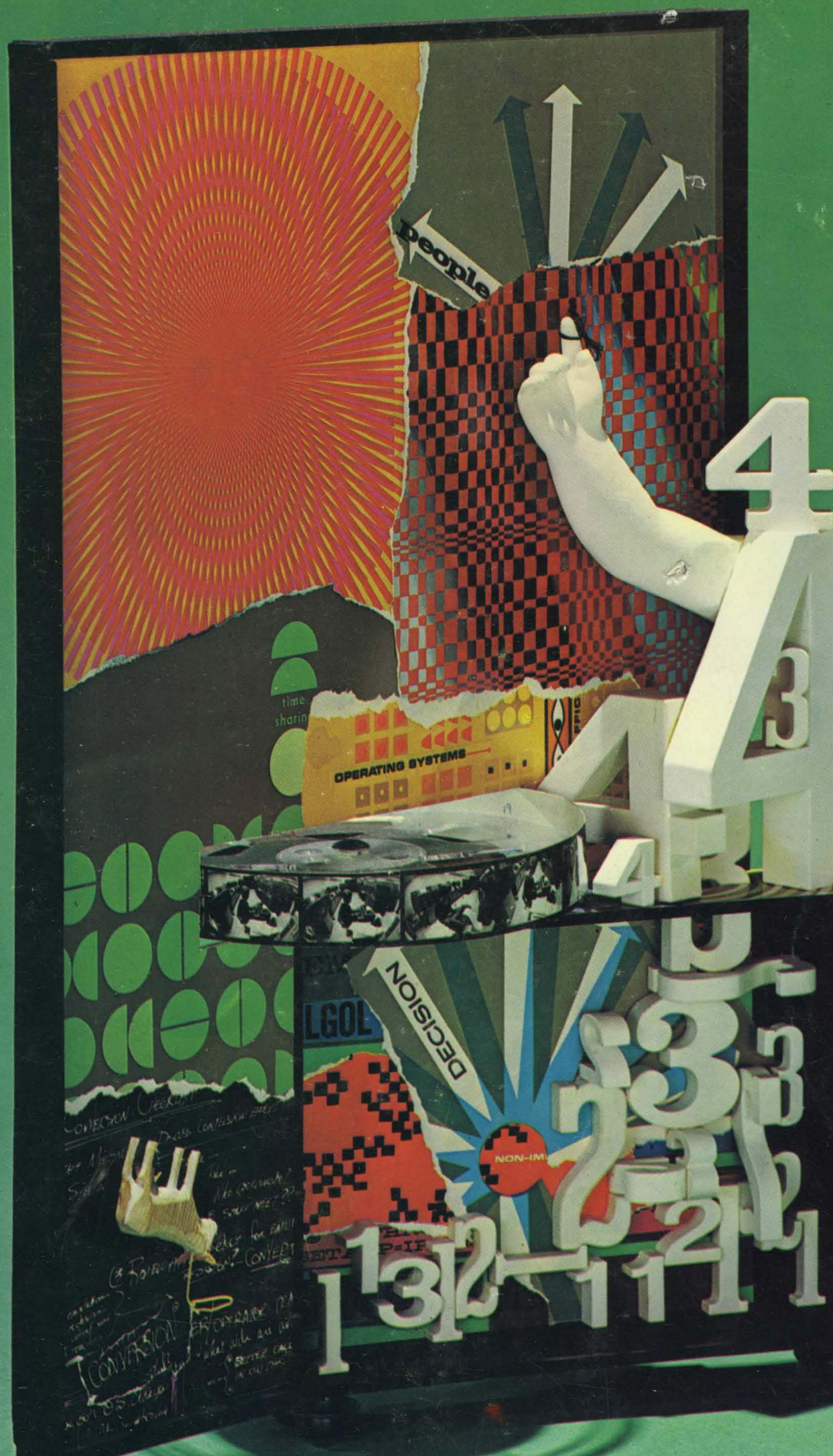
DATAMATION 67

January



THE NEXT GENERATION

When your computer marries one of our single capstan tape transports,

TM-11 or TM-12
for high speeds

TM-7 or TM-9
for moderate speeds

it marries the whole family.

The man in charge of your P & L statement will be glad to buy the license. Here's why:

Within the Ampex range of drive speeds and data transfer rates, you can meet **any** of your digital tape transport requirements.

And you can do it at **one source.** Quickly. Economically.

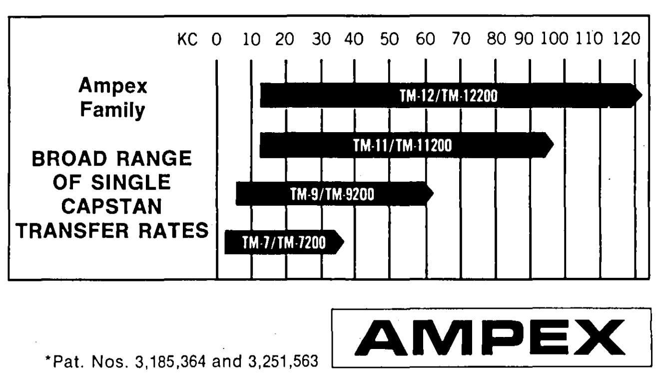
Each member of the Ampex family is interface interchangeable with all of the other members. So you can combine drives, or make replacements easily to meet new requirements. All four basic drives have the Ampex patented* single capstan electronic servo control.

This design commonality gives you many other advantages. Servicing is similar for all units. Training is simplified. Parts provisioning is simplified, with replacements readily available from one source.

MTBF is 2,000 hours—at least a billion start/stop operations. That's partly because we use only one-fifth as many parts as non-single-capstan drives. And partly because **at Ampex whatever we build we build the best we can.**

You need order only the items necessary for your immediate requirements, easily add on later. Just a transport. Or one with electronics and control. Or a system of several drives with time-shared data electronics.

There is much more you should know. Write Ampex, Dept. 7-14, Redwood City, California 94063.



*Pat. Nos. 3,185,364 and 3,251,563

AMPEX

CIRCLE 1 ON READER CARD

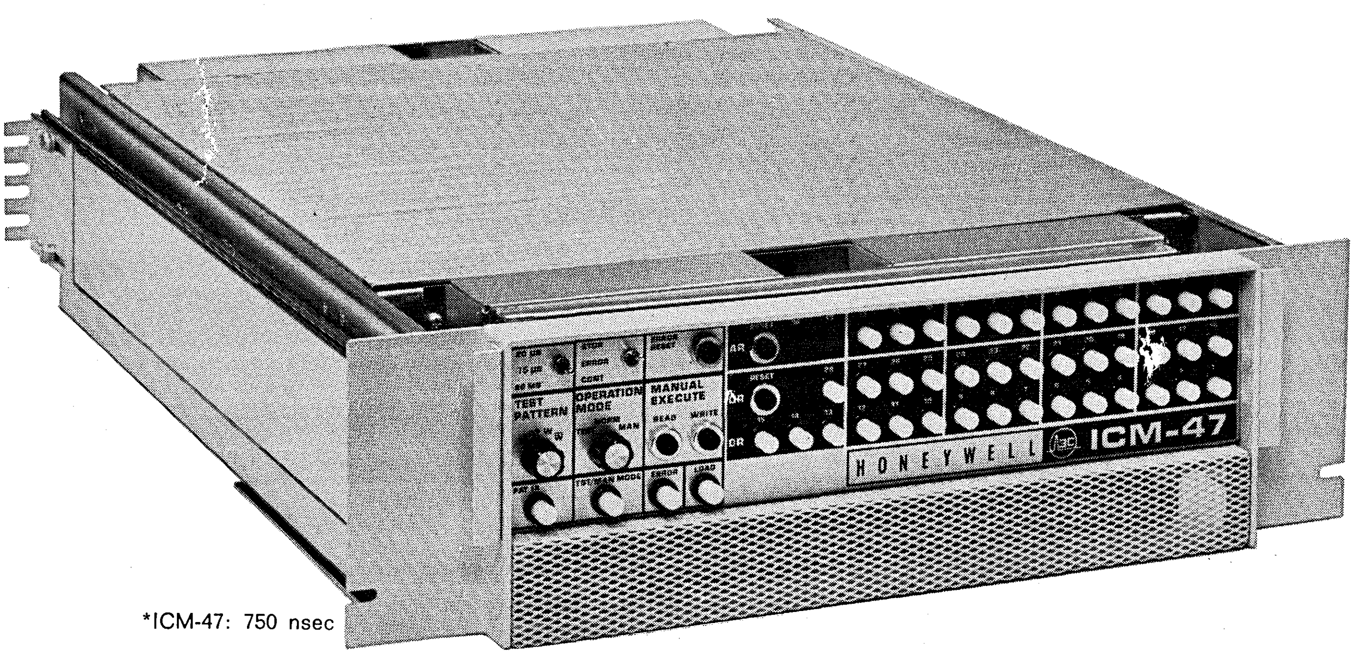
Only Honeywell Offers A Family of Compatible High Speed* I/C Core Memories

μ-STORE ICM core memories are fast, reliable, and able to store more words in less space than any other core memories on the market. They are field-proven and in high volume production . . . yet offer a flexible design which meets a wide range of system requirements.

ICM-47 — 750 nanoseconds full cycle time; capacities from 4K to 32K words in a single 5¼" high module (like the one shown below). ICM-40 — 1 microsecond full cycle time; capacities from 4K to 32K words. In addition, multiple module capability allows ICM's to be expanded to larger capacities. Both models feature high noise protection, data retention in case of power failure and maximum use of integrated circuits to achieve high reliability. In brief, you'll find the ICM-40 and ICM-47 designed to perform comfortably in a wide variety of operating environments and to fit easily into almost any system requirement.

Because ICM's come from Honeywell, Computer Control Division, you know they're backed by more than eight years' experience in the design and production of standard core memories . . . and by some pretty intensive special purpose memory systems experience as well. Add to this our I/C capabilities, logic module capabilities, and digital computer capabilities, and you can be sure of dependable support in solving your core memory applications and systems design problems.

Write today! Ask for our μ-STORE summary brochure. Honeywell, Computer Control Division, Old Connecticut Path, Framingham, Massachusetts 01701.

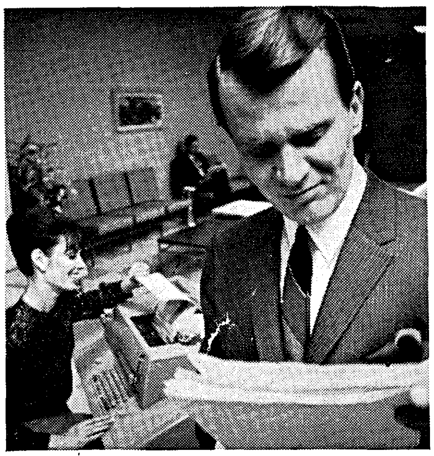


*ICM-47: 750 nsec

Honeywell

COMPUTER CONTROL DIVISION

CIRCLE 4 ON READER CARD



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:

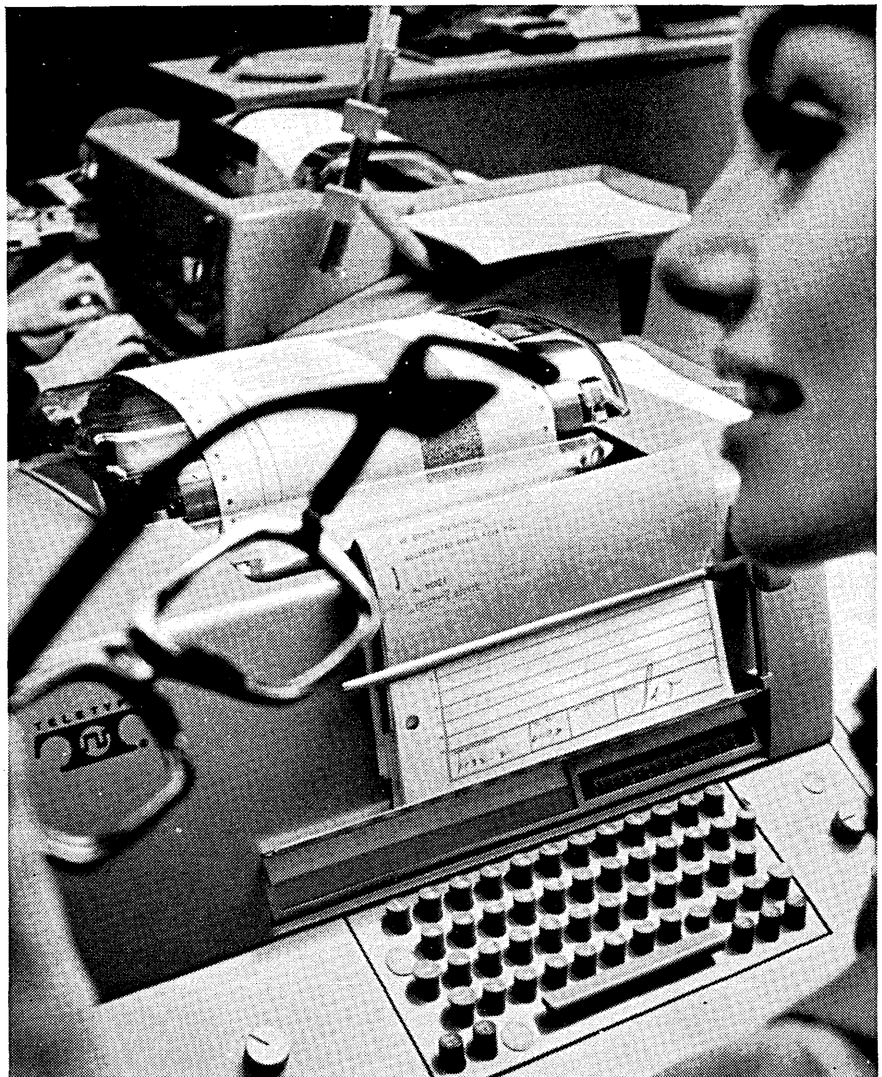
- Assuring management of adequate, timely information to make accurate decisions,
- Eliminating the costly errors caused by duplicated paperwork,
- Speeding distribution by cutting costly paperwork,
- Reducing customer complaints, and
- Enabling management to communicate quickly with remote computer 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. 81A, 5555 Touhy Avenue, Skokie, Illinois 60076.

TELETYPE ®

CIRCLE 5 ON READER CARD

SIEMENS

Teleprinter 100 for Internal Data Networks

Lower Price
Higher Speed
Faster Delivery

The Teleprinter 100 is used by railroads, utility and pipeline companies, plants, department stores, many other organizations, to transmit and receive data on internal communications networks. It is compatible with all systems—over 100,000 are now in use in over 100 countries.

Up to 13 characters per second. 5 level code. Transmits to one unit, several or all units in system. Low noise level. Makes up to 12 carbons. Sends in red, receives in black, or vice versa. Receive-only units available. Tape reader and tape punch attachments. Many special features.

Available on sale or lease basis.

SIEMENS AMERICA INCORPORATED
350 Fifth Avenue, New York, N.Y. 10001

A Corporation of THE SIEMENS GROUP IN GERMANY
Berlin • Munich • Erlangen

In Canada:
SIEMENS CANADA LIMITED
407 McGill Street, Montreal 1, P.Q.

CIRCLE 6 ON READER CARD

january
1967
volume 13 number 1

Publisher	**GARDNER F. LANDON**
Editor	**ROBERT B. FOREST**

Managing Editor & Art Director	**CLEVE MARIE BOUTELL**
Associate Editors	**EDWARD K. YASAKI**
	WILLIAM J. ROLPH
Assistant Editors	**HEIDE H. THORSTENSON**
	WENDY R. REID
Eastern Editor	**ANGELINE PANTAGES**
European Editor	**CHARLES WHITE**
Contributing Editors	**HOWARD BROMBERG**
	ROBERT V. HEAD
Washington Reporter	**PHIL HIRSCH**
Editorial Adviser	**ROBERT L. PATRICK**
Technical Consultant	**LOWELL AMDAHL**
Production Manager	**MARILEE PITMAN**
Director of Circulation	**FRANK DeCARLO**
Circulation Fulfillment	**ALGENE TRAINA**

Eastern District Managers — **JAMES M. MORRIS**, **WARREN A. TIBBETTS**
35 Mason Street, Greenwich, Conn. 06830
(203) 661-5400

New England District Manager & Vice President — **WARREN A. TIBBETTS**
112 West Haven Rd., Manchester, N.H., [603] NAtional 5-9498

Midwest District Manager — **JOHN BRENNAN**
205 West Wacker Drive, Chicago, Ill. 60606
[312] Financial 6-1026

Western District Manager & Vice President — **HAMILTON S. STYRON**
1830 W. Olympic Blvd., Los Angeles, Cal., 90006
[213] 385-0474

EDITORIAL OFFICES
1830 WEST OLYMPIC BLVD.
LOS ANGELES, CALIF. 90006

BPA — Circulation audited by Business Publications Audit

ABP — Member, American Business Press, Inc.

DATAMATION is published monthly on or about the tenth day of every month by F. D. Thompson Publications, Inc., Frank D. Thompson, Chairman; Gardner F. Landon, President; Gilbert Thayer, Senior Vice President. Executive, Circulation and Advertising offices, 35 Mason Street, Greenwich, Conn. 06830 (203) 661-5400. Editorial offices, 1830 W. Olympic Blvd., Los Angeles, California 90006. Published at Chicago, Ill. DATAMATION is circulated without charge by name and title to certain qualified individuals who are employed by companies involved with automatic information handling equipment. Available to others by subscription at the rate of $15.00 annually; single issues (when available) $1.50. Reduced rate for qualified students. Foreign subscriptions are on a paid basis only at a rate of $25.00 annually. No subscription agency is authorized by us to solicit or take orders for subscriptions. Controlled circulation paid at Columbus, O. and Chicago, Ill. Form 3579 to be sent to F. D. Thompson Publications, Inc., 205 W. Wacker Dr., Chicago, Ill. 60606. Copyright 1967, F. D. Thompson Publications, Inc. Microfilm copies of DATAMATION may be obtained from University Microfilms, Inc., 313 No. First St., Ann Arbor, Michigan.

Printed by Beslow Associates, Inc.

This issue 70,100 copies

DO YOU HAVE A SHOVEL WITH A ROPE HANDLE?

(A COMPUTER WITHOUT INPUTS OR VICE VERSA)

If you have tried interfacing standard computing equipment to instruments and/or people, you know the problems. Berkeley Scientific Laboratories has designed a line of small, special purpose computers and data input consoles which solve these problems quite nicely. Our engineering has brought the computer world to the laboratory in a sensible and economical way. The results, in major clinical and research laboratories where **BSL** systems are now operating, speak for themselves. These same units provide complete source data acquisition systems for any application in which results or transactions are reported by people or instruments.

BSL Data Input Consoles have built-in interfaces for most instruments with electrical outputs—plus a well designed keyboard for identification data and/or manually entered transactions. All data are displayed before transmission and recording. Designed for bench top use.

BSL DATA INPUT CONSOLE

left half of register displays data identification. Right half displays instrument output or test results before transmission. Plug-in scaler or DVM loads test result register.

LABORATORY DATA COLLECTOR™

with incremental magnetic tape option allows off-line recording or on-line operation with computers. The LDC is a general purpose digital interface with built-in maintenance and check-out panel.

One to 20 Data Input Consoles can be attached to our Console Controller and **LABORATORY DATA COLLECTOR™**, which provides real-time input to any computer or drives any data recording device such as magnetic tape, paper tape or printer. Our laboratory data processing systems include small computers and complete programs for real-time data processing and preparation of reports.

(P.S. We also make a printing digital voltmeter for analytical instrument data recording, 0.1% but only $1 ,450!)

THESE PRODUCTS HAVE ALLOWED US TO DESIGN, ASSEMBLE, DOCUMENT AND DELIVER THE FOLLOWING SYSTEMS WITHIN A 90 DAY AVERAGE:

CLINICAL LABORATORY SYSTEMS for the National Institutes of Health and the University of California Medical School: general purpose data input consoles for cell counters, spectrophotometers, and direct input; **LABORATORY DATA COLLECTOR,** local printer, and incremental mag tape off-line/on-line systems interfaced to **CDC 3200** and **PDP-8** computers for real-time operation.

PORTABLE FIELD DATA ACQUISITION SYSTEM for geophysical research: **BSL** designed analog multiplexor, precision digital clock, **A/D** converter and incremental magnetic tape all connected and controlled by standard **LABORATORY DATA COLLECTOR;** truck mounted.

OEM DIGITAL DATA RECORDING SYSTEMS for microdensitometer manufacturer: standard **LABORATORY DATA COLLECTOR** with incremental magnetic tape option (see picture above). Instrument electrical interfaces supplied by **BSL.**

RCA 301—DIGITAL PLOTTER INTERFACE AND CONTROLLER: standard **LABORATORY DATA COLLECTOR** (more being delivered for six different computers). The **LDC** also allows off-line operation of digital plotters, incremental mag tapes, and printers for system check-out and maintenance with arbitrary test data.

NOW UNDER CONSTRUCTION: A BANK TELLER TRANSACTION AND ACCOUNT VERIFICATION SYSTEM. Twelve consoles, an **LDC** plus mag tape, and small general purpose computer—a complete real-time system with off-line backup recording of all transactions.

We invite your specifications for any data acquisition or computer system. We have no salesmen—we send design engineers and systems programmers for serious discussions.

Our products are only part of the story. We have major research and development contracts for bio-medical instrumentation and automation, large real-time computer systems and programming systems for military and space programs, and a variety of electronic instrumentation and small computer systems (we've even tried our hand at such things as electronic alarm systems and voting machines—both of which are operating quite well for the customers). If you're interested in our work, please contact us.

BSL **BERKELEY SCIENTIFIC LABORATORIES**
2229 Fourth Street □ Berkeley, California 94710 □ (415) 841-8812

CIRCLE 7 ON READER CARD

If we were a BIG Corporation, this MDS DATA-RECORDER would still be buried in someone's file folder

We're happy as clams that all of our decision-makers are under one roof.

All of our products are designed and manufactured there, too. Since we "job" no products, we have full control from concept to installation.

Because MDS is a compact team, we can more easily tailor our family of machines to customer requirements and we can act quickly when necessary.

For example: our new MDS 1109 DPC DATA-RECORDER.

We already had the basic 1101 Keyed DATA-RECORDER, for transcribing information from source documents direct to magnetic tape, ready for use as computer input.

We also had the 1103 LDC DATA-RECORDER, providing the most economical throughput for long distance data transmission.

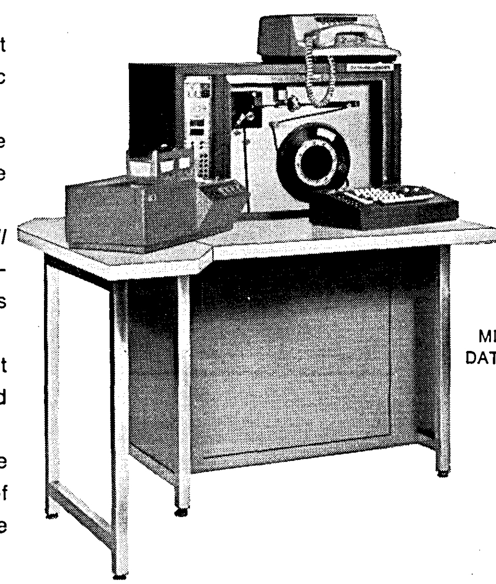
And our line included the 1106 PCR DATA-RECORDER that converts data from punched card turnaround documents to magnetic tape, without requiring even a second of CPU time.

There were customers and prospects who wanted all three machines, but their work loads wouldn't justify the multiple machine costs.

All of which led us to wonder whether we could combine *all three functions in a single unit, at a saving to the user.* The decision-makers promptly gave the idea the green light. We were in business with the 1109. All we had to do was ask you for the orders.

Our specialized, expanding efforts are concentrated on input preparation equipment to meet the demands of today's sophisticated computers.

If you're looking for more profitable use of your magnetic tape computers... through faster, more accurate input... perhaps one of our "home-grown" specialties will put you on the right track. Phone or write your MDS Specialist.



MDS 1109 DPC DATA-RECORDER

MDS

MOHAWK DATA SCIENCES CORPORATION
HARTER STREET, HERKIMER, NEW YORK 13350
TEL.: 315/866-6800
SALES-SERVICE OFFICES IN MAJOR MARKET AREAS

CIRCLE 8 ON READER CARD

DATAMATION

january
1967
volume 13 number 1

automatic
information
processing
for business
industry & science

datamation departments

Computemp.

It's the name of our new computer room air conditioners. Here's the "short and sweet" of it: they maintain a temperature of 72°F, plus or minus 2.5°F, and 50% relative humidity, plus or minus 5%, within the computer area. They are completely self-contained. They meet the requirements of all makes of computers.

Let us tell you more . . . write for our detailed brochure:

BLAZER Corporation
400 PATERSON PLANK ROAD
EAST RUTHERFORD, N. J.

CIRCLE 10 ON READER CARD

calendar

DATE	TITLE	LOCATION	CONTACT/ SPONSOR
Jan. 23-27	Course: Methods of Operations Research $225	Univ. of Miami Coral Gables, Fla.	Univ. of Miami
Jan. 27-28	Workshop: Simulation	College of Engineering Univ. of Missouri Columbia, Mo.	Univ. of Missouri
Feb. 1	Symposium: Computer Science and Statistics	Univ. of California Los Angeles, Calif.	UCLA, L.A. ACM & American Statistical Assn.
Feb. 7-9	Convention: Aerospace & Electronic Systems	International Hotel Los Angeles, Calif.	IEEE
Feb. 8-15	EDP Trade Fair	Frankfurt Trade Center Frankfurt, Germany	U.S. Bureau of International Commerce
Feb. 13	Courses: Computer Systems, Edp for Management, Symbolic Languages, Introduction to Computers.	Oakland Univ. Rochester, Mich.	Michigan State Univ. Dept. of Continuing Education
Feb. 13-17	SHARE XXVIII	Hilton Hotel San Francisco, Calif.	IBM Users' Group
Feb. 14-24	Course: Theory and Design of Reliable Computers. $300.	Room 4442 Boelter Hall Univ. of Calif. Los Angeles	UCLA Extension
Feb. 16-17	Conference	Sheraton Hotel Chicago, Ill.	Assn. of Data Processing Service Organizations.
Feb. 20	Paper deadline: 1967 National ACM Conference		Dr. Jack Minker, Auerbach Corp., 1815 N. Ft. Myer Arlington, Va.
Feb. 20-21	Users Meeting	International Inn Washington, D.C.	RCA Computer Users Assn.
Feb. 25	CDP Examination	DPMA Test Centers 100 national locations	Data Processing Management Assn.
March 1-3	Conference	Statler-Hilton Hotel Detroit, Michigan	Numerical Control Society
March 15	Paper deadline: International Electronics Conference		Dr. Rudi de Buda, Int. Elec. Conference, 1819 Yonge St., Toronto 7, Canada

Our optical reader can do anything your keypunch operators do.

(Well, almost.)

It can't return from a two-day weekend with a three-day hangover. Or phone in sick. Or turn out half the work in twice the time. But it *can* read. And gobble data at the rate of 2400 type-written (or hand printed) 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. It can handle 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, or verify as it reads. Lets you forget format restrictions, leading and trailing zeros, skipped fields, and fixed record lengths. And our reader won't 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 key-punch operators. At least that's what it is doing for American Airlines.

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

RECOGNITION EQUIPMENT Incorporated

U.S. Headquarters: Dallas, Texas 214-637-2210 Offices in principal U.S. cities and Frankfurt, London, Milan, Paris and Stockholm

CIRCLE 9 ON READER CARD

think faster think Burroughs memory systems

IN MEMORY SYSTEMS THE FASTEST BIT MAKES THE DIFFERENCE . . . AND BURROUGHS MAKES ITS OWN BITS (BOTH CORE AND THIN FILM).

The new Burroughs line of core Memory Systems is fast . . . as fast as 0.6 μsec. full cycle time. You can also have a "not-so-fast" model at lower cost if you don't need the speed.

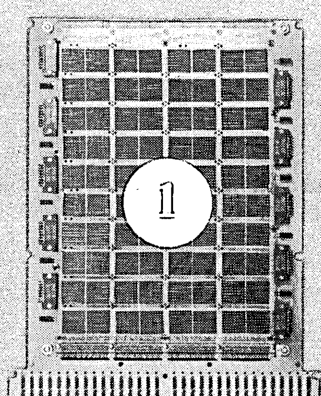
Now, Burroughs 14 years of experience is available to provide you with the Memory System you need for your data handling equipment.

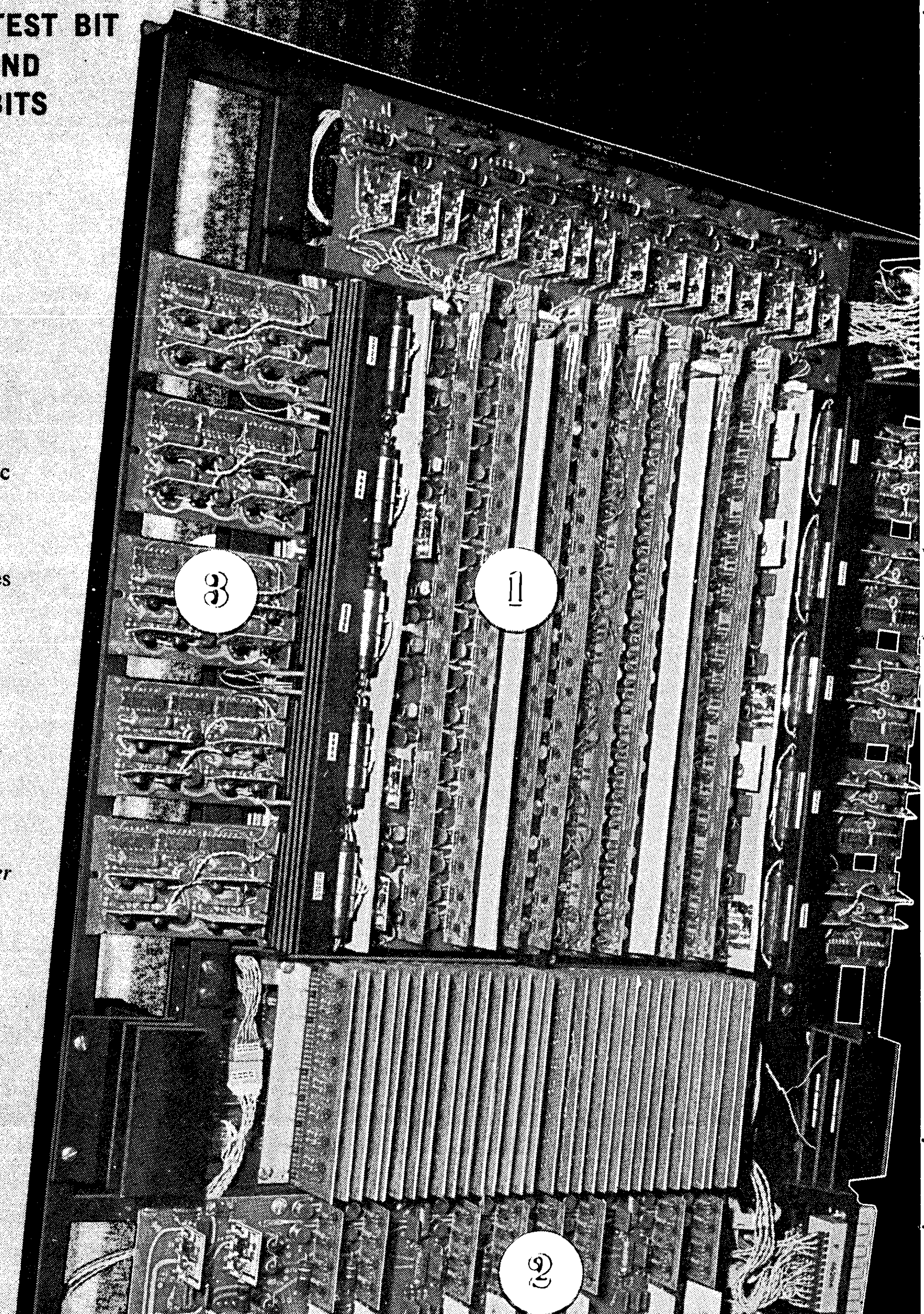
- System cycle times of 0.6 and 1.0 μsec.
- Modular building block construction—basic module is 8192 words by 20 bits and contains the core-memory, sense amplifiers, driver circuits and information registers.
- Associated memory control module includes timing circuits, address register and decode logic.

FEATURES:

1. 20 mil, 2-1/2D ferrite core memory—manufactured by Burroughs.
2. Driver Circuits and sense amplifiers use Burroughs hybrid microcircuits.
3. Monolithic integrated circuits used for all logic and registers.

If you would like your system to think faster write or call for further information on Burroughs memory systems.





Burroughs Corporation / ELECTRONIC COMPONENTS DIVISION
PLAINFIELD, NEW JERSEY 07061

Lease this 60 cps Tally data transmitter for less than $25 per month. No installation or maintenance charges.

Many of you are familiar with our elegant and sophisticated System 311 Data Communication Center. Fewer know that we make the broadest line of data communication equipment on the market today. Fourteen different systems are available on an off-the-shelf basis including the System 100 that leases for less than $25 per month. Systems, which are used with data sets, include both parallel and serial data transmitters and receivers, tape conversion units, and tape conversion transmit/receive systems. Here's a sampling.

1. Tally's System 100 Transmitter and System 200 Receiver go together to provide unequalled simplicity of operation coupled with low price. Speed is 60 characters per second over ordinary telephone lines. Low price, lack of installation or maintenance charges on the System 100 and minimal charges on the System 200 make these systems ideal for multiple installations reporting to a central accounting or computing facility.

2. System 108 Transmitters and System 208 Receivers also operate at 60 characters per second. However, these systems offer unique and important error detection features. When an error-free tape with parity is transmitted, the System 108 will stop transmitting if an error arrives at the System 208 Receiver. The System 108 then reverses the data tape to a block character and resends the tape to insure perfect tape generation by the System 208.

3. High transmission speed (120 cps) and error control are offered in the System 111 Transmitter and System 211 Receiver. Data can be transmitted manually or automatically for fast error-free data gathering over ordinary telephone lines. Where two-way data transmission is required, the System 311 Data Communication Center should be used. The System 311, in addition to combining the functions of Systems 111 and 211, can be used to duplicate and edit tape off-line.

4. A highly versatile data center, the Tally System 700 provides data transmitting or receiving on either paper or magnetic tape and bi-directional conversion of data between paper and magnetic tape. It handles data at the rate of 60 to 120 characters per second, and is available with a wide range of optional features.

For complete information on all 14 Tally Business Communication Systems including sale and lease price information, please address Robert Olson, Tally Corporation, 1310 Mercer Street, Seattle, Washington 98109. Phone: (206) MA 4-0760. TWX: (910) 444-2039. In the U.K. and Europe, address Tally Europe Ltd.,
Radnor House, 1272 London
Road, London, S.W. 16,
England. Phone:
POLlards 9199.

TALLY®

CIRCLE 12 ON READER CARD

← FOR BURROUGHS CIRCLE 11 ON READER CARD

letters

assemble or compile

Sir:

In the article, "Assemble or Compile?" by Christopher J. Shaw (Sept., p. 59), the numbers in the assembly and compiler language cost comparison seem odd—especially the computer usage rates. With these, programmers and analysts should go back to picking cabbages . . .

JEAN P. HINCELIN
Paris, France.

Mr. Shaw replies: I re-checked the figures. They are not typographical errors, and unless the (standard) statistical programs that were used to compute them were buggy, they accurately reflect the costs of the sample programs. Of course, computer usage rate depends greatly on the speed of the computer, and program production rate depends on many factors, including application area (business programs seem to be considerably easier to produce than other types) and, in particular, program size (which seems to affect program cost exponentially). So I would not be surprised, in any given case, if the rates cited in my article were off by an order of magnitude—either way. But I must firmly reject M. Hincelin's suggestion that the people who built these programs would be better employed picking cabbages; I know some of them, and they are quite capable.

computer model numbers

Sir:

I enjoyed the article by K. E. Knight ("Changes in Computer Performance") in the September issue. His commentary on Grosch's Law is especially significant. But there is one area of research to which he gave entirely too little attention: the correlation between the performance of a computer system and its model number.

It is obvious that such a correlation exists, for we have seen the 701 grow into the more powerful 704, which led to the even more powerful 709. The same may be seen in numbers used by most manufacturers. But it is much less obvious how we should go about comparing the products of two different manufacturers who happen to derive their model numbers from different equations. (Or perhaps there is, in fact, one universal equation, and only the parameters are changed from one firm to the next.) Further, we seem to lack a theoretical basis for dealing with some of the more modern systems of notation (are 360 and 40 to be regarded as two components of a vector, or are they entirely incommensurate?).

Lest someone question the practical value of research in this field, I would hasten to point out that the very success of a product in the market place may turn out to be crucially dependent on the existence of a proper relationship between model number and performance. Who can say but what STRETCH might have been a resounding success but for the peculiar relationship of 7030 to 7010, 7040, and 7090?

Of course the ultimate goal of the research I have mentioned is the actual prediction of performance from knowledge of model numbers. If we can do away with the need for empiricism and wrest from Nature the secret of the correlation we observe, the effect on systems planning will be tremendous. There will be no need for benchmark problems or the evaluation of voluminous proposals. Think what it would mean if one could simply perform a few calculations on the model number of a proposed machine and arrive at the exact running time for his program! Or conversely, one could start with the statistics of his operations and derive exactly the model number of the machine he should buy.

No doubt the work of the product planner would be greatly simplified also. Ultimately we might hope that systems would come to be designed with sufficient modularity so that a machine having exactly the model number needed could be assembled rapidly from a catalog of standard items.

JAMES H. HAYNES
Phoenix, Arizona

natural language i/o

Sir:

In connection with our article, "The AMTRAN System," in the October issue (p. 22), we would like to clarify the following points:

1. The MADCAP[1] system of Mark Wells introduced and pioneered the use of the natural language of applied mathematics as the input-output language of an on-line computer system.

2. The Klerer-May[2] system has extended the development of the natural mathematical input-output format initiated by MADCAP. Both MADCAP and the Klerer-May system represent significant advances toward the full implementation of the language of applied mathematics as a computer language.

3. The wording of the fourth paragraph of the section on other conversational mode systems is unfortunate. It attempts a brief summary of the AMTRAN System and it should have appeared in the conclusion.

L. H. WOOD
R. N. SEITZ
J. REINFELDS
P. L. CLEM, JR.

[1]M. B. Wells, *Communications of the ACM*, Vol. 4, p. 31 (1961).
[2]M. Klerer, J. May, *Communications of the ACM*, Vol. 7, p. 290 (1964).

PL/I: ouch

Sir:

Regarding Dr. Burkhardt's article, "PL/I: An Evaluation" (Nov., p. 31), I would like to make a number of comments.

Aside from an excessive number of syntactical errors in his examples as well as inventing a SEQUENCE statement, a DELAY statement and an I/O CALL option, Dr. Burkhardt appears to understand PL/I reasonably well. But, I wonder if he understood any of the motivation and philosophy behind the development of PL/I. There is no indication that he really understands what has been attempted.

Dr. Burkhardt's claim that a PL/I drawback is incompatibility with existing languages is incomprehensible. He is attacking PL/I for not achieving something which was never a design objective. Compatibility (in hardware, too) is not notable for its contributions to progress. How compatible was ALGOL 60 with ALGOL 58?

The limitations he mentions are not for all System/360 compilers but are, in fact, specific to the F-level (64K) implementation presently available. There is nothing inherent in the language to inhibit other implementations from selecting their own limits.

Dr. Burkhardt seems disturbed that

Engineers' and Management Surveys indicate:

STARTING SALARIES OF ENGINEERS ARE DECEPTIVELY HIGH

By James M. Jenks

TWO SEPARATE STUDIES appear to contradict the commonly held belief that engineers today make out better financially than their colleagues who major in non-technical subjects.

The first survey polled graduate engineers; the second, company executives. The findings of these surveys indicate that the average engineer — despite a high starting salary — climbs fast but not far.

The need for technically trained men in recent years has exceeded the supply to such an extent that companies have been forced to bid for their services — to actually set-up "recruiting" offices on college campuses all over the country. Thus, starting salaries have gone up and up. But the income ceiling for these technically trained men is lower than for managerial personnel.

According to figures compiled by the Engineers Joint Council, the average engineer can only hope to earn about $13,000 a year. Even an engineer who is at the top of his profession (one whose salary is in the top ten per cent) earns only about $17,500 a year. In contrast, an American Management Association study shows that a middle management man can expect a maximum salary of between $20,000 and $30,000 a year in the larger companies. And, of course, a man who becomes a middle manager early in his career is still promotable. He still has the opportunity to reach the top executive level and earn much more.

This, of course, is not to say that engineering students would be wise to shift to the study of business administration — or that working engineers face a bleak future. Quite the contrary, the continuing growth of technology means that men with technical backgrounds are ideally qualified for the highest rewards industry has to offer — *if they also have a knowledge of the underlying principles of business.*

FREE . . . "FORGING AHEAD IN BUSINESS"

If you want to avoid the thorny barriers to success — if you're ambitious, determined to move up fast — send today for the Institute's 32-page descriptive booklet, "Forging Ahead in Business."

It explains what a man must know today to make $20,000 or more a year . . . what he must do to accumulate this knowledge. It tells why men of equal ability fare so differently in the race for better jobs and bigger salaries. It analyzes the causes of failure . . . the reasons for success. And it outlines an executive-training program which is so complete and so scientific that each day subscribers are brought a little closer to a mastery of business procedures.

There's no charge for "Forging Ahead in Business." And no obligation . . . other than the obligation to read it thoughtfully, and decide for yourself whether the training it describes is meant for you. To obtain your complimentary copy, simply fill out and return the coupon below.

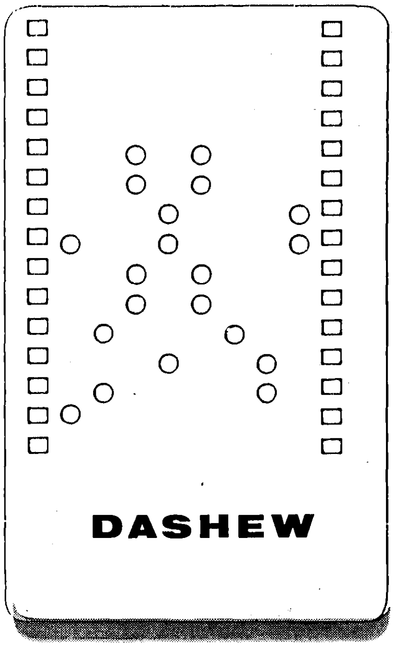
ALEXANDER HAMILTON INSTITUTE
235 East 42nd Street, New York, New York 10017

ALEXANDER HAMILTON INSTITUTE
Dept. 803, 235 East 42nd Street
New York, New York 10017

Please mail me, without cost or obligation, your 32-page book, "Forging Ahead in Business."

Name . . . .
Firm Name . . . .
Business Address . . . .
Position . . . .
Home Address . . . .
Zip Code

DEPEND UPON DASHEW...



for AUTOMATIC DIALER card needs

Now Dashew can process plastic "Touch Tone" automatic dialer cards directly from tabulating cards, in one operation.

No matter whether your requirements are for punched, punched and embossed, or punched and stamped cards, Dashew can handle them. And Dashew can also provide fixed data input for your EDP system, whether it be an NCR Class 53, Ultronic, or any other system that utilizes punched plastic cards for input.

Dashew's total automatic dialer card production capability allows you to go to one source for the design, manufacture, punching, embossing and/or stamping of your cards. Single-source responsibility means reduced handling, maximum security of records, greater speed and efficiency. This means a lower cost for you.

Low cost, completely processed dialer cards make practical — for the first time — large scale data collection and transmission systems employing automatic dialer cards.

No matter where you are, Dashew is only a 'phone call away. Service centers are conveniently located in Los Angeles, Chicago, and Toronto.

Remember — Dashew, and only Dashew, is your one complete source for plastic automatic dialer card service!

DASHEW BUSINESS MACHINES

Santa Monica — 2219 Main Street 213-392-3984

Chicago — 319 North Albany Street 312-533-1400

Toronto — 90 Thorncliff Park Drive 416-421-9585

CIRCLE 15 ON READER CARD

letters

the character set does not conform to the proposed ASCII set. The ASCII set is not particularly useful for programming; we who have lived with PL/I for almost three years are more disturbed at X3 for attempting to foist this code on the data processing community. On the divergence between the PL/I 48 character set and that used by ALCOR, I can only be thankful that we have selected the existing 48 character set. While it is no beauty, it is far better than the ALCOR set. In any case one would hope that 48 character sets (such as ALCOR) won't be with us much longer.

More serious is Dr. Burkhardt's statement about compiler performance and potential usefulness. First-cut compilers (incidentally not for the full language) are running. By whose measure do they perform poorly? Are we still measuring performance by cards per minute? (What's a card?) Although few would claim that the current compilers are high speed, unsupported remarks about a first-try compiler must strike many people as competitive jealousy. I would remind Dr. Burkhardt that PL/I is a rich, complex language that at best will never be as easy to compile as FORTRAN and, remember what FORTRAN was like in 1957?

On behalf of the user's group which has spent time and effort on PL/I, we resent Dr. Burkhardt's innuendos that we cannot be trusted. But, beyond this, we resent his remarks when he has made no contribution to PL/I through one of the many public channels. For his benefit, the SHARE PL/I Project will accept input from any source. Further, X.3.4.2c in its pre-standardization activity will accept his input. Both SHARE and IBM are actively supporting the X.3.4.2c activity, have been doing so, and will continue to do so. Dr. Burkhardt's remarks have the tone of one who feels left out and unheard.

Since Dr. Burkhardt began his remarks by stating that "probably no committee will ever develop a really useful programming language," I must stand in awe of his espousal of a Programming Institute to design, specify, and implement a language. There seems to me to be an astonishing piece of logic here: "A committee isn't good enough so let's have an institute."

PHILIP H. DORN, *Manager*
SHARE PL/I Project
New York, New York

The author replies: The task of an evaluator, like that of a botanist, is not to weed out the flowerbeds, but to show which plants will be flowers, and which weeds. So the proposition that only contributors to PL/I can be evaluators must be rejected.

From the developmental effort for a new programming language, I should have liked to see emerging not an all-purpose tool (similar to those from some junk-shops, which are not useful as efficient instruments), but rather one that generates special tools, or transforms into those, at will (stressing adaptability of the language more than a collection of language features in the design).

The "excessive number of syntactical errors" and language features are not invented by me but by the various authors of PL/I manuals.

For example, the explanation of SEQUENCE, DELAY and I/O CALL option is found on pages 104, 81, 125, respectively, in the second manual from Ref. (2) of the article. Each version of the manual shows new additions and deletions, most of them rather unimportant for an understanding of the language. The manual referred to in Ref. (1) had not been available as a basis and is given only as the current version.

No excuse exists for poor program performance, especially if it is due to inadequate language design; performance is measurable, and to apply 1957 standards seems no longer appropriate.

Many people are unhappy about the ASCII code, but if it or its successor will be a standard, then it should be used by language designers. With the character set and elsewhere, I got the impression of too much change for change's sake. Compatibility is a desirable goal, especially if available at little cost.

PL/I appears in its incompatibility and level at this time like the latest and biggest Model T car: unable to use available parts.

binary diet

Sir:

I forward the limerick below, of my own invention, for publication:

There was a young man who, with digits,
Made jolly green giants from midgets.
They ate tons and tons
Of zeroes and ones
But finally died of the fidgets.

STUART GROVER
Boston, Mass.

automatic abstracting

Sir:

In my article, "Automatic Abstraction of Legal Information" (Nov., p. 63), there is an omission at the bottom of the first column on p. 64. The article states that new text material would be annotated for immediate distribution "if they contained the words as specified in the following formula:" Alas, the formula is missing! It should be:

$W1 \cdot (W2_a \vee W2_b) \cdot (W3_a \vee W3_b \vee W3_c) \cdot (W4_a \vee W4_b \vee W4_c \vee W4_d)$ where • = *and,* v = *or,* and numerals following the letter *W* identify groups.

Jack Sieburg
Denver, Colorado

2000-hour guarantee

Sir:

There is an error in your New Product story on p. 95 of the November issue. Our 7-track digital magnetic recording head is guaranteed unconditionally for 2,000 hours—not 200, as you stated.

John Turnbull
Ferroxcube Corp. of America
Saugerties, New York

memories & terminology

Sir:

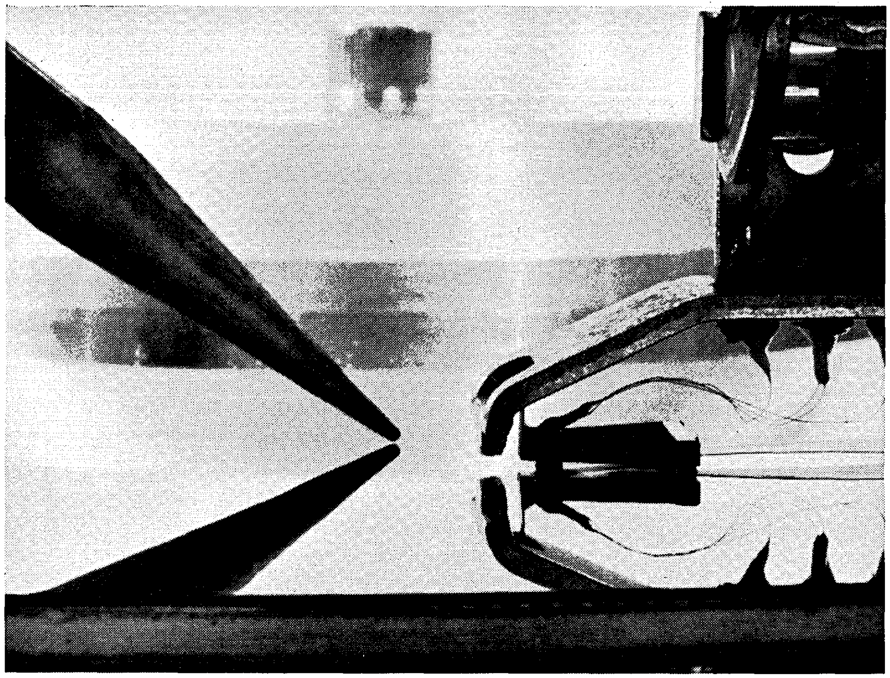
As a reaction to the discussion in your magazine on computer memory terminology, I would like to add the terms we have been using. We distinguish between files and memories where *file* refers to the logical unit of storage and *memory* to the hardware containing the file.

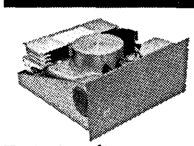
Random access, referring to the way one retrieves information, is not a suitable term to distinguish memories from one another. For the latter purpose, we use *addressable* or *addressed* memories (like disc or drum) and *sequential* (like tapes). The term *direct* is used as opposed to *indirect:* the latter signifies the method in which reference to an address yields another address, while direct addressing means that the reference to an address yields an operand.

Ir. G. C. Nielen
N. V. Philips' Gloeilampenfabrieken
Eindhoven, The Netherlands.

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.

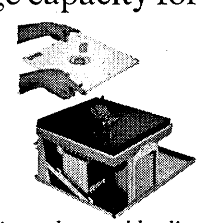
"In-contact" disc memories store 50% more bits per dollar



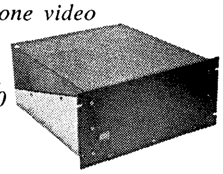


F Series disc memory system. Includes electronics. One head per track. Stores 100,000 bits per track. Available with 16, 32, or 64 tracks for max. capacity of 6,400,000 bits. Average access time: 16.7 ms. Data transfer rate: 3,000,000 bits/sec.

Data Disc put the read/write heads in gentle contact with the disc in order to record 3300 bits per inch of track. That's twice the storage density possible with floating head memories, and it means that you get about 50% more storage capacity for every dollar invested in equipment. □ If you're worried that head contact will cause wear, you ought to see the disc we've been spinning beneath in-contact heads for over 20,000 hours. The disc is not so much worn as polished, and it still reads out error-free data—just as we recorded it over two years ago. □ There are secrets to reliable in-contact recording, but we can tell you this much: we plate the discs with a thin rhodium armor to protect the magnetic storage medium. Then we polish the surface to a near optical finish that deviates from perfect smoothness less than 0.4 microinches A.A. The result is insignificant wear, and less than one transient dropout for every 10 billion bits.



M-6 interchangeable-disc memory system. Includes electronics. Stores 12,000,000 bits per disc. Discs permanently encased in protective cartridge.



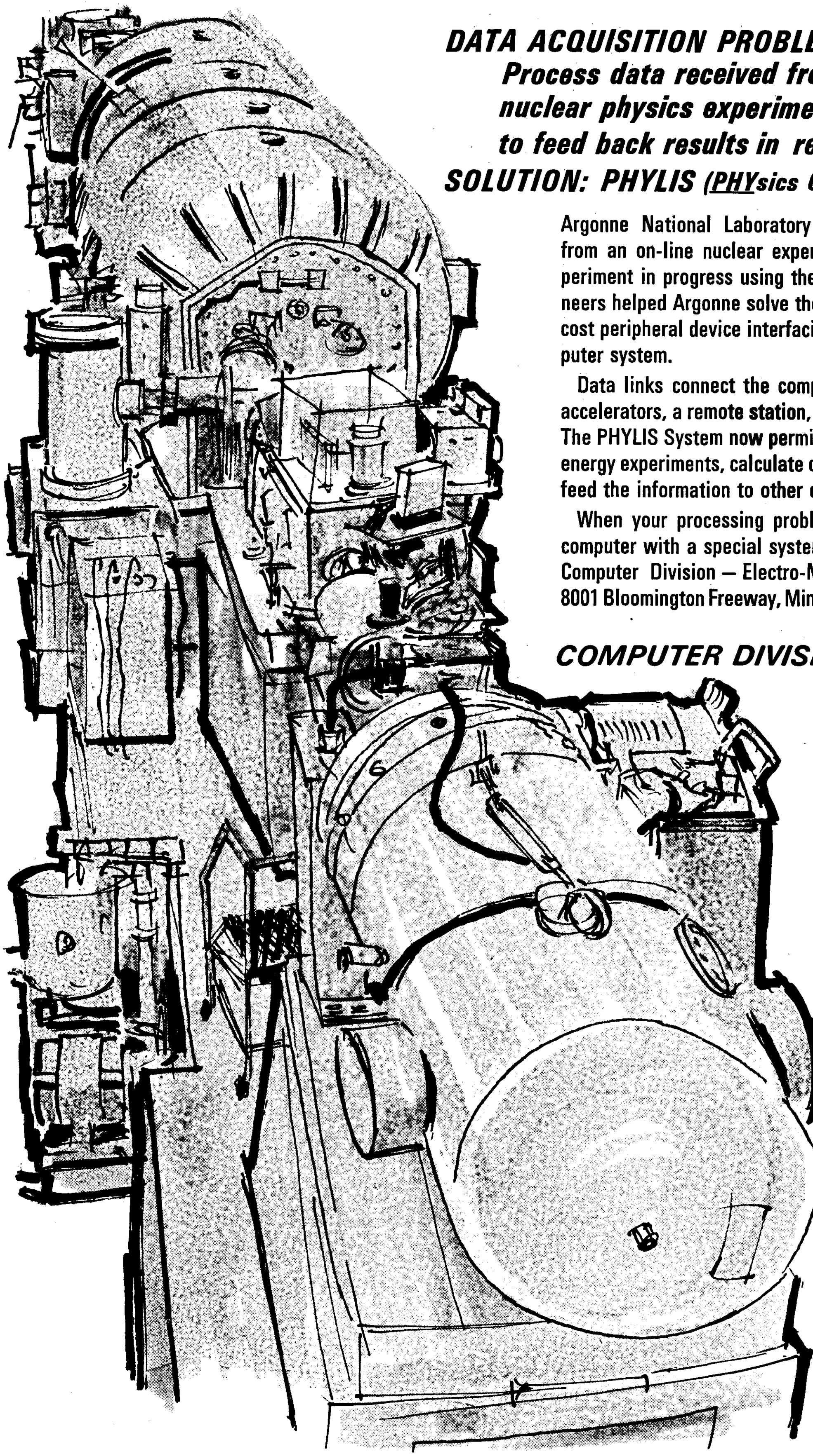
F video buffer. Stores one video frame per track on up to 20 tracks. Records analog video to 4.2 Mc, digital video to 200,000 bits per frame.

Data Disc, Incorporated, 1275 California Ave.
Palo Alto, California 94304 • Phone (415) 326-7602

DATA DISC

CIRCLE 16 ON READER CARD

DATA ACQUISITION PROBLEM AT ARGONNE:
Process data received from on-line nuclear physics experiments fast enough to feed back results in real-time.
SOLUTION: PHYLIS (PHYsics On Line Information Station).



Argonne National Laboratory wanted to process data from an on-line nuclear experiment and modify the experiment in progress using the results. Our system engineers helped Argonne solve the problem with special low cost peripheral device interfacing with a high-speed computer system.

Data links connect the computer system, two particle accelerators, a remote station, and other instrumentation. The PHYLIS System now permits Argonne to analyze low-energy experiments, calculate calibration distribution, and feed the information to other controls.

When your processing problems require a high-speed computer with a special systems touch, call or write to: Computer Division — Electro-Mechanical Research, Inc. 8001 Bloomington Freeway, Minneapolis, Minnesota 55420.

COMPUTER DIVISION EMR

Look for us at the
15th Annual Physics Show,
Hilton Hotel, New York, N.Y.
Booths 177-178-179.

look ahead

GE STILL SEARCHING
FOR LOSS-TRIMMING FORMULA

Although GE announced in November that it was laying off 450 people at its Phoenix plant, many outsiders claim the number is more likely 2-3 times that, with more cuts due worldwide. Many of the Phoenix folks are being offered jobs elsewhere in the Corp., and body snatchers and other recruiting vultures invading Phoenix say only "deadwood" is available there. The company says it's not cutting back marketing, but admits "adjustments" in some sales offices. Also, the Computer Research Lab in Sunnyvale is no more, with the work there either terminated or transferred to other locations. The company is reportedly re-evaluating its peripherals, may stop making its own tape drives, is looking for a new small disc source.

Not to be interpreted as a sign that GE is bailing out, the cutbacks instead are an attempt to reduce the corporation's staggering edp losses, estimated in some quarters as $400 million or more. One source says that GE's edp losses last year were 45¢ per sales dollar. Meanwhile the company continues to believe that a good GE-trained manager can manage anything, leaves the information systems division in the hands of management relatively new to the costly mysteries of the computer biz.

RCA, REI WIN
TEXACO STARS

Texaco Houston won't confirm it, but it appears that the Texas oil company has awarded RCA its biggest commercial edp order yet, for six Spectra 70/45's with a purchase value of some $8 million. The contract may depend on the performance of the first system, due in next summer.

Recognition Equipment Inc. also landed a whopper with Texaco, an order for 16 optical character recognition units with a purchase value of $5 million. The first of the units will be installed in April '67. The second phase of the program will begin a year later when REI starts replacing nine of the current generation OCR machines with the first of nine bar code reader/sorters which will include an electrostatic ink jet printer. The computer-controlled units will encode account numbers on gas sales charge slips while they're being read.

