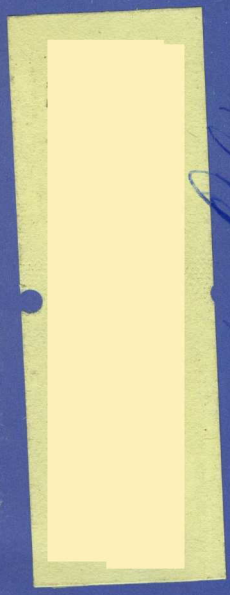
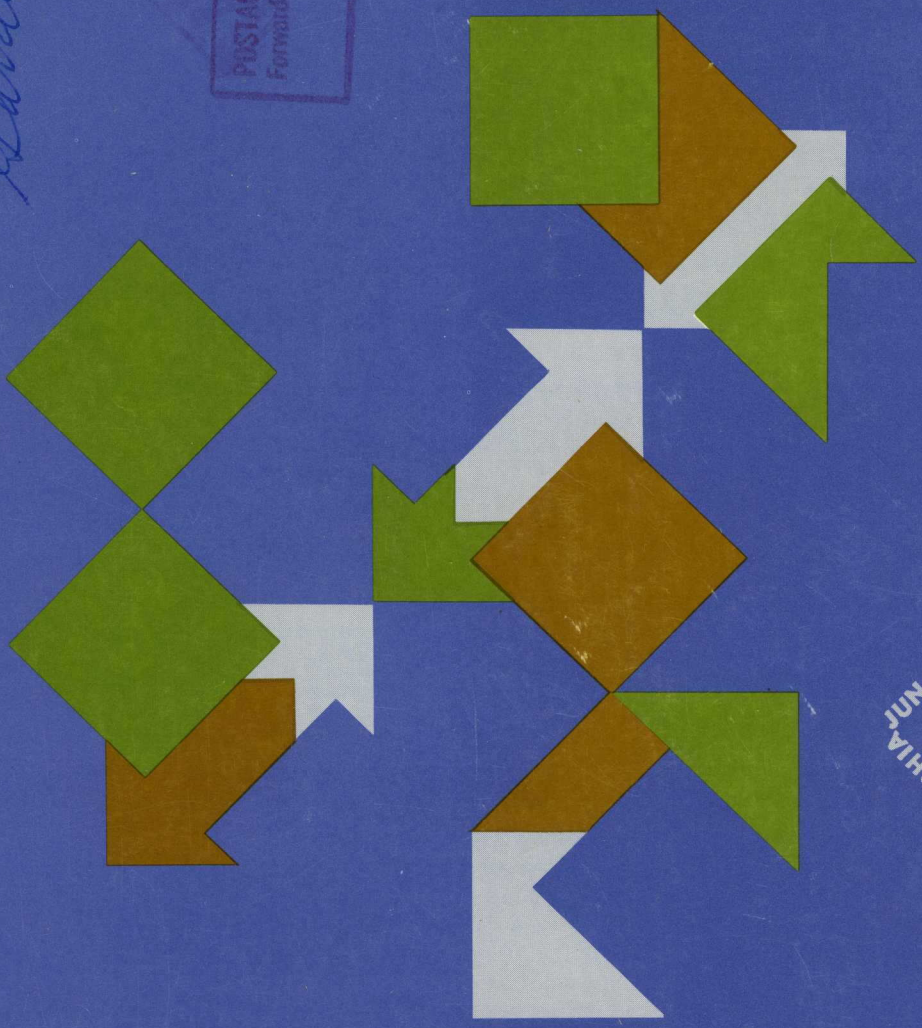
DATAMATION®

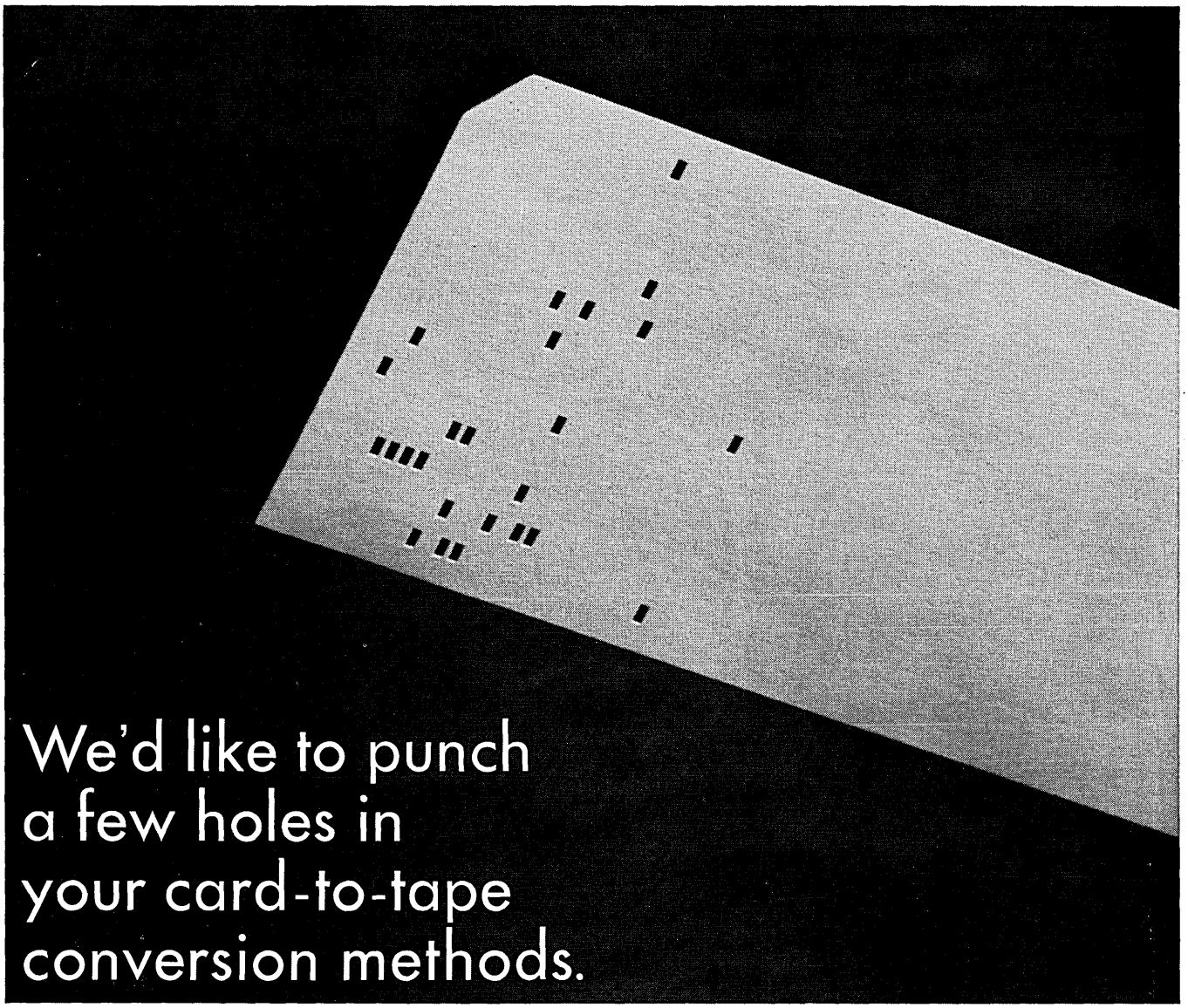
65

June





JUN 29 JUL 2 DPMA CONFERENCE PHILADELPHIA



We'd like to punch a few holes in your card-to-tape conversion methods.

New Ampex Card-Tape System operates at up to twice the speed of other systems. At one-third the cost.

Put your computer back to work at the job it was designed for—computations. Let the new Ampex Card-Tape System take over: it's the fastest, most economical converter system for high-speed, volume requirements.

What makes the CTS revolutionary: it can handle up to 1500 cards/min. for 80-col. cards and up to 2000 cards/min. for 51-col.—square or round edges. It produces high-density tape (556 or 800 CPI) to give you savings in computer processing time. And you can choose from four low-cost CTS systems to fit your speed and volume requirements. You can lease or buy.

What makes the CTS efficient: you can operate it off-line—does not tie up your central computer. It's IBM compatible: generates tapes for IBM 7330, IBM 729 series, IBM 2400 series or ASCII tapes. Uptime is high because of automatic system stop on bad card jam; ability to be cleared by operator (no standby maintenance required); the incorporation of an advanced design tape transport whose highly simplified threading and gentle handling of tape give maximum data reliability; and space-age dependability of system.

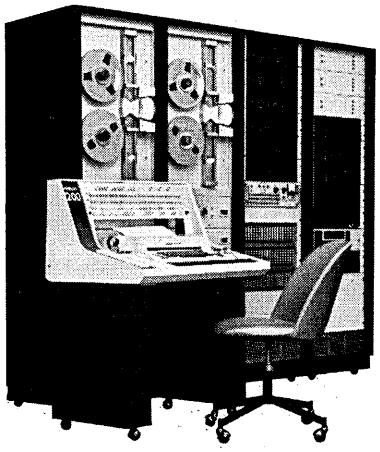
What makes the CTS reliable: Ampex. A world leader in computer tapes, digital tape transports, core memory devices and tape recorders. Write for more information on the CTS. Write Ampex Corp., Redwood City, California.

See Ampex CTS "in action" at the DPMA International Conference—June 29-July 2. Convention Hall, Philadelphia. Ampex Booths #113 and #114.

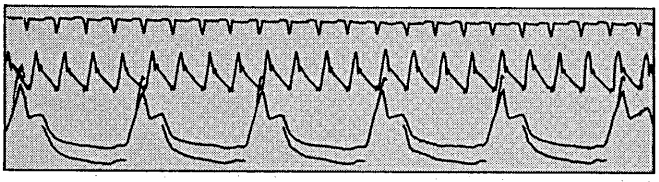
AMPEX

CIRCLE 1 ON READER CARD

AMBILOG 200 the only computer designed especially for signal processing



Using the best of both analog and digital techniques, the AMBILOG™ 200 Stored Program Signal Processor is designed from the ground up to handle the "floods of data" generated in test and research programs. Although such programs cover many fields — biomedical monitoring, geophysical research, test stand instrumentation, automatic weapons checkout, speech analysis — all require complex *signal processing:* multiple input acquisition and output distribution, monitoring, editing, arithmetic, analysis, recording and display. Because of its high processing speed and extensive input/output for both analog *and* digital data, AMBILOG 200 is ideally suited for such tasks. Here are some examples.



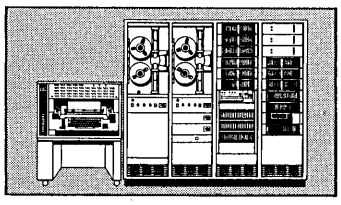
Real Time Waveform Measurement

Peak values, axis crossings, ratios of successive differences, and other characteristics of analog signals are measured in real time. Incoming signals are monitored for events of interest, using complex programmed detection criteria. In a typical biomedical application, the result is a 100-to-1 reduction in the bulk of magnetic tape output records.

$$A(n,w)=\int_0^T W(t)F(n,t)\cos(wt)dt$$
$$B(n,w)=\int_0^T W(t)F(n,t)\sin(wt)dt$$

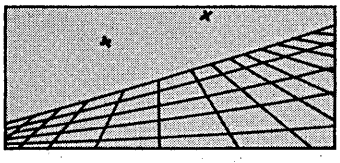
Spectrum Analysis

Parallel hybrid multiplication and summing, 2 microsecond 30-bit digital storage, and a flexible instruction format providing efficient list processing combine to make the AMBILOG 200 powerful in statistical signal analysis techniques such as Fourier transformation, auto and cross correlation, power spectrum density analysis, and generation of histograms of amplitude spectra.



Digitizing and Recording

Multiple inputs, from up to several hundred sources, are routed through a multiplexer switch array under stored program control. At no penalty in sampling rates over conventional systems, the AMBILOG 200 converts incoming data to engineering units for recording or monitoring. An analog-to-digital converter performs a complete 15-bit conversion in 4 microseconds for digital storage, recording or outputing.



Display Generation

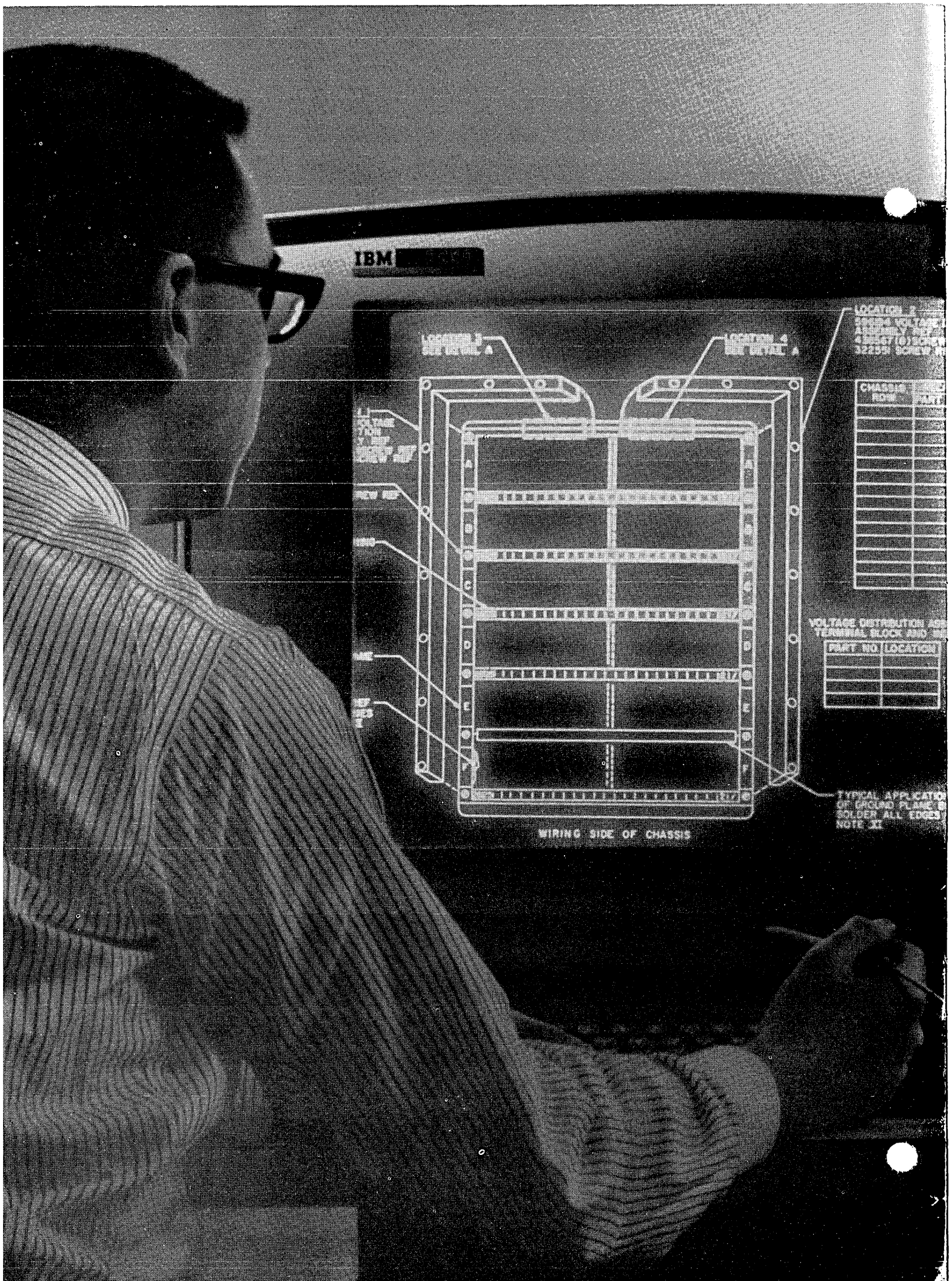
Multiple analog outputs facilitate close man-machine relationships in systems involving visual displays. Points of an image stored in memory are rotated through three space angles and projected on a CRT at a 50 Kc rate. Co-ordinate transformation is accomplished simultaneously with digital-to-analog conversion.

For technical reports describing in detail these and similar AMBILOG 200 applications, write I. R. Schwartz, Vice President.

Adage INC

1079 Commonwealth Avenue, Boston, Massachusetts 02215

CIRCLE 4 ON READER CARD


IBM
WIRING SIDE OF CHASSIS

A revolution in engineering design. Display the design on a "TV" screen. Change values. Try new arrangements. Let IBM's SYSTEM/360 calculate performance, even redraw the design automatically.

SYSTEM/360 can also type, tape, print, punch, draw, photograph or answer a telephone.

No one but IBM offers you so many ways to use a computer.

No other manufacturer makes it so easy to choose and to use a Management Information System sized right for your company.

IBM SYSTEM/360 offers you a choice of eight central processors. Over fifty different units to put information in or get it out of this system. Two kinds of core storage. Two types of visual display units. Four types of direct-access storage. Five types of data communications terminals. And much, much more.

If you are a milk company, you may need only a simple card system to improve route accounting. We can help you.

If you are a wholesale grocer, you may need small interchangeable direct-access disk storage to keep up to date on inventory. We can help you.

If you are a large manufacturing company, you may need 16 high-speed tapes, 3 billion characters of direct-access storage and high-speed communications with a satellite computer. We can help you.

An engineer may need a visual display that lets him make changes in designs instantly on a cathode ray tube. He may need printed output in the form of graphs or contour maps. He may need only 2,048 words of core storage or over 2 million words.

In any case, we can help him tailor SYSTEM/360 to his needs.

We designed SYSTEM/360 to adapt. When your problems change, you modify the system, you don't abandon it for a new one.

And we don't abandon you. Our people are on call any time they can help you.

They always will be.

SYSTEM/360–The Computer with a Future.

IBM®

CIRCLE 5 ON READER CARD

DATAMATION

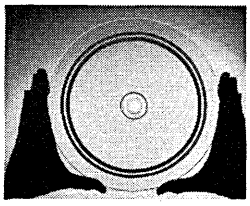
june
1965
volume 11 number 6

Microfilm copies of **DATAMATION** may be obtained from University Microfilms, Inc., 313 No. First St., Ann Arbor, Michigan. DATAMATION is published monthly on or about the tenth day of every month by F. D. Thompson Publications, Inc., Frank D. Thompson, President. Executive, Circulation and Advertising offices, 141 East 44th Street, New York, New York 10017 (MUrray Hill 7-5180). Editorial offices, 1830 W. Olympic Blvd., Los Angeles, California 90006. Published at Chicago, Ill.
DATAMATION is circulated without charge by name and title to individuals who qualify by our standards and are employed by manufacturers or users of automatic information-handling equipment in all branches of business, industry, government and the military. Available to others by subscription at the rate of $15.00 annually; single issues (when available) $1.50. 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. Form 3579 to be sent to F. D. Thompson Publications, Inc., 205 W. Wacker Dr., Chicago, Ill. 60606.

Printed by Beslow Associates, Inc.

THIS ISSUE—60,128 COPIES

Up to 156 billion characters, or the equivalent of 15,000 reels of tape . . . with four megacycle readout rate . . .



