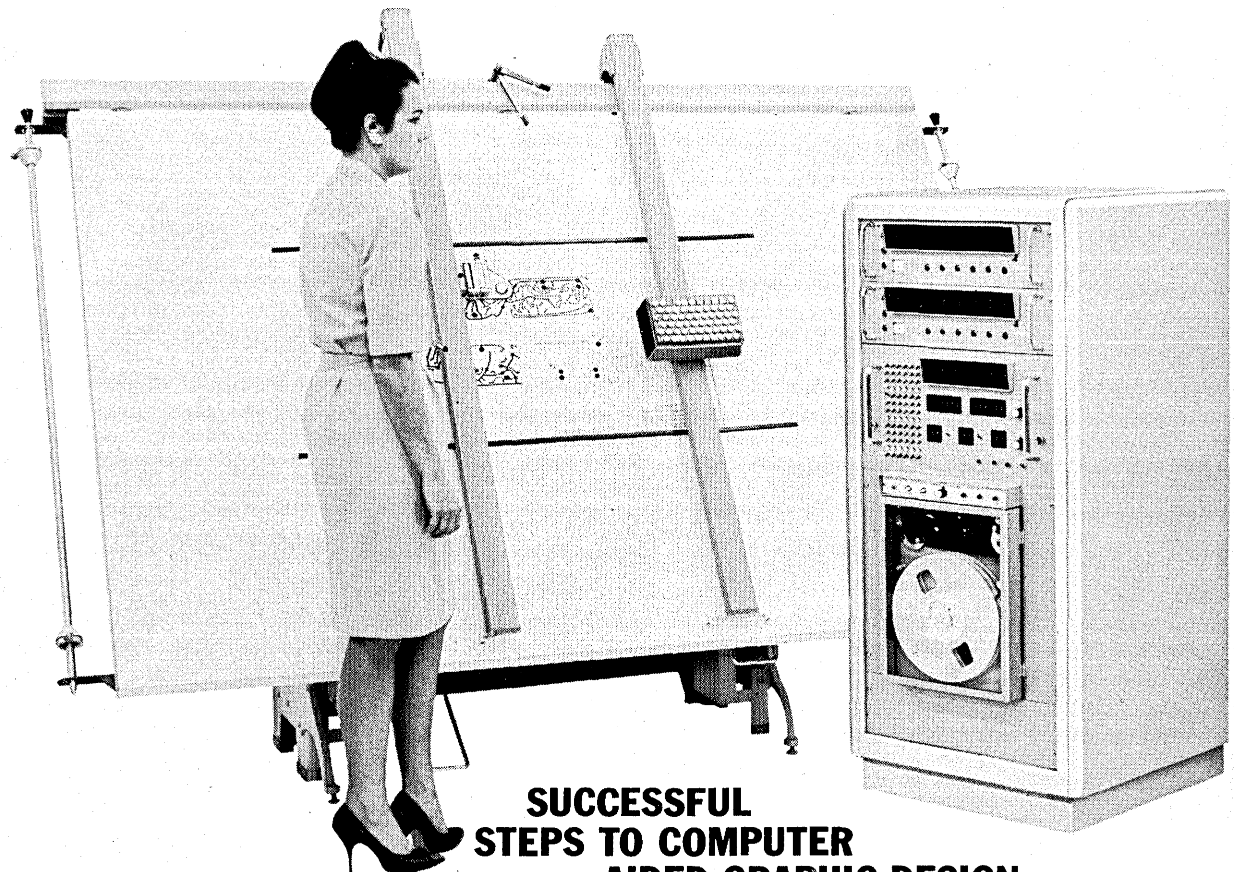
| **DIGITAL EQUIPMENT PDP-8/S** | $250[A] | 9/66 | 32 | 8 | 4 | 12b | 15-90[G] | MR WC | √ | — | — | — | 512K[L] | 8.4 | 16 | 800[M]<br>100 | 300[N]<br>63.3 | 1000[P] | — | √ | 0[S] | √ | — | — | — | √ | √ | — |

A. No rental prices announced. Prices derived from purchase price and do not include cost of magnetic tape units. G, L, M, P. See PDP-7. N, S. See PDP-5.



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# news briefs

## EXPLOSION DESTROYS H-200 AT PHELPS-DODGE

When an explosion destroyed a $290,-000 Honeywell H-200 system, leased by the Phelps-Dodge Copper Products Corp., Fort Wayne, Ind., Honeywell replaced the computer five days later, according to Jack Carmean, the company's systems and data processing manager.

The blast, caused by escaping gas, occurred Aug. 23, a Tuesday. The replacement was flown from Brighton, Mass., to Fort Wayne, arriving in the Indiana city at 1:30 Sunday morning, the 28th. By 8:00 a.m., said Carmean, Honeywell engineers had it in operation.

The computer, with a 16K core memory and four tape drives, was for "all practical purposes destroyed." It was insured for Honeywell by the St. Paul Fire and Marine Insurance Co.

Also destroyed and immediately replaced without cost to Phelps-Dodge was IBM gear, contained in a room adjoining the computer center. It consited of a 407, a sorter, and a "roomful of keypunch and verifier equipment."

About 150 magnetic tape files were stored in a Diebold fireproof safe. With these files, the data processing staff was able to continue work the next day, using an H-200 at Michigan Blue Cross in Detroit.

"We bought the safe two years ago and thought it was a big white elephant," said Carmean. He was smiling.

## ASA SUPERSEDED BY USA STANDARDS INSTITUTE

The United States of America Standards Institute has been established to expand the program of the American Standards Association, which it replaces. One reason for the new name is the custom in other countries of considering American as the word to describe all of North and South America, rather than just the United States.

First president of the new institute is Harry E. Chesbrough, a vice president at Chrysler Corp. Donald L. Peyton, formerly general manager for government relations of the U. S. Chamber of Commerce, has been appointed managing director.

All previously approved ASA standards will be labeled USA Standards. Major objectives of the new organization include broader participation by such groups as federal departments and agencies, increased representation in international standards programs, and emphasis on consumer interests. Standards approval will continue to be based on consensus of all groups represented.

## EDP REORGANIZED AT GENERAL ELECTRIC

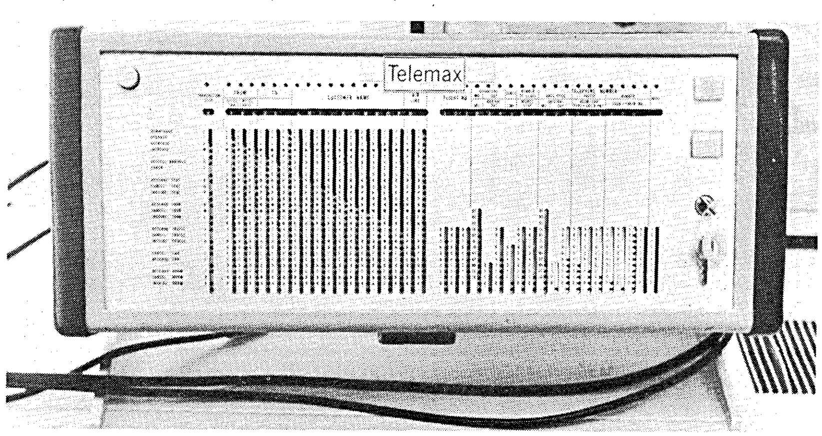
In a major reorganization, GE last month chopped up its huge Information Systems Division to form a new Industrial Process Control Division, and shuffled people, assignments and lines of communications. Dr. Louis T. Rader will head up the new IPC division, while Hershner Cross, vp and group executive, Industrial and Information Group, serves as the acting general manager of the revamped ISD.

GE pulled most of its information processing activities into one large Information Systems Division last January, evidently in an attempt to focus previously decentralized and somewhat loosely connected operations into one powerful assault on the edp market.

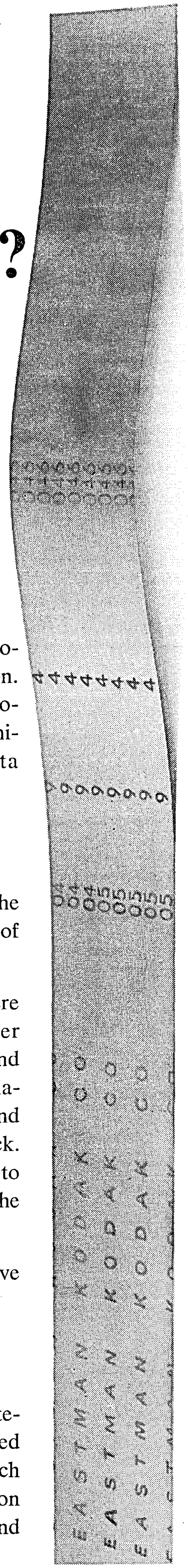
Dr. Rader, brought back to GE in 1964 after a tour of duty as top man at Univac, was picked to head up the new division. Under Rader, process control, general-purpose computers, peripheral equipment, communications, semiconductors, etc. were brought into the divisional tent. It appeared to be a reversal of the ancient and honored tradition within GE of autonomous department profit/loss responsibility along functional lines. Thus, the computer department in Phoenix became essentially the focal point for equipment engineering and manufacturing under Louis E. Wengert, while marketing and field engineering—among other activities—were assigned to Jerome T. Coe, out of NYC.

Under the new setup, the Phoenix operation again centralizes marketing, field engineering, engineering and production under Wengert, who as head of Information Systems Equipment, is one of four deputy division general managers reporting to Cross, who continues as vp and group executive. The others are Coe, who heads up Information Services, including the data centers, Medinet and Internal

The Telemax Message Composer, manufactured by Rixon Electronics Corp., is used by subscribers to the Telemax Reservation System, a communications network for travel organizations scheduled to begin operations this month. Set up by Telemax Corp., a subsidiary of Maxson Electronics, the service will use two Univac 491's, a 1004, Fastrand, and tape units—backing up thousands of terminal units in the U.S., Canada, Mexico, Bermuda, Puerto Rico, and Hawaii. With headquarters in East Orange, N.J., the Telemax service will go into action in the spring, starting with about 2500 subscribers, including hotels, motels, car rental agencies, and travel agents. At a demonstration of the system, a reservation was made and hard-copy confirmation produced within five seconds. The Telemax computer center will be managed by Aries Corp.



# Why do so many buyers come to CEC for "traceable" tape?




# Because only CEC has it.

When the new CEC Magnetic Tape was introduced, we expected it would start a revolution. And *that* it did. For this tape, created and produced for CEC by Eastman Kodak, has eliminated virtually every tape problem in data recording.

## The key is traceability

All CEC tape is *numbered*—color-coded on the box, reel; even digitally numbered on the back of the tape itself for instant identification.

For example, on every 15 inches of tape there appears an internal Kodak reference number which immediately identifies the tape by type; and every 30 inches there is a numbered tape signature which provides an index to the coating and test records for that particular production block. So efficient is this coding method, it is possible to trace any roll of tape all the way back to the master web from which it came.

As a result, reel mixups and misplaced data have become problems of the past.

## A tape for every recorder

CEC tapes are divided into *four* specific categories. Collectively, they meet the most advanced requirements of *every* data recorder. Yet each tape records at the highest applicable resolution and sensitivity—with the greatest uniformity and lowest tape and head wear obtainable today.

## Now add these other advantages:

- Only CEC tapes provide a standard nomenclature for simplified identification and ordering: S-1 standard, 100 KHz; SX-1 standard extended, 300 KHz; M-1 medium band, 600 KHz; W-1 wide band, 1.5 MHz.
- Only CEC tapes are so precisely differentiated that users are no longer subjected to the time-consuming burden of performance evaluation.
- Only CEC tapes come shielded in metal containers—packed in cardboard filing boxes covered with protective plastic sleeves.
- Only CEC tapes are protected from shipping and storage damage by means of a plastic waffle hub, thus preventing tape serration and flange deformation.

Yet, with all these exclusive benefits, CEC Instrumentation Tape costs *no more* than the conventional tape you may still be using.

Write now for your free CEC INSTRUMENTATION TAPE CHART. This special chart lists CEC tape categories, applications, and models of recorders for which each tape is recommended. Ask for CEC Chart DM-47-X3.

CEC
Data Instruments Division

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CIRCLE 61 ON READER CARD

# news briefs

Automation Operation; Leonard C. Maier, Jr., Systems Development and Components (essentially R&D), which includes a Planning and Resources operation as well as Semiconductor and Remote Access operations; and Harrison Van Aken, who continues as deputy division manager, overseas operations.

The major effect of the reorganization is to streamline communications, especially between marketing, engineering/production and field engineering, and to centralize the responsibility for product line success in sales, service and performance. The move appears on the surface to be a demotion for Rader, who now heads up only one portion of what used to be his total responsibility. But GE says the move is intended "to place increased emphasis on the booming process control business."

What GE calls "immediate software" activity—software for established machines—has been assigned to Paul Quantz, who reports to the head of engineering at the Computer Equipment department in Phoenix. John Weil, who is acting head of engineering, will head up long range hardware and software development as manager of the Advanced Systems and Technology operation under Maier. Bob Bemer will continue to serve as software consultant to Weil, while Pierre Abetti, formerly manager of large-scale systems applications for both Olivetti-GE and Bull-GE, will serve as manager, Applied Management Information & Control Systems under Maier.

The reorganization was interpreted by some outsiders as a retrenchment and a weakened faith in time-sharing. But there have been no personnel or budget cuts, according to the company. And our understanding is that GE will continue to offer the 645 (time-shared version of the 635) to interested parties, although there will be no software guarantee. What is likely to happen is that GE will offer people interested in the 645 the alternative of later delivery of a more expensive, faster version of the 645 with proven software.

GE took the early time-sharing play away from IBM with prestigious orders at Project MAC and Bell Labs, but IBM made one of its patented rapid recoveries, announced the 360/67 as its answer to the 645, and has walked off with a bundle of orders (perhaps 60-70). The success of the 360/67 suggests that GE's new management alignment must come up with a significant improvement over the 645 and the /67 if GE is to maintain a successful assault on the large-scale t-s system market. Even then, it's not clear how many t-s enthusiasts will accept the delayed delivery.

## NIPPON ELECTRIC CO. OFFERS COMPUTER SERIES

A new series of computers, the NEAC 2200, has been announced by Nippon Electric Co. The character machines—models 50, 100, 200, 300, 400 and 500—will offer 2K to 16K core and an I/O transfer rate of 819K cps. Rentals will range from around $722 to $2500/month, according to one newspaper report. "Three E" software will include Japanese-language Easy Bill (for banking), Easy Pull (a version of FORTRAN), and Easy COBOL. It's believed to be the first major Japanese-language software package. A time-sharing system is being planned, with work to take place at Osaka Univ. on a 2200-500, to be delivered in December.

## DPMA ANNOUNCES SIXTH ANNUAL CDP EXAMINATION

The Data Processing Management Assn. will offer the sixth annual examination for the certificate in data processing at 99 sites in the U.S. and Canada on Feb. 25, 1967.

A total of 7304 have now passed the test, open to applicants with at least three years of full-time job experience in data processing who have also met certain college course requirements. A study guide, which includes information on these requirements, application forms and a list of test sites will be available from local DPMA chapters and from international headquarters at 505 Busse Hwy., Park Ridge, Ill. 60068. Applications for the next test must be filed by Dec. 1.