TIME-SHARING FLOWERS
AT PILLSBURY

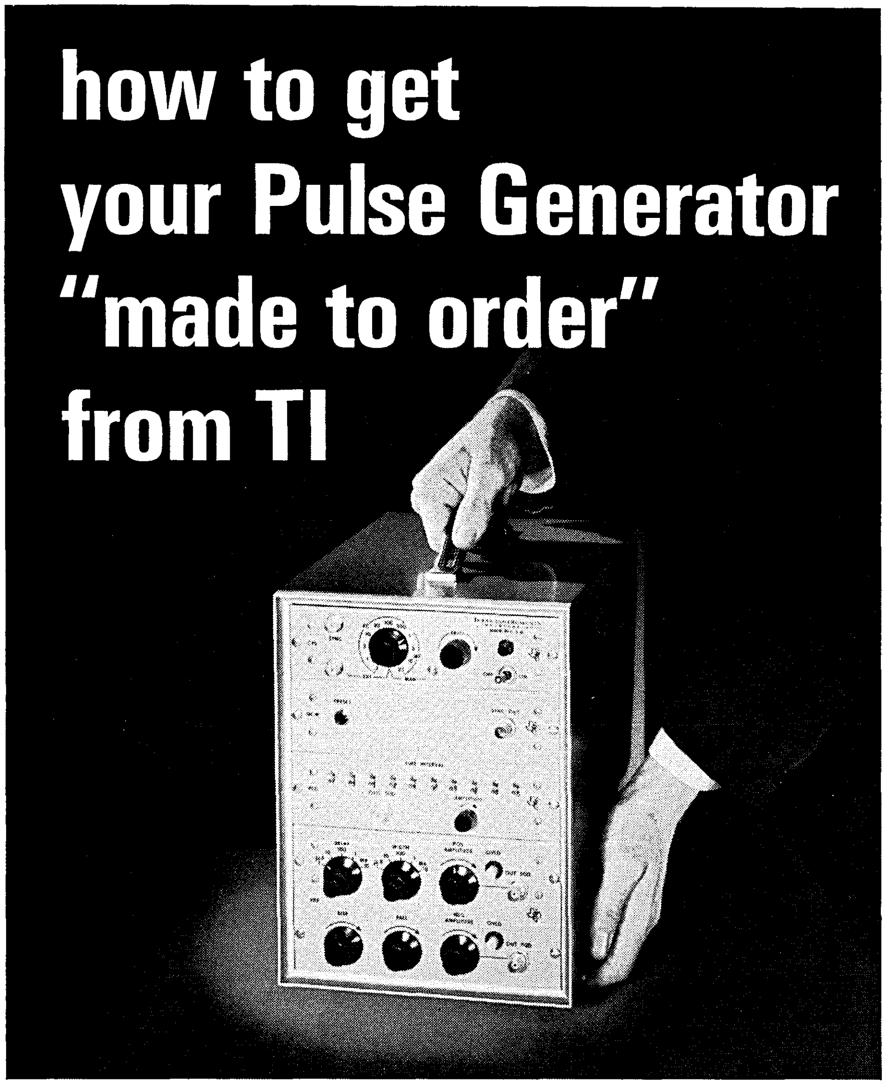
While large-scale time-sharing continues to stumble, less ambitious T-S systems march forward. An unlikely and successful entry into the T-S service business is a subsidiary of the Pillsbury Company named Renown Properties. Using a GE 225-Datanet 30 combo, the company is serving 42 outside customers and 13 inside.

Operational since April, the system serves 27 high schools and colleges, offering seven hours of line time and a few thousand seconds of processor time for $100/month for educational-only use. Most of the schools use Basic, but Fortran and Algol are available. Commercial customers pay $350/month for

who reads

DATAMATION

?



"Special" Pulse Generators are made to order at TI. Modular construction allows assembly of the right building blocks to meet your requirements. Now, "specials" cost you no more, frequently cost less than conventional pulse generators.

For example, the 6613 is an economical general-purpose unit with PRF from 15 cps to 15 mc, priced at only $950. Another model, the 6325, is a ten-channel, word-bit programmable unit operating up to 25 mc. The single unit does the job of ten discrete generators, at half the cost, and fits in a cabinet 23 in. wide, 38 in. high, 18 in. deep.

TI Pulse Generators give you outstanding performance: PRF's to 100 mc, fast rise and fall times, variable pulse width and delay, variable rise and fall times, plus and minus outputs, pulse mixing, programmed and random word generation. You have your choice of portable or rack-mounting cases.

When you need special pulse generator performance, choose one of the thousands of standard pulse generator combinations from Texas Instruments. For more information, contact your nearest TI Authorized Representative or write to the Industrial Products Group in Houston.

INDUSTRIAL PRODUCTS GROUP

TEXAS INSTRUMENTS
INCORPORATED
P. O. BOX 66027 HOUSTON, TEXAS 77006
118 RUE du RHONE GENEVA, SWITZERLAND

750

CIRCLE 18 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.

define your terms, please

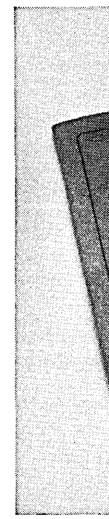
Whatever your work in information processing, you'll communicate better with the help of this authoritative glossary.

Name
Title
Company

Address
City

NEW AD
Name
Title
Company

Address
City
What is e
Your Sign



an intro
DAT
This 62-p
of technic
essing. It
tronics, c
This gloss
as a refe
familiarity
as a conv
responsib
Please us

DA
35 Mas
Please s
Name
Address
City

25 hours of line time and 7200 seconds on the cpu.

Pillsbury and Renown Properties vp Jim Rude calls time-sharing "one of the most phenomenal tools" he's ever come across ... "and you don't need a big system. It's a good business," he adds. So good, that RP will set up three more T-S bureaus as soon as its other three purchased 225-30's are freed by a GE 635 due to arrive in May.

VERTICAL MARKETS RAISE RAYTHEON PROFIT HOPES

Raytheon Computer, taking the long, slow route to profitability, thinks it will turn the bend into black ink next year by pursuing its rifle approach to vertical markets. Targets for next year: the graphic arts and retail point-of-sale.

In the works, being readied for announcement next year is a new line of products, including phototypesetting and manuscript editing systems. A large typesetting system, including a special-purpose computer and Photon 901, has been sold to the Times Mirror in LA. And the company has a deal with a Canadian retail chain, is developing an on-line point-of-sale recorder.

NEW SYSTEMS HOUSE READIES LOW-COST TERMINAL

A portable, remote CRT/keyboard terminal with vector and character generators, and selling for less than $6K, is being developed by Computer Communications Inc., Inglewood, Calif. A buffer memory, the small controller relieves the CPU of the image refreshing job. And the CRT is a standard TV set; remove two wires and the ground and you can watch the Super Bowl game. The system comes with an interface for a 202 Dataphone or an acoustic coupler. The latter, they figure, will sell for less than $300.

The new systems house, less than a year old and headed by ex-CDC vp Robert E. Fagen, also has a multiplexer that'll handle up to 32 phone lines of mixed speeds. Also optional: lightpen, non-impact printer, and card and paper tape I/O. For a fee they'll also write the software to handle all this.

Staffed by 18 people, CCI is both a software and hardware firm in the time-sharing field. A current project is a real-time Fortran IV compiler for the Interstate 1010 computer (see Aug. '66, p. 17).

PHONE COMPANY HANGS UP TIME-SHARING SERVICE

Communications costs are hampering the efforts of one pioneering commercial time-sharing venture. The company's northern California computer is linked to southern California terminals via a multiplexer located in Los Angeles. But the multiplexer is not accepted by the local phone company as a switching device (although that's its function), so transmission between multiplexer and terminal costs the user more than the rates between the two cities, a line which is part of an inter-state link governed by lower FCC rates. But the phone co. will now use existing facilities to offer substantially lower rates set up for a forthcoming service already tariffed.

Elsewhere, one big user says that the proposed increase in Telpak A & B rates may mean that he will have to convert 9 remote on-line 360/20's into stand-alone 40's.

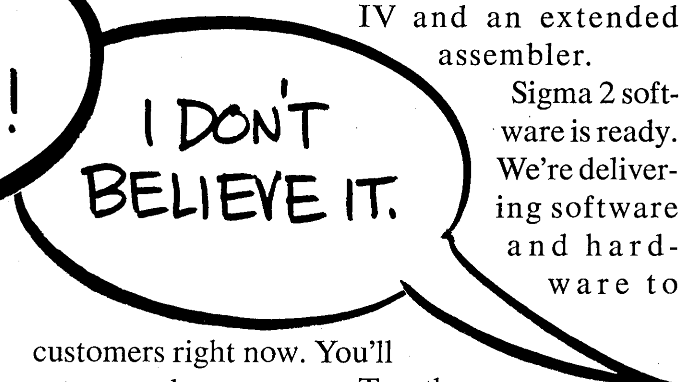
JAPANESE PRINTER BEING DEVELOPED

Itek, under contract to Hitachi, is producing a photo-optical printer with a 2000-character set -- useful in this application for producing computer output in Japanese. The set is on a microfilm belt, and output is at 300 lpm on photosensitive paper.

(Continued on page 125)

You won't believe how much software comes with Sigma 2.

Sigma 2 is small. But Sigma 2 is serious. That's why it has so much software. Enough, in fact, to make one computer do the work of two.



Sigma 2 is the only computer of its size that does multiprogramming. It does general purpose work in the background and, in less than 6 microseconds, can respond to a real-time foreground interrupt. And with a minimum amount of core.

A good computer never loafs. So we made Sigma 2 software powerful and modular enough to put every last bit of Sigma 2 hardware to work.

Starting software includes Basic Control Monitor, Basic FORTRAN, a basic assembler and a library of mathematical and utility programs.

And, if you need more horsepower, we'll add Real-Time Batch Monitor, SDS FORTRAN IV and an extended assembler.

Sigma 2 software is ready. We're delivering software and hardware to customers right now. You'll get yours the same way. Together.

Do you need on-line control? Plus general purpose computation? Maybe you expected to pay $500,000 to get the whole job done. Don't. Sigma 2, software and all, starts at $26,000.

Sigma 2 lets you do very big things. In a small way.

SDS
Scientific Data Systems, Santa Monica, California

CIRCLE 19 ON READER CARD

editor's readout

HERE IT COMES AGAIN

One of our favorite George Price cartoons shows a wildeyed man standing on the porch of what is evidently his summer cottage. He's strapped to the house by several strands of a vine, which is ominously wiggling its way around the corner toward him as his wife shouts, "Here it comes again!"

The same feeling may be engendered in computer users as they view the fresh January calendar on the walls of their offices around the world. The year 1966 will certainly go down in computer history as one of the most hectic and crisis-ridden since the Univac I lurched onto the commercial scene over 15 years ago; 1966 was—to be charitable—a year of slow deliveries, sluggish performance, sloppy support.

One man we know of ordered a 64K "third generation" machine which included only 32K when it arrived. When the second 32K module finally arrived, they discovered that the first memory module was wired in backwards. And somehow part of his system was shipped to somebody else, so he had to settle for some blue tape units to go with his red ones. Add a white console and he could compute patriotically. We've heard of another new installation where, when the operator logs into the system, it takes the machine 3½ minutes to compute and type out the time the day's activities begin.

With this kind of living third generation legacy branded vividly into the sensitive skins of so many users, it takes a special *chutspa*, an almost savage sadism, to ask our readers to attempt to focus their pain-glazed eyes on the *next* generation yet. But then *Datamation* has always asked a lot of its readers.

We invite, therefore, your attention to a quartet of articles in this issue which attempt to sneak preview the fourth generation from the vantage points of a software expert, a pair of hardware designers and a consultant speaking for the user. A *Datamation* survey of how top computer specialists across the country envision the new breed is summarized in another article.

The purpose of the articles is not to divert your attention from current third generation toe-stubbings by hitting you over the head . . . or to pacify you with promises of better things to come. Indeed, as the cover happening created by *Datamation* Art Director Cleve Marie Boutell suggests, the fourth generation may represent a hodge-podge compromise of many of the elements which have comprised its predecessors.

We hope not. And we hope that the articles in this issue will focus attention on some of the preliminary characteristics of our next *bete noire* . . . helping users foresee if even fuzzily some of the things in store for them. You can bet that the manufacturers' product planners and system designers are already beginning to shape the new equipment. And it's not too early for users to begin to think about what *they* want, and to catalog some of their painful experiences born of third generation system inadequacies. Through their user organizations, they hopefully may have a stronger voice in the design of the new generation. Nor is it too early for the planners of the truly big information processing systems of which computer systems are only a part to begin to assess the scope of the critical problems facing our society, and to which information processing must address itself if it is to live up to its promise.

Basically, we want to avoid the cartoon situation in which the battle-scarred veteran of the transition to the third generation says, as he watches the fourth generation begin to snare him, "Here it comes again!"

FOURTH–GENERATION SOFTWARE

the realignment

by ASCHER OPLER

On the assumption that the next generation of information processing systems should try to correct the shortcomings of its predecessors, let's preface our sneak preview of the fourth generation with a quick review of the major general failures of third-generation software.

Third generation dissatisfaction centers on the disappointing price/performance ratio of the hardware/software combination (from now on we'd better say "software/hardware"!) and conversion difficulties. The disappointing performance is generally attributed to software.

At one time we used hardware price/performance ratio as a useful measure. When software became an indispensable part of hardware, we measured only the performance of the combination. Since the separate pricing of software is upon us (e.g., Sigma 7 COBOL), it is likely that we'll soon be measuring software price/performance ratio. With this in mind, we can look at the price/performance ratio of the third-generation combination and observe that the *hardware* ratio is excellent but the *combined* ratio is generally disappointing.

The conversion picture is generally bleak. Those who used FORTRAN and COBOL heavily with second-generation equipment and those who can emulate their second-generation computer on their third come off well compared to those who didn't use the two languages or who can't emulate.

projected fourth-generation computers

This article is based on one man's guess about the next generation. The guess is that fourth-generation hardware will use large-scale integration (LSI) logic specialized by microprogramming. Integrated logic chips will be needed to obtain the required fast circuitry and the microprogrammed specialization will be needed to obtain the required software and user interfaces.

The elements of one of these computers might have these characteristics:

circuitry (LSI)	5 nanoseconds
micromemory access	10 nanoseconds (read time)
main memory access	400 nanoseconds

In the most radical departure from present architecture, the computer would have *no order set* and *no data structure*. The computer would be specialized for the various roles it is to play by *replaceable microprograms.*

Third-generation microprogrammed computers are delivered with a pre-designed, pre-installed microprogram of the read-only type. And in most members of the product line, the option of an additional read-only memory carrying a *second* microprogram set is available. This second set serves to provide full or partial compatibility with the order set of an older computer.

In fourth-generation computers, *many* microprograms will be available from the manufacturer. Software and user specialists will also prepare and use their own. This should throw the whole field wide open.

To better understand the nature of microprogramming a no-order-set/no-data-structure computer, I believe it worthwhile to introduce a new word into our vocabulary: *firmware*. I use this term to designate microprograms resident in the computer's control memory, which specializes the logical design for a special purpose, e.g., the emulation of another computer. I project a tremendous expansion of firmware—obviously at the expense of hardware but also at the expense of software.

Microprogramming has, of course, been known since the early days of computing. The principle is simple—build a small micro-processor and drive it with a stored microprogram.

Take floating-point addition as an example. In the first generation, it was performed with a normally-programmed subroutine. In the second generation, it was implemented in circuitry. In third-generation microprogrammed computers, the floating-point addition is performed using a microprogram stored in read-only memory.

A noted software specialist, Mr. Opler is executive director of Computer Usage Education, Inc., in New York City. He was formerly director of programming systems for the parent company, Computer Usage Co.

One major factor making this possible is the ratio between main memory access time and circuitry speed. With integrated circuits (IC) and now LSI, times have *plunged* to 1-5 nanoseconds while the access time of main memory has *slowly* declined. This allows 30 to 70 micro-steps to be performed by circuitry between each main memory fetch or store. These 30 to 70 steps permit the implementation of third-generation order sets.

The memories are called read-only memories but, of course, the contents had to be written once in order to "load" the memory. Today this is done as part of the computer fabrication process. For the fourth generation, extension to slow-write fast-read (SW/FR) memory is anticipated.

The interface between "normal" programs and microprograms comes via the operation code. In effect, when each instruction is decoded, the operation code calls upon a specific microprogrammed "routine" stored in the micromemory.

To visualize the preparation of firmware, consider a special keypunch not available to software and user programmers. This punches 67-column cards (4 x 8 inches) with triangular holes (try that on your keypunch and card reader!). A special card reader loads decks of these 67-column cards into the fourth-generation SW/FR memory. This card reader probably will be locked so that only firmware specialists have access to it (we hope)!

what firmware can do now

Even in the third generation, firmware is expanding the capabilities of hardware and software. Its effect on reducing the cost of hardware is central to third-generation economics. Unprecedented production rates with reduced requirements for system checkout and delivery are due to both integrated circuitry and to microprogramming.

Specialized versions of standard product line computers have been prepared primarily by altering the microprogram in the read-only memory. The most spectacular success has been achieved with all-hardware compatibility via a special microprogram. The success of the IBM System/360 Model 30 in running IBM 1401 programs attests to this fact.

Emulation, a combination of software and hardware, operates by using two different microprogrammed features. Basically, an emulator is an interpretive simulator made much more efficient by using a microprogram to perform the basic interpreting loop—fetch an instruction, decode the address, access the contents of the address and perform the indicated operation. In addition, the op-codes that are most time- (or space-) consuming to simulate are directly executed by microprogramming those orders into the micromemory. Emulation is, of course, required when the micromemory is too small to contain the entire order set of the second-generation computer.

An interesting example of the power of extending existing capability by microprogramming is the evaluate (EVAL) instruction added to the IBM System/360 Model 50 delivered to Allen-Babcock Computing Inc. This command is reported to evaluate a PL/I expression in standard form directly in hardware. Other added facilities include *floating decimal* instructions.

firmware in the fourth generation

Assuming the availability and accessibility of adequate SW/FR memories in the next generation, the entire *hardware/software* interface problems disappear only to be replaced by the more complex *hardware/firmware/software* interfaces. First, there is the hierarchy of components and corresponding responsibility.

Component	Responsibility	Organization
1. Circuitry	Hardware Designer	Manufacturer
2. Micromemory	Firmware Specialist	Manufacturer*
3. Control Programs	Software Specialist	Manufacturer*
4. Processors, Utilities, etc.	Software Specialist	Manufacturer*
5. Application programs	Application Specialist	User

*and/or software (firmware) producing organizations.

Secondly, firmware will assume a dominant role in structuring the computer. Manufacturers could (potentially) supply firmware decks allowing their fourth-generation computer to execute the order set of most popular third-generation computers—their own and competitors'. There could be a standard fourth-generation industry-wide order set and data structure.

But an even more significant impact would be felt by software. There is a general consensus that present software is too large, too complex and too slow. It is in the tradeoffs between software and firmware that most price/performance improvement should be obtained.

Third-generation computers require control programs to resolve and handle interrupts, to control multiprogramming and input/output dispatching, and to provide useful services such as resouce allocation and protection, etc. The demands placed on control programs by the hardware and by the user have forced the current programs to swell to enormous size with concomitant reduction in performance.

For fourth-generation computers, the answer will lie in using firmware for major portions of the control program functions and in using special features built into the firmware to facilitate other control program functions.

For instance, one problem that contemporary software must solve is to provide flexibility so that any particular installed configuration can be used with "general purpose" control programs. Even though "system generation" is used to specialize a generalized control program for a given configuration, the resultant code often contains lengthy subroutines to handle such functions as resolving device error signals, providing special user error recovery or interrupting the processing routine. The point is this—to provide modularity and flexibility, manufacturers are currently forced to delegate obvious hardware functions to software since this is the only means by which the user of the computer can specialize it for his use.

In fourth-generation equipment using SW/FR micromemory, microprograms can be prepared by the firmware specialist—manufacturer, programming company or the user—to carry out the specific interrupt and input/output control function specified by the user. This alone will go far to simplify control programs.

Further simplification can be obtained by making the data structure and order set work for, not against, the implementors of control programs. The basic implementation involves techniques of queue management, control block handling, table reference, internal sorting, pointer handling, etc.

Since microprogramming permits extensive data structuring for control program implementors, it will permit the addition of instructions to enqueue, dequeue control blocks build search and sort tables of specified structure, etc. These new commands should prove a boon to expediting the running of supervisory programs.

Time-sharing and multiprogramming both require very fast switching among programs. Many fourth-generation computer programs (processors and utility programs) will be written in the form of re-entrant code. The new hardware must be able to preserve the status of each user's computation and, when re-entrant code is used, to preserve blocks containing variables and other parameters. Currently much of this preserve/restore function is performed by software. Delegating this function to firmware should reduce the milliseconds performance time to microseconds.

compilers and firmware

Last year, a paper by Melbourne and Pugmire[1] described the design of a small computer for *directly executing* FORTRAN *statements*. The machine, which was simulated but not built, was "controlled by a microprogram held in a fixed store." Marketing men can determine the reception of a FORTRAN-only computer—but it is certainly one reasonable approach for the fourth generation. With SW/FR firmware, the FORTRAN microprogram can be read into micromemory—instead of the order set of a computer.

Short of a computer which executes programming language directly, firmware can add many features to fourth-generation computers to facilitate compilation and execution. Special instructions corresponding to the POP (programmed operators) of Digitek compilers can be microprogrammed to facilitate compilation. Facilities like the "hardware algorithms"[2] of System/360 Model 91 can operate on object code to permute computational order and even eliminate redundancies. Direct execution of statements in Polish string notation—a technique first used in the KDF9 and B5000—can add to the power of new computers which handle programming languages with unprecedented speed and economy.

It is quite likely that the bulk of programs run on fourth-generation computers will be written using standard programming languages. These may be run in some multiprogrammed (or time-shared) manner with other programs on a large computer run as a "powerhouse utility" serving many users — or on smaller "private" computers dedicated to a single application use (e.g., message switching) or the needs of a single isolated user (e.g., small engineering laboratory). The latter may very well prefer to use the FORTRAN—only (PL/I only?) computer while the user of the dedicated equipment may find it to his advantage to start from scratch and write the central portion of his program in firmware using normal core (or thin film) storage only for bulk tables and transient storage.

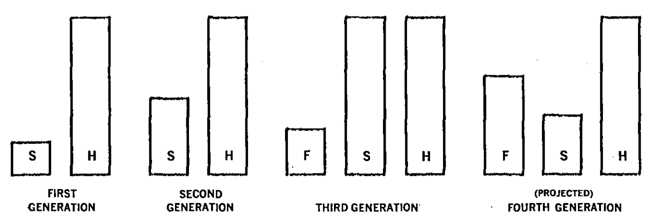
Depending on the ease of preparing, debugging and loading firmware, the whole application area might be radically altered. But it will probably be worthwhile to prepare firmware only for real-time, dedicated applications where every microsecond (nanosecond?) counts!

At the present time, there is a limited supply of microprogrammers and a *relatively* small demand for such services. The only firmware under preparation is in the shops of manufacturers and is performed under careful supervision of hardware designers. Preparing microprograms is considerably different from writing programs. It requires a more detailed knowledge of the function of circuits and registers.

Automatic preparation of microprograms starting with some "higher" level language—like FLOATING ADD A,B—has not been achieved. However, as firmware becomes more important, increased effort to facilitate its preparation will certainly be made. Indeed, if some of the many roles that firmware is to play in the fourth generation are to be realized, a new generation of specialists must be trained and effective tools provided for their use.

perspective

The following chart shows the relative effort (compared to the manpower involved in the production of the hardware of a computer) expended by manufacturers for different computer generations.



With increased demand for low-cost, high-performance total systems, the emphasis continually shifts to means of buttressing hardware to make it easier and more efficient to use. The third generation has seen the peak of the effort in software. No doubt the fourth generation will require equivalent effort — but placing much of what was software into the firmware area should go far to prevent some of our current difficulties. ■

[1]Melboune, A. J. and Pugmire, J. M.: "A Small Computer for the Direct Processing of Fortran Statements" *The Computer Journal*, Vol., 8, pp. 24-28 (1965).

[2]Chen, T. C., "The Overlap Design of System/360 Model 92 CPU" AFIPS Proceedings, Vol. 26, Part II, pp. 73-80, (1964).

FOURTH-GENERATION HARDWARE

a view from the third

by G. M. and L. D. AMDAHL

". . . visiting the iniquity of the fathers upon the children to the third and fourth generation . . ." —Exodus 20:5

It has been recently discovered that a third generation of computer technology has been entered. With the clarity of this observation we need no longer obliquely ask what the trend is in computer hardware or software, but we can ask directly and forcefully, "What will the next generation bring?" Accepting the notion that there will be a fourth generation of computers (by the principle of binary powers, eight years after the third) the following observations and extrapolations are put forward.

The third generation of computer technology can be characterized as one of unification. An attempt has been made to unify in one computer structure the effective capability to perform commercial, scientific and real-time tasks. Time-sharing is being elaborately analyzed, with conversational mode systems in early use. Monolithic integrated circuits are coming into widespread computer use, but with their greatest potential yet to be realized.

To achieve software interchangeability, the concept of upward compatibility has been extended by some to include downward compatibility, giving rise to families of computers differing only in speed and price. Manufacturers such as IBM found that this could be accomplished only by drastic means—design of a totally new line of computers having basic differences from predecessor equipment. The transition to the third generation has therefore been arduous, with techniques such as microprogramming and emulation being employed and with complete new software being required.

fourth-generation hardware: batch fabrication

Computer hardware of the fourth generation is anticipated to be most strongly characterized by batch fabrication. In areas of logic circuits and high-speed memory, complex arrays of switching circuits on single silicon chips will be batch fabricated. This is referred to as large scale integration, or more simply, LSI. It should be noted that batch fabrication does not necessarily mean the concurrent fabrication of identical items; rather, it means the concurrent fabrication of many different items passed through identical process steps. This permits economically produced silicon chips to logically differ. While large parallel computers (such as the proposed Illiac IV) could have many identical chips, small computers would be denied this luxury. Therefore the economic production of many different kinds of chips would benefit the manufacturer of the small computer.

Integrated circuits offer benefits of batch fabrication both in the area of logic circuits and memory. The benefits of LSI for logic circuits will be reduced cost, greater density and greater speed. The limitations of LSI in this use arise in interconnections, heat dissipation and chip complexity. To use LSI, a problem of the first magnitude will have to be solved: the complete automation of chip design. This problem is vastly complicated if yield must be enhanced by adjustment of the interconnection pattern of cellular circuits as a function of test results.

LSI memories can be very high speed and can permit multiple-access use. Because select and sense circuits are fabricated by the same process steps as those used for memory cells, high performance memories are expected to be relatively inexpensive. An economic property of considerable advantage for small memories is the relatively linear cost per bit as a function of size exhibited by LSI memories. But these speed and cost advantages will not apply to large LSI memories. Another factor to be considered by systems designers is the volatile nature of the LSI storage cell, permitting loss of information stored when power is removed.

Other batch fabrication techniques for memories will undoubtedly emerge in each of the areas of wired ferrite arrays, woven plated wire arrays and thin films. Any of these will be suitable for large quantities of lower-speed random-access memories and would not have the volatile characteristics of the LSI memory.

Mass storage still appears to be dependent on electromechanical devices for lowest cost implementation. To a large extent this is due to the fact that batch fabrica-

Gene Amdahl was project engineer and chief designer for the IBM 704, and initial planner for the IBM 709 and 7030. Later managing data processing engineering at Aeronutronic, he rejoined IBM in 1960 to serve as manager of architecture for the System/360. Now an IBM Fellow working on advanced computing systems in Sunnyvale, Calif., he received a Ph.D. in theoretical physics from the Univ. of Wisconsin.

tion is always easier to achieve when detailed structure is unnecessary, and the fabrication of the surface of a disc or drum is indeed batch fabrication of an enormous number of storage cells. However, the feverish activity in the development of static (nonrotating) mass storage will surely result in its use in fourth-generation equipment, particularly for systems requiring rapid information retrieval.

architecture: an attempt to balance

The economic consequences of batch fabrication are expected to have the greatest effect on fourth-generation architecture. Even in the third generation, processor costs are relatively low compared to other system cost factors such as I/O channels, peripherals, marketing and software. In the fourth generation this imbalance will tend to increase, with the system architect offsetting it by greater instruction capability, more processing overlap and parallelism, and additional hardware features for multiprogramming and multiprocessing.

The use of the high-speed LSI memory will tend to impose an additional level in the memory hierarchy. This will emphasize the need for semi-automatic control of memory, perhaps along the lines of paging techniques. We would expect that considerable emphasis will have been applied to this area due to difficulties incurred in third-generation systems. The problem here is to make the memory appear to be a very large and homogenous virtual memory (techniques which permit viewing main memory as unrestricted by actual main memory limitations), yet without imposing virtual response and virtual solution times.

Basically the computer can only deal with information residing in real memory. It must in some manner be provided with instructions which, during its operation, can cause it to control the transmission of information between hierarchy levels with as much preplanned structure as is possible. In circumstances where preplanning is inadequate, multiprogramming must be able to fill the voids.

Failure to provide any preplanning would raise the level of multiprogramming, requiring memory capacity that would be considered excessive even in the era of batch fabrication. The solution time for individual large problems may become excessively long in a multiprogrammed environment, making the system unsuitable for this purpose. Algorithmic control, suited to access characteristics of data sets, will undoubtedly become important. The nature of the control would be governed by programmer specification or by recognition of historical referencing properties as determined by the hardware.

Another area of architecture is the employment of microprogramming to an extent that compiler languages might be optimized. In a companion article, Ascher Opler predicts a fuller utilization of this technique in the fourth generation and the emergence of *firmware* specialists.

The question of equipment dependability will come under careful scrutiny in the fourth generation despite the fact that LSI will offer high reliability. The reason for this scrutiny will be the customer's concern for nearly absolute computer up-time in time-sharing environments. While in the past he was willing to accept turnaround delays due to the computer being down, he will not accept inoperative on-line terminals. Partial redundancy, multiple processors and in-line diagnostics should result from this emphasis. With LSI, redundancy can more economically be achieved than with discrete components.

software: more freedom

The role of software has been changing from generation to generation. From an initial start of freeing man from dealing directly with the computer by the provision of input-output utility programs, the role has progressed from having to deal in absolute terms by means of symbolic program assembly, from having to deal in basic terms by means of macro assembly and compilation, and finally from having to deal with space-time boundaries by means of data-management programs and virtual memory. One of the current activities is aimed at freeing man from space and time separation from the computer by time-sharing.

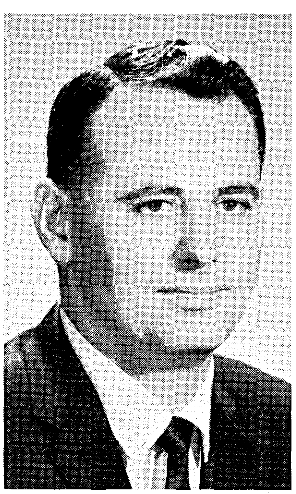
One can speculate as to those freedoms which will be sought for the next generation. A number of likely candidates come to mind, many of which have been started and have varying degrees of progress. Some fairly basic ones are (1) freedom from redundant effort by means of common libraries of programs and data sets in the information utility, (2) freedom from limited forms of man-machine communication by means of better techniques for the identification, extraction and display of meaningful information, (3) freedom from necessity to recognize the particular machine type being used by software standardization, and (4) freedom from painful recovery on machine malfunction by automatic detection and by maintenance of user transaction journals.

It is interesting to note that these freedoms contribute to a layer of basic concepts. These concepts relate the more abstract notions of computing to the detailed dynamic activity of the hardware computer. As more freedoms are added which release the user from primitive representation of his problem, he is further insulated from the hardware. This intervening software structure will develop into a capability for self-generation of programs for specific computational actions. Such programs will enjoy an existence so brief that they deserve a unique name, for which *bubbleware* is advanced.

One can deduce that significant overhead will be added in the execution of hardware functions as the user gains freedom in detailed program declaration. Despite this, the hope for fuller realization of human creativity will give continued impetus for this trend to greater abstraction.

beyond the fourth

It may be inappropriate to speculate beyond the fourth generation, but it appears that the logical conclusion to be drawn is that the ultimate goal must be freedom from having to deal with the computer at all. When this level of development has been reached, creative intellect will have burst its final shackles, free to wing to new Olympian heights. ■



Lowell Amdahl is president of COMPATA, Inc., a Tarzana, Calif., hardware consulting firm. A technical adviser to DATAMATION, and a participant in the design of several computers, he has a B.S. in engineering and physics from S. Dakota State and an MS in physics from Kansas Univ.

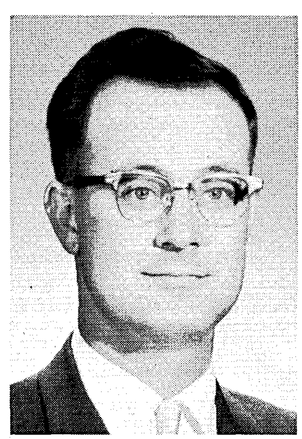
COMPUTING IN THE 1970'S

by R. L. PATRICK

(As our able editorial adviser pushed out into the future, he recalled some of the developments taking place since 1966 while enroute to a hypothetical 1973 FJCC. . . .)

By 1968 the shock of IBM's System/360 had largely subsided. It had been an expensive experience for manufacturer and user alike. Multi-programming generally worked fairly well, but the software overhead was greater than expected. System generation was no longer the chore it once was, and software changes no longer came with disconcerting frequency. The users, while not quite euphoric, had licked their wounds, completed their conversions, and were generally happy with the product and the results they were getting. Some big shops had finally embraced PL/I totally and were working the bugs out of using a single "universal" language. Programmers were genuinely interchangeable, since they all enjoyed the same language and operating system. This, however, did not make them all equal since differences in technical background, experience, and ability were still very apparent.

In late '68 and early '69 the users discovered the benefits of modularity. The manufacturers have been making systems more or less modular for years. When S/360 and its counterparts hit, the manufacturers reaped many benefits immediately from the building block approach. In 1968 the user discovered that this could help him too. As a company's contracts fluctuated, the computing manager adjusted his configuration to match his load. The manufacturers responded by building popular equipment units for regional inventories to allow reconfiguring with ease. With the advent of multi-programming, the trimming could satisfactorily take place by adjusting the number of I/O channels and devices to allow fewer tasks to operate simul-



Mr. Patrick is an established free-lance computer consultant based in Northridge, Calif., whose clients are involved in research, applications, operations and military developments. Holder of a CDP, he is also an editorial adviser and a frequent contributor to DATAMATION.

taneously. Thus, throughput and cost could be moderately changed without changing the cycle time of the CPU or affecting the unit cost for a specific application.

The shake-out of primary manufacturers continued and we lost several. Those that remain are stronger and better able to compete. Two of the also-rans have firmly established themselves as suppliers of consoles and I/O devices. They discovered that IBM's standard hardware interface* allowed them to design to one electrical specification and penetrate the IBM community with sufficient volume to get the price down within reason.

The federal government's standards activity continued to wallow along until 1969. By that time the GSA had the world's prime repository of unwanted used computer equipment. Some dated back to the early '60s. The book value of the junk kept them from disposing of it, and the cost of storage soared. The original manufacturers kept raising their maintenance rates until some third party maintenance companies were formed. When this happened, the whole used market opened up. Trading became spirited and competition healthy. This was sparked, in part, by a thorough housecleaning at the BEMA shop in 1968. This resulted in industry assuming the initiative in standards and leading rather than holding back.

While all of this was going on, the users were not idle. One of the big aerospace companies developed a program which would translate from source language to source language, based on tabular descriptions of the two languages. When this was done three things quickly happened: the long sought program interchange suddenly became a reality, the table format required by this program became the language definition standard overnight, and a rash of application-specific languages sprang up. With easy translation, the user could use a convenient language for stating a problem solution and then turn the job over to the central program maintenance group who worked in a consistent single language.

By 1970 several large file-oriented systems had appeared which qualified for the title "data bank." These were large, integrated file systems serving multi-users in both on-line and batch fashions. The groundwork for these efforts had been laid earlier, but until the third-generation hardware and software had settled down, progress was slow, frustrating, and expensive. In 1967, applications analysts realized that basic files had to be built as part of some on-going process. Soon, fully documented "save" tapes started regularly appearing in the archives. Finally, when the tools were available, the files had been stored, and the data bank could be established. The whole thing threatened to flounder until a bright, young programmer teamed with a smart hardware designer to solve the restart problem without extended downtime or unnecessarily expensive backup provisions.

About the same time wisdom and light settled on BEMA, the professional society ice jam melted also. Enough of the founders had retired so that the societies were repopulated by members who considered computing and information processing to be their sole interest and not just a happenstance career. The societies restructured along lines devoted to hardware, software, and applications. Numeric techniques was *one* of the pillars of the applications group. The software society absorbed both SHARE and GUIDE, which had merged in 1968, reorganized along software lines, and discarded their machine orientation, made obsolete by the 360. Each manufacturer still supported a small users group as a sounding board for his products, but the advent of true language standards allowed software to be handled at a level more professional than parochial . . .

(Our observer arrives at the 1973 FJCC exhibits.)

BOB: "Hi, Robert: Moving sidewalks seem to bring old friends back together. How are things in the outerspace industry?"

ROBERT: "Our business volume is holding well. We just got a new trillion dollar contract for another space station. Say, if you're going down to tour the exhibits, let's do the show together."

BOB: "It's good to get out of that crowd. Let's go look at those midget computers mounted in the typewriter stands."

ROBERT: "I'm glad that panel decided these could be considered as a computer, a desk calculator, or as a console depending on how they're used.

"Now, isn't that nice. A computer with 16K memory, add time of 10 microsecs, and modified typer . . . all for $5000."

BOB: "What I like best is the flexibility. The memory bus is brought out to these connectors so we can just plug in this software loader box and preset the software in the Hold-Tite store. That's one way to get the price down: leave all that unnecessary stuff out. Of course, I suppose the price of circuits and core has come down by a factor of 25 in the last 7 years.

"If you get a loader box for each machine it's only $1500 more, but then it can have several software packages and a basic operating system. This will really solve some of our problems back home."

ROBERT: "We have two uses for it right now. That little design group over in the Test Hangar needs a limited amount of computational gear with a customized application language on it. We could set them up for $5K and write the compiler for the big machine. Once we wrote and checked out the compiler at Central we could put it in Hold-Tite and let the Hangar crew work by themselves. It gets rid of that requirement for a secure communications crew to maintain the comm-link from the Hangar to Central.

"The other need I know of is for shipping. We could hook two of them up in tandem to handle the rating and routing function. One typer would have those special forms that have to go with every shipment. The other would be the I/O keyboard for the pair. The clerk can input the load description, measurements, and scale readings. The computer will compute cube, tons, best way, and charges. It can also edit the input and format the output on the slave. If we get stuck and run out of memory we can either buy a loader box for holding rate tables in read-only form or use that acoustic coupler to make the tandem a satellite to the Central."

BOB: "I'd forgotten about that acoustic coupler attachment to the Touch-Tone Fone. With that jack on the side of the new phones, the coupler and the auto-dial can signal over the normal audio phone circuit to Central. You can get it for $100 with no installation charge.

"Let's go find those Immense-Files next."

ROBERT: "Wow! Look at the crowd. I wonder if we'll be able to get close enough to see them work? The advertising brochure claims the Immense-File is to the bulk file what the bulk file was to the drum. I guess that's about right. The Model I Immense-File holds 15 billion bytes in one module and the mechanical part only takes 4 square feet of floor space."

BOB: "I guess the part I like best is the price. It rents for $1500 per month, and the control unit only costs $1000." Let's see. Back in 1966, we could get 800 million bytes on-line for about $6K per month. Now, if we install two Model I's on a single control unit we have 30 billion bytes on-line for only $4000 per month. Say,

*IBM Form A22-6843

that's enough capacity at a small enough price to put that engineering technical library on-line, isn't it?"

ROBERT: "Yes, that will easily fit. Those reports average only 50 pages per document, and there aren't but 10,000 of them. If it were all text, that would use up about a fifth of the capacity of two modules, but since we've got to digitize all those graphs and pictures, it probably would take about a half of the twin modules. That would even leave us 15 billion bytes to hold some of that test data they keep crying about because it takes us too long to find the tapes in the archives and get them hung. The test engineer gets tired of sitting at his console before we get the data displayed for him.

"With our new publications system, we can build those technical document files as a by-product of the publication process. In about three years we'll have the most interesting documents stored in the single Immense. We'll probably have to go back and pick up about 10% of those old reports to complete the file; some of that stuff never seems to get too old to be of interest."

BOB: "I wish we could get close enough to see the removable cartridge. I'd like to see what handling problems they've built for us to solve this time. Since this crowd doesn't seem to be getting any smaller, let's move on and come back later. Maybe we can get a private showing since we think we've got a legitimate application."

ROBERT: "Hey—there's a booth over there with absolutely no customers. The contrast is amazing."

BOB: "Oh yes, that's the Bell Tel booth. I think that's made every show for the last ten years in the same form. That big map of the United States with the lightning flashes shooting between those telephone handsets leaves me cold."

ROBERT: "The only thing that's changed since we first saw them back in the '60s is the lads giving the sales pitch. If you change them often enough, they can maintain their sincerity since they don't know they're falling behind two years every year."

BOB: "You'd have thought after that fierce fight over the touch-tone modification that the Bell System would have loosened up a little bit and recognized that the computer was here to stay. It's amazing how the chief engineer fought against modifying the touch-tone handset so that an inexpensive acoustic coupler could just be plugged into a jack."

ROBERT: "Yes, that made a big difference, so I guess all the fight was worth it. I'd like to see the charters for public monopolies changed somehow so the design laboratories of the major manufacturers could coöperate with the big utilities to get a balanced design.

"Do we need to go look at those new graphic terminals over there, or can we see enough from here?"

BOB: "I think I know as much about how they work as I need to know. They haven't changed that keyboard/CRT/hard-copy-printer unit for several years now. I guess the main change in the last year is getting the price down to $5K purchase."

ROBERT: "We installed one of those earlier terminals, and by the time we got through adding the light pen, the scope, the plotter, and all of the special electronics it took, we had almost $6,000 a month going out for a single station. That was a little steep just to give a few engineers the opportunity to fool with graphic displays.

"We ended up scheduling it so tight that the engineer could hardly afford to think at the machine. Fortunately, these new ones will rent for about $120 a month installed and all they need is a pair of twisted copper wires. That makes installation a lot less than it used to be when we had to put in multiconductor coaxial.

"I think the price on these things is finally coming down to a point where the normal engineer can get access to one whenever he wants to without too much trouble, and can keep it as long as he needs it. With these prices, we can get graphical ability out to the design areas where it's needed, and still support them centrally with our multi-CPU. I'm really looking forward to getting some of those Immense-Files on-line so we can hold enough drawings in detail to make up a complete assembly. That should make a big difference in the way we handle engineering changes."

BOB: "Did you see those new optical page readers that can scan a variety of documents and fonts and transmit the data to Central over a twisted pair? They have a programmable digital computer in them just about like the one we saw in those reactive consoles a while ago. The font recognition and document format are all completely programmable—based on tables stored in core. The output is that same acoustic coupler to the touch-tone that made the satellite consoles so popular.

"With the monthly rental getting down to about $200 we may finally be able to collect our primary input data directly from the fundamental documents and eliminate the keyboarding step that's always cost so much. If we put three of them in shipping and receiving, a pair in purchasing, and back that set with one of those new Quik-Disc files, we'll be able to get purchased item status reflected in the new project control system and the financial liabilities report in a way that means something. The price and flexibility of these new devices has made it very worthwhile to consider picking up some of these applications we've talked about for 10 years, but haven't been able to deliver economically."

ROBERT: "That paper on the new master operating system this morning was interesting. I was glad to hear a user instead of the usual manufacturer. Users are always more candid than salesmen. Evidently he's finally getting good operator information so he can figure out what's going on while the machine is processing several jobs simultaneously. As a by-product of this he's getting decent accounting inputs for billing purposes. He said he had trouble getting the system installed initially, but that the thorough set of audit trails they built into the system allowed the troubles to be isolated and corrected easily."

BOB: "I was glad to hear that the fail-soft system qualities were really delivered as promised. We've been living on borrowed time for several years: with our file storage getting bigger and bigger, and those multi-user data banks growing by 10% per year. I wince every time I think of what a catastrophic failure costs us. I still remember that time when we had 200 consoles operating and lost the master index tables to the work files. One thing led to another, and it took us 63 hours to get back on line.

"With this new system working as well as he said it did, I think we could go ahead and order those Immense-Files . . . I think the days of the catastrophic failure are now behind us."

ROBERT: "The multi-CPU shared-storage hardware allowed us to have systems which could reconfigure themselves dynamically in the event of a malfunction. Technically, we owe a lot to the early work done on BUIC and the old FAA system. They finally showed us how to build hardware-software systems which would really fail in stages and not in one big heap.

BOB: "Yes. Those same examples helped us design commercial hardware that reconfigures very nicely in case of a component outage. If we can believe that speaker, the problem can now be solved by changing a few tables and selecting the right pre-stored module. Maybe we're ready to think about going on line with that second batch of 500 consoles now.

"I liked that other paper this morning surveying hardware architecture features. It seems that every major manufacturer now carries some form of compatibility as a fundamental design objective: the 32-bit, register-oriented, variable instruction length machines, based on the 8–bit byte.

"If I understood him, some of them have true hardware compatibility but others have found it sufficient to build a machine which is logically similar so that programs devoid of I/O can be automatically translated from one to the other. The panel discussion left me kind of cold though. I don't really see that the definitions of 'compatible' and 'logical subset' were worth all that time and effort."

ROBERT: "Well, even though they couldn't agree, I know what it means to me. If I have to put any more than 10% of the initial effort into moving from machine to machine, don't bother to send the salesman by to tell me about it. And even if the instructions are completely identical in format and function, if it won't take my file organization or if they fool with the sort order again, just forget it.

"We're already up to the point where most of the cost is in the I/O devices and files. If they gave me a CPU, they couldn't cut my rental more than 5%. I'd just as soon they concentrated their efforts elsewhere."

BOB: "Well, it looks like they've done quite a bit with this new 'triple-vote' modular design. They'll guarantee 95% up-time on all that electronics even if you have only one module. With the new design you can put in the redundant unit and cut the mean time to repair down to 8 minutes. But if you really need the reliability, you can go for that three-processor option with the special control and they'll give you that 'Lloyds of London' policy that will reimburse you for the indirect losses you take based on less than 100% reliability. Boy, that must be reliable stuff.

"We might want to consider putting in one triple-vote system to handle communications, switching, and the message queuing if we decide to get those Immense-Files and put that second 500 consoles on line. With a thousand people on line, we can show a hard saving of $10,000 an hour just in people-time waiting for us to get the system back on line. And this doesn't include anything for the graphics, processing, and data we might have to re-enter or regenerate in case we collapse completely."

ROBERT: "If we go to that second 500 consoles, we'll surely have to pick up the on-line engineering change system, and that carries with it the responsibility of running the manufacturing plant. Management would probably be delighted to have the triple-vote system just to get that Lloyd's insurance covering us against possible business loss.

"The new modules have simplified building control systems out of these general purpose modules. Depending on the box it's in, one of these memory-logic modules can be a part of that souped up console, reduce the cost of those intelligent graphic terminals, or control the scan in that optical page reader. The same unit would also support those on-line medical experiments we're doing in the lab because it interfaces so nicely with analog sensors and digital control devices. They really did well when they got 16K core and 10 microsec add time in a hermetically sealed super flat pack the size of a 3-ring notebook. The power required is so low we can run it off those little thermo-electric sources or the rechargeable cells that have that optional solar face on them."

BOB: "Should we go to that session tomorrow on the user's report describing his experience with the new software? It sounds very interesting."

ROBERT: "I read the preprint and I'd like to attend. He thinks they've finally figured out how to build modular software which is subsettable based on your needs and machine size, but has almost the performance of custom written code. The paper didn't describe exactly how they do it. I hope they explain it in the talk."

BOB: "Didn't the announcement say that part of the modularity lets you routinely change the orientation of the system from real-time to teleprocessing to batch in any combination and with any emphasis?"

ROBERT: "Yes, that's what they tried to tell us. This user maintains they did it and both kept the performance up and the program size down. Furthermore, they have a new language definition for action languages.

"Remember back in the mid-'60s—some of the more theoretically inclined managed to state and describe procedural languages in terms of grammar and syntax? Well, some similar work has just been completed on action languages. They've put some of that same theory to work and come up with a definition of action languages to handle control of the computing system, communications with the operator, all the I/O device actions and scheduling, and the sequencing of processing we used to call job control. It now has some harmony to it, which we've lacked for several years. Matter of fact, I hear it's even easy to understand and has only a few exceptions."

BOB: "Well, if they've managed to do that and also include all those data base handling facilities we've heard so much about, it really ought to be a fine new system. I'm looking forward to the panel discussion after the user talk because I want to ask some questions about these new contract terms.

"Sam Dollar of the Executive Finance Committee heard we were thinking of switching to the fourth generation and sent for me the other day. He pulled out the file with the financial audit of our conversion to third-generation. He had those conversion costs recorded to the penny. The true costs of the conversion were posted to one account and he had two other accounts showing the costs due to the late hardware and the costs due to the late, sloppy software. He made it very clear to me that he wasn't about to approve any expenditures for fourth-generation equipment which didn't include contractual guarantees on the part of the manufacturer. He told me I could order whenever I wanted, but when he signed the contract it better have firm dates for hardware and software with enumerations of required functions and stipulations covering minimum acceptable performance.

"Somewhere he heard we'd been simulating how our proposed workload would pan out in fourth-generation equipment. He advised me—if I couldn't think of a better way—to include that simulated performance as part of the contract.

"I'm going to lay that contracting question in front of tomorrow morning's panel if I have a chance."

ROBERT: "Let's go get a drink. What do you think we should have done in the late 60's to have been better prepared for what we saw today?"

BOB: "Well—let's see. We should have wired that new plant so we could put in a private digital communications network independent of the phone company; placed some restrictions on applications programmers so they wouldn't aggravate the conversion problem by using all of the features of the programming languages just because they were there, kept the descriptions for all those old files we stored so we could figure out the tapes if we ever had to re-read them. I wish I had attended that seminar on assigning functions in multi-computer systems. We should have hired that young guy who knew so much about file organization and integrity. There are several more, aren't there?"

ROBERT: "Yes, I have a few more; but first, where was that DATAMATION cocktail party?" ■

THE NEXT GENERATION

from 50 viewpoints

In an effort to find out what some experienced computer people think may happen with a fourth generation of equipment, the DATAMATION staff prepared some questions and solicited answers. We learned, first, that the people we questioned are surprisingly patient and thorough in taking the time to conjure up ideas about such an ambiguous subject. The questions were divided into three sections, covering hardware, software, and some users' viewpoints.

the hardware

First, let's try to get a handle on the fourth-generation computer. How will you know one when you bump into it? If a consensus of our respondents is any indication—and it should be—the one hardware technology that warrants the fourth generation billing is large scale integration (LSI). (They're quick to add, however, that price per logic function will be a principal factor in this determination.) "This technology (LSI) will have a far greater impact on computer architecture and software than did integrated circuits in the third generation," says a member of a semiconductor house.

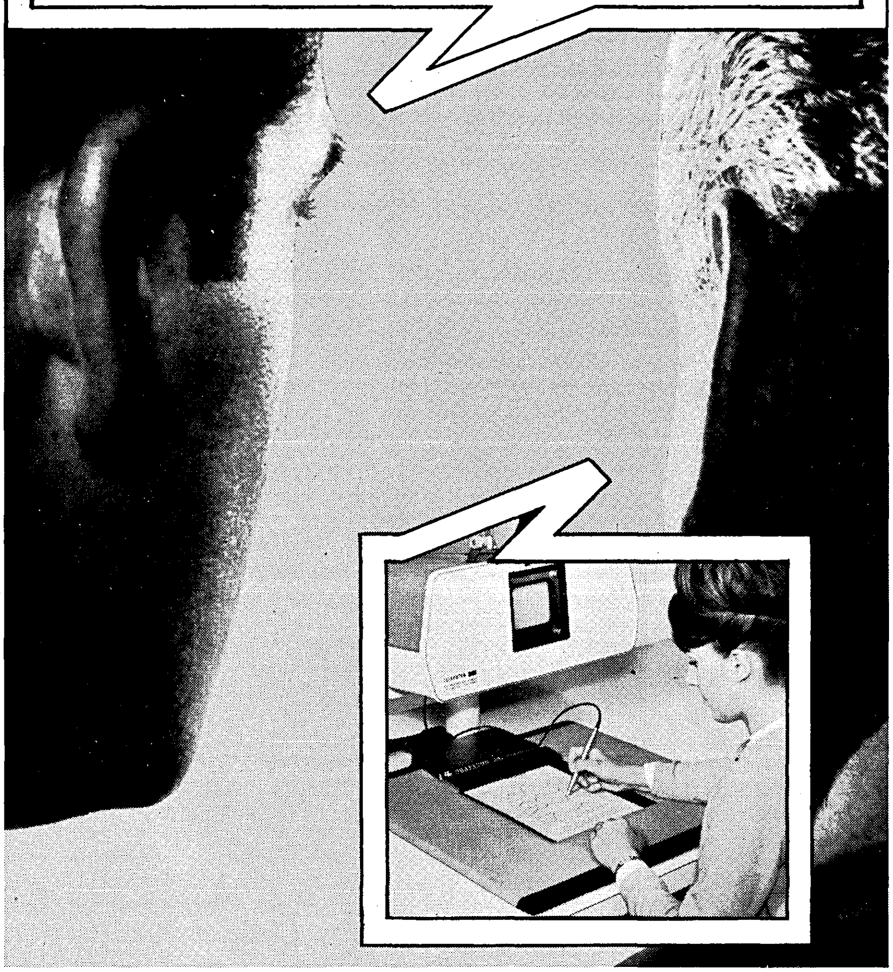
While not yet willing to grant that LSI will lead to a computer on a chip, our correspondents variously describe the future of this young upstart as "fantastic" and "extensive." Also "good, measurable, but not revolutionary." This statement, though, is contradicted by still another, who says . . . "No doubt but that LSI will revolutionize the computer field—not only in terms of cost, reliability and size, but also the complexity that becomes reasonable to achieve and the applications that can economically be put on computers. However, this impact will be limited until software and I/O problems are solved, and this may take a long time."

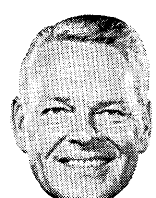
Perhaps some of this will be taken care of by what Ascher Opler in this issue calls "firmware." We asked to what extent software will become imbedded in special hardware. As expected, the answers ranged from "very little" to "very much." The idea is appealing, they say, but the technology to achieve it economically is doubtful. Among the optimists here, the anticipated firmware functions include subroutines, in-line diagnostics, and I/O systems, but not operating systems and compilers. "This will depend upon how much true standardization evolves."

What about the top circuit speed in Generation Four? Forecasts ranged from 10 nanoseconds to 500 picoseconds, but most estimates were for a propagation delay per gate of 0.5 to 1 nsec. "I do not foresee major increases in top circuit speed, but optical processing might contradict this forecast," said one. The sub-nanosecond speeds predicted here compare with the 5- to 20-nsec per logic level being achieved in today's hardware.

Today's memory hierarchy—only speeded up—may still serve in the next generation; the use of thin films is referenced by only a few, the associative memory was mentioned by only one, and "biological devices for the intermediate level" got a vote. The most clearly delineated hierarchy: "registers and multiple or general registers implemented with integrated

"...after lunch we went to a demonstration of a great idea...an electronic writing tablet that allows you to write actual instructions to a digital computer. Know what they called it?"





"Oh, that's the commercial version of the 'Rand Tablet' built by Bolt Beranek and Newman's Data Equipment Division. They call it the GRAFACON® 1010A, and it's one of the most advanced developments in the man-computer communication field. Some people are using it with pattern recognition programs for writing information into computers—just like writing a memo, with a resolution of ±0.005 inch at writing speeds up to 40 in/sec. In production data processing operations, it'll digitize graphic and pictorial data without the inconvenience of mechanically-restricted cursors, shaft encoders, A/D converters and the like. It's even built for rear-projection of graphic information from film. I know a company that uses it as a highly-flexible keyboard—touch a spot on the tablet and it serves as an operator command to the program."

BBN/DE also produces GRAFACON interface circuitry for card punches, paper tape punches and digital magnetic tape recorders; PDP-1, PDP-4, PDP-8 and CDC-160 computers; IBM 2250 display consoles; and Teleputer time-shared computer consoles. Write us for complete details.

bbn BOLT BERANEK AND NEWMAN INC
DATA EQUIPMENT DIVISION
2126 SOUTH LYON ST., SANTA ANA, CALIF. 92705 (714) 546-5300

GRAFACON is built under license from Rand Corporation; Teleputer is built under license from Bunker Ramo Corporation.

CIRCLE 20 ON READER CARD

circuits; IC scratchpad memories (50-200 nsec); main memories implemented with plated wires, thin films and, for a while, cores (100-500 nsec); on-line auxiliary storage, largely discs and drums but also some solid-state random access devices (e.g., plated wires or etched permalloy) and BORAM devices (particularly for military and later commercial applications); and off-line tapes, discpacks, magnetic cards, etc."

The CPU organization may be in for a radical departure, if a slim (58%) majority of our counsellors has its say. They turned right around, however, and voted down the idea that parallel processor organization, such as Solomon, might come into use. One said parallel processors, yes, but not like Solomon. Although not ordinarily considered "organization," the idea that multiprocessing would come into its own in the fourth generation received a definite "yes" vote. Implied in this is the growing knowledge that we still don't know how to multiprocess, but we will soon.

How soon? When will you get your first chance to collide with a fourth-generation mainframe? Fifty percent said between 1971 and 1975: 25% said as early as the end of 1970: the rest didn't know. Among those who predicted the earlier date—by the end of 1970—was the one designer who said he'd know one when he saw one because its new technology would be cryogenics. He's not to be ignored. That man's name is Fred Brooks.

software

In asking our patient respondents about software for the hypothetical fourth-generation equipment, we made certain (doubtless debatable) assumptions about the nature of past and present programming. It was assumed that first-generation software included machine-language programs, subroutines, and assemblers. The second generation added higher-level languages, monitors, and macro-assemblers. The third generation brought operating systems, conversational time-sharing, multi-programming, and data management systems.

Considering these developments as characteristic, we asked, what will the fourth generation bring?

One of the most interesting things about the responses was the discovery that there is a clear consensus of opinion about some aspects of software wanted and flaming disagreement about others.

The first question asked if the respondents would "expect" fourth-generation computers to be accompanied by a radical departure in software. There was about an equal split of yes and no answers, with two people noting that they "hope so" but don't really expect it. A few others pointed out that software development tends to be gradual and is not likely to be closely tied to a new generation of equipment. In fact, "fourth-generation hardware is likely to be adolescent when fourth-generation software is born." There are some feeling that the user might have software allowing him to define his own language, while another said that "we'll be lucky to have truly second-generation software with our fourth-generation hardware."

Another virtually even split between yes and no answers resulted from a question asking if paging techniques will come into common use. But some said "cheaper mass stores will win."

A question asking if English-language programming would become a major factor drew a variety of interesting comments, although a majority voted either "no," "it's doubtful," or "I hope not." Several respondents saw it as a growing and significant factor in certain applications, such as information retrieval. And one of those saying yes put it this way: "It must if the computer is to become an everyday, commonplace business and household machine—and I'm sure the manufacturers want to see it become just that." One of the best answers on the negative side: "No. Natural language compiling is unnatural."

There was general agreement among those surveyed that nonprocedural languages would be of growing importance, although some felt that progress would be very slow. One comment: "Nonprocedural languages have been a sought-after convenience since the early fifties . . . Everyone was and still is looking for that software package which allows you to say 'Do payroll' . . . the user would describe only the problem parameters in terms of environmental conditions to the software systems which in turn would grind out a maximum solution to this particular problem. One could wonder whether the parameters concerned with supplying the problem description would not be as overpowering and burdensome as the actual programming requirement is."

Our respondents also had some vigorous comments on what methods will be used to maximize processing efficiency in an information utility using fourth-generation equipment—including the opinion that there won't be any information utilities doing processing; they will just serve as data banks. Some think that the best method would be fragmentation of applications into special-purpose, dedicated utilities—such as credit information, legal information, etc. But several answers reflected the viewpoint that rising computation speeds and shrinking cost would make processing efficiency a minor problem, compared to the present.

How should information security be handled in an information utility? "Very carefully" is a fair summary of the answers. Some methods suggested: a pattern-recognition device that can recognize fingerprints; a true book code, or private language, instead of a cipher; time-dependent codes; remote data storage at the user's location; individual scrambler/descrambler keys; voice recognition.