Photostore Disc

Available as an auxiliary memory or free-standing with the MCP-1 Memory Centered Processor . . .

People with tapes only get in the way of Itek's new data processing system — the Memory Centered Processor. It offers 100 times more mass random storage capacity than ordinary memory systems. Unique photo-discs store so much data that your entire storehouse of magnetic tapes can be placed ON-LINE in one MCP Digital Library Unit. Each disc holds information equivalent to two reels of tape (25 million characters), and once in reading position offers 15 millisecond average random access. The serial readout rate is four million bits per second. The MCP System delivers any record in a trillion-bit file in 2.5 seconds maximum, and any queued ("look-ahead") record in 250 milliseconds. You will soon be able to see units of the MCP System store, search, compare, translate, extract, and edit information at Itek's New York Information Processing Center. To visit the Center or to obtain information about our lease/purchase plan for auxiliary mass memories or the MCP System, write

Itek

Itek Corp., Digital Data Systems Division, 10 Maguire Road, Lexington, Massachusetts 02173, Tel. 617-862-6200

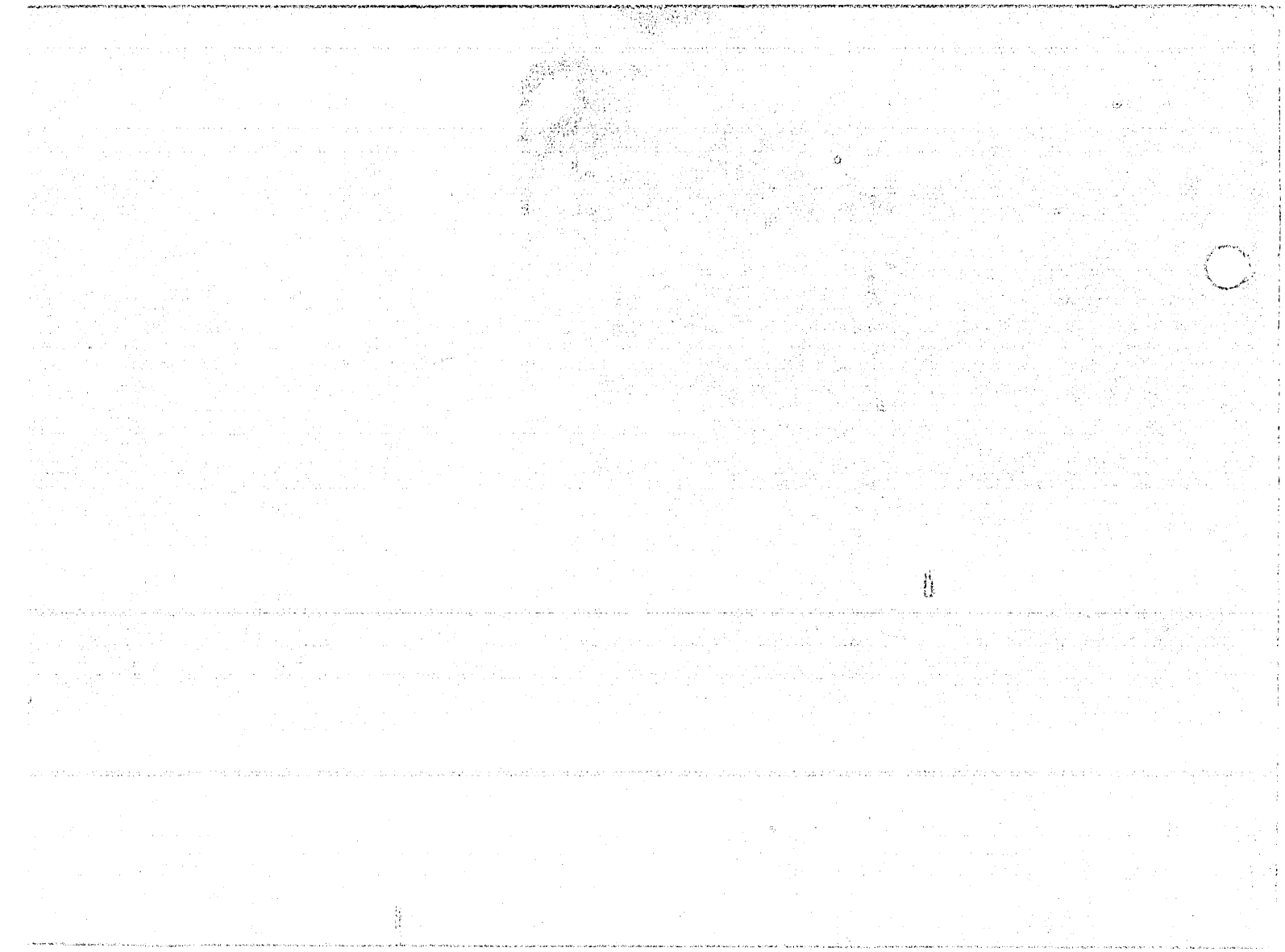
CIRCLE 8 ON READER CARD

DATAMATION 65®

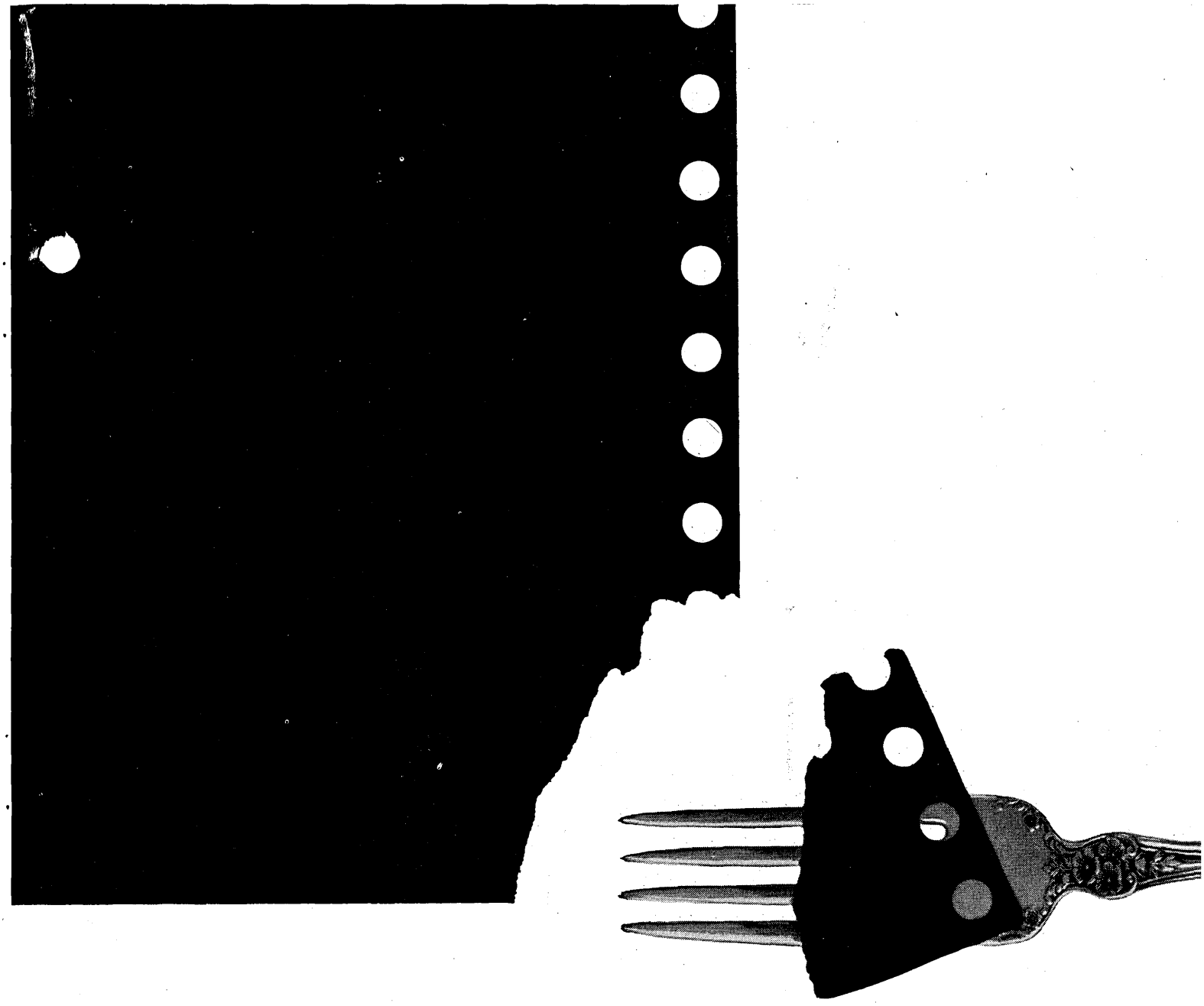
june
1965

volume 11 number 6

automatic
information
processing
for business
industry & science



Printers eat forms.



We guarantee ours are more digestible.

When a printer has indigestion, it means downtime.
And that's the ailment Machine Mated forms cure.

They're designed to operate flawlessly on your printer.
We guarantee it. Here's how.

We work with the company that makes your printer.
We find out what the printer can do. The range of forms.
The sizes. The plies. The carbons. The fastenings.

Then we consider your needs. Draw up the specs to meet them. And follow them to the letter.

To find out more, call our local representative. Or write Standard Register, Dayton, Ohio 45401.

Your printer will thrive on the diet we prepare.

MACHINE MATED™ FORMS BY STANDARD REGISTER

CIRCLE 10 ON READER CARD

DATAMATION calendar

● "Education, Keystone of Management" is the theme for Data Processing Management Association's annual conference. Both the conference and the business exposition will be held in Philadelphia Convention Hall, Pa., June 29-July 2.

● Courses on "EDP Audit and Controls" will be held July 19-23, Marriott Twin Bridges Motor Hotel, Wash., D.C.; July 26-30, Ascot House, Chicago, Ill.; and October 25-29, Doric Dinkler Motor Hotel, Los Angeles, Calif. Courses are sponsored by the Automation Training Center, Phoenix, Ariz.

● Summer program on the Management of Research and Development will be held August 2-13, at MIT, Cambridge, Mass. The program is intended for persons in government and industry responsible for directing research and development programs and managing engineers and scientists.

● A course, "Bio-Engineering Applications of Analog Simulation," will be given August 16-20, Princeton Computation Center, Princeton, N. J. The course is sponsored by the Education and Training Group, Research and Computation Div. of Electronic Assoc., Inc., West Long Branch, N. J. Fee: $250.

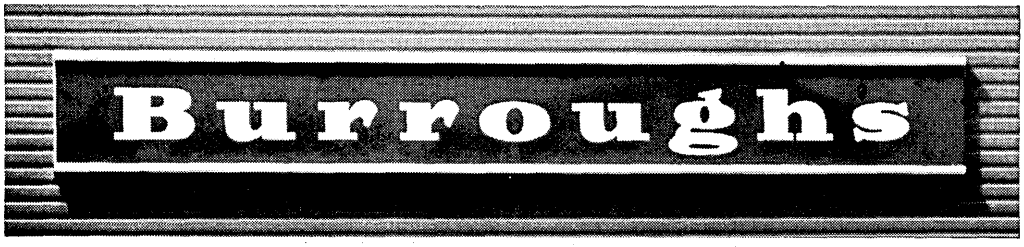
● Course on Simulation Modeling and Programming by means of the SIMSCRIPT simulation language is being offered by The California Analysis Center Inc., Los Angeles, August 23-27 and December 6-10.

● Association for Computing Machinery will hold its 20th national meeting, August 24-26, Sheraton-Cleveland Hotel, Cleveland, Ohio.

● Western Electronics Show and Convention will be held, August 24-27, Cow Palace, San Francisco. Sponsors are IEEE and Western Electronic Manufacturer's Assn.

● Tokyo Symposium on Systems Engineering for Control System Design will be held, August 25-28, Tokyo, Japan. Meeting is co-sponsored by International Federation of Automatic Control and Science Council of Japan.

● American Mathematical Society summer meeting is scheduled for August 30 to September 3, Cornell U., Ithaca, N. Y.



The Mark of Excellence in Electronic Data Processing

EXCELLENCE IN HARDWARE DESIGN, with new concepts like the all-electronic access Burroughs Disk File. With the versatile, multi-programing Burroughs B 200. With the new Burroughs B 300, and its capacity for simultaneous on-line and off-line processing. With years-ahead systems like the Burroughs B 5500 . . .

EXCELLENCE IN SOFTWARE DEVELOPMENT, with today's most efficient scientific compiler. With the fullest implementation of COBOL, for both large and small computers. With the most powerful and fully operational automatic operating system. With PRIME—a new technique giving complete program independence to an unlimited number of organizations sharing the same on-line system . . .

EXCELLENCE IN CONTINUING SYSTEMS COUNSEL, minimizing installation and programing costs and helping management achieve its objectives on schedule —a major reason for the retention of 90% of all Burroughs EDP customers in over a decade in the commercial computer business . . .

EXCELLENCE IN SERVICE AND MAINTENANCE, with a large, thoroughly trained force of data processing field engineers. With exclusive techniques like built-in Maintenance Test Logic for the Burroughs B 5500 . . .

You'll find this record of achievement the result of a continuing commitment to excellence, producing greater efficiency and profitability for Burroughs EDP customers.

Burroughs Corporation

Burroughs TM

CIRCLE 12 ON READER CARD

letters

ascii & standards

Sir:

In the March issue (p. 19), the statement is made that a magnetic tape standard is being published over the objections of a certain computer manufacturer and that other manufacturers "will probably raise a howl too." It is also stated that the proposed standard specifies ASCII and that no current computer can record ASCII.

The American Standard Code for Information Interchange (ASCII) was proposed and subsequently became an American standard prior to its being available in hardware and systems. The code was developed to facilitate the then and now pressing need for general information interchange. ASCII is a foundation for the media standards (paper tape, magnetic tape, punched cards, and data communications); without the media standards all of the benefits of ASCII cannot be derived.

ASCII is currently being implemented in various systems and services such as the DOD Autodin extension, the Bell System 4-row TWX service, the GSA Advance Record System, and in equipments and/or systems manufactured by General Electric, Bunker-Ramo, Honeywell, and others. In addition, the British ICT 1900 computer employs the ISO 7-bit code (international version of ASCII) internally.

A proposed paper tape standard is well on its way for acceptance as an American standard representation of ASCII. A proposed punched card standard, which retains many of the advantages of the "Hollerith" encoding but which facilitates translation to ASCII, is under development. The proposed magnetic tape standard, referred to above, is being advanced as the standard representation of ASCII in magnetic tape.

The reported opposition to the proposed magnetic tape standard results not from a disagreement with the proposal as an acceptable representation of ASCII in magnetic tape, but from the fact that the proposal specifies ASCII as the only "American standard" for information interchange using magnetic tape. The objections are based on the fact that there are other codes used in information interchange (those now offered commercially by the objectors) and that this proposal infers that whenever 9-track, half-inch magnetic tape is used for information interchange, the data should be recorded as specified in the proposal.

It was the intent of the designers of ASCII and of those who supported it as an American standard that ASCII would be used in general information interchange. This of course implied that hardware, software, and system would be developed, manufactured, and used. This is being done. Media representations are being worked out. Opposition to these media standards are apparently motivated not by the opinion that ASCII cannot accommodate the needs of general information interchange but by the desire to have another code or codes recognized in general information interchange.

The decision to conform or not to conform to ASCII is an independent decision of each manufacturer and user. However, a decision not to conform to ASCII coupled with a decision to advance another coded character set for general information is of concern to all manufacturers, all users, and all general interest groups.

J. B. BOOTH
New York, New York

programmers & unions

Sir:

In the February issue (p. 103) under the title "Programmers of the World Arise," you mention "recent decisions by the National Labor Relations Board which bar companies from attempting to exclude programmers and systems analysts from membership in a clerical union." However, searching for some of these decisions, I was sent two which *both* exclude programmers from the Union. These are:

1. D-6667 Englewood, Colorado 150 NLRB, No. 29 Case No. 17-R-1293, General Iron Works Company and OEIU Local 5.
2. D-6055 Massena, N.Y. 146 NLRB No. 109, Case No. 3-R-1310, Aluminum Company of America and OEIU Local 180.

Would you send me the indentification of some of these recent decisions that prompted the article?

JOHN A. MOORE
Programming Manager
The Reader's Digest
Pleasantville, New York

Readers in the know are encouraged to communicate with Mr. Moore.

atoll credits

Sir:

My article, "The ATOLL Checkout Language" (April), was marked by a glaring omission: recognition of those responsible for the development of ATOLL. It would be difficult to identify each individual, but the effort was initiated and guided by Mr. Chalmers Riley, chairman of Sub-Board 4 of the MSFC Automation Board, the latter chaired by Mr. Hans Fichtner.

Subsequent to its initial definition, much of the responsibility for serving as a secretariat for ATOLL was delegated to MSFC's Computation Lab, and in particular to Mr. Charles Cozelos. These gentlemen and many more from MSFC, KSC, and stage contractors should be given credit.

B. L. RYLE
Mesa Scientific Corporation
Huntsville, Alabama

npl deliveries

Sir:

I believe there is an error of one year in the MPPL schedule reported in the May Business & Science column. According to all the information I have received, MPPL, formerly NPL and soon to be PL/I, has been committed for delivery in March and September '66, not this year as indicated.

E. C. WITT
Union Carbide Corporation
Oak Ridge, Tennessee

Right you are. Specifically, delivery dates for the 44K and 200K NPL (PL/I) operating system are March and September '66, respectively. The 10K basic operating system is scheduled for March '66, and the 16K card system for September of '66.

dallas dealings

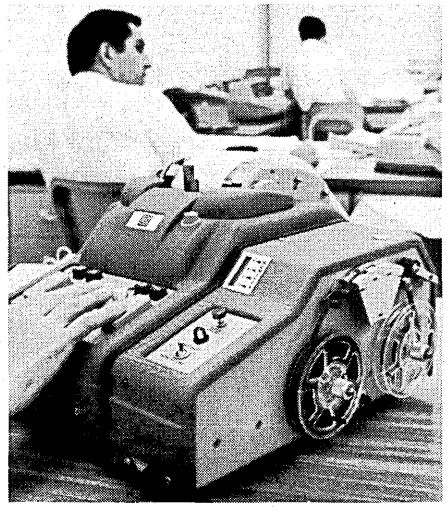
Sir:

Your May issue (p. 19) states that University Computing Co. has acquired the Information Processing Div. of the Western Co. This statement is misleading . . . UC did not acquire the IP Div . . . They did acquire three accounts which were serviced by the Information Systems Div. of the company. Their Fort Worth staff does include three individuals who were formerly with the Information Systems Div . . . Therefore, it is improper to refer to this as an acquisition.

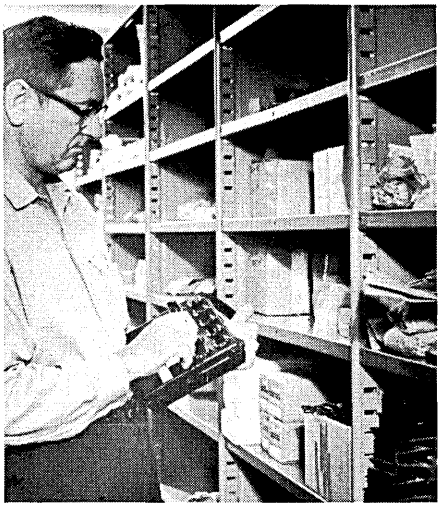
B. G. REDDIN
The Western Company
Fort Worth, Texas

Record it...