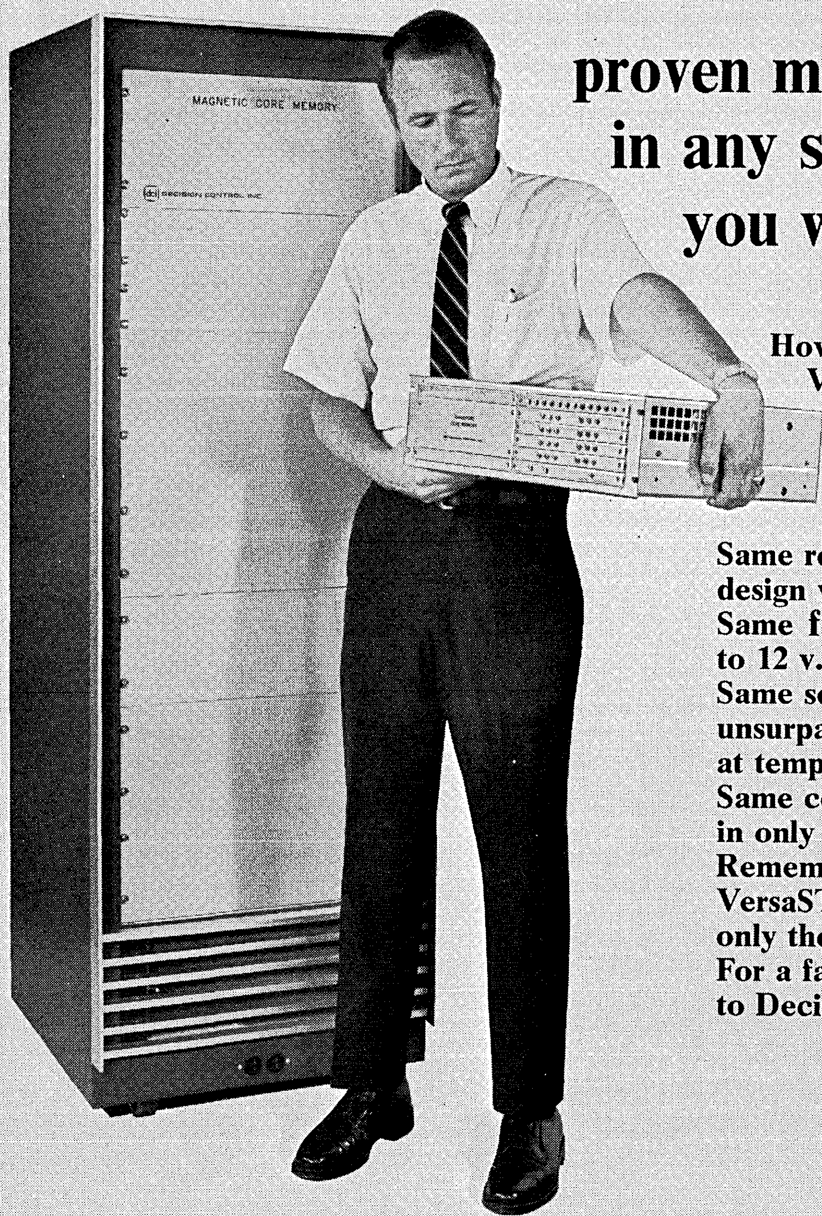
## CHICAGO FIRM PLANS RAILROAD DATA CENTER

RAILDATA Corp., a newly-formed Chicago company, is setting up a computer and communications system that will record, store, and retrieve freight car information. It will be known as the Car Information Clearing House (CINCH), according to Marvin W. Ehlers, president.

Ehlers said that his company will use two IBM 360/40's with 400 million characters of disc storage, up to eight tape drives, and several video displays. Total cost is expected to be $2.5 million.

To make the operation practical,

# Now, from Decision Control



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CIRCLE 63 ON READER CARD

Ehlers says, his company will have to serve railroads whose combined ownership of freight cars amounts to at least one million of the estimated million-and-a-half in operation. Later this year, Ehlers and his associates will decide, based on letters of intent from railroads, whether there is enough interest to go ahead. Thus far, he says, "the results have been much better than we have expected."

The subscribing railroads will provide data in any convenient form. "We seek to be as flexible as possible," says Ehlers.

Initially, he anticipates that each of the subscribing railroads will ask car location questions of RAILDATA from a central point. He reasons that since they now have this kind of information in one location and in one individual, centralized system, it will present few difficulties in hooking up to the RAILDATA computing center. Ultimately, however, he thinks car location data may be furnished from switching points and transfer yards across the country.

Ehlers points out that freight car locations will be only the first—though most important—service offered. Others he anticipates:

Correlation of "piggy-back" trailers and containers. The shipper now has information on the trailer only, not on the car carrying it.

Clearinghouse per diem charges for cars used by other railroads. A centralized system could provide a service similar to a bank when it clears checks.

Message switching to let all railroads use a central system to communicate with each other by computer or Teletype is another service being considered.

Ehlers is executive vice president of Ehlers, Maremont & Co., Inc., of which RAILDATA is a wholly owned subsidiary. He was a midwest representative for C-E-I-R, Inc. Serving as vice president and general manager of RAILDATA will be Robert L. Bell, formerly manager of systems and procedures for The Milwaukee Road.

### IBM DATATEXT STARTS ON WEST COAST; VIP SYSTEM WILL START IN EAST

An on-line editing service called DATATEXT that allows up to 80 customers access to a computer has been announced by IBM, with the first system now operating in San Francisco. It's basically the same as their Administrative Terminal System, with the addition of housekeeping routines to clock charges.

This is the second time-sharing service to be sold by the new Information Marketing organization, a part of the Data Processing Div. They also have QUIKTRAN and Industry Information Service, a computer-based marketing analysis plan.

Users need type any document just once, using a 2741 terminal, for entry into a 1440. The text can then be edited, corrected, or updated and a new copy requested at the terminal. For large jobs, a 270-lpm printer will be available that can handle both upper and lower case letters. Only 40 terminals can be in action at once, the total of 80 being arrived at by operating two six-hour shifts. Costs are the usual mishmash of lease or buy, installation charges, line usage, minimums, and options, but IBM estimates a typical customer would be in for about $600 a month.

Other DATATEXT centers are planned for Chicago, Cleveland, Los Angeles, New York, and Philadelphia.

Meanwhile, a nearly identical service has been underway in the east, to be offered by VIP Systems Corp. President Joan Van Horn will open the first center in Washington, D.C., about Nov. 1 and plans to add New York and Boston next year in June. VIP's system uses the same IBM equipment but it's to be available on one eight-hour shift instead of two of six hours. Another important difference is that VIP's prices are scheduled to be lower than IBM's. Basic charge will be $375 a month, with some ups and options too. Plans include a later switch to System/360's as well as further expansion to other cities.

### COMMERCIAL TIME-SHARERS SEE PROFITS ON HORIZON

Time-sharing marches on. In Boston, KEYDATA—a test case for commercial t-s—is moving toward viability. The firm has over 60 terminals on-line and some 50 subscribers, half of whom are paying customers, all in New England.

Over in Princton,N.J., Applied Logic Corp.'s PDP-6 has 10 customers in action (up to four simultaneously) with 18 waiting in the wings while a drum interface is installed, when the system will be able to handle 12 users concurrently . . . probably this month.

At MIT's Project MAC, the granddaddy of t-s, the GE-635 is running with a 645 simulator and the 645 is being shaken down. It looks as though the 645 will be operative in the spring, with "customers" on-line by June.

GE's Los Angeles service bureau,

# Disc Memories! No one has more to offer than Librascope

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Inexpensive 10″-disc memories with capacities to 300,000 bits.

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**LIBRAFILE 4800:**
48″-disc mass memory capable of transferring data at up to 432 megabits/sec.

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Small, compact 6¼″-disc memories designed for airborne (MIL-E-5400, Class 2) applications, and larger, high-speed random-access 14″- and 24″-disc information storage systems for shelter, van, or shipboard applications.

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**See the Librascope disc-memory line at the Fall Joint Computer Conference. Booth 528-534.**

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CIRCLE 65 ON READER CARD

## news briefs

using a 265, is sold out and there is talk of adding another system.

Also on the west coast, but spreading out fast, is Allen-Babcock Computing. ABC has offices in Los Angeles and Palo Alto, site of their 360 Model 50, custom-modified for time-sharing to the firm's specifications. President Jim Babcock has just added a 2-megabyte mass core which is in operation, will soon have a Datacell as well. They now have 20 terminals going, all being used by paying customers. Most are on the coast, but some have been installed in Houston and New York. A real novelty: ABC offers PL/I to customers. The company is waiting for delivery of 40 more terminals, adding Telex and TWX users Nov. 1, and planning a demonstration at the FJCC.

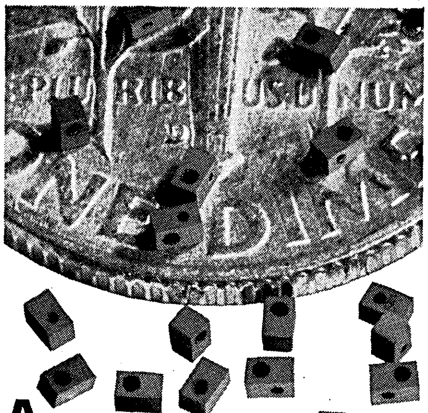
In Washington, D.C., CEIR's experimental time-sharing service, using a GE-265, has 62 customers—each averaging about 60 hours a month—and is about at the break-even point.

And as a prelude to future time-sharing systems linking incompatible computers, the TX-2 at Lincoln Lab and Q-32 at System Development Corp. have been joined by a 1200 bps, 4KC, dial-up broadband service. The project, funded by existing ARPA contracts, will permit users at each location to work problems using remote programs, including graphic software. The Q-32's replacement, a 360/67 due late this year, and MAC's 645 may also join in. First description of the effort will be at the FJCC.

### ACM NATIONAL CONFERENCE ATTRACTS 1,500

The 21st national conference of the ACM (Assn. for Computing Machinery), held last month in Los Angeles, came off very well in terms of technical content. It drew more than 1500 paid registrants. Notable among its accomplishments was the awarding of the prize for best technical session to a group discussing the social implications of computing. Organized by Paul Armer of the RAND Corp., The Social Responsibilities of the Computer Professional and the Industry featured Richard Hamming of Bell Labs as moderator, and panelists Emmanuel Mesthene and Anthony Oettinger of Harvard, and Robert Ryan of the Regional Industrial Development Corp. of Southwestern Pennsylvania.

The changing technology, of course, affects both the lay public and people in the industry. And so the ACM Council, meeting before the confer-





## news briefs

ence convened, voted an additional $20K to the already-available $25K for the association's professional development program. It also created the position of a full-time director whose job will include holding courses on compilers, information retrieval, etc.

The feature of the Undergraduate Student Papers session was the presence of a 13-year-old boy from Poughkeepsie, John D. Sybalsky. The seventh grader presented a paper, "A General Purpose Translation Demonstrator." The prize for the best paper, however, went to a student at Carnegie Tech, Robert N. Chanon, for his Almost Alike Programs. This is software that analyzes the way student programs solve an assigned problem, picks out similarly-written programs, and leads instructors to any cheating by students.

### DPMA FALL CONFERENCE MEETS IN LA OCT. 25-28

The fall conference and business exposition of the Data Processing Management Assn. will be held late this month in Los Angeles, with headquarters at the Biltmore Hotel. Running from Oct. 25 to 28, it will feature technical sessions, audience-participation workshops, tours, and exhibits.

Keynote speaker on Wednesday, Oct. 26, will be Dr. Lee L. Davenport, president of General Telephone and Electronics Laboratories Inc., the advance research arm of GT&E. Associated with developments in laser systems and data communications, Dr. Davenport will speak on The Challenging Future of Business Communications.

In the 48 seminar sessions, with some 80 speakers participating, topics such as these will be covered: statistical decision making, management simulation techniques, new development in languages, graphics and videos, optical scanning, and medical dp and hospital administration. There will also be 16 workshop sessions devoted to specific problem areas. No advance registration for the conference is required.

● A major order for retail point-of-sale data collection equipment has been placed by the Joseph Magnin Co. with the American Totalisator Co., a division of Universal Controls. Coming to about $1 million, the order may be the largest yet placed in retailing for automating sales and inventory data collection and transmission. About 250 Uni-Tote registers will be installed in the 28-store group. They are to be fitted with data transmission equipment specially designed for the application by Ultronic Systems Corp. These units will feed into telephone lines to complete a network for the California/Nevada retail chain.

● The Richland, Wash., computer center of Computer Sciences Corp. has opened a link to Boise, Ida., for on-line use of its Univac 1107. This is the third city to get the service, which is called Remotran; Seattle and Vancouver, B.C., hooked up in April. CSC now has about 40 customers in the Pacific Northwest.

● With a 301 donated by RCA, the Roper Public Opinion Research Center at Williams College, Mass., will set up a massive file of public-opinion information, covering some 400 million answers to questions gathered since 1936. Plans for next year call for linking the system to UC Berkeley, MIT, and the Univ. of Michigan, with help from the National Science Foundation. A data bank will then be built up from the results of more than 7000 studies conducted in the U.S. and other countries by Roper, Gallup, and 101 other domestic and foreign polling organizations. Social scientists at the universities will then have access to the data, with the computer handling statistical breakdowns of 74 major subjects.

● The results of a three-year project of controlling traffic signals by computer have convinced the city of San Jose, Calif., to install an IBM 1800 data acquisition and control system. The experiment, conducted jointly by IBM and the city, involved a three-mile thoroughfare with a traffic rate of 35,000 cars/day and 32 traffic lights. Under computer control, the lights permitted a reduction of time for the trip to 10 minutes from 11 and saved drivers about 50,000 stops per day, an improvement of 17%.

● Ford Motor Company has established a communications link between Ford of Germany in Cologne and their Technical Computing Center in Dearborn, Mich. The center has a Philco 212, with a GE-265 and Datanet 30 tied into telephone lines. Rout-

# news briefs

ing through the lines of five telephone and cable companies completes the connection with Teletype terminals in Cologne. This is the second overseas hook-up for the center; Ford of Britain at Basildon went on-line in June. The system also includes 57 U.S. remote terminals.

● Another plan to make the telephone serve as a computer input device is being proposed, this time by the Stromberg-Carlson division of General Dynamics. Their experimental model, which may be demonstrated in October, includes both inquiry and voice response units in one instrument, a modified Stromberg-Carlson Tone-Dial telephone. It has 12 push buttons and one of them acts as a shift to let the others serve dual functions. The "4", for example, is also a square root instruction and the "8" is also a plus instruction. Another key is used either as a decimal point or to request the verbal response after transmission of input. The experimental unit is at the Rochester, N.Y., plant.

● Changes to the model 465 Databosser, manufactured by Dashew Business Machines, make it possible to produce plastic dialing cards directly from punched cards. The automatic dialer cards can be punched, embossed, or stamped with both alphabetic and numeric data. Since Touch-Tone phones are becoming widely used for data collection and transmission, with cards the most convenient means of supplying static data, large-scale production capacity for the cards has become significant. The modified model 465 can turn out 3000 per hour.

CIRCLE 171 ON READER CARD

● The Digital Computer Assn., LA's original computer, marching and chowder society which paved the way for more orderly professional organizations, will conduct its annual nostalgic bash aboard a sternwheeler Nov. 18. Thirsty newcomers who wish to brush up on the industry's highly informal past and prepare to perpetuate disorderly traditions are invited to join the oldtimers. Reservations for the event, being sponsored by DATAMATION, can be made by calling 213-399-2225.