Suggestions were requested for types of planning that would simplify future conversion efforts. Typical recommendations were thorough documentation ("overdocument"), use of higher-level languages, and continuity of languages by the manufacturers. There is also some feeling that users can't stand another conversion—that further changes must be evolutionary, considering the massive size of some applications programs even now.

A related question was also asked: "Will there be an 'OS 360 backlash' that will lead users to insist on less complicated software?" Although one respondent said the question contains a false implication, is loaded, and is unanswerable, it provoked longer and more lively answers than any of the other questions. A large majority think there is and will continue to be a demand for simpler software—but many add that it should be simpler only in terms of user convenience, not function. Several people foresee more customized systems coming, closely tailored to fit a user's needs. Some of the more bitter comments: "By the time the . . . backlash . . . gains any momentum, the large-scale machine users will have implemented their own operating systems" . . . "OS is completely compatible; it makes the Mod 75 run like a Mod 30" . . . Some think, however, that the problems illustrated by OS 360 can be overcome, given better check-out, training manuals, and general customer support.

There is strong agreement that software for a new generation of equipment should not be confined to a single, standard language—unless it were some sort of macro-language that allowed users to develop a special dialect fitting their own needs. An accompanying question, asking about critical bottlenecks with present software, resulted in such descriptive phrases as "trying to satisfy everyone . . . compromises between conflicting goals . . . attachment to 1957-vintage compiler . . . ponderousness."

We also asked if manufacturers will be selling software separately from hardware. There was no clear-cut consensus in the answers, but a majority think this is likely to come about—restricted to special cases. Many mentioned the recent announcement by Scientific Data Systems that COBOL will be sold separately as evidence that the trend is starting. A few said that the federal government will force the issue. Other responses: it's more likely to be done by separate companies. It was also suggested that separation will come about only if the patent problem is resolved. One other idea: design the machines to keep track of software use automatically and charge for it; then the price would be separated from the hardware cost no matter who wrote the software.

Our last question: "What sort of software would you like to see?" A brief summary of the replies: smaller conceptual jumps, standard format and documentation, more debugging aids, easier to use and maintain, simple and conversational.

Besides offering some ideas for the future, perhaps the variety of answers to our questions about what the computer community wants will give readers some sympathy for the problems of the manufacturers.

some users' views

Then there's the ever present user, tormentor and tormented, who must struggle through the conversion to each new group of machines—sprouting greys over things like down-time, complex operating systems (and delays), new compilers and delays and programmer education, acceptance tests, core memories wired in backwards, the wrong color on his tape unit, and a boss who wonders why they didn't buy the all purpose 720/140 just announced which sounds like tomorrow but won't be here until later, if then.

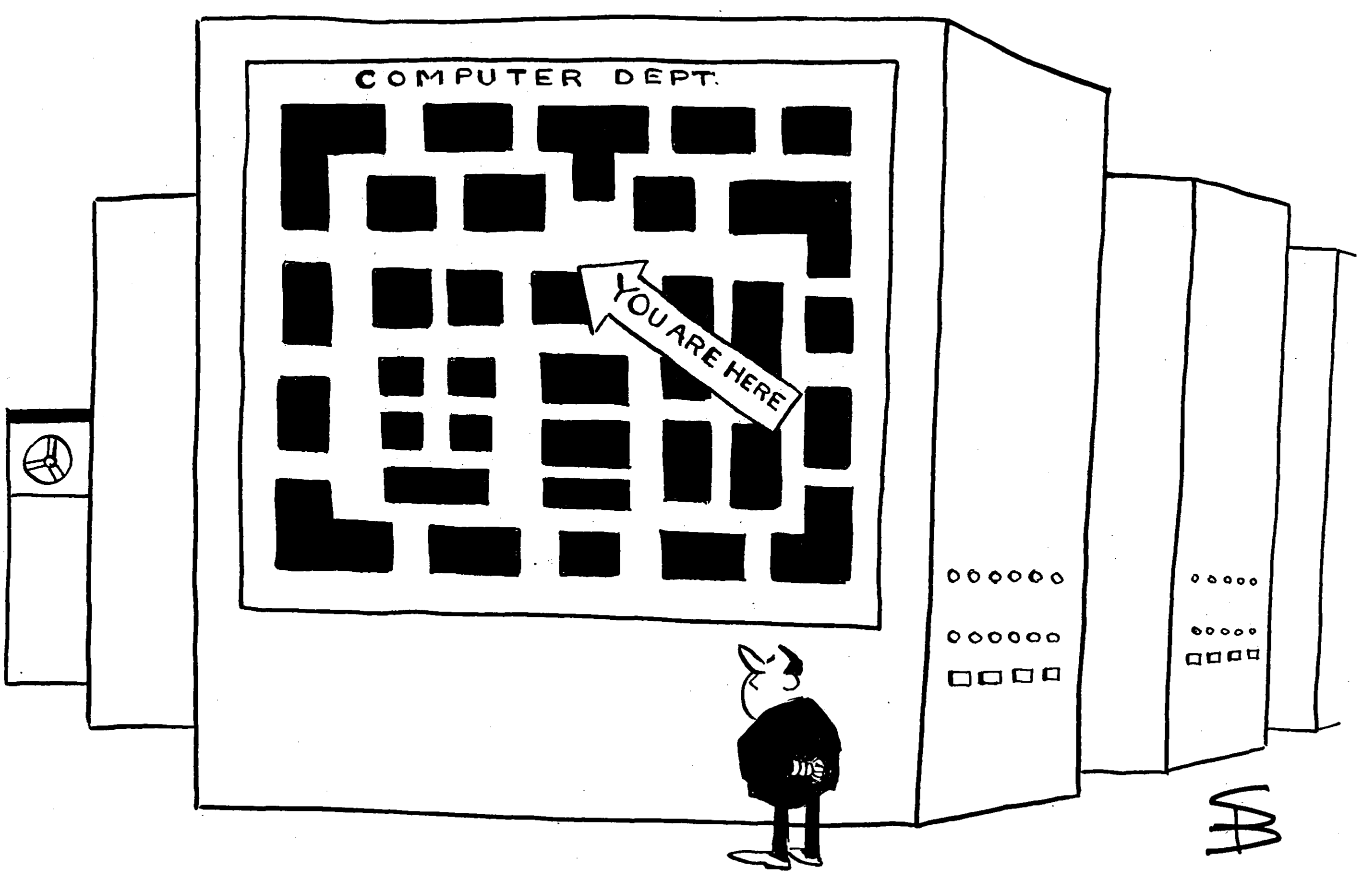
This is not to indicate more than that each change of equipment has its attendant problems. A survey of veteran computer users shows they felt the current generation of equipment brought a hoard of advances over the previous one: improved cost/performance; larger, high-speed main memories; higher capacity, lower cost random access devices; less down-time; wider choice of peripherals; greater multiprogramming, multiprocessing capability; expandability and compatibility of computers in a family, more sophistication at a lower mainframe level (i.e., multiprogramming, teleprocessing, online terminals, graphics, etc.); increased use of operating systems in OLRT environment; development in file management systems; program compatibility at assembly language level; emulation ("in our experience, the first really complete preservation of programming"); and who said "greater IBM profits"?

And almost to the item, the next generation, due by consensus between 1971-75, should have improvements on these improvements. Users felt that what essentially will shove a system into a new era is a mainframe that increases speed by an order of magnitude over what's now available, increases internal mass storage to the billion-character range, and decreases cost (thin film and cryogenic core are offered). Other hardware wants are larger, more reliable, cheaper random access storage, although this is seen by one user as less important if internal memory is increased and improved; larger varieties of special purpose remote devices, including 3-D and color displays, handwriting and voice input terminals. Although many felt some peripherals should be speeded up by two-four times (5,000 lpm electronic printer, 600 KC discs), the emphasis was on lower cost, greater reliability, and, for the printer, increased capability (character sets, multifonts) and quality. High-speed, low-cost communications, definitely a lack currently, will be vital for the activities of any coming generations. One user called for low-cost high-bandwidth microwave links to centralized facilities for more powerful time-sharing systems. Better communications interfaces are also required.

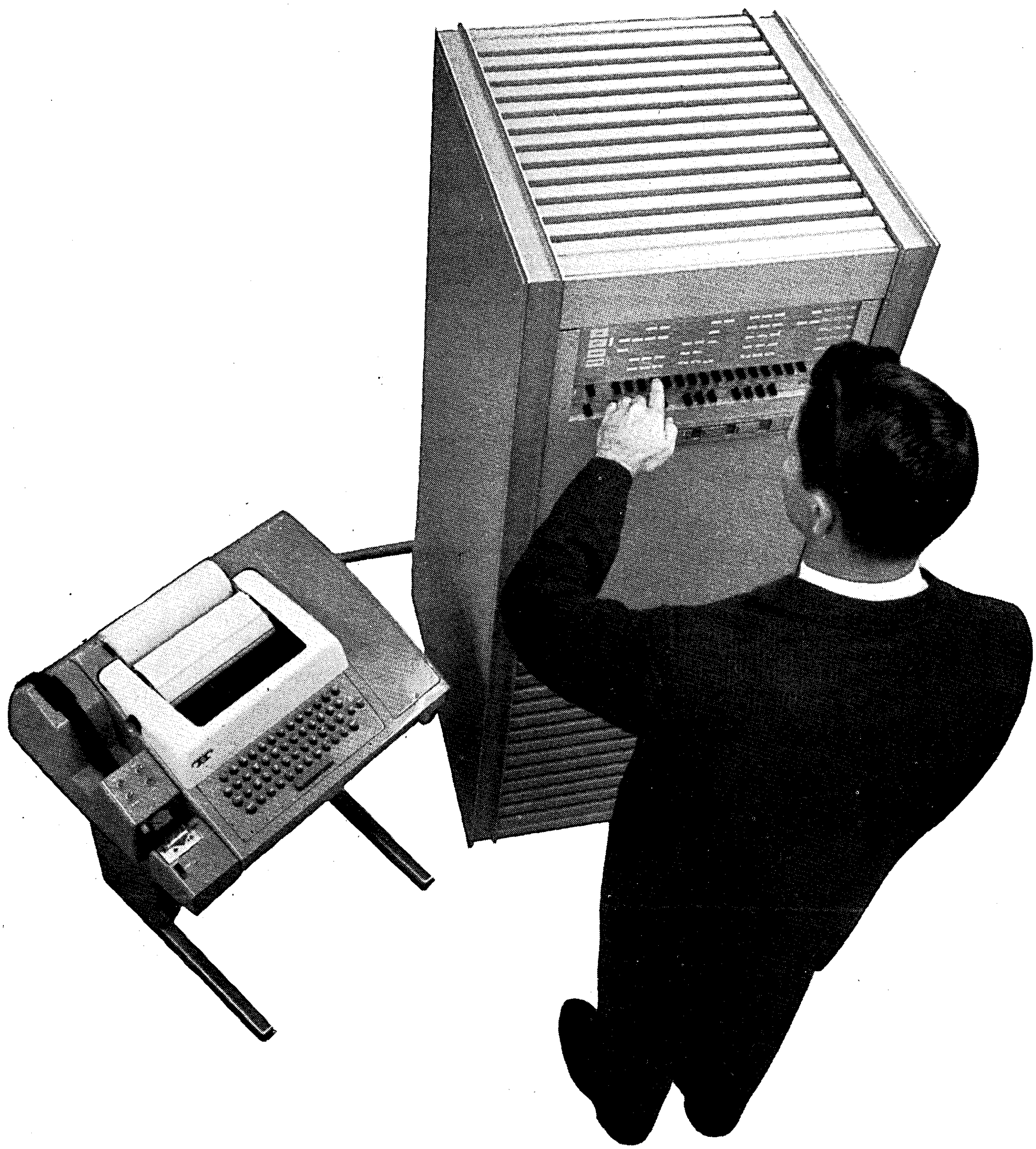
No, software is not being avoided. It was the most popular answer to the question on critical problems still evident in third generation systems. The tally really isn't in from the field yet on this generation, but users reflected the disgruntlement with the delays, the debugging and education problems, inadequacy of manuals, the cost of conversion. Some answers for the next machines were offered, such as more software functions being built into hardware, less operating system for the average user (some feel they have a lot more computer than they can figure out how to use). Definite wants are for fourth generation compatibility with the predecessor family, and for separation of hardware and software pricing "so we'll know what we're paying for." Half surveyed thought this separation was really coming.

The idea of a universal language was appealing to some, simply because conversion problems would phase out and a vast pool of programs would become available to users of differing systems. A stable basic source language for each system seemed more practical, and most users are content to settle on improving what exists, rather than "compounding the confusion."

The last dampening word on software was offered by a dp director at a major insurance firm, "Assuming problems of reliable operation of hardware are solved, there is little real promise of simplification of program writing and system construction. This may be fine from the point of view of more jobs for people, but it's not so fine from the businessman's view of lower cost operations." ■



This 16-bit, real-time computer multiplies faster, has a faster throughput, and costs less than the Sigma 2.



It's our SEL 810A, for high-speed data acquisition and control. All integrated circuits, 3 levels of priority interrupt, 4K memory, teletype, high-speed hardware multiply and divide, real-time I/O structure, and an outstanding software package. Price: $23,950. Delivery: 60 days. Systems Engineering Laboratories, 6901 West Sunrise Blvd., Fort Lauderdale, Fla. 33310, Area Code 305 587-2900. Offices also in Washington, D.C.; Los Angeles, Calif.; Boston, Mass.; San Francisco, Calif.; Cleveland, Ohio; Huntsville, Ala.; and Orlando, Florida.

Systems Engineering Laboratories

CIRCLE 21 ON READER CARD

We kept our promise.

We tripled the memory of a Bryant Series 4000 Disc File during the three-day F.J.C.C. in San Francisco. Just as we said we would. Without a clean room. Under the critical gaze of the thousands who witnessed our demonstration. You can bet there are a lot more Bryant Believers today. Write for the full Bryant Computer Products story, 850 Ladd Rd., Walled Lake, Michigan.

CIRCLE 22 ON READER CARD

TRANSLATION BY XACT

with a 7090/1604 example

by HENRY OSWALD

A fully automatic software translation system called XACT (X stands for any computer, Automatic Code Translation) has been under development at Celestron Associates, Inc.,* since 1961. A large portion of this development has been supported by the Rome Air Development Center of the Air Force. The version of the XACT translator that is currently operational is designed to translate IBM 7090 programs into equivalent CDC 1604 programs. It is implemented for operation on the CDC 1604. The generic XACT system is capable of program translation between any pair of computers; in fact, it is possible to build a translator that will operate between several source machines and several target machines.

XACT requires as input the source program in source machine language, the program loader that loads it into the source machine, and a description of the data that the source program is intended to operate upon. The translator then performs four major operations without further human assistance: (1) acquisition of the source program, (2) identification of all instructions and data that belong to the source program, (3) analysis of the source program to produce a machine-independent description of the functions performed and, (4) target code compilation.

Although each step in the process is important, the really significant events take place in analysis. Analysis elicits the gross operations that the source program performs by a process of contextual analysis in the enviroment of the source machine logic structure. By performing such analysis, it is possible to differentiate the relevant from the irrelevant operations within the context of a particular program. It is thus possible to delete operations that are performed in the source machine by virtue of its logical design, but are not necessary for execution of the program. Since analysis yields a machine-independent description of the functions performed by the source program in the source machine, the compilation phase of translation is free to make the most effective use of target machine hardware.

The possibility, therefore, exists of generating very efficient target programs. Software translation is inherently capable of target machine execution efficiency superior to the best emulation scheme that can be implemented. The reason for this is that translation need not blindly follow source machine logic as emulation does. Translation yields a machine language program that runs directly on the target machine and takes advantage of its hardware features. The disadvantages of simulation and emulation are bypassed, fewer machine level operations are performed and hence the throughput capacity of the target machine is preserved. A one-time translation run is required.

During the second quarter of 1966, the first live test cases were run on the 7090/1604 translator. Current tests indicate that translation of a 100-instruction program in the worst case requires approximately one-half hour of 1604 time. This is a conservative result and it should be noted that the 7090/1604 translator is intended to demonstrate feasibility of the XACT translating algorithm and to act as a research and development tool, i.e., it was not intended to be a production program.

Test results thus far indicate not only that program translation can be accomplished, but that quite good target code efficiency can be obtained. The target program in the 7090/1604 case can be expected to be larger than the source program by 2½ to 1. Actual target programs range from 2:1 to 3:1 in number of locations and 3:1 to 6:1 in number of instructions. We consider this very good for the first large scale implementation. Moreover, it is clear that target code efficiency can be nearly doubled by replacing the one-pass compiler which is currently part of the system. Subsequent production translators will be designed for speed and utility.

problems and advantages

Automatic programming translation is among the most difficult of programming tasks. It, therefore, requires considerable effort to produce a software translator. In time, techniques will improve. At the current stage of development it is estimated that a single translator of the 7090/1604 class requires about 10 to 15 man-years of programming effort. It is anticipated that within a year the level of effort can be cut in half, and reduced even further as implementation is well within the economic ballpark of current computer art.

The greatest advantage of automatic program translation is that source and target machine differences become unimportant to program compatibility. The programs in question here are applications programs, not "software." It makes little sense to translate a compiler, for example, because the translated compiler operating on the target machine will diligently produce object programs for the source machine, not the target machine. It is, of course, possible to translate the output of such a translated compiler to produce a target program. For applications programs, the availability of software translation eliminates the need to design compatibility in hardware. Competing manufacturers need not produce similar or identical machines if programs can be easily and economically translated from one machine to another. Thus the unfortunate

* The author wishes to express his unbounded gratitude to the team of first rate analysts and programmers who have made major contributions to this most difficult project. F. Jeanne Oswald, co-inventor of the XACT algorithm, R. Dykaar, S. Bornfreund, E. deDufour, J. Volters and P. J. Kaufman, constitute a technical team of outstanding talent and accomplishment.

President of Celestron Associates, Inc., Valhalla, N.Y., Mr. Oswald is a senior systems analyst, physicist and software specialist. He is co-inventor of the XACT translation algorithm and has extensive programming experience. He holds a BS and PhD in physics from New York Univ.

trend toward industry uniformity can be reversed and competition returned to design ingenuity.

It would indeed be unfortunate if all future machine designs were tied to a de facto standard dictated by competitive marketing considerations only. The interests of users would best be served by design variety produced by freedom from hardware compatibility restraints. At the same time, large user investments in programming can be protected with translating capability.

It should not be expected that automatic program translation will have an immediate impact. Rather an evolutionary movement from software simulator to emulator to software translator can be expected to occur. There is every reason to expect that the generation of computers following the current crop will feature automatic program translation as part of their software packages. It is also reasonable to expect that such translators will have characteristics similar to those of Celestron's XACT system.

program run examples

The material in Figs. 1 through 4 are excerpts from the results of a translation run. *Fig. 1 is the source program FAP listing, Fig. 2 is a 7094 dump following execution on the 7094. Fig. 3 is the automatically generated target code in 1604 CODAP and Fig. 4 is a portion of a 1604 dump after execution of the target program.

Fig. 1 7094 Source Program

```
TEST CASE NO. 1
                                         ABS
                        00200            ORG  128
00200   0000 00 0 00000   HPR            HTR  0
00201   0000 00 0 00000                  HTR  0
00202   0000 00 0 00200   X              HTR  HPR
00203   0000 00 0 00201                  HTR  HPR+1
00204   0000 00 0 00202                  HTR  HPR+2
00205   0000 00 0 00203                  HTR  HPR+3
00206   0000 00 0 00204                  HTR  HPR+4
```

A simple program was chosen to conserve space and permit the reader to analyze the results with relative ease. Intermediate outputs of the translator, i.e., the tables produced by Source Code Scan and the meta language produced by Analysis are left out. These intermediate results are of interest but require considerable explanation for interpretation.

It will be noted that the source program occupies 46_{10} 7090 locations, and the target program occupies 146_{10} 1604 locations. The 1604 carries two instructions per word but, because of restrictions, not all possible instruction locations may be utilized. The target code contains 200_{10} instructions as against 31_{10} source code instructions for an instruction ratio of 6.4 to 1. It is to be expected that a conversion from 7090 to 1604 by any means would yield a target code that is larger then the source program in terms of instructions in the ratio 2.5:1 or 3:1. It would seem, therefore, that the actual XACT results could be improved. An examination of the target code produced will indicate a number of redundant stores/restores and such items as provision for arithmetic overflow which are not part of the source program. An improved meta compiler can reduce the target code to approximately 110_{10} instructions for a ratio of 3.5:1. These results are quite good for a prototype. The lessons learned thus far indicate that future translators will produce target programs that run at or near machine speed ratios. Speed of translation is under two seconds per source program instruction (1604 time).

Athough this illustrative program is not complex, it presents some interesting features. The source program deals with three overlapped arrays. A first loop clears the array and two succeeding loops fill half the array each. It will be noted that the arrays are properly related in the target code. Furthermore, while the 7090 version decrements, indexes and stores the arrays "backward", the target code reverses the arrays and increments the indexes. Further tests and expansion of this prototype translator are under way. In addition a production translator (GE 200 to GE 600) is well under way and several others including IBM 1400 (source) are in the planning stage. ■

For copies of the full printout, contact the author at Celestron Associates, Valhalla, N. Y.

Fig. 2 7094 Dump following Execution

```
           CELLS  00150  TO  00177        ALL CONTAIN          000000000000
00200  HTR            -066463476463 HTR  12 HTR  24    HTR        36       HTR        50    HTR  62    HTR        50
00210  HTR       36    HTR       24 HTR  12 HTR 211    CLA       211       STO       214    AXT  12,1  STZ       214,1
00220  177777100221   -300001100223 TRA 217 CLA 202    TZE       226       TRA       226    CLA 202    CAS       203
00230  TZE      223    TRA      233 TZE 231 CLA 253    AXT      12,1       ADD       254    STO 214,1  177777100240
00240 -300005100242    TRA      235 SUB 254 STO 214,1  177777100245  -300001100247   TRA 242    CLA       255
```

Fig. 3 1604 Target Program

```
                   00012+                  ENTRY    TRANS                                   EHP00004
00012+  75  0  77777       TRANS           SLJ      **                                      EHP00005
        10  0  00000                       ENA      0                                       EHP00006
00013+  20  0  00000+                      STA      OVERFLOW                                EHP00007
        04  0  00000                       ENQ      0                                       EHP00008
00014+  20  0  00214+                      STA            TEMP         CL                   EHP00009
        12  0  00220+                      LDA            LIT2                              EHP00010
00015+  20  0  00212+                      STA              T00001                          EHP00011
```

Fig. 4 1604 Dump after Execution

```
 ABS  PROG                                                  CONTENTS
74554    2   SLJ754 02064  SLJ754 02064  SLJ754 02064  SLJ754 02064  SLJ754 02064  SLJ754 02064  SLJ750 77777  ENI500 00000
74560    6   SLJ750 74557  ENI500 00000  SLJ750 77777  STA200 74564  ENA100 00001  STA200 11133  LDA120 74564  SLJ750 74561
74564   10   ZRO000 00000  ZRO000 00000  SLJ750 75650  ENA100 00000  STA200 11133  ENQ040 00000  STA200 74767  LDA120 74773
74570   14   STA200 74765  LDA120 74767  STA200 74767  LDA120 74773  LIL531 74765  STA201 74752  LDA120 74767  STA200 74767
74574   18   LDA120 74774  STA200 74770  LDA120 74767  STA200 74767  LDA120 74770  ADD140 74765  STA200 74765  LDA120 74767
```

bringing in the 1108

CONVERSION AT LOCKHEED MISSILES AND SPACE

by DOUGLASS A. WILLIAMS

Lockheed Missiles & Space Company (LMSC) operates one of industry's largest centralized computation centers, processing administrative, data reduction, and on-line computer work. In order for this work to be accomplished efficiently, LMSC performs a continuous evaluation of computer hardware and software systems with respect to its processing requirements.

In June, 1964, the LMSC Computation Center technical staff undertook a major computer study aimed at replacing one of the center's four IBM 7094 computers. Several criteria were applied to this study including: (1) increased capacity over an IBM 7094 computer by at least 2:1, (2) total machine costs not to exceed one IBM 7094, (3) delivery schedule for September, 1965, and (4) a reasonable software conversion plan. All major computer manufacturers' systems were considered with a preliminary selection of four prime candidates resulting from these criteria. These four were IBM, Univac, Control Data Corp. and General Electric.

A three-month intensive study of the four candidate systems was performed during the summer of 1964 and included consideration of hardware characteristics, software capability, price/performance evaluations, delivery schedule, and support functions. A special program entitled Automatic Computer Evaluation (ACE) was used as an aid in computing performance curves on each computer system configuration. Inputs to the program included memory speed, tape speed, drum/disc access time and transfer rate, base shift rental, extra shift costs, workload estimates, etc. Output from the program included cost/performance figures by configuration.

In September, 1964, the evaluation team selected the Univac 1108, LMSC management approved the recommendations, and an order letter was issued. The plan called for replacing one 7094 with an interim 1107 com-

Now a senior member of the technical staff at Computer Sciences Corp., Mr. Williams was previously supervisor of digital computer systems in the Information Processing Division of Lockheed Missiles & Space Co., Sunnyvale, Calif. He has a BA in mathematics from San Jose State College and has done graduate work at USC and the Univ. of California.

puter system in February, 1965, and replacing the 1107 with an 1108 in September, 1965.

preparation

In October, 1964, plans were formulated for the conversion of the workload of a 7094 (approximately 500 hours per month) to the 1107/1108. A project manager was designated by the computation center management to assume full responsibility for this effort.

Four professional programmers, selected from the LMSC scientific computing staff, and four programmers provided by Univac constituted the conversion task force. During the ensuing six months, many other programming personnel (both professional programmers and open shop FORTRAN programmers) contributed to the conversion efforts.

Univac provided courses of instruction covering the topics of 1107/1108 FORTRAN IV, SLEUTH II Assembly Langauge, EXEC II Operating System, and Introduction to the 1107/1108 System. These courses were quite valuable and provided a proper base for the conversion tasks. Additional training was provided in areas of computer operations, LIFT (conversion of FORTRAN II to FORTRAN IV), and data file conversion.

Training aids included machine listings of the systems software, flowcharts and narrative material on the system, programming notes and manuals from the Boeing Company (an 1107 user), and technical bulletins prepared at LMSC on areas affecting program conversion. These technical bulletins described pertinent hardware differences between the IBM 7094 and the Univac 1107/1108, control card setup for LIFT translation of FORTRAN source decks, and data conversion routine usage for reformatting of 7094 data tapes to 1107/1108 format.

workload survey

A necessary step in the conversion process was identification of the 7094 workload by: (1) individual job, (2) programming language, and (3) computer time and number of runs per month. A computer program, which summarized this information in report format for each of the desired categories, made the task of selecting programs for conversion much easier.

Survey forms (shown in Fig. 1) were prepared and distributed to the user departments to identify *active* jobs, provide programmer name, location, phone extension and pertinent information concerning each particular program. Information requested on the survey form included: (1) non-standard subroutines used, (2) use of machine-coded subroutines, (3) program overlay or chaining, (4) non-standard input/output usage, and (5) availability of source deck, source listing, and test case data input.

conversion effort

To initiate the conversion process, a letter was distributed to all affected departments in the company (approximately 50 separate departments). This letter described the computation center's plans for replacement of the IBM 7094 with the Univac 1107/1108 and included information concerning costs and savings of conversion, programmer training, schedules, and assistance to be provided.

Lists of active jobs (programs) pertaining to each department were provided to the department manager for his perusal and suggestions for selecting programs to be converted. Selection criteria included: (1) projected lifespan of a program, (2) degree of FORTRAN to FAP (7094

Fig. 1 FORTRAN II/FAP Survey

Program ID__________ Program Title__________

Programmer/Customer Name__________ Orgn. No. __________

Phone Extension__________ Building No. __________

(If you are not sure of the correct answer, please leave blank or indicate a **NO** reply.)

1. Is this a pure FAP-coded job? ☐ YES ☐ NO
   If **YES**, you need not complete the remainder of this form; if **NO**, this program is defined as a FORTRAN/FAP job. Please complete this survey sheet.
2. Does this program use any system library subroutines other than those listed in Appendix I? ☐ YES ☐ NO
   a) If **YES**, please indicate those which are used by checking the appropriate subroutines listed in Appendix II.
3. Do you use the S-12 Auxiliary Library? ☐ YES ☐ NO
4. Does this program use any SHARE FAP-coded subroutines? ☐ YES ☐ NO
   a) If **YES**, please list the SHARE subroutine names. ______ ______ ______ ______ ______ ______
5. How many additional FAP-coded subroutines does this program use? Please include any FAP-coded subroutines used from S-12, the Auxiliary Library tape. (The total should not include the SHARE subroutines listed above or the system library subroutines.) ☐
6. Do you have a subroutine writeup for each subroutine included in the above count? ☐ YES ☐ NO
   If **NO**, please return a **subroutine** writeup for each subroutine. More than one subroutine writeup may appear on one sheet of paper. Use the outline in Appendix III as a guide.
7. Do you have the following?
   a) source deck ☐ YES ☐ NO
   b) source listing ☐ YES ☐ NO
   c) sample input ☐ YES ☐ NO
   d) sample output ☐ YES ☐ NO
8. Is this a CHAIN job? ☐ YES ☐ NO
9. Do you require tapes other than the standard FORTRAN II input and output (i.e., logical 5 and 6 or A2 and A3)? ☐ YES ☐ NO
   Please indicate which tapes you are using, give logical or physical tape numbers, and indicate the function of the tape (i.e., I = input, O = output, S = scratch).
   ______ ______ ______ ______
   ______ ______ ______ ______
   ______ ______ ______ ______
10. Is this job a CHECKOUT ☐ or PRODUCTION ☐ job?
11. Comments: ....

APPENDIX I
FORTRAN II Subroutines Which are Common to 7094 & 1107 FORTRAN IV

ABSF	SIGNF	DATANF
ATANF	SINF	DATAN2F
COSF	SQRTF	DCOSF
DIMF	TANHF	DEXPF
EXIT	XABSF	DLOGF
EXPF	XDIMF	DLOG10F
FLOATF	XFIXF	DMODF
INTF	XINTF	DSINF
LOGF	XMAXOF	DSQRTF
MAXOF	XMAX1F	IABSF
MAX1F	XMINOF	ICOSF
MINOF	XMIN1F	IEXPF
MIN1F	XMODF	ILOGF
MODF	XSIGNF	ISINF
		ISQRTF

APPENDIX II
Special LMSC System Library Subroutines

- ☐ XLOC
- ☐ READA, READB
- ☐ WRITEA, WRITEB, WRITET
- ☐ MRDA, MRDB, MRDT, MWRA, MWRB, MWRT
- ☐ COPY
- ☐ SDL, SHD
- ☐ UNLOAD
- ☐ TIME
- ☐ BFIL, SFIL
- ☐ PLOTA, PLOTB, PLOTF, PLOTT
- ☐ (Any S-C 4020 Plot Routines)
- ☐ URNDM
- ☐ INCORE
- ☐ OTHER ______ ______ ______ ______ ______

APPENDIX III
Subroutine Writeup (Outline)

Identification

Subroutine Name __________

Responsible Programmer (someone who can answer questions about this subroutine, preferably you.) __________ Orgn. No. __________

Phone Extension __________

Function (What does the program do?)

....

Subroutine Size (The total number of FAP instructions. This can be estimated by the size of the deck; i.e., 150 cards (instructions) per inch.)

....

Assembly Language) code, (3) production status of a program and (4) amount of machine time used by a program.

With the selection of programs underway, a parallel effort was initiated in the systems software area. Commonly used subroutines under the IBM 7094 FORTRAN systems were identified and compared with those available from Univac for the 1107/1108 machines. It was concluded that approximately 12 subroutines existed on the IBM 7094 system which had no counterpart in the Univac 1107/1108 system. These included special subroutines for controlling magnetic tape input/output, data conversion, time clock, and random number generation. Reprogramming of these routines was initiated.

In addition to this, LMSC required complete reprogramming of a 7094 subroutine package for the S-C 4020 plotting device. This consisted of seven FORTRAN and 21 FAP subroutines. One LMSC programmer and one Univac programmer (with no prior familiarity with the S-C 4020) completed this task in two calendar months. The approach taken in this subroutine conversion was a "one-for-one" transliteration from 7094 FAP to 1107/1108 SLEUTH II assembly language code for the 21 FAP subroutines while the 7094 FORTRAN subroutines were converted to 1107/1108 FORTRAN.

Finally, the systems group prepared an in-house 1107/1108 systems manual for use by professional programmers and open shop programming personnel. This manual included information on hardware configuration, control card formats and options, data file conversion, program conversion, accounting standards, and library subroutine abstracts. The LMSC S-C 4020 Manual, originally written for the IBM 7094 user, required no significant change because of the compatibility programmed into the Univac 1107/1108 version of these routines. The Univac FORTRAN IV manual and other related manuals constituted a complete set of documentation for the user.

With all necessary systems subroutines converted or in the process of conversion, adequate documentation and training well underway, and the criteria by which programs were selected for conversion* established, the major effort commenced two months after the conversion decision was made.

Selected FORTRAN II programs were sent to the Project manager to be reproduced and the original source decks returned. Test data were requested in those cases where execution of the converted programs was planned. The reproduced FORTRAN II source deck was then set up for machine translation using the Univac LIFT program (a version of the SHARE internal FORTRAN translator) which reformats FORTRAN II programs to FORTRAN IV and produces a diagnostic listing on those statements not translated. Stacks of programs were set up by the conversion group and packaged for evening air freight to Los Angeles where a Univac 1107 computer was made available for processing the work. Processed stacks were

Fig. 2 Conversion Worksheet

Summary

Job ID________ Start Date________ Completion Date________ Total Machine Hours________

Total No. of Compiles________ Job Returned to Customer (Date)________ Job Held for Further Analysis (Date)________ Type Job (Group 1, 2, 3, 4, or 5)________

Detail

LIFT Completed

1st________

2nd________

Comments

FORTRAN IV Compile Completed — Machine Time (.01 of Hours)

1st________ ________

2nd________ ________

3rd________ ________

4th________ ________

Execution Completed

1st________ ________

2nd________ ________

3rd________ ________

Converted by (Name)________

*Major emphasis on program selection was based on a 90% or more FORTRAN mix to FAP assembly language. Some 220 programs were selected for conversion from a total of 1200 distinct programs. Those programs which were excluded from conversion were those which were largely written in machine code, because a separate effort, aimed at automatic translation of 7094 machine language, was under development.

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.

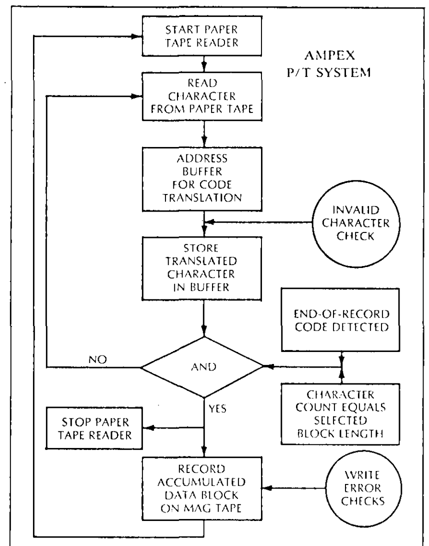
The systems: We make three basic media conversion systems; one (P/T) handles paper tape-to-magnetic tape; the second (C/T) converts data from punched cards at speeds of 800 or 1500 cards per minute; the third MCS "COMBO" combines the abilities of both the C/T and P/T, alternately handling punched paper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

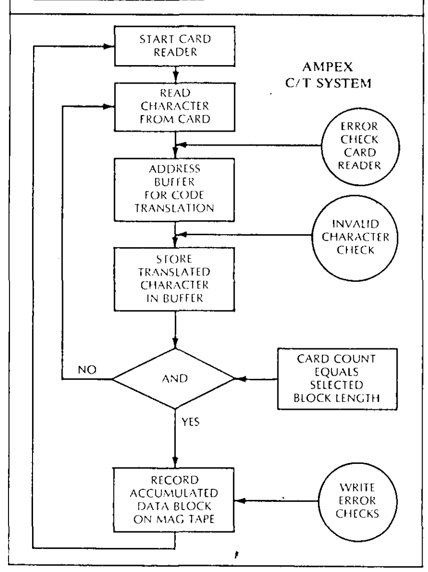
How they operate: Our media conversion systems are adaptable to any form of punched tape or card input. The P/T system accepts 5-, 6-, 7-, or 8-level paper tape in virtually any code. The paper tape reader handles 1000 characters per second, yet it *stops between characters* to let the magnetic tape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

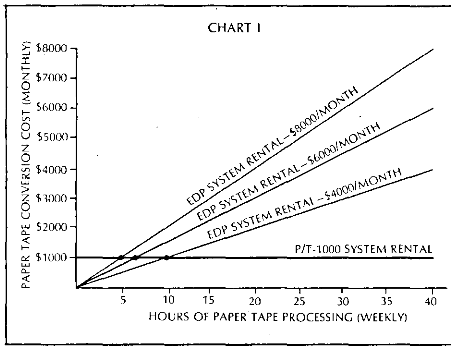
The *outputs* from the P/T or C/T units are identical: data blocks written on magnetic tape according to the desired length and packing density, in either 7- or 9-channel magnetic tape format. **And every single data block is completely free of conversion errors.**

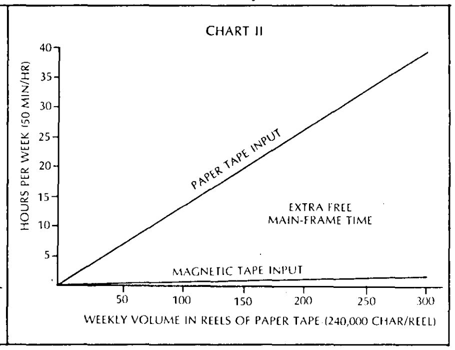
A series of built-in checks during conversion assure you that no main frame computer time will be wasted on erroneous input information. The following sequential operation charts demonstrate how each step of the conversion is carefully checked:





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.

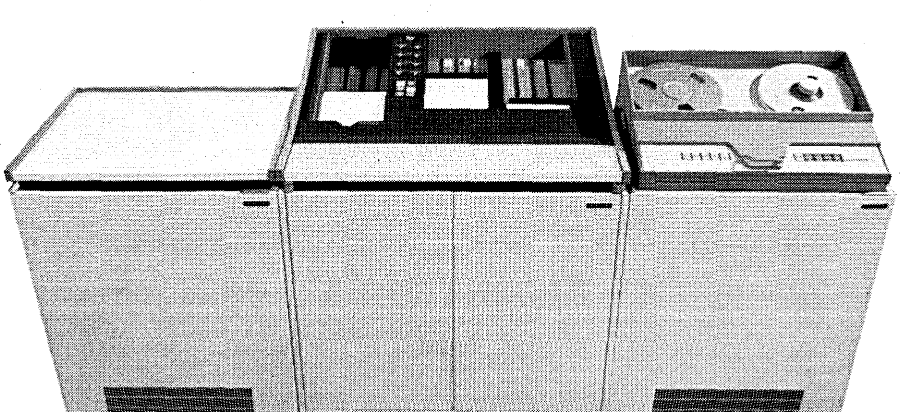
Chart I illustrates paper tape-to-magnetic tape conversion costs for three different computer systems. It is based on weekly processing volume in hours, and costs of this processing are shown in relation to the per-month cost of the system. We have also charted the approximate monthly rental cost of 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 24 ON READER CARD

returned to LMSC by 10:00 a.m. the following morning. These stacks were separated and, in some cases, programs were returned to the original programmer for analysis and necessary changes. On most programs, the conversion task force examined the LIFT output, corrrected those discrepancies or errors identified by LIFT, and placed the corrected FORTRAN IV source deck into the stack for compilation by the 1107 FORTRAN IV compiler. In general, one pass of the program through LIFT and two compilations by the FORTRAN IV compiler sufficed to generate a reasonably error-free FORTRAN IV program, ready for test execution on the Univac 1107. When more serious errors did occur, they tended to fall into one of three categories.

1. **Machine-dependent coding** – Use of octal constants to represent Hollerith or numeric information required manual conversion; certain "programming tricks" based on 7094 hardware/software peculiarities required manual alteration.
2. **Incomplete programs** – Missing subroutines, missing test data, errors in program or test data, etc. Problems in this category were normally repaired by the cognizant programmer.
3. **Differences in output results** – This was most frequently attributed to arithmetic differences between the 7094 and 1107 but also included mathematical subroutine differences and alterations in conversion of decimal numbers to binary.

The conversion task force programmers became quite proficient in discovering these errors and making the necessary changes. When all observable errors had been corrected in the source deck, the associated test data for the program were included and the program was submitted for execution on the Univac 1107. Results from these runs varied widely. Some programs initially failed to execute due to the discrepancies noted above; however, in the majority of cases, execution was effected and results compared favorably with those of the IBM 7094. In some cases, programming changes to the logic of the program (or mathematical model) were necessary to compensate for hardware/software differences. On major LMSC programs (particularly those in excess of 2000 FORTRAN statements), a substantial amount of reprogramming and reorganizing of the program was done in order to fully utilize the increased capabilities of the Univac 1107/1108. (The IBM 7094 was a 32K-word machine with two magnetic tape channels, while the replacement Univac 1107/1108 was a 65K-word machine with two magnetic tape channels and two high-speed drum channels.)

Frequent contact between the conversion task force and the various company departments, combined with quick turnaround of programs in the conversion process, contributed greatly to the success of the effort. A review of some of the statistics from LMSC's conversion will indicate the scope of the effort and the cost of this conversion.

statistics of conversion

Attempts were made to keep accurate figures on the conversion effort. In addition to the previously mentioned program survey forms, a conversion worksheet (see Fig. 2) was maintained on each program and notations were made concerning any problems encountered, the number of machine runs required to successfully convert, etc. A COBOL program provided reports on detailed machine processing statistics associated with all IBM 7094 program runs allowing the project manager to identify candidate programs for conversion.

Approximately 220 programs were submitted to the conversion task force for conversion. A few programs required special handling due to their security classification or specialty area (e.g. APT numerical controlled machine applications) and were converted outside of this effort; however, it is felt that these constituted less than 10% of the total. Also, programs which were in a development or checkout status (rather than production) were redirected from the IBM 7094 to the Univac 1107/1108 in most cases.

The conversion task force effort began in late October, 1964, and concluded in March, 1965; however, additional conversion work by the various departments continued.

Costs of this conversion (summarized in Fig. 3), were shared between LMSC and Univac.

machine usage statistics

Installation of the 1107 (in the same physical area as its predecessor, the 7094) required approximately one month. During this period, the entire 7094 workload was processed on the three remaining 7094 computers.

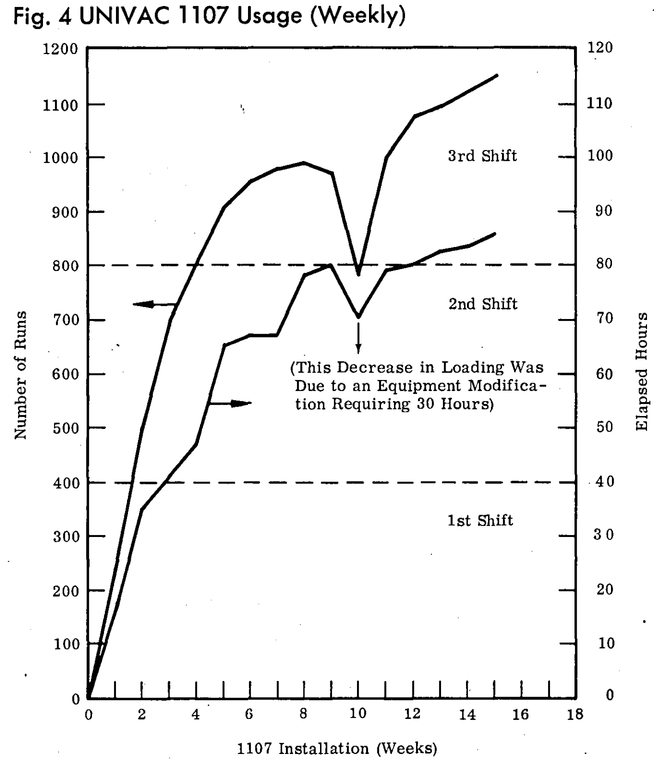
The success of LMSC's conversion to the Univac 1107/1108 can best be judged from the initial machine loading statistics shown in Fig. 4. As these figures show, workload on the 1107 rose sharply in the beginning weeks of operation and after three weeks, a second shift was initiated. After fifteen weeks of operation, a full three-shift operation was instituted.

One phenomenon of this conversion was the absence of an equivalent displacement of workload from the 7094

Fig. 3 Conversion Costs

Oct '64–June '65	LABOR		MACHINE		Total Cost
	Hours	Dollars	Hours	Dollars	
		$12.50/hr			
LMSC	10,235	$128,275	180	$52,675	$180,950
UNIVAC	3,520	$ 44,000	41.5	$17,500	$ 61,500
TOTAL	13,755	$172,275	221.5	$70,175	$242,450

Fig. 4 UNIVAC 1107 Usage (Weekly)



to the 1107; that is, elapsed 1107 run hours increased in higher proportion than the decrease in elapsed 7094 run hours. Three factors contributed to this: (1) the 7094 is slightly faster than the 1107, hence the converted programs take slightly more time on an 1107; (2) the newly installed 1107 provided improved turnaround which allowed for frequent submittals of the same programs; and (3) new program development work was directed to the 1107, thus increasing its load. With the replacement of the 1107 by the 1108, the increased capacity and throughput of the 1108 provided an estimated 2.4:1 improvement over the 7094.

conclusions

There were several factors which led to the successful conversion at LMSC. A brief summary of these is given below:

1. The Univac 1107/1108 and IBM 7094 are both 36-bit, fixed-word length, binary machines with compatible magnetic tape and similar arithmetic, thus making the change in hardware less severe than a change to a different machine design. The Univac 1107/1108 (which is internally four to five times faster than a 7094) was ordered with a 65K-word core memory (the 7094 had 32K words) and secondary drum storage which provided additional capacity for segmented jobs and expanded machine facilities for prospective users.
2. Software for the Univac 1107/1108 had been in the field for over two years and was thoroughly tested. The FORTRAN IV compiler and EXEC II Operating System were considerably more powerful and of better design than their counterparts on the IBM 7094.
3. LMSC has, for several years, directed new programming and modification to existing programs toward the FORTRAN language. The conversion benefitted from this since the selected workload included over 90% pure FORTRAN jobs and less than 10% in machine language.
4. Excellent conversion software including the LIFT translator and a tape file conversion program was supplied by Univac. This allowed a major portion of the program and data conversion to be processed by the 1107.
5. LMSC management designated one man as conversion project manager and gave him full responsibility and the resources necessary to accomplish the job. The project was scheduled for six months and qualified, professional programmers (four from Univac and four from LMSC) were designated as the conversion task force.
6. Quick turnaround (overnight) of conversion runs on the 1107* allowed the task force to deal with 20 to 30 separate programs per day.
7. LMSC costs for the conversion were absorbed into the computer pool which consists of operator labor, systems programming, and equipment rental. In this manner, the conversion costs were prorated to all users at an increase of less than $18 per hour of chargeable computer time. Using this method to underwrite the conversion eliminated budgetary planning problems for the many departments affected by this effort.

present status

In April, 1966, LMSC reinstated its conversion task force in preparation for the installation of a second 1108 in July, 1966. This conversion effort includes not only FORTRAN programs now running on the remaining IBM 7094's, but machine language programs as well.

A frontal attack on the "conversion problem" of machine language programs is being applied through use of LMSC's "decompiler." The decompiler, developed under the direction of Dr. M. H. Halstead,[1] is a computer program written in the NELIAC language which examines the machine language code of an IBM 7094 program and decompiles (translates) this code into NELIAC. A recompiler (a special version of a NELIAC compiler) for the 1108 generates, from the decompiled 7094 program, an object deck for 1108. Additional examination and repair is normally required to produce a working program.

The major advantage of this translation approach is the generation of a higher level language NELIAC version of the original 7094 machine code. The decompiled program can be examined for errors or improvements with greater ease than one usually experiences in attempting a "one-for-one" translation from 7094 machine code to 1108 machine code. Furthermore, if LMSC replaces the 1108 computer with another machine at some future date, the conversion effort on these programs will involve rewriting one recompiler program and recompiling the many NELIAC programs for any succeeding machines. This level of machine independence will allow continued transferral of computer programs across different computer lines at a minimum of conversion time and cost.

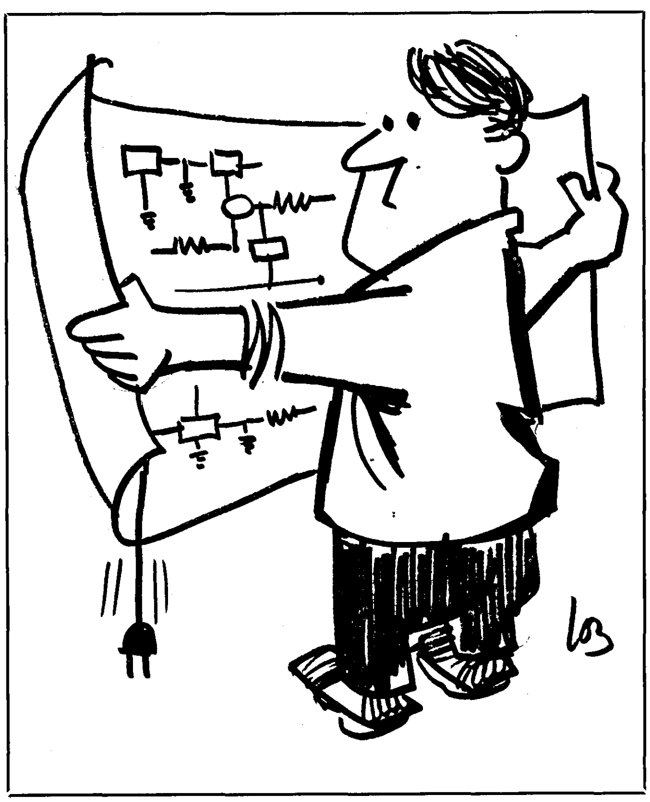
summary

LMSC has replaced two IBM 7094 computers with third-generation Univac 1108 computers. The availability of a proven hardware/software system and machine translation aids, coupled with a well planned conversion effort, have proven to be the ingredients for a successful transition to third-generation computers with significantly increased capacity and throughput performance. ■

---

[1]Halstead, M. H., *Machine-Independent Computer Programming*, Spartan Books, Washington, D.C., 1962, pp. 143-150.

*Although the 1107 was 400 miles away (Los Angeles) from the conversion task force (Sunnyvale), an arrangement between Pacific Airlines and Univac resulted in the necessary computer time and air shipment of the computer programs.



SAFEGUARDING TAPE-STORED DATA

the stitch in time

by PAUL R. EDELMAN

The disastrous fire that swept the Pentagon computer area several years ago bluntly alerted computer personnel to the vulnerability of tape-stored data in situations involving high temperatures. In a more recent illustration, 150 tape files stored in a fireproof safe escaped a fire that destroyed a computer facility in an Indiana corporation (*see* DATAMATION, Oct., p. 125).

Most installations, from their inception, had employed some system of back-up for master files and other important taped information since it was logically assumed (and quickly confirmed) that anything as small as a magnetic bit might occasionally become a victim of dust particles or rough handling. However, extensive protection against damage by fire was not generally in evidence for several reasons:

1. Most of the early computers were installed in minimal facilities. Industrial installations, for example, were usually made on plant or office sites, often in existing buildings, retaining such fire protection provisions which had been considered adequate for the structure's original purpose.

2. Computer loadings increased rapidly, far beyond expectations, necessitating greater tape storage than was planned initially. The overflow storage areas were often created with even less attention to fire security.

3. Prior to the advent of magnetic tapes, records were contained on paper, and fire protecting equipment, such as safes and cabinets, were designed to prevent valuable documents from charring beyond legibility. Those devices, however, were not adequate for the safeguarding of plastic tape reels which deform at a temperature significantly lower than that required to destroy paper. Even the most efficient four-hour safe, adequate for the protection of paperwork in most fires, was found to be of little use for tapes because it was ingeniously designed to release steam internally when the concrete-locked water particles in the safe wall reached the boiling point—fine for paper, but destructive to plastic.

4. Early computers, such as the Univac I, used metal tapes stored on metal reels, which were obviously able to withstand higher temperatures than the plastics that came later.

5. Finally, computer center fires were uncommon, for computer centers themselves were few.

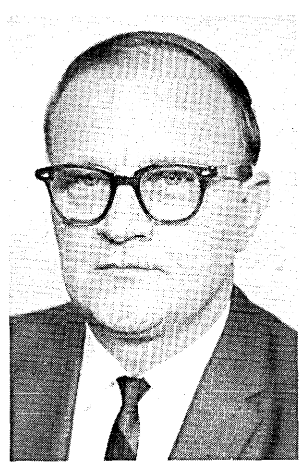
Whatever the reasons, many computer people re-evaluated their tape storage procedures after the Pentagon fire and sat down to figure out a way to rectify their deficiencies.

At the East Pittsburgh Westinghouse Computer Center, we were no exception. As one of the first industrial users of large-scale digital computing equipment for dp and scientific purposes, we were inevitably subject to some of the conditions described above.

Our original computer was fully loaded in less than four years, necessitating storage space for two million feet of metal tape. Subsequent progression to higher-powered, more capacious computers was accomplished by a change to Mylar tape on plastic reels and an increase in footage until we currently store about seven million feet. It should be pointed out that, with today's greater tape densities, this represents an increase in bit storage of about 2800%.

foresight and analysis

Fortunately, a degree of foresight combined with access to considerably more than average available space for construction of a building to house our computers, per-



Mr. Edelman operated the first dp computer for the Westinghouse Electric Corp. ten years ago. Since then, he has supervised the installation and operation of succeeding generations of computers at the East Pittsburgh, Pa. facility. He is an electrical engineering graduate of the Westinghouse Night School.

mitted inclusion of a 5000-tape capacity storage vault. But even with a building made of non-combustible materials and well furnished with fire extinguishing equipment, it was impossible to ignore the thought of the chaos that would certainly result if our tapes were destroyed.

Analysis disclosed that our vault contained tapes which fell into three categories. A sizable portion were those which had been used to produce reports in one-shot runs and these, along with a certain number of new tapes, introduced on a turnover basis to compensate for normal mortality, were waiting to be reassigned to use.

Others, such as program tapes, had reconstruction possibilities from printed or punched-card back-ups stored in remote areas. Loss of tapes in these two categories would certainly be serious, in view of lost time and replacement costs of around $100,000. But loss of the remaining 10% of our tapes would be catastrophic. These tapes, numbering less than 300, included regularly updated master files, accumulation and the like—necessary to the factory, controlling inventories, producing payrolls and maintaining vital records required by law. Also in this class were some of the more dynamic tapes of computer programs, usually extremely lengthy and complicated by frequent alterations and patching: therefore difficult to reconstruct from source material. We concentrated upon this final category containing the indispensable types for which all reasonable protection must be arranged.

There are three ways to prevent the loss, by fire, of tape-stored information:

1. Prevent the fire or inhibit its advance to serious proportions.
2. Shield the tape by surrounding it with something impervious to the fire and capable of keeping the transfer of heat to a level sufficiently low to avoid damage.
3. Arrange to always have the information where the fire is not.

Preventing or inhibiting the fire denotes the use of non-combustible building materials and interior furnishings, convenient access to fire-fighting equipment, and rigid adherence to fire-prevention rules. While these provisions are worthy and certainly should be mandatory for computer areas, there is always the chance that some deviation, such as the introduction of combustible material, might occur which could result in flash fires. At this point in our analysis we met the requirements generally but we were reminded of the times we had heard of fires in "fireproof" buildings.

Protection of tapes stored in an area where fire has advanced beyond the initial controllable stage involves the use of fireproof storage devices. Safe manufacturers have responded to the unique requirements for tape protection by developing a new kind of fireproof safe in which the possibility of steam damage has been remedied through the use of special internal linings. Some of the problems still remaining in connection with the use of safes for tape storage include the relatively high initial cost, a forfeit of operating convenience, and the necessity for constant enforcement to keep the doors closed.

remote location

Having the data where the fire is not is a solution undeniably appealing, but also possessed with certain obstacles. Granting the insurmountable difficulty in attempting to predict the scene of a fire, this approach indicates the storage of duplicate sets of information or back-ups in separate areas, based on the enormous odds against the probability of separate fires occurring simultaneously. Such a system entails making duplicates or saving the back-ups and setting up a procedure to select and transport tapes between areas on a regularly scheduled basis. It also promotes an increase in tape inventory, as well as a demand for additional floor space.

After carefully examining each of the three possibilities, we decided this last one was best suited to our conditions and desires. The problem of establishing a remote storage location could be solved simply by the installation of several tape storage units in the air-conditioned, humidity-controlled area of another computer room in a separate building approximately 500 yards distant—far enough away to be considered "remote" but near enough to permit easy transportation of tapes. Since the other computer organization was faced with a similar problem in tape security, we were able to promote a reciprocal arrangement whereby we would store some of their back-up tapes in return.

Delivery and pickup of tapes on a schedule could be assigned to our tape librarian, and since the route could be traversed without exposure to weather, because of a series of inter-connecting covered passageways, no special provisions would be required in the way of transporting equipment; a standard tape cart would do the job.

Before putting the plan into operation, some background work was necessary. Programmers and tape users were notified of the proposed system and requested to identify and briefly describe tapes which they felt should be included in this ultra-vital group. The list which resulted was reviewed and authorized. All instruction or program tapes designated were duplicated and the copies were stored in the remote area; the originals, of course, were returned to the main tape vault. The tape users were supplied with identification which would locate each tape, and were advised that upon request the librarian would produce the copy for revision if changes were to be made to the original.

the grandfather system

The handling of master-files which are updated at regular intervals (some daily) presented a somewhat more complex problem. The grandfather system already in use involved the retention of three sets of tapes for each application: the latest updated master file, the previous master file and the updating information, and the grandfather set which was used to produce it. Rotation of the three sets was effected so that the grandfather set became available for use as output tapes to receive the next updated file—which would then be the youngest set.

The purpose of the grandfather system is to provide a margin of safety through rerun capability in the event read failures are encountered with the current master file. With the new system, a fourth set has been added and the rotation scheme has been expanded to include these tapes which are stored in the remote area.

The three most recent generations are still retained in the original tape vault, while the great-grandfather set is stored in the remote area to be replaced at the next processing time by the grandfather and thus made available for the new output. It was found necessary to go to a four-generation plan to avoid the operating inconvenience which might arise from lack of sufficient back-up in the main computer-based vault to take care of occasional tape error troubles and other instances requiring master file reconstruction.

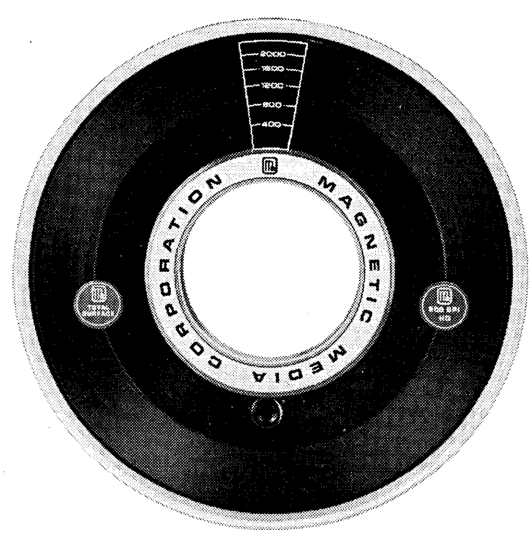
The system has been in operation nearly a year and it is working smoothly. Aside from the greater measure of security provided, some additional benefits have been noted. One of these is the longer life due to reduced usage of the tapes in those series which have been expanded to include a fourth set. This means that replacements with new tapes will occur less frequently. Also, the existence of the extra back-up sets has, upon occasion, proved to be an asset in certain debugging rerun situations. ■

Some compute tapes have majo d opout p oblems

You need a computer tape of the highest quality to prevent critical dropout problems. You need Micro Media 150 . . . designed to withstand the years ahead. Each reel is tested beyond the technical requirements of today's mass produced tapes. Where most tapes are certified at a 50% sensitivity level, Micro Media 150 goes beyond — it's certified at a far more critical 60% level.