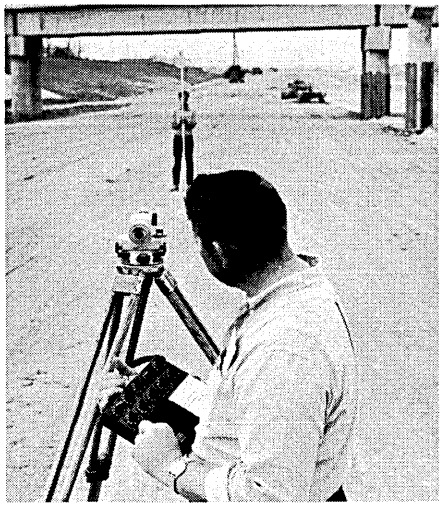
(on magnetic tape)



...in accounting department



...at the parts bin



...on the job site

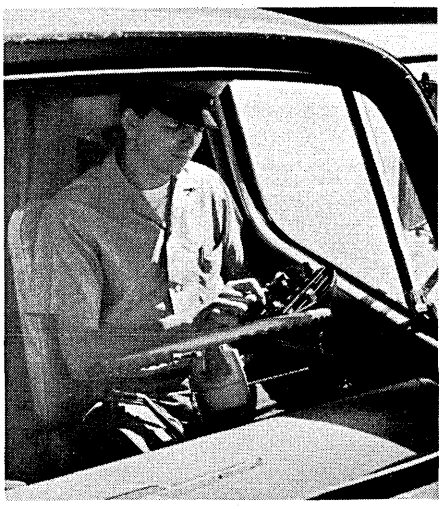
...at the meter

...in the warehouse

...at the cash register

...at the tank farm

...in the payroll department



...in the delivery truck

Report it!

(quickly, correctly)

SODA System closes the gap between data sources and computer

Now—a data acquisition system which enables you to capture data where *you* specify... to virtually eliminate key punching and verifying... and to remove the possibility of error in transcription. SODA—Source Oriented Data Acquisition offers these capabilities along with many more cost and time-saving advantages.

SODA is a simple two-step system: First, the worker at or near the source of data records entries on magnetic tape with a digital magnetic recorder. Next, the resultant tapes bypass intermediate conversion and go directly through a tape reader into the computer. Record it, report it!

Flexibility

SODA System gives you the flexibility to tailor the hardware to the application. Magnetic recording devices are available in both portable and desk top models. You can capture data when and where your requirements dictate. All hardware is easy to use; only minimum operator training is required.

Reliability

Four key factors combine to assure high level reliability with SODA—First, all recording is made on low density magnetic tape to insure data capture; second, data are usually entered on simple devices by the worker who is most familiar with the meaning of the data itself; third, once the data are recorded on tape there is no further transcription; fourth, computer speed is utilized by programmed routines to accomplish the desired parity function, validity tests and control totals. Accuracy is inherent in the system.

Dollar Savings

In addition to enhancing overall EDP payout, SODA offers dramatic dollar saving advantage. Cost savings in just key punch time and cards add up to overwhelming economic justification in many applications.

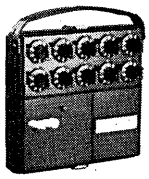
Capability

The SODA concept and hardware blanket a broad range of applications and data acquisition requirements. It answers the need for acquisition of data collected at scattered locations... for faster computer input of inventory and forecasting data... and most important, reliable and high speed acquisition of decision-generating data for operating and management reports. SODA allows you to RECORD IT... REPORT IT quickly, economically, accurately! For full information, write: UGC Instruments, Inc., 5610 Parkersburg Dr., Houston, Texas.

SODA
Data Capture Hardware

SODA permits data capture from virtually any source, including other business machines. All devices produce a reusable ¼ inch tape in a BCD 4 level code, enumerating from 450 to 13,000 words per reel, 10 characters per word.

SODA Metercorder®

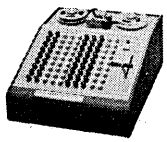


Portable Digital Tape Recorder weighing only two and a half lbs.

SODA Amcorder®

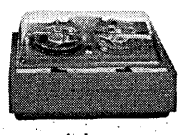
Adding Machine / Digital Tape Recorder. Available in single position and shuttle carriage models.

SODA Countercorder®



Portable Battery - Powered Tape Recorder.

SODA Adaptocorder®

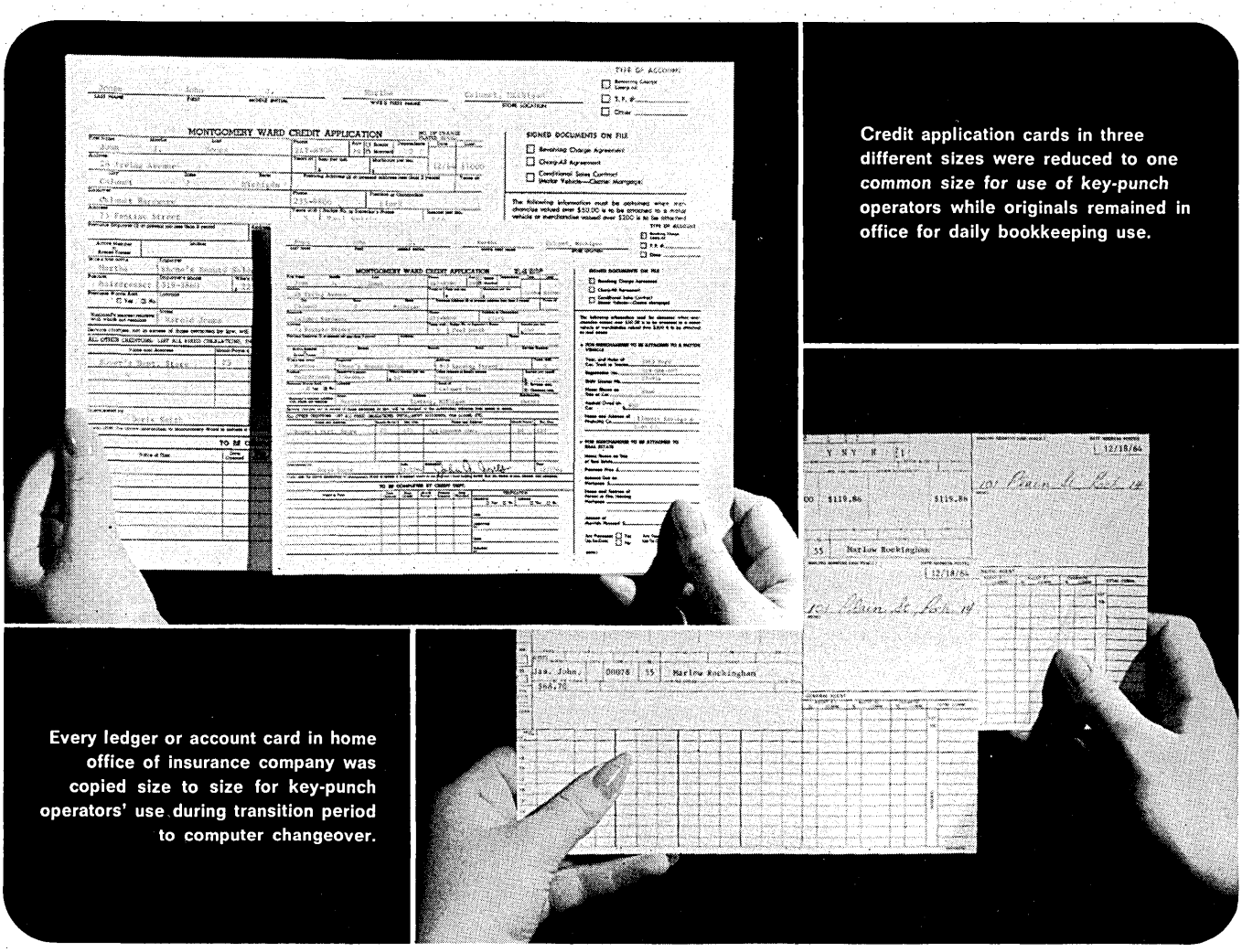


Digital Tape Recorder Interfaces with many adding machines, cash registers, calculators.

UGC Instruments, Inc.
A Subsidiary of United Gas Corporation

CIRCLE 14 ON READER CARD

Converting your record keeping systems?



Let us duplicate your paper records to avoid work delays during conversion.

When forward-looking companies convert to EDP bookkeeping, transition without disruption is the big problem. Missing records, delays, and confusion can plague even the most carefully planned changeover.

There is a proven way to avoid this condition.

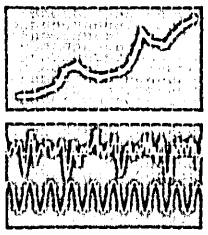
Let us make a duplicate set of each type of document needed by your key-punch personnel. Then your active records need not be removed from daily use.

We microfilm your original records on site. They do not leave your premises. Each document is out-of-file only momentarily. High quality xerographic copies on any size card stock you want are reproduced and returned in three days.

Our Xerox Reproduction Services are strategically located throughout the country to serve our network of U.S. and Canadian branch offices. Consult the one nearest you or write Xerox Corporation, Dept. XRS, Rochester, New York 14603.

XEROX

CIRCLE 15 ON READER CARD



BUSINESS & SCIENCE

THE ABC's OF TIME-SHARING:
NEW SERVICE BUREAU PLANNED

Share president Jim Babcock has left Rand and set up his own shop in L.A.'s gleaming new Century City. Called Allen-Babcock Computing, Inc., the company plans a scientific time-shared service bureau using a modified 360/50: they'll use microprogramming, a special version of PL/I and their own operating system to adapt the 50 to on-line use & effective use of bulk memory ("no swapping," says Babcock). Scheduled for installation in the 2nd quarter of '66, the 50 will include 256K core, 60 Selectric terminals. Meanwhile, three-man ABC is working on some software contracts, awaiting two new employees.

ANOTHER NEW NAME,
MORE COMPILERS FOR NPL

The short, unhappy life of MPPL (nee NPL) is over. The 360 language is now known as PL/I, which leaves plenty of room for Roman numeral successors. Although the future of the language is still in doubt, we understand that Digitek is building a GE 635 PL/I compiler for Bell Labs, and that Tom Cheatham's Computer Assoc. is doing a variation of NPL for the Nike X project at Bell Labs. Written for the 7094, the compiler will later be adapted to the 635. Digitek, by the way, has "sold" four of its Fortran IV D compilers.

GE, IBM SPLIT UNIVERSITY
TIME-SHARING TWIN BILL

Carnegie Tech., which gave the early nod to CDC, has opted for an IBM 360/67M (Michigan paging modification) scheduled for delivery in Oct. '66. System will include one CPU, a megaword (32-bit) bulk core (2.8 usec cycle), 75K of 750 nsec core, 31 TTY lines, two disc packs, two drums, two data cells, four tapes, plus card and printer. The G-21 will have a direct, addressable connection to the bulk memory. Valued at something over $2 million, the system will be partially funded by ARPA. Initial plans are for 30-40 remote stations. Software will include Algol and IPL.

Ohio State, meanwhile, went GE 635 (the modified version known internally as 636), which will land in Sept. '66. Initial system will include one CPU, disc, tapes, remote bulk terminals, other I/O. Some 20 terminals will include CRT's (some with keyboard, some with light pens) and Teletypes. Another CPU, more memory are slated for later.

HUGHES GOES MULTIPLE VENDOR:
GE CRACKS AEROSPACE MARKET

Hughes Aircraft has boiled its computing depts. down from four to two, and will split the orders for same between IBM and GE. The Aerospace Group will use a twin-CPU 635, including two 64K cores, and the 9SA, (a simulator which makes the 635 look like a 94),

Continued from page 17

tapes, disc, plotters, etc. Scheduled for arrival in June '66, the system will replace a d-c 7040/94, will offer about a dozen remote terminals on a serial interrogation -- not time-shared -- basis. Meanwhile, a 360/50, due in January, will serve business users.

LESSEE CEIR TURNS LESSOR, OFFERS NEW SERVICES

CEIR, long silent, looks as if it's beginning to move. The co. has bought three 7094's from GE, is leasing them back to GE until 600's arrive, expects to get most of its money back in 10 months. In LA, CEIR is selling its package of banking programs, and has announced a new business language franchised from a European outfit. User fills out one of several kinds of cards for standard edp applications, sends in for compilation on 1401. Reported cost: $50. A compiler tape can be purchased for $5K, or leased for $275/month. It's said to clobber itself if customer tries to tinker with it.

NEW FACES IN SOFTWARE, SERVICES

New software houses keep sprouting. Up in Canada, Ian Sharp, former chief programmer at Ferranti-Packard, has formed I. P. Sharp Assoc., Ltd., now seven men strong. One assignment: adapt Algol for business dp on an F-P 6000 at Saskatchewan Power Corp.

In Minneapolis, Aries Corp., founded by Fred Lang in '62, has 70 people, specializes in real-time and diagnostics...will go public soon.

And Automated System, Inc., of Dallas, is selling edp services to bank customers. Starting with medical billing in '64, AS has broadened its services, now has a plumber and a florist signed up at its Memphis operation (florists send out 5-10 times as many statements as Drs.). The co. acquires and installs the remote gear (1001's plus touch-tones), gets charged by statement by the bank, adds a flat fee plus profit for client billing. The service helped lure one fat medical account to one bank, but AS is looking at new possibilities: e.g., housekeeper's bookkeeping, and has started an info retrieval service for one doctor.

RUMORS AND RAW RANDOM DATA

RCA is expected to come through with a high-end-of-the-line 70/65 shortly; the "missing" 45 is still in the works. With the 3301 moving well, the company is holding off on a heavy push for the 70's until fall...Don't hold your breath waiting for that NCR 600 series; it's maybe a year away. Although the series is to be software-compatible with the 315, it won't offer downward internal compatibility...Something to look forward to at the end of the summer vacation season: a new line of machines from Univac... The slow shift of Bunker-Ramo's process-control capability to GE, which began with nonexclusive patents followed by a batch of technical people, has now been extended to installation, service, and maintenance with GE acting as subcontractor...Control Data is expected to acquire General Precision's Librascope commercial computer operation in a move to broaden CDC's base with some upgradable customers, as with the Bendix acquisition...Informatics is taking over CPM Systems, Inc., formerly part of Hughes Dynamics, has opened an office in Europe.

F/P-5-101-A

56 Integrated Circuits!

FAIRCHILD MICROLOGIC™—WIDEST LINE IN THE INDUSTRY

MICROLOGIC INTEGRATED CIRCUITS	HIGH SPEED μL MICROLOGIC −55°C to +125°C	INDUSTRIAL FμL MICROLOGIC +15°C to +55°C	MILLIWATT MWμL MICROLOGIC −55°C to +125°C	TRANSISTOR/ TRANSISTOR TTμL MICROLOGIC −55°C to +125°C	DIODE/ TRANSISTOR DTμL MICROLOGIC −55°C to +125°C	COMPLEMENTARY TRANSISTOR CTμL MICROLOGIC +15°C to +55°C	COUNTING CμL MICROLOGIC 0°C to +75°C
GATES	NAND/NOR **903** 3-input **907** 4-input **914** Dual 2-input **915** Dual 3-input	NAND/NOR **903, 915** 3-input **907** 4-input **910, 911** (see MWμL) **914** Dual 2-input Epoxy	NAND/NOR **910** Dual 2-input **911** 4-input	**103** Dual 4-input **104** 8-input	**930** Dual 4-input **946** Quad 2-input **962** Triple 3-input	NOR **952** Dual 2-input inverter AND **953** 2-2-3-input **954** Dual 4-input **955** 8-input	
ADDERS	**904** AND/OR 2-level Half Adder	**904** AND/OR 2-level Half Adder **908, 912** (see MWμL)	**908** EXCLUSIVE OR **912** AND/OR 2-level Half Adder				
BUFFERS	**900** Low Impedance	**900** Low Impedance Epoxy **909** 2-input inverting	**909** 2-input		**932** Dual 4-input **944** Dual 4-input	**956** Dual 2-input	
STORAGE ELEMENTS (Flip-Flops)	**902** RS **905** GATED RS with inverter **906** GATED RS **926** J-K	**923** Epoxy J-K **905** GATED RS with inverter **913** TYPE D **926** J-K	**913** TYPE D		**931** CLOCKED **945** CLOCKED Low Impedance **948** CLOCKED Low Impedance **950** A.C. Coupled R.S.	**957** DUAL RANK	**958** DECADE COUNTER CASCADING **959** BUFFER/STORAGE (coming 2nd qtr. '65) **960** DECODER/ DISPLAY DRIVER (coming 2nd qtr. '65)
OTHER	**901** Counter Adapter	**921** EXTENDER Dual 2-input	**921** EXTENDER Dual 2-input		**933** EXTENDER Dual 4-input **951** MONOSTABLE MULTIVIBRATOR		
PERFORMANCE (Logic form, speed, power, noise immunity, packaging)	RTL; 12 nsec; 15 mW/node; 300 mV; TO-5, Cerpack ¼" x ¼" flat	RTL; 12 nsec; 2-15 mW/node; 300 mV; TO-5, Metal or Epoxy	RTL; 40 nsec; 2 mW/node; 300 mV; TO-5, Cerpack ¼" x ¼" flat	TTL; 25 nsec; 22 mW/gate; 450 mV; Cerpack ¼" x ¼" flat	DTL; 25 nsec; 5 mW/gate; 1.0V; TO-5, Cerpack ¼" x ¼" flat	CTL; 5 nsec; 35 mW/gate; 600 mV; Dual In-Line Industrial type	RTL; TO-5, Dual In-Line Industrial

New circuits in red

Micrologic— Fairchild's brand name for digital integrated circuits.

PLUS—NEW MONOLITHIC LINEAR CIRCUITS

1. High Gain, Wideband D.C. Amplifier—μA702A
Precision instrumentation amplifier for high speed analog systems. Offset voltage: 2mV. Voltage gain: 2800.

2. High Speed Differential Comparator—μA710
Variable-threshold Schmitt trigger. Pulse height discriminator. Memory sense amplifier. Compatibility with all integrated logic forms. Offset voltage: 3mV. Response time: 50nsec.