# On November 8th Tasker unveils the Series 9000 Modular Display Console...

**a true building-block system you design to your requirements ... with the speed, options and capability you'll need in coming years.**

**See it at the Fall Joint Computer Conference.**

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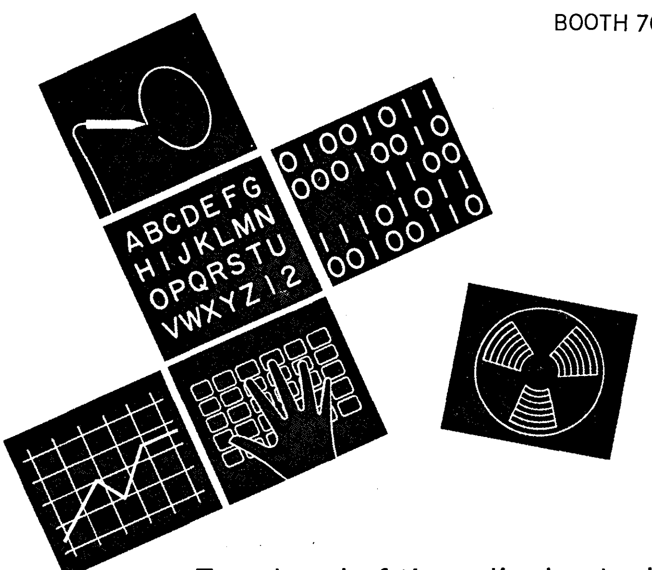


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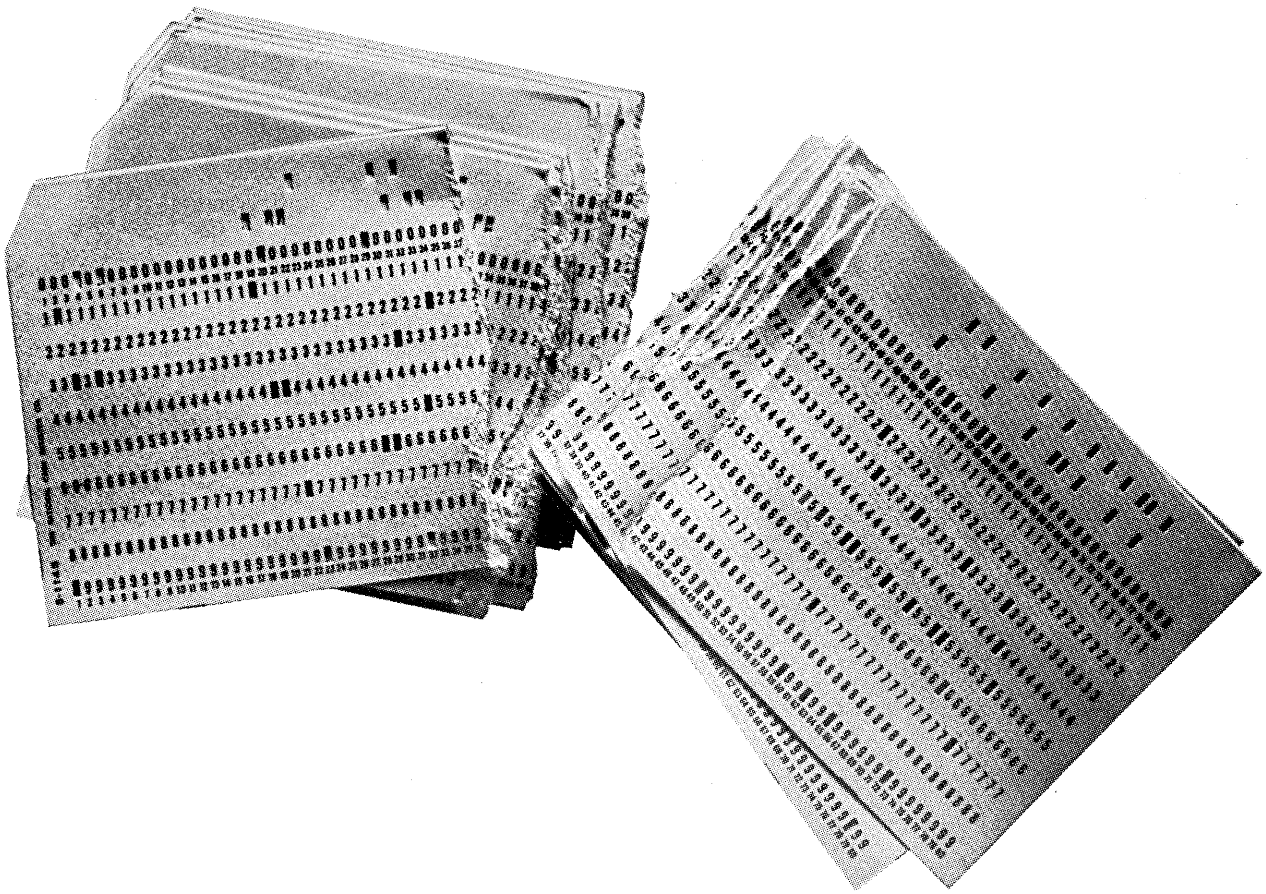
It's the NCR 735 Magnetic Tape Encoder.

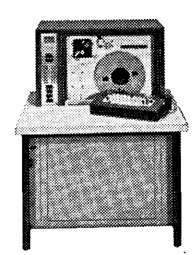
It has a keyboard like a card punch, it's about the same size as a card punch, but it doesn't work like a card punch. It works like an NCR Data Encoder. It "writes" directly on mag tape. It eliminates a computer run, saves computer time, and increases throughput speeds.

You have no cards to buy, punch, read, store, or insure. You have one device that both "punches" and verifies. Your input media is magnetic tape . . . storable and reusable and less costly than cards.

So play your cards right. Get rid of them in favor of magnetic tape. Your NCR representative can tell you how. Or write to us at NCR, Dayton, Ohio 45409.



NCR



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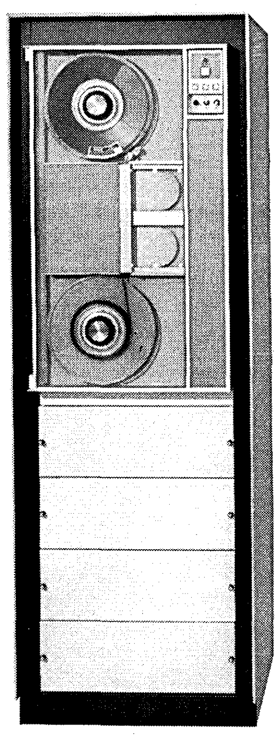
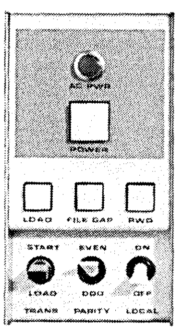
CIRCLE 72 ON READER CARD

# This New 3M Asynchronous Digital Recorder writes data at the rate of 2000 characters per second

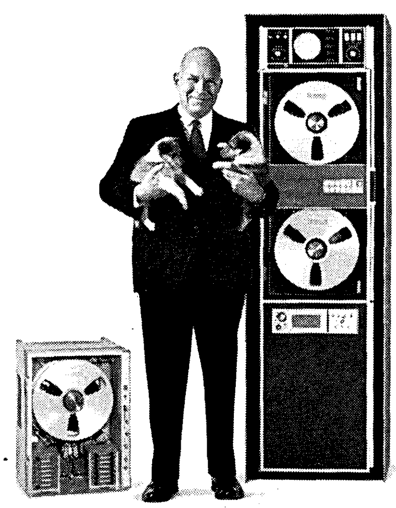


See it at Booth 1139, Fall Joint Computer Conference, Nov. 8-10, San Francisco



**Revere-Mincom's new ADR-100 records during the start interval** —that's why you never lose any data in the asynchronous mode, and why this 3M system accepts data at least four times faster than any other asynchronous digital recorder available to date. 2000 characters per second, internally produced inter-record gap if required.

Perfect backup for all IBM systems. Using IBM-compatible 7- or 9-channel tape format, ADR-100's packing density (up to 800 bpi) is due to improved skew control with skew ıated at less than 250 microinches. Single-capstan friction drive, no pinch rollers.



Developed and manufactured by the leader in instrumentation recording—Revere-Mincom in Camarillo.

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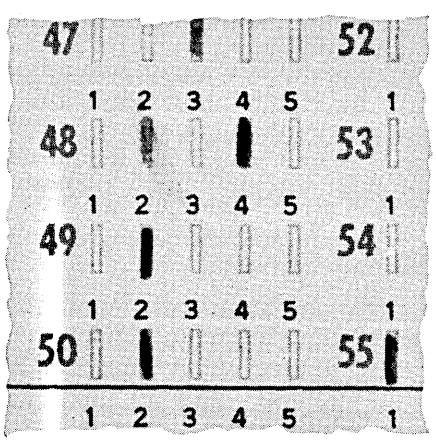
CIRCLE 73 ON READER CARD


DURA
MACH 10

# Now, any ten-year-old can feed data to your computer.

**Now anyone,**
**anywhere in your organization,**
**can talk to your computer.**
**All they need is**
**a No. 2 pencil.**
**All you need is**
**a Digitek**
**Optical Reader: $29,750.**




Straight lines: that's all it takes.

Short, vertical lines that can stand for numbers, letters, people, things, opinions—in English, Swahili, BCD.

(Remember the Board Exams? The Preference Tests? Enrollment Forms? Chem 101 Finals? That's where the idea of using a pencil mark to represent data began. Incidentally, if you do have tests to mark, we can do that, too. But that costs $39,780.)

You can put up to 2440 of those straight lines on an 8½ x 11 sheet, and then feed it to our Digitek optical reader. To be precise, you can feed 2400 of those sheets an hour to our Digitek optical reader; it's three times faster than others.

The Digitek system will:

- ☐ Transfer the data to paper tape. Or to mag tape. In a read format that suits your computer: we're compatible with them all. Matter of fact, we'll even paint the Digitek unit to match what you've got.
- ☐ Provide item analyses.
- ☐ Read only the darkest mark in each response grid. (See the poor erasure on item 48? It doesn't count.)
- ☐ Sort out all improperly marked sheets.
- ☐ Switch from job to job in less than twenty minutes.

And Digitek's price doesn't hurt at all: less than $30K for the reader and your choice of mag tape or punched tape output.

The forms cost as little as $8.50 a thousand. The pencils, you've got in your desk. And you already have a data-acquisition terminal anywhere you've got an employee.

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CIRCLE 100 ON READER CARD

## gp computer

Available for rack mounting or as a desk console, the Series 480 is a byte-oriented processor with an 8-usec cycle time; a 2-usec core memory is also available. Memory is expandable from 1K to 64K characters. The memory is character-organized, each 10-bit character consisting of eight data bits plus parity and word-mark bits. Each 8-bit byte can contain two digits, a character, or eight bits of binary data. A word consists of any number of characters.

The 480 can be fitted with up to four I/O channels, three of them having simultaneous compute capability. Each channel can address six I/O devices. Peripherals include paper tape readers and punches, 80-column card punches and readers, printers and plotters, discs, drums and mag tape drives. There's also data communication gear, keyboards, and a-d and d-a converters. BUSINESS INFORMATION TECHNOLOGY INC., Natick, Mass. For information:

CIRCLE 101 ON READER CARD

## ˇ punched tapes

punched tapes with thick-
ɴ 0.0043 to .0015 inch have
to the firm's line. They
in 1$\frac{1}{16}$, ⅞ and 1-inch
ɪ without splices. The
les paper/Mylar/paper
ɪr/foil/Mylar, and met-
ɔombinations. ARVEY
ɔ, Ill. For information:

ON READER CARD

## upgraded displays

If there's a 360 in your future, the 2250 mod 2 and 2840 mod 1 have been replaced by improved units. The new 2250 mod 3 and 2840 mod 2 display and control systems are said to perform simultaneous lightpen operations on up to four display terminals without computer support, and sketch, modify, move and highlight images with little or no computer support. Larger and faster buffers have also been added, improving image stability while displaying more vectors. IBM DP DIV., White Plains, N.Y. For information:

CIRCLE 103 ON READER CARD

## accounting machine

The E1400 is a low- to intermediate-range unit that operates on business forms with a magnetic-ink stripe. It includes a console with features of the firm's accounting machines, plus special-purpose control keys and lights. The processor has a 52-position core memory, as well as a wired mem-

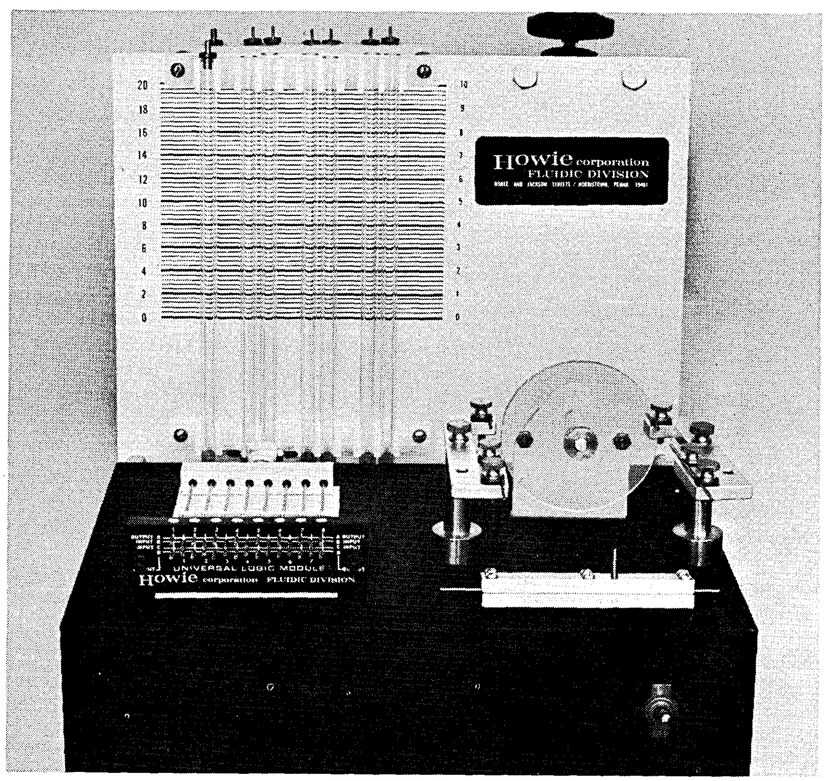
## PRODUCT OF THE MONTH

For the experimenter, this desk-top fluidic systems lab demonstrates capabilities of fluidic logic and control, using turbulence amplifiers. Serving as a logic breadboard, the unit is designed to show how turbulence amplifiers can be used in logic systems, control systems, and industrial applications.

Heart of the unit is a Universal Logic Module which has eight turbulence amplifiers with a supply and an output manifold. The output passes through an interconnection block that is ported to give five output connections to each amplifier. Logic functions (or, nor, and, not, memory) can be set up and tested. Circuits can be tested for condition sequencing, programming, counting, or checking industrial operations.

The lab consists of the universal logic module, fluidic limit switch, supply level manometer, six manometers for indicating signal levels, air stream detector, two interruptable jets, pressure regulator, etc. FLUIDIC DIV., HOWIE CORP., Norristown, Pa. For information:

CIRCLE 104 ON READER CARD



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discou
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put, an
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state unit
functions. Bu
troit, Mich. Fo
CIRCLE 1

**magnetic disc**

Two disc files fo
525-line video frame
Frames can be stored
of analog video at freq
to 4.2 Mc or digitally at 200,0
frame. The F Video Disc
stores up to 20 tracks (frames). Fix
head-per-track design, along with
storing one frame per concentric track,

enables separate frames to be shown on separate consoles. The M Video Disc Recorder uses interchangeable cartridge discs to store 131 frames of video on each side. A single movable head can record or reproduce a frame in an average ⅛ second. DATA DISC INC., Palo Alto, Calif. For information:

CIRCLE 106 ON READER CARD

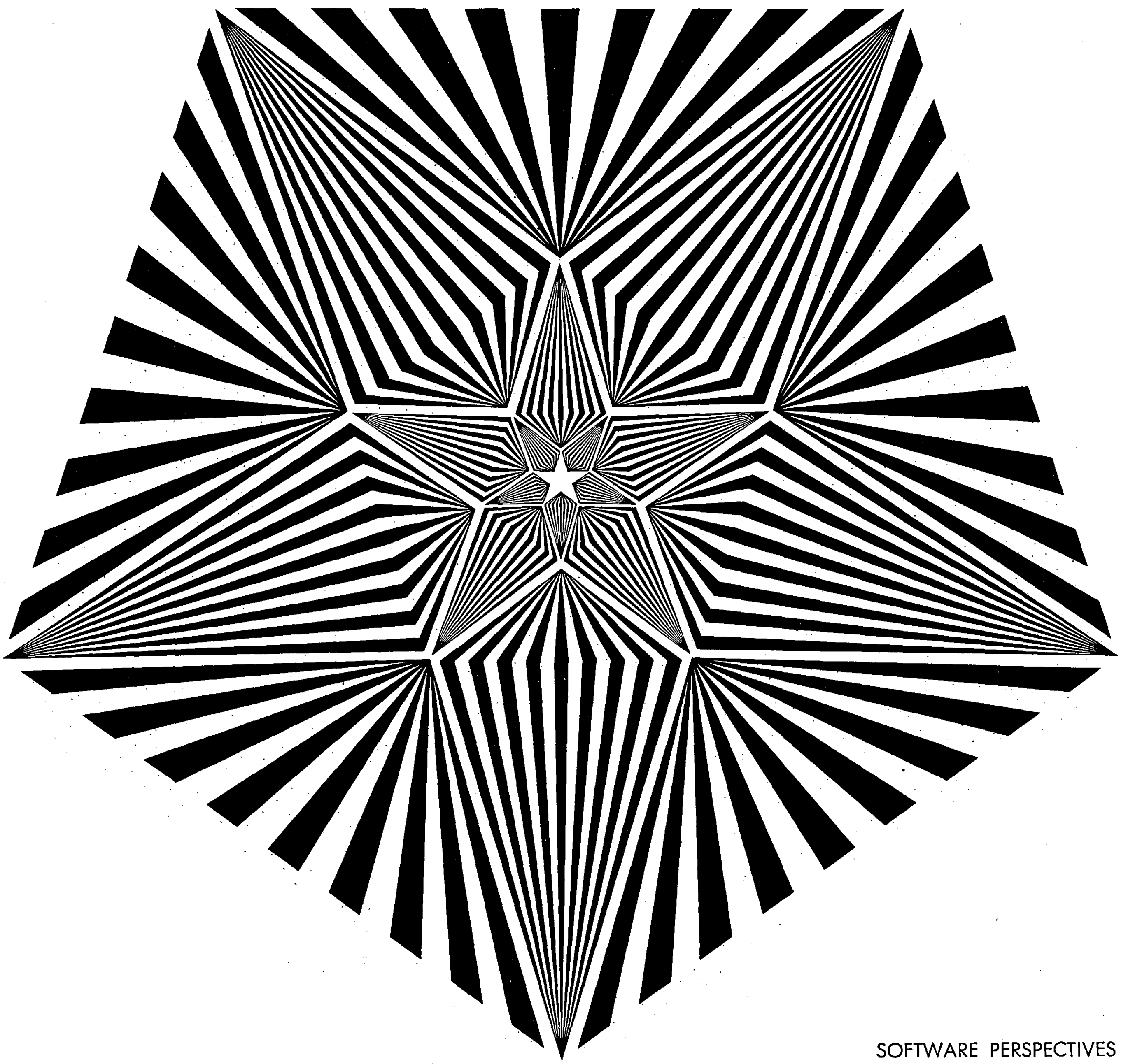
**enlarged card storage**

The model 353-5 is a CRAM unit that uses larger cards to store up to 62 million characters. It holds decks of 384 magnetic cards, each of which has 144 tracks, compared with seven and 56 tracks on earlier models. (Past decks had 128 and 256 cards.) The new unit also features a movable head asssembly with 36 read-write heads, an average access time that is speeded by a third, and a transfer rate of 38,000 cps. First delivery is m
NATIONAL CASH REGIST
Dayton, Ohio. For informati

CIRCLE 107 ON READER

**line printers**

Printers with speeds of
lpm have a character
font is the ECMA t
units have 132 and 1
Each has its own c



# let yourself GROW

## at NCR's expanding electronics division in los angeles

Take Southern California's largest commercial computer facility, multiply by two, and you have a quick picture of today's expansion at NCR Electronics Division. You can accelerate your own future by joining this dynamic organization now. At NCR, you will share new challenges with men who have already placed some of the world's most advanced digital systems hardware on the market. And you will help create systems to bring business automation to more than 120 countries. The Southern California skies are clear and the track is fast. On your mark, get set, grow.

This Is Growth Year at NCR Electronics Division buffer, which can accommodate data at 200,000 bytes/second. The units are models 4554 and 4555 (1350-lpm) and 4560 and 4561 (750-lpm ENGLISH ELECTRIC-LEO-MARCONI COMPUTERS LTD., London, England. For information:

CIRCLE 108 ON READER CARD

### engineering software

For the PDS 1020 computer, an advanced engineering interpreter is available. The PR5464 enables the use of everyday mathematical terms for such computations as square root, sine, cosine, arctangent, etc., from a single command. PACIFIC DATA SYSTEMS INC., Santa Ana, Calif. For information:

CIRCLE 109 ON READER CARD

### disc video store

The Videodisc stores up to 20 seconds of real-time signals from a TV camera or other video signal source on a 12-inch aluminum disc coated with a nickel cobalt recording medium. The 20-second recording consists of 600 video signal frames. Applications include vehicular traffic flow, real-time X-ray exams, and aircraft landings and take-offs. The portable unit weighs from 25 to 50 pounds. MVR CORP., Palo Alto, Calif. For information:

CIRCLE 110 ON READER CARD

### forms cutter

Marginally-punched continuous forms are cut and trimmed, leaving four clean edges, by the models 20 and 25. Both single and double cuts are made by both models, which handle one- or multi-copy forms with or without interleaved carbons. Speeds range up to 25 forms/minute on the 25, and up to 160/minute on the 20. The unit is also equipped with a sequential forms stacker. The mod 25 is controlled by a paper tape, and the mod 20 is controlled mechanically. STANDARD REGISTER CO., Dayton, Ohio. For information:

CIRCLE 111 ON READER CARD

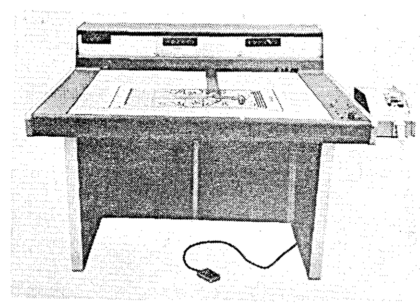
### upgraded computer

The DATA 620 processor can now be had with a microprogramming capability. The MicroEXEC makes it possible — externally to the processor — to control memory, registers, bus connections, I/O, adder and shift logic. Interfacing to the I/O bus, the added capability is available in several forms. The micro-bus and interface logic can be in the mainframe, or the micro-bus is available with the mainframe logic and a remote console, enabling manual execution of macro functions. In a third configuration, the micro-bus, mainframe logic and I/O chassis are wired to the micro- and I/O-buses and logic power; the customer then implements his own algorithms. DATA MACHINES INC., Newport Beach, Calif. For information:

CIRCLE 112 ON READER CARD

### coordinate digitizer

Model IDP 40 has a working surface of 36 x 36 inches, and IDP 60 30 x 60 inches. Both have a resolution of 0.0005 inch and accuracy of ±0.001 inch. Designed for use as an image plane digitizer, for graphical digitizing, and use as a layout table, the



systems feature incremental encoders coupled in the X and Y axes to produce 2,000 bi-directional counts/inch of travel. The resultant position is displayed in six digits (±99.9995 inch). DATA TECHNOLOGY INC., Watertown, Mass. For information:

CIRCLE 113 ON READER CARD

### random-processes software

The RAVAN (random vibration analysis) program performs various statistical analyses of such random processes as vibration, acoustics, and fluctuating pressure. It also analyzes Gaussian, Rayleigh, auto- and cross-correlation, power spectral, and similar functions. The program runs on a 7094 with a 1401 off-line printer and S-C 4020 plotter. If a plotter is not available, there's also a print-plot option. NASA COSMIC, Athens, Ga. For information:

CIRCLE 114 ON READER CARD

### display systems

Featuring a 23-inch CRT, the series 9000 console can be equipped with a standard keyboard, five other control devices, four display devices, and four different memory subsystems. Typical random position access time is 4 usec to traverse and settle on any part of the CRT: formatted characters are function-generated at 4 usec each, including spacing. Information displayed

## new products

can be digital, analog or a combination, and dynamic data can be superimposed on static data. The operator can edit, create, update, delete and retrieve information. Optional controls include lightpen, joystick or bowling ball (vector controls), transparent address grid and slide format projection. Also optional are vector generator, static grid generator, hardcopy output and symbol writer. Store/refresh memories available are delay line, drum, disc or core. TASKER INSTRUMENTS INC., Van Nuys, Calif. For information:

CIRCLE 115 ON READER CARD

### computer tape

The No. 777 mag tape is certified error-free at all densities up to and including 1600 bpi. 3M CO., St. Paul, Minn. For information:

CIRCLE 116 ON READER CARD

### optical reader

For banks and other financial institutions, new optical reader/sorter can be added to existing GE MICR document handlers. It reads the new COC-5 type font that can be printed on continuous forms and documents by GE-200 and 400 series computers. Document handlers with the expanded capability are said to process paper imprinted with both the COC-5 and E13B fonts as though only one font appeared. Unlike the 7-bar magnetic-ink font used in Europe, the COC-5 character is made from five vertical bars or lines irregularly spaced. GE INFORMATION SYSTEMS, Phoenix, Ariz. For information:

CIRCLE 117 ON READER CARD

### digital voltmeter

The model 3430A is a reduced-cost unit with an accuracy of 0.1% plus 1 digit. It can make measurements up to ±500 volts dc removed from ground, and input impedance is 10 megohms on all ranges. Price is $595. HEWLETT PACKARD, Palo Alto, Calif. For information:

CIRCLE 118 ON READER CARD

### dp tape safe

Data-Vault safes are available for mag tape, disc packs, data cell, aperture cards, and microfilm. Available as free-standing and walk-in models, they feature hermetically-sealed pressure doors with a single closing bar. Tests show that inner temperatures are about 110° F after being subjected

# 2½D or 3D. Lockheed offers both.

**Model CD-65.**
650 nanosecond full cycle time—less than 400 nanosecond access time. Capacity, up to 65,536 words and word length of 80 bits.

**Model CC-100.**
1.0 microsecond full cycle time—less than 400 nanosecond access time. Capacity, up to 32,768 words in 4096 word increments. Word length up to 120 bits.

**Applications:**
Commercial digital computer manufacturers; instrumentation system manufacturers; suppliers of computers for process control systems; government and military installations requiring real time monitoring and control systems; large-scale communications facilities requiring automated switching for telephone and teletype operations.

The customer proven performance of the CC-100 series derives from their Lockheed designed-in reliability. This same designed-in reliability has been coupled with the 2½ D organization to bring you the faster CD-65 Series. They both are demonstrations of Lockheed's wide capability in the design, development and manufacture of core memory systems.

Tell us about your memory system application, so that we can supply you with the most useful information about the CC-100 and CD-65 Series. Write to Lockheed Electronics Company, 6201 East Randolph Street, Los Angeles, California 90022.

LEC
**Lockheed**
**Electronics Company**
A Division of Lockheed Aircraft Corporation

CIRCLE 79 ON READER CARD

If you are a qualified engineer interested in working on memory systems, we can offer you challenging and stimulating work in this field. Join the technological leader in high-speed memories. Write or call collect to Mr. Ed Haas, (213) 722-6810. We are an equal opportunity employer.

to oven temperatures of 2,000° F for four hours. DATA-AMERICAN EQUIPMENT CO., Chicago, Ill. For information:

CIRCLE 119 ON READER CARD

**off-line printer**

The PS-6010 consists of an MT-36 vacuum-column tape drive and the 3502 chain printer. It operates at 600 lpm, and has up to 192 characters in 120 or 132 columns. Tape speed is 45 ips, data transfer rate is 36KC, and tape loading time is 15 seconds. POTTER INSTRUMENT CO. INC., Plainview, N.Y. For information:

CIRCLE 120 ON READER CARD

**farmer's computer**

The Feed Formulation Computer is an analog machine designed for the solution of feed-mix blending problems on a least-cost basis. Manual adjustment of potentiometers also enables a nutritionist to derive the best formula corresponding to a pre-determined cost. A 30 x 19 coefficient matrix defines the lab analysis of the percentage constituent in each raw material, which is entered by setting up the matrix of pots. Cost per unit weight and restrictions applied to each raw material are also entered as pot settings, and constraints placed on the level of constituents in the final mix are set up on dials. The percentage of each ingredient required is displayed on a digital voltmeter and printed on an electric typewriter. ELECTRONIC ASSOCIATES INC., West Long Branch, N.J. For information:

CIRCLE 121 ON READER CARD

**multiprocessor software**

The Associated Support Processor (ASP) program enables a 360/40 or 50 to perform routine clerical tasks and job scheduling when it's linked to a mod 65 or 75. In addition to handling local job I/O, the support computer can also send work to and receive work from remote computers that act as high-speed terminals for card reading, punching and printing. Locally, the support unit also performs media conversion. Software availability is scheduled for the first quarter of 1967. IBM DP DIV., White Plains, N.Y. For information:

CIRCLE 122 ON READER CARD

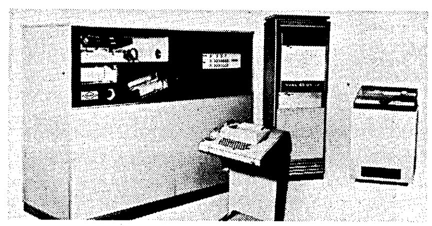
**marketing software**

Market analysis system reportedly facilitates the projection of new-product profit and loss statements. It projects statistics up to three years into the future. Produced are estimates of sales, expenditures, production and shipping volume on a monthly basis. As sales results on a new product are entered into the computer, they are compared with previous estimates to generate new estimates. One of the statistics produced is the predictable net income of the product by unit, city, region and sales area. It takes into account promotional expenditures, shipping costs, etc. INFORMATICS INC., Sherman Oaks, Calif. For information:

CIRCLE 123 ON READER CARD

**optical page reader**

The model 3030 page reader/computer system reads the firm's 12L font, which can be preprinted, typewritten or high-speed printed at 10 characters/inch or wider. Optionally, it reads the ASA-A font, which can be intermixed with the 12L. Output at 400 cps can be on mag tape, punched cards or tape, or combinations of these. The Data Machines computer, with memory expandable from 4K to 32K, is for control purposes, but in



expanded form can be used as a gp processor. Software available includes an assembler and FORTRAN IV.

Paper size accommodated is 4½ to 8½ inches wide and 5½ to 13½ inches long. Lines to be read are normally spaced five or six to the inch, but lines can also be selectively skipped. Optionally, 26 underscored capitals can be read to produce upper and lower case characters in the output. FARRINGTON ELECTRONICS INC., Springfield, Va. For information:

CIRCLE 124 ON READER CARD

**numerical control software**

Postprocessors for APT III, written entirely in FORTRAN IV, make the output of an APT processor acceptable to machine tools controlled by DynaPath Control systems. Applications of the postprocessors currently available are to a family of multi-axis tool changing machines, 2-axis lathes, and 2- and 3-axis milling machines. The new software can be run on the CDC 3600, Univac 1108, Philco 212, GE 635, and IBM 7094 and 360's. INDUSTRIAL CONTROLS DIV., BENDIX CORP., Detroit, Mich. For information:

CIRCLE 125 ON READER CARD

# new literature

**DATA TRANSMISSION SYSTEM:** Telespeed 1200 EDC paper tape sending and receiving equipment, which operates at 1,200 or 1,050 words per minute and automatically detects and corrects errors in transmission, is described in information sheet. TELETYPE CORP., Skokie, Ill. For copy:

CIRCLE 140 ON READER CARD

**MEMORY SYSTEM:** Four-page brochure describes the NANOMEMORY 900 with a capacity of 16,384 words of up to 84 bits, access time of 650 nsec and cycle time of 300 nsec. Specifications are listed, including a functional diagram and clear/write, read/restore and split cycle timing charts. ELECTRONIC MEMORIES INC., Hawthorne, Calif. For copy:

CIRCLE 141 ON READER CARD

**REVISED MANUAL:** Dynamic Storage Allocation Language in FORTRAN II is based on a series of 80-odd FORTRAN subroutines which include dynamic storage allocation, list processing procedures, character manipulation, ranking and sorting routines, statistical and matrix operations. 308-page manual provides instructions in the use of DYSTAL, including exercises and answers. Cost: $3. SOCIOLOGY COMPUTER LAB., Brown Univ., Providence, R.I.

**TAPE OPERATING SYSTEM FOR 360:** Handbook for programmers acquaints the inexperienced programmer with the scope of tape operating systems and provides a convenient reference to TOS techniques and control card formats. Among the subjects covered are system concept, job control, linkage editor, supporting a typical installation. Single copy: $1.50, or bulk rates. COMPUTER USAGE DEVELOPMENT CORP., Mt. Kisco, N.Y.

**TYPESETTING GLOSSARY:** 112-page book is an encyclopedia of automated typesetting progress and practice containing over 1,000 entries emphasizing computerization and associated use of photographic procedures. In addition to descriptions of systems, hardware and typesetting machines, the glossary also covers basic and advanced terminology in related subjects such as tape-controlled typography, photographic composition, data transmission, text editing, optical character recognition, cathode ray tube character generation. Free to CIS members; non-members: $15. COMPOSITION INFORMATION SERVICES, 1605 N. Cahuenga Blvd., Los Angeles, Calif. 90028.