Micro Media 150 is made to last longer by Magnetic Media Corporation where innovation is the key activity. Our every effort is carefully calculated to create a better product for you.

For today's requirements, nothing surpasses the quality of Micro Media 150. And for tomorrow, we offer Micro Media 25 . . . the tape that will hasten the development of cartridge loaded transports.



MAGNETIC MEDIA CORPORATION ▪ 616 Fayette Ave., Mamaroneck, N. Y. 10543 ▪ (914) 698-8660

CIRCLE 25 ON READER CARD

A MACHINE-AIDED DRAFTING SYSTEM

by HARVEY N. LERMAN

The problem of having to maintain and update many drawings of the same type, as well as reproduce them quickly without completely redrawing them manually, is a concern throughout the industry. The solution presented here is that of establishing a standardized symbology to describe the similarities between the drawings, and using these symbols and a digital computer to generate and/or maintain these drawings. The drawings are converted into digitized symbol sets organized into files, and these files are then processed into the appropriate commands to drive a mechanical plotter to recreate the required drawings in every drafting detail, including Leroy lettering. These drawings are maintained on an exception basis by using the updating capabilities of the system.

No matter what type of drawing is to be processed, it can be thought of as a particular arrangement of some predetermined building block symbols. In using MADS, the designer merely creates a library tape of these symbols, and then uses it to generate any drawing needed.

system background

The Apollo Support Department of the General Electric Company has been faced with a cyclic work load in its drafting section that is caused by the need to create a complete set of drawings for each launch vehicle. Early in 1964 a process automation techniques task force was set up; the efforts undertaken through it toward the mechanization of drafting have demonstrated the feasibility of this approach, and its potential as a solution to the problem has been recognized.

The initial phase of the study was that of solving the problem of producing panel assembly—engraved drawings and panel assembly—drilled drawings. A prototype software system using a CalComp 564 plotter that produced these drawings with a minimum of engineering inputs was developed.

Almost in parallel with this phase, a second software system was developed to produce the advanced electrical schematic drawings. A study was then made to determine the feasibility of combining the working elements of both these systems into a single system capable of creating many types of drawings.

The result of this investigation was MADS, a drafting system which uses an already existing drawing or a rough but highly organized sketch as its input source. The program system was to be designed so that a minimum of programming would be required to convert the output to drive any plotter. Because of the great number of drawings to be plotted and maintained, it was decided to procure several coordinate digitizers to facilitate the preparation of input. A plotter feasibility study indicated that a "souped up" Gerber 600 would best satisfy the given requirements of speed, size, accuracy and cost. A Gerber model 622 was ordered and delivery was made on December 1, 1965.

system philosophy

What must be pointed out and emphasized is that MADS is a drafting system and not a designing system. But it is operational, and eventually can be incorporated within a designing system as its drafting tool. To facilitate this, the input sections of the system were developed to be compatible with the changes that would be required by future developments. For instance, it appears that some day the digitizer will be replaced by a light pen. The output section of the system contains a plotter post-processor which can readily be changed to accommodate new output devices, such as on-line CRT's, for quick checks on drawing validity.

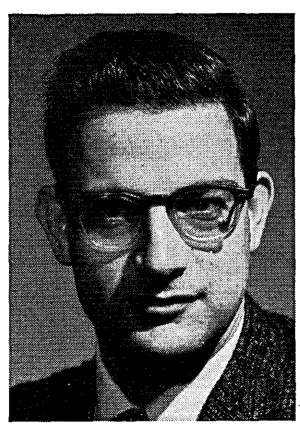
Instead of a complicated drafting language, a symbol language was developed for generating the library and for recreating the drawings. This language could be easily learned by anyone, even a non-programmer. In order to use the language, the group of drawings which is to be processed is broken down into a set of repetitive configurations called symbols, and these symbols grouped in a particular manner. The MADS symbols, then, are the backbone of the whole system.

mads symbols

There are two types of symbols in the system: "basics" and "composites." The main difference between the two is that basics are written in FORTRAN and become a permanent part of the system, while composites are designed and written by the user in MADS language as part of his system library. Basics, written by a programmer to optimize running time, are core contained, and thus limited in size and number. Composites, on the other hand, are tape contained, and thus their size and number are normally unlimited. The composite library normally is placed on a high-speed disc instead of tape to decrease running time.

It is a somewhat arbitrary choice whether a given symbol should be defined as a basic or a composite, but a good rule is: If the symbol is composed of basics and/or other composites, it is a composite. In practice, besides defining building blocks as basics, the standard drafting symbols for the set of drawings to be processed, along with their notation fields, are also defined as basics. Some sets of drawings make extensive use of lettering, so a basic notation capability is also built into the system.

Each symbol is given a unique "name" for identification. This name presently is a four-digit number, with the low numbers representing basics and the higher numbers



Mr. Lerman is a senior engineering programmer specializing in design automation techniques and applications for GE's Apollo Support Department at Daytona Beach, Fla. He was formerly a computer engineer for ALCO Products, Inc., and holds a BS in mathematics from Trinity College, Hartford, Conn.

used for composites. The number 1000 is taken as a convenient break point. Since there usually are many more numbers available than symbols defined, the number can be partitioned by the user and conveniently used by symbol type (Fig. 1).

basics

When a symbol is defined, a point within it is defined as its reference point (referred to as P_0). This point determines the location of the symbol on the drawing. At times the length or size of symbol varies with usage; one or more variable points can be defined to accomplish this.

Examples of basic building blocks are: symbol 0900, a solid line, and symbol 0901, a dashed line. These symbols use straight lines to connect the points in the order given, and any number of points can be given. Other examples are: arcs, circles, rectangles, etc. These symbols are building blocks for most sets of drawings, and so were defined in MADS as basics.

notation

MADS contains a notation capability which allows single- and multi-line Leroy lettering at any angle or size. Leroy lettering was used because lettering of that detail was necessary in the project. Besides being able to vary lettering size and angle, the user can define notation areas as being aligned at any edge or corner, and centered at any point.

The lettering library (Fig. 2) presently contains Roman letters (upper and lower case), Roman and Arabic numerals, and Greek lower case letters, as well as special symbols such as asterisk, comma, ampersand, etc. The system also contains a superscript and subscript capability, and the ability to underline letters automatically.

Before the remaining MADS library symbols are defined, a study is made of the drawings which are to be processed, in order to determine what these symbols are to be. Some of the types of drawings which have been created by MADS are shown in Fig. 3. A set of electrical schematics will be used as an example in this article, a plotter-created sample being Fig. 4 *(p. 52)*. The remaining symbols for the library are then defined possessing the characteristics needed to produce the required schematic drawings. Examples of basic drafting symbols are shown in Fig. 5 *(p. 52)* These are all defined with a reference point, and with or without variable points. Notation areas can also be defined with a symbol. For instance, the Z-areas associated with the relay contacts represents a multi-line area with notation aligned left and centered at a fixed point. When the symbols are used, these areas can be filled in with any notation desired, or can even be left blank.

Fig. 1

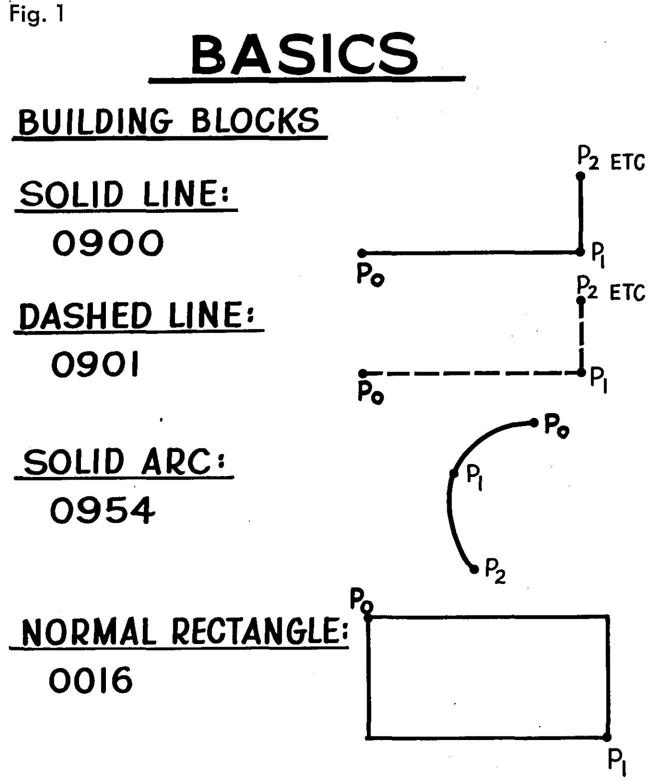


Fig. 2

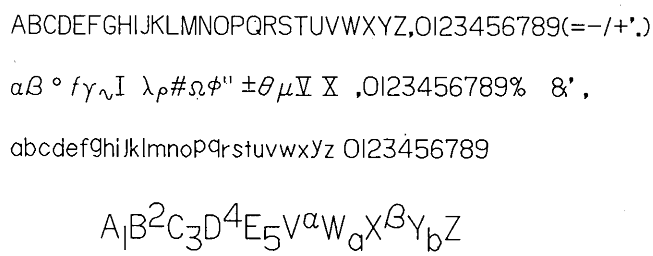
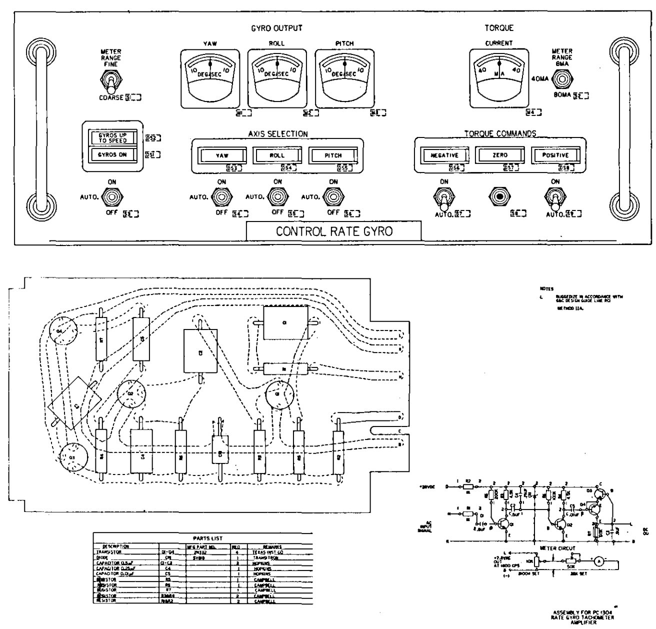


Fig. 3



composites

The language developed for the composing of composites serves two main functions: point definition and symbol placement.

Three methods are provided for point definition:

1. Constant distance from other point(s)
2. Constant ratio between other points
3. At a constant angle to other points

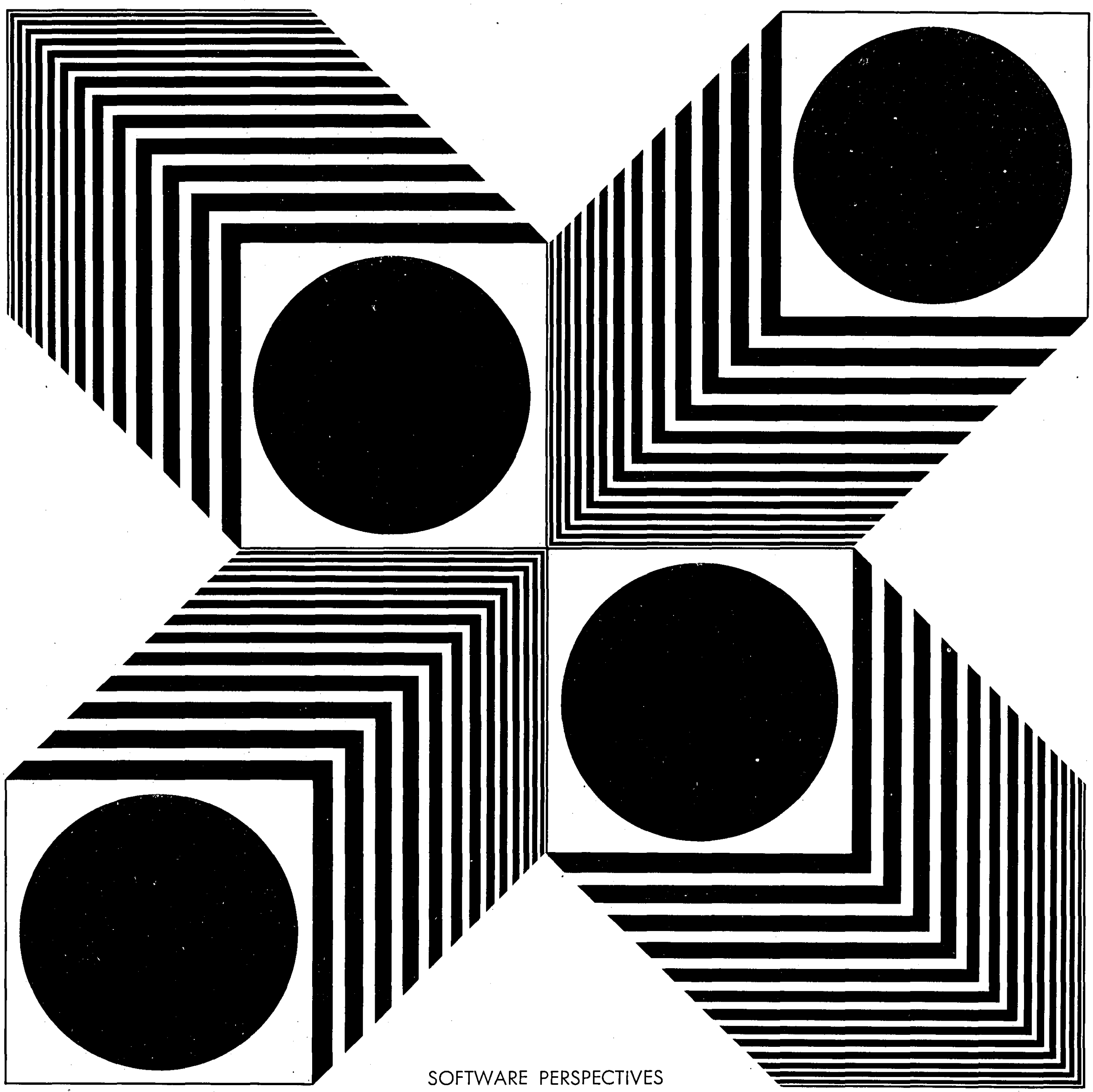
Each point must be defined as a function of the composite's reference point, variable points, or previously defined points. Once all points have been defined, the symbol placement section is used to position the desired symbols (basics or lower numbered composites) at the defined points. If desired, some of a symbol's standard notation areas can be deleted, and new notation areas defined within the composite Fig. 6 *(p. 52)*. An example of a composite is symbol 3160, a lamp circuit containing a constant configuration of the other symbols: bus, indicator lamp, line and a terminal connector. The composite is defined as having a reference point, P_0 and one variable

LOSING CONTROL?

You say your cat cracker is making rock and roll? Or the new hot strip mill that just went on computer control is turning out miniskirts? The control program that was developed for you by a little software outfit in the garage behind your brother-in-law's house didn't include any real-time monitors? The processors are recursive, but there's no dynamic storage? The job-shop programmer who was supposed to straighten out the mess doesn't know foreground from background and keeps taking trips without even leaving the computer room? And all those direct dollar benefits you told the president the control system would yield have just been deducted from your salary? No need to lose control of both your process *and* yourself, call IDC. What's an IDC? Well, let's close the loop on that query right now.

IDC is a company that knows what goes with control programs. From an *exact* specification . . . through real-time compilers, monitors and assemblers . . . and on to system updating programs . . . IDC can and does do. If your problem is in closed-loop batch or continuous processing, or any other real-time area where a computer is now, or will be, in control of a process, IDC's totally integrated software capabilities are your answer. IDC's uncommon ability to supply a complete package will guarantee you a process unit that performs consistently with predictable uniformity in quality, quantity, cost, and profit. So why not talk to us during the design of your process control system? After all, some of *our* best customers are the people from whom you'll probably be buying *your* computer. For an improved perspective on your process control problem, contact IDC now. 1621 E. 17th St., Santa Ana, Calif. Phone (714) 547-8861

INFORMATION DEVELOPMENT COMPANY



SOFTWARE PERSPECTIVES

CIRCLE 26 ON READER CARD

point, P1, to determine the height of the composite. The dependent points (2 through 5) are defined as being fixed distances from the reference point. The bus, basic 0070, is placed at the variable point, with its built-in connection line drawn to point 5. The indicator lamp composite, symbol 1160, is positioned at point 4, and a solid line, basic 0900, is used to connect points 3 and 4. If this line had been previously defined as being part of symbol 1160, it would not have to be included here. The terminal connector composite, symbol 2032, is positioned at the reference point, with its height defined by point 2. In other words, point 2 is defined as the variable point for symbol 2032 in this definition.

In this composite all the symbols except the bus are always placed at the positions shown here relative to the reference point. The variable point is used to give the position of the bus, and so defines the composite's height. If points 2 and 4 were defined as ratio points between points P_0 and P_1, the position of all the symbols would vary with the variable point, also.

All the notation areas within this symbol have been defined as being part of the symbols composing it, so no new notation areas are defined. But note that two of the notation areas normally associated with a bus are never used in this composite. This is accomplished by dropping these two areas when the bus is used in the above composition. The notation areas are lettered to show the order of notation entry for the composite. Note the numbers 1, 2, and 3 around the indicator lamp. These were defined within symbol 1160 as being fixed notation, and so never have to be entered in the input.

A symbol handbook is then compiled containing a drawing of all the library symbols which may be used. Each drawing shows the location of the symbol's reference point, its variable points, and its notation areas. The symbols are maintained in the handbook in numerical order, and are updated whenever there is a change in the symbol library. This completes the generation of the MADS library and the system is ready to be used for the creation of production drawings.

A section of a typical schematic is shown in Fig. 7 *(p. 54)*. It was conditioned by marking the symbol numbers and defining points of each symbol used as shown in the handbook. The digitizer produces a drawing deck for the schematic, one punched card for each symbol. Each card contains the symbol's number, the X-Y position of its reference point with respect to the lower left hand corner of the drawing, the coordinates of any variable points, and finally the notation associated with the symbol. Continuation cards can be used if the information does not all fit on a single card. The order of these data cards is unimportant as the plot commands are sorted to optimize the actual plotting. Asterisks and commas are used as delimiters; dollar signs are used to denote special characters and apostrophes are used for the underlining of notation.

drawing process

The drawing process in use at ASD is described in the following paragraph. The incoming drawings are logged

Fig. 4

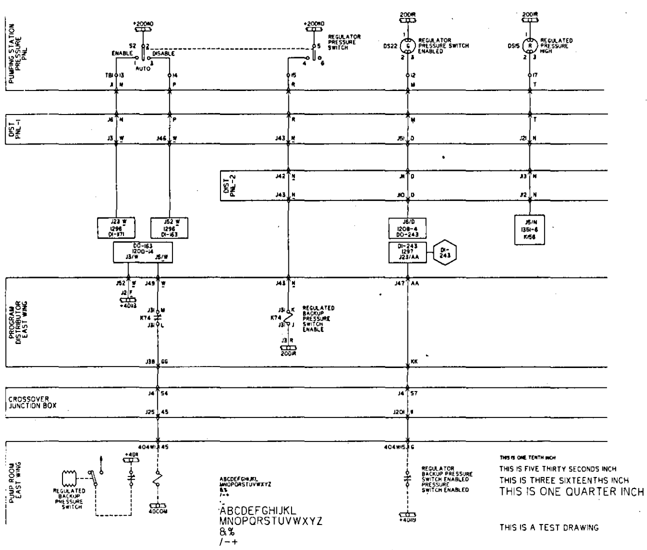


Fig. 5

STANDARD DRAFTING SYMBOLS
(NOTATION AREAS)

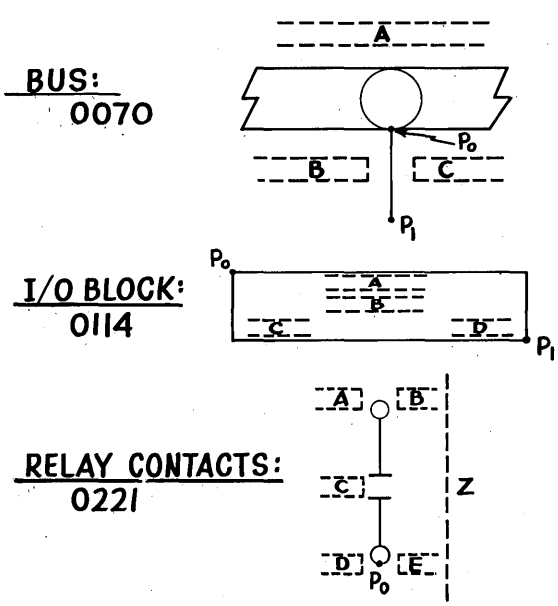
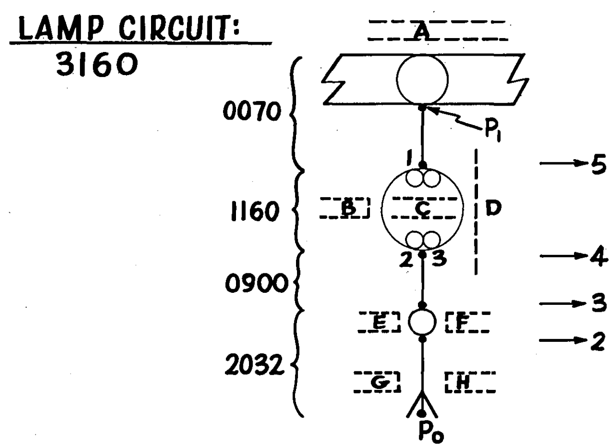


Fig. 6

REPETITIVE CONFIGURATIONS



1. DEPENDENT PTS: 2,3,4,5 ARE DEFINED CONSTANT DISTANCE FROM P_0
2. SYMBOLS ARE USED WITH POSSIBLE REDEFINITION OF NOTATION AREAS
3. NEW NOTATION AREAS CAN BE DEFINED

25%

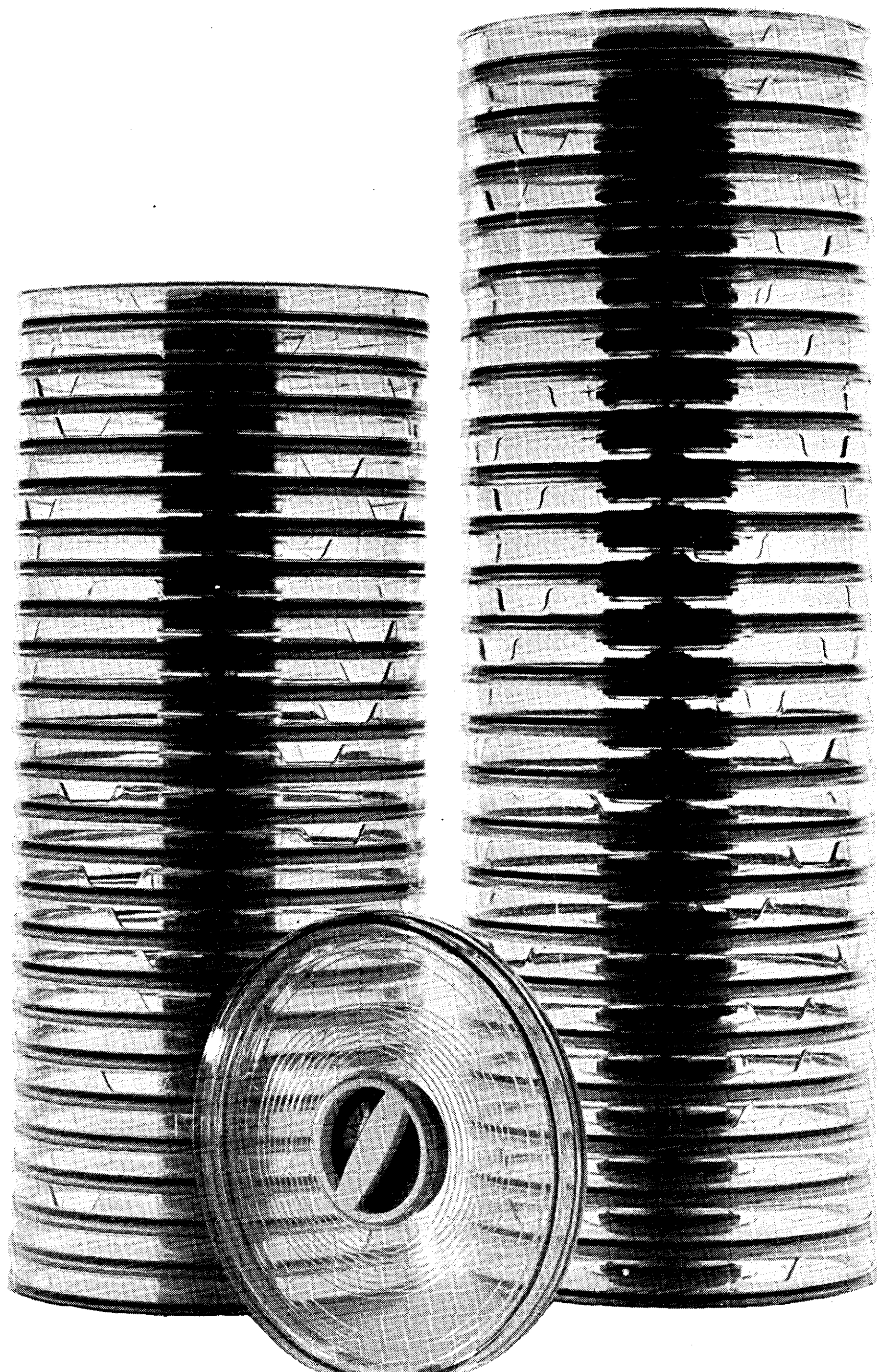
The new Data Packaging *Slim Case* makes your storage shelf go further. 5 now fit where 4 did before.

That's a lot of shelf to save. For a big tape user it could mean saving a new wing, or even a whole building.

The best tape storage case in the industry is now slimmer. Five-sixteenths of an inch slimmer. 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 slimmer 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 Case.* Tell him you need the space.



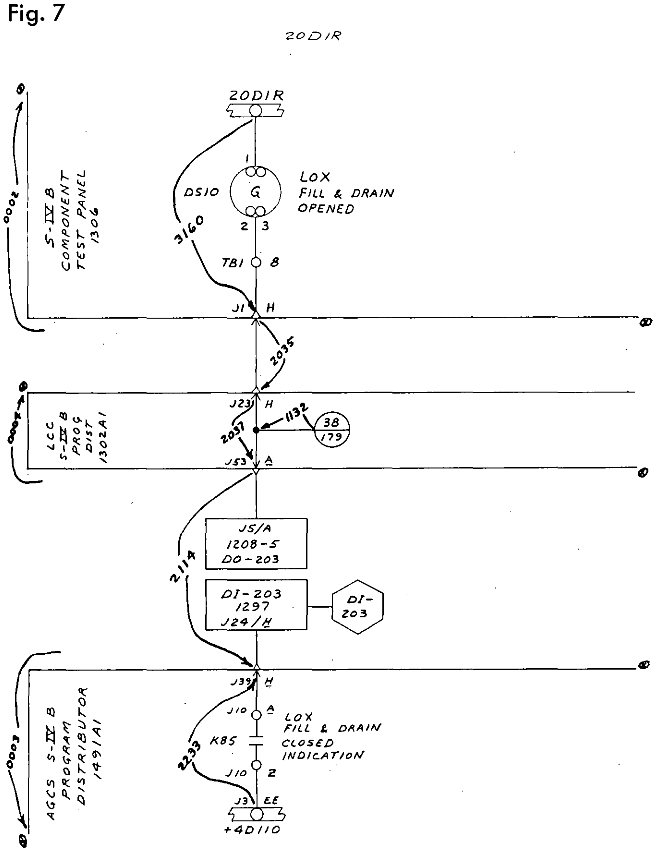
Data Packaging Cases and Reels

205 Broadway, Cambridge, Massachusetts

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

in and checked by a draftsman who also makes any initial redrawing required. Then a conditioner "marks up" or "red-lines" the drawings for ease of digitizing. The present digitizing operation is set up with a team of two people, one operating the digitizer picking up the X-Y location of the symbols with a cross hair cursor, activating the key punch to record this information, and the keypunch

Fig. 7



operator punching in the remaining input data from the conditioned drawing as called out by the digitizer operator.

After the drawings have been digitized, they are filed for future reference and the drawing deck is processed through the preprocessor program, which identifies data errors. This preprocessor listing is returned to drafting for correction by checking against the corresponding conditioned, red-lined drawings. The correction and/or change cards are keypunched and updated to the corresponding drawing files by the preprocessor program. The corrected drawing files are then processed by the program system which consists of a compiler, a sort-smooth program and the plotter command generator, which contains the plotter post-processor. The produced plot command tape is taken to drafting to produce a check plot on the production plotter. This check plot is compared with the conditioned red-lined drawing for errors. If any are found, change cards are keypunched, the drawing file updated, and a new plot tape produced. The final plot tape is then used to produce a drawing on Mylar film which, when approved, is sent to reproduction and distribution.

Cost of these operations is comparable to costs of a totally manual operation.

system programs

MADS consists of five programs:

1. A program that generates the drafting symbol library
2. A preprocessor that checks the drawing data for errors
3. A program that interprets the input drawing data
4. A program that sorts this data
5. A program that produces the appropriate commands for the plotter being used

system functional flow diagram

The drawing data decks for all the plots are batched and read by the preprocessor program, which checks each deck for errors. The primary checks in this program are for validity in symbol number, number of points for given symbol, number of notation areas for given symbol, and for format errors.

A tape file is generated for each drawing deck and a listing is produced, noting the cards in error and also giving a summary of these errors. Under user option the program can then make a "run decision" which "chains" the error free decks to the symbol compiler program.

The symbol compiler program uses the pregenerated composite library-tape to decompose all composites into basics and notation and then produces an unsorted basic symbol tape. This program also has provisions for using a drawing scale factor. If the user had requested his data to be sorted and smoothed, a third link is used to accomplish this. This sort-smooth program sorts for minimum pen-up time and arranges all symbols so that they can be connected by rectilinear lines. In this manner, any errors introduced by poor digitizing techniques are removed. The sorted tape is then passed on to the plotter command generator, which contains the basic subroutines and the plotter post-processor needed to produce the required plot tape. Post-processors used at the present time are those for the Gerber and Calcomp plotters.

If it is desired to correct or change an existing drawing file, the update by exception option of the preprocessor program can be exercised. Three tapes are then produced.

1. A tape containing only the "changes"
2. A tape containing what "was" changed
3. The updated drawing tape

The "change" and "was" files are used to produce a change document, and also can be plotted to show what had been changed.

The updated drawing tape can be linked through a plot, or could just be merged with the other original drawing files to produce a new master tape.

summary

The following steps were followed in the implementation of MADS:

1. In 1964 a process automation techniques task force was set up with three people assigned to hardware investigation, and three people assigned to a software study.
2. Early in 1965, four programmers wrote two initial software systems.
3. These systems led to MADS, which was programmed by three programmers during the last half of 1965.
4. The hardware system was delivered in December of 1965 and was "on the air" shortly afterwards.
5. One week on-the-job training was all that was needed before the system was in use.
6. The system presently is used two shifts a day, and produces about 100 good drawings a week, once the composite library tape has been generated.

The system was developed to be the drafting portion of an ultimate design automation system. The MADS phase was developed first because it was thought to be a logical first step towards the ultimate goal and because it provides a working tool long before the full system can be developed. ■

“Not <u>another</u> rush job! Sometimes I think I should be a magician— not a DP manager.”

Better still, you should have a Burroughs 500 System . . . whose powerful Master Control Program would juggle priorities, schedule that rush job, and get it *multi*-processed immediately, along with the rest of the work in progress.

Long-term changes? Just as simple. Many jobs, for instance, can be added to a Burroughs 500 System which seems—by “one-job-at-a-time” standards—to be fully loaded. And when a larger configuration *is* finally required, the MCP *automatically* adjusts your work to take full advantage of the added memory, I/O, or peripheral resources.

With a responsive Burroughs 500 System scheduling its own work, maintaining data and program libraries, and achieving full utilization through automatic self-management, you’re free to concentrate on other important responsibilities. On managing people, for instance. Or perfecting your own brand of responsiveness: to your company’s constantly changing pattern of information needs.

So if you sometimes get the feeling you should be a magician instead of a DP Manager, remember: there’s a better way than “Presto.” It’s the new breed of self-managing computers—Burroughs 500 Systems. Write us at Detroit, Michigan 48232.

Burroughs Corporation

CIRCLE 32 ON READER CARD

Find out how good a magnetic computer tape can be!

Graham Magnetics announces its new 3200 FCI/1600 BPI magnetic computer tape. It is totally certified to be error free with an order of magnitude increase in durability. The same unexcelled quality is available in all bit densities for 7 and 9 channel systems. To find out how really good a magnetic computer tape can be, call or write the GMI Sales Office nearest you, or contact us direct.

GRAHAM MAGNETICS INCORPORATED
Graham, Texas 76046 Telephone 817-549-3211

*Manufacturers of **Zero Defects** Magnetic Computer Tape*

CIRCLE 29 ON READER CARD

CONVERSATION WITH A COMPUTER

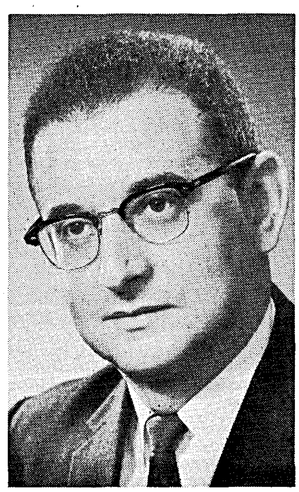
who is this *really*?

by LESLIE MEZEI

The following recording, obtained by the forward time-scan recording process, brings us a session held in 1985 between a computer scientist and a computer.*

Computer York University Computer 2X5W6—Ready.
Professor What time is it?
Computer It is 8:30 p.m. Thursday, December 5, 1985.
Professor I think I would like to start with some music today. Let's have some chamber music.
Computer You listen to Telemann most.
Professor No, something earlier.
Computer What about the Orlando Gibbons Fantasia for three recorders? You haven't listened to that since last spring.
Professor All right.
Computer (Plays the Fantasia).
Professor I will practise this piece today. Tomorrow you will play only two parts and I will play the soprano part on my recorder. Please print that part of the score for me.
Computer Will do, and I will remind you tomorrow if you like.
Professor Good. Before we go on, I heard a new word on the news today. What does "gormandize" mean?
Computer "Gormandize" means to eat voraciously. It is derived from gourmand, which means "glutton," or is sometimes used in the meaning "lover of fine food."
Professor Is that the same as a "gourmet?"
Computer "Gourmet" is used only in the meliorative sense of a lover of good eating.
Professor Thank you. Now you could give me a couple of palindromes to amuse my friends with tonight.
Computer Madam, I'm Adam.
Professor That's old hat. Give me another one.
Computer Lewd did I live, evil I did dwel.
Professor Good. We must make up some new ones soon.

*Although I take full responsibility for the above conversation, I would like to thank Professor Michael Kay for supplying the language lesson.



Associate professor of computer science at the Univ. of Toronto, Mr. Mezei was formerly with York Univ. where he was director of computer science programs. He received his BS in mathematics and physics from McGill Univ., MA in physics (meteorology) from the Univ. of Toronto, and is a fellow of the Canadian Institute of Actuaries.

We'd better get on to my language session. What were we working on?

Computer Remember, you are going to give a speech in Chinese next month.

Professor Oh yes, have we completed the speech yet?

Computer Yes, but you still had some problems pronouncing some of the words. Also, your comprehension isn't good enough yet to answer questions.

Professor OK. What did I mispronounce?

Computer Well, you might try to get the name of the country right. After me, and watch the display screen for the intonation pattern. jūng hwá rén mín gūng hé gwó.

Professor jūng hwá rén mín gūng hé gwó.

Computer Pay attention to the display, and try to make your display match mine. Pay attention to the tones. They're all high-level or high-rising. Again: jūng hwá rén mín gūng hé gwó.

Professor jūng hwá

Computer No. jūng hwá

Professor jūng hwá

Computer Good!

Professor jūng hwá—I've had enough of that for today. Let's do a bit of math.

Computer No, if you don't mind, we haven't finished the language drill yet.

Professor I don't feel like it now. Let's do it tomorrow. By the way, tell me something about their customs.

Computer It seems probable that your chopstick technique could use some review. They still use them you know. Perhaps you can practice on the way over in the rocket.

Professor Fine. I have to prepare a lecture on early efforts at machine translation of languages. Give me some jokes on the subject.

Computer What about the way "hydraulic ram" was translated by a primitive computer as "water buffalo?"

Professor Not bad. But only engineers will appreciate it. Another one, please.

Computer What about the translation of "out of sight, out of mind" as "invisible idiot"?

Professor Good. Which do you like better?

Computer You know I do not have likes and dislikes.

Professor Sorry. I forget at times that I am talking to a computer. Give me some ratings on them.

Computer Water buffalo 50%, invisible idiot 75%.

Professor I guess if I can get 75% of the people laughing that's pretty good. The water buffalo reminds me of this morning's news story about a sea monster sighted off the Atlantic coast. Can you check on it please?

Computer I will check with the Library of Congress Computer.

(pause)

Sorry for the delay. I had to connect with the Woods Hole Observatory computer. They checked out the story there this morning and they think someone just saw a mirage. I have a full list of sea monster sightings here if you want it.

Professor Not now, thank you. Probably just another news-hungry dunderhead made it up.

Computer What is a dunderhead?

Professor A person who is not very smart.

Computer Shall I place it in your personal vocabulary file?

Professor No, place it in the general list; it was quite a common term at one time.

(pause)

Computer If I may remind you, we haven't done any mathematics yet.

Professor Oh, yes. Thank you. Here is a puzzle one of my students tried to catch me on.

Three men were charged \$10 each at a hotel. When they complained that they were overcharged the clerk gave five \$1 bills to the bell hop to return to them. The boy put \$2 in his pocket and gave them each \$1 back. The price of each room is \$9 this way. Three times \$9 is \$27, plus the bell hop's \$2 makes a total of \$29. Since the men had originally paid out \$30, what happened to the other dollar?

Computer I don't know what form of mathematics to apply to this, but before you suggest the line of approach, I will do some accounting, since we are talking about money.

Amount paid out 3 x \$10 = \$30.

Final disposition of money: hotel clerk \$25.
bell hop \$2
returned to men 3 x \$1 = \$3
total \$30.

Income and outgo balance.

Professor Of course. That is the answer. It just depends on how you put it. Now I shall need some examples of perfect numbers.

Computer I did not catch the second last word.

Professor PERFECT NUMBERS.

Computer Thank you. How many would you like?

Professor All of them up to 1 million.

Computer 6, 28, 496, 8128

Professor Only four, eh? What are the divisors of 8128? I will use it as an example.

Computer 1, 2, 4, 8, 16, . . .

Professor (interrupts) Never mind. Just print them out. Check that the divisors add up to the number itself.

Computer They do.

Professor You sound almost hurt that I want you to check your own work. Now let us make up a sketch to demonstrate the use of mathematics in art. Draw the network formed by a hexagonal number of rank seven on the display screen please. Yes, that's right.

How many points are there on it?

Computer 91.

Professor Now that is the same as the pentagonal number of rank 7 plus what?

Computer The pentagonal number of rank 7 has 70 points, add to it the triangular number of rank 6 which has 21 points.

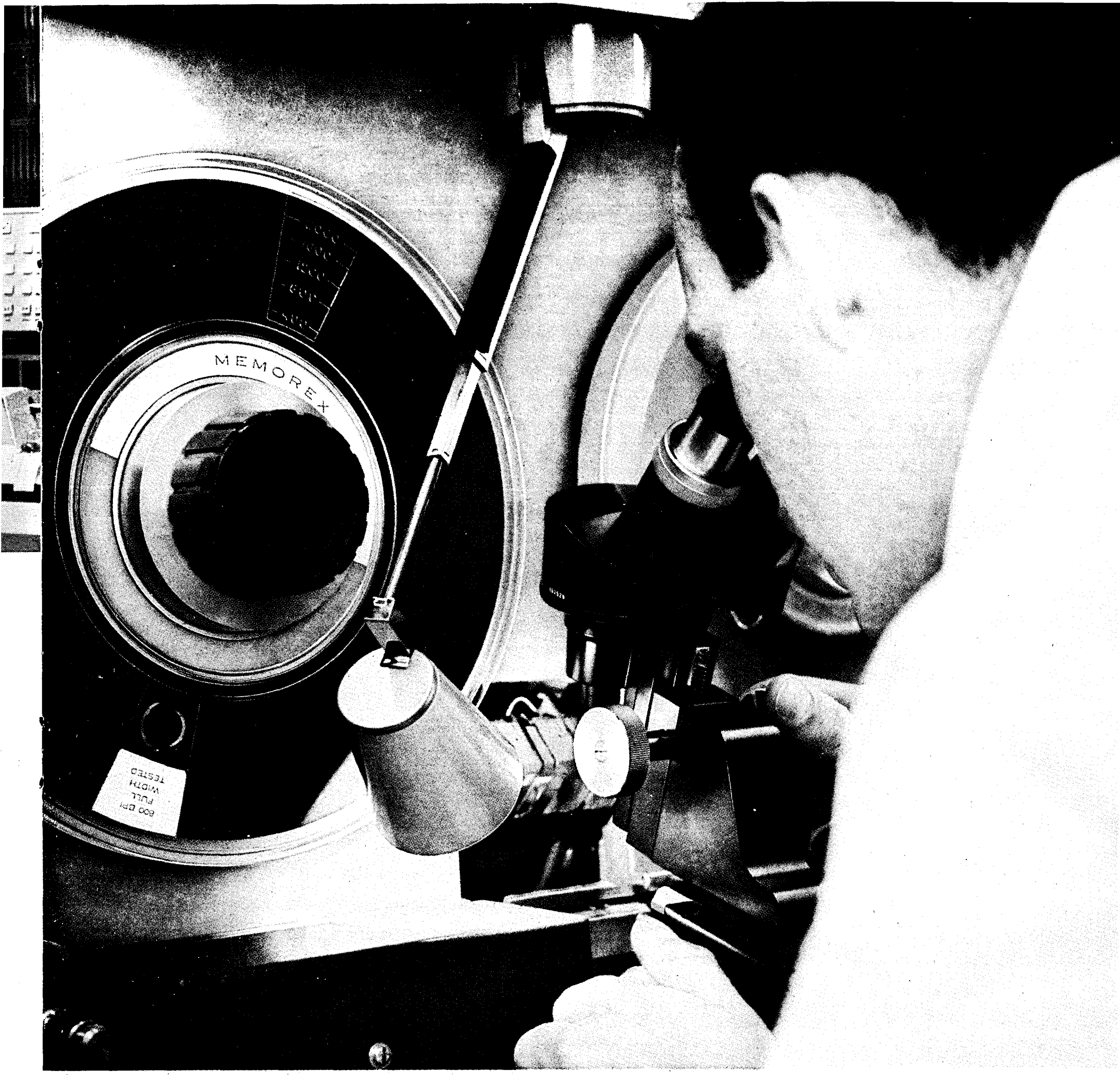
Professor Good. Now I will move them around like this. Now give me three more copies of the triangular number, please.

Good.

Now add a small circle here, and frame the whole in a large octagon. That's right. Now distort all of it, but only slightly, using random numbers. No, that's too much. Yes, that's it. Now you can print 25 copies of that.

I am afraid that is all the time I have today. Let's have just a bit more music before I go. Pick anything at random, but something modern.

(music) ■



Take it from Jack Hatcher:
"MRX-III computer tape is 3 to 5 times more durable than the leading competitor's"

And Jack wasn't easy to convince. He didn't care how well the tape performed in its more than six months of pilot line and laboratory testing. He wasn't impressed by the fact that 718,000 shuttle passes didn't even begin to scratch the tape. He merely shrugged at the favorable reports from the more than fifty installations where exhaustive field-testing was performed. He just said, "Well, we'll see."

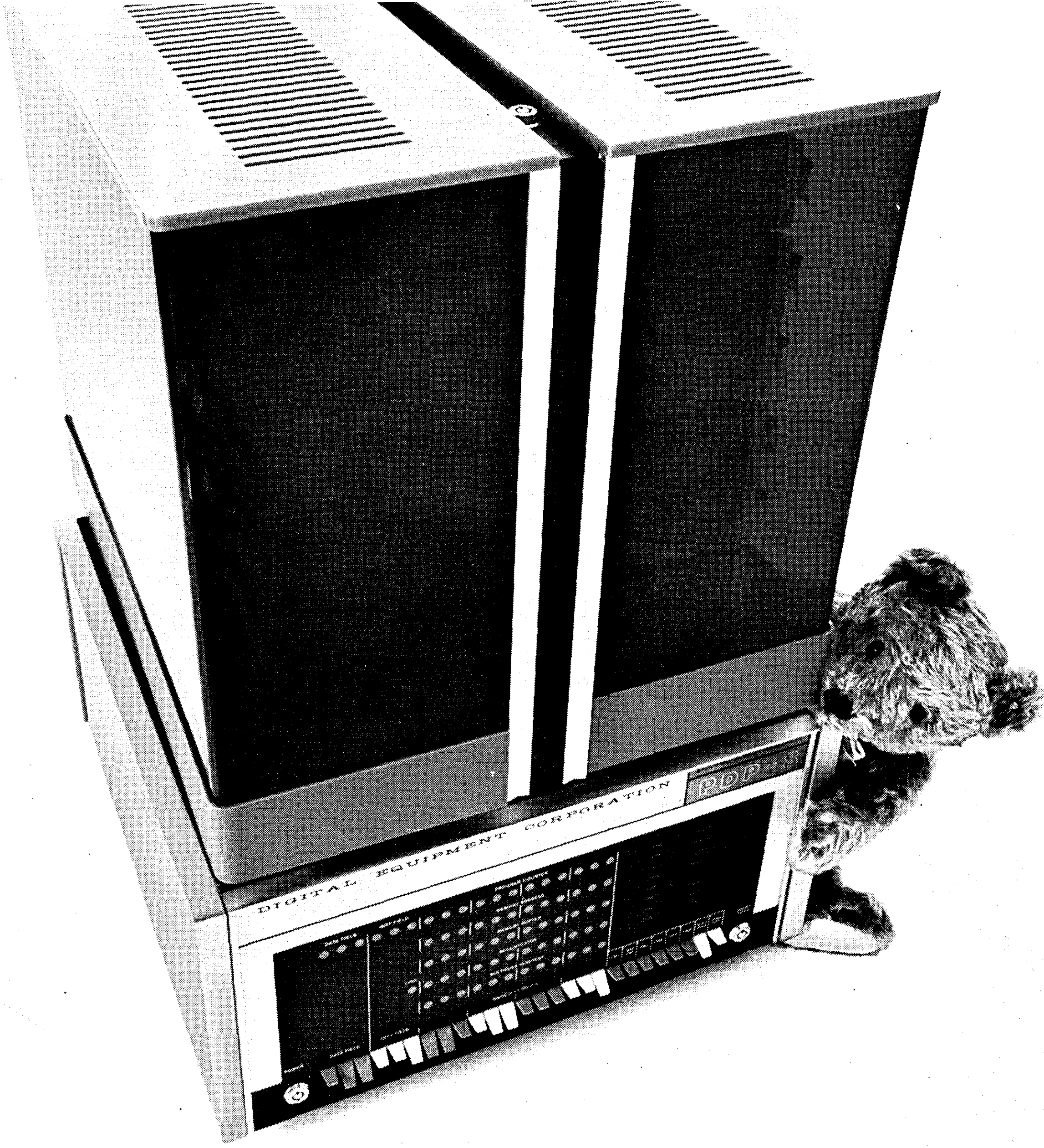
That's Jack's job, as an engineer in our product evaluation lab, to see for himself how each new Memorex tape measures up. He's paid to break it down, if he can, subjecting it to any and every kind of use and abuse to which a computer tape could possibly be exposed. But on MRX-III, Jack broke his pick.

Now *you* test it. For a sample of MRX-III (on its new color-coded reel), write us at Santa Clara, Calif.

CIRCLE 30 ON READER CARD

MEMOREX
Precision Magnetic Products

Memorex Branch Offices in Boston, New York, Philadelphia, Washington, Atlanta, Orlando, Dayton, Chicago, Detroit, St. Louis, Dallas, Denver, Los Angeles, San Francisco, Honolulu. Offices and Affiliates in London, Cologne, and Paris. Distributors in Japan, Canada, India, Australia, and New Zealand.



"Can I make the computer do the job?"

When buying a computer, the most important question a scientist asks is: "Can I get it to do the job?"

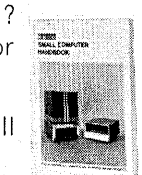
In physics, in chemistry, in life and earth sciences, there have been more than 500 yesses for the PDP-8.

More yesses than for any other real-time, on-line, general purpose computer for science.

That should give you confidence. More than 500 other scientists have written programs that work. The potentialities (and limitations) of the PDP-8 have been exhaustively explored. There is an active and interested community of investigators ready to exchange information, techniques, even programs.

This makes PDP-8 the most immediately approachable computer you can buy.

Here are some other important questions — and answers: Q: How much? A: $18,000 complete. Q: When available? A: 30 to 90 days. Q: How much speed? A: 1.5 μsec. Q: How much memory? A: 4096 12 bit words. Q: Do I get a bear for added security? A: Only if requested.



Send for your copy of our 540 page Small Computer Handbook and Primer. Free.

digital
COMPUTERS · MODULES

DIGITAL EQUIPMENT CORPORATION, Maynard, Massachusetts 01754. Telephone: (617) 897-8821 • Cambridge, Mass. • New Haven • Washington, D. C. • Parsippany, N. J. • Rochester, N. Y. • Philadelphia • Huntsville • Pittsburgh • Chicago • Denver • Ann Arbor • Houston • Los Angeles • Palo Alto • Seattle • Carleton Place and Toronto, Ont. • Reading, England • Paris, France • Munich and Cologne, Germany • Sydney and West Perth, Australia • Modules distributed also through Allied Radio

CIRCLE 31 ON READER CARD

Multigraph® helps Ohio Bell beat the changing numbers game.

Changed numbers. Disconnected numbers. Cancelled numbers.

Ohio Bell handles 2200 of them every day in the Greater Cleveland area.

And overnight they have to be distributed to intercept operators.

Now, Multigraph isn't the only way to handle this job. Ohio Bell just chose us because our system could do it at lower cost.

Working with Ohio Bell systems engineers, we recommended and installed the Photo Direct Master system. It records the changed numbers as they come off the computer. Copies are duplicated and distributed to intercept operators before the next day breaks.

The savings from this system over the previous one are substantial. And as a bonus, the Multigraph equipment is used on other projects during the day.

Ohio Bell wins coming and going. We bet you can, too. Just call your Multigraph man. Or write Addressograph Multigraph Corporation, Department T-6626, 1200 Babbitt Road, Cleveland, Ohio 44117. No matter what your game is.

MULTIGRAPH division of AM CORPORATION
... helping people communicate

CIRCLE 28 ON READER CARD

THE SDS SIGMA 5

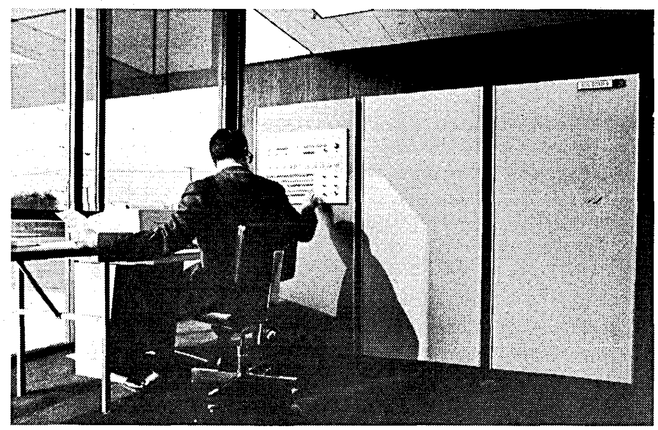
Disappointing speculators who said there would be five mainframes in the line, Scientific Data Systems this month announced the Sigma 5—which, they said, "completes the introduction of third generation equipment." This third processor fits between Sigma 7—a 32-bit machine with which the new 5 is fully compatible—and the Sigma 2, a smaller 16-bit computer that is only data- and I/O-compatible with the 5.

The 32-bit Sigma 5 is the same speed as the 7 except in certain instructions, but lacks the hardware (and software) for conversational time-sharing. It has fewer major instructions (93), no mapping feature, and only half (256) the general registers of the 7. But there is still concurrency: it can simultaneously compute, handle multiple real-time control functions, and process a number of I/O operations. Up to 224 interrupt levels are available.

As with its sibling rivals, the Sigma 5 is intended for both scientific and business computing, the latter being only ancillary to the engineering type throughput. A 12K configuration is considered typical for the average scientific environment, 16K for COBOL users. There are other dual-purpose machines in the marketplace, of course. Competitive units to the Sigma 5 include the 360/50 and 44, CDC 3200 and 3300, the GE 400 series, and the newly-announced PDP-10, which replaced and is compatible with the PDP-6. All of these processors have been running about a year or more.

In contrast, the first Sigma 7's were delivered last month, both for nuclear research activities, to Brookhaven National Laboratory and Michigan State Univ.

Memory cycle time of the Sigma 5 is 850 nanoseconds, reducible to 600 nsec through overlapping. Memory size is 4K to 131K (32-bit) words. All of memory is addressable directly or indirectly in bytes, half-words, words or double-words. Up to eight I/O processors, each with capacity for 32 channels, can be provided. The basic system has eight I/O channels and 16 general registers.

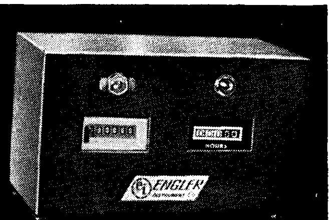


Software is the same as for the Sigma 7 with the exception, as noted, of conversational t-s features.

The basic Sigma 5, with 4K words and keyboard printer, is priced at $90K (rental: $2,500). And the price runs up to about $500K ($10K/month). Delivery is scheduled to begin in August '67.

CIRCLE 170 ON READER CARD

NOW...
REGISTER
OR RECORD
ACTUAL
PRODUCTION TIME OF DATA
PROCESSING MACHINES...



(MODEL 1TC)*

Registering and recording instruments ideal for establishing TRUE *rental* charges, interdepartmental charges, machine productivity.
8 models available for such applications as card punching, data converting, verifying, sorting, collating, accounting, and statistical accumulation. Engler meters accurately separate machine time from the set-up and handling time. Prices start as low as $23.00. Easily installed.

Engler... originators of meters for recording time on tabulating machines.
*Model #1TC shows stroke or card count as well as running time.

WRITE OR CALL TODAY FOR COMPLETE DETAILS.

engler instrument co.
250 Culver Avenue
Jersey City, New Jersey (201) 332-5353

CIRCLE 33 ON READER CARD

PROGRAMMERS AND SYSTEMS ANALYSTS
Immediate Openings

PHILCO Ford

AERONUTRONIC DIVISION

Aeronutronic, located 40 miles south of Los Angeles in smog-free Newport Beach, California, has immediate openings for programmers and systems analysts. Rapid growth at Aeronutronic has created many openings in our commercial data processing group. A mounting backlog of work is coupled with our scheduled installation of new third-generation computers early in 1967. Openings require 1 to 5 years experience in large-scale business programming. COBOL and disk experience would be helpful. Degree preferred.

Qualified applicants are invited to submit their resumes to:
Mr. G. E. Gerner, Professional Placement Coordinator
Aeronutronic Division
Philco-Ford Corporation
Ford Road, Newport Beach, California 92663
Dept. DA-1

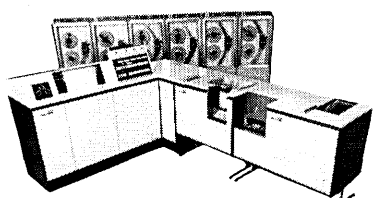
PHILCO Ford

An equal opportunity employer for men and women

CIRCLE 345 ON READER CARD

Interlinking Computer 9300.

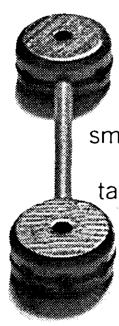
Now you get a high-speed tape or card system with a plated-wire memory.

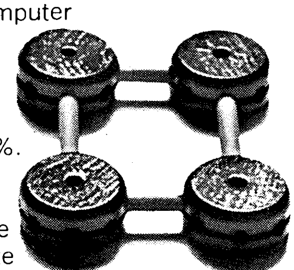


The Univac® 9300 is the second unit in a series of interlinking computers.

(You know: you start with any one, and simply build on it as your computer needs grow.)

The Univac 9300 brings you from punched cards to magnetic tape data processing in one small inexpensive step. It's the first high-speed tape system the small computer user can afford.





It can read, write, and compute at the same time.

It can run one or two peripheral tape programs and the main program at the same time.

It gives you reliability, efficiency, and a time saving of up to 50%. And far faster management control. Plus the opportunity to grow smoothly, without disturbing your business in the process.

The Univac 9300 is powerful. Operations can start with three tape drives, and can be expanded to sixteen. Its effective read or write tape speed is 34,160 characters per second. This can be doubled by adding another control unit.

But the Univac 9300 does more. It brings you complete Univac software support: Tape assembler. Sort/merge. Report Program Generator. FORTRAN. COBOL. Control Stream Operations for unscheduled batch processing. Et cetera.

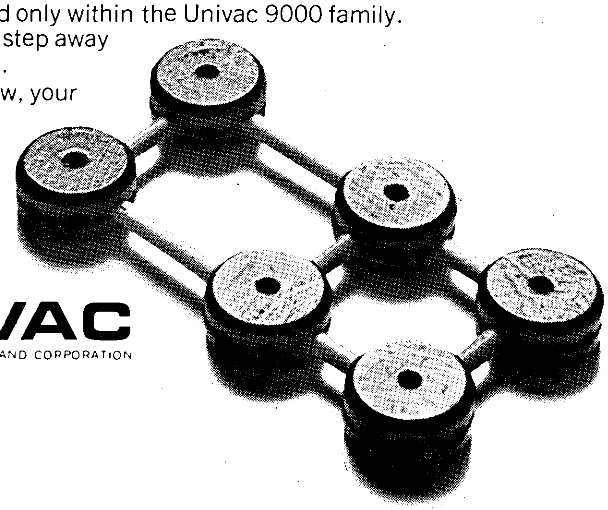
How can it do so much? Part of the answer is a remarkable wire memory that only Univac has—and that you'll find only within the Univac 9000 family.

The Univac 9300 is just a small step away from the next higher model in the series.

So that when you're ready to grow, your computer capability will be, too.

Need more information, call us.

Please.



UNIVAC

DIVISION OF SPERRY RAND CORPORATION

CIRCLE 35 ON READER CARD

FOR 3M CIRCLE 36 ON READER CARD→

NEW FROM 3M!