FAIRCHILD SEMICONDUCTOR

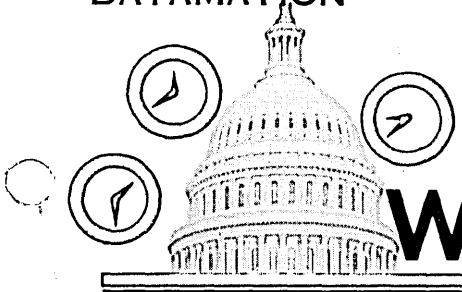
EASTERN ALABAMA *Huntsville: Schweber Electronics, 539-2756.* **CONNECTICUT** *Hamden: Cramer Electronics, 288-7771.* **FLORIDA** *Orlando: Crescent Electronics Sales, 423-8586; Hall Mark Electronics Corp., 855-4020.* **MARYLAND** *Baltimore: Valley Electronics, NO 8-4900/D. C. Area: Powell Electronics, 474-1030.* **MASSACHUSETTS** *Newton: Cramer Electronics, WO 9-7700/Watertown: L. L. Schley Co., WA 6-0235.* **NEW JERSEY** *Cherry Hill: Valley Electronics, NO 2-9337.* **NEW YORK** *Baldwin, L.I.: Taylor Electronics Corp., 223-8000/Buffalo: Dart Sales, 684-6250; Summit Distributors, 884-3450/Syracuse: Dart Sales, GL 4-9257; Eastern Semiconductor Sales, Inc., 455-6641/Westbury, L.I.: Schweber Electronics, ED 4-7474.* **PENNSYLVANIA** *Philadelphia: Powell Electronics, 724-1900.* **CENTRAL ILLINOIS** *Chicago: Avnet Electronics, 678-8160; Semiconductor Specialists, 622-8860.* **MICHIGAN** *Detroit: Semiconductor Specialists, LU 4-5901.* **MINNESOTA** *Minneapolis: E. C. Electronics Sales, 888-4626; Semiconductor Specialists, UN 6-3435.* **MISSOURI** *St. Louis: Durbin-Hamilton Electro Corp., 966-3003.* **OHIO** *Cincinnati: Sheridan Sales Co., 761-5432.* **TEXAS** *Dallas: Norvell Electronics, FL 7-6451/Houston: Norvell Electronics, MO 5-0558.* **WESTERN ARIZONA** *Phoenix: Hamilton Electro, 272-2601; G. S. Marshall Co., 946-4276.* **CALIFORNIA** *Los Angeles: Hamilton Electro, 870-3300/Mountain View: Hamilton Electro, 961-7000/Redwood City: G. S. Marshall Co., 365-2000/San Diego: Denny-Hamilton Electronics, 279-2421; G. S. Marshall Co., 278-6350/San Marino: G. S. Marshall Co., MU 1-3292.* **COLORADO** *Denver: Hyer Electronics, 771-5285.* **NEW MEXICO** *Albuquerque: Hyer Electronics, 268-6744.* **WASHINGTON** *Seattle: Hamilton Electro, 282-3886.* **CANADA** *Toronto, Ontario: Avnet, 789-2621/Montreal, Quebec: Avnet, 697-1993.*

FAIRCHILD SEMICONDUCTOR SALES OFFICES

EASTERN ALABAMA *Huntsville 536-4428.* **FLORIDA** *Orlando CH 1-2596.* **MARYLAND** *College Park 779-6868.* **MASSACHUSETTS** *Bedford 275-8450.* **NEW YORK** *Endwell 754-2600; Long Island ED 4-8500; Poughkeepsie 454-7320; Syracuse GR 2-3391.* **PENNSYLVANIA** *Jenkintown TU 6-6623.* **CENTRAL ILLINOIS** *Elmwood Park 456-4200.* **OHIO** *Dayton 228-1111.* **MINNESOTA** *Minneapolis UN 6-3301.* **TEXAS** *Dallas FI 2-9523.* **WESTERN ARIZONA** *Phoenix 946-6583.* **CALIFORNIA** *Los Angeles HO 6-8393; Palo Alto 321-8780.* **WASHINGTON** *Seattle AT 2-5344.* **CANADA OFFICE:** *Ontario, Toronto 782-9230.*

FAIRCHILD SEMICONDUCTOR/A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION/313 FAIRCHILD DR., MOUNTAIN VIEW, CALIF./962-5011/TWX: 910-379-6435

CIRCLE 17 ON READER CARD



WASHINGTON REPORT

BUREAU OF STANDARDS TRIES TIME-SHARING

A novel time-sharing experiment, underway at the Bureau of Standards for the last five months, is demonstrating how those fiscally-dismal early morning hours on West Coast computers might be profitably used, a turn of events being duly noted by the GSA's dp coordination staff. Involved are a GE-225/Datanet 30 system at the homebase in Phoenix, a similar system at Dartmouth U. in New Hampshire, and four I/O terminals at the B of S. On the Dartmouth machine, B of S researchers are allotted the 1-5 p.m. hours. In the morning, though, the Phoenix computer is almost always idle, thanks to the 4-hour time differential, and bureau users can enjoy virtually unlimited access to the 225 via long-distance lines.

The operation points the way to coast-to-coast sharing of machines, based on the three- or four-hour (DST) time differential, analogous to the sharing of electric power-generating facilities by England and France to take advantage of peak work loads staggered by several hours.

The long-distance tieup has also sold the bureau on the merits of the BASIC compiler, a FORTRAN subset written by Prof. Kemeny of Dartmouth and a group of students. B of S computerites consider it the greatest thing since the abacus.

COBOL MANUAL DELAYED TILL NOVEMBER

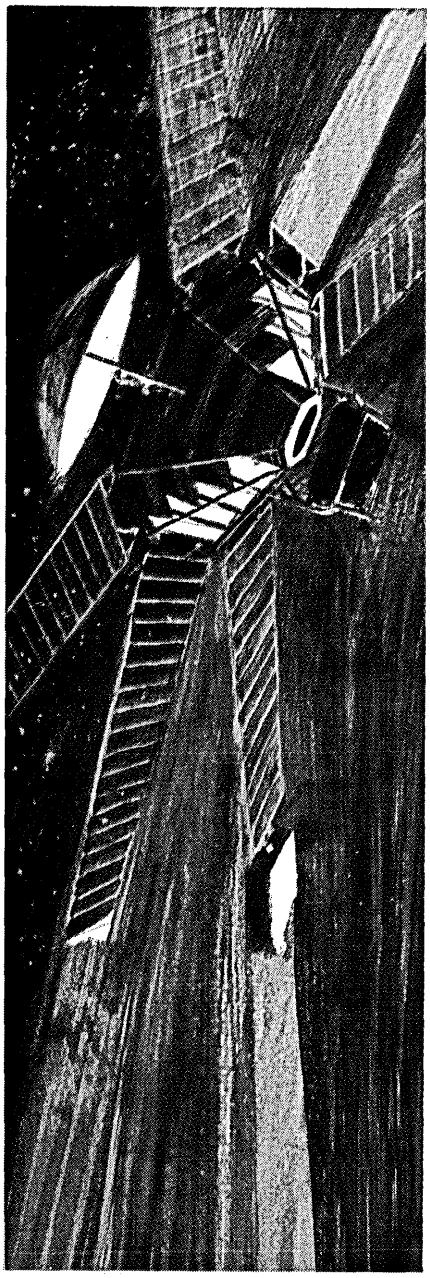
COBOL 65, promised for this summer, has run into snags, won't be available till near year-end. Difficulties have arisen over certain standard symbols with the European Computer Manufacturers Assn., and also over some indigenous English-language ambiguities. Target date for the new manual is November.

OPPONENTS OF BROOKS BILL MAKE APPEARANCES

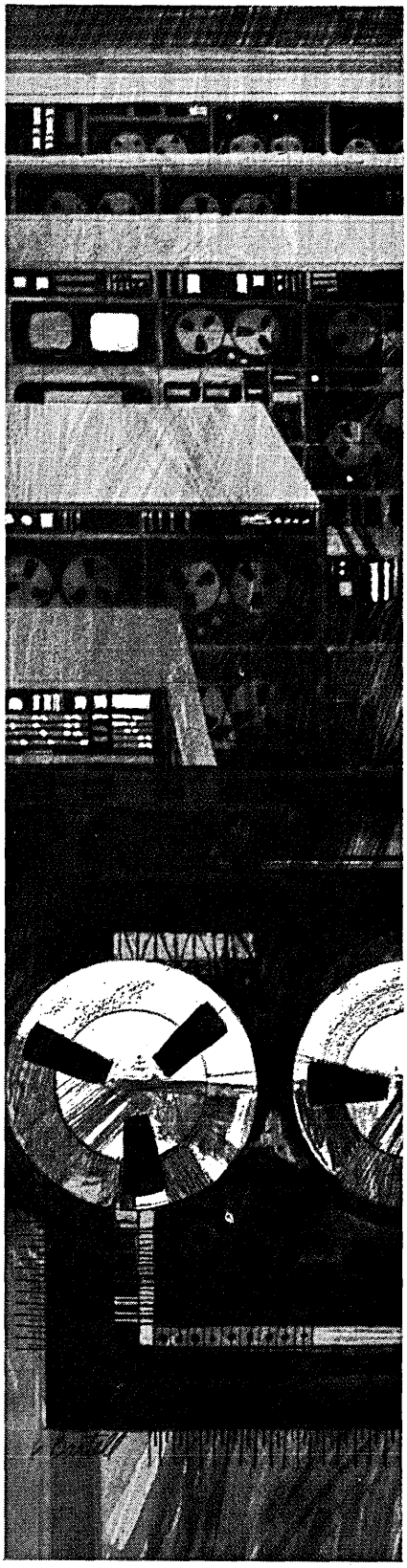
Written statements in strong opposition to the Brooks Bill (HR 4845) as it applies to contractor-operated, government-financed computers were submitted by the Aerospace Industries and Electronic Industries Assns. In a flank attack, the House Military Operations subcommittee opened fire on the Gen'l Accounting Office, whose reports on ADP mismanagement have provided the major rationale for 4845 – and who would have procurement responsibility for government dp equipment if the bill passes.

"Great concern" was expressed to the committee by contractors and the DOD "over the difficult and sometimes awkward situation created by the GAO audit reports." These reports, numbering almost 60 over the last three years, have alleged taxpayer losses of almost $83 million through dp mismanagement by federal agencies and contractors. The subcommittee also heard assistant Defense secretary Paul Ignatius' opposition to the idea of a sole procurement agency.

What goes on out there...



Depends on what goes on in here and...



Mesa software makes it go

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

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

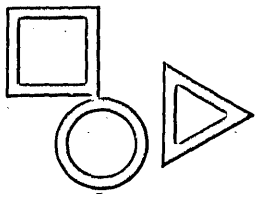
The software package exceeds 30,000 instructions. Special flexibility of the executive provides for several hours of set-up, calibration, and ambient testing prior to the actual data acquisition phase. In the data acquisition mode, the executive provides for monitoring 1 or more of 380 different measurements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

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

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

MESA SCIENTIFIC CORPORATION

CIRCLE 18 ON READER CARD



EDITOR'S READOUT

A MATTER OF DEGREES

This month some few hundred thousand college graduates will hit the streets, and many of them will undoubtedly wander or be sucked into the computer industry. The degree (you'll pardon the pun) of their ability to contribute to their employers and the industry is a big, dark question mark. In the Q^3 (Quantify, Quantify, Quantify) world of computing, the mystique of the graduate grab bag must be especially frustrating.

In an attempt to remove some of the mystery from raw recruiting, more and more colleges are offering courses and even degrees in the computer sciences. It's impossible to find out how many students have had computing courses, and there's no accurate, up-to-date information on the number granted some sort of computing degree. (Two recently released surveys of college computing '63, however, indicate that there were then 40-60 colleges offering such degrees. But some of these—either eight or 25, depending on which survey you read – are junior colleges).

Depending upon your point of view, this is a lot – or not enough – of computer science programs. Until we know more about what comprise these curricula, we're not sure.

We don't believe, for instance that we need more hardware experts who know nothing about software, and vice versa. Let's talk a bit about what we do need, in the light of the nature of the industry.

First of all, information processing cuts across several disciplines which were previously unrelated. Thus the demand for a broad curriculum is apparent. One of the ways to assure a broad curriculum is to make up the computer sciences faculty from departments representing the various disciplines which go into the design and use of computers . . . something like the set-up at The Moore School of Engineering.

Another side of the same subject: the main goal of any program should be the development of intelligent people, not narrow specialists peering out from core, to borrow one of Jackson Granholm's apter phrases . . . people who know not only the how but the why. Al Perlis has noted that we are turning out specialists who can define the kinds of machines we need, but not the kinds of people we need. He's considering inserting some humanities courses into the computer sciences curriculum at Carnegie Tech. Not a bad idea, even if it is an indictment of our undergraduate programs. And while we're at it, let's try to develop people who make waves . . . who are not afraid to question, to criticize and to wonder.

Secondly, information processing is highly volatile: today's technology and techniques are quickly by-passed. It would be a mistake to establish narrow courses pursuing ephemeral phenomena. Principles are the thing.

Third, information processing has probably made the boldest and broadest impact of any of the modern technologies. Holders of advanced degrees should certainly be expected to understand the relationship of their technology to the real world . . . and their responsibilities to their profession, the democratic system and society at large.

Finally, the industry is constantly expanding, poking its tentacles into new technologies and applications, finding new economic levels at which to work. We need a continual supply of leaders for tomorrow. Yet one computer educator notes that dollars, relatively easy to acquire for research, are almost impossible to corner for education. Let's try to correct this criminal imbalance. ■

UPDATING AN I. R. SYSTEM

a legal information file

by JACK SIEBURG

In the development of an information retrieval system, three questions require immediate answers. First, what is to be the content of the master file? Is the file to contain the full text of the governing material? Perhaps abstracts, prepared by manual or machine methods, will suffice. Or, does the body of the text lend itself to a coding technique?

Second, what is to be the "unit" of the machine processable text? What specific segment or segments will be used for comparison purposes in the search and retrieval operations?

Third, how will the units or segments of the text material be identified? By what coding system can accuracy of search comparisons—the matching of text segments against data to be retrieved—be assured? Does the coding technique allow for a high degree of machine efficiency?

When the three original questions have been satisfactorily answered, and the machine programs required to store, search and retrieve the text file have been determined operational, management and systems personnel are lulled into a false sense of security. *They* have developed an operational information retrieval system; the time has come to rest on their laurels, to sit back and enjoy the compliments—and perhaps envy—of others who are still struggling with the many problems of the field. But the feeling of security is short-lived . . . there is still an unanswered question: How do we update the files?

For the past year, I have been a systems research analyst on Project LITE (Legal Information Thru Electronics) —an Air Force system designed to retrieve fiscal management and legal information. Under the LITE system, the three *basic* questions were answered as:

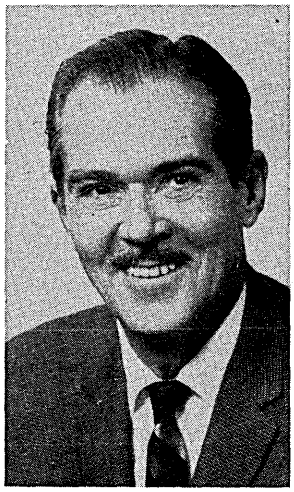
1. The master files were to contain the total text of the subject matter material. For the pilot system, the complete text of the United States Code and Volumes 19-41 of the Comptroller General's Decisions were processed and stored on magnetic tape.

2. A word, as contained in the text material, was defined as a unit.

3. The identity of a unit was established by a text locator consisting of (a) the document number assigned to the particular portion of the text (for the United States Code, a section within a title was defined as a "document"), (b) the number of the sentence (within the document), and (c) the number of the word (within the sentence). The text locators, developed for each word of the master file—except for common or structure words, such as *the, but, and,* etc.—establish the exact location of the word within the main body of the text.

In the search phase of the system, the text locators of a word, or previously defined group of words, are compared with the text locators of another word or group; the results of these comparisons identify the data to be retrieved. To illustrate, to retrieve all occurrences of the phrase "act of aggression," the search instruction would require the text locators of the word "act" to be compared with those of "aggression." In those cases where the document and sentence numbers for the word "act" were identical to those of "aggression" and the word number for "aggression" was two larger than the word number for "act," the document would be retrieved. If the occurrence of two or more specified words within the same sentence, or document, is sufficient justification for the retrieval of data, the comparison operations would be performed on the sentence and document numbers or, in the latter case, on document numbers only.

Still, the question remained: How were the LITE system master files to be updated? One answer was obvious: Using appropriate portions of the original system, we could periodically process the new and revised material to develop a new and current master file. The new text could be merged with so much of the old as remains current and applicable; the revised or revoked material could be eliminated or modified. The text locators, the means of identifying and locating the specific units of data could be developed anew. But, from a machine utilization standpoint, this method is far too costly. On the original LITE



Mr. Sieburg is a systems research analyst with the Office of the Staff Judge Advocate of the Air Force Accounting and Finance Center, Denver, Colo. In the area of legal and fiscal management I.R. systems, he is currently engaged in the automatic abstracting and indexing of full text input. He has also been occupied with business dp applications, having been in the field since '58. He is currently majoring in math at the U. of Denver.

system, an IBM 1410 with four tape drives and two modules of 1301 disc memory, it required 20 hours of machine time to generate the text locators for 17 million words of text; projecting this to the 100-million-word base planned for the follow-on system—even assuming a decrease in unit processing time due to faster equipment and improved programming techniques—made this approach impracticable.

Forced to abandon the easy answer to the problem, our research staff studied and evaluated other known file maintenance methods and techniques; these, too, were quickly rejected for cost and/or processing inefficiency reasons. At this point we made the decision—so often bypassed in data systems design—to tailor our system to our specific needs, not modify our requirements to fit the processing capabilities of an existing system. In an attempt to delimit the requirements of the LITE system, some basic ground rules were established.

First, it was decided that new, or revised, material would be added to the original file, with no attempt being made to modify the original text; both current and superseded text data would be available for search purposes and, if desired, retrieval operations. On an annual basis, the master file will be purged; all rescinded or obsolete material will be extracted and, based upon human judgment, destroyed or stored on secondary electronic data processing media.

Second, the updating of a particular file base would be controlled by the urgency factor of its content. New or revised material would be analyzed and, based upon its information value, added to the master file *now* or during the next scheduled update.

Third, a looping technique would be required to assure the retrieval of *all* text locators associated with a particular word; text locators related to and developed for revised material, as well as those pertaining to the original text, had to be accessible for search operations. Further, to permit processing with a minimum of sorts and merges, the various strings of text locators had to be in ascending numeric sequence.

Fourth, the system had to have the capability of identifying the period of time during which the text material was current and in effect. And, finally, the capability of locating and retrieving all related material—i.e., current and/or revised information pertaining to a certain document or section of the master file—was required.

Let us consider the last mentioned requirements first. To control the active life span of a specific segment of text posed no real problem. An additional control line, developed and made a part of the associated text during the original load and file updating runs, contains two data fields. These hold the date the information material became effective, and the date it was rescinded or revoked.

To assure control of related documents, three other fields were added to the control line. The first contains the document number assigned to the original text material plus a two-character alpha suffix which establishes the sequence in which the original data has been updated. The other two fields, labeled *Doc 1* and *Doc 2*, contain (1) the document number assigned to this section of the text and (2) the number assigned to the revising material. For revoked material, the date of revocation is stored but the *Doc 2* field remains blank.

Prior to performing file updating operations, data to be added to the file is analyzed to determine if it is *new* or a revision of previously stored information. A control message, identifying the type of material to follow and its effective date, is then prepared and associated with the body of the text. For rescinded material, a code signifies that there is no text material to follow. For other than new material, the control message also contains the number originally assigned to this section of text; reference numbers of prior revision are not required input.