**AUTOMATED DRAFTING:** System codes conventional drafting symbols and the coordinate locations on standard size drawings for entry on tapes used to drive a high speed photo-composition machine. Tech brief 66-10362. Cost: $15. CLEARINGHOUSE FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION, Springfield, Va. 22151.

**A-D CONVERTER:** Four-page bulletin covers operating modes, accuracies, control signals and resolutions (from 7 bits to 11 bits or three BCD and sign) and input impedance (over 100 megohms) for model 761A. ELECTRONIC ENGINEERING CO., Santa Ana, Calif. For copy:

CIRCLE 142 ON READER CARD

**TAPE READER AND SPOOLER:** Brochure details reliability test of 143 million lines and 50,000-hour redundant light source, plus specifications of the 100-cps, five to eight-level reader, which has one moving part. PHOTOLOGIC CO., Garden Grove, Calif. For copy:

CIRCLE 143 ON READER CARD

**PHOTOTYPESETTER:** Producing metropolitan telephone pages at a page a minute, Photon ZIP 901 inserts headings, page number and advertisements. Setting type across page width, the machine composes lines in all columns in each forward and backward pass producing a fully made up page. Six brochures describe this system, discuss operating methods, speeds in various applications, show samples of the work, detail computer require-

ments and machine specifications. PHOTON INC., Wilmington, Mass. For copy:

CIRCLE 144 ON READER CARD

**INCREMENTAL MAGNETIC RECORDING:** Eight-page bulletin compares relative costs, reliability and speed between various recording methods. Continuous and incremental reading options and Flux Check method of verification of data from tape are described, and pointers in the selection of incremental recorders and partial list of users are included. KENNEDY CO., Pasadena, Calif. For copy:

CIRCLE 145 ON READER CARD

**COMPUTER BIBLIOGRAPHY:** 80-page journal lists material that has been published in the U.S., U.K. and parts of Europe. Titles are listed alphabetically by author and material covers programming, translating and business machines, automatic computer control and computer design. Copies are available free as long as supply lasts. ROBERT MAXWELL & CO., LTD., Oxford, England. For copy:

CIRCLE 146 ON READER CARD

**TAPE CERTIFICATION:** 12-page booklet has center pull-out section comparing areas tested by various tape processes. Used are 16 testing heads arranged in an overlapping pattern for scanning and certifying the recording surface of the tape, testing a larger area than other methods. U.S. MAGNETIC TAPE CO., Huntley, Ill. For copy:

CIRCLE 147 ON READER CARD

**EQUALIZATION OF TELEPHONE LINES:** Eight-page booklet discusses delay distortion, delay equalizers and various methods of employing equalization devices to make lines suitable for high-speed data communication. RIXON ELECTRONICS INC., Silver Spring, Md. For copy:

CIRCLE 148 ON READER CARD

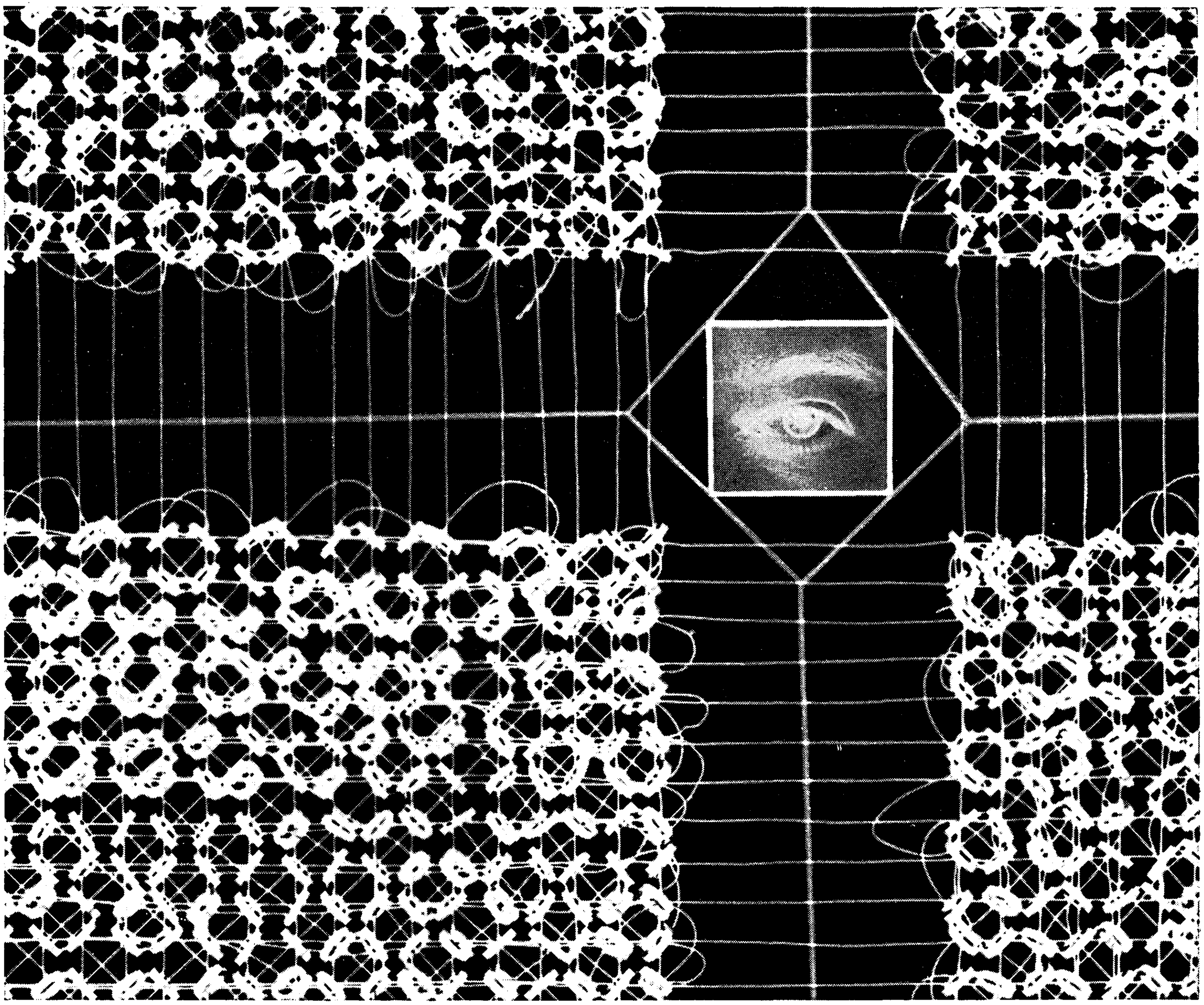
**RECORDER/REPRODUCER SYSTEMS:** Eight-page catalog describes performance characteristics, technical specifications, application areas for units W-7000, L-4000 and 6000, and P-4000 and 5000. WINSTON RESEARCH CORP., SUBSIDIARY OF FAIRCHILD CAMERA AND INSTRUMENT CORP., Los Angeles, Calif. For copy:

CIRCLE 149 ON READER CARD

**COMPUTER IN PHYSICS INSTRUCTION:** Existing physics programs for computational and linguistics-mode computer-assisted learning, and recommendations for future directions of experimentation with the computer as a teaching tool in physics are described in 80-page report. Contains price information and descriptions of remote console equipment available for use in physics teaching, detailed account of the Univ. of California, Santa Barbara, computer system, and a sample program for that system, as well as a flow diagram of a trial tutorial program on weightlessness. COMMISSION ON COLLEGE PHYSICS, Univ. of Michigan, Ann Arbor, Mich. For copy:

CIRCLE 150 ON READER CARD

**PERIPHERAL EQUIPMENT:** 38-page report covers general market factors, history, availability, relative costs, and major technical socio-economic developments. The structure of the industry is reviewed and future role of traditional firms and new entrants is weighed. Analysis, historical data and market projections are included for 19 product groups. Appendices list and describe 67 medium-sized firms active in the field and provide a trade



*Lockheed information systems hold the answer to a challenging career*

At Lockheed, the young and vital field of Information has created the industry's broadest range of outstanding opportunities. Scientific computing, satellite tracking, real-time data processing, hospital, educational, business, and governmental administrative information systems offer a unique opportunity for a varied and fulfilling career.

To accomplish its highly diversified assignments Lockheed maintains a centralized data processing facility —one of the largest computer centers in the country.

Scientific computing at Lockheed plays many important and varied roles in Flight Mechanics, Trajectories, Thermodynamics, Electronics, Propulsion, Structures, Flight Technology, Hydrodynamics, Navigation Guidance and Control, and other vital fields.

In other areas of activity, Lockheed has developed a revolutionary process for handling patients' records to free doctors and nurses to perform their primary duties. Lockheed also leads the way in state-wide information systems such as the one planned for the State of Alaska.

In addition, the planning and control of all U.S. Air Force orbiting missions is conducted at the Satellite Test Center, which also maintains one of the world's largest and most powerful real-time computing facilities with assignments ranging from simple ballistic missile shots to highly complex, classified satellite missions.

Engineers and scientists are invited to write Professional Placement Manager, Lockheed Missiles & Space Company, P.O. Box 504, Sunnyvale, California. Lockheed is an equal opportunity employer.

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CIRCLE 313 ON READER CARD

journal bibliography. Cost: $100. Subscription: four quarterly studies $325. ECONOMIC INDEX & SURVEYS INC., 10550 Park Ln., University Circle, Cleveland, Ohio 44106.

**DIGITAL PLUG-IN MODULES:** 40-page catalog describes VersaLogic and contains circuit diagrams of the modules and engineering data to aid the design engineer. VersaLogic is designed around the NAND gate, flip-flop and power amplifier, and is available in three speeds, 200KC, 2 and 8 MC. Included are flip-flops, gates, clock and timing modules, system interface modules, drivers and A/D modules. DECISION CONTROL, INC., Newport Beach, Calif. For copy:

CIRCLE 151 ON READER CARD

**FLUIDLESS PROCESSOR:** Model 1380 records CRT-displayed data, processes it, and produces positive and negative film records in approximately 3 minutes. Bulletin describes the camera/processor/viewer system which uses Kodak Bimat, a photographic developing material that requires no free fluids. PHOTOMECHANISMS INC., Huntington Station, N.Y. For copy:

CIRCLE 152 ON READER CARD

**MEMORY SYSTEMS:** Eight-page brochure describes and illustrates the construction and operation of FX-12. Random access memory, read-only memory, time buffering, format-conversion buffering and split sector are explained with block diagrams and examples of applications. FERROXCUBE CORP. OF AMERICA, Saugerties, N.Y. For copy:

CIRCLE 153 ON READER CARD

**TELEMETRY DATA SYSTEM:** DATACORE, the launch-area system for acquisition and processing of telemetry data from Saturn/Apollo and other vehicles launched from Merritt Island or Cape Kennedy, is described in four-page folder. Each system accepts PCM, PAM/PDM, and continuous analog telemetry data and time information simultaneously from sources via radio receivers, tape recorders, and wideband transmission lines. The system then converts analog data to digital form, identifies individual data samples, and stores data samples and time information in a magnetic core memory for pick up on demand. MONITOR SYSTEMS INC., Fort Washington, Pa. For copy:

CIRCLE 154 ON READER CARD

# look ahead

*(Continued from page 19)*

of four 1108's, lots and lots of 1004's and massive backup storage arranged in two double-1108 configurations. They've just installed a fourth 494, will now be handling the mission command and telemetry as well as communications processing. The 1108's go into the Computation & Analysis lab, where there is also an 1107. In addition, Univac is doing some $1 million/year worth of programming for the MSC.

Meanwhile, back at the labs, there are rumors of new products which may continue to make Univac salesmen smile in the years to come. Like the company may be near a lab version of an NDRO laser memory, consisting of a garnet crystal surrounded by an electromagnetic field which can be switched in either direction. Read-write cycles are described as a combination of optical & magnetic. A laser beam records on the crystal in a thermal fashion ... hence the nondestructive readout by the output laser beam. Storage density is up to 10K bits/in.$^2$.

HOLY PROLIFICS! DEC ANNOUNCES AGAIN

The PDP-10, running with an improved version of the PDP-6 software, will be the next out of Digital Equipment Corp. Announcement is expected at the FJCC. This all-new computer will come in four versions: a 4K (36-bit) word basic system, 16K extended, 16K multiprogramming system, and 32K time-sharing.

MORE GEAR FROM BUSY BIT

Business Information Technology, Natick, Mass., is readying announcement of a 900 series of data communications terminals, built primarily around its new 480 processor (see Sept. look ahead). Models 902-908, selling under or around $20K, will have the 480 as a buffer control unit for the Potter Instrument chain printer and/or a card reader, punch or reader/punch. The 901 will be a slave printer terminal selling for under $16K. Interfaces for standard 2- and 4-wire data sets will be provided. Later extensions of the stored-program series will include Potter mag tape drives in various combinations with card equipment and printers. Not stopping there, BIT also plans to come out with media conversion equipment competitive with Mohawk Data Sciences' line.

RUMORS AND RAW RANDOM DATA

Delivery on the Honeywell mass memory devices (mag tape strip) has slipped from third quarter '66 to mid-1967, but needy customers can substitute the H-259 disc drive, whose deliveries begin the end of this year. The drive, announced to the field in June, has a 9.66 megacharacter storage capacity on a six-disc pack, a 97.5 msec average access time, and 208K cps transfer rate. Control unit can handle 8 drives... We hear Fairchild will announce a 60 sq.-mm. monolithic i.c. chip soon which will contain 80 gates... Computer Control Div. of Honeywell will soon reveal its new i.c. computer, supposedly the "smallest, fastest, most powerful" 16-bitter on the market. Delivery should be fast too...The faltering municipal bond market has contributed to the demise of Munitype, New York firm which offered on-line bond calculation on a GE-215. Ultronic, which suspended its bond service several months ago due to equipment problems, will resume it sometime in the future, along with other services, on new equipment...Certron, L.A.-based tape certifier, is teaming up with an Australian firm to offer the service Down Under. The company is also test marketing in the midwest and Texas, thinking about other overseas ventures after it digests the new Aussie operation.

Engineers, Scientists, Programmers, Systems Analysts
Computer Professionals with B.S., M.S. or Ph.D. degrees

# Present your qualifications to over 25 leading employers during FJCC.

## Interviews will be held in San Francisco on November 8th to 11th. Use the coupon even if you cannot attend.

Over 25 employers from throughout the country are sending their top technical staffs to San Francisco for another important CAREER CENTER interview session the week of November 7. A number of employers will have several divisions present, so that approximately 50 different employment units will actually be interviewing. Literally thousands of new opportunities are available.

Whether or not you intend to visit San Francisco during FJCC, you can register and have your qualifications reviewed by sending in the coupon below. Please act now, so we will have enough time to send you the necessary registration material, and so the employers will have sufficient time to review your qualifications.

Your registration materials contain a simple data sheet. When the completed data sheet is received by us, we eliminate your name and address and rush the sheet to those employers which plan to attend. They then indicate their interest in meeting you by contacting us. Of course, there are never any fees for the CAREER CENTER service.