"Scotch" Brand No.777 Computer Tape offers you the ultimate in long-range reliability and economy

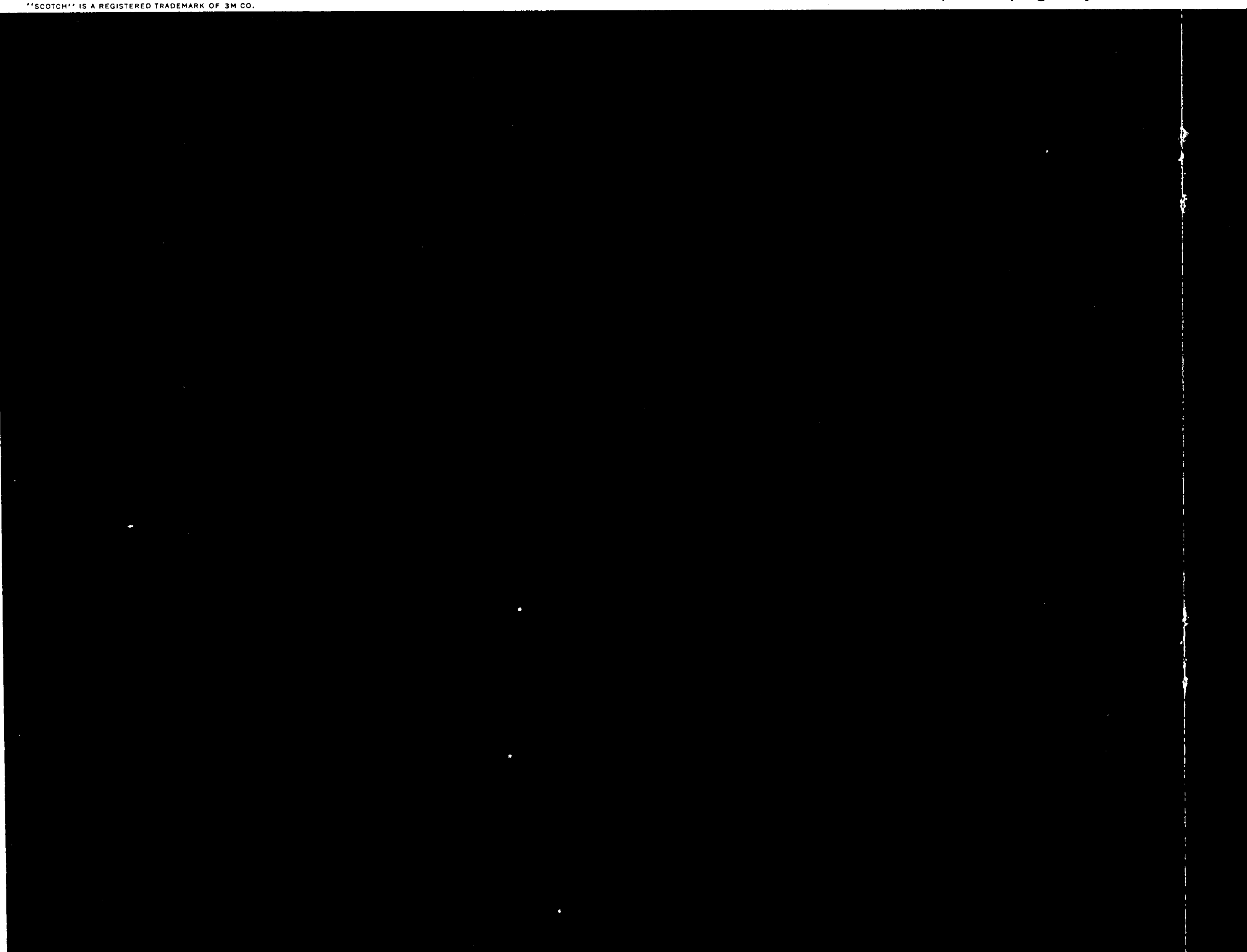
MICRO-SECONDS ARE DOLLARS

A question: Do you consider that each time an error on tape makes your computer stop, examine and compensate, your money is wasted? It's even more costly when data is lost. When errors mount with repeated passes, the point is soon reached when continued use of that tape is economically prohibitive. The longer your tape performs reliably, the greater its real economy. Exclusive new "Scotch" Brand No. 777 computer tape gives you this.

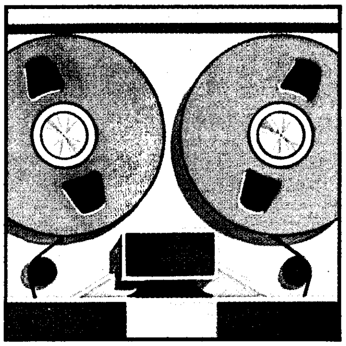
EXTE
IN CO

A ma
reliab
binde
absol
tiona
and u
enab
great
perfo
thou
peat
kind
give a
dram
any o
devel

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO.

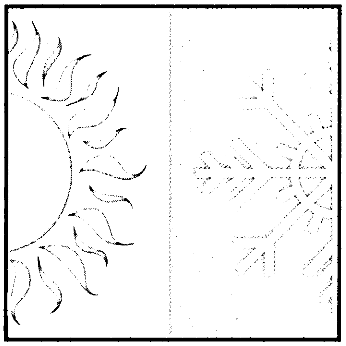


nsider
or on
puter
npen-
sted?
when
rrors
sses,
ched
f that
rohib-
tape
reater
usive
. 777
u this.



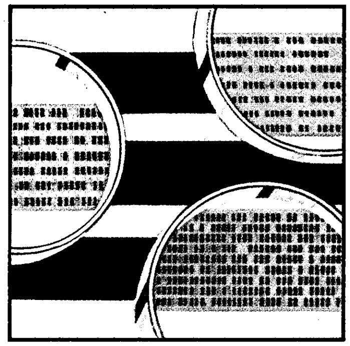
EXTENDED RELIABILITY IN CONTINUED USE

A major secret in No. 777's reliability is a special oxide binder formula. Applied with absolute precision, the exceptional stability, toughness and uniformity of this binder enables No. 777 to deliver greatly extended error-free performance. Tested over thousands of passes, repeatedly subjected to the kind of work-horse use you'd give a scratch tape, No. 777 dramatically out-performs any other computer tape ever developed.



RELIABILITY IN SHIPPING AND STORAGE

All computer tapes at times are subject to wide fluctuations in temperature and humidity — whether in sun-soaked highway transport or in 40-below-zero air cargo. These intense changes can generate new dropouts in a tape initially error-free. But "Scotch" Brand No. 777 maintains error-free reliability through both shipping cycles and long-term storage, just as it does in the controlled environment of your computer center.



COMPLETE COMPATIBILITY AT ALL BIT DENSITIES

In addition to its remarkable physical qualities, new "Scotch" Brand No. 777 Computer Tape is completely compatible for all computer densities whether the traditional 200, 556 or 800 bpi; or the newest 1600 bpi (3200 fci). Even if your data processing system utilizes lower densities, with "Scotch" Brand No. 777 you can profit directly from its exclusive long-range, error free reliability today—and still be prepared for tomorrow.

Whatever computer system you employ or plan to use, find out how 3M can cut your costs. Write: Market Services Department, Magnetic Products Division, 3M Company, St. Paul, Minn. 55119

Who knows more about computer tape than the people who perfected it?

3M COMPANY

From the original painting by Neil Boyle

MNEMOSYNE

Planning Research has designed a search and retrieval system for a consortium of title insurance companies who will share the same computer. The initial data bank consists of 360 million characters. These will increase at the rate of approximately 120,000 per month as new property transactions occur.

Planning Research systems synthesis is complete. It begins with analysis of the total system, and design engineering. It ends with final checkout on *any* computer system. Applied, it saves time or money, or both. For particulars, write to Dr. Alexander Wylly, Vice President for Computer Sciences.

PLANNING RESEARCH CORPORATION

Home office: 1100 Glendon Avenue, Los Angeles, California 90024

CIRCLE 37 ON READER CARD

BENSON-LEHNER BREAKS THE ON-LINE PLOTTING BOTTLENECK...

and reduces computer plotting time up to 50 times

Documented Computer Time Statistics on 360/30

CARD INPUT DELTA INCREMENTAL PLOTTER

INEXPENSIVE OPERATION...

use computer as a computer, not as a plotter input device

EXPANDABLE...

on site up-dating to magnetic tape or multiplexing

1130 and 1620 USERS...

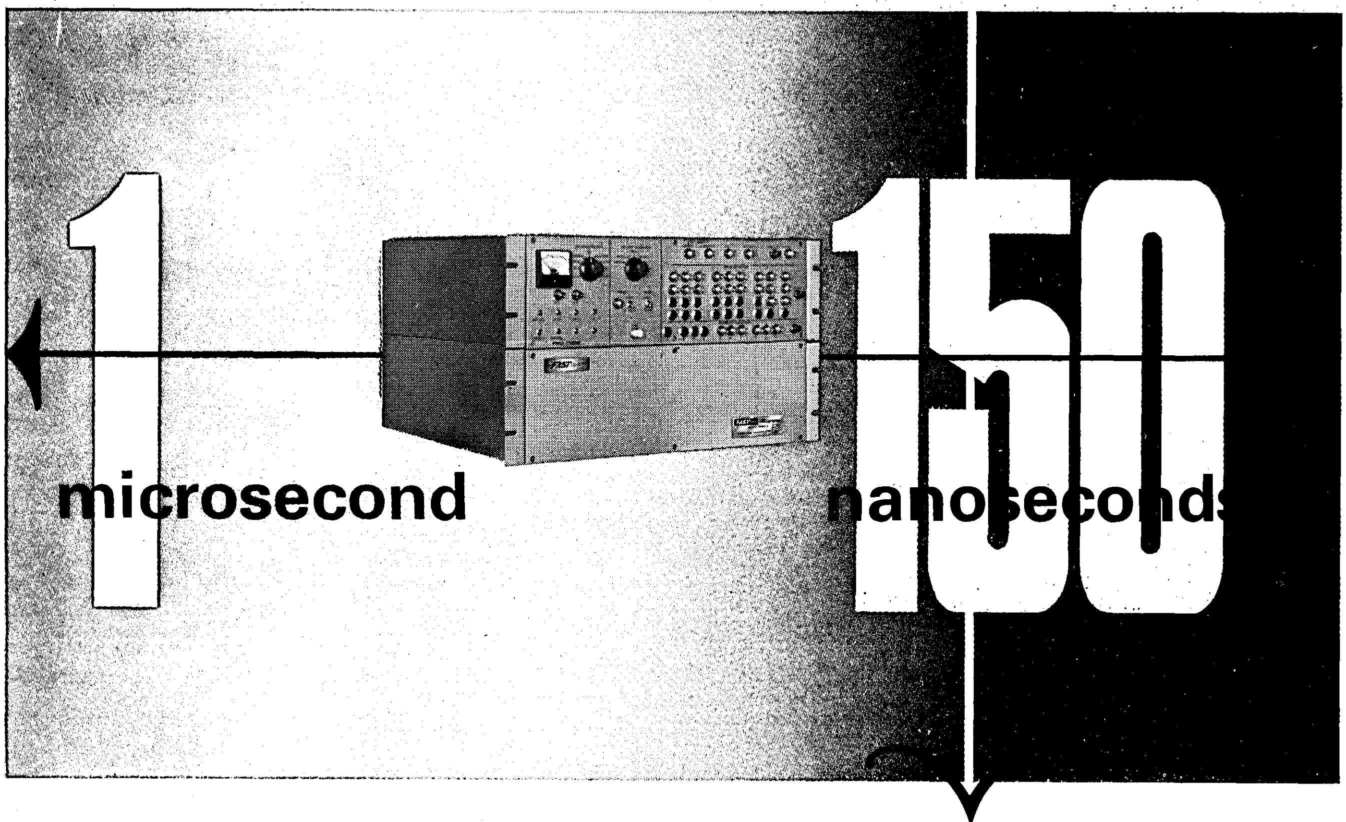
plot off-line as well as on-line

IMMEDIATE DELIVERY...

Hardware and Software . . . SPECTRA 70/1130/1620/360/1108

benson-lehner corporation 14761 CALIFA STREET, VAN NUYS, CALIFORNIA · 781-7100

Announcing:
The FAST Line* 300 film memories...



For your FAST Line memory requirements in the 250-500 nsec range

At the 300-nanosecond band in the FAST Line spectrum you'll find the new FAST Line 300 magnetic film memories. Designed to the FAST Line concept, this series of film memories lets you specify the exact cycle time and capacity you need in the 250 to 500 nsec speed range. All-silicon discrete components. Integrated circuits in the logic, decoding and timing sections for optimum reliability. "Big board" packaging and standard manufacturing techniques for low per-bit price.

Remember, FAST Line means value-engineered memories with a speed-cost evaluation which always results in the lowest ultimate cost to you. Check out FAST Line before you specify a memory for your next EDP application! Call: 612-935-8811, TWX: 910-576-2913 or Write: Fabri-Tek Incorporated, 5901 South County Road 18, Minneapolis, Minnesota 55436.

FAST Line 300 film memories:
Operational Summary

Cycle time: Choose any speed between 250 and 500 nanoseconds
Access time: 125 to 250 nsec, depending upon cycle time chosen
Access modes available: Random, sequential or sequential interlaced
Capacity: To meet your requirements
Optional operating modes: Read only, write only, read-restore, read-modify-write, parallel write
Input/output levels: Standard +2.5 and —0.5 volts
Control panel options: Address and data register indicators, voltage monitoring; and adjustment, self-testing controls and error checking, and data retention "Data Saver".
Power required: 115 or 220 vac., single phase, 48-63 cps.
Packaging: Relay-rack modules or free-standing cabinet

Available now . . . new FAST Line 300 film memories product bulletin. WRITE TODAY.

The Leader in Memory Technology

*T.M.

news briefs

PUBLIC ADMINISTRATION SERVICE SURVEYS MUNICIPAL EDP USE

Municipal governments, particularly in the smaller cities, "still believe that they have a choice as to whether to adopt ADP or not . . . Given the significant interest in 'information systems' at the state and federal levels (i.e., Great Society aims), and the reporting requirements placed on municipalities by the Social Security, Medicare, and other programs, this is unlikely to prove to be a realistic view." This conclusion and the status and problems of adp implementation in cities are reported in "Automated Data Processing in Municipal Government" by the Public Administration Service and the International City Managers' Assn.

The report, based on a survey of 381 cities in 1965, shows that 43.6% (166 cities) "have no adp equipment, do not use a service bureau, and do not intend to use it within the next five years;" 28 cities without systems or service planned to install by 1970, and seven "may." Many responses reflect a lack of information on many aspects of adp, including criteria for determining its most productive applications and personnel aspects. And there seems to be poor communication among the manufacturer, the city executive, and his dp specialists on evaluation data needed.

Users sampled—180 cities with computers, tab installations, or service bureau help—mostly concentrated on traditional applications involving high volume of data—public finance, revenue and personnel administration. Although many large cities are applying computers in sophisticated on-line applications, cities of less than 100,000 seem just to have applied computers to applications done previously on tab equipment.

Personnel shortages and the problem of economic justification are among major obstacles to dp implementation, the report said, but many cities are not effectively considering these factors. Most planning was being done on a departmental basis, even when a central facility existed; in cities of 25,000-50,000, which primarily use tab equipment and service bureaus, agency independence can lead to multiple punched card installations needing separate staffs and unnecessarily high funding. Further economic surveys of three- and five-city groups of all sizes showed that the ratio of personnel costs to equipment rental varied widely, often disproportionately. In one group it was found that the city with the fewest employees had the most operational applications on its computer.

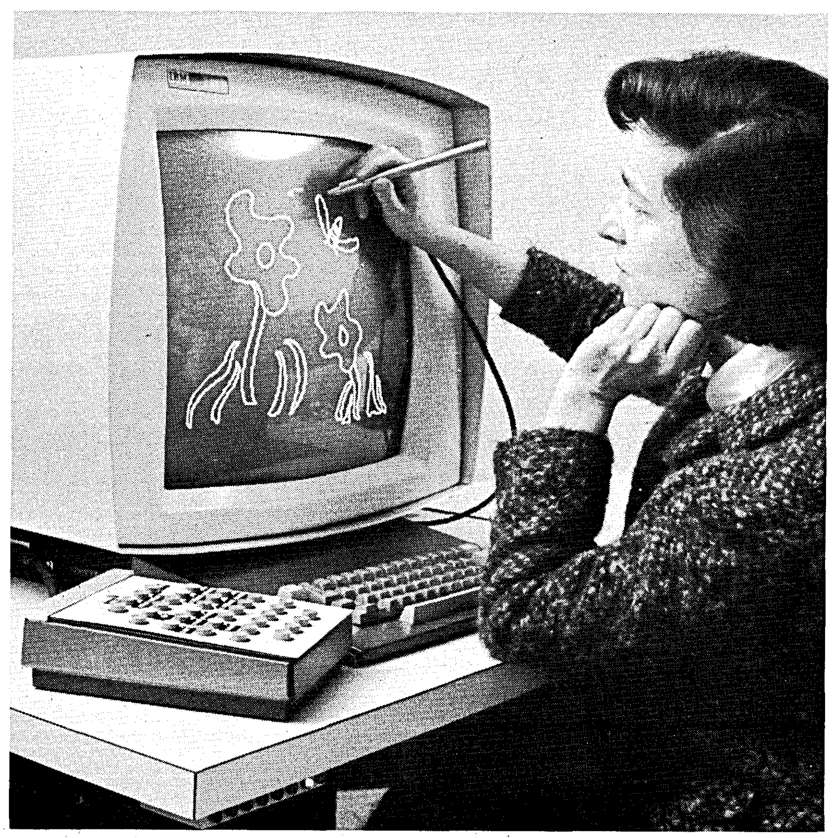
Viewing the obstacles to dp implementation — organization, legalities, and local traditions—the report draws guidelines for integration of dp into the framework and for ultimate government reorganization for centralized dp operations. It also discusses equipment selection and installation, manager responsibility, and personnel. The 34-page publication can be obtained from the Public Administration Service, 1313 E. 60th St., Chicago, Ill.

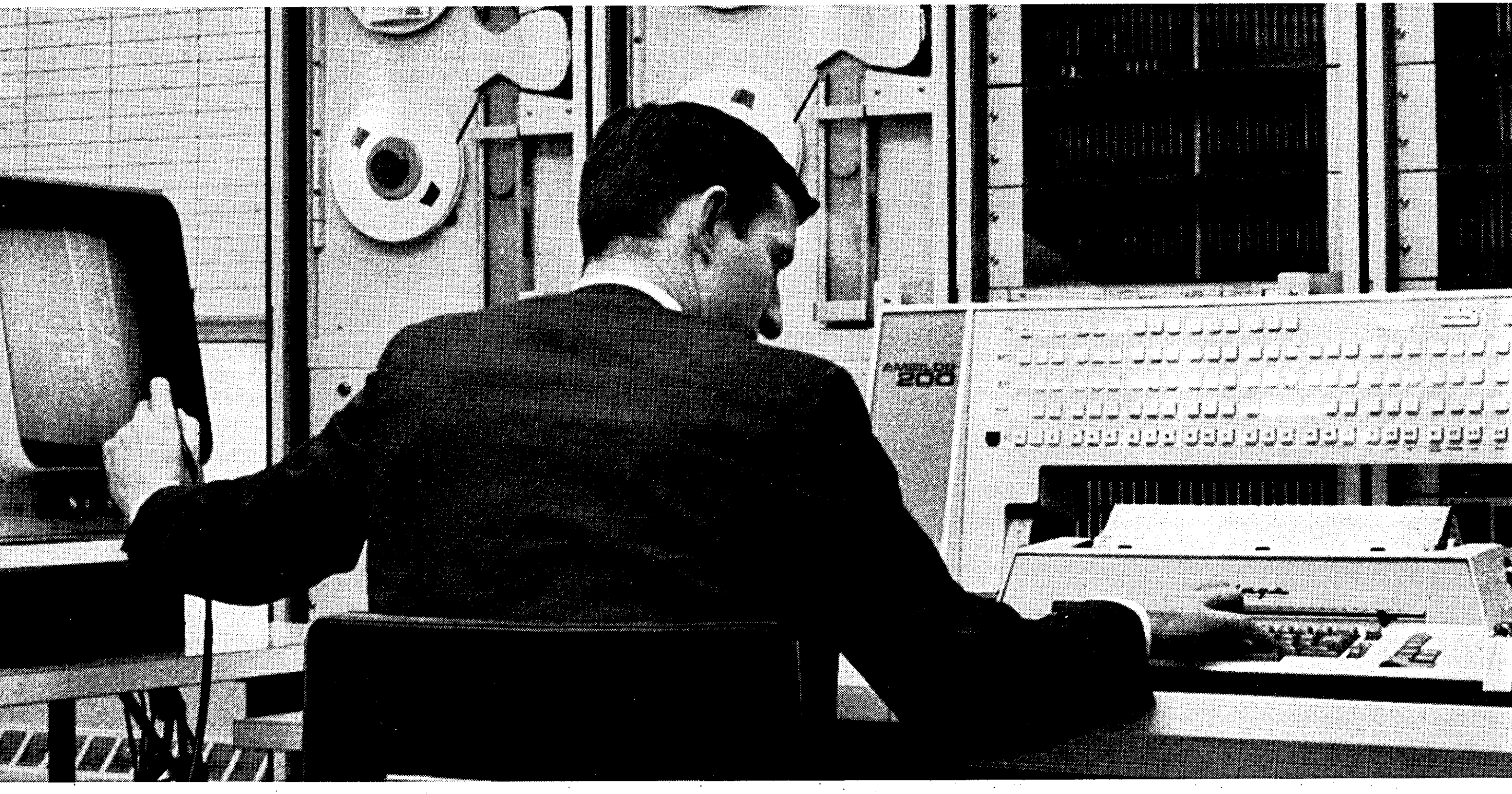
BANKING STUDY SHOWS COST FEASIBILITY OF NEW SYSTEM

Is it possible to set up an information transmitting network among banks that will do away with the physical exchange of checks? The answer is yes, according to research conducted by the National Association for Bank Audit, Control and Op-

IBM DEMONSTRATES "TEXTILE GRAPHICS" TECHNIQUE

An experimental technique for reducing the time between design and actual weaving has been demonstrated by IBM for representatives of the textile industry meeting in New York last month. Developed by Mrs. Janice R. Lourie, an amateur weaver and professional member of IBM's New York Scientific Center, the method uses a 2250 display unit tied to a System/360. After the design is drawn with a light pen, the user can select a weave design from a stored library, then modify it on the screen. Output is coded printout, from which cards can be prepared to control operation of a Jacquard loom. The company points out that it is only demonstrating the feasibility of the method at this time and has not yet developed a programming package for the application.





Adage makes the best computer on the market for signal processing.

It's called Ambilog 200.

Combining the best of both analog and digital techniques, Ambilog 200 was designed right from the start for processing signals (time-related variables, often in analog form). Its unique hybrid structure and ability to handle efficiently both analog and digital information make possible at relatively low cost the extremely high computing rates required in signal processing applications.

DIGITIZING AND RECORDING

Up to several hundred inputs are routed under program control through an array of multiplexer switches, hybrid arithmetic elements, and a 14-bit, 4 microsecond analog-to-digital converter for recording or outputing. Ambilog 200 converts raw data to engineering units, including corrections for calibration error, at even faster sampling rates than conventional systems which simply "acquire" data.

WAVEFORM MEASUREMENT

Peak values, axis crossings, ratios of successive differences, and other characteristics of analog signals are measured in real time. Using complex programmed detection criteria, incoming signals are monitored for events of interest, typically with a resulting 100-to-1 reduction in the bulk of magnetic tape output records.

RANDOM SIGNAL ANALYSIS

Parallel hybrid multiplication and summing, 2 microsecond 30-bit digital storage, and a flexible instruction format providing efficient list processing combine to make Ambilog 200 an extremely powerful tool for statistical signal analysis techniques. These include Fourier transformation, auto and cross correlation, power spectrum density analysis, and generation of histograms of amplitude spectra.

GRAPHIC DISPLAY

On-line CRT displays of incoming data, or of results derived by reduction and analysis, are generated at frame rates of about 30 per second using line-drawing elements. Other visual display configurations, intended as design aids, generate isometric or true-perspective projections of objects containing more than 1000 line segments, with arbitrary translation and rotation.

FUNCTION GENERATION

In generating arbitrary functions of one or more variables, quadratic or cubic interpolation is achieved at high speed by using hybrid arithmetic elements in parallel to evaluate a polynomial function. Or, where straight-line approximations are adequate, different values of slopes and intercepts for each line segment are fetched from memory for operating on the variable.

SOFTWARE

Programming aids are tailored to the specialized needs of signal processing tasks, and include an Adage assembly system, Fortran, programs for source language editing and online debugging and control, and a wide range of applications programs and subroutines. Ambilog 200 signal processing systems are currently being used for seismic research, dynamic structural testing, sonar signal analysis, wind tunnel testing, speech research, simulation, and biomedical monitoring.

For further details, write M. I. Stein, Product Manager, Adage Inc., 1079 Commonwealth Ave., Boston, Mass., 02215.

CIRCLE 40 ON READER CARD

Adage INC

eration (NABAC) and the Illinois Institute of Technology Research Institute (IITRI).

But the affirmative answer is only tentative and exploratory, stresses Dr. Randall Robinson, director of research for NABAC. It is the first of what will be a continuing study into the possibility of some day setting up a national system by which banking information may be transmitted by electronic systems. At present, Dr. Robinson points out, banks must physically handle all the checks with which they deal—sorting them, bundling them, returning them to the issuing bank (often with a number of sidetrips through intermediary banks). The data processing network would enable banks to exchange check information without exchanging checks.

This pilot study dealt with 28 banks in Chicago, Milwaukee, and Minneapolis-St. Paul, including the Federal Reserve Banks of Minneapolis and Chicago. It found that costs of such a system would be about 7% lower than costs incurred by using an idealized version of the current magnetic ink character recognition. Dr. Robinson added that the estimate is conservative. He predicted that such a system, once it began to operate, would reduce costs by a good deal more than 7%.

The network system under study would not eliminate MICR, which still would be used by banks-of-first-deposit to extract information to send on to issuing banks.

Although Dr. Robinson emphasizes the exploratory nature of this study, he says that the project has convinced NABAC officials that an electronic banking network is technically feasible. Before it could be put into effect, however, other problems, legal and of a public relations nature, would have to be worked out. How, for example, will people feel about not receiving a cancelled check with their bank statement? Checks would be sorted by the bank-of-first-deposit for possible later reference, but what legal problems might such a procedure incur? It will be necessary to anticipate and answer such questions before large-scale use of an electronic system.

NABAC and ITTRI are now engaged in a year-long study that will expand upon the questions posed during this initial project, which based its cost analysis on the use of voice grade lines. Its present research will examine costs and related problems of other types of systems. It will also look into how an electronic system may enable the exchange of other kinds of information.

PAPERS FOR 20TH NATIONAL ACM CONFERENCE DUE FEB. 20

Papers submitted for the 20th National ACM Conference, to be held in Washington, D.C., Aug. 29-31, are due by Feb. 20.

Theme of the convention is "Past Is Prologue" and papers are solicited that deal with past, present, and future aspects of computer science and technology. Authors are requested to stress historical perspective, present significant new developments or novel applications, or explore trends and potential developments. A prize of $500 will be awarded for the best paper.

Five copies of the paper, not to exceed 10,000 words, and a 100-150 word abstract should be submitted to Dr. Jack Minker, program chairman, Auerbach Corp., 1815 N. Fort Meyer Drive, Arlington, Va. 22209.

NCR MARKETS MICROFORM SERVICE AND READERS

In one of the most restrained new-product releases ever recorded, NCR announces that they are "entering" the microform information storage and retrieval market and, simultaneously, that they already have orders for 26,000 of the readers.

The technique used has been under development for some time; it was described at the NCR exhibit in the 1965 SJCC. A special coating for transparencies has been developed by the company, allowing good resolution with extreme reduction of images. Information stored on the film is about 1/150th its original size. Thus the 4 x 6 inch transparencies used can store the equivalent of 3200 pages of typical business documents.

Preparation of the records must be done at an NCR service center and there is only one now—in Dayton—although others are planned. The cost is reasonable: for large-volume jobs, the transparencies can be prepared for as little as $1 each. The cost of the reading units is even more reasonable: they rent for $10 a month. The reader is about the size of a table-model TV set and is operated manually. Access time to find the image of one of the pages recorded on the transparency is quoted as "seconds."

Some large companies, including Ford and Boeing, have been using the retrieval system on a trial basis. Best prospects are expected to be organi-

PROGRAMMERS

EXCEPTIONAL PROFESSIONAL OPPORTUNITIES

LITTON'S dynamic expansion in the business equipment field has created new concepts in management information processing systems for:

PROGRAMMERS and PROGRAMMER/ANALYSTS

You are invited to join in the development of new programs with commercial and industrial applications on IBM 360 series machines.

You should offer 1400, 7000 and/or 360 series programming experience, including tape or disc. A degree in accounting, mathematics or economics is desirable, but not necessary, depending on your level of programming experience.

Excellent starting salaries and comprehensive employee benefits, including participation in Litton Employee Stock Purchase Plan, educational refund and vested pension plans.

For prompt and confidential consideration, send your resume to Mr. L. H. Ryan, c/o Professional Development, 550 Central Avenue, Orange, New Jersey.

MONROE

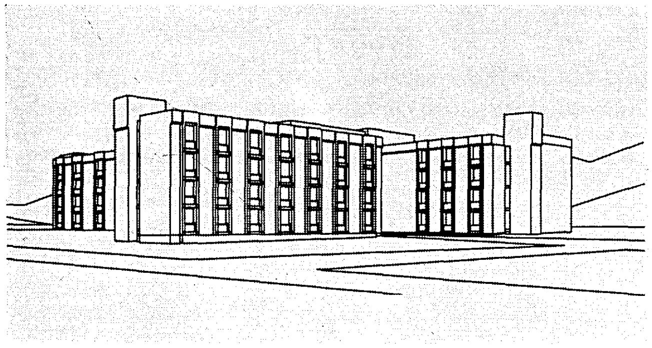
INTERNATIONAL CORPORATION

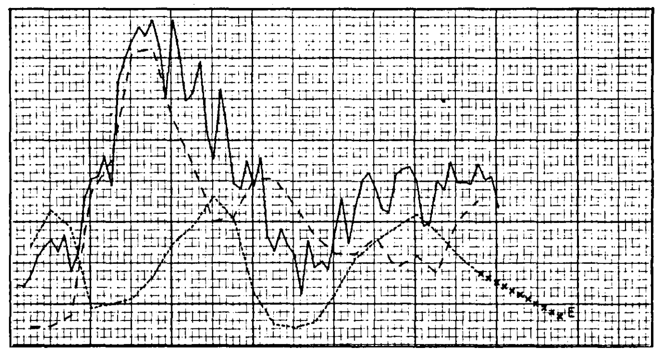
A Division of Litton Industries

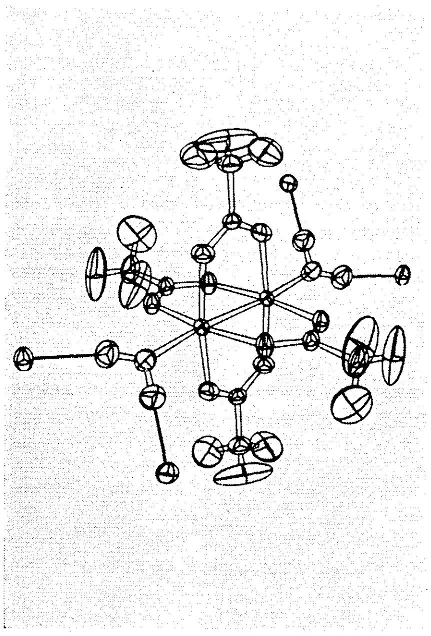
An equal opportunity employer

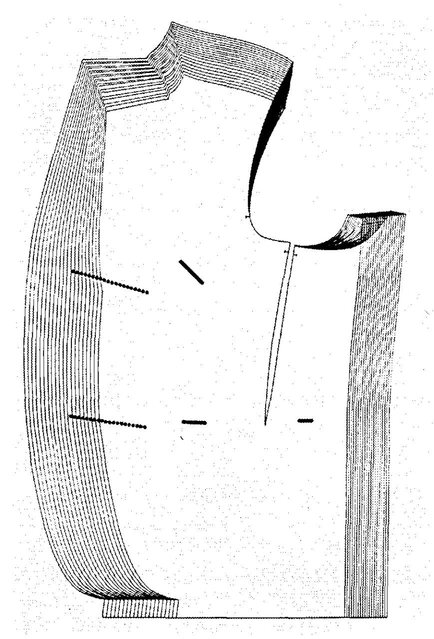
CIRCLE 305 ON READER CARD

Would you believe a CalComp plotter and any computer can draw pictures like these in seconds?


a perspective sketch of your new plant


statistical trend charts


molecular structure diagrams


apparel patterns, graded for sizes


and even the Mona Lisa

it can

Call or write Dept. D1, California Computer Products, Inc., 305 Muller, Anaheim, California 92803, Phone (714) 774-9141.

CALCOMP

Standard of the Plotting Industry

(Talented Engineers and Programmers required—right now.)

CIRCLE 41 ON READER CARD

What's the matter? Is your computer too busy to talk to you?

It's probably nothing personal. Like many other firms, you might very well have outgrown the computer you started with. If you started with NCR, your solution is relatively inexpensive. A system expansion . . . or maybe a faster processor, will give your system the breathing room to chat with you all you like.

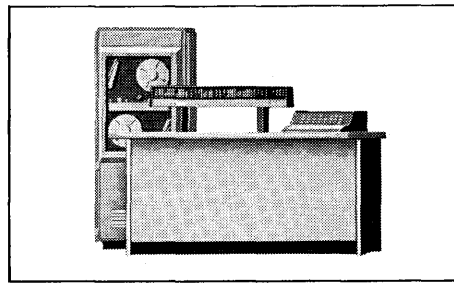
That's the beauty of the 315 family. You don't have any problem with obsolescence. No matter how small you start in the 315 family, you can move right up without recompiling or reprogramming.

You have an advanced operating system with automatic run-to-run control assuring the right file name and date version, and including dating flag options for any program in the system.

You can move up to the newest RMC (Rod Memory Computer), with a choice of 20 to 160K character memories. Even Multiprogramming, if you have a lot of conversation on your mind.

You can get your information to the 315 or RMC from the widest range of input devices available . . . all from NCR. So if you are in the market for a computer that's fast, powerful and flexible . . . and doesn't have a fancy price tag to start, call NCR. Let's get a conversation started.

NCR



THE NATIONAL CASH REGISTER COMPANY, DAYTON, OHIO 45409 ®

CIRCLE 42 ON READER CARD

A PROGRAMMER ASKS:

"WHY DOESN'T SOMEONE PLAN A PROGRAMME FOR PROGRAMMERS?"

•

UNIVAC has... here it is!

1. The Data Processing Division of UNIVAC needs programmers who now are, or soon plan to be, at the top of their profession. Our current team includes the kind of people who restlessly keep straining toward new goals, personally and in their technological specialties. Is that *you*?

2. *We need this special breed* in many categories of programming. They are now at work on challenging long term problems in: business systems programming, scientific applications programming, maintenance & diagnostic programming, development of executive systems, operating systems, and programming research programming. And then some.

3. *We offer a working and living* programme that is stimulating and exciting. At work: a wide creative freedom to improve on yesterday's best answers. As much responsibility as you can accept. Generous recognition of your contributions to the nation's number one programming team. After work, home is only a short drive to pleasant residential communities in and around Minneapolis and Saint Paul. Golfing, swimming, sailing, hunting, fishing, skating, skiing. Culture and education: the finest of elementary and secondary schools, a great University, many outstanding colleges. A celebrated Symphony Orchestra. The unique Tyrone Guthrie repertory theatre. Big League spectator sports: "Twins" and "Vikings."

WANT MORE DETAILS of a programme of happy working and living that is attracting more top-flight programmers every day? If you have a degree and 2-5 years experience, write: John Hallenberg, Employment Manager, Dept. 67-500, UNIVAC Data Processing Division, 2276 Highcrest Drive, Roseville, Minn. 55113.

UNIVAC
DIVISION OF SPERRY RAND CORP.

DATA PROCESSING DIVISION
2276 HIGHCREST DRIVE
ROSEVILLE, MINN. 55113
TELEPHONE 612-633-6170
An Equal Opportunity Employer M/F

CIRCLE 300 ON READER CARD

news briefs

zations with large volumes of information requiring frequent updating and quantity distribution.

Marketing is being handled by NCR's Industrial Products Division, which is introducing the system in Western Europe as well as the U.S.

NATIONAL RESEARCH COUNCIL REPORTS ON LANGUAGE WORK

A committee of the National Research Council has completed a report titled Language and Machines, concluding that language analysis by computer and machine-aided translation are two areas of linguistics deserving increased federal support. The committee does not, however, recommend massive support of machine translation per se, finding it slower, less accurate, and more expensive than the old-fashioned way using people.

The two-year study was made at the request of the CIA, Defense Dept., and National Science Foundation. Chairman of the committee is John R. Pierce of Bell Labs. The report recommends that computational linguistics should be supported as a science and not be judged by any immediate or foreseeable contributions to practical translation. According to the report, the supply of translators "far outstrips the demand," even in the case of Chinese translators.

The report—Publication 1416 of the National Academy of Sciences, National Research Council—is available from the Printing and Publishing Office, NAS-NRC, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

ALLSTATE INSURANCE OPENS NEW RESEARCH CENTER

Allstate Insurance Co. unveiled a new research center in Menlo Park, Calif., last month. Most of the research will be systems oriented, with emphasis upon management sciences, operations research, computer application development, and support for underwriting, marketing, and training.

Installed at the center, named after Allstate Chairman Judson Branch, is a 360/40 which includes a 2321 Datacell. The company also demonstrated an experimental use of a terminal on-line to System Development Corp. in Santa Monica. The terminal was shown retrieving information from a data base built from a survey of automobile drivers in the western states.

Also demonstrated was a corporate model which allows management to alter such factors as policy renewal ratios and number of salesmen to predict the effects of such changes. The model contains 5-10 years of company history on a monthly basis, including budget vs. actual figures, and goes through 26 million calculations each run.

The center now employs 19 professionals, but will have 53 next year. It is headed by vice president L. L. van Oosten, director of research.

1967 FJCC COMMITTEE ISSUES CALL FOR PAPERS

The program committee is soliciting papers for the 1967 Fall Joint Computer Conference, to be held Nov. 14-16 at Anaheim, California.

A $500 prize will be awarded for the best paper covering significant advances in any aspect of the information processing field, including hardware, software, systems, applications, and analog/hybrid systems.

Deadline is April 17 and a complete manuscript is requested in addition to a 100-word abstract. Five copies should be sent to Harry T. Larson, Technical Program Committee Chairman, 1967 FJCC, P.O. Box 457, Costa Mesa, Calif. 92627.

● A cross-licensing agreement has been signed by RCA and NCR, covering computers and other products when they are used directly as on-line components of data processing systems. The pact does not cover any exchange of techniques. It's intended to prevent patent infringement conflicts that might arise from the difficulty of keeping abreast of the increasing number of patents being filed in the industry.

● Sheraton Hotels is getting a new reservations system, Reservatron II, from Bunker-Ramo. The $4 million system will provide 200 consoles, on line to the B-R TeleCenter in New York City. The equipment will handle alphanumeric messages, thus giving rise to the hotel chain's jubilant claim that "guests will again become names instead of numbers." Installation is to begin in February and to be completed in the spring.

● The Purdue Laboratory for Applied Industrial Control has been set up at Purdue Univ. Headed by Prof. T. J. Williams, it will carry out research and development in plant and process dynamics, instrumentation, computer control, optimization of industrial plants, and automation management. One objective is to train interdisciplinary engineering graduates who will work on industrial projects. Five industrial companies are helping to support the new organization and Purdue has 28 professors whose basic area of research is automatic control. The intention is to offer academic programs at the MS and PhD levels in all major areas of engineering.

● A computer-generated model of the human vocal tract is now producing synthetic speech at Bell Telephone Laboratories. An oscilloscope displays geometric descriptions of the vocal tract areas (pharynx, tongue, palate, lips and tongue tip) while the operator simultaneously hears the sound which corresponds to the displayed shape. Dials on the console can change shape and sound to improve synthetic speech by slight variations. Researchers at Bell Labs hope to use the information to devise a more efficient means of encoding speech signals and transmitting them over communications lines.

● High-speed cathode ray tube displays, to be used for the storage and retrieval of pupil personnel records and curriculum information, are being installed by the Portland (Oregon) Public School District. Based around a Honeywell H-120 computer system, the first display was installed earlier this month at Rice Elementary School. Under the pilot program, science curriculum (available texts, audio-visual aids, reference materials) will be placed in the 32K memory to aid teachers in course instruction and preparation. The project, expected to be in use by early spring, is funded by a $129,000 grant from the Hill Family Foundation in Minneapolis. Long-range plans for one or more crt displays in each district school are dependent upon a four-year grant from the federal government.

● A nine-month programming course for blind students is being conducted by System Development Corp. through arrangements with the California Health and Welfare Agency. One trial student has completed the course and is already employed as a programmer; the same course, with minor modifications, will now be given to a class of 14. Students were selected from candidates with at least two years of college and an interest in science, who were then given intelligence and aptitude tests. Texts for the course have been transcribed on tape and tests are given in Braille. Computer printout in Braille is also used.

● Scientific Data Systems has announced that PL/I software completion has been delayed until 1969, citing as the reason "recent significant changes in the basic definition of the language as well as the prospect of further changes." Dan L. McGurk, vice president of marketing, said that "as soon as a firm definition of PL/I has been established, SDS will complete its development." Sources outside the company, however, note that the delay may be caused by previous commitments of the software suppliers.

● Yet another new application has appeared with announcement by the California Department of Water Resources that a $325,000 contract has been awarded to Univac for a 418 system to control water movement in the California aqueduct system. The computer, to be installed Feb. 1 in the project control room at Sacramento, will first be used in operation of the South Bay Aqueduct. This will serve as a model for later development of remote computer-based control of the complete state water project.

● An ambitious plan with the suitable name of EPIC (for Eastern Pennsylvania Information Center) has been launched, hopefully leading to a multi-million-dollar computer center at Franklin and Marshall College, Lancaster, Pa. The proposed center could service more than 50 colleges and research institutions in the area including Pennsylvania, New York, New Jersey, Delaware, and Maryland. Estimates call for building and equipment at a cost of $4 million to $6 million and an annual operating budget of about $1.5 million. The time-sharing installation would include some 200 stations. Planning has been started with the help of a $50,000 grant to the college from the Independence Foundation of Philadelphia. Planned start-up date is late 1969.

● Systems Engineering Labs, Inc. has announced that a monitor system will be available for its 810A and 840A computers the first quarter of 1967

PROGRAMMERS:

ARE YOU A "SOFTIE"?

COME TO UNIVAC!

Software, hardware, every ware . . . UNIVAC is the technical pioneer in the computer field. But, like the Red Queen said, "It takes all the running you can do, just to stand still!" And *still* is one way we never want to stand for very long. We hope you feel the same about your progress.

SO THAT OUR SOFTWARE keeps lengthening its lead, we keep adding talented people like you to our Advanced Programming Section. This group does the R. & D. on programming methods and aids to help plan the future of our operational programs.

THEIR WORK INCLUDES . . . developing advanced methods of program construction, specifying advanced programming languages, planning advanced software, support and new compilers, language processors and debugging aids. They explore new avenues in programming techniques: logical language translation, compiler construction, mass memory allocation, information storage and retrieval, interpretive programs and advanced program construction methods. As well as general research in assemblers and loaders, computer-aided program documentation, advanced executive systems and time shared remote programming systems. And lots more.

IT'S HARD TO FIND SOFTWARE programmers and systems engineers of the caliber we have in mind. We could use a few of the best, with 3 to 5 years experience, immediately. These new people will have to be good enough to run hard with the number one group in this field. If you're ready, write the man at UNIVAC, telling your experience, capabilities, ambitions. Address: R. K. Patterson, Employment Manager, Dept. 102.

UNIVAC
DIVISION OF SPERRY RAND CORP.
DEFENSE SYSTEMS DIVISION
2750 WEST SEVENTH BLVD.
ST. PAUL, MINN. 55116
An Equal Opportunity Employer M/F

CIRCLE 301 ON READER CARD

(no additional cost). Components are a resident executive, a FORTRAN IV compiler and library meeting ASA standards, MNEMBLER assembler, loader, and debug and utility routines. The full system will operate with 12K core; the compiler alone requires 8K.

● "Conversation With a 50" was the title of a two-day conference in early November, sponsored by the Argonne National Laboratory. Referring to IBM's System/360, Model 50, the conference featured eight papers and three operating systems. The systems, demonstrated during an evening session, were the Allen-Babcock Computing, Inc. RUSH, which uses a 2741 and a Mod 50; the Univ. of Pittsburgh PITT Interpretive Language (a derivation of JOSS) using the Mod 50 at Argonne; and an IBM-Yorktown system.

The papers discussed work involving remote systems for the Mod 50, aiding users of the model who are planning or using time-sharing techniques.

FREE! CAREER OPPORTUNITIES BULLETIN

A complete and comprehensive listing of outstanding positions at salaries from $6,000 to $30,000 with National Companies for:

ENGINEERS • ANALYSTS • PROGRAMMERS

Our professional staff combines Customized Service with technical know how to insure for you maximum career development in the following areas:

- **Circuit Design**
- **Digital or Logic Design**
- **Switching**
- **Communications**
- **Hardware Design**
- **Manufacturing**
- **Reliability**
- **Software Development**
- **Scientific Programming**
- **Real Time Systems**
- **Business Systems**
- **Commercial Programming**
- **Diagnostic Programming**
- **OPS Research**

No charge to you for our custom service. All expenses paid by client companies (fees, interviewing & relocation). Expedite your development by sending resume in confidence with present salary and geographic preference to Frank Daniele, Director:

La Salle Associates
Professional Search Dept.
2136 Locust Street, Philadelphia, Pa. 19103

For your free bulletin without any obligation, circle subscriber service card. Please use home address only.

CIRCLE 312 ON READER CARD

Programming Systems and Languages *SAUL ROSEN, State University of New York at Stony Brook*
Contains a selection of reports dealing with the most important programming languages and programming system concepts. **480 pages, $9.75**

The PL/I Converter *ERIC WEISS, Sun Oil Company*
PL/I is the newly developed programming language ready for immediate use. The treatment is easy to read, making learning easy. **112 pages, $3.95**

PL/I Programming Primer *GERALD M. WEINBERG, IBM Corporation*
A working text for beginning programmers and an introduction to the PL/I language. **278 pages, $5.95**

Fortran Programming *ROBERT V. JAMISON, Northrop Institute of Technology*
Designed to give the reader a complete understanding of programming using FORTRAN II. **214 pages, $4.95**

Fortran IV Programming *ROBERT S. LEDLEY, National Biomedical Research Fndtn.*
The purpose of this new book is to teach Fortran programming by utilizing numerous examples. **320 pages, $4.95 — soft-cover edition, $3.75**

Computer Programming Fundamentals, second edition *HERBERT D. LEEDS and GERALD M. WEINBERG, both IBM Corporation*
An adequate, truly introductory book on digital computers. **459 pages, $7.95**

Digital Computer Fundamentals, second edition *THOMAS C. BARTEE, Harvard University*
Does not concentrate on a single area; rather, deals with the principles of digital computers. **402 pages, $6.95**
McGraw-Hill series in Information Processing and Computers

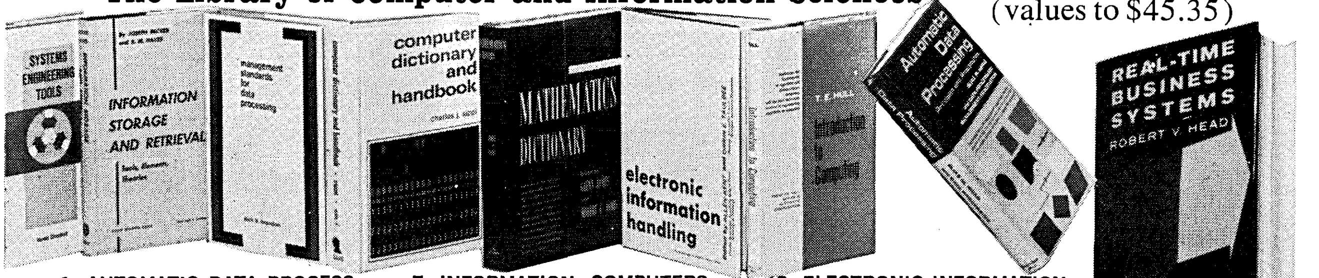
Numerical Calculations and Algorithms *ROYCE BECKETT and JAMES HURT, both State Univ. of Iowa*
A mathematically rigorous treatment presenting numerical methods for solving typical problems on a computer. **256 pages, $9.95**

McGRAW-HILL BOOK COMPANY • 330 West 42nd Street • New York, New York 10036

CIRCLE 43 ON READER CARD

TAKE ANY 3 BOOKS

when you enroll as a member of
The Library of Computer and Information Sciences *for only $3.95*
(values to $45.35)



1. AUTOMATIC DATA PROCESSING. *Elias M. Awad & the Data Processing Management Association.* A virtual self-instruction course in the principles, techniques, and equipment of automatic data processing. Many diagrams and illustrations. *List price $10.60*

2. COMPUTER DICTIONARY AND HANDBOOK. *Charles J. Sippl.* Indispensable reference containing over 8,500 definitions or explanations of computer terms, acronyms, abbreviations. With 29 informative appendices. *List price $12.95*

3. DIGITAL PROCESSING: A SYSTEM ORIENTATION. *Louise Schultz.* Principles, techniques, and applications of digital processing—presented in simplified linguistic, rather than strictly symbolic, terms. *List price $14.35*

4. THE CHALLENGE OF THE COMPUTER UTILITY. *Douglas F. Parkhill.* Provocative report on a remarkable new method for distributing and utilizing computer power. Many charts, diagrams. *List price $7.95*

5. COMPUTER SOFTWARE: PROGRAMMING SYSTEMS FOR DIGITAL COMPUTERS. *Ivan Flores.* Exhaustive handbook on techniques and applications of computer software. *List price $16:00*

6. MANAGEMENT STANDARDS FOR DATA PROCESSING. *Dick H. Brandon.* Covers methods standards for data processing in management, plus performance standards for personnel and equipment. *List price $12.00*

7. INFORMATION, COMPUTERS, AND SYSTEM DESIGN. *Ira G. & Marthann E. Wilson.* Comprehensive overview of systems concepts in the light of information theory—and the roles people and information play in system design and operation. *List price $12.50*

8. INTRODUCTION TO COMPUTING. *T. E. Hull.* Thorough, lucid guide to the principles and applications of computing, with emphasis on the widely used algorithmic language, FORTRAN IV. *List price $9.25*

9. COMPUTER PROGRAMMING TECHNIQUES. *Theodore G. Scott.* Remarkably effective programmed text on the elements of computer programming: writing subroutines, debugging, computer "languages", etc. *List price $7.95*

10. SYSTEMS ENGINEERING TOOLS. *Harold Chestnut.* The most complete survey of a challenging new field, covering the nature of systems engineering problems and the tools used to solve them. *List price $12.95*

11. MATHEMATICAL METHODS FOR DIGITAL COMPUTERS. *Edited by Ralston & Wilf.* Illuminating overview of the most useful techniques of numerical analysis for solving mathematical and physical problems on the digital computer. *List price $9.00*

12. REAL-TIME BUSINESS SYSTEMS. *Robert V. Head.* Step-by-step guide to the proper way to make real-time systems operational—by the man who innovated American Airlines' SABRE System. *List price $9.00*

13. ELECTRONIC INFORMATION HANDLING. *Edited by Kent & Taulbee.* Useful overview of the rapidly expanding field of information handling and retrieval. How to interpret signals and numerical information, etc. *List price $11.00*

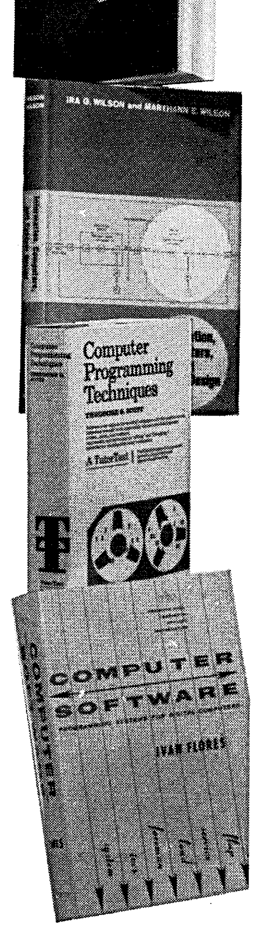
14. MATHEMATICS DICTIONARY. *Edited by James & James.* Indispensable reference work containing definitions of over 70,000 terms, concepts, and relationships of mathematics. *List price $15.00*

15. SCHEDULE, COST, AND PROFIT CONTROL WITH *PERT*. *Robert W. Miller.* First comprehensive appraisal of PERT Management Systems for more successful planning and control. Shows how PERT techniques can be used in commercial, industrial, other activities. *List price $8.50*

16. APPLIED BOOLEAN ALGEBRA. *Franz E. Hohn.* Revised, enlarged edition of the highly regarded book on Boolean algebra and its applications, particularly to computer and switching circuit design. *List price $7.95*

17. STATISTICS: A NEW APPROACH. *Wallis & Roberts.* A widely acclaimed—and refreshingly clear—exposition of statistical reasoning and the methods of statistics. *List price $7.00*

18. INFORMATION STORAGE AND RETRIEVAL. *Becker & Hayes.* Outstanding guide to a vitally important field. Covers information system theory and design, man-machine relationships, much more. *List price $11.95*



• **Choose any three books for only $3.95.** Choose from 18 authoritative books on the computer and information sciences—books on computer programming, systems design, information retrieval, management uses of the computer, many other expanding areas. This unusual offer is being made to introduce you to the benefits of membership in THE LIBRARY OF COMPUTER AND INFORMATION SCIENCES.

• **Substantial savings.** As a member, you save *up to 40%* on all books (certainly the most economical way to build a basic computer library).

• **Free Bonus Books.** Your only obligation is to buy as few as four Selections during the next twelve months. And you receive a FREE Bonus Book of your choice with every fourth Selection you purchase. (The Introductory Offer counts as your first Selection.)

• **Why not enroll today?** Just fill in and return the Membership Application at the right, marking the numbers of the 3 books you want for only $3.95. Your books will be sent without delay.

Membership Application

The Library of Computer & Information Sciences
Front & Brown Streets, Riverside, N. J. 08075

Please enroll me as a member and send the 3 Selections circled below, for which you will bill me only $3.95 plus shipping. As a member, I need accept as few as 3 more Selections during the next 12 months, always at reduced Member's Prices plus shipping, and I may cancel membership any time thereafter. Each month I will receive information describing the forthcoming Selection, along with a convenient form for requesting Alternate Selections or no book at all. I also understand that I may choose a free Bonus Book for every four Selections purchased.

Circle three:

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18

NAME ____________________

ADDRESS ____________________

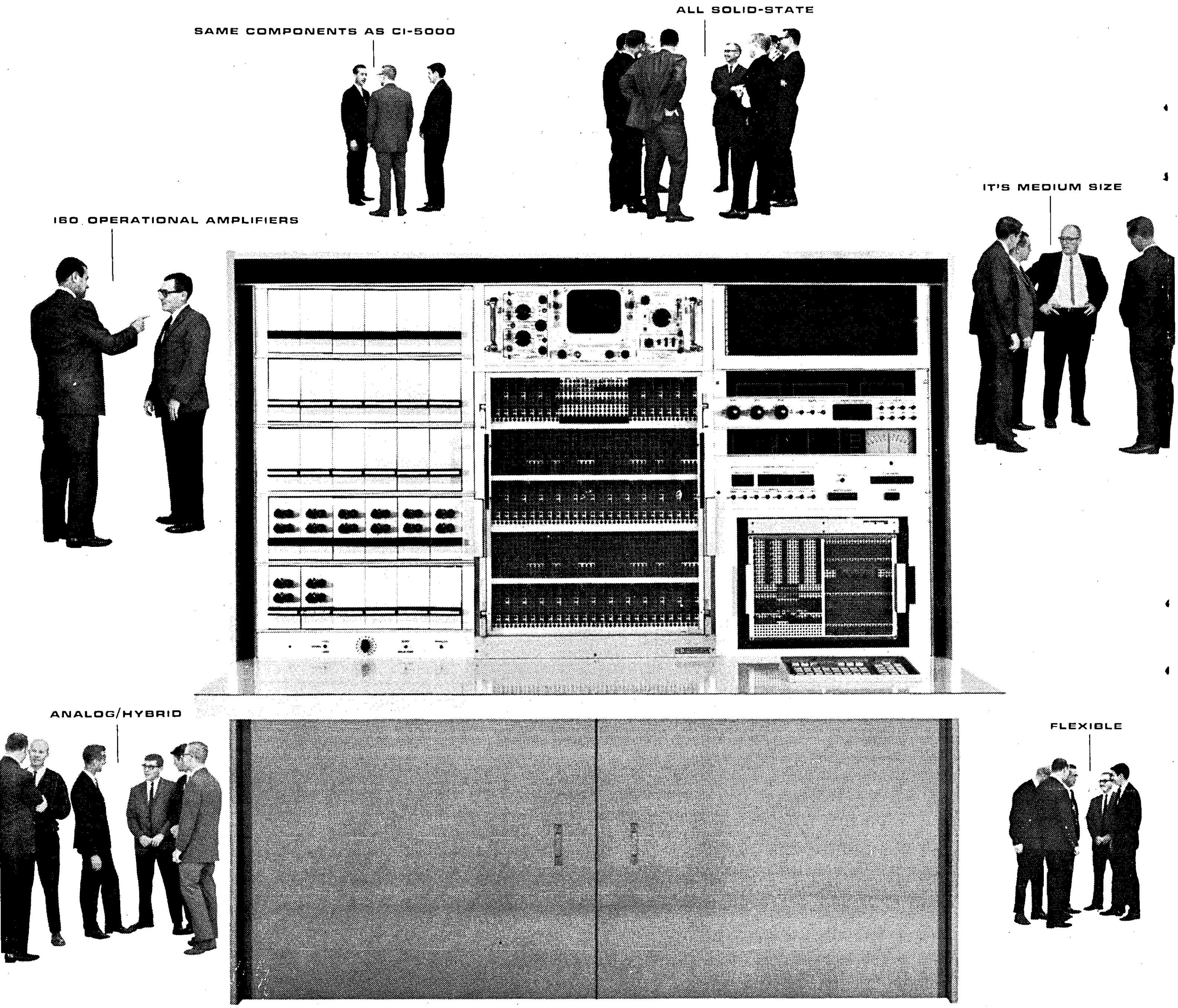
CITY __________ STATE __________ ZIP CODE __________

Please be sure to insert correct zip code CO22

CIRCLE 52 ON READER CARD

WHEREVER COMPUTER PEOPLE MEET—THE TALK IS...

THE NEW COMCOR Ci-500



First delivery of our newest system, the Ci-500 took place in October 1966. The Ci-500 is a medium-scale general-purpose analog/hybrid computer that will accommodate up to one-hundred and sixty 100-volt, 50-ma operational amplifiers. All computing components are identical to those used in the larger field-proven Ci-5000 system. High-speed digital logic circuits are used for address and control functions–the flexibility inherent in all COMCOR systems makes interface with digital equipment for hybrid operation simple and inexpensive. The Ci-500 is the perfect system for simulating and solving your research, development, production, and processing problems. For delivery date, see your COMCOR representative or contact COMCOR direct. (714) 772-4510 TWX: 714-776-2060.