Control line data is used in the output phase of the LITE system. By use of specific output commands, the user may control the volume and time-frame sequence of the output material. In the time-frame area, sorting on the S-key field permits output in a most-current-material-first or reverse sequence. Should the user desire to retrieve only such material as falls within a certain time or document number range, he may specify the desired upper and/or lower limits in the search instructions. Comparison operations on data in the *date* (or *document*) fields determines satisfaction of specified range requirements. By establishing a single range limit, material may be retrieved from the beginning of the file to point "x" or from point "x" to the end of the file.

The volume of output may be further controlled by the user's option to retrieve all or specific documents in a related group. (Perhaps I should justify the need for this option. As laws, or any information files, are revised, normal linguistic change would make it possible for words used in the search to identify revised or rescinded material for retrieval but fail to identify the current data. The capability to retrieve *all related material* eliminates this problem). By use of a subscripted output instruction modifier, the user can assure the output of: (1) all documents identified during the search phase; (2) only those documents that have been identified *and* are determined to be current; (3) those documents identified for retrieval plus (if not previously identified) their related current documents; and (4) the identified and all related documents.

The location of text material subject to retrieval is accomplished by use of a table consisting of the document number, the table argument, and the storage address of the associated control line. Once located, the control information determines material to be furnished as output.

The next phase of the LITE file updating system covers the development and control of text locators associated with a particular word or definitive unit of the informational file; for descriptive purposes, referred to as a data accessing loop.

The purpose of the accessing loop is to furnish the processing unit with the storage address of the string of text locators pertaining to a specific word contained in the original body of the text—and, if the original material has been updated, the address of the text locators of the word as found in the revision(s). To accomplish this, two files, identified as the primary and secondary address tables, were developed.

In the primary address table, the *word* field contains the non-common word contained in the main body of the text. $Address_1$ is the storage location of the first text locator associated with the word. $Address_2$ can consist of the actual storage address of this primary table entry, if the file has not been updated, or the address of the secondary table entry if it has. The latter possibility (see file format and definition, below) pertains to the first additional string of text locators for the word being processed. $Address_3$ locates the *equivalents file* entry of a word which, by separate programs, has been determined the grammatical equivalent of the search word—i.e., the *word* contained in this primary table entry. And $Address_4$ locates the *thesaurus file* entry. It is similar to the above except that the text locators pertain to a word which, for search purposes, is considered synonymous to the search word. (Note: the equivalents and thesaurus file entries are, in fact, primary table entries; content and format

are the same, but the data pertain to grammatically equivalent or synonymous words).

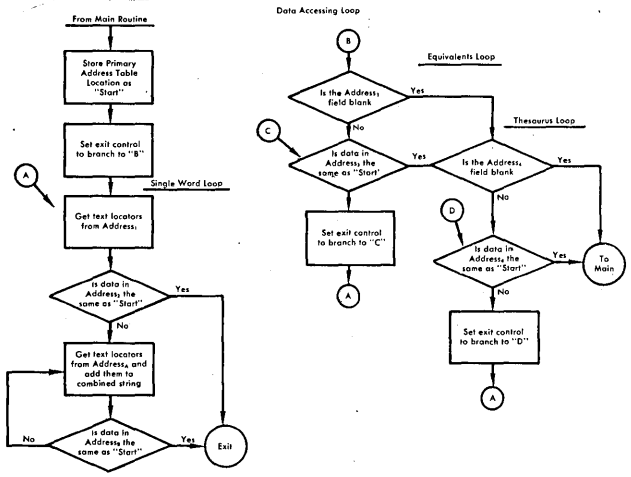
In the secondary address table, $Address_A$ is the location of the first text locator of this string. And $Address_B$ locates the next secondary table entry or, for the entry pertaining to the most recent file update, the related primary table entry.

The original development and subsequent modification of the primary and secondary address table entries are dependent upon input data which, under the LITE system, is contained on magnetic tape. This tape, prepared by a separate phase of the update system, consists of the non-common words and their associated text locators. The individual words are in alphabetical sequence; the related text locators in ascending numeric.

Assuming the primary and secondary table entries, and the associated text locator data, to have been developed and stored, let us now see how the *looping technique* is used in search and retrieval operations. Suppose we need to search for and retrieve text material containing the word *movement* and its grammatical equivalents and synonyms. If the master file has been updated twice prior to search time, the primary and secondary address table entries might be recorded as shown in Fig. 1.

The search program would first locate the word *movement* in the primary address table by use of a modified binary technique. If the search word is not located in

Fig. 1



the primary table—as when a unique word (one that has been recently "coined" or not previously used in the body of the text) has been discovered in revision data—the add-on section of the table is scanned by means of a table-lookup operation. If the word is still not found, an appropriate message is furnished as output.

Having located the word, the program accesses the location identified by $Address_1$ data and moves the first string of text locators to a working storage area; additional strings of locators for the word *movement*—and, if requested by the user, for grammatical equivalents and/or synonyms—are added to, or merged with, the original list until a complete string is developed. Fig. 2 illustrates how the looping technique processes text locators for a single word and for grammatically equivalent and synonymous words.

It should be noted that entry into the processing loop may be by any one of the interrelated words. Had the requestor used the word *shipment* as the main search word, the loop would have progressed from *shipment*-to-*shipments* - to - *transportation* - to - *movement* - to - *movements* - to - *shipment;* again, we are back to the point of origin and all wanted text locators are assembled in the working storage area.

The development methods used for the primary and secondary address table entries also serve to assure that all text locators for a particular word are in the proper sequence when moved into the working storage area. As the file is updated, the next available document number is assigned to the related text material; thus the text locators controlled by the initial secondary address table entry are numerically higher than those controlled by the primary table entry. Subsequent entries to the secondary table continue the ascending sequence in their associated text locator codes.

Preliminary work on the periodic purge routines indicates that the address table control of text locator sequence will also eliminate the need for regenerating

Fig. 2

Primary Address Table

Word	Add_1	Add_2	Add_3	Add_4	Actual Memory Location
Movement	10	100	2	3	1
Movements	40	2	1	3	2
Shipment	50	3	4	5	3
Shipments	60	4	3	5	4
Transportation	70	5		1	5

Secondary Address Table
(entries for the word "movement")

	Add_A	Add_B	Actual Memory Location
1st:	20	200	100
2nd:	30	1	200

Note: The "actual memory location" numeric identifiers are used for illustrative purposes only; actual data is dependent upon the hardware in use.

locator codes during file purge operations. We plan to assemble all active text locators in a single string, addressable by data in the modified primary address table entry; secondary address table data will be erased pending the next file update. By employing this method, address data pertaining to thesaurus and equivalents files will remain constant and require no modification.

The system designs and methods of Project LITE have been tested, under controlled conditions and on pilot-type equipment, for a six-month period. In the future, as other information files are added to the complex, it will undoubtedly be desirable to define different search and retrieval units for the distinct text files; the table addressing method and text locator accessing loop will work equally well on other data-locator units. Output control, by use of the C-line information, can be modified to meet any file requirements. And, as the LITE system has the total text of the information base in its master files, the number of by-products available to the user is unlimited. At this moment, collations and KWIC (Key Word In Context) indices have been prepared; *Profile Referral* and *Citator Service* subsystems are operational for the present equipment.

The cost of a total text system—for initial text conversion and high volume immediate access storage requirements—can not be denied. Our experience, however, indicates that these costs are more than offset by the system's capabilities. With a full text system, *all* of the information is available—and can be retrieved, in the manner and format specified. ■

QUALITY CONTROL AND ASSURANCE IN RECORDS CONVERSION

by NORMAN SCHNEIDEWIND

One of the most important considerations in large file conversions is the type of quality control and quality assurance applied. Here, quality control means those measures taken to hold the error rate within prescribed tolerances. Quality assurance refers to the use of a plan to accept or reject the output of the conversion process, depending upon a pre-determined risk of accepting product of given quality.

Quality control makes use of control charts which permit the detection of errors from an assignable cause—i.e., outside the realm of pure chance. Quality assurance consists of a program of acceptance sampling which provides a method for accepting or rejecting converted material on the basis of samples drawn from lots of converted material.

In the case of small files, it may be physically possible and economically feasible to have 100% inspection. In the case of files involving several hundred thousand or millions of items, however, it usually is not. Indeed, in the field of industrial quality control, it has been known for some time that 100% inspection does not necessarily produce greater accuracy than a good sampling plan, and is much more expensive. The cost of inspection increases appreciably as incremental improvements in accuracy are called for. In addition, the fatigue associated with 100% inspection, and errors made in the inspection process itself, place a limit on the accuracy which can be achieved. Should a large increment in investment be made in an attempt to achieve a doubtful increase in accuracy?

In some applications it is difficult to associate a cost with the penalty of making an error. These are applications in which a client relationship, public safety, or legal considerations are involved. A stated objective of less than 100% accuracy is considered to be intolerable, although 100% accuracy may be impossible to achieve and the cost of attempting to achieve it may be substantial. Here, a distinction is made between desired accuracy and realized accuracy. Although 100% accuracy is not realizable, unless the number of items is small, it will usually be stated as an objective because any other statement would imply that the output of the conversion process is unacceptable. However, by accepting the fact that some error is inherent in any physical and/or human process, a realistic goal for accuracy can be established which will permit the use of statistical sampling procedures.

These procedures can be designed to minimize the cost of inspection for a given degree of desired accuracy. As in any statistical procedure, the accuracy objective will be achieved over a large number of items. Some batches of items will be accepted where the error rate exceeds the desired error rate. Other batches will contain an error rate less than the desired error rate. However, the desired error rate will be achieved over the total number of batches.

A systematic method for achieving desired accuracy at minimum cost is presented here. This technique is one which has been applied successfully in the field of industrial quality control for many years.

conversion procedure

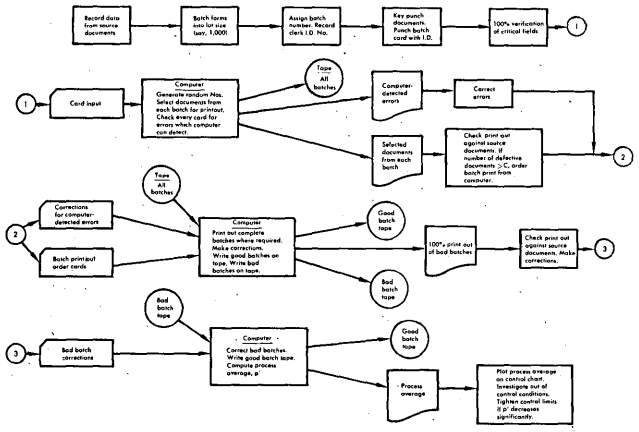
A computer-assisted conversion procedure is illustrated in Fig. 1 (see p. 28). Documents are batched into lot sizes. The lot size should be no larger than that required to permit easy grouping and handling of documents. The larger the lot size, the greater the consequences of accepting a lot which exceeds the allowable number of defective documents. Data fields should be categorized according to the effect of an error in the ultimate application. A 100% key punch verification may be called for on critical fields. In the case of a large number of items, it would be appropriate to provide key verification on a sampled basis to determine which batches of cards should be accepted and which should be subjected to 100% verification. However, it is impractical to pull groups of cards from the deck for selective verification. Since verification is a machine process, the cost of 100% verification is not as significant as 100% manual inspection.

The card input is fed to the computer, which generates

A part-time student and consultant, Mr. Schneidewind is writing a dissertation on a model for systems design and selection of computing systems under a Ford Foundation Fellowship at USC. He has been associated with Univac, Title Insurance and Trust Co., Los Angeles, Computer Usage Co., and Planning Research Corp. He holds a BS in electrical engineering from the U. of California and an MBA from the U. of Southern California.

a group of random numbers equal in number, and within the numerical range, of the sample size. These numbers correspond to the sequence in which the documents will enter the computer. As each set of cards, representing the data for a particular document, enters the computer, a counter is advanced by one and its setting is compared to the list of generated random numbers. If equality is obtained, the complete document record is printed. All

Fig. 1



documents, whether sampled or not, are written on magnetic tape. All errors which can be detected by the computer, such as the absence of required fields, numeric or alphabetic field check, logical consistency checks, etc., are performed on each document. Since all documents must be passed through the computer, 100% checking is in order.

Printouts of the selected documents are compared with source records. If the number of defective documents exceeds the allowable number, a printout of the entire batch is ordered from the computer. Corrections of computer-detected errors are made on the next computer run and complete printouts of requested batches are provided. The remaining documents in the bad batches are checked against the source documents. Corrections are punched and entered into the computer. On this run, the process average, which is the total number of defective documents divided by the number of documents inspected, is computed. The process average is plotted on the control chart, and any consistent out-of-tolerance condition is investigated.

It has been assumed, in the procedure just described, that a computer has been available to assist in the records conversion. Usually, there is inadequate time for conversion work on the machine which has been ordered, prior to going on the air with the application. However, it may be possible to use a nearby machine of the same make as the machine on order, or to use service bureau equipment. If no machines exist in the local area of the type on order, the increasing degree of tape compatibility may make the use of another model feasible. The availability of a computer throughout the conversion period is highly desirable for the following reasons:

1. The records can be gradually corrected and converted to tape or other computer storage media as the conversion proceeds. A large volume of records conversion is avoided at the time of computer installation, when the computer is in great demand for program checkout.

2. The computer can be used to generate random numbers for batch sampling purposes and can provide printouts of selected documents or entire batches. If random numbers were assigned manually, it would be inconvenient to change them often. It is necessary to change the random numbers often to avoid the possibility of clerical workers knowing in advance which documents will be selected for inspection.

3. If the computer did not perform the sampling process, it would be necessary to manually count through each batch of documents and to select the sample on the basis of the random numbers established.

4. The computer sampling method provides a means of sampling after both clerical and key punching operations have been completed. Without the computer, it would be necessary to sample prior to key punching, since it is difficult to manually sample from a deck of punched cards.

5. The computer provides better control of making corrections, since correction cards can be used to correct batches which are already on tape. In a manual system, it would be necessary to store and maintain control of both original cards and correction cards.

definitions

Before proceeding with a discussion of control charts and acceptance sampling plans, it is necessary to define some terms commonly used in the field of quality control.

- p = **Incoming Quality.** The percentage of defective items in a lot prior to inspection and correction of errors.
- p^1 = **Process Average.** The average incoming percentage of defective items for all lots.
- AOQ = **Average Outgoing Quality.** The average percentage of defective items, after inspection and correction of errors has taken place.
- AOQL = **Average Outgoing Quality Limit.** The maximum value of AOQ.
- N = **Lot or Batch Size**
- n = **Sample Size**
- C = **Allowable Defectives.** The number of defectives permitted in a sample of size n.
- P_a = **Probability of Acceptance.** Probability of accepting a lot with a percentage of defective items equal to p.
- P_R = **Probability of Rejection** = $1 - P_a$
- OC Curve = **Operating Characteristic Curve.** The curve which shows the relationship between P_a and p.
- I = **Percentage of Items Inspected**
- pm = Percentage of defective items at which the AOQL occurs.
- I.P. **Inflection Point.** The value of p at which the maximum slope on the OC curve occurs.
- UCL **Upper Control Limit.** Process average p^1 plus three standard deviations.
- LCL **Lower Control Limit.** Process average p^1 minus three standard deviations.

Single Sample Plan. That plan in which a decision to accept or reject a lot is based on a single sample.

quality control

The quality control phase of the conversion program uses standard control charts, with the process average p^1 as the center line and three sigma limits as the upper and lower control limits. In order to establish the value of p^1 initially, a pilot run of the conversion process can be made. In addition to finding the initial value of p^1, the pilot run is also extremely useful for training conversion personnel and for debugging the conversion procedure prior to full-scale conversion. The value of p^1 is computed by dividing the total number of defective documents by

the number of documents inspected during the trial run. The UCL is computed from $p^1 + 3\sqrt{\frac{p^1(1-p^1)}{n}}$ and the LCL from $p^1 - 3\sqrt{\frac{p^1(1-p^1)}{n}}$. The value of n is equal to the sample size to be used in the quality assurance plan, which is described in the next section, and is not equal to the total number of documents inspected.

The control limits must be changed periodically, if p^1 shifts downward significantly. A change in p^1 will also require a change in sample size n. Statistical tests of significance can be used to determine when a significant shift in p^1 has occurred. Control limits should not be revised upward with an increase in p^1. The cause of the increase in p^1 should be determined and corrected.

quality assurance

Quality assurance is provided by the use of acceptance sampling plans, which assure the ultimate user of the converted data that the percentage of defective items will not exceed a pre-determined value over a large number of batches of converted output.

The important characteristic of a good sampling plan is the ability to sharply differentiate between acceptable and unacceptable lots at the process average or over a range of percent fraction defective, if the process average is variable. The sampling plan should cause lots of unacceptable quality to be rejected and lots of acceptable quality to be accepted. The ability of a sampling plan to differentiate between good and bad lots is represented by the shape of its operating characteristic curve. The OC curve relates the probability of acceptance of a lot to the fraction of defective items in the lot.

Several OC curves are shown in Fig. 2. Each OC curve is characterized by a sample size n and the number of allowable defectives C. At any given process average, the quality of a sampling plan can be measured by its ability to provide the greatest possible acceptance of lots with a fraction defective equal to or less than the process average and the least possible acceptance of lots with a fraction defective greater than the process average. Plan 1 illustrates the shape of an OC curve with a perfect but unobtainable discrimination at the process average. This plan provides complete acceptance of good lots and complete rejection of bad lots. All other plans in Fig. 2 allow some good lots to be rejected and some poor lots to be accepted. For a given n and p^1, the value of C at which the greatest discrimination between good and bad lots occurs is at the inflection point of the OC curve, where the slope is greatest. The point of inflection is found by setting the second derivative of the Poisson distribution equal to zero, for various values of C, and solving for p. The point of inflection is given by $p = \frac{C}{n}$. For given values of process average and C, and for $n > \frac{C}{p}$, the slope of the OC curve increases with increasing values of sample size. Therefore, for a given process average and C, and for $n > \frac{C}{p}$, greater discriminating power is always obtained with larger values of sample size.