**Partial List of Attending Employers:**

| | |
|---|---|
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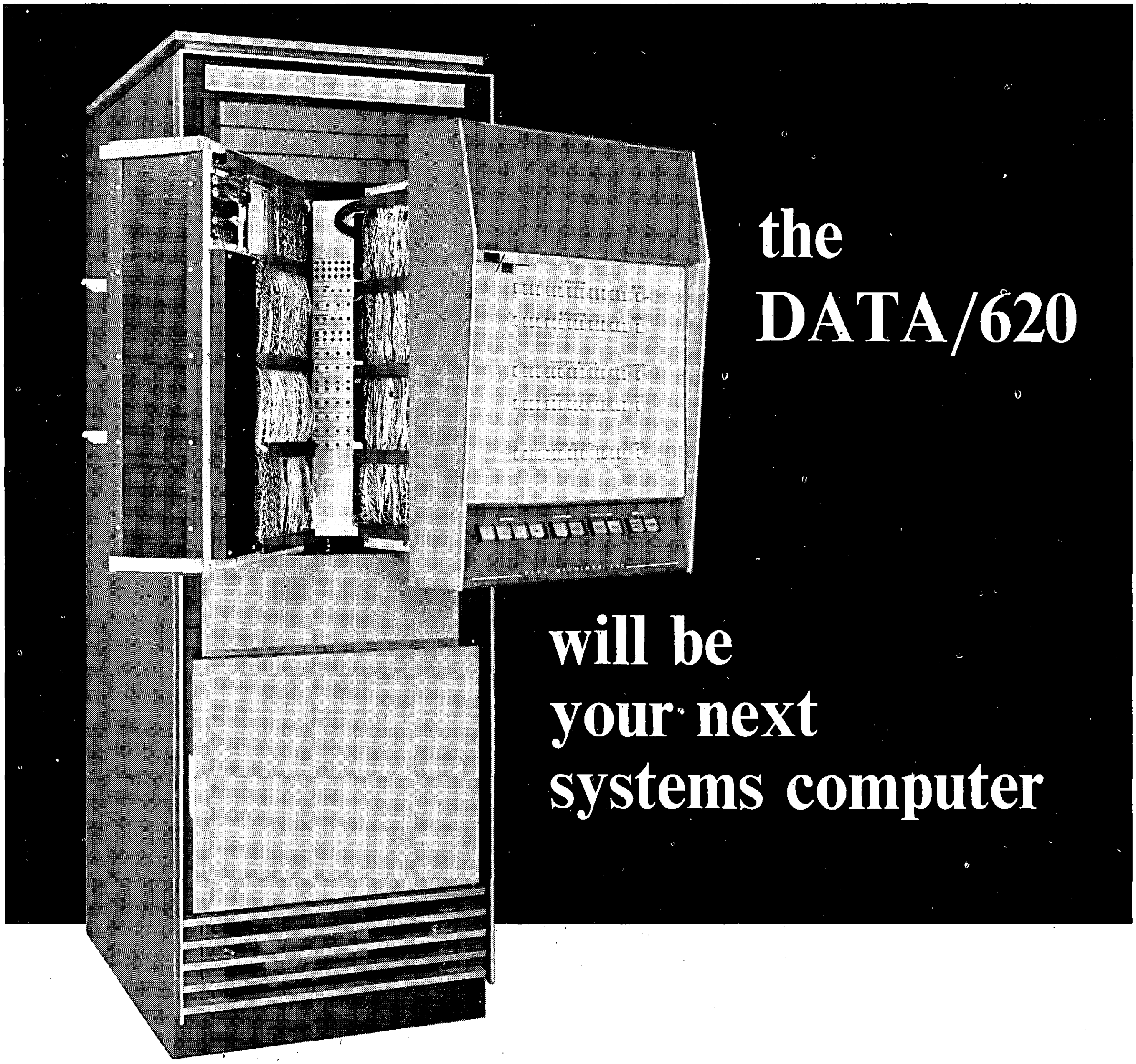


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# world report

## U.K. INVITES U.S. PROFS FOR SHORT-TERM STAY

Britain's Ministry of Technology is attempting to attract top American university personnel across the Atlantic for periods of one or two years to join in a new programme of post graduate research and education. This is not a deliberate ploy to reverse the persistent flow of scientific brainpower from east to west but is part of a campaign to resolve the U.K.'s computer manpower shortage. Manufacturers still provide the bulk of training for all types of computer and dp jobs in Britain, and a Ministry-sponsored survey showed that for the quarters ending March and June '66 manufacturers had pushed through their training schools a total of 14,000 people. The job breakdown figures show that the schools handled 464 systems analysts for the manufacturers' own services and 469 for users' staffs. The comparable figures for programmers were 1,615 and 6,588. The remainder of people covered in the survey were on appreciation courses.

Main conclusions drawn by the Ministry were that the rate of intake in the computer field was not high enough to meet the manpower needs of 1970 forecast by the Ministry of Labour, and that the small number of systems analysts under training was particularly alarming. Recommendations have now been made for a drive to recruit at least 400 key people into this area with post-graduate scientific, higher accountancy, advanced business or operations research qualifications. These will provide a nucleus for spreading advanced computer management techniques throughout commerce and industry. Says the working party reviewing manpower, courses for post-graduate advanced systems must be established immediately at all major universities and the new business schools to meet the shortage. Recruitment of top teachers and researchers from the U.S. is recommended if they can be tempted to join a British unit for either long or short-term periods.

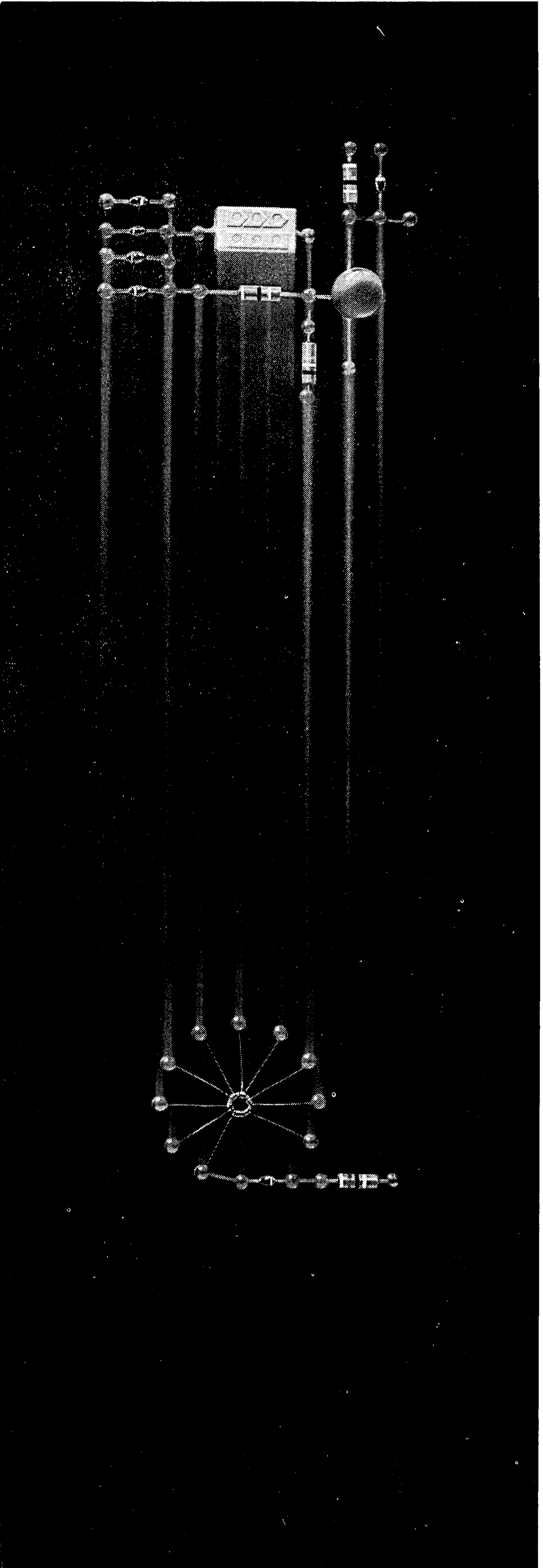
## TIME-SHARING, BRITISH STYLE

A General Electric process control machine (made in the U.K. by Associated Electrical Industries under GE license and with the label Con-Pac 4060) will form the multiplexor in a typically British hardware-oriented system specified by the U.K. Atomic Energy Authority. It will be part of a time-shared installation based on an IBM 360 and providing computing service via typewriters simultaneously for up to 160 scientists and engineers. The 4060 will perform straightforward functions of polling and queuing. At $140,000, a Con-Pac processor is expected to yield a cheap and effective hardware-software compromise for implementing multi-access.

## A MOTLEY SET OF READABLE FONTS

Britain's Paymaster General's Office has reversed a decision on document handling methods which could have wrought chaos among the cheque and money voucher systems being introduced into the U.K. As it is, there are major differences in adopted standards between banks,

*(Continued on page 165)*



(Continued from page 163)

credit houses, and government organisations.

As the first institutions into the automatic document handling field, a joint committee of the cheque clearing banks opted for the ABA's E13B font. Some credit and insurance houses expressed a later preference for the Continent-developed CMC7 bar code, which has a full alphanumeric character set plus special symbols. With its greater range of characters and easier legibility, this more recent method for document sorting was the first choice of the Paymaster General's Office, which issues millions of money orders a year to government employees and contractors for payment through the commercial banking system.

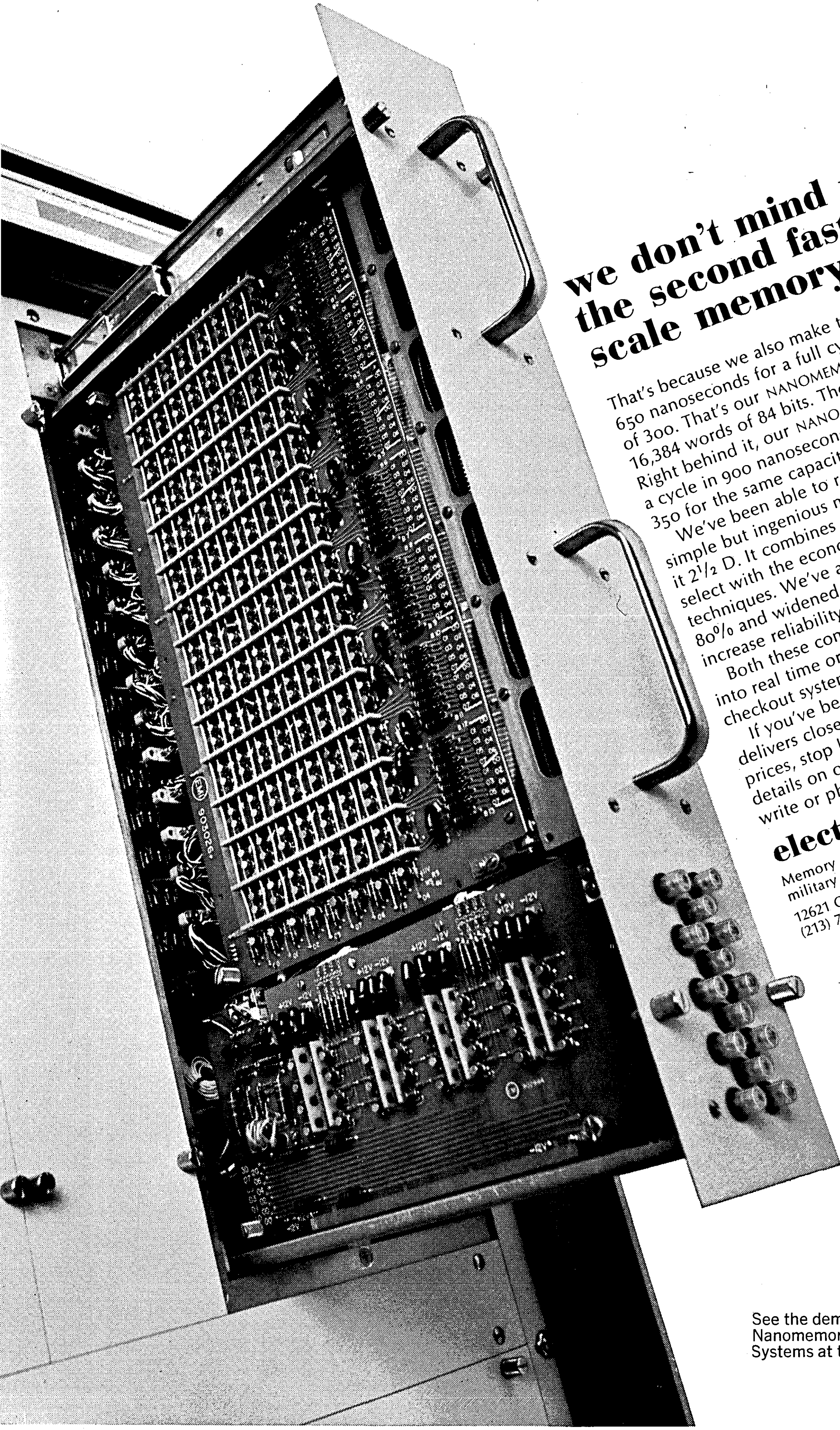
Now the Paymaster's office will use a document handling system which is compatible with that of the banks. In its Giro banking and money order schemes, however, the Post Office is to use a mixture of magnetic CMC7 and optical ISO B character reading machines. Small wonder that peripheral equipment developers view computer users with a jaundiced eye.

**HONEYWELL PUSHES NEW APPLICATIONS**

Since acquiring 3C as the mainstay of its computer control division, Honeywell has been extending its European organisation to cover the simulation, process control and scientific computing fields. New applications for the DDP computer series include the digital end of a flight simulator for Britain's Phantom jets and the French Concord supersonic jet airliner, on-line data reduction linked to a spark chamber, and data recording and analysing at a Swiss mountain-top radio & optical telescope observatory.

**BITS & PIECES**

Algol compilers for the 360 are due from IBM's Nordic Lab, Stockholm, in August '67. To many Europeans, this acknowledgement of Algol looks like a "mountain to Mohammet situation"...Software labour is cheaper in Europe, as Honeywell has found in deciding to establish an advanced programming centre in the U.K. under Louis G. Edwards. Plans are to have 40 people recruited from throughout Europe by year-end working on operating systems and compiler designs...Four Univac 9300's worth $700,000 have been ordered by Mills Assoc. Computer Service, Monmouth. They will supplement computer bureaus operating in South Wales and the West Country...Ferranti won out in a battle with Cossor-Raytheon for CRT displays for British Overseas Airways. Eventual contract value is $7 million. The displays, 700 in total, are organised with one Argus 400 computer providing character generation for each group of 12 CRT's...Cossor-Raytheon will supply displays to the British Navy for twin Univac 492's to be installed for stores control of Polaris submarines and the operational fleet... Britain's new Ministry of Social Security has ordered 100 data terminals and 270 data preparation units from Creed and Co., a U.K. subsidiary of ITT. ICT won the contract to supply the prototype system for a machine centre linked to 84 branch offices via telephone lines. If successful, the system will be copied for six other regions in the country with the Creeds order presumably escalating from today's $700,000 to $4,200,000...ICT has received a $2.8-million order for 1900's from British Railways.



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## GOVERNMENT STEPS UP LEASEBACK PROGRAM

A leaseback contract covering an IBM 360/30 may be sought by the Dept. of Agriculture before the end of 1966. Last month, the same agency became the first in the federal government to negotiate such a deal when it contracted with LMC Data Inc. for the purchase and leaseback of 190 units of punched card equipment at rates 23.6% below IBM's charges.

The pending negotiation, by expanding the leaseback concept to computers, would vastly expand the potential savings to the government. At least five other agencies reportedly are exploring the idea; among them is the Veterans Administration, which has about $400K worth of EAM equipment that appears to be eligible. State governments are also leasing back dp equipment. Last month, Maryland signed a contract with MAI which will produce savings "in excess of $100,000 a year," says a company spokesman.

According to the release announcing last month's contract between the Agriculture Dept. and LMC Data, the federal government could save nearly $40 million in annual rental charges by making maximum use of leaseback. About $7 million of this represents rentals on tab gear; the rest, computer charges.

LMC Data will save the Agriculture Dept. about $5,820 a month, and $69,840 a year. This represents 12.3% of the department's total punch card equipment rental costs.

## GSA CENTRALIZES DP MANAGEMENT TEAM

All GSA dp management activities are now centralized. They've been shifted horizontally on the organization chart, from the Office of Finance and Administration to a new Office of Automated Data Management Services. Ed Dwyer remains in charge. He has a new title (acting assistant commissioner), a new boss (H.A. Abersfeller, Federal Supply Service Commissioner), and, reportedly, more clout. Instead of being an advisor and coordinator, Dwyer's role is now management and operation. Also, OADMS has been given several jobs formerly dispersed throughout GSA — e.g., supervision of annual FSS negotiations with dp suppliers, and control of excess equipment reutilization.

Hill observers are not especially impressed with the change. "Basically, personnel capability, not organization, has slowed implementation of the Brooks Bill over there," says one source. "GSA now has new spurs, but it remains to be seen whether the horse will gallop."