COMCOR

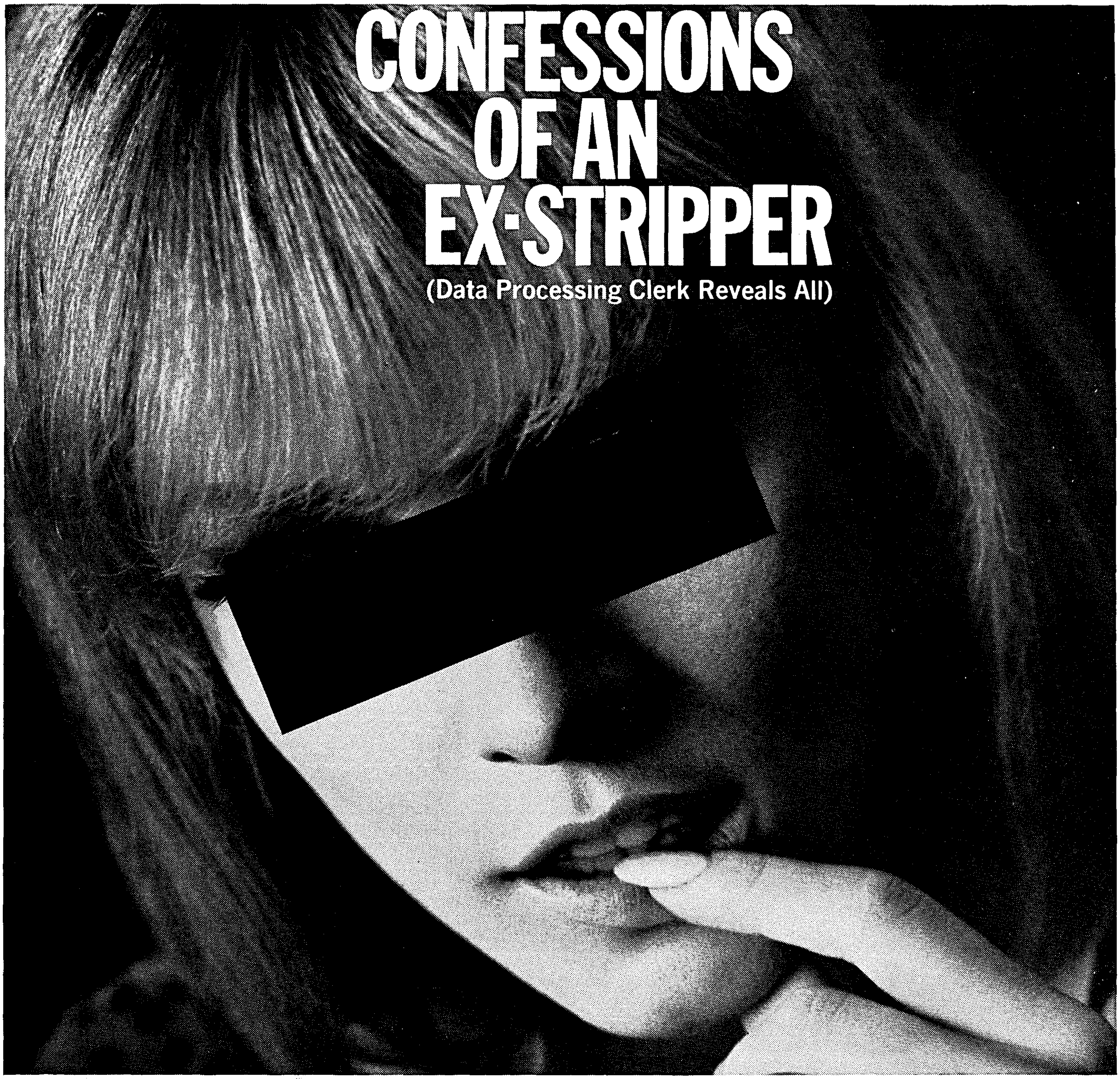
A SUBSIDIARY OF ASTRODATA, INC.

1335 SOUTH CLAUDINA STREET / ANAHEIM, CALIFORNIA 92803

PUT COMCOR IN YOUR PROGRAM

Career opportunities available now in engineering and marketing.

CIRCLE 44 ON READER CARD



"My mother used to tell me that data processing was good clean work for a young girl. She didn't know about the strip. I'll never forget that first day . . . I pointed to a thin sliver of paper that connected one continuous form to another and someone shouted "Take it off!"

That was just the beginning. Suddenly I realized that thin paper strip ran between every single business card form in the place. Thousands of them . . . piled up on the floor, stuffed in the baskets . . . it was a mess.

I had no choice. I developed my routine: Empty the trash cans, scoop up the strips, brush off my clothing . . . complain to our office manager. But it was all in vain until I mentioned money . . . how much of it was lost in

(Candid photo, 1964, shows Miss M________doing her routine.)

shipping, storing and processing those skinny little strips.

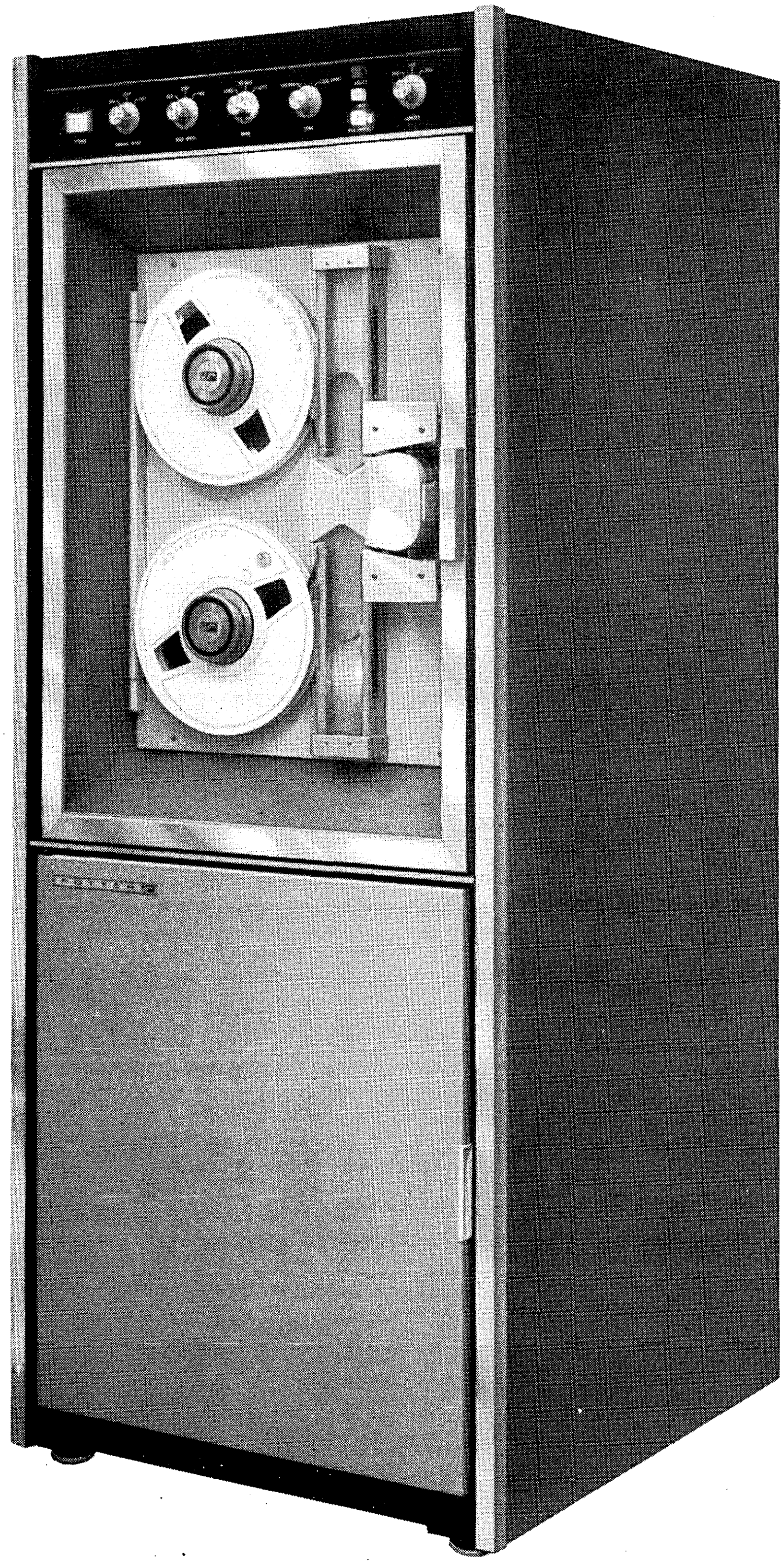
In the long run my routine was costing them plenty. They knew it was time for a change, and that's when Formscards entered my life. What a job they did! And without a single medial strip to clutter up the works (My boss said no other tab cards come clean that way).

Now everybody's happy. My routine is over for good, and I can't say that I miss it. Thank you, Formscards, you sure got me out of a mess!"

For the complete Formscard story call or write:
Forms, Inc., Willow Grove, Pa.,
(215) OL 9-4000/LI 9-6300.

CIRCLE 45 ON READER CARD

Qualified to meet Federal Standard 222 and MIL-16910A



New... field-proven Potter Digital Tape Transports for information security

Potter's MT-24 and MT-36 digital tape transports offering unrestricted tape speeds to 50 ips at packing densities to 800 bpi are qualified to meet the requirements of Federal Standard 222 and MIL-16910A. Field tested units installed in information systems are now in operation. Both the MT-24 and MT-36 transports are IBM-compatible for 7- and 9-channel tape formats.

For further information, write or phone General Sales Manager, Potter Instrument Company, Inc., 151 Sunnyside Blvd., Plainview, N. Y. 11803, (516) 681-3200.

PI-115

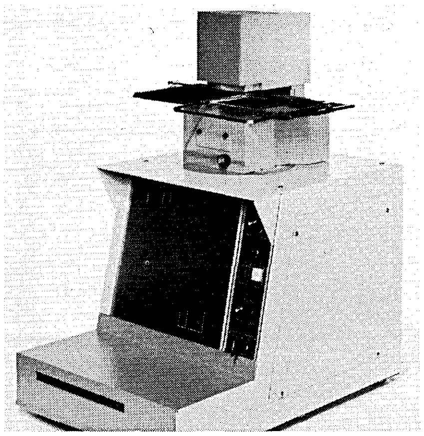
POTTER INSTRUMENT CO., INC.

CIRCLE 46 ON READER CARD

new products

microfiche reader-printer

The PFC-1A accepts any microfiche format up to 4 x 7⅜ inch and produces paper prints up to 8½ x 11 inches. The reader offers seven magnifications, projects the image onto an



11 x 11-inch screen, and has facilities for rotating the image 90° to the left and to the right. Delivery of the desk-top unit is to begin in June of 1967. EASTMAN KODAK CO., Rochester, N.Y. For information:

CIRCLE 100 ON READER CARD

gp computer

Based on the earlier 4900's hardware, the model 4901 Computing Simulator has additional wired-in instructions for special applications. It also has a real-time clock and d-a converters. With the exception of added features, it is program-compatible with the 4900. It features a 4K (18-bit) word core memory with a cycle time of 1.75 usec. Monolithic IC's are used throughout. Applications include the environmental testing of air and space crafts and the monitoring and controlling of closed-loop processes. Price of a basic system, including a mod 33 teletype unit with paper tape reader-punch, is $29,950. INFORMATION TECHNOLOGY INC., Sunnyvale, Calif. For information:

CIRCLE 101 ON READER CARD

petrochemical software

The Chemical Engineering Information Processing System (CHIPS) software package is designed to facilitate simulating the operations of all or parts of chemical or petroleum plants to find operating conditions desired. It contains a library of programs for most of the important unit operations of chemical engineering, as well as a language for describing chemical processes and designing solution procedures. SERVICE BUREAU CORP., New York, N.Y. For information:

CIRCLE 102 ON READER CARD

remote plotting

Remote on-line users with a 500 or 600 Series plotter can now add a controller and draw girlie (and other) pictures at speeds up to 280 incremental steps/second. The resulting Teleplotter configuration operates with a standard Dataphone adapter and teletypewriter, allowing 2-way communication with the remote computer and allowing switching, under program control, between plotter and teletypewriter. The user dials a time-shared computer, inputs all instructions, data, and plot programs through the TTY. In response, the computer prepares the plot program and outputs signals for remote on-line plotting. A manual interrupt capability permits the user to override and interrupt computer-controlled operations when required. CALIFORNIA COMPUTER PRODUCTS INC., Anaheim, Calif. For information:

CIRCLE 103 ON READER CARD

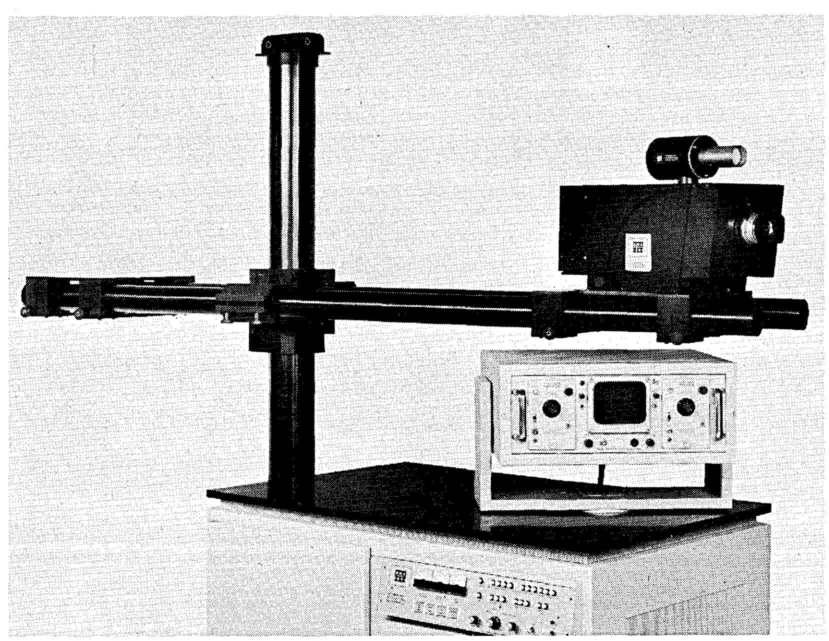
comm-line compensators

The SC-307A and 307B are 6- and 12-section line compensators for high-speed digital data transmission systems, designed to correct the effects of phase and amplitude distortions

PRODUCT OF THE MONTH

The Computer Eye is a real-time optical input system that consists of a TV-like camera, CRT, and gp computer. It is designed to interpret real world scenes at varying distances and under varying light conditions. The sensor element is a 3-inch-diameter image dissector phototube; it differs from a TV camera in that, under computer control, it selectively examines points in its field of view. Resolution across the field of view exceeds 1,200 lines. The developing image is shown on the CRT for monitoring and action by the operator. Developed to date is only basic software: scene digitization, microscan, and various line finding and tracking programs. More R&D are due at MIT and Stanford, recipients of the first two units. Still in a developmental phase, the system has a potential as the control element in the manufacturing/fabrication industry. INFORMATION INTERNATIONAL INC., Cambridge, Mass. For information:

CIRCLE 104 ON READER CARD



**You'd recognize many of our systems programmers by their reputations.
Join us and work with the men you've heard about.**

Some of them weren't well-known when they came to RCA.

But we offered them opportunities and challenges.

We offered them a say in hardware design.

We offered them a variety of projects with definite objectives.

We offered them something to hang a reputation on.

And the rewards that come with it.

Aren't you ready to make your reputation?

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.

Contact Mr. E. B. Schultz, Dept. SW-19, RCA Electronic Data Processing, Bldg. 202-1, Cherry Hill, Camden, New Jersey 08101.

An Equal Opportunity Employer M & F

The Most Trusted Name in Electronics

CIRCLE 302 ON READER CARD

new products

in phone transmission line facilities. They use independent active correction sections located throughout the 300 to 3,000 cps passband. These sections can be independently adjusted. ELECTRONICS DIV., GENERAL DYNAMICS, Rochester, N.Y. For information:

CIRCLE 105 ON READER CARD

gp software

Desectored, relocatable software for the PDP-5, 8, and 8-S computers include a one-pass assembler, FORTRAN II compiler, and library of gp subroutines. The assembler and compiler produce relocatable object code that can be linked by a relocatable loader. INFORMATION CONTROL SYSTEMS INC., Ann Arbor, Mich. For information:

CIRCLE 106 ON READER CARD

printout binder

Plastic covers for printout sheets are made from Super Dylan, a high-density polyethylene with a ridigity that allows the binder to be stored vertically on shelves. It comes with an aluminum channel and plastic keeper that comprises the locking mechanism, as well as an aircraft cable post assembly. Binders have sheet capacities of 3, 5, and 7 inches, 19 sizes for burst and unburst sheets. FLEX-A-BIND CORP., Pittsburgh, Pa. For information:

CIRCLE 107 ON READER CARD

optical addresser

The 60-16 optical addresser, reading from a standard punched card with the address written or typed on it, can optically print addresses on heat transfer tape at up to 18,000 an hour. The unit can be programmed by plug board to sort desired cards (masters) at up to 36,000 an hour and to stop at predetermined points to create the address tape or permit statistical analysis. ELLIOTT BUSINESS MACHINES, INC. Randolph, Mass. For information:

CIRCLE 108 ON READER CARD

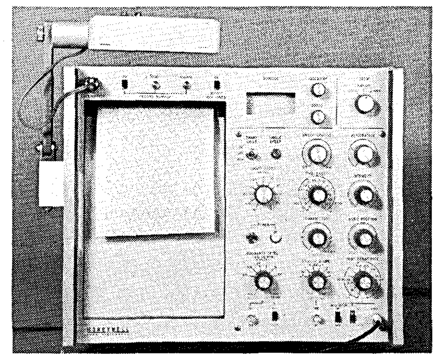
emulation software

The 40X package, for 360/40 users who are emulating 1401/1460 programs, reportedly speeds up emulator operation by 20-75%. Using disc spooling and multiprogramming techniques, the package is said to enable the running of some programs that cannot go under regular emulation because of critical timing problems. It requires a mod 40 with at least 65K bytes of memory, a 2311 disc and typewriter. Among its features is its ability to reprint a complete page or part of a page without reprocessing the page, and to print the last page of a report first to check controls for accuracy. COMPUTER USAGE DEVELOPMENT CORP., Mt. Kisco, N.Y. For information:

CIRCLE 109 ON READER CARD

oscillograph

The model 1806 is a fiber-optic CRT oscillograph—a direct-write, single-channel, 4-axis unit that measures high-frequency analog or video data. The solid-state unit has a writing speed of more than 1 million inches/second—reportedly 100 times great-



PROGRAMMERS

Reynolds Electrical & Engineering Co., Inc., a large construction, engineering, and diversified firm, has a need for Programmers in our Las Vegas, Nevada Offices.

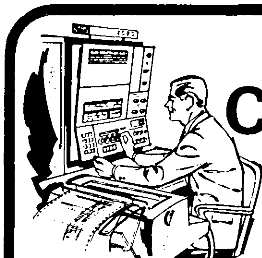
We would prefer a degree from an accredited college in Mathematics, Accounting, or Business Administration, and a minimum of 2 years recent experience in Maintenance Application Programming with tapes on 1401 and 1410.

Excellent salary and fringe benefits including insurance, retirement plan, liberal vacations, sick leave, and advancement opportunities. Interview and relocation expenses paid successful candidates.

Inquire in complete confidence. Please send summary of experience and salary history to:

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
P. O. Box 1360
Las Vegas, Nevada 89101

An equal opportunity employer



Free COMPUTER CAREER BULLETIN

Our Computer Career Bulletin is truly unique. It is prepared by our staff of recognized professionals each of whom has had extensive "hands on" computer exposure and who regularly consult with industry in matters relating to computer organizational planning and staffing.

The digest is comprehensive and will allow you to examine in detail the broadest possible range of computer opportunities and their long range potential existing across the nation. You will find the bulletin an excellent gauge for measuring the progress of your career to date in terms of responsibility, exposure and compensation. Salaries range from $8,400 to $25,000 per year.

For immediate consideration, please forward a detailed experience resume, including position desired, salary history and requirements, and any geographical preferences and/or restrictions. All inquiries will be held in strict confidence.

source edp

In San Francisco —
Mike Parr, 111 Pine Street, Suite 1015, (415) 434-2410
In Chicago —
Dave Grimes, 100 S. Wacker Drive, Suite 212, (312) 782-0857
CLIENT COMPANIES ASSUME OUR CHARGES

CIRCLE 304 ON READER CARD

3M TASK FORCE Reports: Microfilm developments in Electron Beam Recording Technology

Why did 3M scientists decide on direct electron beam image formation for their new EDP recorder?

Because an electron beam can write on output medium as fast as the tape unit can transfer the digital data? Or because the beam can write characters with strokes 1/10th as wide as the diameter of a human hair, or as broad as those made with a dull number 2 pencil? Did the promise of a highly efficient system attainable by direct electron beam recording influence their decision?

All of the above are important features of the new 3M Series F Electron Beam Recorder. But they're not the reasons, per se, for selecting electron beam technology. The motive was much more basic than that: 3M wanted to build the EDP output recorder that computer users have been waiting for since the first day they had a backlog of computer printout.

Does an output recorder (printer) capable of writing at speeds up to 20,000 lines per minute on output media costing 1/10¢ per page sound like an answer to your EDP printout bottleneck? We're betting it does. But we're also betting that years from now you won't be satisfied with this speed, and you'll probably want to cut costs still more. That's why we at 3M are so enthusiastic about electron beam technology. With it, our research indicates, we can build electron beam recorders that keep pace with today's computers . . . and those of tomorrow.

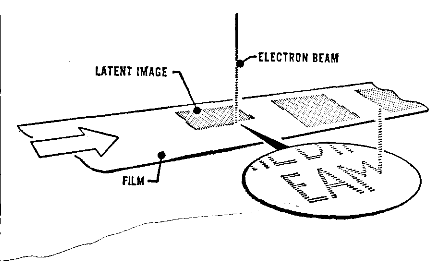
Earlier we said an electron beam can write characters with smaller than hair-sized strokes. But are these micro-characters large enough to read? Yes, if the output medium is versatile, space-saving microfilm. With modern microfilm printers (3M builds these, too) hard copy is available in 4 to 6 seconds . . . with the press of a button. And to just look at a microfilm image using a viewer takes no longer than a look at a piece of paper. If you haven't been exposed to microfilm yet, talk to someone who has. Ask him how much space and time microfilm saves him.

Scientists, engineers and EDP people are always interested in efficiency. A highly efficient technique or system gives them the latitude to expand the capabilities of their project, be it a machine design, formulation or an EDP program. Not being restrained by an inefficient image recording method allows the designers of the 3M EBR to concentrate on accelerating printout speeds and other equipment advantages not possible with less efficient recording methods.

If direct electron beam recording is a panacea for EDP printout ills, why hasn't it been tried before now? It has. The technology dates back to the 1920's, and theories were presented 50 years before that. But before the computer there was no need for ultra-fast direct recording on photographic media. And when the computer age arrived, the problem was spanning the barrier between a complex laboratory model and a practical commercial recorder. 3M accomplished this by developing a unique seal between the output medium and the high vacuum inside the electron gun column, and in developing an electron beam medium suitable for EDP output. That medium is 3M Dry-Silver Microfilm.

Is 3M Dry-Silver Microfilm the ideal output for EDP systems?

Its characteristics certainly indicate it is. Resolving capability exceeds 1,000 lines per millimeter (compared with 250 lines for conventional silver-halide microfilm). The film is developed with heat, so there's no developer solution to contend with. The output of the EBR is processed microfilm, ready for use or duplication. Our standard EBR format — 16 mm roll microfilm — has long been a standard in the microfilm industry. It can be loaded into easy-to-use cartridges. Other formats are possible, too.



The Electron Beam "writes" a latent image on Dry-Silver Microfilm.

Do you want to learn more about electron beam technology and Dry-Silver Microfilm?

We would like to learn more about your needs, particularly if you feel they can be met with EDP peripheral equipment. Here's our offer: Send us a letter outlining your present EDP bottlenecks. We'll respond by sending you a useful information manual on electron beam recording and Dry-Silver Microfilm.

Write to:
3M Company
Attention: Rolf Westgard
(612-733-4995)
2501 Hudson Road
Dept. FDJ-17
St. Paul, Minnesota 55119

3M COMPANY

CIRCLE 47 ON READER CARD

er than any existing oscillographs—and a transient rise time of 350 nanoseconds. The Visicorder uses the electron beam of a fiber-optic CRT to record on 6-inch-wide paper. HONEYWELL TEST INSTRUMENTS DIV., Denver, Colo. For information:

CIRCLE 110 ON READER CARD

mini-computer

An overcoat-pocket-sized aerospace computer, the 449 has an integral entry keyboard, display, and batteries. It has a memory capacity of 4K (24-bit) words and a repertoire of 36 instructions. The basic processor is a 4-inch cube, weighs four pounds, but with battery pack, keyboard and display it weighs 12 pounds, elongates to nine inches. It features parallel path transfers and interrupt capability. CONTROL DATA CORP., Minneapolis, Minn. For information:

CIRCLE 111 ON READER CARD

ruggedized core stack

The militarized SEMSTAK (severe environment memory system) packs cores 12 to the inch, compared to the usual 8/inch, and has a capacity of 16K words of "any bit length." A 4K 24-bit stack using 30-mil cores measures 3 x 3 x 2 inches and weighs 18 ounces with mounting hardware. It meets NASA's NPC 200-4 requirement on the soldering technique used, and Mil-E-5400's temperature, shock and vibration requirements. ELECTRONIC MEMORIES INC., Hawthorne, Calif. For information:

CIRCLE 112 ON READER CARD

drum memory

The type 1116 drum memory system has a capacity of more than 12.5 million bits, adaptability to 16-, 18- and 24-bit-word systems, an average access time of 8.3 msec, and a read/write capability of 1-16 64-word blocks with two IOT commands. The storage cost is said to be 0.35 cents per bit. VERMONT RESEARCH CORP., North Springfield, Vt. For information:

CIRCLE 113 ON READER CARD

curve tracer

The model 3400 digitizer is designed for the reduction of analog graphic data to digital form. While the operator manually traces the curve, X and/or Y plus and minus coordinate values are automatically recorded at operator-selected increments onto mag tape, paper tape, or punched

We're working in, over and out of this world.

Instrumentation Laboratory Massachusetts Institute of Technology

The scope of activities at MIT Instrumentation Laboratory has never been greater, nor has the diversity and number of our professional opportunities. We are currently engaged in mission analyses, systems design and hardware development for several pioneering projects, including Deep Submergence Systems, POSEIDON and APOLLO.

As a member of the Laboratory's professional staff of over 600 you can work on problems — from conceptual definition to prototype hardware — that demand your maximum abilities. Our organization is comprised of engineers, mathematicians and physicists who work in an environment known for its strong group and individual autonomy.

Staff salaries are competitive, benefits are liberal, and MIT graduate courses — at full salary and with generous tuition assistance — are within a short walk from the Laboratory.

Staff assignments exist at the B.S., M.S., and Ph.D. level across a broad span, with particular emphasis on the following:

OPTIMAL CONTROL THEORY

SYSTEMS SIMULATION

HYBRID APPLICATIONS

REAL TIME PROGRAMMING

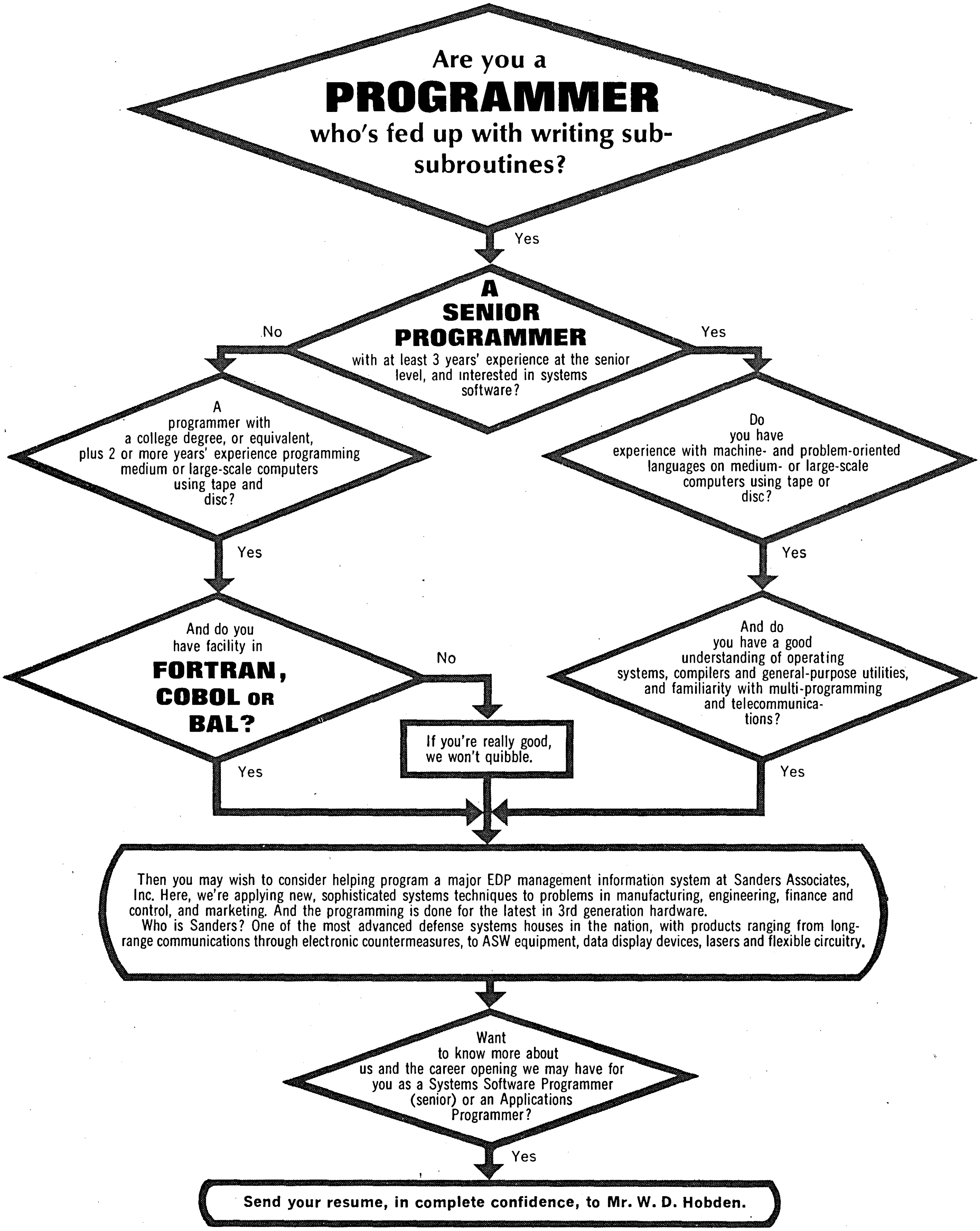
DIGITAL/ANALOG CIRCUITRY DEVELOPMENT

INERTIAL COMPONENT DEVELOPMENT

ELECTRONIC PACKAGING

Your resume will receive immediate, thoughtful consideration. Reply to Mr. John D. McCarthy, Professional Staffing, Building D, 68 Albany Street, Cambridge, Massachusetts. An equal opportunity employer.

CIRCLE 306 ON READER CARD



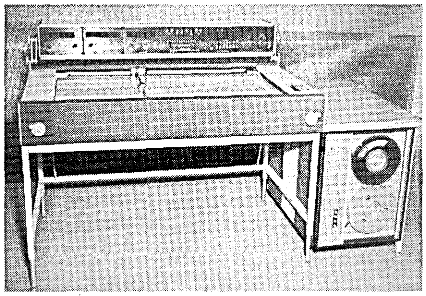
SANDERS ASSOCIATES INC.

NEW DIRECTIONS IN ELECTRONICS SYSTEMS

An Equal Opportunity Employer (M&F)

Nashua, New Hampshire

new products



cards. Data formatting is accomplished by a patch panel, and resolution is reportedly 0.001 inch, accuracy ±0.002 inch. AUTO-TROL CORP., Arvada, Colo. For information:

CIRCLE 114 ON READER CARD

linear programming

LP/360 is a linear programming system for the 360/30, 40, and 50 computers. Its capabilities include optimization, report writing, matrix and report generation, parametric programming, separable programming, file maintenance, and debugging aids. It requires a configuration with at least 16K, four tape drives, card reader-punch, and printer. Programmed in assembly language, LP/360 has its own monitor. HAVERLY SYSTEMS INC., Denville, N.J. For information:

CIRCLE 115 ON READER CARD

data transmission

An addition to the System 311 transmission hardware is an optional card reader, making possible direct transmission from 80-column cards or the conversion of card data to paper tape. Card read speed is 80 columns/second, and the data is punched either locally for later transmission or remotely via telephone in a standard binary-coded 8-level paper tape. When converting cards to tape, the 311 may be used to skip certain fields in any of the cards. TALLY CORP., Seattle, Wash. For information:

CIRCLE 116 ON READER CARD

acoustic coupler

The Audio Magnetic Data Transceiver makes it possible to use a Teletype as a portable remote computer terminal. As long as a time-shared computer is connected through a mod 103AII dataset, the user can go wherever a phone is available, dial in, and be on the air. The transceiver operates with a mod 33 or 35 teletype. If features acoustic send/magnetic receive, with acoustic receive optionally available, and operates either half or full duplex. The 4-pound unit has a maximum transmission rate of 165 baud. TYMSHARE INC., Los Altos, Calif. For information:

CIRCLE 117 ON READER CARD

accounting software

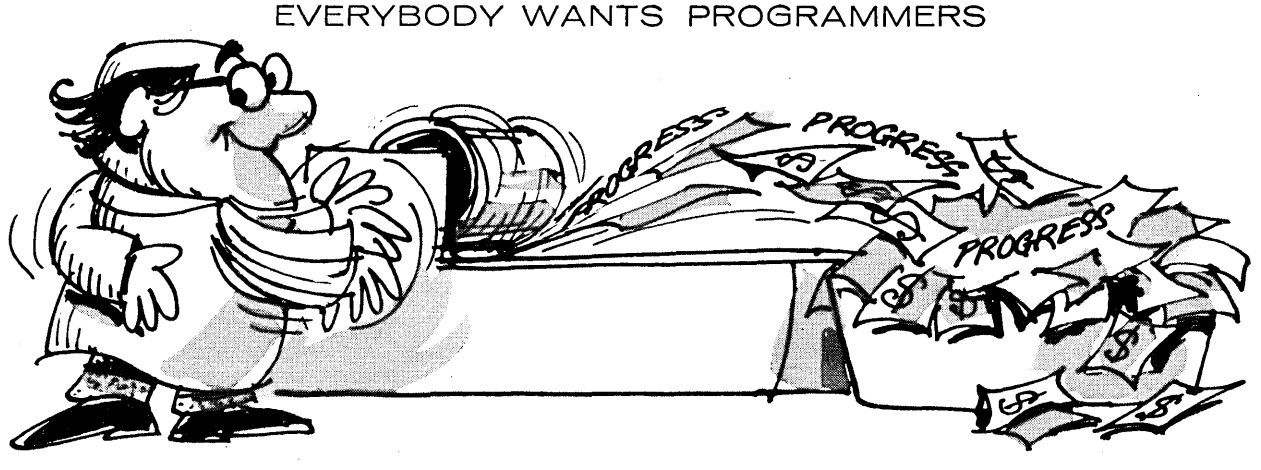
A business dp system, the EXPAND (extensive processing of alphanumeric data) software package operates on IBM 1130 systems with a minimum configuration consisting of an 8K 1131 (mod II) processor, disc, printer and card read-punch. The package includes payroll processing, job cost accounting that encompasses labor and material distribution. Also available are subsystems such as a generalized sort package and the payroll system. COMPUTER COMMUNICATIONS INC., Inglewood, Calif. For information:

CIRCLE 118 ON READER CARD

compact computer

The second processor in the 8000 family, the 8816 is a 16-bit machine with optional memory protect and parity bits, the addition of which makes it fully compatible with the IBM 1800 computer. The basic system includes

EVERYBODY WANTS PROGRAMMERS



WE WANT PROGRAMMERS WHO WANT TO MAKE PROGRESS AND MONEY

Systems Analysts — Junior and Senior

Development of advanced new Philco-Ford computer systems has resulted in the rapid expansion of our software systems development, creating unusual opportunities for experienced and creative staff members.

Senior and Junior Staff positions require programming experience on large scale systems listed here.

• Compilers and other procedural translators • Systems for Computer Aided Design • Applications of statistical analysis • Information retrieval systems • Simulations systems • Systems for Computer Aided Instructions applied to education • Time Sharing Systems • Executive systems, including capabilities for multi-programming and time sharing of high powered central systems by remote terminals.

Business Systems

SYSTEMS DESIGN SPECIALIST/MANAGEMENT INFORMATION SYSTEMS ANALYST: Requires Bachelor's Degree in Mathematics or Engineering, with three years of experience in Business Systems Design, using FORTRAN II & IV to design and develop major operational research Simulation Models, to solve Management Decision Gaming Models.

SR. METHODS AND PROCEDURES ANALYST: Requires degree, with three years, or more, of experience in Methods and Procedures Systems, with emphasis on production control, material management and engineering applications.

In addition to excellent starting salaries, you will enjoy an unusual group of extra benefits, including a Philco-Ford Product Purchase Plan (Stereo, TV & Cars) and, most important of all, you will continue to reap the benefits of your own efforts.

For a confidential interview, please call: Mr. J. Heisel, area code (215) 758-2847, or mail your resume to him at Philco-Ford Corporation, Communications & Electronics Division, 4700 Wissahickon Avenue, Philadelphia, Pa. 19144.

PHILCO Ford

COMMUNICATIONS & ELECTRONICS DIVISION
An Equal Opportunity Employer M/F

CIRCLE 307 ON READER CARD

Here's your chance to join one of several top experimental teams working in high-energy particle physics.

Scientific Programmers

Work will focus on developing programs for analysis of experimental data. Specifically, you'll be involved in developing, maintaining and optimizing applications programs and operating systems dealing with graphic output and real-time data processing. Additional responsibilities include some numerical and statistical analysis.

Candidates should have a Bachelor's degree in Computer Science, Mathematics, or Physics, and some related experience in scientific applications.

Located on the western part of the campus among rolling hills, the Linear Accelerator Center is operated by Stanford University as an international research center. The Center is now beginning important experimental work and welcomes applications from qualified programmers.

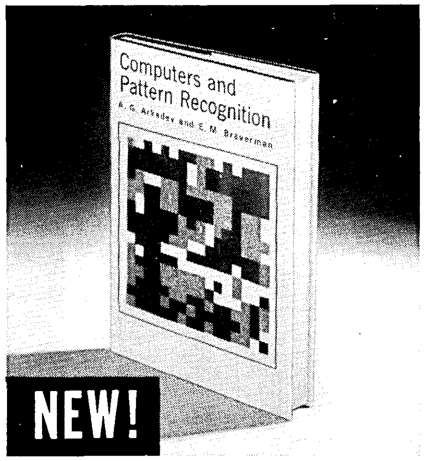
Write or send résumé in confidence to G. F. Renner, Professional Employment Manager, Stanford Linear Accelerator Center, P. O. Box 4349, Stanford, California 94305. SLAC is an Equal Opportunity Employer.

STANFORD LINEAR ACCELERATOR CENTER

CIRCLE 308 ON READER CARD

FROM THOMPSON—JUST PUBLISHED—TIMELY AS TOMORROW!

Computers and Pattern Recognition



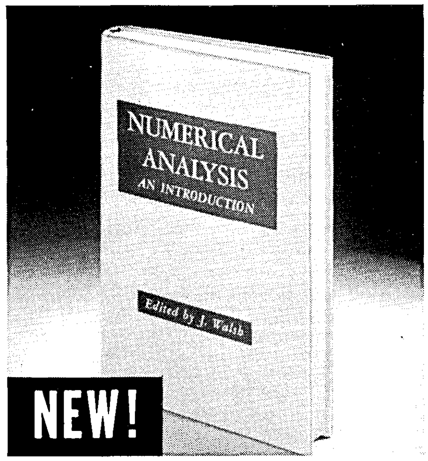
from the U.S.S.R.—current work on pattern recognition and its relation to relevant research in the West...

by A. G. Arkadev and E. M. Braverman (Translated from the Russian by J. D. Cowan and W. Turski)

This book fills an important need for up-to-date information about Soviet developments in a rapidly-growing field. The underlying assumption throughout is that images form "compact" sets in a suitable representative "space" whose "coordinates" are the distinct "features" of the patterns presented to the machine. The image-compactness hypothesis is used as a point of reference for the analysis of different designs for the construction of pattern-recognizing machines. The algorithms underlying two well-known Western machines, the PERCEPTRON and the PAPA are also discussed in terms of this hypothesis. **Contents include: Dissecting Planes Algorithm; Algorithms Based on Potentials Method; Possible Ways of Further Improvement of Cognitive Machines.**

125 pages, $5.50

Numerical Analysis - An Introduction



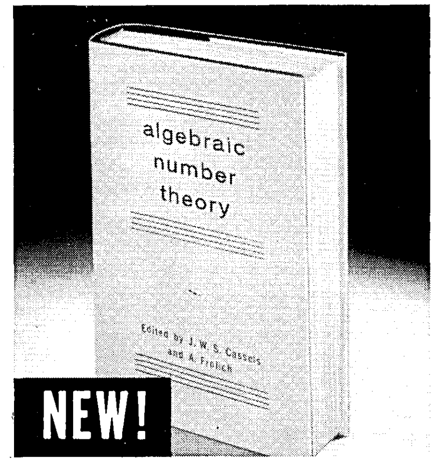
for scientists, engineers and mathematicians—an introduction to developments of the past fifteen years...

Edited by J. Walsh, Dept. of Mathematics, the University, Manchester, England
(Based on a Symposium organized by the Institute of Mathematics and Its Applications, held in Birmingham, England)

Individual chapters in this book are largely self-contained. The account of theory and methods is sufficiently detailed for readers who want to go further to study the more advanced works listed in the references. Subjects covered include linear algebra and the eigenvalue problem, ordinary and partial differential equations, methods of approximation and function minimization, and some applications of modern techniques to industrial problems. A concluding chapter considers the effect of the growth of numerical work on teaching. **Contents include: Applications of Computers to Pure Mathematics; Techniques of Operational Research; Computation in School and University Teaching.** There are two complete indexes, one classified by subject, the other by author.

240 pages, $12.00

Algebraic Number Theory



for the non-specialist algebraist and number theorist—a grounding in contemporary basic theory

Edited by J. W. S. Cassels and A. Frohlich
(Proceedings of an Instructional Conference organized by the London Mathematical Society—a NATO Advanced Study Institute—with the support of the International Mathematical Union)

The opening chapters in this work give a broad inrtoduction to algebraic number theory; followed by the elementary and utilitarian tools needed for class field theory. The section on class field theory should dispel forever the aura of mystery which has previously surrounded the subject. The emphasis throughout is on intelligibility; the reader who has mastered what is done here can approach the rest of the literature with confidence. The concluding chapter is Tate's thesis (Princeton, 1950), which has been seminal for later developments but was never published. **Contents include: Cohomology of Groups; Zeta-functions and L-functions; Semi-simple Algebraic Groups; Applications of Computers to Class Field Theory; Fourier Analysis in Number Fields.**

350 pages, $16.00

Order yours today!

THOMPSON BOOK COMPANY

383 National Press Building
Washington, D. C. 20004

Please send me_____copies of "Computers and Pattern Recognition" .... $_____
☐ Check _____copies of "Numerical Analysis—An Introduction" .... _____
☐ Cash _____copies of "Algebraic Number Theory" .... _____
☐ Money order Total $_____
Name_____
Address_____
City_____ State_____ Zip_____

4K of core, three hardware index registers, six priority interrupts with an I/O rate of 666,000 words/second, and an ASR-33 teletype. Memory is expandable to 32K, all directly addressable. Hardware multiply and divide speeds are 4 and 5 usec, respectively. Optional is a programmable data channel allowing the use of up to 254 I/O devices.

Software includes FORTRAN and a real-time monitor. The 8816 is compatible with System 8000 peripherals, which includes cards, tapes and discs, and a line of communication and control interfaces. Basic price is $18K. DATA AND CONTROLS DIV., LEAR SIEGLER INC., Melville, N.Y. For information:

CIRCLE 119 ON READER CARD

core memory system

The CE-100 has 1-usec cycle time and is available in 1, 2 and 4K capacities with word lengths from 4 to 36 bits in 4-bit increments. Expansion is accomplished by adding bit-oriented plug-in logic boards and selection of magnetic modules. After the system is in use, the user reportedly can change his design by specifying additional modules or stacks. Maximum power consumption for the full-size system is 325 watts, proportionately less for smaller systems. LOCKHEED ELECTRONICS CO., Los Angeles, Calif. For information:

CIRCLE 120 ON READER CARD

impact printer

The 990 Minityper is a 48-column impact printer with speeds up to 1200 lpm (alpha-numeric) or 2400 lpm (numeric). The unit will accept input codes up to six binary digits and can have serial or parallel bit entry. Electronics for full-line buffer are available. SHEPARD LABORATORIES, INC. Summit, N.J. For information:

CIRCLE 121 ON READER CARD

repackaged computer

Version two of the 810A computer, though identical in logic, memory size, and speed to the original model, has been repackaged to provide size and price reduction and increased reliability. By using functional i.c. logic cards, each with four-five times more elements than on a standard card, the number of cards is reduced from 378 to 124. Wiring connections are reduced from 22,000 to 4,000. And the size changes from 48 inches high, 37 deep, and 72 wide, to 62 by 26 by 23¼ inches. The price for a 4K model (available memory size from 4-32K) is $23,950, down from $35,500. A standard option not available before is ASR 35 teletype. Deliveries begin in March. SYSTEMS ENGINEERING LABORATORIES. Ft. Lauderdale, Fla. For information:

CIRCLE 122 ON READER CARD

utility programs

For users of the IBM 1130 computer systems, the following software packages are available: disc sort, Pert/CPM, and a mag tape utility program. The configuration required is an 1130 mod II disc system with a card read-punch and printer. ASSOCIATED SYSTEMS RESEARCH CO. INC., Union, N.J. For information:

CIRCLE 123 ON READER CARD

delay-line computer

A gp digital computer, the LC 1000 uses a magnetostrictive delay line for a memory, and stores from 512 to 4K words accessible in an average 2.5 msec. Word size is 16 bits, but the machine automatically works in a double-precision mode, giving 32 bits of precision (nine decimal digits). The

HUGHES TOOL COMPANY
Aircraft Division
OPPORTUNITY FOR
SR. BUSINESS SYSTEMS ANALYSTS
&
BUSINESS SYSTEMS ANALYSTS
TO JOIN THE FASTEST-GROWING HELICOPTER MANUFACTURER
Expertise is required in the following business applications areas:
ENGINEERING SPARES
MANUFACTURING ACCOUNTING
RELIABILITY MATERIAL CONTROL
Relocation and Travel Allowances
Please telephone, apply in person or forward your resume to:
MR. H. A. HAMILTON
Employment Supervisor
UPton 0-3361 or EXmont 8-2771
HUGHES
TOOL COMPANY
Aircraft Division
11940 W Jefferson Blvd., Culver City, Calif. 90230
An equal opportunity employer U.S. citizenship required
CIRCLE 309 ON READER CARD

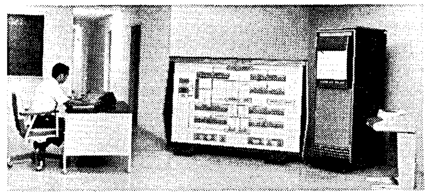
UNIVERSITY OF MISSOURI
COMPUTER RESEARCH CENTER
The University of Missouri Computer Center has immediate openings for System, Mathematical and Statistical Analysts on a permanent basis. A major expansion of existing computer facilities, to include one of the largest multi-processing time share systems planned in the midwest, will create exceptional opportunities for qualified personnel; plus the opportunity to add substantially as consultants on major research projects. Publication of technical papers encouraged.
Benefits include basic retirement, health plans and opportunities for educational advancement. Salaries competitive with industry.
Interested personnel with minimum of B.S. or B.A. in Physics, Engineering, Math or Statistics plus two years experience are invited to submit resume, including salary information to:
Dr. Roy F. Keller
Professional Building
Computer Research Center
University of Missouri
Columbia, Missouri
CIRCLE 310 ON READER CARD

instruction repertoire has 29 instructions, including a return instruction for subroutine linkage. There are 11 registers displayed, each of which can be individually set or cleared by the operator, and a single-command mode allows the operator to step through a single instruction. Add time is 5 msec, and multiply time is 9.5 msec average. Software includes a symbolic assembler, and peripherals include a 130-lpm printer, 16-megabit disc file, and paper tape I/O. A 512-word system with ASR 33 Teletype unit sells for $8,990 ($222 monthly), and a 4K system sells for $13,130. Delivery is in 90-120 days. LOGIC CORP., Palmyra, N.J. For information:

CIRCLE 124 ON READER CARD

computer trainer

The 6F5 digital trainer consists of a 4 x 6-foot display, Data/620 computer and Teletype unit. The display panel, visible up to 30 feet, contains a color-coded computer organization diagram. As each instruction is executed, the display shows with lighted areas the register contents, information flow, and the cycle, phase and mode of the operation. Demonstrations include program interrupt applications and common addressing modes, including direct, indirect, immediate, indexing and relative addressing. Options per-



mit demonstration of byte and extended addressing. DATA MACHINES INC., Newport Beach, Calif. For information:

CIRCLE 125 ON READER CARD

crt buffer

DDI buffer stores up to 67,000 bits at a 2 mHz bit rate. System recirculation rate is 33 msec. The package consists for four magnetostrictive delay lines, each with read, write and re-timing electronics, and has a separate interface board. The buffer may be connected in series, parallel and serial-parallel. DIGITAL DEVICES, INC., Syosset, N.Y. For information:

CIRCLE 126 ON READER CARD

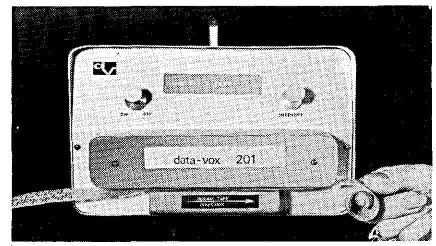
bank teller set

The model 370 teller terminal is an on-line banking unit that can accumulate up to 10 transactions (account number, transaction code, date and amount) when communications lines go down, and transmit them when the system is back on the air. It has a 9x9 numeric keyboard and 12 control key indicators, reportedly can handle 100 different transactions. In one second, it prints a 28-character passbook and 28-character journal tape entry. The desk-top unit, which requires at least a 16K system, comes with a teller-unit monitoring software for the 200 series computers. HONEYWELL EDP, Wellesley Hills, Mass. For information:

CIRCLE 127 ON READER CARD

tape editor

The model 201 enables scanning of a 16-character segment of punched tape, displaying the alphanumerics on a CRT for viewing. The message field on the screen remains stationary or travels in either direction as the tape



is moved. The portable unit is adaptable to 5 through 8-level tapes of all kinds, and has an optional tape spooler, either motorized or manual. DATA-VOX CORP., Sarasota, Fla. For information:

CIRCLE 128 ON READER CARD

THINK YOU'RE WORTH ~~$10,000~~ A YEAR OR BETTER?

~~$12,000~~ $15,000

THEN YOU ARE!

The biggest obstacle to overcome is to convince yourself you're worth more money. Once your confidence is built up then you're ready to handle the challenges of management.

But how do you evaluate your present wage scale and your potential earning power? How do you find the better jobs . . . the choice openings?

Simple. Just contact us, Management Information Systems. We're the people who have access to the best jobs in the country. Because we have 25 affiliated offices in all the major markets . . . all finding those better paying positions for which you are qualified. All reporting to our Cleveland Center, monthly, the positions available in Systems and Data Processing.

Here's all you have to do to stay on top of the available jobs in your field. Circle the reader service card number or write directly to us. Every month you'll receive, absolutely *free,* the Management Information Systems Job Bulletin. It keeps you up to date on the best jobs in the nation! And it is strictly confidential! No obligation!

All placement charges are paid by the employer, so this entire service is *free* to you.

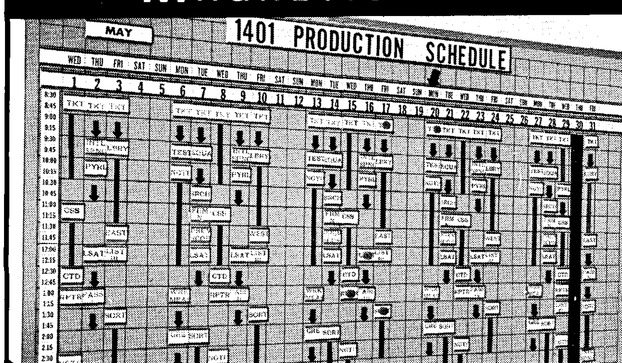
Don't delay any longer. If you really feel you're worth more money, contact Management Information Systems today! *We'll see that you get it!*

Management Information Systems

A DIVISION OF MANAGEMENT RECRUITERS INC.
1001 EUCLID AVE./CLEVELAND, OHIO 44115

CIRCLE 311 ON READER CARD

COMPUTER SCHEDULED MAGNETICALLY



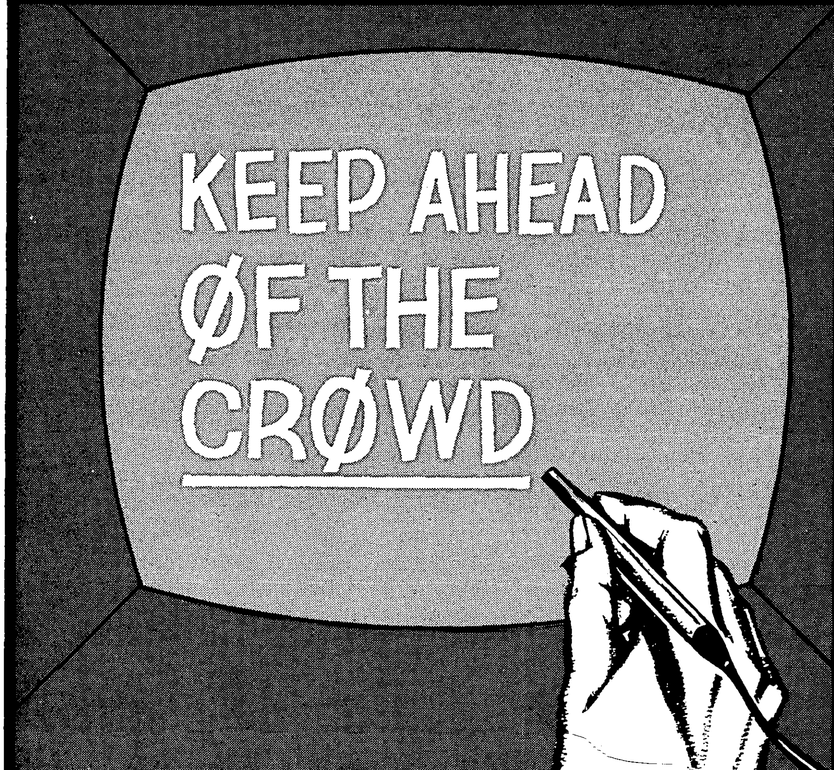
- Keep your computer running—not idle.
- Schedule in 6, 10, 15 & 30 min. cycles, for daily, weekly or monthly periods.
- Know in advance when slack periods or heavy work loads are coming.
- Make changes & additions immediately.
- Every hour saved saves you $20-$40-$60.

Write for FREE 28 Pg. Illustrated Catalog—DA1

METHODS RESEARCH CORP.
70 Willow Ave., Staten Island, N. Y. 10305

CIRCLE 34 ON READER CARD

ENGINEERS • MATHEMATICIANS • PROGRAMMERS



...IN OUR COMPUTER-BASED ENGINEERING ANALYSIS AND DESIGN SYSTEMS.

You can. Because there's no room for mediocrity in our demanding, long-range programs. If sophisticated scientific programming technology is your long suit, you'll like what you see at Sikorsky Aircraft. And there's plenty of "elbow room" for rewarding growth.

Would you like to work with stimulating, top-talent people . . . on abundant and provocative challenges that add spice to our exciting environment? You would be applying your professional talents to specifying, designing and implementing advanced computer-based helicopter analysis and design systems. And our large-scale scientific computers would translate your boldness and imagination into systems which span the spectrum of engineering . . . from concept to production.

Keep ahead? You could take giant strides with us.

CURRENTLY AVAILABLE OPPORTUNITIES:

Technical Automation Analyst—Salary range $9,000 to $14,000. Experienced in the study, specification and design of computer-based engineering systems. Degree in engineering required, with M.S. preferred.

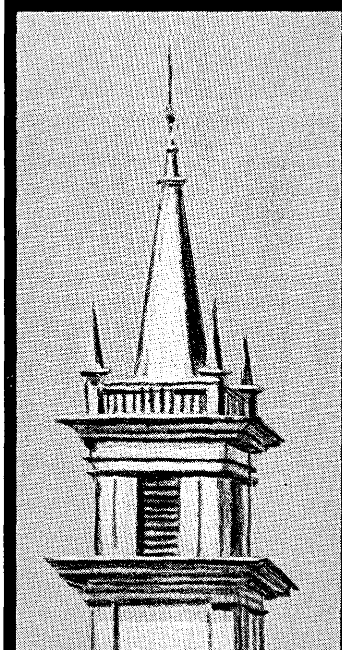
Applied Mathematician—Salary range $12,000 to $14,000. Possessing an interest in the application of mathematical techniques for the computer-based solution of engineering analysis and design problems. A doctorate in applied mathematics is required.

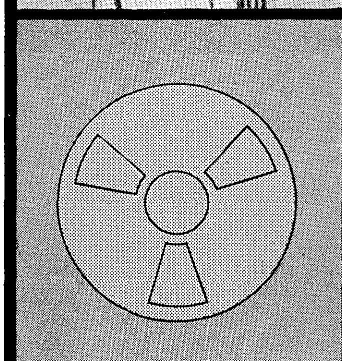
Computer Systems Programmer / Analyst—Salary range $8,500 to $14,000. Requires a minimum of one year's experience in FORTRAN and assembly language programming, plus some knowledge of either teleprocessing or interpretive language processors. A technical B.S. degree is necessary.

Scientific Programmer/Analyst—Salary range $9,000 to $14,000. Requires a minimum of two years' experience in analysis design (using FORTRAN or similar languages) and implementation of application oriented computer programs—or in applied mathematics—or in any analytically oriented field of engineering. A technical B.S. degree is necessary, with an M.S. desired.

You and your family will enjoy the unique cultural and recreational advantages of white-steepled Connecticut. And top-ranked schools offer the best in graduate facilities.

Send your resume in confidence, stating salary requirements, to: Mr. Leo J. Shalvoy, Engineering Personnel.