Unfortunately, for a given value of C the percentage of items inspected increases with increasing sample size. For a given sample size, the percentage of items inspected decreases with increasing values of C. Good discrimination at the process average requires a steep OC curve at that point. For a given C, a large sample size will provide a steep curve at p^1. The large sample size causes the probability of acceptance to be low, which results in a large number of rejected batches. Both the large sample size

Fig. 2

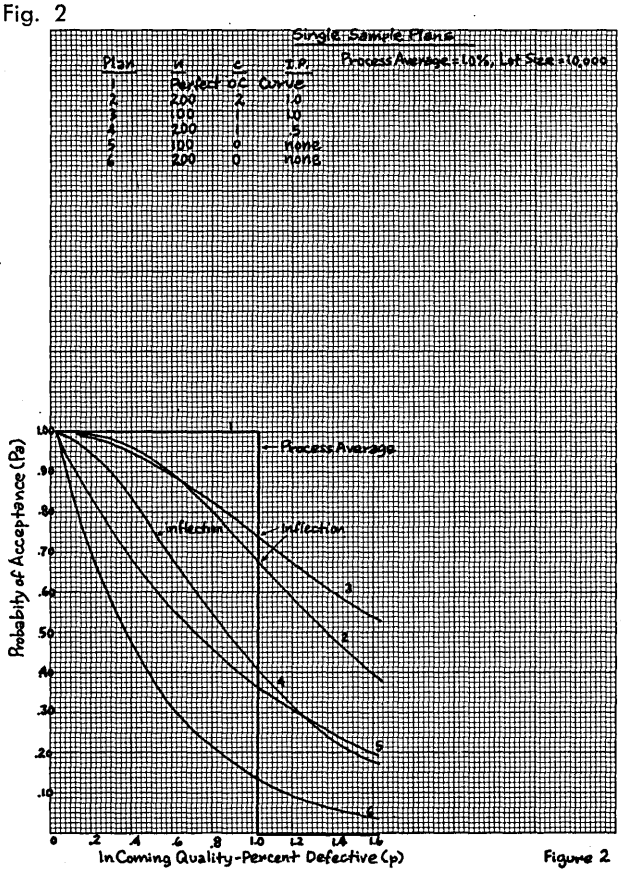


Figure 2

Fig. 3

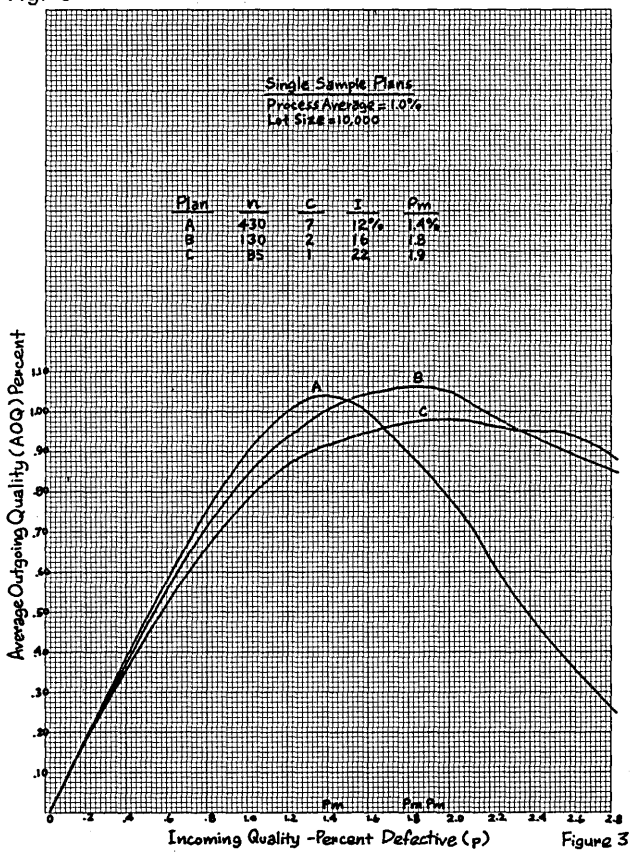


Figure 3

and low probability of acceptance result in high inspection. However, for a given slope, or degree of discrimination, at the process average, a combination of n and C can be determined which will minimize the amount of inspection required.

An interesting point, in relation to the discriminating power of a sampling plan, is the fact that plans with C = O do not possess an inflection point, i.e., the slope continually decreases. This condition is shown in Fig. 2 for Plan 5 and Plan 6. In general, plans with zero allowable defectives should not be used, unless the lot size is very small.

The amount of inspection can also be minimized for a desired value of outgoing quality if a *range* of process average values is used rather than a single point. Since the process average is not likely to remain constant, the consideration of a span of values for p is a more realistic approach to take when selecting a sampling plan. The average outgoing quality (AOQ) varies with the percent defective, as shown in Fig. 3 (see p. 29). At some value of incoming quality, the average outgoing quality will be at its worst, or maximum point. The value of AOQ is approximated by Pap, probability of acceptance multiplied by incoming quality. For incoming lots of good quality, p is small and P_a is large, which results in a small AOQ. For incoming lots of poor quality, p is large and P_a is small, which also results in a low AOQ. Most lots of good quality will be accepted and most lots of poor quality will be rejected. The probability of acceptance for lots of intermediate quality is neither high nor low. Many lots of intermediate quality will be accepted and will cause the AOQ curve to possess a maximum.

The Dodge-Romig sampling tables were established on the basis of permitting the selection of a sampling plan which will minimize the amount of inspection at the process average for a given AOQL. The rationale of these plans can be understood by reference to Fig. 4, where AOQL is plotted against the amount of inspection for various values of n and C. It can be seen that for a given value of AOQL, the values of n and C which result in minimum inspection are not always the smallest n and largest C.

In Fig. 3, the curve farthest to the left at AOQL = 1.0% is at n = 430, C = 7. The curve for C = 8 would be slightly to the right of the C = 7 plan at an AOQL of 1.0%. Therefore, the plan n = 430, C = 7 will minimize inspection and will result in an outgoing quality which will not exceed 1.0%. This plan is for an incoming process average of 1.0% and a lot size of 10,000 items. This plan is contrasted to two other plans, n = 85, C = 1 and n = 130, C = 2 in Fig. 3. The dramatic improvement in outgoing quality, for incoming lots of poor quality, by the use of Plan A is clearly evident. The point of incoming quality at which the average outgoing quality is maximum occurs at a lower value of p in the case of Plan A. A graph of the OC curves for these plans would show that the shape of the OC curve for Plan A is such that the probability of acceptance is higher for low values of p and lower for high values of p than is the case in Plan B or Plan C.

It would also be possible to select a plan on the basis of achieving minimum AOQL for a given amount of inspection. This procedure would be appropriate when a limitation is placed on the amount of money which can be spent on inspection. The minimum AOQL can be found from trial and error calculations or from a more extensive set of curves, similar to those in Fig. 4. Unfortunately,

Fig. 4

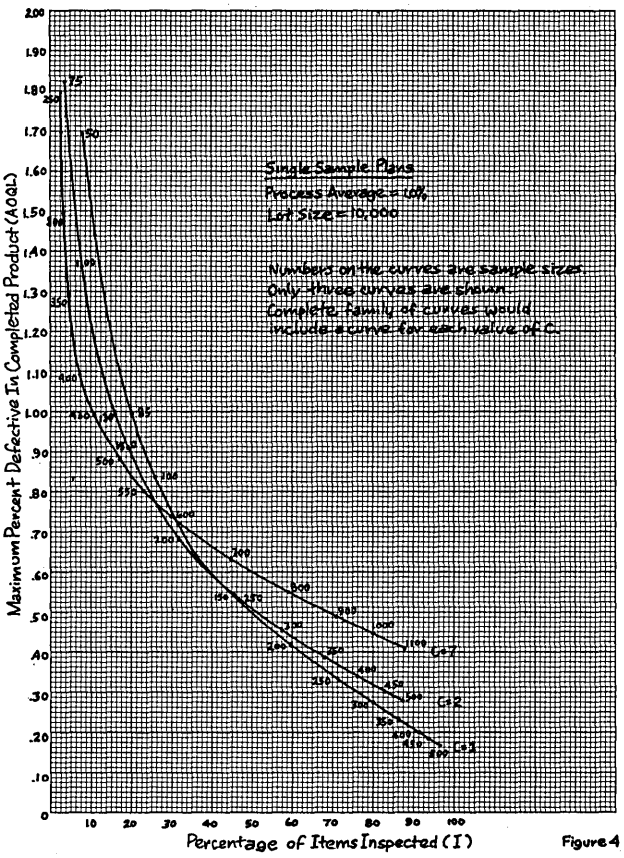


Figure 4

tables to minimize AOQL, for a given amount of inspection, do not exist as in the case of the Dodge-Romig tables for minimizing inspection for a given AOQL.

summary

1. Control charts and acceptance sampling provide an effective means of achieving quality control and quality assurance in conversions where 100% inspection is infeasible or too costly.

2. In those cases where 100% inspection is required, control charts can be employed to control the process average.

3. In addition to one-time conversions, quality control and quality assurance can be applied to the production of transactions in a going system on a continuous basis.

4. The steps in implementing a conversion quality control and quality assurance program are as follows:

A. Establish a conversion procedure or records flow plan such as the one shown in Fig. 1.
B. Make a pilot run in order to debug the conversion procedure and to determine the process average.
C. Establish control charts from the process average.
D. Determine the maximum outgoing error (AOQL) which can be tolerated in the converted records.
E. Determine a sampling plan from the lot size, process average and AOQL by referring to the Dodge-Romig Sampling Inspection Tables.
F. Revise the control chart limits and sampling plan if there is a significant decrease in the process average. ■

REFERENCES:

Dodge, H. F., and Romig, H. G., "Sampling Inspection Tables," Wiley and Sons, 1944.

Duncan, Acheson J., "Quality Control and Industrial Statistics," Richard D. Irwin, 1959.

Grant, E. L. "Statistical Quality Control," McGraw-Hill, 1952.

CHARACTERISTICS OF PRIORITY INTERRUPTS for on-line control

by Emil R. Borgers

On-line control is the basis for a broad spectrum of significant work being performed in a wide variety of applications areas. The "slow class" applications have been attacked first—and successfully. By "slow class" is meant those applications requiring relatively slow response times (chemical processes requiring 5- to 10-minute control cycles, one or two human reactions data logging). Conventional general purpose computers designed primarily for batch processing have been the nuclei of these initial systems. The problems encountered have made the phrase "program around it" commonplace.

The "fast class" of on-line applications remains to be done. In these applications, control cycles measured in a few milliseconds are typical. The demands implicit in the process or simply the cost feasibility require that on-line systems, particularly the central computer, be designed so that "programming around" a deficiency is not necessary. This is not for the convenience of the programmer since he is professionally committed to the performance of different tasks, but because the phrase implies the substitution of a sequence of program steps requiring a measurable amount of time for hardware capable of responding in an instruction time. These "fast class" applications cannot tolerate replacement of hardware by programming because the required response times are so fast that programming implementation is infeasible.

Basically, in all on-line control systems, the central computer acts as a "transponder" (i.e., the computer performs some calculations and initiates subroutines on the basis of an incoming signal). Some examples of incoming signals are time-sharing customer stations, clock pulses, emergency alarms and management inquiries. To such incoming signals, the computer must respond rapidly and reliably. While in some applications the need for fast response may appear doubtful, it is important to note that the ability to do more "work" is basic to the economics of all such systems. How well the computer is able to respond generally determines the maximum capability (and, therefore, the value) of the on-line system. A costly computer can be reduced in capability to that of a less expensive model due strictly to an inability to respond in an on-line environment. A necessary ingredient in the responsive ability of the on-line system is the inclusion of a powerful and flexible priority interrupt system.

priority interrupt systems

Priority interrupt, as a concept, has been with us for a long time. Interrupt experiments were conducted on systems as early as the Whirlwind I. Subsequent command and control systems have incorporated interrupt techniques which can be applied to the "slow class" problems. In the last three years, however, specific interrupt techniques have been developed to satisfy the "fast class" on-line applications. This development coincides with the appearance of production-line real time computers.

To measure the effectiveness of a priority interrupt system, certain criteria must be established:

Reaction Time—The time between the occurrence of a signal (or request) external to the central computer and the commencement of execution of the first *useful* instruction requested by the external signal.

Overhead—The difference between the total time necessary to completely process the incoming request and the execution time of all useful instructions.

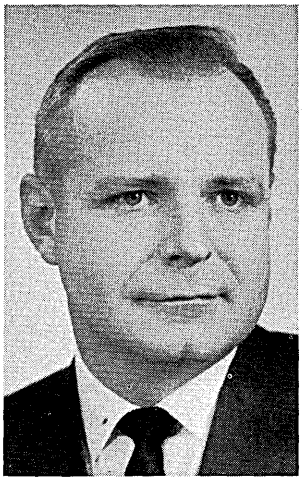
Optimum Priority Response—The ability of the central computer to correctly react to incoming priority requests. Ideally, the computer should always be executing the "most important" instruction as determined by the environment. Thus, if the environment (through priority request lines) determines an instruction (or subroutine) to be more important than that presently being executed, the computer should instantaneously react and execute the desired instruction. The instantaneous reaction should occur in zero time. Since, however, digital computers cannot react in less than an instruction time, *optimum* priority response is theoretical only. How well a priority interrupt system compares with this optimum is a measurement of value.

System Saturation—That which occurs when the on-line system cannot respond quickly enough to all of the requests, and data are essentially "lost." The system is underdesigned if this state exists.

types of priority interrupt systems

At least three types of priority interrupt systems are in general use today. These are the search ring method, the single-level indicator method, and the matrix control method.

Search Ring Method—The search ring method is implemented by use of an n position electronic stepping counter which continually scans n interrupt lines. The highest



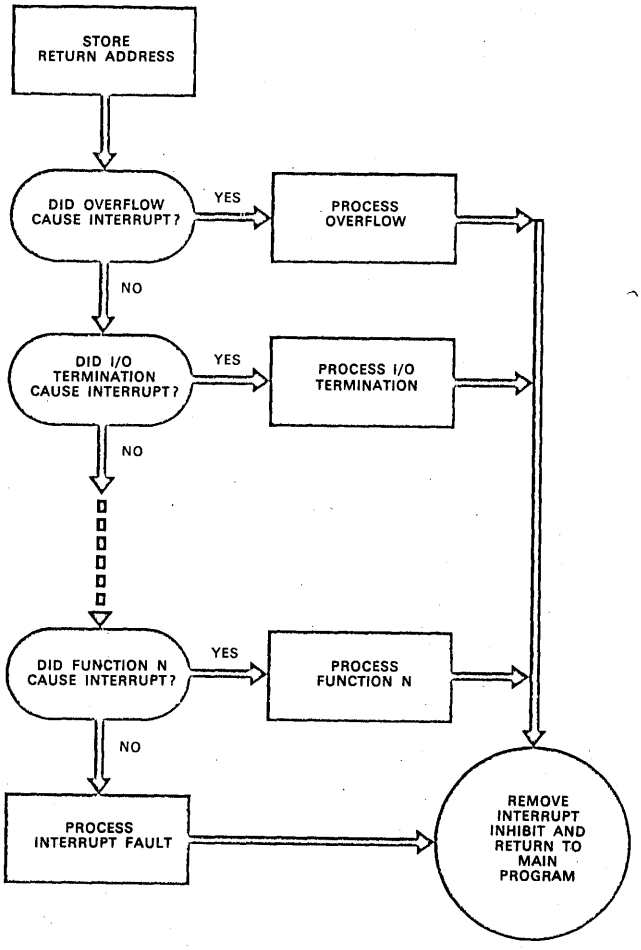
A vice president of Scientific Data Systems Inc., Santa Monica, Calif., Mr. Borgers is responsible for the newly-formed Systems Dept. He is one of the founders of the firm, and most recently served as director of programming. Prior to joining SDS, he had been associated with Packard Bell Computer and Thompson Ramo Wooldridge Inc.

This article is based on a paper given at a recent UCLA/Informatics symposium on On-Line Control.

priority lines are scanned first so that if two requests are received simultaneously, the higher priority line is recognized. The counter associated with the position of this interrupt is then transmitted to the central computer to be used in forming the address of the first instruction to be executed. The program counter is automatically saved and restored at the end of interrupt processing.

This method has poor reaction time since if any interrupt is presently being processed, the computer is "locked out" from all other interrupts. In the worst case, the response time can be as long as the longest interrupt servicing routine in the system. Overhead, however, is not excessive since the program counter is saved and restored. True priority response is not present since the simple scanning technique prohibits a high priority interrupt from being recognized while one of lower priority is being processed. This method is thus said to be single level as opposed to true priority. Another disadvantage of the search ring method is its capacity. As n increases, the time

Fig. 1. Example of interrupt processing routine; single level indicator method.



to scan all lines increases. If n is large enough, either faster (and more expensive) components must be used or the scanning cycle increases, lengthening the reaction time even further.

Single Level Indicator Method—The single level indicator method is the most common (and least expensive) method in use on existing computers. Essentially all interrupt lines develop an "OR" output which serves as the interrupt request signal to the central computer. At the completion of the current instruction, the program counter is stored and an interrupt processing subroutine is entered (see Fig. 1). This subroutine tests each interrupt line in sequence to determine which request caused the interrupt. Either by program or automatically, the interrupt line recognized is reset and program control is transferred to the correct routine.

The response time and overhead for this method are both very high since, after the interrupt request line is activated, a significant number of program steps must be executed before the central computer begins to obey the request. While the highest priority requests will be tested first, the high overhead may make the lower priority interrupts ineffective. This method is also single level since no interrupt can be recognized while one is being processed.

The combination of slow response time and high overhead *plus* the lack of true priority response makes system saturation a possibility before the capacity of the central computer has reached an economic level. Consider an m microsecond computer having two interrupts occurring every 500 m time intervals. The overhead on each interrupt processing would conservatively be 20 m. The nonuseful computing time just to recognize these interrupts would take 8% of the computer's capacity. If more interrupts of lower priority are added (with their correspondingly high overhead) system saturation is very likely to occur.

Matrix Control Method—The third method, matrix control, provides two flip-flops for each interrupt line to be recognized. These flip-flops provide the necessary memory to determine the current status of the line. Three states are used.

State	Condition
1	No interrupt has been requested on this line.
2	An interrupt has been requested, but has not been recognized by the computer.
3	The requested interrupt has been recognized by the computer, but has not been completed.

Each interrupt line (or level) is positioned into a matrix based on the order of priority—the highest priority being closest to the output while the lowest priority is the farthest away (see Fig. 2). An interrupt request being received at a given level automatically causes the level to shift from state 1 to state 2. If no higher priority level is presently in states 2 or 3, the matrix permits the interrupt request line to be activated to the central computer. At the same time, an address unique to the requesting level (determined by diode selection) is supplied to the computer. At the completion of the present instruction, the computer transfers control to the memory location determined by the provided address. At this point the program counter is preserved and a signal sent to the priority interrupt system to change the state of the highest priority level presently in state 2 to state 3 (by design, the requesting interrupt level). At the completion of the desired routine, a unique instruction returns control to the point of departure, simultaneously signaling the priority interrupt system to change the highest priority level presently in state 3 to state 1.

The matrix control method provides both a short reaction time and low overhead. Every interrupt request is obeyed immediately provided no higher priority request is presently in execution. A favorably low overhead is achieved since no program time is used to transfer to and return from the desired routine. The biggest advantage of this method, however, is a near-optimum priority response. The most important instruction is being, or is about to be, executed at any instant of time. When the required routine for any interrupt level is completed, the matrix control method ensures that the next routine to be executed will have the highest existing priority regardless of how

many lower priority requests remain only partially completed.