## NBS MOVES TO EXPAND ITS SERVICE BUREAU

Federal dp managers apparently find attractive the National Bureau of Standards' service center. Set up in 1964 to demonstrate the feasibility of operating such facilities in-house, the pilot center provides 220 hours of processing time weekly, primarily on a 7094, H-1200, and CDC 3100. And non-NBS government agencies use roughly 65% of the machine time.

Now the center is being upgraded, and establishment of more centers seems likely. The new system will double the present capacity. NBS, which expects to reduce its need for private service centers about 10%, will benefit most.

The RFP specs call for a CPU with 300K characters of main memory expandable to 1 million characters;

*(Continued on page 171)*

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| REAL-TIME APPLICATIONS | Programming Reservations, Time-Sharing, Message Switching and Process Control Systems. |
| SCIENTIFIC PROGRAMMING | Designed and programmed large-scale War Games; programmed evaluation of problems in Engineering, Space Physics, and Nuclear Physics. |
| FACILITY MANAGEMENT | For NASA, manage the computer activities at the Goddard Institute for Space Studies and the Automatic D.P. Facilities at Kennedy Space Center. |
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(Continued from page 169)

200 million characters of auxiliary storage; 28 remote I/O stations, located at NBS headquarters in Gaithersburg, Md., or in Washington; a less-than-30-minute turnaround time (versus 24 hours at present); capacity to handle 600 debugging runs per 8-hour shift, each containing an average of 500 statements; batch processing mode operation with on-line interrupt capability. Bids are due Nov. 14; an award is planned a month later, and the startup target date is June 25, 1967.

## BROOKS BILL AUTHOR OPPOSES SOFTWARE PATENTS

Congressman Jack Brooks believes that patenting computer programs may not be a good idea. He fears application of dp — inside, outside the government — would be hindered if program users had to pay royalties and developers had to go through the red tape of applying for patents. "Deciding whether one program infringed on the patent for another would be particularly sticky," says a spokesman. "Everyone's long-term interest might be better served if the present patent law were clarified to specifically exclude computer programs."

Assistant Secretary of Commerce J. Herbert Holloman has assured the Texas Congressman that action proposed as a result of the current Patent Office study of computer program patents will be reviewed by the Commerce Department's front office. Brooks has similar reservations about the advisability of copyrighting programs.

## CAPITOL BRIEFS

A federal court last month told AT&T it must obey a 1965 FCC order by "unifying" Telpak A and B rates with private line charges. A major goal of the order is to lower the latter. Instead, AT&T, which does not plan to appeal the ruling, expects a rise in Telpak rates "which may be substantial"...The Baltimore dp center of the Social Security Administration probably will be in the market for a 360/65 or similar-capacity system within the next year. SSA's newly-acquired 7080, obtained from Greyhound Leasing last July, is loaded, officials report, and the workload (primarily processing of Medicare and retirement benefits) is rising fast. A final decision on the new computer awaits completion of a planning study which just began...Hearings may be held this month on Sen. Ted Kennedy's bill (Senate Joint Resolution 187); it authorizes a feasibility study of a computerized information retrieval system, replete with remote I/O stations, which would help local governments prepare applications for federal aid programs, and help federal officials evaluate programs...The Patent Office plans to issue an RFP this month for a computer complex to be installed in fiscal '68 and '69, at a projected cost of $900K. The system will take over work now farmed out to computers in other government agencies and commercial service bureaus...The Census Bureau plans to buy a Stromberg-Carlson tape-to-microfilm converter this fiscal year, and, next fiscal year, a Univac 1108. The computer will replace two 1105's and supplement two 1107's.

# books

***The New Utopians*, by Robert Boguslaw, Prentice-Hall, 1965**

The "new utopians," according to Dr. Robert Boguslaw (a senior social scientist with the System Development Corporation), are today's system engineers, operations researchers, computer programmers—that is, the readers of *Datamation*. They are the professionals who create large-scale systems, for example, "(to) link the peoples of the world together in communications networks; insure the timely production, transportation, and distribution of bananas, beeswax, and bombs; and increasingly use high-speed digital computers in the process."

These great systems are becoming more than just isolated hardware artifacts. They are affecting us as people. Under the name "automation" they are said to be taking people's jobs away, or forcing them to upgrade their skills, or obsoleting them two or three times in a life time. This lack of concern for the effects of their systems on people is the blind spot of the new utopians, says Dr. Boguslaw.

In this lack of social concern, the new men are in sharp contrast to the "classical system designers," such as Sir Thomas More, author of *Utopia,* Plato of *The Republic,* Francis Bacon of *New Atlantis,* and many more. These old utopians had a "basic humanitarian bent." They designed their systems around people. Even the most recent utopian, *1984*'s George Orwell drew his repulsive utopia-in-reverse to warn of what life would be like if non-human values ran wild.

The dominant value orientation of the "utopian renaissance," Dr. Boguslaw writes, can best be described as "efficiency." The emphasis is upon the hardware, computers, and programs. While man as a "human factor" may be given some design consideration, the human being as the underlying reason for all this bother in the first place is considered outside the bounds of the system requirements.

Dr. Boguslaw would bring man back into the center ring. He wants scientists and engineers to become more sensitive to human purposes. He wants their training broadened to include "*all* significant variables in designing systems—rather than merely those that lend themselves to hardware implementation or formal modeling." He would like to see more funds available for research on these matters. Furthermore, dropping the other shoe, he feels that union leaders and managers, military men, philosophers, and social scientists need to become more at ease with the concepts of computer systems. They should be involved in the human implications at the time of design, not afterward when it may be too late.

This brief summary of the book's thesis hardly does justice to the author's subtlety and insight, nor to the flashes of humor which illuminate his writing. Knowledgeable in both computer technology and the social sciences, Dr. Boguslaw will be found intelligible, I believe, by both system designers and laymen. That is, by discussing utopian schemes of the past in the language of modern system design, he makes these humanitarian concepts more meaningful to the engineer. Similarly, the union man or the philosopher, watching Dr. Boguslaw apply system thinking to social and economic plans, will gain some appreciation of the power of the system approach.

The main body of the book reviews four of these approaches. The first approach, formalist design, employs precise models, such as linear programming. Francis Quesnay's *Tableau Economique,* produced in 1758, attempted to model the economics of a country. Most of the early utopias, including those of Charles Fourier and Robert Owen, were formal designs.

The second and heuristic approach, which uses principles to provide guides for action, can work even in "completely unanticipated situations," where there could be no formal model. For example, Pierre-Joseph Proudhon, rather than blueprinting a formal utopia, chose to set forth certain principles which would lead to the ideal society. These principles were liberty, equality, fraternity, and justice. H. G. Wells, Baron de Montesquieu, and Jean-Jacques Rousseau were among those working this street.

In the operating-unit approach to system design, on the other hand, it is the components which are planned. To build a utopia, the individual humans (the operating units) are selected or trained to possess the desired characteristics. The society which results, then, is the outgrowth of these characteristics. B. F. Skinner's *Walden Two* and Orwell's *1984*, published in 1948 and 1949, are said by Dr. Boguslaw to be examples of this approach. So, too, are Isaac Asimov's robot sto-

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ries, with the robots constituting the operating units.

The last method, the *ad hoc* approach, starts with present reality and moves by small, practical steps to another stage. Dr. Boguslaw regards the mercantilism economic system of the seventeenth and eighteenth centuries and the subsequent laissez-faire system as examples of this approach.

Unfortunately, by limiting his analysis almost entirely to just two areas, the old utopias and the new system design, Dr. Boguslaw fails to develop the great area in between. For example, out of the heuristic thinking of Montesquieu (and scores of others) came the United States Constitution. Its principles set up a game—of elections, branches of government, the rights of the first ten amendments, and politics—within which for almost two hundred years we have adjusted human values to completely unanticipated situations.

Similarly, out of *ad hoc* economic beginnings have developed the heuristic principles of John Maynard Keynes and his followers. Originally applied to the great depression of the 1930's, these principles are now being applied to the opposite—and perhaps unanticipated situation—the long-continuing boom.

Furthermore, we have developed heuristic principles of organization and management, sometimes unknown to physical-system designers, but often used by managers.

The point is that modern system designers do not really work in a physical-science vacuum even though, in their ignorance of political science, economics, and management, they may feel isolated. Actually, it is the function of politicians and lawyers, economists, and business men to apply the heuristic principles of government, economics, and management to our problems, as it is the function of physical scientists and engineers to use the principles of system design.

Of course, the efforts of all these professions still fall short of achieving the ultimate utopia. But progress has been made since the old utopians first spun out their dreams. Undoubtedly, better appreciation of computers and system design by the one side and of politics, economics, and management by the other side, as Dr. Boguslaw urges, will help the social-physical interface in large-scale systems, currently a sticking point hampering further progress.

—Ware Myers

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*"The Community Chest gives us a chance to make sure our help will really count. When we give to the Chest, we can be sure that we are helping our neighbors and our neighborhood in the right way. And when we do that, we are making our country a better place to live in for ourselves and our children."*

**"A splendid opportunity"**

*"We can't possibly know about all our neighbors in need. Somebody must show us the way to help them. This is the purpose of these United Campaigns in over two thousand communities across the land. They provide us with a splendid opportunity to express the traditional neighborly concern of America."*

**"I hope that you will join"**

*"I hope that you will join in this great national effort, this great national crusade through the United Way, and give. It will make your community a happier place; it will make you a happier person, and in the real sense that your community is your country—it will make our country a finer place in which to live. United, there is little we cannot do..."*

**"A proud record"**

*"One of our enduring American traditions has been the voluntary contribution of time and money to strengthen our country's many communities. Nowhere else in the world do people give so generously toward this end. Millions of Americans perform both a public service and an act of human compassion by their participation in and generosity to their United Fund or Community Chest. In doing so, they express a common desire to help their community assist the young and old, the sick and distressed."*

## One gift works many wonders/the United Way

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*WORLD TRADE CORPORATION*

CWT is currently selling, at a fraction of the original cost: IBM 1401 (several models); IBM accounting machines (402, 403, 407, 419); IBM calculating punches (602, 604).
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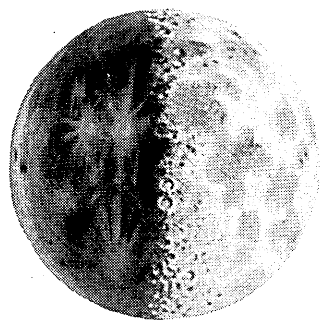
For further information please contact: DATAMATION Magazine, Classified Advertising Dept., 35 Mason St., Greenwich, Conn. 08630 (203) 661-5400.

# COMPUTER SPECIALISTS

## You recognize this, of course,



## but have you ever thought how computers can be used to get there and beyond?

Bellcomm, the systems engineering contractor for the National Aeronautics and Space Administration, has openings for imaginative computer specialists interested in contributing to manned spaceflight.

We need people who can:

- ☐ analyze data processing requirements of advanced missions
- ☐ determine functional requirements for the next generation of spaceborne computers
- ☐ study optimal computer organization for reliability (hardware and software)
- ☐ define computer systems for supporting launch and flight operations of multiple missions
- ☐ develop management procedures for controlling computer resources
- ☐ define ground network for distribution of data transmitted from space
- ☐ evaluate data management systems
- ☐ determine impact of new programming techniques for all of the above

If you believe you are such a person, Bellcomm will welcome your inquiry. Send your résumé to Mr. N. W. Smusyn, Personnel Director, Bellcomm, Inc., Room 1413-E, 1100 17th St., N.W., Washington, D. C. 20036.

Bellcomm is an equal opportunity employer.

**Bellcomm, Inc.**
**A Bell System Company**

# We intend to accelerate the generations at RCA.

We know that the most advanced systems today are only a beginning.

So we're looking for systems programmers who can take software into the 4th, 5th and 6th generations.

Programmers who won't be content to work on a single project for years on end.

Programmers who want a say in hardware design.

Adventurous men, with a penchant for the esoteric.

The rewards are greater than you think.

Write to us if you've had experience in language processors, operating systems, utility systems or communications systems.

We also have openings in Sales, Field Systems Support, Product Planning and Engineering.

**SEE US AT THE FJCC IN SAN FRANCISCO.**

Contact Mr. E. B. Schultz, Dept. SW-13, RCA Electronic Data Processing, Bldg. 202-1, Cherry Hill, Camden, New Jersey 08101.

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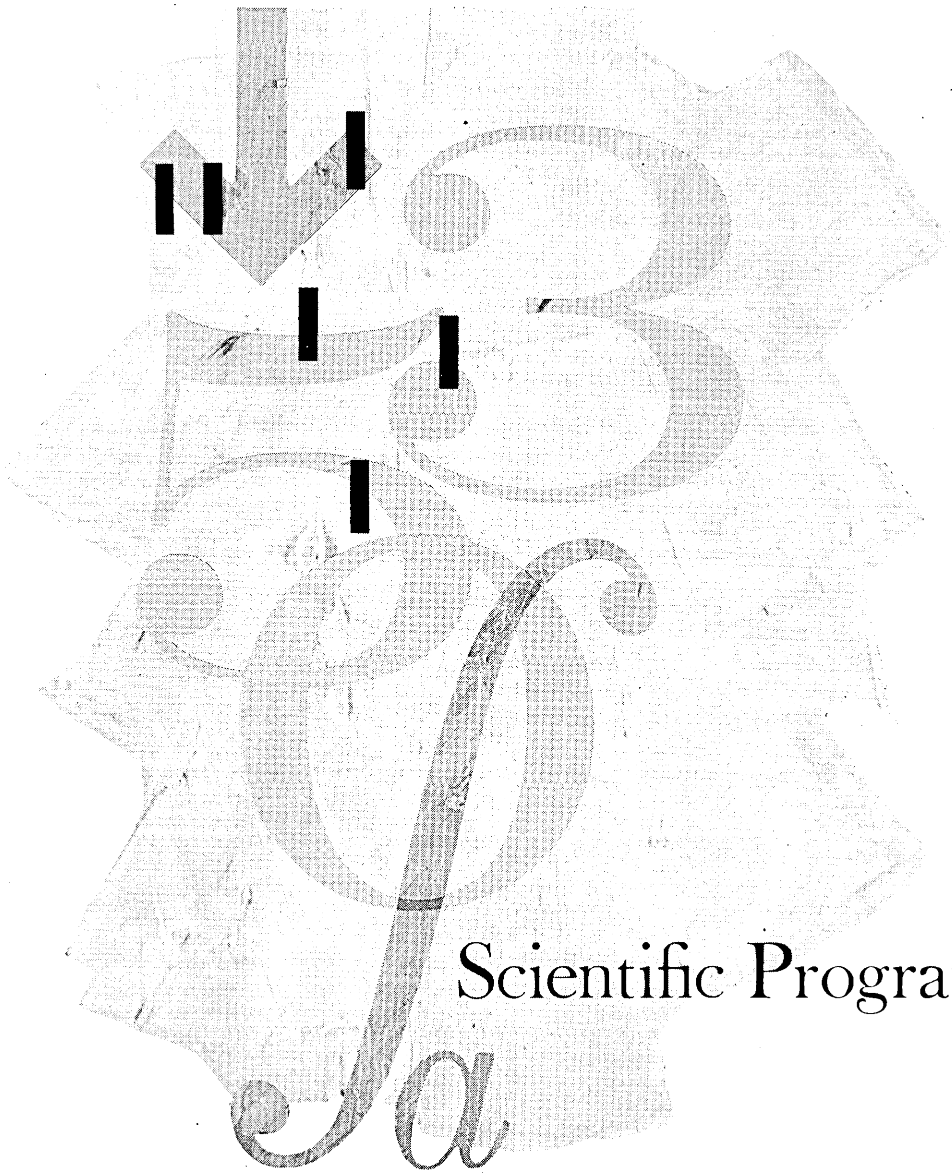

# Scientific Programmers

New research laboratory for high-energy particle physics is offering career opportunities to programmers in the following areas:

**APPLICATIONS** Responsibilities will include development of computer methods and programs for analysis of experimental data. Will perform engineering calculations for the design of experimental devices, in addition to theoretical model calculations and similar assignments.