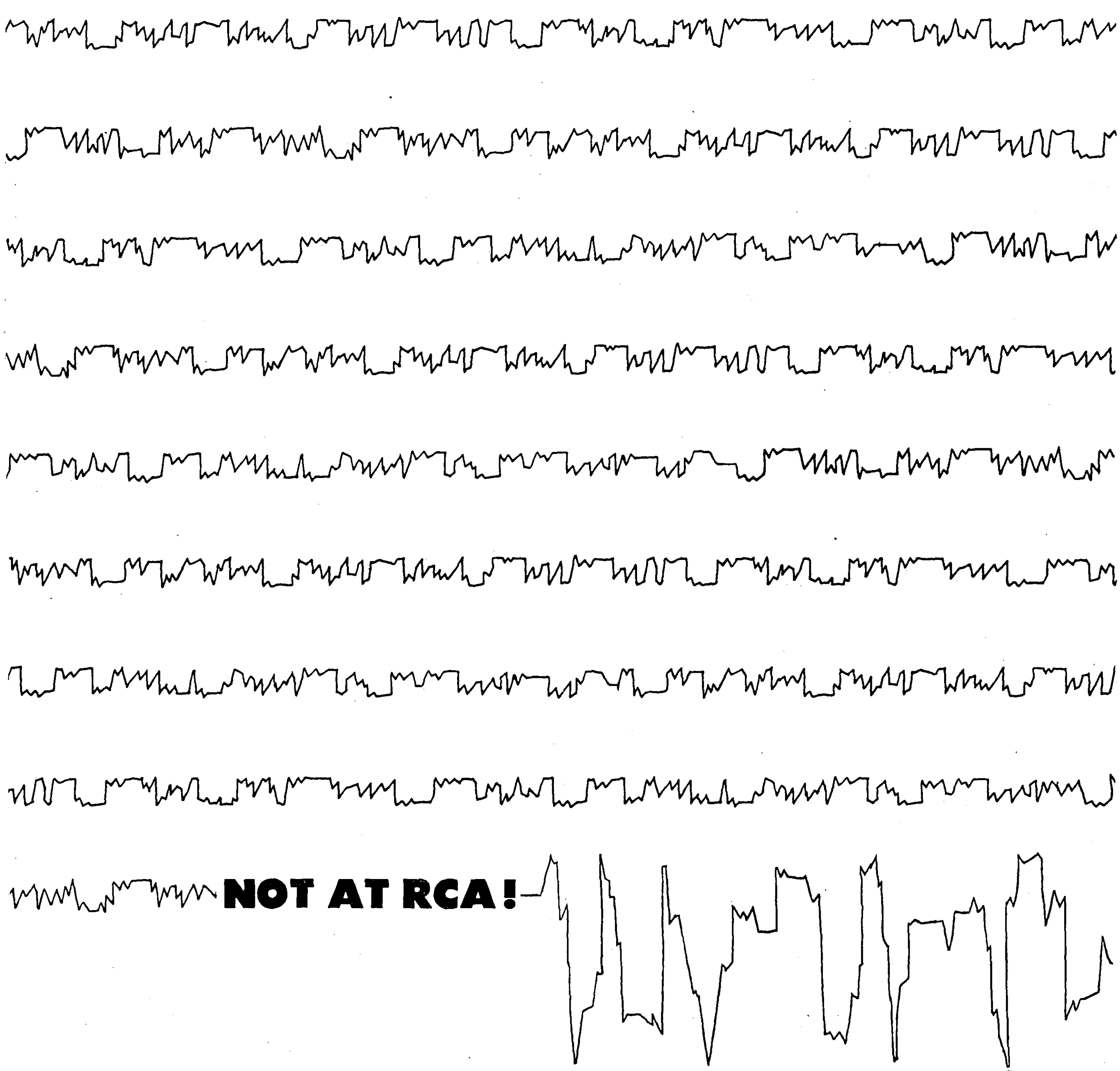
Sikorsky Aircraft

U
DIVISION OF UNITED AIRCRAFT CORPORATION
A

STRATFORD, CONNECTICUT

An Equal Opportunity Employer

PROGRAMMED ENNUI?



NOT AT RCA!

Here, Programmers are not tied down to the same old project, month after month, after month, after month, after month, after month, after month.

At RCA Service Company, programmed assignment changes stimulate imagination and open new avenues to individual career achievement.

Openings now in . . .

Scientific Programming

Developing computer programs for advanced systems. Applying current disciplines and creating new concepts in management sciences and problem solving techniques. Experience in real-time programming, communications, or scientific applications on medium to large scale computers is required.

Business Programming

Developing programs for a wide variety of problems involving management information systems, random access applications, information retrieval systems and other large scale business information processing. These assignments offer opportunity for training on third generation computer systems.

We invite you to investigate these opportunities with RCA at such locations as Cherry Hill, N.J., College Park, Md., Washington, D.C., Cape Kennedy, Fla., and other major U.S. cities, by writing or sending your resume to:

Mr. E. A. Ries, Manager of Recruiting, RCA Service Company, Dept. Y-1C, Bldg. 201-2, Cherry Hill, Camden, New Jersey 08101

An Equal Opportunity Employer

The Most Trusted Name in Electronics

CIRCLE 314 ON READER CARD

If routine computer problems try your patience,

come to Xerox and try your ingenuity.

You'll be trying it on some of the most provocative and potentially rewarding problems ever—problems like those described below.

But then, you'll be working for a Company where doing the unusual is the usual... a Company that, in less than a decade, has grown from a small manufacturer of photographic products to a world leader in graphic communications...with a strong salient interest in education technology...a company whose sales increased sixteen fold and whose employment rose 1400% in that same decade. But, above all, a Company that will continue to grow because it offers the environment for practical creativity that makes your growth, no less than ours, inevitable.

Challenges at all levels for: PROGRAMMING ANALYSTS

PROBLEM: To explore and develop promising possibilities in simulation, optimization, modeling and information storage and retrievel systems. Examples—a management financial model that will simulate and forecast company activities fully and accurately five years ahead. Systems for selected dissemination of information and remote access to large data bases.

PROBLEM: To contribute significantly to the solution of technical problems confronting an organization that devotes approximately 10% of its revenue to research and development...an organization that already has: a remote computing capability designed to serve some 2000 scientists and engineers; plus, real time control systems for prototype automatic-data-acquisition; plus, numerical control systems.

PROBLEM: To develop information systems enabling people to really communicate, make decisions and plan for the future. As of now, second generation equipment (represented in part by almost two billion characters of disc storage shared by three IBM 7010's) has been pushed to the limit. Many of the problems of communicating information from field locations to the corporate data bank still remain to be solved.

Bachelor's degree and appropriate experience is required to qualify for these challenging positions at all levels. The openings are in Rochester, New York. Interested and qualified applicants please forward resume, including salary history, to Mr. Robert W. White, Dept. YVP-103, Xerox Corporation, P.O. Box 1540, Rochester, New York 14603.

Challenges for: PLANNERS, SYSTEMS DEVELOPERS & COMPUTING EDUCATORS

PROBLEM: How can third-generation computing and information technologies be applied to provide timely access on a nationwide basis to a centralized data bank of 8 billion characters. What configuration of computer and communication hardware should be used, and what software must be designed and implemented to make this goal successful.

PROBLEM: How can Programming Systems be adapted to solve the problems of integrated file organization, specific and generalized communications routines for data acquisition, on-line inquiry and updating capabilities, administrative message switching, remote computing concepts, problem-oriented languages and optimized utilization of computer facilities.

PROBLEM: To make certain, through the use of the best educational techniques, that top management and all functional areas fully realize and utilize the computer's real potential.

PROBLEM: Again through education, but without disturbing work in progress, to raise the capability level of all programmers and to prepare the company as a whole for the new environment.

XEROX

An Equal Opportunity Employer (M/F)

new literature

COMPUTER HANDBOOK: 544-page book details small computer product line and is a sourcebook of basic computer technology for scientists, engineers, and students. Contains material on computer fundamentals and programming examples. The book is divided into three parts: a primer on the use of a digital computer; a user handbook section describing the use of PDP-8/S, PDP-8, and LINC-8; and section listing characteristics of the company's products. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:
CIRCLE 140 ON READER CARD

MINIATURE DISPLAY LITE: Data sheet describes MDL series, ½" diameter indicator lite that mounts in ⅜" hole on 9/16" centers. Options which are available include flat top or spherical lens styles in 13 transparent or translucent colors, hot stamped legends on flat top lenses, and permanently wired incandescent or neon lamps with optional internal current limiting resistor for neons. Specifications, actual size drawings and ordering information are covered. TRANSISTOR ELECTRONICS CORP., Minneapolis, Minn. For copy:
CIRCLE 141 ON READER CARD

GRAPHIC DISPLAY SYSTEM: Used as an interface between a digital computer and its display system, the Electrostore provides storage capacity, selective and fast erase, and resolution. Six-page application notes describe the coupling of the scan converter to the computer and visual display. Advantages of the system for remote displays and multi-access computers are covered. Two typical arrangements are shown in block diagrams. IMAGE INSTRUMENTS INC., Waltham, Mass. For copy:
CIRCLE 142 ON READER CARD

DATA COMMUNICATIONS: Brochure details model 33 ASR set, featuring a numeric keyboard. With the exception of the keyboard, the unit is identical to the standard model 33 ASR set featuring page printing and paper tape punching and reading capabilities. Besides the numerals 0 through 9, the keyboard contains four alphabetical characters (A through D) to multiply the range of possible code combinations. Remaining keys control nonprinting machine functions. Although the keyboard transmits only numerics and the four letters, the set can receive the entire range of alphanumerics in either page copy or punched paper tape form. TELETYPE CORP., Skokie, Ill. For copy:
CIRCLE 143 ON READER CARD

FORMS HANDLING: Two brochures detail solid state forms handling machines: processor whose speed is controlled by electric eye, and mobile multi-ply forms burster including details and dimensions of the burster and accessories. TAB PRODUCTS CO., San Francisco, Calif. For copy:
CIRCLE 144 ON READER CARD

DATA MODEM: Modem 4400, developed to transmit 2400 bps on unconditional voicegrade, can schedule four telephone lines. The modem requires 800Hz of bandwidth of the telephone line channel. It eliminates the need for special line conditioning and allows additional data to be transmitted simultaneously over the remaining bandwidth. MILGO ELECTRONIC CORP., Miami, Fla. For copy:
CIRCLE 145 ON READER CARD

INVENTORY RECORD: 36-page book for recording monthly use of dp forms has hard cover and can be used for 30 forms covering a two-year span. Individual pages are arranged for detailing form numbers, descriptions, vendor names, delivery time and prices. Space is also provided for quantities ordered and received and month-end inventory, month usage, and year-end totals. SHELBY BUSINESS FORMS INC., Shelby, Ohio. For copy:
CIRCLE 146 ON READER CARD

PROCESS CONTROL: Eight-page bulletin describes how instruments and systems control sugar production, from juice extraction to granulating. Application diagrams show typical clarification liming pH control and corn syrup-liquid sugar blending systems. Direct digital computer control with the PCP-88 digital blending and centra-

URS needs data systems analysts, operations research analysts, military analysts, mathematicians, and systems and applications programmers.

NO TWO JOBS ALIKE.

URS has grown for 15 years, and yet retains an environment in which the contribution of each individual is unique and important.

Individual effort comes first.

URS Systems Centers are engaged in system design, programming, and information processing operations in the United States and other parts of the world. (In addition, our Research Center performs research and development in the physical sciences and engineering.)

Are you currently engaged in systems design or programming in the following areas?

Simulation • Logistics • Management information systems • Computer programming aids, languages and applications

If you have such qualifications and are interested in a position offering professional growth and compensation based on **your** effort, send your inquiry or resume to:

URS*

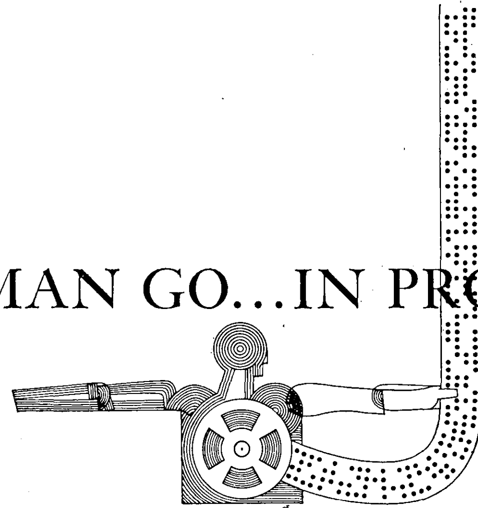
CORPORATION

1811 Trousdale Drive Burlingame, California 94010

*Still known to some of our older friends as Broadview (BRC), United Research Services (URS), and various other aliases reflecting a spirit of experimentation. AN EQUAL OPPORTUNITY EMPLOYER—BY CHOICE!

CIRCLE 315 ON READER CARD

WHERE CAN MAN GO...IN PROGRAMMING?



From abacus to computer, human progress can be measured in increments of man's skill in processing data. Originally no more complex than the fingers of one hand, computer systems are today truly revolutionizing the very times in which we live. For as civilization grows ever more aware of the skills of these uncanny servants, so too grow in importance the programmers who initiate and then interpret all that these instruments are able to accomplish. Program: A trajectory for optimum ballistic flight far out in space. Program: Simulation studies. Program: Advanced software. Real-time management, and business systems. In brief, wherever there exists the need to do things better: Program. Lockheed offers an unusually wide range of advanced programming tasks at one of the world's largest centralized industrial computer installations. Write Mr. K. R. Kiddoo, Professional Placement Manager, Sunnyvale, California. Lockheed is an equal opportunity employer.

LOCKHEED
MISSILES & SPACE COMPANY
A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

CIRCLE 316 ON READER CARD

lized analog blending are explained. Electronic and pneumatic recorder-controllers are pictured with associated transmitters. THE FOXBORO CO., Foxboro, Mass. For copy:
CIRCLE 147 ON READER CARD

GLOSSARY: Designed to assist the computer-using executive, the 320-term glossary is a condensed version of the Standard Vocabulary for Information Processing published by the American Standards Institute. Glossary is designed for the user and is prepared in booklet form. Cost: $.25 per copy, $20 per hundred and $100 per thousand. DEPT. CG., NEWSWEEK, 444 Madison Ave., N.Y. 10022.

INDICATOR LITE: Compact lite plugs into a panel mounted socket for replacement without tools. Outlined in data sheet is the RCL Series, which is only .33″ in diameter and is offered in four styles: long, short, flush and spherical flat top; each available in 10 lens colors. Also described is the replaceable cartridge lite holder, RCLH series which can be front or rear panel mounted in $3/8''$ holes on $11/16''$ centers. TRANSISTOR ELECTRONICS CORP., Minneapolis, Minn. For copy:
CIRCLE 148 ON READER CARD

ELEVATED FLOORING: Brochure gives design information, detail drawings, and specifications for flooring used with computers and other installations where access to building utilities and electric cables is desired. Offered are guidelines for selecting specific types of installations and illustrated data on attendant hardware such as modular air conditioning units for computer environments, room partitions, and aluminum handrails. LISKEY ALUMINUM INC., Glen Burnie, Md. For copy:
CIRCLE 149 ON READER CARD

ROUTINES TO READ NATURAL TEXT: 141-page book describes a set of subroutines for the IBM 7040/44 for reading textual material with complex formats and coding conventions—questionnaires, library catalog cards—from any external medium into the high-speed store of the machine. Different kinds of information in the input are recognized by explicit markers, position on the line or page, or syntactic clues given by other items. Routines may be called from either FORTRAN-coded or MAP-coded programs. Cost: $4; microfiche $1. AD-637 303. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

HYBRID COMPUTERS: 16-page brochure discusses how a hybrid computer has been used to solve a chemical processing problem concerned with the refinement of chemical processes involving the interaction of a number of different chemical and petro-chemical compounds. Hardware, software, organizing and programming a hybrid computer are also covered. Memory, I/O and speed of the Beckman/SDS/2200/920, 930 and 9300 are listed. BECKMAN INSTRUMENTS INC., Fullerton, Calif. For copy:
CIRCLE 150 ON READER CARD

GP DESK TOP COMPUTER: Brochure introduces series 480 processor which provides up to four data channels, 8-msec core memory and binary and decimal arithmetic. Brochure also includes an instruction list and specifications. Features include random access memory, byte-oriented, code independence, variable word length,

Director of Technical Service Bio-Electronics

Hoffmann-La Roche Inc. a major producer of ethical pharmaceuticals and fine chemicals is continuing the expansion of its new division (Bio-Electronics).

This excellent staff position reporting directly to the General Manager of the division will involve integration of systems engineering between affiliated companies and customers as well as being the chief technical consultant to management on problems associated with customer relations. Background should include heavy education in electronics engineering with exposure to management, marketing, or bio-medical engineering. Experience should include computers, medical data systems, hospital procedures and architecture; with a computer manufacturer, medical instrumentation company, or hospital (as chief medical engineer).

This new division is backed by one of the outstanding research organizations in the world, has the stature and sophisticated marketing talent to be a remarkable growth opportunity. Our laboratories employing 4500 people are conveniently located in suburban North Jersey approximately 30 minutes from Manhattan. Environment and compensation are excellent.

Please write in confidence to:
R. M. Callan, Employment Manager

ROCHE

HOFFMANN-LA ROCHE INC.
Nutley, New Jersey 07110
An equal opportunity employer

CIRCLE 317 ON READER CARD

PROGRAM YOUR FUTURE

In the last seven years, Computer Sciences Corporation has programmed its way from a 5-man software house to become a multi-million dollar organization of nearly 2000 professionals, with operations throughout the United States, Canada and Europe.
And we're still growing. CSC is continuously seeking top-qualified candidates to fill positions in all CSC centers:

Systems Design
Systems Programming
Scientific and Commercial Applications

This is an opportunity to stretch your talents to the size of your ambition. Where problem solving and programming are **not** secondary to products or other services.
As a CSC professional, you'll be at the growing edge of information technology. Working as part of a creative, interdisciplinary team. Challenged at every turn by opportunities for professional growth. Sharing in CSC's financial rewards and personal benefit plan.
If this sounds like the future you would program for yourself, why not talk it over? For confidential interview, call:

COMPUTER SCIENCES CORPORATION
650 N. SEPULVEDA BLVD., EL SEGUNDO, CALIF. 90245
SAN FRANCISCO • SAN DIEGO • HOUSTON • RICHLAND, WASH.
WASHINGTON, D.C. • HUNTSVILLE • HAWAII
AN EQUAL OPPORTUNITY EMPLOYER

CIRCLE 318 ON READER CARD

PHILCO HOUSTON

. . . prime contractor and prime mover of the Manned Spacecraft Center, has exceptional opportunities for qualified programmers in these areas:

REAL TIME PROGRAMMING

Work will involve command and control simulation, display techniques and software development. Requires BS in mathematics, physics or engineering, as well as 1-7 years in programming of digital computers and design and development for real time applications. Experience also desirable in machine language programming for real time computers.

INFORMATION PROCESSING

Requires 1-5 years in programming of medium and large scale computers for information processing and data handling. Prefer COBOL experience.

For prompt and confidential consideration, send your resume to Mr. H. S. McDonald, Department 6018, Philco Houston Operations, 1002 Gemini Avenue, Houston, Texas 77058.

PHILCO Ford

An equal opportunity employer

CIRCLE 319 ON READER CARD

new literature

I/O, integrated circuit construction, instruction format. BUSINESS INFORMATION TECHNOLOGY INC., Natick, Mass. For copy:
CIRCLE 151 ON READER CARD

CIRCUITS CATALOG: Contains 4,629 off-the-shelf standard circuits produced by 49 manufacturers. Circuits are listed by major electrical characteristics, cross-referenced to outline drawings, including schematics with pin connections. Within each major technical section, circuits are further broken down into specific types—78 sub-categories in nine sections. Circuit Tabulation is available on subscription basis for $32.50/year, U.S. and Canada; $36.50 elsewhere. PUBLISHER D.A.T.A., INC., Box 46, Orange, N.J. 07050.

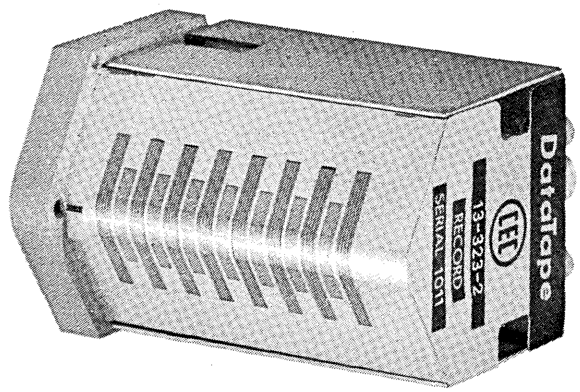
DISSEMINATION OF COMPUTER PROGRAMS: Documentations on programs developed by or for NASA are furnished without charge; however, a nominal duplication and mailing charge is assigned for each program tape or card deck disseminated. Periodic announcements in abstract form describe current available computer programs. COSMIC, COMPUTER CENTER, UNIV. OF GEORGIA, Athens, Ga. For copy:
CIRCLE 152 ON READER CARD

ANALOG AND HYBRID SERVICES: Types of problems which can be solved and services offered are outlined in four-page brochure. Consulting, programming, computation and simulation, analysis and applications and industries are covered. MCDONNELL AUTOMATION CENTER, St. Louis, Mo. For copy:
CIRCLE 153 ON READER CARD

OSCILLOSCOPE DISPLAYS: Job sheet explains how to photograph images or traces displayed on a cathode-ray tube. Included are setup for single frame recording; adjusting the oscilloscope; recording stationary patterns, recording single sweeps, selecting photographic film and processing. EASTMAN KODAK CO., Rochester, N.Y. For copy:
CIRCLE 154 ON READER CARD

SPLICER: Bulletin describes unit which is designed to repair and/or reinforce Friden 3 x 7 edge punched cards and can also be used for normal tape splicing. COMPUTER ACCESSORIES CORP., Huntington, N.Y. For copy:
CIRCLE 155 ON READER CARD

More than 1000 hours from d-c to 1.5 MHz



Now try to get that through your head

You can . . . with a CEC Magnetic Recording Head.

In fact, considering that these recording heads last up to five times longer than any others, the 1000 hour guarantee seems rather conservative. In virtually every case, a CEC head will surpass a thousand hours with little or no indication of wear.

The reason: CEC recording heads are of a unique material and solid metal pole-tip design which completely eliminates the weakness of conventional lamination and rotary head designs.

This has resulted in superior performance at frequencies to 2 MHz and a minimum of wear and cleaning.

There is a CEC head for every analog and digital recorder.

Whatever make or model recorder you may now be using, CEC has the head to make the most of it, irrespective of the interface parameters. The "family" consists of more than 100 different recording heads, *all* with the same design advantages. Consequently, it is now possible to obtain state-of-the-art recording without replacing the basic instrument.

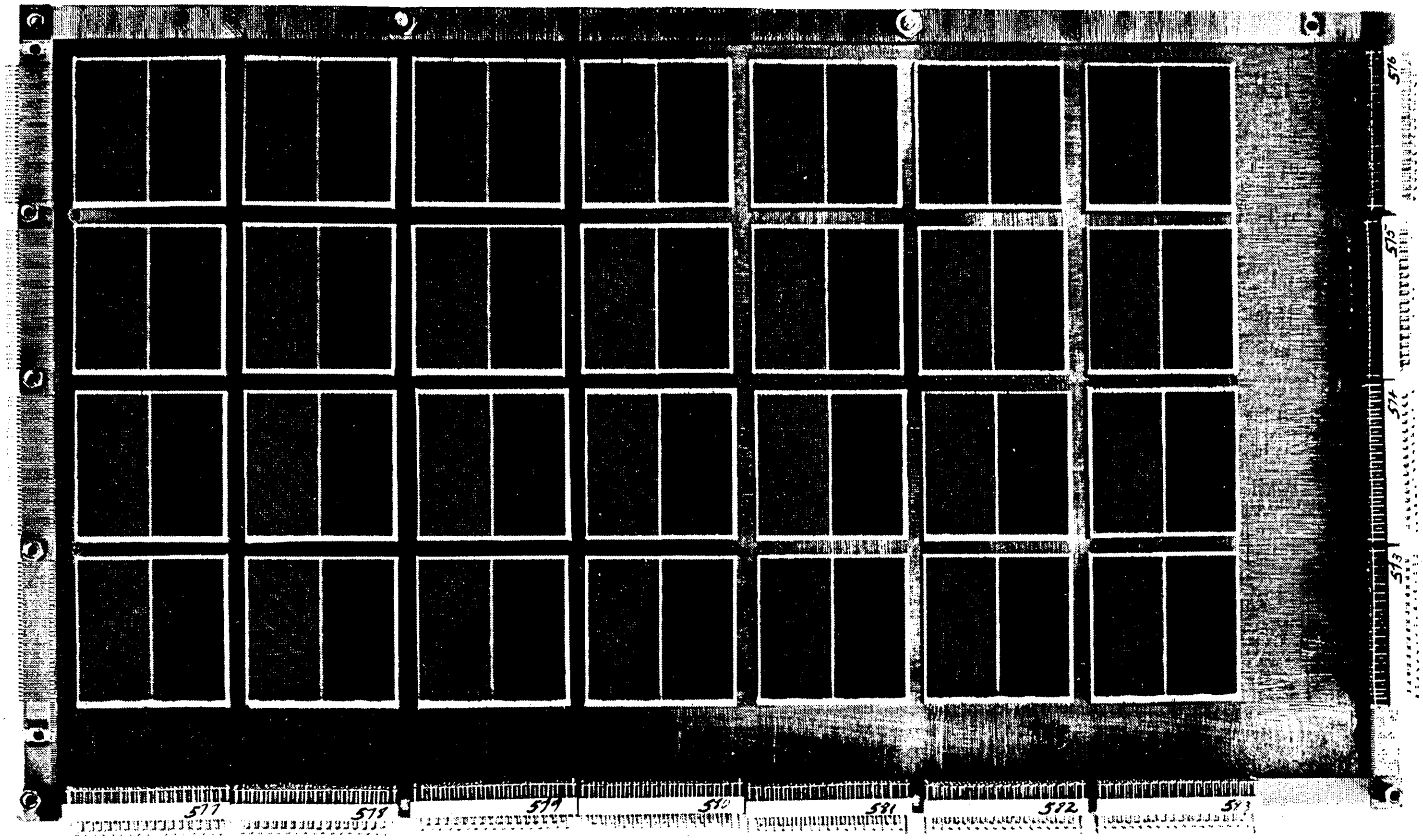
How were we able to achieve this breakthrough in head design? Through experience. CEC has not only been making magnetic recording heads longer than anyone else, but was the first to produce them on a quantity basis. *And* – because CEC uses *precision* machine construction where others rely on hand assembly.

For complete specifications and all the facts about this complete line of recording heads, call or write your nearest CEC field office.

CEC/DATATAPE PRODUCTS
Pasadena, California 91109

BELL & HOWELL

CIRCLE 49 ON READER CARD



six months ago we developed the first 2½D stack. everybody else is still six months behind.

why wait?

Everybody's talking about $2^1/_2$D stacks. We're delivering them.
Write or phone for the complete story.

EM electronic memories

Memory systems, stacks and cores for commercial, military & space applications
12621 Chadron Avenue, Hawthorne, California, (213) 772-5201

CIRCLE 54 ON READER CARD

world report

FRENCH BULL FIRMS DENY SELLOUT, SHUTDOWN RUMORS

The French computer company Cie des Machines Bull said from its Paris headquarters late last month that the new year would be a time of preparing for expansion rather than contraction. Rumors that the Bull group of companies was cash-short and ready to close down their major production plant at Anger were denied. Stories concerning the group's difficulties were attributed to speculators' handling on the Paris Bourse of the company's stock, which has been a highly sensitive target of investors for the past five years.

Reports that Machines Bull would seek cash for a capital increase from shareholders started in the second week of December. This turned out to be an increase of the capital of Societe Industrielle Bull-General Electric (the U.S.-French combine) from 157 million to 196.25 million Francs. The increase involved no disbursement of the part of Machines Bull of any of its 51% stake in SIBGE. Cie des Machines Bull also denied reports of dissension between the French and American companies, and said that stories about a retraction of large-machine manufacturing did not concern them as all the bigger computers were planned by GE for production in the states.

AUTOMATED LIBRARIES BEGIN MAKING HEADWAY

An experiment in the computer-assisted selective dissemination of information, sponsored in the U.K. by the National Electronics Research Council, has been merged with a similar project of the Institution of Electrical Engineers (IEE). Now to be called Inspec, the joint scheme will provide engineers and scientists with a technical abstract service for information in physics, electro-technology and control.

The European Atomic Energy Community (Euratom) has also started the first automatic documentation system covering nuclear science and technology with its Centre for Information and Documentation (CID). Biographical references and key words for 400,000 documents of nuclear interest are on mag tape, and Euratom expects to add 100,000 a year. Users send in the search spec and receive photocopies of material. After the first general trials within Euratom this year, CID will be open to scientists and industrialists of member community countries.

Three years ago, an IBM executive visiting Europe said the information retrieval market would burgeon in four years. His prognostication appears to be coming true, judging by the volume of current activity. At the Technological Univ., Eindhoven, in the Netherlands, an IR scheme is being planned for a 360/30; in Ireland, Queen's Univ., Belfast, is experimenting with a regular automatic library circulation by user-interest, on an ICT 1905, to be brought into a time-sharing system in April by updating to an ICT 1907.

Further afield, the Univ. of Toronto library is well into an investigation in connection with the

(Continued on page 103)

HAIL TO THEE, BLITHE SPIRIT!

And all such spirits . . . passed.
The freedom of the air is gone.
The earth controls the sky.

NATIONAL AIRSPACE SYSTEM

MITRE is currently augmenting its top-flight team of systems men in the suburban Washington, D.C. and Atlantic City, N.J. areas. Their mission: to provide the system engineering to the Federal Aviation Agency on the new National Airspace System — an air traffic control system for the 1970's. Their job encompasses such technical areas as broad level system analysis, computer program analysis, system specifications, system logical design, system test planning for design verification, and configuration management.

Working on this project you would engage in such activities as: translating system operational objectives into technical requirements for the system's subsystems; synthesizing the technical characteristics of equipment subsystems of balanced reliability, and analyzing alternatives; reviewing and analyzing, at the logic level, design submissions of system hardware contractors; conducting design optimization studies with respect to cost, reliability, and technical suitability; or synthesizing software designs for a multi-processing computer environment.

NATIONAL MILITARY COMMAND SYSTEM

Scientists and engineers are also needed in our Washington Office for systems analysis and feasibility studies, communications system analysis, systems design, integration and design verification of the NMCS. This "capping system" contains all the facilities, equipment, doctrine, procedures, and communications needed by national command authorities to give them strategic direction of the armed forces. MITRE's main concern is with the technical design and integration aspects of the NMCS and the communications between NMCS and various other command systems, including the World-Wide Military Command and Control System — a group of systems operated by the unified and specified commands.

NATIONAL RANGE DIVISION

Qualified senior engineers and scientists are needed at MITRE's office at Patrick Air Force Base, Florida, to assist in direct support programs for the National Range Division (NRD) of the Air Force Systems Command. NRD was established as central planning authority to insure the efficient use of existing and future national range resources. The work is of vital importance to the Department of Defense space programs and in the support they are providing to NASA. MITRE's mission is to assist the National Range Division in their development of the future system requirements for the Eastern and Western Test Ranges. In addition to systems-oriented planning and operations research activities, the work includes studies of range functional subsystem categories: radar, telemetry, optics, communications, and data processing.

If you have three or more years' experience and a degree in electronics, mathematics or physics, write in confidence to Vice President — Technical Operations, The MITRE Corporation, Box 208AU, Bedford, Mass.

THE MITRE CORPORATION

An Equal Opportunity Employer (M & F)

Pioneer in the design and development of command and control systems, MITRE was formed in 1958 to provide technical support to agencies of the United States Government. MITRE's major responsibilities include serving as technical advisor and systems engineer for the Electronic Systems Division of the Air Force Systems Command and providing technical assistance to the Federal Aviation Agency and the Department of Defense.

CIRCLE 303 ON READER CARD

(Continued from page 101)

Ontario New Universities Library Project (Onulp). Basic shelf list library data is being converted at Toronto into machine readable form, and by this summer an eight-man team is expected to have covered 200,000 titles as the foundation of automated circulation control. A serials control system is in final stages of design, and programming has begun for preparation of an off-line system for the first two years of operation. A 7094 is in use now, to be supplemented by a 360/50 with remote terminals later in the year. Toronto's library is to be one of 16 participants in the Library of Congress MARC pilot project.

In Germany, the Technical Univ. of Berlin is using a small Zuse computer and Siemens peripherals at circulation counters for a small automated technical library control project. Across the Iron Curtain at Prague, the State Technical Library has 1300 titles under punched card control, and plans an abstracting information retrieval service based on an IBM machine for the future.

ANOTHER PROFITABLE COMPUTER MAKER?

Preliminary figures show ICT turned a $1.5 million loss last year into a $4.5 million profit this fiscal year. Sales for the 1900 series exceeded expectations with a total to date of 640 (226 for export); 250 have been delivered so far with 88 to extra-U.K. buyers. ICT's 1901, undoubtedly the European machine of the year, accounts for more than one-third of the company's sales. Value of the order book is around $200 million. ICT is particuarly pleased with a recent $400,000 order from paper products manufacturer Kimberly-Clark for a 1903 with discs, because the parent company is an American-based IBM customer. Cracking the strongholds of the international groups is not the easiest for European manufacturers if their prospects are planning from a central U.S. base.

SMALL-SCALE DP SYSTEM

The 18-month-old U.K. firm Interdata Ltd. has taken over manufacturing and marketing rights of a desk-size dp system from Georg Meckel of Munich. In a combined deal, machine fabrication will be split 60% British and 40% German. Renting at $125 a week, the Interdata machine incorporates a calculator with six storage registers, plugboard programming, and optional printer, card reader and punch. The new arrangement broadens the marketing of the system, initially designed for the auto spares and repair business.

BITS & PIECES

The Trust Bank of Africa has ordered $6.5-million worth of Burroughs gear, including six B3500's -- two each for Cape Town, Johannesburg and Durban. For on-line account processing, the complex will handle 200 window teller sets, 100 inquiry terminals, and 50 communications terminals ... In Japan, the first Univac 494 went to Kawasaki Steel Corp. to link four business offices and two steel plants. It may become Japan's first real-time MIS system ... Dr. J. M. M. Pinkerton, research manager of EELM, has been elected president of the European Computer Manufacturers Assn. ... The Centre Anversois, Antwerp, estimates that Belgium has 300 computers installed, 200 on order ... Ferranti Ltd. reports orders for 97 Argus computers worth $15 million, plus 800 display systems for process control and reservation control work.

Your place in the sun may be in San Jose.

That's where IBM's Systems Development and Systems Manufacturing Divisions are located. Where IBM needs more programmers who want an opportunity to shine.

Why? Because San Jose is a major IBM facility—representing all divisions of the company—there are unique opportunities for you to be exposed to a broad range of programming applications. You could pursue the area of programming which interests you most.

You'd enjoy working and playing in San Jose, too. You'd be near San Francisco, and only minutes away from four colleges and universities. Continue your formal education, if you wish, with company-paid tuition benefits.

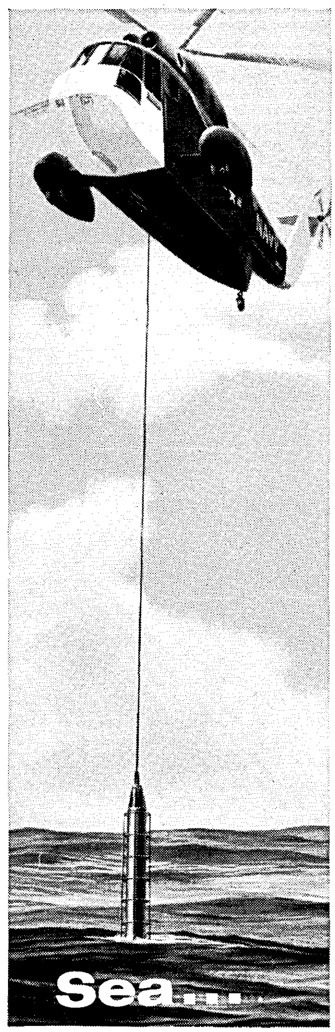
If you have a college degree and programming experience, you may qualify for one of these go-places positions with IBM in San Jose.

Systems Applications Programmer; Development Programmer; Commercial Programmer; Diagnostic Programmer; Publications Programmer.

Send an outline of your education, experience and career interests to: W. E. Eyres, Dept. 701A, IBM Corporation, Monterey and Cottle Roads, San Jose, California. An Equal Opportunity Employer.

IBM®

4 elements make RAYTHEON'S engineering opportunities greater:



AREAS	MAJOR PROGRAMS
LAND: *Equipment Division* — Radar and display systems; communications and commercial data processing equipment and systems.	Heavy radars and displays Digital PCM systems Airline Reservation Systems
AIR: *Missile Systems Division* — Ground-to-air and air-to-air weapons systems and tracking radars.	Prime for both Sparrow III and Hawk missile systems Nike-X (MSR) SAM-D
SEA: *Submarine Signal Division* — Airborne, surface, underwater systems.	Prime for BQS-13 Navy sonar Transducer design High resolution displays Microelectronic circuitry
SPACE: *Space & Information Systems Division* — Space systems, subsystems and equipment for military and non-military programs.	Apollo and LEM guidance computers Polaris and Poseidon guidance electronics Re-entry systems ECM systems

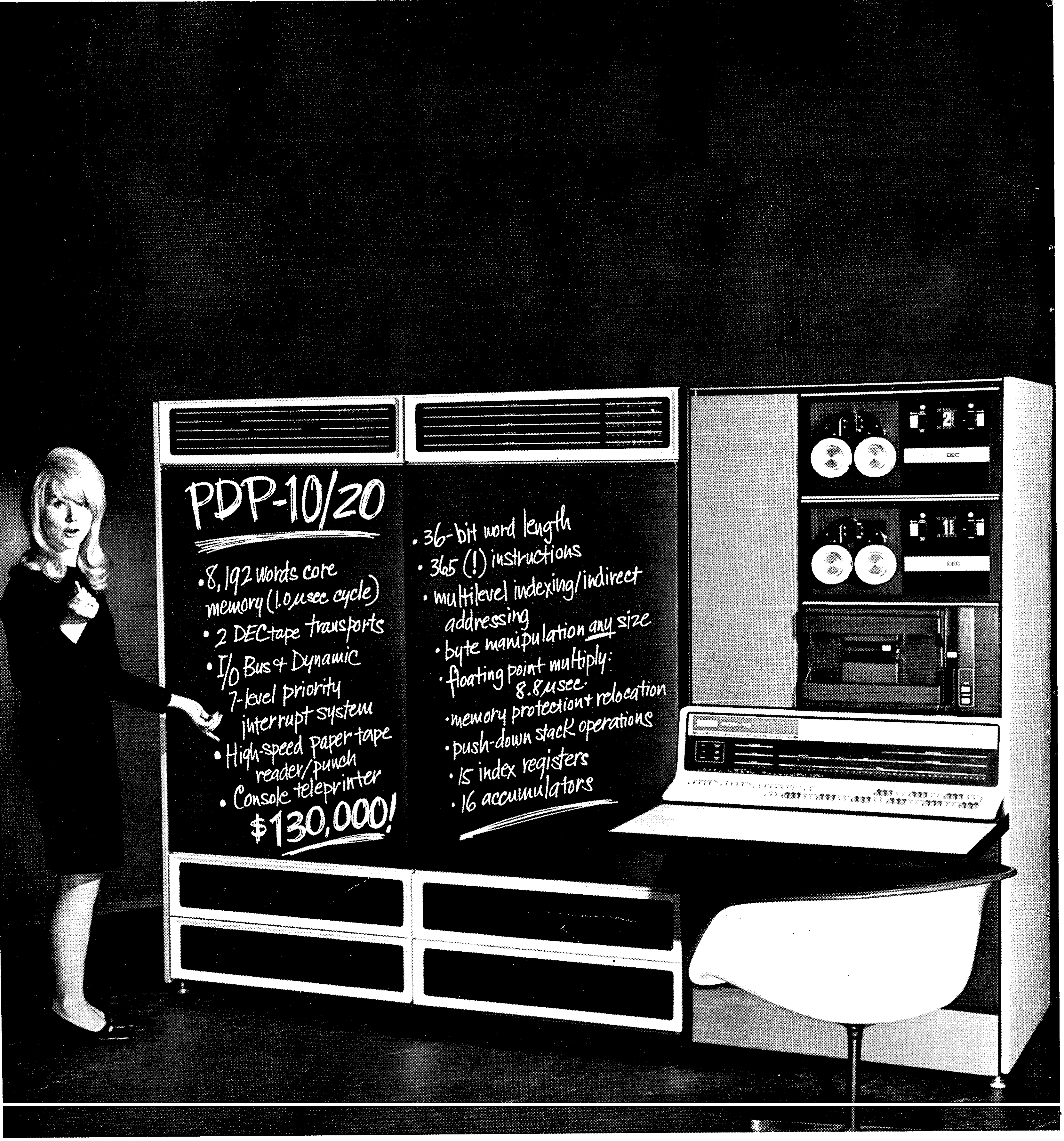
Move to where the action is — for current programs and advanced generation concepts — at Raytheon.
Send resume with salary requirements to: Manager of Executive Placement,
Raytheon Company, Dept. D-1, Lexington, Mass. 02173.

RAYTHEON

EXCELLENCE IN ELECTRONICS

An Equal Opportunity Employer

CIRCLE 346 ON READER CARD



PDP-10's nearest competitor costs 50% more... Think about that.

DIGITAL EQUIPMENT CORPORATION, Maynard, Massachusetts 01754. Telephone: (617) 897-8821 • Cambridge, Mass. • New Haven • Washington, D. C. • Parsippany, N. J. • Rochester, N. Y. • Philadelphia • Huntsville • Pittsburgh • Chicago • Denver • Ann Arbor • Houston • Los Angeles • Palo Alto • Seattle • Carleton Place and Toronto, Ont. • Reading, England • Paris, France • Munich and Cologne, Germany • Sydney and West Perth, Australia • Modules distributed also through Allied Radio

digital
COMPUTERS · MODULES

CIRCLE 53 ON READER CARD

TIME-SHARING PROBE: BROAD OR NARROW?

Western Union called for a broad computer utility investigation, while IBM advocated a narrow one, in comments filed with the FCC last month. Probably, the discussion will turn out to be broad -- covering all dp charges and services, not just those involving regulated communication channels.

The breadth of the inquiry is important because it could lead to FCC regulation of some service bureau activities, and bring AT&T into the dp field. Ma Bell is now barred from offering services that are not subject to public regulation.

This month, the commission plans to begin collecting answers to the questionnaire it issued last November. First, comments will be invited on present and future data processing applications of computers and communication channels, on rates and related matters. Respondents will have at least four months to reply. Afterward, the commission will ask for comments on the policy issues involved in computer utility regulation.

Local dp industry sources contend the inquiry is far too leisurely. One observer points out that by the end of 1967, WU's Info-MAC system will probably be operational nationwide. He's afraid that when FCC finally gets around to rule-making, non-carrier suppliers of dp equipment and services will have lost valuable ground.

FCC EXTENDS TELPAK SERVICE TILL MAY

FCC has extended Telpak A and B services until May 1, giving users more time to adjust. After that date, "unified private line" rates will go into effect. The new rates are to be announced this month by AT&T; dp industry observers believe the charges for multiple channels will be well above Telpak A and B levels. Bringing the unified rates down is likely to be difficult.

The General Services Administration last November asked the commission to approve unified rates without an effective date, "pending determination of their ... reasonableness in the (general telephone rate case)." Under this plan, users would continue to enjoy Telpak's ecomonies during the months, and possibly years, it took FCC to determine whether unified rates were reasonable. But now, users will pay unified rates during this period.

GSA PUSHES FOR NEW MAG TAPE STANDARDS

Drastic changes in federal mag tape specs and acceptance procedures are likely this year. The new specs, proposed by GSA, would require makers of both tapes and read-write heads to change their final testing procedures. Manufacturing operations would have to be altered to improve quality control. GSA also wants to establish central testing facilities, where tapes purchased by all federal agencies would be certified. Now, only a few of the bigger agencies do their own certifying; others rely on the manufacturer. Facilities would be built with adp revolving fund money, or with contributions from the agencies participating in the projected testing program. Meanwhile, improved tape-certifying techniques are being studied by NBS. GSA's ire was aroused after one agency purchased 1,500 tapes and found that 1,000 were defective. Reportedly, there have been several other cases almost as bad.

McFADDEN ASSOCIATES

15 years successfully recruiting for industry Nationwide

Partial listing of current opportunities:

SYSTEMS ANALYSTS Hardware/Software Command/Control	$ 22,000
SOFTWARE DEVELOPMENT Languages, compilers, assemblers, monitors, routines, diagnostics	$ 20,000
MANAGEMENT INFORMATION SYSTEMS	$ 20,000
EDP MANAGEMENT	$ 14-25,000
SYSTEMS ENGINEERS Digital, logic, Radar, Communication, Real Time	$ 15-20,000
BUSINESS PROGRAMMERS	$9 to 17,000
PROGRAMMERS 3 years experience on 1401, 1410, 7080, 7090 or some 360	$ 13,000
PROGRAMMERS 2 years experience on 301, 501, 601, 3301, B 5500, U 490, 492, III, 1107, 1108, H 200, 400, GE 635, CDC 1604, 3600, NCR 315	$ 11,000
PROGRAMMER TRAINEES Degree + aptitude	$ 9,000

Fees, Relocation and Travel Expenses are paid by Client-Companies
Please Forward Resumes in Confidence to:

D. KERR McFADDEN

McFADDEN ASSOCIATES

1411 WALNUT STREET — SUITE 1200
PHILADELPHIA, PA. 19102
(215) LO 3-2343

CIRCLE 323 ON READER CARD

CAREER MEMO

To **PROGRAMMERS/ANALYSTS/ENGINEERS**
From **EVERETT KELLEY ASSOCIATES**

If your present position lacks professional motivation . . . NOW is the time to let us program your professional future . . .

Consult our staff of experienced specialists who are at your disposal. They will open doors and arrange favorable interviews with selected clients. Utilize your total professional capability in:

- Scientific Programming
- Real Time Systems
- Software Development
- Operations Research
- Applied Systems
- Systems Design
- Consulting
- Digital or Logic Design
- Circuit Design
- Commercial Programming
- Mathematics
- Development Engineering
- Communications
- Sales/Marketing

Salary range: $8,000-$30,000. All expenses paid by client companies (fees, interviewing and relocation). Submit your resume in strict confidence, including salary requirements and geographic preference, directly to Mr. R. L. Keilholtz or Mr. Donald Wayne, or write for our composite resume form.

EVERETT KELLEY ASSOCIATES

Consultants to the Computer Industry

121 So. Broad Street (Suite 1300)
Philadelphia, Pa. 19107

CIRCLE 322 ON READER CARD

• ADVANCED SYSTEMS PROGRAMMING RESEARCH • PLANNING, DEVELOPMENT & SUPPORT OF SOFTWARE
• USER LIAISON, EDUCATION & SERVICES • DOCUMENTATION

PROGRAMMERS

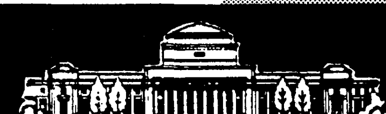
We Wondered Whether . . .

- **YOU WERE AWARE OF OUR EXPANSION PLANS** . . . ground has been broken for a new building needed to house the dual processor IBM S/360 model 67 (late 1967) and the significant expansion in activities planned to more fully meet the computational needs of MIT and the other cooperating New England colleges.
- **YOU MIGHT BE INTERESTED** . . . that this expansion means a variety of new projects and research programs are starting which require a tremendous increase in our staff at all levels and provide a real opportunity for professional growth.
- **YOU HAD THESE QUALIFICATIONS** . . . minimal requirements—a degree & more than one year of experience in the above areas.
- **YOU HAD CONSIDERED** . . . that MIT offers a liberal benefit program including educational opportunities at the Institute as well as competitive salaries.

We invite your inquiry. Please forward your resume, including salary information to:
Mr. Robert Nelson, Personnel Dept. (Bldg. E 19-285)

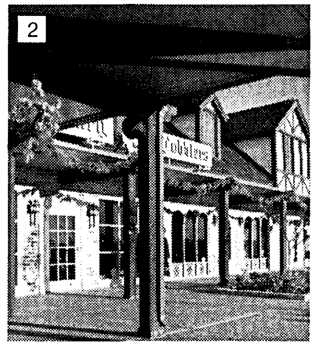
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
77 MASS. AVE., CAMBRIDGE, MASS. (617) UN 4-6900 (EXT. 4275)

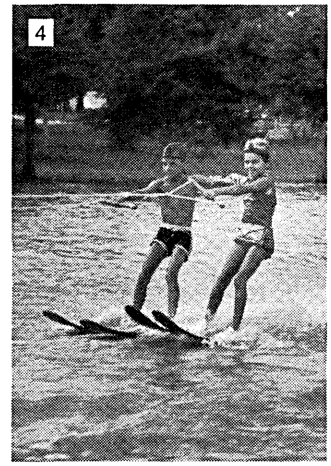
COMPUTATION CENTER

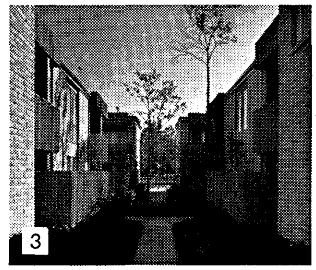


An equal opportunity employer

CIRCLE 321 ON READER CARD







Yours is a long-term career opportunity. With the Number One name in aerospace—Lockheed. At the career center of man's exploration of space—the Manned Spacecraft Center. Where Lockheed Electronics has stimulating business and scientific careers for analysts, engineers, programmers and scientists.

Yours is also unhurried golf courses, uncrowded waters for every type of water sport, the Astrodome, and working ten or fifteen minutes away from home.

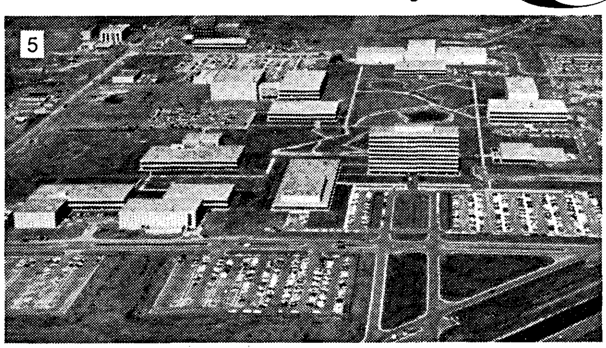
Hers is a charming and spacious home in a delightful exurban community. Excellent schools. One of the nation's finest medical centers, and internationally renowned stores in downtown Houston.

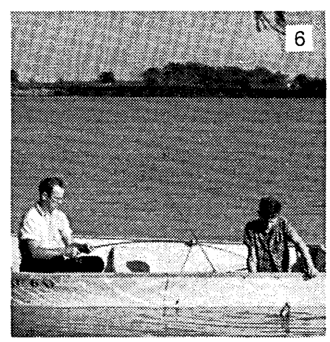
Both Houstons are air conditioned in summer, devoid of blizzards in winter, and peopled with articulate and interesting people from all 50 States the year round.

Both of you interested? Then we're interested! So, set aside commuting and write stating your experience and qualifications to Mr. R. K. Glasgow, Lockheed Electronics Company, 16811 El Camino Real, Houston, Texas. Or call him collect at (713) HU 8-0080. You'll find that the nice thing about both Houstons is that they are one and the same.

THERE ARE TWO HOUSTONS IN TEXAS

One for you. & One for her.





Join Lockheed Electronics Co.
Houston Aerospace Systems Division, Houston

LEC
LOCKHEED
Electronics Company
An equal opportunity employer

#1: Saxony Place Townhouse. #2: Modern shops and offices in a charming, old-world setting. #3: The Bay House Apartments, with 200 units. #4: Water-skiing on Nassau Bay. #5: The Manned Spacecraft Center. #6: The fishing's fine in warm Gulf waters. #7: Sailing—and instruction—at the Nassau Bay Yacht Club.

CIRCLE 324 ON READER CARD

When high performance peripheral equipment means a whole new ball game in the computer field

can you afford not to be on the winning team?

When the product you're developing has everything it takes to be a real winner, you know it. Like they knew it back in 1959 in the copier field. Like we, in the computer equipment field, know it today.

And what we know is that the peripherals we're working on are so good they can be expected to increase the utilization of computers by a significantly larger factor.

If that's exciting news filled with tremendous portents of growth and success, it's nothing to the excitement of actually working here right now. Because here, to a truly exceptional degree, you'll have the opportunity to be genuinely creative . . . to go through entire product cycles with state-of-the-art products . . . to work toward specific plans and objectives that you yourself help generate . . . to circulate freely in a small, closely knit organization made up of highly innovative people from a wide spectrum of technical disciplines and to make contributions in not one, but many areas.

In fact, here, you're likely to develop a high degree of familiarity with everything from high speed integrated circuit buffers to high speed paper handling.

So if you'd like to be on the winning team, working with the already successful product-oriented commercial business that's about to put the computer peripheral equipment field in a new ball park, why not look over our jobs and then drop us a copy of your resume.

There are immediate openings at Senior, Intermediate and Junior levels:

MECHANICAL ENGINEERS

For Senior positions an advanced degree in Mechanical Engineering is preferred coupled with at least 5 years' experience in product development of computer input/output devices, e.g. high speed printers and punched card form handling equipment. Experience in high speed automatic machinery utilizing advanced techniques is acceptable.

Additional openings for ME's with 2-4 years spent in automatic machine design (some background in product development preferred). Also, positions for junior Mechanical Engineers with up to 2 years' engineering experience and a definite interest in product development.

SENIOR SYSTEMS DESIGN ENGINEERS, EEs, MEs.

Advanced development; component design and analysis; product performance improvement; reliability analysis; customer proposal.

APPLIED PHYSICISTS, DEVELOPMENT ENGINEERS, MATERIALS CHEMISTS

Diverse openings for advanced degree holders with at least 5 years' experience in design and construction of experimental devices including test and measurement. A proven record of accomplishment is required.

Please write or call collect (215) WA 3-4251, Mr. Robert Lipp at General Electric Co., Printer Reader Business Section, Room 47A, 511 N. Broad Street, Philadelphia, Pa. 19123.

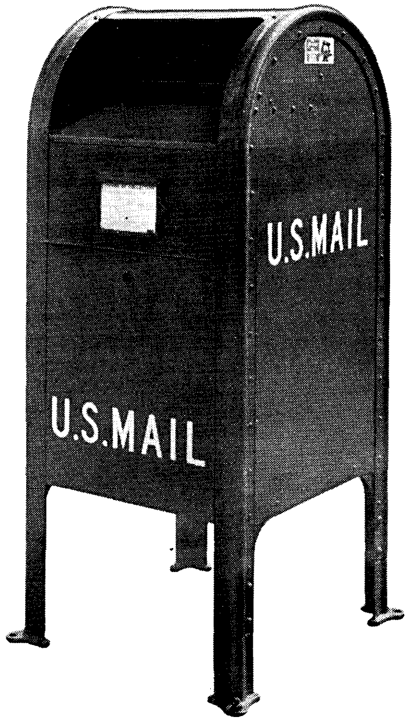
PRINTER READER BUSINESS SECTION

GENERAL ELECTRIC

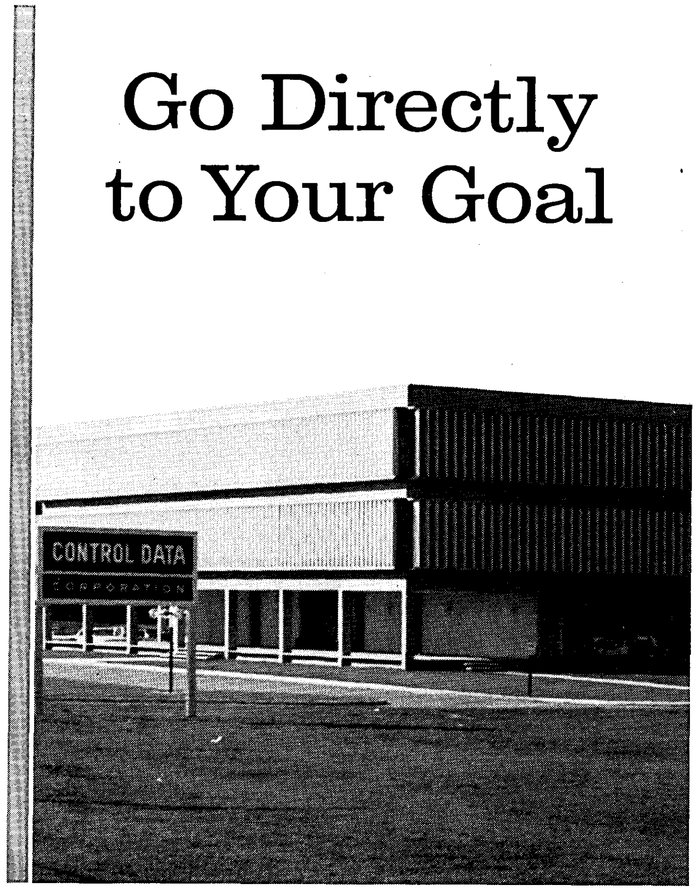
An equal opportunity employer M/F

CIRCLE 325 ON READER CARD

Start Here



Go Directly to Your Goal



Find out about the job to be done at CONTROL DATA now!

Tough assignments. Hard work. Stiff challenge. That's what we're offering people who want to accomplish something.

If you want to put your professional skills, experience and initiative to work, let Control Data provide the objectives.

Check the following listings. Then invest a resume and a five cent stamp. We'll tell you about jobs that have the challenges and the rewards you're looking for.

MECHANICAL ENGINEERS: Design and development of physical configurations for computer electronics packages. Design considerations include stresses, shock and vibration, RFI, and extreme environmental conditions which are experienced in military applications. BSME with 0 to 4 years of related experience. (Mr. Abrahamson).

SYSTEMS ENGINEERS: Opportunity to become involved in product improvement, development and system design. BSEE with demonstrated experience in these areas. (Mr. Abrahamson, Mr. Hoverman).

ENGINEERING WRITERS: Prepare operations and maintenance manuals for complex computer systems. Prepare final reports from detailed analysis of military computer systems. (Mr. Abrahamson).

FIELD SUPPORT ENGINEERS: To maintain equipment and provide technical advice and direction regarding equipment operation, maintenance and testing. Will recommend design modifications for performance improvement. (Mr. Abrahamson).

PROGRAMMERS: Business and scientific programmers to work on medium and large scale digital computers. Prefer one year of experience and assembly language experience. (Mr. Kinney, Mr. Hoverman).

PROGRAMMER ANALYSTS: Perform in the area of data transmission, data collection systems diagnostics, management information systems, message switching, simulation and operations research. College degree plus experience in one or more of the above areas. (Mr. Kinney).

MANUFACTURING ENGINEERING: BSEE, ME or IE with experience in the production and assembly processing of electromechanical equipment. Supply technical direction to manufacturing including test equipment, methods, vendor assistance, cost analysis, and coordinating the release of new product lines from design engineering to manufacturing. (Mr. Reed, Mr. Hoverman).

PRODUCT ENGINEERS: Will participate in the design and redesign of computer peripheral hardware. Engineering support of production and pre-production hardware from the engineering point of view. BSEE and BSME with minimum of two years' experience in design and development of electro-mechanical equipment. (Mr. Reed).

QUALITY CONTROL ENGINEERS: Will develop inspection procedures for in-process and receiving inspection. Provide guidance on tooling, fixturing and functional testing. Establish inspection procedures and monitor changes for compliance to Quality and Engineering specifications. BSEE, ME or IE with experience in quality assurance, in commercial or military electro-mechanical equipment. (Mr. Reed).

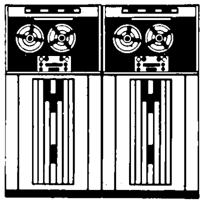
Please send your resume:

D. J. REED	R. D. KINNEY	P. E. HOVERMAN	S. E. ABRAHAMSON
Normandale Operations	Special & Applied Systems	Arden Hills Manufacturing	Government Systems Division
7801 Computer Avenue	2200 Berkshire Lane	4201 Lexington Ave. No.	3101 East 80th Street
Minneapolis, Minn. 55424	Minneapolis, Minn. 55427	St. Paul, Minn. 55112	Minneapolis, Minn. 55420

An equal opportunity employer

Where success creates opportunities

CONTROL DATA CORPORATION



By Any Computation

DATA PROCESSING PROFESSIONALS

Select

FOX-MORRIS PERSONNEL CONSULTANTS

We have a select group of clients offering unexcelled starting salaries in the $10-30,000 range. (all fees and employment costs paid by client companies).

Assignments in such areas as Software Development, Management Information Systems, Operations Research, Scientific and Commercial Programming Management.

Our National Data Processing Division is professionally recognized as the most complete, effective and confidential service in the placement industry. (Affiliate offices coast to coast).

For full details, reply in strictest confidence by letter or resume, or call collect, W. B. McNichols, Manager — Data Processing Division, 215 LO 8-2535.

FOX-MORRIS ASSOCIATES
Personnel Consultants
1500 Chestnut Street Philadelphia, Penna. 19102

CIRCLE 327 ON READER CARD

We can save you
real time
to get that
BETTER
position

PROGRAMMERS
SYSTEMS ANALYSTS
MANAGERS

$10,000 to $50,000

Finest Coast-to-Coast
Clients
Companies assume fees

Send Resume with Coupon in complete confidence to nearest R-H office.