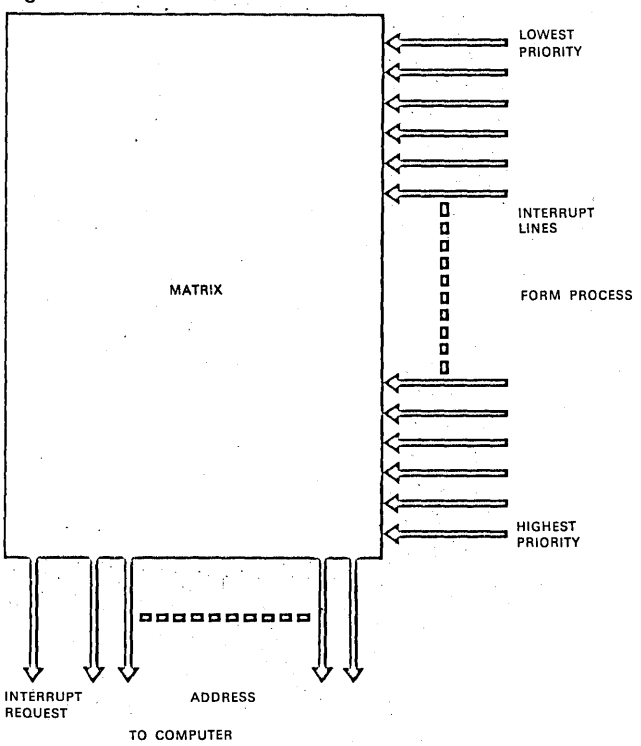
The effect of the matrix control method may be achieved without the structure described here. The required elements are a) memory for each interrupt level, b) a hardware priority structure, and c) central computer communication to inform the priority interrupt system of a change in state. To conserve cost, interrupt levels have been "shared" by a number of interrupt lines in some systems. Since the lines must not interact, the on-line systems designer must take this approach with caution.

Method Comparison—The matrix control method, or some variation, is clearly superior to both the search ring or single level indicator methods using any of the effectivity measurements. While versions of the latter methods exist on some modern computers, it is only because batch processing capability (where priority interrupts are not considered critical), rather than on-line use, was the prominent design criterion. Computers specifically designed for on-line applications generally have a priority interrupt system similar to the matrix control method. Some variations between manufacturers exist with regard to reaction time, overhead, priority response and the maximum number and cost of priority levels.

current-status preservation vs. overhead

Thus far, the problem of preserving machine registers (other than the program counter) has not been mentioned. This problem is discrete and exists regardless of the interrupt recognition methods mentioned previously. If the routine executed in response to an interrupt request

Fig. 2. Matrix control method.



uses (or destroys) any of the machine registers (such as the accumulator, index registers, overflow indicator, etc.), the contents prior to use must be preserved and restored after completion. The problem is likely to become more complicated since computers are being designed with more and more machine registers for greater flexibility. Approaches used thus far have been a) let the program decide what to save and restore, b) implement through hardware an automatic store sequence to save registers in memory and automatically restore after completion, and c) maintain all registers in memory and provide multiple register groups for each interrupt routine and the main program (when an interrupt occurs, a pointer automatically selects the unique register group). The first approach is generally effective if the instruction set is designed to allow many operations to occur without affecting any (or few) registers. In this way, the programmer has alternative choices to keep the overhead low. The second approach involves a fixed overhead no matter what functions are performed in the interrupt routine. The third approach gives a very desirable flexibility to the interrupt capability. If, however, the registers are accessible at the same cycle time as instructions, the tendency is to slow the whole computer down just for the sake of interrupt capability.

Future computer design, representing a departure from the conventional structure, must effectively solve this problem and reduce the overhead even further than is presently done. While this factor does not reduce the efficiency of the computer as a transponder as much as some of the other factors, it tends to limit the maximum efficiency obtainable in on-line systems. Ideally, the overhead time should approach zero.

interrupt arm/disarm capability

In more complex on-line applications, the requirement occasionally exists for inhibiting recognition of certain interrupt requests while other functions are being performed. For example, a high-speed transmission such as a disc transfer, which may have low priority until the instant that the request has been initiated, must capitalize most of the computer time. If the priority structure is allowed to stand, higher priority items might interfere with the transfer and cause transmission errors due to loss of information. On the other hand, the system may require that certain critical interrupt lines remain open at all times so that the prevention of all interrupts is not feasible. This situation requires the use of an interrupt arm/disarm capability. To accomplish this, a flip-flop is placed on each required interrupt line external to the interrupt control system. Each flip-flop must be under control of the central computer. When the flip-flop is SET by the central computer, interrupt requests can be recognized and the interrupt line is said to be armed. Correspondingly, when RESET, interrupt requests are inhibited and the interrupt line is disarmed. To conserve computer time, interrupt arm/disarm flip-flops are usually placed in the desired state in multiple groups rather than singly.

priority interactions

Assignment of priority interrupt levels to particular functions in a given on-line system is, at times, an interesting and perplexing problem. At first, it appears that the systems designer should order the request functions on the basis of importance and assign levels accordingly. This, however, produces the most effective system performance only by accident. Priorities must be assigned using the interaction of functions with each other as a primary basis.

Consider a simple on-line control system with three major requirements: (1) receive and modify input data, (2) output these data and (3) maintain time in milliseconds. The estimated length of execution of these functions and the worst case frequency of occurrence is shown in Fig. 3. *(See p. 34)*

In this hypothetical case, the maintenance of time is for future off-line processing and is the least important of the three functions. Since the output of data is possible only after data input and modification has occurred, system input is the most important function. If priority were assigned strictly on the basis of importance, it can be seen that the time function would be missed under certain conditions. This erroneous time measurement can-

not be tolerated. If, however, the time function is assigned the highest priority (as shown), no time information will be lost. More important, the net effect of this assignment is to prolong either system input or system output by a few microseconds. Since worst-case conditions are shown, no serious problem results and system saturation is avoided.

The on-line systems designer must ensure that all possible interrupts in the system are operating compatibly with each other when worst-case conditions occur. Debugging on-line systems with incompatible priority interrupt assignments is, at best, a horrendous task. These problems must be solved during the design of the system—not during program and hardware checkout. System interactions involving priority interrupts are, many times, not observable during system checkout. Even when trouble is detectable, it presents to the human a behavior pattern similar to an intermittent component failure. This generally leads to many false and frustrating excursions before a solution is found.

dynamic priority reallocation

Based on the occurrence of certain events, it may be necessary to reassign the priority levels of key interrupts dynamically under program control. This requirement is fairly common in military command and control systems, resulting from a change in the tactical situation. This capability has been implemented in a number of ways on different systems. Implementation has ranged from large banks of flip-flops to core switching matrices. Typically, a large amount of expensive hardware is necessary if total flexibility is required.

If only a few different options of dynamic priority reallocation are required in an on-line system, it is usually cheaper to assign a given interrupt request line to two or three different priority levels in the interrupt system. Coupled with arm/disarm capability on each line, each request can be reassigned to a different priority level as the situation changes. This method is generally less expensive than the more flexible approaches.

future requirements

At least two advances are required in the priority interrupt area to make effective use of the higher performance hardware being developed for on-line systems use. They are time related priority assignments and externally weighted priority.

Time Related Priority Assignments—Existing techniques are not adequate to handle a phenomenon which is appearing more frequently as on-line systems become more complex—the time related priority assignment. Consider an on-line system with a low priority task requirement of once each second. Immediately after this function has been completed, it should have the lowest priority in the system. On the other hand, if a whole second has passed since execution, its priority should be high. What is required then is a technique which allows this function to "creep" upwards in priority as a function of time. This case continually exists in time-sharing systems as a given user would like to "wait in line" for his next turn even though some users have a higher overall priority. Present hardware to implement this requirement is very complex and expensive. A software approach, while technically feasible using push-down lists, increases overhead prohibitively and reduces overall efficiency.

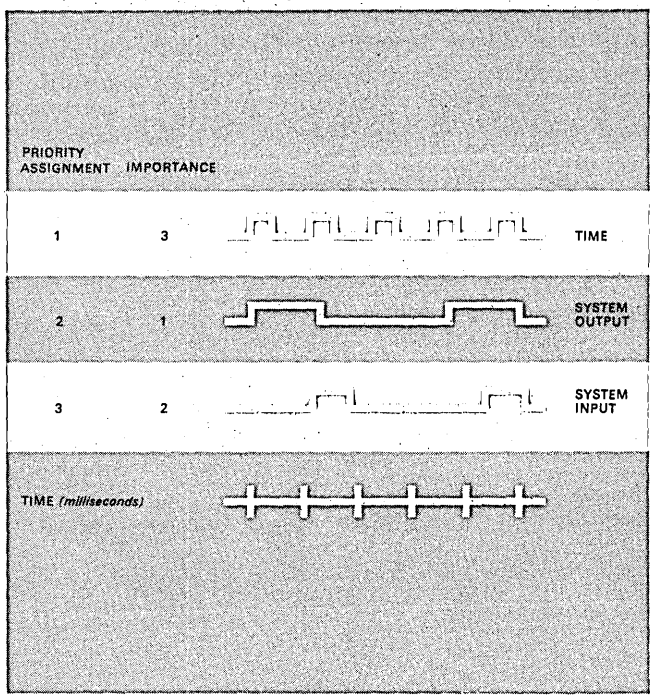
Externally Weighted Priority—In on-line multiprocessing environments, separate tasks are being performed in a number of computers, the results of each having only a partial effect on the entire system. Priority requests between computers are more effective if the requesting computer can "qualify" its importance based on the situation. The receiving computer can then use this qualification as a weighting factor to determine the ultimate priority of the request.

For example, in a three-computer complex, computer A receives requests from computers B and C at the same time, for the same task to be performed. Since it is not likely that computer A is able to evaluate what is going on in B and C to choose the more important request, it would be desirable for the sending computer to "qualify" the importance of the request.

Certain time-sharing systems involving many users will require a similar capability. Let us give the user a number of levels of service, selectable at his console, for which he will pay different usage rates. The different service levels would provide the user with different priority usage of the time-shared computer, either more frequent access or longer on-line time at each access.

To provide efficient on-line systems of the type described above, externally weighted priority must be available without increasing overhead. To achieve this, the incoming signal must be accompanied by a multi-bit weighting code, interpretable by the matrix control logic. This weighting code, in effect, would force priority to shift upward or downward.

Fig. 3. Example of priority interaction.



conclusion

The amount of attention given the design of an effective priority interrupt capability has not always been proportional to its contribution to the overall on-line system. A weak priority interrupt (or none at all) can reduce the number of useful instructions executed by the central computer to as little as one-half the total. Excessive computer-power must then be employed to compensate for the loss of efficiency. As on-line requirements become more complex, the use of priority interrupts will become more important and more prevalent. Adequate solutions have not been found to meet all foreseen requirements. Yet, we are learning to make effective use of what is available to make the digital computer properly react to the on-line environment. ■

COMPUTER SECTIONING AND CLASS SCHEDULING

for mass registration

by MARTIN FAULKNER

Washington State Univ. now has a computer program in operation that helps solve the perplexing problem of building a time schedule of course offerings with a minimum number of student schedule conflicts while optimizing the utilization of available space, time, and instructors. Computer sectioning gives each student a class schedule, showing which sections of his chosen courses he will attend.

Until recently, little organized effort had been directed toward the scheduling problem. The volume of data and a lack of understanding of the complex decision processes prevented serious effort toward a solution until large-scale computers became available to universities. Even with the aid of a computer it is difficult to know which direction to take.

Mathematical approaches such as linear programming and simulation will be used more and more in the near future to aid in solving the scheduling problem. However, there is still not enough information available to make good use of these methods. Only the heuristic approach has so far had any real success. For example, Robert Holz and others at MIT have developed a program which has been used successfully for high schools and small colleges.[1]

The idea of computer sectioning at a university, however, is not new. Purdue Univ., under the direction of James Blakesley, was sectioning by computer in 1958.[2] In the early 1960's IBM developed a demonstration sectioning program under the direction of Loren Bullock at the New England College Computing Center.[3] Modified versions of this program have been adopted by the Univ. of Massachusetts and the Univ. of Rhode Island.

typical program structure

The basic logic of these programs is much the same. A vector of meeting times is established with a bit position for each time that a class can begin during the week. Each course in the time schedule of classes has its own time

Mr. Faulkner is assistant professor of both information science and of business administration at Washington State Univ., Pullman, Wash. In addition to teaching an application course to students in the social sciences and another on system analysis and design, he is investigating methods of generating the university time schedule by machine. He holds a BA in business administration and an MBA from Washington State.

[1] Holz, Robert E., *School Scheduling Using Computers; a Prospectus*, MIT, Cambridge, Mass., Feb. 1, 1963. See also Holz, "State of the Art of Automatic Scheduling and Registration," *Proceedings, Ninth College and University Machine Records Conference*, April 1964, pp. 253-8. Much useful work in the area of high school scheduling by computer has been done by G. Ernest Anderson Jr., director, Research and Development, New England Education Data Systems.

[2] Blakesley, James F., "Registration is Now a Matter of Minutes," *College and University Business*, November 1959, pp. 38-44.

[3] Bossert, Harmon and Bullock, *Student Sectioning on the IBM 7090*, IBM Corp., Cambridge, Mass., May 1, 1962.

vector with a bit turned "on" for each time the class meets. Each student is also given a time vector which has initially been set to zero.

The time bits for the first course assigned to the student are combined with the student's time vector with a logical OR. The time bits of the next request are AND'ed to the student's time vector and a test is performed. If the result of the AND is a word (or words) containing all zeros, there is no conflict and a logical OR is performed to add this request to the student's time vector. If, as a result of the AND, the word contains any nonzero bits, a conflict is indicated and appropriate action must be taken. This may take the form of trying a different section of the same course or it may require backing up and using a different section of a previously assigned course. If the conflict cannot be resolved, the request may be deleted, or the student's entire set of requests may be rejected, depending on the logic of the program.

After five years of development, the Washington State Univ. computer sectioning program was successfully used in scheduling 8,687 students for the fall semester, 1964. Students registered from Wednesday noon until 3 p.m., Friday, when student course requests were recorded on magnetic tape and the sectioning began. By 9 a.m., Saturday, student schedules were ready for distribution. Every student received a schedule but in some cases a certain course request could not be scheduled due to closed sections or a conflict.

An immediate result was that last-minute changes could be based on total and accurate student requests for courses. From the departmental Course Request Report (explained below), over 400 changes were made by deans and department chairmen after studying the number of students requesting each course. These changes included combining and dropping sections, changing the size of multiple section courses, shifting sections and courses to larger or smaller rooms, adding sections, and shifting sections to other periods or days. This procedure implies that the administration can schedule courses to meet at unpopular hours to make best use of facilities. However, the program has a built-in feature to make possible "free time" for students to participate in various student body activities and part-time work.

major modifications

In general, WSU uses a substantially modified version of the IBM demonstration program with a 709 and 1401. The demonstration program rejected a student if a single, unresolvable conflict was found; the WSU program generates complete or partial schedules for the student.

While the logic is much the same, a more extensive set of decision rules is necessary, and a substantial volume of housekeeping is required. The demonstration program tries 500 times to generate a usable schedule; the WSU program tries 5,000 times. The demonstration program was written in FORTRAN II and used FORTRAN II input/output. On an IBM 709 it would process approximately 1,000 students an hour, which was too slow for the time constraints imposed. By discarding the FORTRAN I/O and replacing it with a buffered I/O package handcoded in FAP, the processing speed was increased to 2,500 students an hour.

Because of the need to generate partial schedules, the program was modified and ways found to speed up internal processing. In a program of this kind, extensive internal sorting is necessary; the demonstration program does it by actually moving blocks of information around in core. In the current WSU program, very little data is moved. Instead of physically sorting, the program simply keeps track of where information is in core via pointers and a special indexing scheme. As a result, about 12,000 students an hour can be processed in the IBM 709. (The Purdue Univ. sectioning program with essentially the same logic written in COBOL for the 7090 was able to process about 2,000 students per hour in the spring of 1964).

The machine configuration necessary for the sectioning programs to operate includes a 709 and 1401. The 709 must have a 32K memory and a minimum of seven tape drives and two channels. The 1401 must be composed of a 16K memory, four tape drives, index registers, a move record instruction, and a column binary feature. All 709 programs should run on a 7090 or 94 without alteration. Index registers have not been used in combination.

The supporting 1401 programs were written in Autocoder. They include card-to-tape, listing and punching programs, and all but one of the programs for operating on the time schedule. The calculation portions of the sectioning program are written in FORTRAN II. All input/output for the sectioning program is handcoded in FAP. These routines are buffered. The sectioning program operates at slightly less than tape speed. All other 709 programs are written in FAP, have buffered I/O routines, and operate at tape speed. The FORTRAN II monitor system is used with all 709 programs.

the time problem

Available time exerts a strong influence on the machine sectioning system. Only two and one-half days are available for registration, during which time student requests are gathered and put into machine-digestible form. If this is done on schedule, only 14 to 16 hours remain for processing schedules before distribution to students.

A backward look at the conventional procedure of mass registration of students and a glance at the computer sectioning outline points to the fact that there is considerably more to automated scheduling than just sectioning. The annual time schedule is still constructed primarily at the convenience of the departments. Students pick up their enrollment packs according to a rotated alphabetical sequence, report to advisers for enrollment counseling, pay fees, and turn in the cards at the registrar's stations.

The manual sectioning operation, which required the services of 150 faculty and 70 staff members, no longer exists. The scramble for preferred sections and courses has been eliminated. The struggle to keep sections balanced has been eradicated. The "crystal ball" has been replaced by "head counts."

Under the computer sectioning program, the annual time schedule has been transferred to tape. All changes in the annual time schedule by the departments are reflected in an updating pass to the master time schedule file. The content is the same but the format has been changed to correspond to the needs of the sectioning program. There are two other updating passes to the master time schedule file each semester. The first is a week before registration and the second is the last evening of mass registration. In the fall of 1964, the first updating pass was small, with less than 50 changes. At this pass, unrestricted changes were allowed. The second updating involved over 400 changes and will be discussed in more detail below. The annual time schedule for the fall semester, 1964, consisted of 1,475 courses with 2,441 sections.

As before, the student picks up his enrollment pack between Wednesday noon and Friday noon and sees his adviser for counseling. When the student fills out his enrollment card, he specifies only the course prefix, number, and credit. After paying fees, the student's enrollment card is checked in his presence for accuracy. This is very im-

portant. Errors missed at this point are not likely to be caught, since no further contact is made with the student until he receives his schedule of classes.

The enrollment cards (see Fig. 1) are turned over to a group of 60 clerks who record the requests on mark sense class cards (see Fig. 2). One card is marked for

Fig. 1

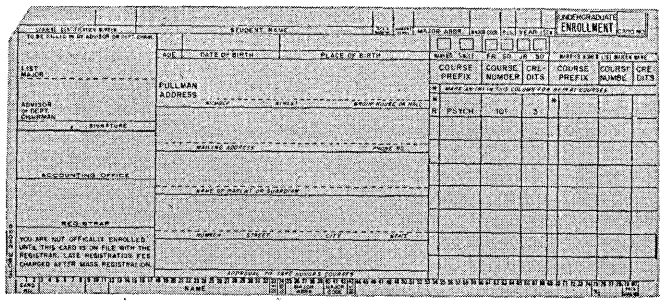
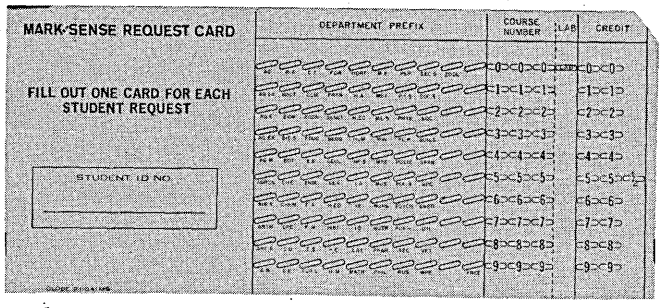


Fig. 2



each course request. The student's identification number is gang-punched from the enrollment card into the mark sense cards and the request information is sensed and punched.

processing and reports

The card images are put on tape by the 1401. The card-to-tape program does extensive editing and picks up nearly all marking errors. The program checks every field on the enrollment card as well as the mark sense request cards for invalid information. If an error is found, the student's requests are not put on tape, and an on-line message indicating the nature of the error is printed. Thus errors can be corrected and the student's requests resubmitted during the next card-to-tape pass. Students average about seven requests each. The most common error is marking too lightly on the mark sense card. This becomes very noticeable late in the afternoon.