Applicants should have a Master's Degree in Computer Science, Mathematics, Statistics or Physics — or a Bachelor of Science Degree with appropriate experience.

**SYSTEMS** Assignments will involve the development of real-time analysis and control programs, advanced assembly routines, special purpose compilers and system simulators.

Applicants should have a Master's Degree in Computer Science, Mathematics or equivalent, with related experience.

Here is an opportunity to associate with a new international research center. Liberal benefits are the same shared by professional employees of Stanford University.

Send résumé in confidence to G. F. Renner, Professional Employment Manager, Stanford Linear Accelerator Center, P.O. Box 4349, Stanford, California.

**STANFORD LINEAR ACCELERATOR CENTER**

An Equal Opportunity Employer

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# people

■ Frank C. Mullaney, one of the founders of Control Data Corp., has been elected to the board of directors of Analysts International Corp., Edina, Minn. He recently resigned as vp and member of the board of CDC.

■ Emil R. Borgers has been named vp, programming, Systems Engineering Laboratories Inc., Fort Lauderdale, Fla. He was previously vp, computer systems, Scientific Data Systems, Pomona, Calif.

■ Dr. David N. Freeman was recently appointed associate director and systems manager, Triangle Universities Computation Center, Durham, N.C. He was previously manager, new systems architecture, IBM Corp., Endicott, N.Y.

■ Dr. Raymond E. Roth has been appointed director of the computer center, State Univ. College, Geneseo, N.Y.

■ William R. Lonergan has been named division vp, product and programming planning, RCA EDP, Cherry Hill, N.J.

■ James D. Tupac of The RAND Corp., Santa Monica, Calif., was elected president of SHARE at the annual meeting last month in Toronto.

■ Dr. Morton G. Spooner will head the computer research dept., Cornell Aeronautical Laboratory Inc., Buffalo, N.Y.

■ Dr. David Van Meter has been chosen chief, computer research laboratory, at NASA's Electronics Research Center, Cambridge, Mass. He was formerly manager of the information sciences laboratory, Litton Industries, Waltham, Mass.

■ At B.F. Goodrich, Akron, Ohio: Charles I. Staire has been named manager, tele-computer planning and control; Gerald H. Green will serve as manager, systems and distribution planning.

■ Frank R. Heath has been named corporate director, systems planning, for the Carrier Corp., an air-conditioning firm, in Syracuse, N.Y.

■ William E. Huggins has been appointed assistant treasurer of the Arlington Trust Co., Lawrence, Mass. In this capacity, he will manage the bank's new dp center.

■ David F. Alison has been appointed director of the technical training and management institute recently established by Brandon Applied Systems Inc., Washington, D.C. He joins Brandon from C-E-I-R, Inc.

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## advertisers' index

# READOUT

Where success creates opportunities

**CONTROL DATA CORPORATION**

## St. Paul Facility Has Openings at All Programmer Levels

Thirty more programmers are to be hired at Control Data's Development Division in Arden Hills, a suburb of St. Paul.

Arden Hills develops software for 3000 Series computers.

Jobs are available at all levels, according to David M. Noer, Arden Hills Personnel Administrator. There are excellent openings in systems development, in continuing development of existing systems, and in quality assurance programming.

A degree in Math, Physics, Engineering or business is preferred, along with 2-5 years experience in assembly language programming.

A San Francisco interview can be arranged by forwarding a resumé or letter to D. M. Noer, Arden Hills Facility, 4201 North Lexington Ave., St. Paul, Minn. 55112.

## Data Centers Announce Fastest Linear System, Major Job Opportunities

The Data Centers Division of Control Data has announced the release of ALLEGRO, the fastest linear programming system yet developed. The success of this system is creating exceptionally good jobs for programmer analysts in the Data Centers.

ALLEGRO is capable of solving up to 4000 constraints on the Control Data 3600 computer.

Data Centers are developing computer applications in practically every business field. The eight centers are located in Minneapolis, New York, Washington, D. C., Boston, Houston, Cincinnati, Los Angeles, and Palo Alto, Calif.

For more information on job openings, write J. D. Cassidy, Control Data Corporation, 8100 34th Ave. S., Minneapolis, Minn. 55440.

***Recently Announced . . .***

**For the Smithsonian Astrophysical Observatory,** Cambridge, Mass., a 6400 system

**For Westinghouse Electric Corporation,** Pittsburgh, a 6600 system and multiple 3100 systems

# Control Data Team Will Describe Job Openings During FJCC Nov. 8-10

*"Oh, it's not a bad job. It's just that there just isn't any chance for promotion."*

If you're attending the FJCC, you can get all the facts on jobs open at Control Data.

All divisions will be represented Nov. 7-10 for the big meeting in San Francisco. Purpose: to describe openings for professionals in every one of the Corporation's facilities.

"Regardless of the area or the type of job you'd consider, we'll be prepared to talk with you in San Francisco. Our people will be armed with as many facts on specific openings as possible," according to A. L. Tschida, Manager, Corporate Staffing Administration.

To arrange for a confidential interview during FJCC, write Control Data as soon as possible. Address your letter to Charles Hart, Control Data Corporation, Dept. D1, 8100 34th Ave. South, Minneapolis, Minn.

## *Palo Alto Needs 10 Systems Programmers For 6000 Series*

The Palo Alto facility of Control Data's Development Division has 10 openings for systems programmers.

Programming systems used with Control Data's 6000 Series computers, the world's largest systems, are developed here.

"We are doing advanced state-of-the-art development work in time sharing, real time and remote access systems and other areas," said a staff member.

At least a BS in Math or Science and 2-5 years of experience is preferred. Experience in compiler development or operating systems development is of special interest.

"We'd like to talk to anyone who's interested and coming to San Francisco for the FJCC. Drop down and see what we're doing," said Dan Moran of the Personnel department.

For more information or to arrange an interview, write or call Dan Moran, Control Data Corporation, 3260 Hillview Ave., Palo Alto, Calif. 94304, phone (415) 321-8920.

## *Systems Engineers and Analysts Urgently Needed At Howard Research Div.*

Special systems projects require additional staffing immediately at Howard Research Division.

More qualified personnel are specially needed in projects covering the design of a Field Deployed Tactical Computer for the Army.

"Howard Research is growing fast, to keep pace with our backlog of special systems, according to Employment Manager J. C. Kinkead. "We must fill 75 important junior and senior positions immediately."

Systems engineers and analysts can get full information by sending a resumé to J. C. Kinkead, Employment Manager, 7735 Old Georgetown Road, Bethesda, Md. 20014.

***What's so funny?***

*The burly fullback was called into the dean's office, and the coach went with him.*

*"I'll give you one last chance," said the dean. "How much is six plus seven?"*

*The grid star thought hard, then answered "Twelve."*

*"Now don't be too hard on him, Dean," put in the coach, "he only missed it by two."*

# the forum

*The Forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.*

## PROGRAMMERS: THE INDUSTRY'S COSA NOSTRA

*Home again is the author of Grosch's Law. A computer pioneer, noted industry gadfly and bearded prophet with honor, Dr. H. R. J. Grosch was an early and frequent contributor to* DATAMATION *until he departed for Europe, where he spent several years consulting. He returned to this country about a year ago, and has since been spending most of his time thinking positively about* DEACON, *an online, natural-language, data base system. Last June the real Herb Grosch stood up at an ACM-sponsored conference in Stony Brook and took the industry to task (see July '66, p. 81). We are pleased to print here some extensions to his talk . . . and to welcome the industry's original polemicist back to the pages of* DATAMATION.

I guess I really am thinking positively a good deal of the time these days. My new farm is fun, and I run it as I did the old 701 plantation back in the '50's—clear out brush all day and spread lots of fertilizer! But every once in a while the pretty DEACON vistas blur, and I hear the old familiar drumming. Dr. Jekyll would recognize the symptoms.

At Stony Brook, I tried in just a few minutes to get at the heart of our troubles: the almost unbelievable reluctance of Cosa Nostra to accept the realities of management. That reluctance makes terms like "profession" or "discipline" ridiculous: at most we might claim to be a trade; more likely, a huge confidence game. There's this scene with three walnut shells called DARTMOUTH, MAC and BELL and a little rubber pea labelled T/S—and have you ever noticed the similarities between The Magic Language Con and The Spanish Prisoner Con?

We are at once the most unmanageable and the most poorly managed specialism in our society. Actors and artists pale by comparison. Only pure mathematicians are as cantankerous, and it's a calamity that so many of them get recruited by simplistic personnel men. The turbine designers and astronomers and nuclear physicists and aircraft engineers who were the pioneer users were accustomed to reality, and struggled with it face to face. Their bosses measured them by the problems solved, not by the elegance or eruditeness of the techniques. But today honest problem solvers are submerged in a wash of software artists: dialect bootleggers, SHARE committeemen, operating systems cosmetologists. And the horrible sight of three thousand gooney birds swarming over IBM's 360 programs shows how little management learns; remember the thousands of sage grouse at SDC? Or, closer home, remember the SCAT/SOS fiasco when the 709 slithered on stage in 1958?

One especially sad drama revolves around remarkably successful attempts to disguise the costs of computation. In the old closed shop, programming and machine charges were right out in the open. Then the bad managers got sore at all the fun the good managers were having, so they invented the open shop. The programming costs increased, of course, because amateurs were involved—but nobody could prove it! The engineering and accounting budgets absorbed the inefficiencies of third-rate FORTRAN coding and running, and the computing center budget shimmered like a mackerel in the moonlight. By Gresham's Law, closed shops were driven out.

But machine costs were still revealing, and embarrassing. So consoles were installed all around town, and RATS took over (remote access time-sharing, that is). Worthwhile work is to be relegated to a not-yet-functioning limbo called "background," and pipsqueak computing is to dominate. The real cost of *A* times *B* is perhaps three times what a non-conversational open shop or five times what a well-managed closed shop using the same quality central processor would have charged, but the poor novice customer is happy. The systems programmers are all committeeing away redefining MULTICS, usually at expensive resort hotels on the other side of the continent. And their managers, deluded by growing empires and elaborate mechanized PERT reporting, take pride in the struggle—but keep a few resumes out just in case!

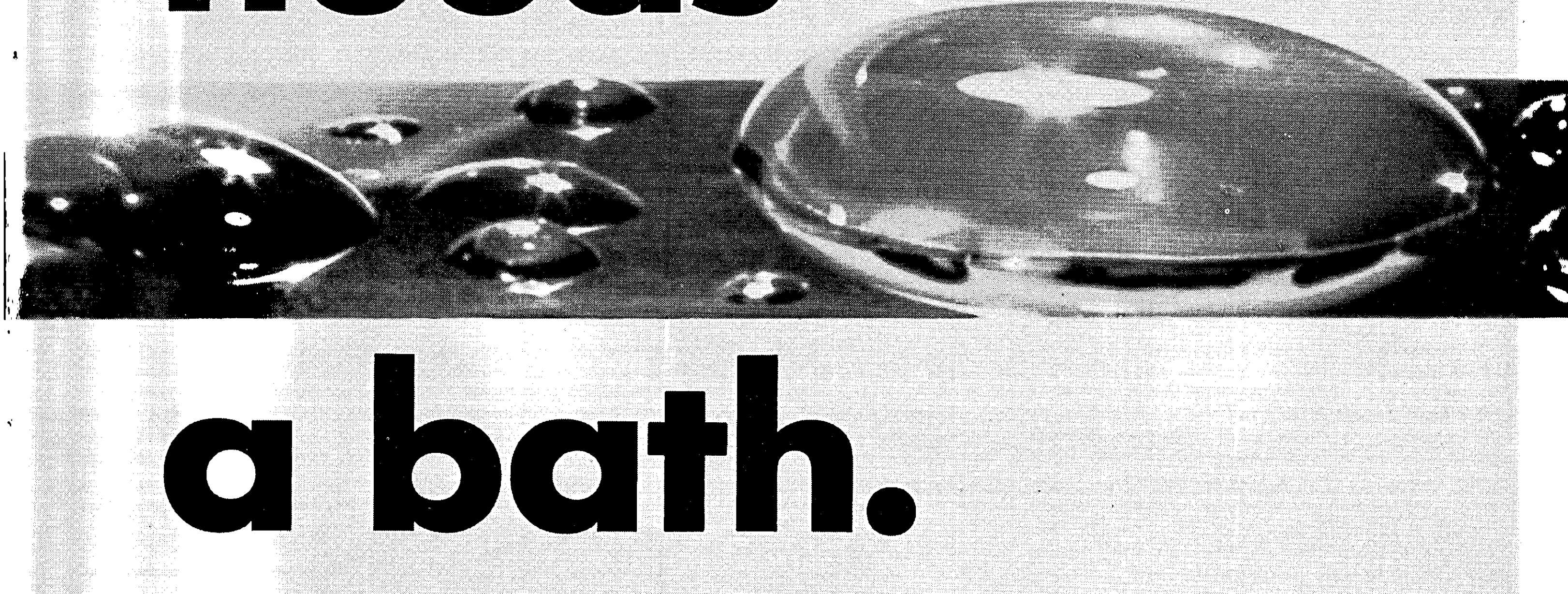
I used to end with a peroration: straighten up, fly right, use your hydraulic toothpick after meals. No more; it's a topsy-turvy world, where IBM profits increase not only along with but because of its 360 troubles, UNIVAC moves its international operations inland, and CDC plays footsie with MIT and ignores Illinois. Nowadays all I have to say is, it would be *even more* fun if our racket were both more manageable and better managed.

I'd like to see SHARE and GUIDE disband, except for 360 pressure groups. I'd like to see BEMA fight back openly at the BOB and GSA bullies. I'd like to see AFIPS be the outfit to tell Congress why we're where we are, and where we could go, instead of John Diebold. Above all, I'd like programmers to go back to work; quit trying to remodel the hardware, quit trying to persuade human beings to speak algebraic Volapük, quit trying to put a console in every kitchen. I'd like 'em to accept reality, not rebel against it. And I'd like to see their managers refuse to embark on grandiose or unworthy schemes, and refuse to let their recalcitrant charges waste skill, time and money on the fashionable idiocies of our racket.

Yep, I'd *like* all that—but I don't expect to see it! Meanwhile, I enjoy the scene, one of the ripest microcosms of LBJ America.

H. R. J. Grosch
Manager, DEACON Project
General Electric Company

# tape needs



# a bath.

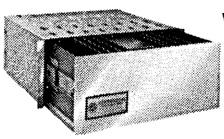
Surprising? Not at all. Tape collects microscopic ferrous oxide and polyester dust during the slitting process. This damaging contamination cannot be seen. But your equipment will show it's there—in read-write signal loss, error skips, equipment cleaning downtime, and accelerated tape and head wear. Scraping or wiping off not only neglects the edges of the tape but can harm the surface. That's why MAC — and only MAC — goes one step beyond. We give our tape a bath — face, back and edges. We bathe it because water's the only way to completely rid tape of contamination without damaging it. Our unique process sends every "bit" of tape through specially built washers, gently and thoroughly flooding away all loose contamination in a jet stream of warm water. This extra treatment takes a little longer and costs us a little more. But cleanliness is just one of the reasons why MAC is your best value in tape. That's why we make "every day Saturday night at MAC."

**MAC**

MAC PANEL CO. High Point, N.C.

CIRCLE 2 ON READER CARD

# Now you can throw out less versatile storage techniques. A Ferroxcube core memory costs as little as $1,190.



We haven't been a leading core memory manufacturer all these years for nothing. We learned how to mass produce core memories and thereby sell them to you at prices competitive with less reliable, less versatile storage techniques.

Aside from price (we'll get back to that in a moment), consider the advantages of core memory systems. Speed. Random access. Non-dissipative. And they're nonvolatile. We could go on and on. We won't because you've probably always wanted to design your system around core storage anyway. Only the cost stopped you.

Now you can buy a Ferroxcube 128 x 8 core memory system complete with stack electronics, data register and timing for a paltry $1,190. That's our FX-12. Its capacity ranges up to 512 x 8. The FX-14 picks up there and goes on to 4,096 x 32. Prices are comparably low. Moreover, the FX-14 is available with almost any choice of interfacing elements. Buy only what you need to interface with what you already have.

In brief, Ferroxcube core memories make both functional and economic sense. Write or call for Bulletin M661.

**Ferroxcube**

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