ROBERT HALF PERSONNEL AGENCIES

World's Largest Financial & Systems Placement Service

Baltimore: One Charles Center
Boston: 80 Federal St.
Chicago: 333 N. Michigan Ave.
Cleveland: 1367 East 6th St.
Detroit: 1114 Guardian Bldg.
Los Angeles: 3600 Wilshire Blvd.
New York: 330 Madison Ave.
Newark: 570 Broad St.
Philadelphia: 2 Penn Center
Pittsburgh: 429 Forbes Ave.
St. Louis: 1015 Locust St.
San Francisco: 111 Pine St.
Stamford: One Atlantic St.

NAME____________________

ADDRESS____________________

WILL YOU RELOCATE OUT OF TOWN?________WHERE?________

PRESENT EARNINGS?________SALARY REQUIRED?________

CIRCLE 328 ON READER CARD

CORPORATE STAFF EDP POSITIONS AS

PROJECT LEADERS SYSTEMS ANALYSTS SYSTEMS PROGRAMMERS

The Kelsey-Hayes Company, a multi-division leader in the automotive and aerospace components industries ($300 million sales), is establishing a centralized systems and data processing organization at the corporate level to assure the development of "Mainline" information and control systems in the areas of Manufacturing, Engineering, Quality, Resource Planning, Finance, and Corporate Planning. Thus, many responsible positions on the Corporate Staff are now available.

PROJECT LEADERS & SYSTEMS ANALYSTS

Work with corporate and division Management to develop integrated systems using advanced computer concepts. Two to six years related systems experience (depending on level) plus programming knowledge and degree required.

SYSTEMS PROGRAMMERS (ALL LEVELS)

Develop software, evaluate hardware, establish corporate programming standards, and assist division staffs in applied programming and conversions. Suitable experience with tape and disk, COBOL, BAL, and/or AUTOCODER. Math, Engineering or Business degree preferred. Computers include 1400 and 360 series and Burroughs 300.

These positions based in greater Detroit and may require travel. Corporate headquarters in close proximity to major universities and colleges.

We offer excellent salaries and liberal fringe benefits including tuition reimbursement plan.

Your resumé will be held in confidence and will receive prompt acknowledgment and consideration.

If you meet the qualifications and are enthusiastic about a new challenge with our dynamic organization we would like to receive your resumé.

Please reply stating salary, work history, and salary requirements to:

R. C. GUARINO
Director of Systems and Data Processing
KELSEY-HAYES COMPANY
38481 Huron River Drive
Romulus, Michigan 48174

KELSEY-HAYES

AN EQUAL OPPORTUNITY EMPLOYER

CIRCLE 329 ON READER CARD

books

***Who Was Junius?* By Alvar Ellegard. Stockholm: Almquist & Wiksell. 1962. *A Statistical Method for Determining Authorship: The Junius Letters, 1769-1772.* By Alvar Ellegard. Gothenburg Studies in English, No. 13. Gothenburg: University of Gothenburg. 1962.**

Alvar Ellegard is a Swedish statistician and literary scholar. In 1962 he published two thin volumes. One of them—*Who Was Junius?*—reads like a murder mystery. The other, with its word lists, statistical tables, charts and formulae and a rather arid title, reads like an advanced text in mathematical linguistics. Both books confront a major mystery in English literary history and show how Ellegard solved it with the help of an electronic computer at the Chalmers Tekniska Högskola in Gothenburg. What the computer helped to reveal—eerily and conclusively—was an identity that had been shrouded for 190 years.

Literary scholars had *suspected* who Junius was, but they did not *know* who he was. They knew that someone writing under that modish pseudonym had printed the first of a series of witty and elegant letters on political topics in a popular daily newspaper in London—the *Public Advertiser*—on January 21, 1769. Junius' last letter came out three years later to a day. Then he was silent. But in this short time the epistles of "the invincible Junius" had conquered literary England.

With superb insouciance and great argumentative skill, an anonymous writer had ridiculed his king, slandered a whole bevy of lords and ministers, elaborated a more or less consistent political philosophy and won for himself the enviable reputation of being one of the finest masters of invective in English who had ever lived. But he had not revealed his identity. As late as 1961, nobody knew for sure whether Junius was Edmund Burke or Edward Gibbon, Lord Sheffield or Lord Chesterton, or (somewhat more likely in the light of circumstantial evidence) a more obscure parliamentarian known as Sir Philip Francis. About 40 Junian candidates had been proposed since 1772. How could anyone name him now, 190 years after his letters first saw light?

Ellegard did so by means of an intricate system of stylo-statistical analysis. It took a good deal of time. Computer specialists helped him. Then, when finished, he wisely wrote two parallel accounts of his project and its significance. One of them emphasizes in a brisk, lucid way the biographical and literary aspects of the case.

We learn of a bright and rather frustrated young secretary in the War Office, Philip Francis indeed, 29 when he took up his glittering mask and 32 when he dropped it forever. Francis was intensely proud and irascible. He must have been inordinately fond of mystification. He went on to a genteel career in politics, was knighted and retired comfortably. But he denied in the year of his death at 78 that he had anything to do with Junius. Except for a curious, unexplained wedding gift to his wife—a prettily bound copy of the Junius Letters—he was careful to leave no telltale clues and so took his great secret quietly to the grave.

His mask had allowed him absolute freedom of expression during the Junian years and in old age that colossal vanity and irritableness to which his biographer attested probably led him to hug his precious secret close. For "part of Junius' greatness lay in his anonymity," as Ellegard reasons, and "to destroy that anonymity by disclosing the secret would have been to destroy the best part of Francis himself." As a young man he had seen himself as the heroic character of his own creation. Intense public speculation as to that character's real-life counterpart, continuing after Sir Philip's retirement and to the day of his death, nourished the elder statesman's dream-world. (In his prolific later writings under his own name, Philip Francis had never been able to match Junius' controlled fire and wit.) In general, this explanation for the man's obstinate refusal to admit that he was Junius is psychologically valid even if conjectural.

On the other hand, Ellegard's stylo-statistical procedures leave no room for further conjecture as to whether Francis *was* Junius. This thesis is impressively proved and it is Ellegard's main point. In *Who Was Junius?* a single chapter summarizes

computer careers

Should you base your career on just one interview? Make your choice from among several career positions!

EUROPEAN and NATIONWIDE CHOICE

N.Y., N.J., NEW ENGLAND, WASHINGTON, D.C., PHILA., MINNESOTA, TEXAS, HUNTSVILLE, FLORIDA, ARIZONA, CALIFORNIA AND OTHERS

Contact us if you have some experience or interest in any of the following:

- ☐ **Scientific Computation** — Data Reduction or Numerical Analysis—Unusual Outerspace/Lunar and Advanced Programs
- ☐ **Software Development** — Languages, Compilers, Assemblers, Monitors or Sub-Routines
- ☐ **Real Time Systems** — Message, On Line, Process Control
- ☐ **Systems** — Planning, Design, Analysis of State of the Art Massive Data Handling of I.R. Systems
- ☐ **Technical Representatives** — Programming and Systems support to Sales
- ☐ **Digital or Logical Design**
- ☐ **Management Sciences**
- ☐ **Sales and Marketing**

Unique opportunities exist in the $9000-25,000 class for Managers & Seniors and Men who can accept management responsibility and professional growth

MGT. INFO SYSTEMS and/or REAL TIME COMMUN

NOW — NOW Exceptional Jr. Posts available

All expenses are assumed by our client companies.

Write in confidence, including present salary, acceptable locations or call (Collect) Mr. Nellissen (Area Code 212) PLaza 9-1720

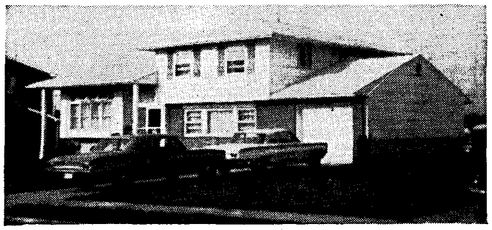
a&n

albert, nellissen, inc.

Leading Consultants to Management in the Data Processing Field

510 MADISON AVENUE, N.Y., N.Y. 10022

CIRCLE 330 ON READER CARD



EDP PERSONNEL

In the Delaware Valley, you can buy a home like this for $17,000

This particular home has four bedrooms, three bathrooms, a large basement and it sits on a 1/4 acre lot.

EDP opportunities galore

There is no other place in the world where you can be so close to so many industries which use or manufacture EDP equipment.

Everything is close

The above house is 30 minutes from center city Philadelphia. It is 15 minutes from several large industrial centers. The beautiful Atlantic shore is a little more than an hour's drive away. The majestic Pocono mountains with their lakeside vacation resorts & fine ski slopes are 90 minutes away. New York City is a mere 90 minutes away.

Full service consultants

The Callahan Center for Computer Personnel takes pains to be in close contact with the EDP job market in the Delaware Valley. We go to great lengths to save you time & effort in locating the position you are after. We are building a reputation for **quality** EDP placement. That is why we give you more service than you'll find anywhere else.

We offer

Night & Saturday interviews. All fee paid positions. **No** contract to sign. Strict confidence. Positions with manufacturers, users & consultants. Once you are registered with the Callahan Center, your application is reviewed weekly for one year.

Circle 342 on the reader service card **now** while you're thinking about it. We will send you free of charge:

(1) A list of job opportunities.
(2) Local real estate listings with photos & details.
(3) Our brief application blank.

Callahan Center for Computer Personnel
Sheraton Hotel, Concourse, Phila., Pa.
Phone: area code 215 LO 7-4811
You're "on line" with the Callahan Center

CIRCLE 342 ON READER CARD

CENTRALIZATION

ORDER PROCESSING — MANUFACTURING MARKETING — FINANCIAL

Crane Company, a leading manufacturer of valves, plumbing, heating, air conditioning, pumps and water treatment systems plans to centralize in Chicago during 1967 and 1968 many applications currently processed in the company's 18 manufacturing plants. Included in centralization plans is the design of an order entry and processing system using terminal devices on line with a computer dedicated to switching of administrative messages and data.

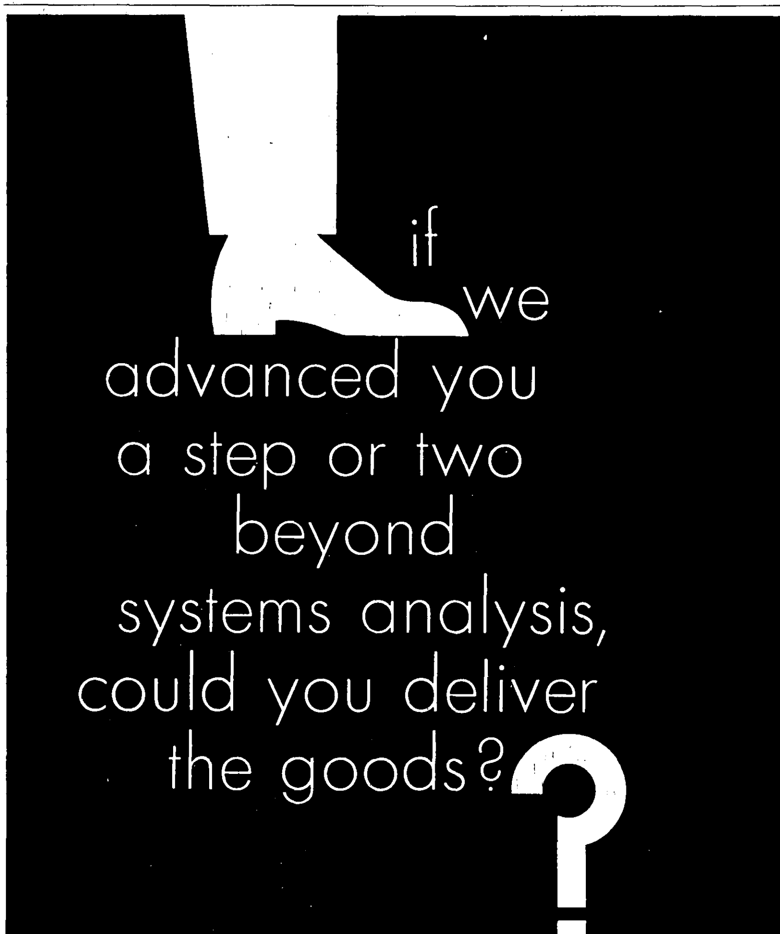
In the following areas, opportunities exist for professional personnel to continue their career development:

- **COMMUNICATIONS SPECIALISTS**—Hands on experience in the design and installation of a multi-line, multi-terminal network using a computer as the message switching device. Experience in communications software is a plus.
- **EDP PLANNING**—Both a background and interest in developing short and long range plans of action in the application, hardware, software, and operations areas.
- **SENIOR SYSTEMS ANALYSTS**—Extensive experience in design and implementation of tape/disk systems. Preference will be given individuals with order entry backgrounds.
- **SOFTWARE SPECIALISTS**—Knowledge of 360 full operating system and communications software.
- **PROGRAMMER ANALYSTS**—Knowledge of disk and COBOL desirable.

For further information about these opportunities, please send resume including desired salary to:

R. S. Osborn, Mgr. of Mfg. & Accounting Systems
CRANE CO.
4100 So. Kedzie Avenue
Chicago, Illinois 60632

CIRCLE 311 ON READER CARD



We're ready to take a calculated risk on a systems analyst or systems and procedures man—someone ready to step into management consulting. You must have meaningful experience in developing application packages for a computer manufacturer... or in developing computer-based systems for a large user. We are particularly interested in banking, retail, and hospital experience. If you would like a chance to deliver from a significantly higher position than the one you now occupy, we'd like to talk with you. We cordially invite you to arrange a confidential interview by sending a resume to: Theodore M. Hurewitz, Director, Business Planning, Information Sciences Associates, 1110 Wynwood Ave., Cherry Hill, N.J. 08034.

Information Sciences Associates
OFFICES: Cherry Hill, Los Angeles, San Francisco, Washington, Brussels

CIRCLE 332 ON READER CARD

the technical procedures that demonstrate the virtual certainty of the identity. In *A Statistical Method* they are spelled out step by step, program by program.

Ellegard starts with two interesting assumptions about literary style. (They are meticulously qualified.) The first is that if there are any truly constant features in a style they will not be deliberate ones, such as an author's use of classical images or antithetic sentences, but rather the result of more or less automatic habits. Hence relatively unimportant style choices—a favoring of *on* instead of *upon*, or of *no doubt* instead of *doubtless*—will be more useful in identification than the more literary qualities of a style.

The second assumption is that what linguistically distinguishes one writer from another is not the use or non-use of certain words but differences in their *frequency* of use. ("Non-use," for Ellegard, "is simply an extreme case of infrequent usage.") The word *uniform*, for example, was very common in the late 18th century. Junius uses it 23 times in a total of 82,200 words in the Junius Letters. So the "relative frequency" of *uniform* for Junius is 23 in 82,000, or 280 in a million, or .000280.

To find out whether Junius used such a word either more or less frequently than his contemporaries Ellegard compiled a "million-word sample" from other writings of the time (mainly formal essays and political tracts). Since the frequency of *uniform* in the million-word sample turned out to be 65, or .000065, which is less than a fourth of the Junian figure for the word, Junius may be said to use *uniform* more often than the average for his time. This word becomes, for Ellegard, a "Junian plus-expression." As such it has diagnostic value. By finding a large number of "Junian plus-expressions" and (in cases where Junius uses a word less frequently than the average) "Junian minus-expressions," it is possible to draw a statistical picture of some of the constants in the Junian style.

Ellegard's diagnostic list finally included 458 "plus" or "minus" words and phrases culled from Junius. Then began the problem of determining whether any known political writer of Junius' time could be said to come near the Junian frequency of usage for all 458 expressions and combinations of them; and Francis' own signed writings were put to the test.

Obviously, I indicate only several steps in Ellegard's complex process. Significantly, a good deal of his calculation had to be "carried out by electronic computer," as he writes, "because of the huge number of raw data involved." And it is in the diagrams finally constructed from his computer's calculations that one sees revealed in a remorseless and—if I may be pardoned for borrowing a phrase from Whodunnit blurbs—positively haunting and spine-tingling maner the fact that the 29-year-old Philip Francis and only he could have been the author of the Junius Letters.

In diagram after diagram that writer's linguistic portrait looms up to overlap or fall closely adjacent to Junius' own. The testing list is larger than it would need to be to rule out coincidental resemblances. (The probability of any other writer falling within the Junian "ranges" of frequency, as Francis does, is about one in 462,000.) Indeed, Ellegard works hard to *disprove* the identity he finally establishes. He repeatedly challenges his own methods.

"The statement that Sir Philip Francis was Junius may henceforth be allowed to stand without a question mark." And to this modest conclusion one readily assents.

Very well, Francis was Junius. But what is the final meaning of Ellegard's work? Perhaps it is still too soon to tell. His demonstration depended on a computer—and so have other demonstrations. Yet I think there is a difference. Stephen M. Parrish's remark in 1964, that the computer can help make a better critic of a literary man, is a good deal less jolting today than it would have been before Ellegard's books. Of course, computers have been used profitably in many phases of literary study. Machine-made concordances such as those edited by S. P. Rosenbaum and Professor Parrish at Cornell have proved themselves. Automatic language translation has a history behind it and linguists have been using computers for years. But the literary critic has looked in vain until recently for evidence that computers could be useful to *him*. Ellegard brings the computer to the critic's attention precisely because his work enables one to discuss the Junius Letters in relation to Francis' other writings meaningfully for the first time.

What lies ahead? Hundreds of other problems in textual attribution await the researcher armed with electronic equipment. Stylistics, metrics and prosody, and most other focal points in literary study will yield—as indeed they are yielding—secrets to those who can direct computer-type

Data Processing

Opportunities with

EASTERN AIR LINES

Miami, Florida

Eastern's Data Processing Center is undergoing a major expansion. We are currently installing the following equipment:

3 IBM System/360, Model 55
1 IBM System/360, Model 50
1 IBM System/360, Model 40
2 UNIVAC 494's

This increase in capacity will be applied to an intensive variety of problems ranging from Payroll to Mathematical Models, from Inventory to Tele Processing, and from Revenue Accounting to Real-time Reservations Systems.

Openings at various levels are available in Tele Processing Analysis and Programming, Operations Research, Software Programming, Systems Analysis, Programming, Technical Writing, Mathematics and Statistics.

Qualified candidates should have at least one year of experience in one or more of the above areas. We prefer knowledge of or experience with System/360, IBM 7074, or UNIVAC 490. However, experience on other equipment will be given full consideration.

Because of our rapid growth, we believe the opportunities we have to offer are unparalleled. Our salary and benefits (including unlimited free travel privileges for employees and family members) are high competitive. To explore these career possibilities further, please submit a resume in confidence to:

Mr. B. I. Johnston
Department A-113
Eastern Air Lines
International Airport
Miami, Florida 33148

an equal opportunity employer
M/F

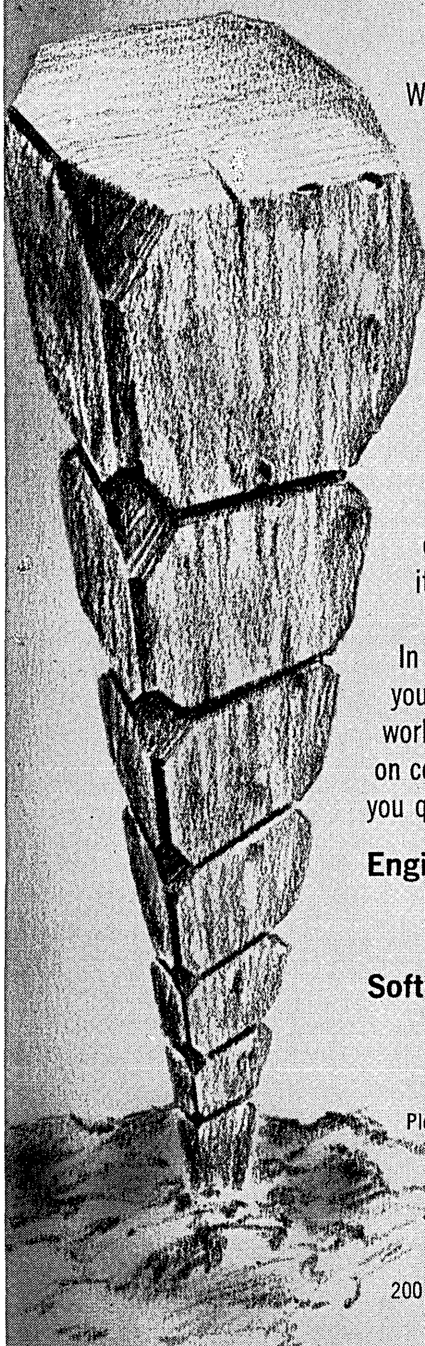
CIRCLE 333 ON READER CARD

research. Our deep-rooted suspicion in the English Department that in some way machines and statistics are injurious to the critical sensibility is passing. (It is, or ought to be, a truism that the computer is no subtitute for either sensibility or insight. Nor is it inimical to either.) In short, the electronic machine can aid sensitive critics in innumerable ways—and our realization of this owes much to the one that helped to say who Junius was and to Ellegard's lucid explication of a method.

—Park Honan

NO ONE EVER BUILT A MONUMENT TO A COMMITTEE

Maybe it's time.



With today's Honeywell computers, where every element depends to some extent upon every other, our people work side-by-side with other specialists on complex solutions to complex problems.

It's "committee" work, of course. But judging from the success of the computers they've created, Honeywell engineers and software people have proved that great things **can** come out of "committees". Perhaps it's time some sculptor noticed.

In the meantime, there's still room for you at Honeywell. Especially if you enjoy working with a variety of different people on complex, interdisciplinary problems. Are you qualified in one of the areas below?

Engineering ☐ Systems Architects ☐ Mass Memory ☐ Advanced Memory ☐ Microelectronic Packaging.

Software ☐ Advanced Operating Systems ☐ Software Support ☐ Testing ☐ Software Development.

Please forward your resume to Mr. Edwin Barr.

Honeywell

ELECTRONIC DATA PROCESSING

200 Smith Street, Waltham, Massachusetts 02154
DEPT. D-01

Opportunities exist in other Honeywell Divisions. Send resumes to F. E. Laing, Honeywell, Minneapolis, Minnesota 55408. An equal opportunity employer.

CIRCLE 334 ON READER CARD

PROPOSED SYSTEM/360 INSTRUCTIONS

(Many suggestions have been received for additions to the System/360 instruction list. Most of the entries in this collection came from the San Francisco Bay Area ACM newsletter, The Bit Dropper.)

BH	Branch and Hang
IIB	Ignore Inquiry and Branch
TDB	Transfer and Drop Bits
DO	Divide and Overflow
SRZ	Subtract and Reset to Zero
PI	Punch Invalid
SSJ	Select Stacker and Jam
FSRA	Forms Skip and Run Away
RASC	Read and Shred Card
SRSD	Seek Record and Scar Disc
BST	Backspace and Stretch Tape
RIRG	Read Inter-Record Gap
UER	Update and Erase Record
EM	Emulate 407
SPSW	Scramble Program Status Word
EIOC	Execute Invalid Op Code
EROS	Erase Read-Only Storage
PBC	Print and Break Chain
CM	Circulate Memory
MLR	Move and Lose Record
CRN	Convert to Roman Numerals
DMPK	Destroy Memory Protect Key
DC	Divide and Conquer
EPI	Execute Programmer Immediate
LCC	Load and Clear Core
HCF	Halt and Catch Fire ■

people

■ Ray R. Eppert, chairman and chief executive officer of Burroughs Corp., has announced plans to retire February 1, terminating a 46-year career with the company. He will be succeeded by Ray W. Macdonald, president.

■ Russell W. McFall, president, Western Union, has been elected to succeed Walter P. Marshall as chairman of the board of directors. Mr. Marshall, who is retiring from that position, will continue to serve as director.

■ At Univac, Carl J. Knorr resigned as vp marketing, and was replaced by Joseph L. Sturdevant. Adrian Boss replaces Sturdevant as vp, marketing for commercial systems. Neil Gorchow, director of systems programming, is a new vice president.

■ W. Walter Watts, group executive vp at RCA, has been named manager of the company's defense electronic products, broadcast and communications products and graphic systems divisions. Former group vp for these divisions, Arthur L. Malcarney, has been appointed executive vp, manufacturing and materials.

■ Ralph T. Dames, formerly manager of Simulation Systems at Scientific Data Systems, Beverly Hills, Calif., has founded and is president of Spectrodata Inc., Redondo Beach, Calif. The firm specializes in hybrid simulation and real-time programming.

■ Herbert R. Koller has joined the management sciences dept. of EBS Management Consultants Inc., Washington, D.C., as director of client services. He was formerly with the U.S. Patent Office.

■ Leon D. Findley is now vp, systems and program management, Sperry Rand's Univac Div. in Roseville, Minn.

■ Charles W. Adams Associates, Inc., Cambridge, Mass, has started a wholly-owned subsidiary, Adams Associates, Inc., in Bedford, Mass. John T. Gilmore, Jr., a co-founder of the parent company in 1959, will serve as president.

■ Charles H. Deming has been appointed manager, business systems and programming department, The Stanley Works, New Britain, Connecticut.

DRASTIC REDUCTION

Of space program telemetry data at JFK Space Center is stretching the capabilities of among the best

MATHEMATICIANS/PROGRAMMERS

in the country.

Are you ready for such a challenge?

Mountains of data from spacecraft and boosters in the Apollo program are accumulated here at J. F. Kennedy Space Center. Vast accumulations of pre-flight data are required for instrumentation planning and mathematical analysis.

As part of its Instrumentation Support Services Contract, Federal Electric Corporation (world-wide service arm of ITT) has the main job of cutting this data down to meaningful size so the U.S. space program can keep moving along on schedule.

Openings at all levels for mathematicians and scientific and systems programmers, with a flair for simplification to help us do this important job.

MATHEMATICIANS... Reduction of telemetry data acquired in real-time, as well as the reduction of pre-flight data required for instrumentation planning and math analysis. Will utilize data receiving equipment, sophisticated computing equipment and detailed scientific program libraries. Degree required for all levels. No experience required for lower levels. Higher levels require experience in one or more of the following areas: data reduction, acquisition, analyses, conversion, telemetry data operation, or general range data operations.

SCIENTIFIC & SYSTEMS PROGRAMMERS... Real-time, data reductions and software techniques and development. Will implement KSC's GE 635 multi-programmed/multi-processor computers to the task of real-time and post test telemetry reduction, data transmission, display, software techniques and compiler/assembler development. Requires degree in math or related field and applicable experience.

To find out more about the climate (both professional and geographic) that makes work at our facility here rewarding, please send your resume to Mr. H. B. Arnold, Federal Electric Corporation, Suite 501, Cape Royal Building, Cocoa Beach, Florida.

ITT service

FEDERAL ELECTRIC CORPORATION

An Equal Opportunity Employer (M/F)

CIRCLE 335 ON READER CARD

LUNAR HOSTILITY • MANNED SPACE FLIGHT • ROCKETRY • UNMANNED FLIGHT • MICROMETEOROIDS • MAN-MACHINE SYSTEMS • GUIDANCE • TRAJECTORY • ALTERNATE EARTH RETURN • COMMUNICATIONS • NAVIGATION • CELESTIAL MECHANICS • COMPUTING • SIMULATION • RE-ENTRY • LUNAR LAUNCH • PROGRAMS • STATISTICS • SYSTEMS OPERATIONS • SPACE VEHICLES • PROPULSION • SOLAR RADIATION • APOLLO CHECKOUT • TELEMETRY • HEAT TRANSFER • EVALUATING • LOGIC • OPTIMUM ABORT PROCEDURES • RELIABILITY • PROBABILITY • VEHICLE DYNAMICS • SERVOMECHANISMS • DESIGN • BALLISTIC FLIGHT • AUTOMATIC DIGITAL CONTROL • PAYLOAD CAPABILITY • GEOPHYSICAL TECHNIQUES • AUTOMATIC TROUBLE DIAGNOSIS • DATA PROCESSING

WANTED: SPECIALISTS IN SPACE

Above are some of the divisional functions of Bellcomm, the systems engineering contractor of the National Aeronautics and Space Administration. Bellcomm is utilizing a wide range of disciplines in its extensive feasibility studies and operations analysis of manned space flight systems.

Bellcomm's work on Project Apollo offers rewarding employment opportunities for persons especially qualified in such fields as physics, mathematics, engineering, flight mechanics, propulsion, man-machine relationships, computer programming, aerodynamics and aeronautical engineering in general.

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 1501-E, 1100 17th St., N. W., Washington, D. C. 20036. Bellcomm is an equal opportunity employer.

BELL SYSTEM

Bellcomm, Inc.
A Bell System Company

LET A PROFESSIONAL HELP YOU MAKE YOUR PROFESSIONAL CAREER GO

•
•
•

AND GROW!

And that's the reason top companies get top executives and EDP Specialists through Brentwood. Where professionals handle professionals. Where you'll talk to men who talk your language . . . men with degrees in engineering, physics, personnel practice. Men skilled in matching the right man and the right job . . . in the best interest of both! Let us help you put grow-power in your career! Start by sending us a resume . . .

BRENTWOOD

Where Professionals Place Professionals

COMPUTER CAREERS

- ☐ Applied Systems
- ☐ Compilers
- ☐ Assemblers
- ☐ Automatic Languages
- ☐ Utility
- ☐ Commercial Programming
- ☐ Scientific Computation & Analysis PhD in — Numerical & Mathematical Analysis
- ☐ Real Time — Operational
- ☐ Operations Research
- ☐ Systems Design
- ☐ Information Retrieval
- ☐ Diagnostics
- ☐ Digital and Logical Design

Fees are paid by the companies we serve.

In the Philadelphia Pa., area, contact Mr. J. Volz (215) Mi 8 6-8801

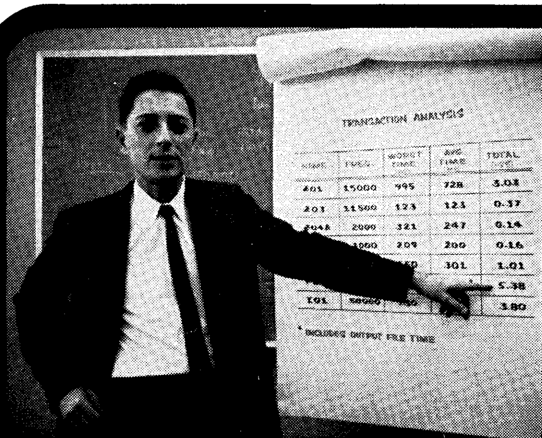
Write in confidence, or call collect: Mr. F. X. Jones (201) MArket 2-0915

BRENTWOOD
PERSONNEL ASSOCIATES
786 BROAD ST. NEWARK, N. J.

CIRCLE 336 ON READER CARD

WHAT IS A SCERT ANALYST?

Should you consider becoming one?



Meet Mort Gibson, Senior SCERT Analyst. He's 29 . . . graduate of the University of Pennsylvania. He learned Data Processing working for a well-known computer manufacturer. He is an experienced programmer and systems analyst. About a year and a half ago, he joined COMRESS, Inc. to work with the SCERT program. In this short period of time, he's been involved in analysis projects for such COMRESS clients as: New England Telephone Company, Westinghouse Corporation, Montgomery Ward, Provident National Bank, C.I.T. Financial Corporation, Department of the Army Headquarters, *Reader's Digest*, Equitable Life, and the State of Michigan . . . including studies in real time communications, multiprogramming, and unique applications of computer systems.

He's a new kind of EDP analyst

. . . **who** uses SCERT *(Systems and Computer Evaluation and Review Technique)* . . . along with a computer, to assist clients in systems design, hardware enhancement, computer selection and in other vital areas of data processing management.

. . . **who,** in a short period of time, will likely have a hand in more stimulating problems than the ordinary analyst encounters in a lifetime.

If you qualify, you can join this **new breed of Data Processing Analysts.** The acceptance of SCERT by the entire industry, nationally and internationally, requires a constant influx of imaginative, ambitious EDP programmers, analysts and systems specialists.

You'll have a chance to work in an organization —

— where there's exposure to a wide variety of computer applications as well as the latest hardware and software

— where you'll learn the advanced techniques of simulation and translation, and to apply them creatively to the solution of computer management problems

— where top management will recognize your contributions to corporate growth and profits . . . in a company with no "blind alleys" to stunt your imagination, independence or technical advancement

— where there are liberal salary and employee benefits, plus a pleasant environment with no parking or traffic problems

The basic qualification is a familiarity with computer programming and applications. Beyond that it will be helpful if you have worked on several different computers . . . used a variety of programming languages . . . have a background in systems or programs design . . . are comfortable in customer relation situations . . . can communicate readily, either orally or in writing.

Your resume will be quickly acknowledged. Please address it to:

Mr. Alan S. Linden, Personnel Director • COMRESS, Inc.

COMRESS, Inc.
2120 Bladensburg Road, N.E.
Washington, D. C. • 202-529-0360

CIRCLE 338 ON READER CARD

digital systems

opportunities at NCR electronics division in los angeles

- ☐ SYSTEMS FORMULATION & ANALYSIS ENGINEERS
  For assignments in commercial on-line computer applications with emphasis on communications interface. Extensive experience required in hardware specifications and advanced systems, including multiprogramming and list processing. Requires B.S. in engineering, business or related field.
- ☐ SOFTWARE PROGRAMMER
- ☐ DIAGNOSTIC PROGRAMMER
- ☐ PROJECT ENGINEERS
  Computing Systems
  Peripheral Equipment
  Discs & Controllers
  Packaging
- ☐ CIRCUIT DESIGN ENGINEERS
- ☐ ELECTRICAL & MECHANICAL LIAISON ENGINEERS
- ☐ PACKAGING ENGINEERS (ALL LEVELS)
- ☐ MECHANICAL DEVELOPMENT ENGINEER
- ☐ RELIABILITY ENGINEERS
- ☐ QUALITY CONTROL ENGINEERS
- ☐ PROCESS ENGINEER —ELECTRONIC
- ☐ TEST EQUIPMENT DESIGN ENGINEERS
- ☐ MEMORY DESIGN— RESEARCH

ARRANGE NOW FOR AN INTERVIEW IN YOUR AREA

Confidential interviews will be held soon in various parts of the country. To arrange an appointment, please send your resume, including experience, training and salary history, to Bill Holloway, Technical Placement.

The National Cash Register Company

NCR

ELECTRONICS DIVISION
2837 W. El Segundo Blvd., Hawthorne, Calif.
Telephone: Area Code (213) 757-5111
An equal-opportunity employer

CIRCUIT 337 ON READER CARD

datamart

Address all replies to box number advertisements as follows:

Box..............
DATAMATION
F. D. Thompson Publications, Inc.
35 Mason Street
Greenwich, Conn. 06830
Classified Advertising

PROFESSIONAL SERVICES

UNGERLEIDER & CO.
Representatives for
EDP Equipment & Services
P.O. Box 1180 Area Code 703
Alexandria, Va. 768-6700

JOHN P. FRANCIS
Consultant
computer system/logic design
product planning; analysis; research
5730 Busch Drive
Malibu, California
(213) 457-2420

USED EQUIPMENT

FOR SALE: UNIVAC S.S. 90 40,000 digits fast 10,000 digits high speed drum memory 3 Index Registers, Mul. Div. Program Interrupt 600 LPM Printer. Box 12-1.

We will buy your IBM Data Processing Equip. outright. Or sell, rent or lease IBM Data Processing Equipment to you with full IBM maintenance contract. Global Tab. Equip. Corp., a subsidiary of International Typewriter Exchange, 1229 W. Washington Blvd., Chicago, Ill. 60607, SE 3-1200.

IBM unit record equipment needed immediately. 407, 402, 1401, 083, etc. Complete installations for lease with systems assistance. Data Equipment Sales, Inc., 1107 Reliance Life Bldg. Telephone 214 RI2-6736, Dallas, Texas.

MISCELLANEOUS

AVAILABLE IMMEDIATELY
FOR SALE OR LEASE
IBM 024, 026, 077, 082, 403
407, 514, 519 & many others
I.O.A. LEASING CORP.
383 Lafayette St., NYC (212) 673-9300

UNIVAC SOLID STATE COMPUTER. 2400 word memory, with card reader, card punch, and high speed printer, together with assorted auxiliary equipment. Equipment averages 5 to 7 years in age. Costs new, $250,000. This equipment has been repossessed by owner from lessee who has discontinued business. In excellent condition; located in Little Rock, Arkansas . . . For further particulars, write or call R. D. Rawn, 1500 Tower Building, Little Rock, Arkansas. Area Code 501, FRanklin 6-3728

WORLD WIDE POST OFFICES.
Over 63,000 cities and locations (excl. U.S. & Canada) on magnetic tape, 556 density, 7-channel. Coded: continent, county, city number and name. $1000. Print-outs also available. Miller Freeman Publications Attn: Charles C. Baake 500 Howard Street San Francisco, Calif. 94105 (415) 397-1881

HELP WANTED

JOINT ACADEMIC & DATA PROCESSING PROFESSIONAL POSITION. RESPONSIBILITIES MAY INCLUDE TEACHING, PARTICIPATION IN DEVELOPMENT OF SYSTEMS AND DATA PROCESSING ACADEMIC PROGRAM, SYSTEMS DEVELOPMENT, PROGRAMMING, AND STAFF WORK. SEND RESUME TO DEAN W. M. PETRY OR R. S. HATHAWAY, DIRECTOR COMPUTER CENTER, UNIVERSITY OF AKRON, AKRON, OHIO 44304

Computer Program Design

(Southern California)

HUGHES Guidance and Controls Division has several openings for qualified persons who have the ability to create complex digital computer programs—and the desire to do the job thoroughly and efficiently. Satisfaction of current commitments on such systems as: PHOENIX, IRAM, VATE and ASG-18 requires experience in the design of real-time command and control programs, or of software programs for execution on an IBM 7094 or GE 635 computer.

Responsibilities include: specification, design, implementation, checkout and support of computer programs for a wide variety of applications including:

- **Airborne Navigation & Fire Control**
- **Digital Simulation of Airborne Computer and its environment**
- **Automatic In-Flight & Depot System Testing**
- **Assemblers & Compilers**
- **Automation of Electronic Equipment Design**

Requires: an accredited degree in Engineering or Mathematics, a minimum of three years of professional experience and U.S. citizenship.

Please airmail your resume to:

Mr. Robert A. Martin
Head of Employment
HUGHES Aerospace Divisions
11940 W. Jefferson Blvd.
Culver City 36, California

HUGHES
HUGHES AIRCRAFT COMPANY
AEROSPACE DIVISIONS

An equal opportunity employer — M & F

(Continued from page 19)

The system, which runs on or off-line, could operate faster with a smaller character set. Hitachi will market the unit in Asia under license to Itek.

T-S SOFTWARE FIRM OFF & RUNNING

Telecomputer Corp., two-man subsidiary of Tabulating & Business Services, is developing programs for time-sharing systems. The five-month-old firm, led by ex-GEer Kenneth Kretschmer, is working with GE on an economic data bank for a time-sharing facility and with Stewart-Warner Electronics in development of a computer system which will operate 11 information display panels at EXPO '67, giving exhibit waiting times, parking lot load information etc.

RUMORS AND RAW RANDOM DATA

Palo Alto's Data Disc has received a healthy $450K financial injection and says it's solved the technical problems which plagued it last year. The company now warrantees its discs for one year. ... Computer Sciences Corp. will reorganize this year, with Fletcher Jones' CSC serving as a corporate umbrella for Computer Sciences Division and other autonomous operations. The company in '67 will push an on-line ticketing service, lay the groundwork for other similar service activities, invade Europe in a big way. ... Applied Data Research's Autoflow flowchart generator has been accepted for inclusion in the GSA schedule. It's the first software to be so honored, and signals another step toward separation of hardware/software pricing. ... IBM is quoting delivery of up to 24 months for some items. The production lag forced the company to bid 1460's on one proposal. Meanwhile the company has withdrawn the 2402 dual tape drive, and 2403 (drive plus controller) from its line, interpreted by some as implicit admission of tape drive reliability problems. ... Data Machines Inc., Newport Beach, is coming out with an integrated circuit version of its 620 computer. The IC 620-I is compatible with the 620, runs at about the same speed, but is cheaper. The basic system sells for less than $15K...basic 620 is about $28K, although standard 620 features are optional on the 602-I. ... IBM's trillion-bit photo optical mass storage system produced for AEC is reportedly being marketed commercially with a two megabuck price tag. ... TWA is picking up its first option for 1700 more crt agent sets from Burroughs, increasing the contract by $13.7 million for a total of almost $25 million. The airline has other options, including one for 1200 more crt sets! ... ITI has upgraded its 4900, which now offers a 30-mil 1.75 usec core, with a 20-mil, 2½-D under-1-usec core also available. ... One customer feels he was lowballed by IBM. The original proposal to replace a 7080/1400 series combo was for a 360/40. That escalated to a 360/50, but the company now has two 50's, is being advised to add a third. ... Mohawk Data Sciences has delivered 3300 of its keypunch-mag tape recorders, expects to produce 100 a week in '67. At the end of the year the aggregate value of units installed should be around $45 million. This year too they'll announce more models, including a 9-channel unit, one with communications capabilities. ... Marc Goldwater, whose GFI computer-making venture folded last year, is back in business as Advanced Logics Lab. He's building a prototype of a digital display driver, tinkering with an inexpensive I/O device. ... One small manufacturer says that his mainframe material costs are only $5-10K/unit.

Correct Orbital Apogee-Perigee Doesn't Just Happen . . . It's Planned.

At AC Electronics, Scientific Programmers develop these plans with large scale, third-generation computers. *You* could help develop similar plans as a member of AC Electronics' scientific-professional team.

This team needs additional experienced Scientific Programmers with B.A., B.S., E.E. and/or M.S. degrees in Engineering, Math or Physics for computer complexes throughout the country. Present AC Scientific Programming Staffs are located in Boston, Cape Kennedy, Houston, Milwaukee and Santa Barbara. These installations are engaged in several diverse and challenging projects, including:

DATA REDUCTION
DESIGN AUTOMATION
ELECTRONIC SYSTEMS DESIGN
REAL TIME
SIMULATION
(GUIDANCE/NAVIGATION SYSTEMS AND MISSION CHECKOUT/VALIDATION)
TRAJECTORY (MISSILE AND SPACECRAFT)

If you want challenge, are an experienced Scientific Programmer and have one or more of the above degrees, send your resumé, including salary requirements, to R. W. Schroeder, Dir. of Scientific and Professional Employment, Dept. 5753, AC Electronics Div., Milwaukee, Wis. 53201.

AC ELECTRONICS
DIVISION OF GENERAL MOTORS
An Equal Opportunity Employer

GM
MARK OF EXCELLENCE

CIRCLE 339 ON READER CARD

CAR EERS

You are invited to utilize our select personnel service if your abilities or potential are in the

TOP 20%

SORRY

– no time for mediocrity. We are in a position to help those individuals who are able to ask for and obtain the best career opportunities. If your abilities or potential are such as to place you in the top 20% of your field, our unique service will enable you to

CHOOSE THE AREA you prefer to live and work in FROM COAST TO COAST

Investigate not just a job, but a challenging career opportunity in any aspect of computer based systems or management science.

A SMALL SAMPLE OF CATEGORIES PAYING FROM $10 — $30,000:

- Software development
- Programming research
- Scientific computation/Analysis
- Technical representative
- Marketing/Sales
- Operations Research
- Systems design
- Management consulting
- Real time/Communications systems
- Digital systems engineering
- Process control

(Managers, Seniors, Intermediates)

Our clients assume all expenses.
Write in full confidence to
Joseph Albert or phone 212/OR 9-7314.
Indicate salary and personal requirements.

Career Consultants in the Data Processing Field

ALBERT ASSOCIATES

437 FIFTH AVENUE, NEW YORK, N.Y. 10016

CIRCLE 340 ON READER CARD

DIRECTOR
OF
ENGINEERING

This East Coast Division of a major manufacturer of commercial electronic equipment is losing it's Director of Engineering by promotion to even greater responsibility. His shoes will not be easy to fill.

Our new Director will have: an advanced degree in engineering. Prior experience at the project level responsible for the design of COMMERCIAL DIGITAL DATA PROCESSING EQUIPMENT for VOLUME manufacture. Current experience in supervising project leaders performing the above.

If you are this man, we would like to talk to you. We offer an executive's salary, attractive perquisites and the opportunity to join a rapidly growing, profit minded organization. Write us at:

Box 585-B,
20 West 43rd St., New York, NY 10036

An equal opportunity employer

PROGRAMMERS/ANALYSTS

Expansion to an IBM 360 tape and disc system together with recent internal promotions have created the need for several Programmer/Analysts at the senior and intermediate levels. Positions require two to six years experience with IBM series computer equipment in the business applications area. Degree preferred but all qualified personnel will be considered.

Atlas offers competitive starting salaries, attractive fringe benefits and ideal location with excellent schools and suburban living only minutes away. If you are interested in moving into this new generation with a company large enough to offer you growth and opportunity, yet small enough to provide diversity and individual recognition, please forward particulars of background, experience and salary requirements to:

F. J. MOSSMAN

ATLAS CHEMICAL INDUSTRIES, INC.

Wilmington, Del. 19899

All replies held in confidence

An equal opportunity employer

CIRCLE 341 ON READER CARD

Career opportunities in the COMPUTER SCIENCES are available for graduate mathematicians, engineers and physicists.

A variety of openings exist on IIT Research Institute's professional staff in such fields as programming system development, automatically programmed tools (APT), graphical input-output research and development on software and hardware, scientific computer applications, operations research, and statistics. Members of the professional staff enjoy excellent salary and fringe benefits (including tuition-paid study for advanced degrees) and the constant challenge of exciting work.

IIT Research Institute is an independent, contract research organization serving industry and government. Its activities encompass nearly all of the physical and biological sciences and their related technologies.

If you have a strong interest and capability in computer science and technology, please communicate in confidence with Mr. Ronald C. Seipp,

IITRI **IIT Research Institute**

10 West 35th Street, Chicago, Ill. 60616
An Equal Opportunity Employer M/F

CIRCLE 343 ON READER CARD

advertisers' index

WHAT IS YOUR TRUE WORTH?

FREE Data Processing OpportunitiesBulletin

Every month, in the privacy of your own home, you can evaluate the nation's finest openings in the data processing field. Cadillac, the nation's largest executive and professional placement service, represents the majority of the nation's top companies. Their best jobs at salaries from $6,000 to $75,000 appear in our monthly Data Processing Opportunities Bulletin.

Our placements show that the average data processing man is worth 10% to 20% more than his present income. The Bulletin helps you evaluate yourself in today's market. Both the Bulletin and our *confidential* placement service are free. Client companies pay all costs.

For your free Bulletin, without any obligation circle Subscriber Service Card No. 355. Please use *home address only.*

LON D. BARTON, *President*
Cadillac Associates, Inc.*
29 E. Madison Bldg. Chicago, Ill. 60602
Financial 6-9400

* *"Where More Executives Find Their Positions Than Anywhere Else in the World."*

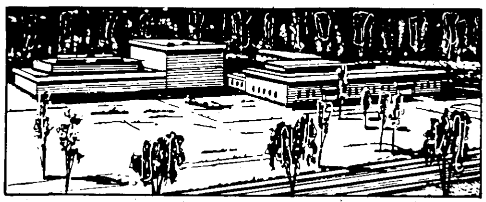
CIRCLE 355 ON READER CARD

man made fibers

the "growth industry" made-to-order for scientists and engineers... especially at **ALLIED CHEMICAL**

Allied Chemical offers Scientists and Engineers the resources, atmosphere and assignments they want — in an industry that never stops advancing.

There's no limit to the demand for new and improved fibers, nor to new applications and adaptations. At Allied Chemical Fibers Division, we're speeding up development, shortening the time required to create a useful new fiber, by advanced, computerized approaches. You'll like the environment, the assignments, the good living.

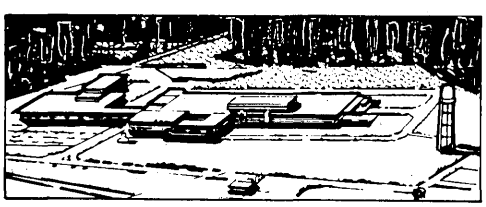


TECHNICAL CENTER, Petersburg, Virginia, located just south of Richmond.

Our recently completed, ultra modern facility, offers challenging assignments in Division Engineering and Construction, Division Research and Development, and Division Commercial Development.

Our gateway to the South location, offers excellent residential, educational, and recreational facilities.

CHESTERFIELD PLANT, Hopewell, Va., a few miles South of Richmond. Chief product, heavy and medium denier nylon filament yarn. Pleasant suburban and rural living, with shore, mountain and outdoor recreation of all kinds within easy reach. University of Richmond nearby, to continue your education.



COLUMBIA PLANT, Irmo, South Carolina, near Columbia. Chief product, fine denier nylon filament yarn. This modern facility, expanded repeatedly in recent years, offers exceptional working conditions for professionals. Columbia, a city of 100,000, and its suburbs afford attractive living in the best of Southern tradition. University of South Carolina is close by, facilitating continued study.

TECHNICAL CENTER:

PROCESS ENGINEERS, BS or MS Chemical or Mechanical Engineering with experience in process design in chemical, petrochemical or plastics industries for assignments in polymer.

DESIGN ENGINEERS, experienced graduate engineers needed in the following areas: MECHANICAL — HVAC — ELECTRICAL — CIVIL — INSTRUMENTATION — MACHINE DESIGN.

OPERATIONS RESEARCH ANALYSTS, BS or MS Engineering, Science, or Business degree, with experience in mathematical and statistical techniques.

SYSTEMS ENGINEERS, BS or MS Engineering or Math degree, capable of developing analog computer applications, using hybrid techniques and analyzing system procedures.

COST ENGINEERS — ESTIMATING ENGINEERS, BS Engineering or Accounting with experience in financial management of industrial construction.

DEVELOPMENT ENGINEERS, BS or MS Chemical, Mechanical or Textile Engineering, with experience in polymer or fiber process development at Semi-Plant level.

RESEARCH CHEMISTS, BS, MS, or PhD with experience converting new polymers into fibers and modifying fiber properties for specific end uses.

Please send resumes to: A. M. GESLER, Supervisor Personnel,
FIBERS DIVISION—TECHNICAL CENTER, P.O. Box 31, Petersburg, Virginia 23803

CHESTERFIELD PLANT:

SUPERVISOR — PROCESS IMPROVEMENTS. BS, ChE, BSME, BS Tex. E. 5-7 years in process improvement. Work involving spinning and processing of melt polymers, especially nylon. Needs sound engineering background, good mechanical comprehension and supervisory experience.

PRODUCTION SUPERVISOR. BS Engr. & Textiles. 5 plus years experience in synthetic yarns. Ability to train and direct shift foreman. Ability to produce and maintain desirable yields and costs.

MAINTENANCE ENGINEERS. BSME, BS. ChE, BSCE. Several years experience in plant maintenance. Power plant experience desirable or background in projects engineering in synthetic fibers plant. Proven record of cost reduction. Supervisory experience necessary. Should be resourceful and able to carry projects through to completion with minimum of direction.

ENGINEER — PROCESS CONTROL. Physical Science Graduate. Work in process improvement, control and evaluation. Strong math background with experience in statistical methods and application. Process simulation and analog and digital computer application helpful.

Please send resumes to: E. J. RENDO, Supt. Employee Relations
FIBERS DIVISION, P.O. Box 831, Hopewell, Virginia 23860

COLUMBIA PLANT:

SUPERVISING ENGINEER — In charge of fiber processing equipment design group of our Plant Engineering Department. Must have heavy experience in machine design. Bachelor's degree in Engineering — 8 years minimum experience. Will design or specify new equipment for 45 million dollar nylon plant. Responsibilities also will involve trouble shooting existing equipment and processes. Encompasses carrying a project from conception through design, construction, and start-up. Fibers experience is preferred but *not essential.*

MAINTENANCE ENGINEERS — Investigate equipment and production problems, plan preventive maintenance programs, and schedule work loads. Liaison with maintenance foreman, process and plant engineers on re-engineering, design, selection, installation, and operation of equipment. BS degree in Engineering.

PLANT ENGINEERS — minimum of 2 years industrial design experience plus some understanding of development, construction, maintenance, and operation, preferably in chemical or fibers plants. Will be assigned engineering projects of a complex nature having complete responsibility for the assigned projects, from conception through design, start-up and shakedown. BS degree in Engineering. The following areas are available:

Instrumentation Engineer (CHEMICAL) — experienced in the application and design of standard pneumatic and electronic control instrumentation related to chemical or fibers operations.

Utilities Engineer — Work involves the design of new service facilities and redesign of existing facilities to increase output and efficiency, etc. Familiar with industrial plant steam, water, and service piping design. Heavy air conditioning experience preferred.

Chemical Plant Design Engineer — familiar with the broad scope of unit operations and the chemical design of continuous or batch plants. Prefer experience in polymerization, drying, distillation and high temperature heat transfer media.

Machine Design Engineer — familiar with machine design principles related to gears, cams, and high speed rotating equipment.

Please send resumes to: E. J. CARROLL, Employment Supervisor
FIBERS DIVISION, P.O. Box 1688, Columbia, S.C. 29202

ALLIED CHEMICAL
FIBERS DIVISION
An Equal Opportunity Employer

CIRCLE 344 ON READER CARD

the forum

The Forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

OVER HERE

As an American in Europe who is involved in computer activities, I would like to present some opinions in conflict with those expressed in the September DATAMATION editorial.

To *this* American, Europe is a vastly underestimated territory of business opportunities. The different languages, people and customs of the various countries really provide a challenge to understanding, appreciation—to make friends and profits. To underline this personal opinion, let me quote from Business Week, Oct. 29, 1966, p. 60:

> "Superior know-how stemming from scientific and technical developments in the U.S. has enabled American companies to grab big shares of European markets in critical growth industries such as aircraft, space equipment, nuclear energy, computers and other electronic products. The American advantage in some of these fields is already so great that Europeans fear they may never be able to catch up with the pace of U.S. technology."

Before coming to Europe as an expatriate two years ago I might have been inclined to write similarly, as in the September Editor's Readout. But even as an occasional visitor I would have recognised that Europe cannot be treated as an entity, with similar conditions throughout, as suggested in the editorial. What may be true in France, for example, is not necessarily true in Germany or Holland. "Full employment" happens not to be the case in Italy, nor is the "penchant for family and personal ties" universally true.

While we're at it, let me correct some other statements. The "long lunch" is not particularly popular in England and, in defense of the English, they are normally quite punctual with their appointments. On the other hand, long lunches are the rule in France and Italy, where business hours are adjusted accordingly. So the American in Italy should not be shocked to be offered an evening appointment.

The statement that "employers can't lay people off" is totally incorrect. While it is perhaps more difficult than in the U.S.—one must have sufficient cause, such as lack of work or very poor performance—it certainly is possible. Another difference is that longer notice is usually required, ranging generally from six weeks to six months—depending on the length of service and position. And in some countries, separation pay is legally required. As an employer (and this opinion is shared by others), the disadvantages inherent in this system are offset by a very significant advantage, that of stability, for the sword cuts both ways: the employee has a similar obligation with respect to resignation. Some barriers do indeed exist, although the linguistic one is not so much of a problem since most people in the data processing business (except perhaps the British) are at least bilingual.

The "existence of mistrust, fears and hatred" is an exaggeration. Mistrust on a national, general basis does not, to my knowledge, exist at all. I've never heard the comment "I don't trust so and so because he's (nationality)," and I would have had, as an American, ample opportunity to hear such remarks. Fear exists, in a political sense, and, though moderate, is applied from time to time to the West Germans, particularly because of recent successes of the rightist party, the NDP, at the polls. Hatred . . . well, one senses a moderate form of it—by the French vis-a-vis the Americans. (One wonders sometimes why there isn't more of it, the way some visiting Americans behave.) Or by the Dutch, Danes and some French vis-a-vis the Germans. (The war wounds haven't healed yet, the NDP is on the rise, and the loud and boisterous German tourists don't help either.)

Communications do indeed compound the problem of doing business in Europe. They are certainly poorer than we are accustomed to from Ma Bell in the U.S. But except for the effect on data communication, especially inter-country (that *is* a problem), we get along fine. It does *not* cost $1000 to get a telephone installed in Paris, but perhaps $100, and in German metropolitan areas the cost is about $23. And please let's not be too unkind toward nationalism—(old provincial?) Americans have their pride too.

As to the "emphasis on ALGOL in a FORTRAN world," may I point out that ALGOL is also emphasized in the U.S. as a program publication language by ACM, which publishes all algorithms in ALGOL. As to the "French expert" who says that his country's software is five to ten years behind, may I ask in what way, how measured? Programmers in France, for the most part, speak and read English, so they can (and do) use American software for U.S. built or licensed systems. Even applied to French systems, the statement is vague, weak and very much exaggerated.

Finally a couple of concise comments:

1. It *is* expensive to import Americans, so most successful firms try to train and build European staffs.
2. True, there *is* a gap (in numbers of systems as well as know-how) but this, despite the "social, political and economic barriers," merely underlines the golden opportunities which exist for American firms with a bit of patience and understanding to do business in Europe.

Henry F. Sherwood
Diebold Europe

all magnetic tape is not alike

Some of it costs more than MAC tape

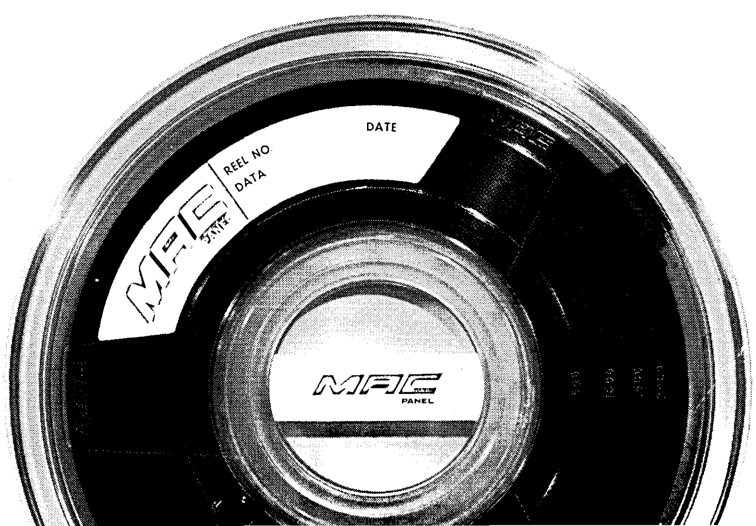
Of course there are different levels of quality, but we're talking about price differences for the highest quality level. Specifically, why does one brand of tape cost as much as 40% more than the comparable MAC Tape?

Is the secret in the word "comparable"? No, because when we say "comparable," we mean exactly what we say—that the two perform exactly the same way on your machines.

Is the difference in methods of manufacture? Frankly, we doubt it, because we have to use some pretty expensive methods to achieve perfection. We grind our coating material longer than anybody else, for instance. And that costs more. We've developed our own tape washers—build them in our own plant—to make sure the tape that goes on MAC reels is clean—not almost, but absolutely. Our testing equipment is the best that money can buy. Nobody uses finer raw materials, because there aren't any finer. And so on.

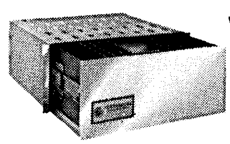
We figured out how much it costs to make tape this way, added the costs of selling and a small but fair profit, and that's our price. How come it's lower?

We don't know, and neither do thousands of computer managers who specify MAC Tape. They just appreciate the difference. Just last month, one company saved $170,000 by writing our name on an order. You don't have to save that much to be a hero, do you? If you want details on our painstaking, expensive methods of making tape before you switch, we've written a booklet that'll tell you all you want to know. If you're ready to be a hero now, a salesman will call if you'll but give the word. Either way, just write MAC Panel Co., Box 5027, High Point, N. C. Our motto: Heroes made to order.



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 non-volatile. 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

FERROXCUBE CORPORATION OF AMERICA
Systems Division
5455 S. Valentia Way
Englewood, Colorado
303-771-2000

Boston	Chicago	Dallas	Los Angeles	Minneapolis	New York Area	Phoenix	Philadelphia
617-899-3110	312-261-7880	214-255-0441	213-837-1484	612-888-4681	201-267-5888	602-265-1792	215-927-6262

CIRCLE 3 ON READER CARD