Procedures are being devised to have the student mark his own requests under trained supervision. At present there is too much transcription of information beyond the source. While the error rate in marking is not high, the cost is disproportionate. It is worth pointing out that input preparation is the most troublesome and expensive area of computer sectioning.

All course requests were recorded on tape by 7 p.m., Friday. The next step was a complete edit of all request information and the generation of a course request report on the IBM 709. At this point, requests were checked for validity and put into a form acceptable for the sectioning program and the number of requests for each course in the time schedule file was tallied. The result of this 35-minute operation is an edited request file for sectioning, a reject file, and the course request report. The report contains, by course within department, the number of seats available in each course, the number of students requesting the course, and the difference.

For the first time, a department chairman or dean knew exactly what the request pattern was for the courses in his area. Friday evening the administrators having responsibility for schedule decisions met and were given copies of the report. Over 400 changes were made in the time schedule to reflect the request pattern of the students. These changes were keypunched and the time schedule file updated before sectioning began. This is one of the most significant byproducts of WSU's computer sectioning procedures.

Actual sectioning took approximately 40 minutes. The output of the sectioning program is a schedule file and a sectioning reject file. The schedule file, sectioning reject file, and edit reject file were then merged and sorted on student identification number for listing of student schedules. Schedules were printed on the 1401 within three hours and were completed by 9 a.m., Saturday.

Concurrently with listing the schedules, two jobs are run on the 709. First, a status of sections report is generated. This gives, by section within course and department, the number of students enrolled and the number of seats available, if any. This report serves two immediate functions. It gives an accurate picture of the balancing of sections within courses. In 50 sections of English composition, for example, the size of sections varied by not more than one student. The report also indicates which sections have seats available for "adds" during the first week of classes. The second job is to generate a class card file which is later punched to allow unit record processing of student records during the semester.

Other processing of management data related to sectioning, which took most of Saturday, includes punching and interpreting the class cards and printing temporary class lists (permanent class books are issued two weeks after the beginning of classes).

Late registrations are processed by machine twice during the first week of classes. This is currently the only means we have of assuring ourselves that the student cannot beat the system.

In spite of a clerical error in updating the time schedule which caused eight sections of one course to meet at the wrong time, and the fact that the main sectioning program blew up after sectioning 6,500 students and was off the air for an hour, things went smoothly. Machine sectioning has been accepted wholeheartedly by both faculty and students as being superior to the manual process.

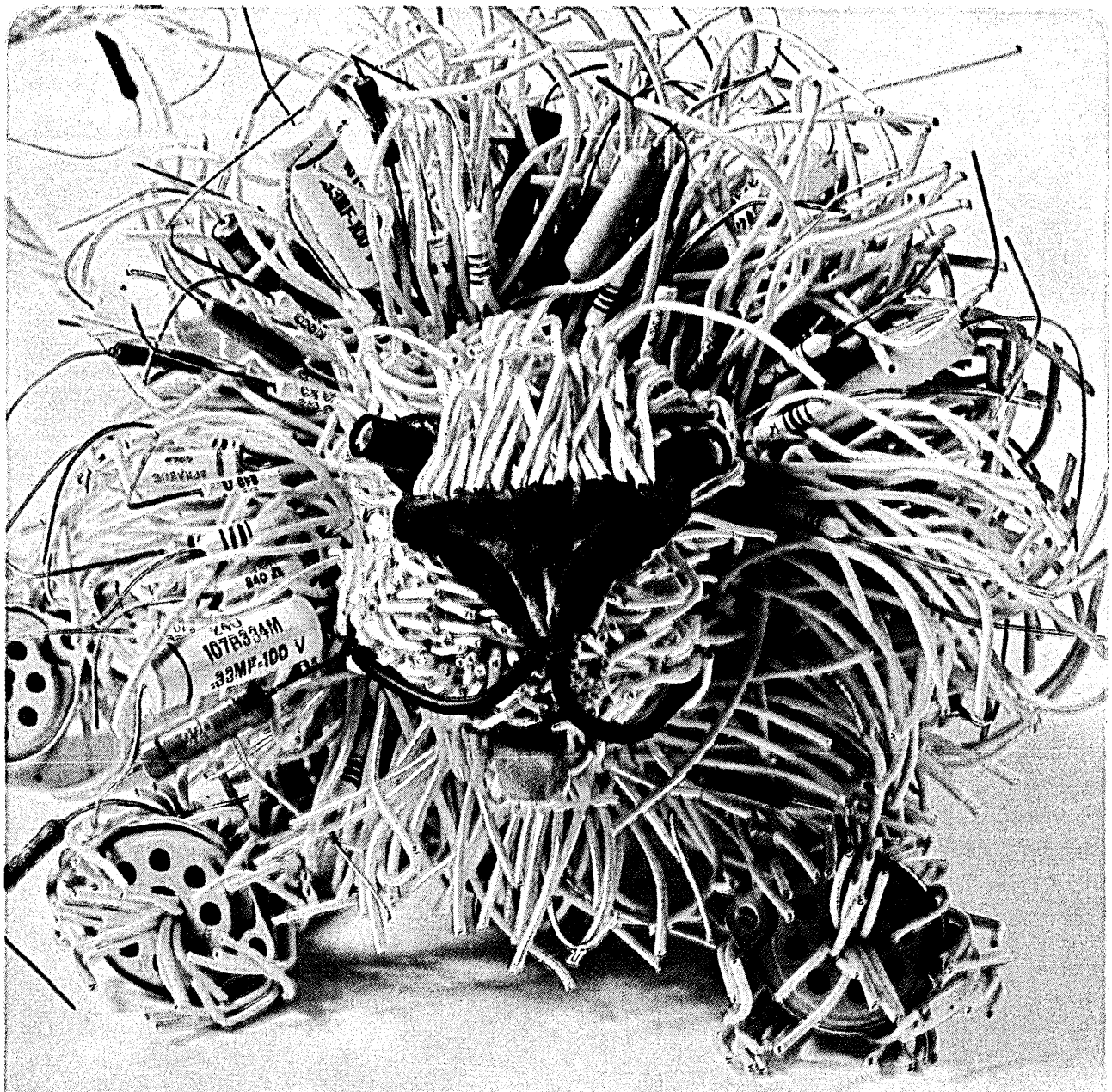
costs & advantages

Design of the system and the development and testing of programs and procedures required at least 24 man-months of direct labor. While exact cost figures are not available, $50,000 does not miss by far the development cost. The out-of-pocket cost for processing last fall was roughly 50 cents per student; half of this amount was input preparation before the information ever reached tape.

A number of important gains were made. The previously mentioned course request report is a prime example. This is the first time that the university has actually known the request pattern for courses. Another benefit is the heretofore unachieved balancing of sections.

Information on space utilization is now in usable form, which will be of material aid in future planning. By carefully analyzing the reject files, the university is gaining a much better understanding of what is required to build a more flexible and efficient time schedule.

Of equal importance is the fact that a new tool in the sectioning program is available. With this technique a wide variety of experimental time schedules is available for research without waiting for registration time. The back-door approach to the problem of an optimum schedule has been a complete success thus far and more logical paths are being formed to the ultimate solution of an optimum schedule. ■



King of the low-cost computers

If you're ready for full-scale data processing — but not ready to pay a king's ransom for it — the powerful new Honeywell 120 is just the computer you need.

The 120 is the lowest-cost real magnetic-tape computer system anywhere.

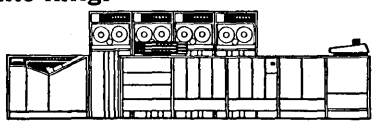
It has a memory capacity of up to 32,768 characters.

It reads and punches cards while it computes.

As a 3-tape system, it starts as low as $2610 per month.

Model 120 is the smallest member of a royal family — namely, Honeywell's compatible new SERIES 200. So if the 120 isn't big enough for you, we'll tailor a larger system to your exact dimensions. We can do that because we've refined all our hardware and software down to the smallest increments of capability ever offered. No wasted capacity: no wasted money. Later, you can add on in gradual, economical increments. It's what we call Dimensional Data Processing.

Interested? Call a Honeywell EDP sales office. Ask to see the king.



Honeywell

ELECTRONIC DATA PROCESSING

CIRCLE 19 ON READER CARD

THE "QUICK AND DIRTY" COMPILER

how dirty is it?

by DR. ROBERT F. ROSIN

There has been a running debate for the past few years concerning compilers for "production programs" versus those of the "quick and dirty" variety.[1,2] Although one may not always be able to assign a particular translator to one class or the other, this distinction is usually supported by the contention that the former are relatively slow in translation but yield efficient object code, while the latter can compile rapidly but the compiled program is not so optimum—thus dirty. (The author does not condone fast compilation at the expense of such features as error analyses and diagnostic output). The quick and dirty compiler is often described as being of value only in university environments.

It is the purpose of this paper to determine the relevance of the word "dirty" in the context described. (There will be no discussion of the nature of "production" jobs versus those "typical of university installations" except to say that experience both within and outside of universities has shown that such distinctions cannot be made.) In particular, we shall examine MAD, often cited as a prime example of the quick and dirty compiler, and illustrate some features of the language which tend to offset the stigma of inefficient object code. In contrast, one can consider 7090 FORTRAN as the "production compiler," for it is the standard, if not the leader, in this area.

compensations: flexibility & language features

The use of the name MAD will refer to both the language and the translator. In fact, in this paper it will be shown that features of the language tend to compensate for some of the object code inefficiencies brought on by lack of complete optimization in the use of index registers, etc. The concepts of a language and its implementation are not so easily separated when evaluating a translator.

One idea which is often missing in a discussion of the "quick and dirty" compilers is that they were developed to meet other needs as well as that of fast compilation. Surely there is a reason for the acceptability of the several languages developed using ALGOL '58 as their guide, such as NELIAC, JOVIAL and BALGOL as well as MAD and possibly some others. ALGOL '58 offered (and still does offer) a far more flexible tool for programmers than most versions of the FORTRAN language.[3] This will be illustrated presently.

That this flexibility is not merely germane to university environments can be shown by the development and use of NOMAD (a MAD offspring) by the General Motors Research programming staff in constructing a heavily used and quite versatile executive system.[4] To quote from a recent paper on this subject:

> "Other features of NOMAD which contribute to its selection for the D-system are more conventional but still important. NOMAD permits a completely general subscription expression, a generalized iteration statement, multiple entries and exits from subroutines, the manipulation of statement labels, the use of internal procedures, nested conditional statements and the use of certain elementary push down list facilities."[5]

These features have been available in MAD since its earliest days in 1960. Some other NOMAD features such as additional operators for symbol manipulation also exist in more recent versions of MAD.

The generalized iteration statement allows one to search a vector for a given argument in one statement.

Dr. Rosin is assistant professor in engineering and applied science at Yale Univ. He has a background in programming and research at the Univ. of Michigan and with IBM, and delivered a paper at the '62 Spring Joint. He holds a BS from MIT, and an MS and PhD from Michigan.

[1] Shaw, Christopher, "More Instructions . . . Less Work," *Datamation*, June 1964, pp. 34-35.

[2] Halpern, Mark, "Computers and False Economics," *Datamation*, April 1964, pp. 26-29.

[3] Oswald, Harvey, "The Various FORTRANS," *Datamation*, August 1964, pp. 25-29.

[4] Jacks, E. L., "A Laboratory for the Study of Graphical Man-Machine Communications," *Proc. FJCC, 1964*, pp. 343-350.

[5] Cole, Dorn and Lewis, "Operational Software in a Disc-Oriented System," *Proc. FJCC, 1964*, p. 356.

```
ST1  THROUGH ST1,FOR I=1,A(I) .GE. 1000
     .OR.I.G.N
```

Generalized subscript expressions allow one to maintain vectors of indices, and to modify these within a pair of parentheses defining subscription:

```
A(B(I),C(I) ) = X(B(I)+C(I) ) + X(B(I)-C(I) )
```

The generality of statement labels allows one to write statements as:

```
TRANSFER TO S(FUNCT.(3*Y) )
```

and

```
ST = SEARCH
```

which is consummated elsewhere in the program by

```
TRANSFER TO ST
```

Thus, one might conclude that the "quick and dirty" compiler may not be quite so dirty in at least one respect. The flexibility obtained by removing restrictions (often found in compiler languages motivated by efficient object code) can make a difference between the feasibility and infeasibility of writing a particular program in compiler language. There surely are many programs which were written in assembly language solely because their expression in compiler language would have been more tedious rather than less so. This often has the adverse effect of removing the program from the realm of understanding of its ultimate user and would-be programmer, in an open shop situation. There are very often "practical" (i.e., extra-university) as well as pedagogical reasons for having the originator of a problem do much of his own programming; for example, he often knows vastly more about his application than will most programmers, and so he probably should.

the fortran barrier

However, flexibility is probably not the most important key to efficiency. For some applications, many of them not so unusual as they might at first seem, the basic generality and extensions in these languages make them far more efficient than "production" compilers in actual object code production. Let us consider the example of the conversion of a 6-character BCD word into a 36-bit integer on an IBM 7000 series computer.

The following is a MAD subroutine which performs the desired operation, while ignoring any non-digits in the original BCD word. (The operators .RS. and .LS. shift the left hand operand right or left the number of binary places specified by the right hand operand. The operator .A. accomplishes bit-wise AND. The constants of the form . . . K are interpreted to be octal representations of machine integers. The shifting operators are of higher procedence than .A.)

```
    EXTERNAL FUNCTION (X)
    ENTRY TO B CDBN.
    NORMAL MODE IS INTEGER
        T1 = 0
        T2 = 0
        THROUGH S, FOR I=0, 6,I.G.30
            WHENEVER X.RS.I.A.77K.LE.9
                T1 = T1 + (X.RS.I.A.77K)*10.P.T2
                T2 = T2 + 1
S       END OF CONDITIONAL
        FUNCTION RETURN T1
    END OF FUNCTION
```

The fact that a person familiar with FORTRAN and only FORTRAN could not produce a similar program with nearly this efficiency is probably quite apparent. The needed artificiality of a division taking the place of a right shift, etc., is neither convenient nor efficient.

However, such a subroutine can be written in assembly language to run much more efficiently than the example above. The writing of such a routine is, of course, out of the reach of the FORTRAN programmer, but he can use such a routine if provided by a programmer on the computing center staff. For example,

```
          ENTRY   B CDBN
B CDBN    SXA     SV4,4
          STZ     T1
          LDQ*    1,4
          AXT     6,4
LOOP      PXD     0,0
          LGL     2
          TNZ     NOGO
          LGL     4
          STO     T2
          CLA     T1
          ALS     2
          ADD     T1
          ALS     1
          ADD     T2
          STO     T1
BACK      TIX     LOOP,4,1
SV4       AXT     **,4
          CLA     T1
          TRA     2,4
NOGO      LGL     4
          TRA     BACK
T1        PZE
T2        PZE
          END
```

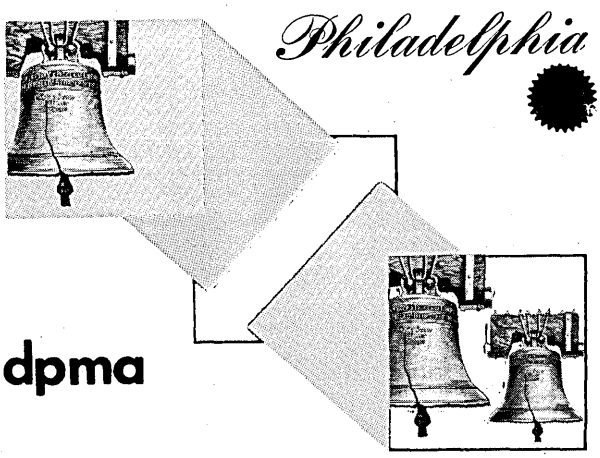
This program is quite efficient in that no multiplications are involved at all. However, the technique employed of shifting and adding in order to obtain the effect of multiplication by 10 on a binary machine is *not* a feature of assembly language, but one of general applicability. It is, alas, very often far out of the reach of the programmer using a "production" compiler.

One can write a MAD program (though not quite so efficient as the assembly language routine due to the latter's use of an index register to control iteration) which has the features that it is within direct reach of the compiler user and it is within the realm of useful efficiency. For example:

```
    EXTERNAL FUNCTION (X)
    ENTRY TO B CDBN.
    NORMAL MODE IS INTEGER
        T1 = 0
        THROUGH S, FOR I = 30, -6,I.L.0
            T2 = X.RS.I.A.77K
            WHENEVER T2.LE.9,
                T1 = (T1.LS.2 + T1).LS.1+T2
    FUNCTION RETURN T1
    END OF FUNCTION
```

Programs of this type are within the scope of any user of the MAD language, provided he has access to the techniques involved. There is no substitute for programming skill, no matter which language is being used. However, good programmers, given adequate tools, are able to take advantage of these more flexible languages in ways which often make their results generally acceptable in terms of efficiency while allowing quicker writing and debugging of their programs. The advantages to the instructor and the programmer, in industry as well as the university, far exceeds that of the often cited translation speed.

While the examples used were based on the MAD language, it is evident that other "quick and dirty" compilers are not nearly so dirty as a casual glance might indicate. Each has facilities which make its use attractive to many programmers, both in "production" and "university" settings. ■



THE PRESIDENT'S MESSAGE

by JOHN K. SWEARINGEN
International President, Data Processing Management Association

Appropriately themed, "Education, Keystone of Management," this year's DPMA International Conference and Business Exposition meets in the Keystone State's largest city—Philadelphia. Although steeped in rich tradition, Philadelphia could well be site of the most progressive DPMA conference to date, for "advancement" seems to be the byword, judging from the following list of seminar program categories:

Advances in Management Information Ssytems
Advances in Data Processing Management
Advances in Data Processing Education
Advances in Hardware
Advances in Software

Some 40 separate seminars will cover new applications, education and techniques in data processing. They will be presented by a number of outstanding personalities in the business and education world of today. The Business Exposition, too, will feature the new—new developments in hardware and accessories. Don't forget, this is the largest data processing exhibit under one roof in existence!

Following on the next several pages is a synopsis of the seminar sessions to be presented and other information about the conference program. I ask you to read it over carefully, after which I'm sure you'll agree with me when I say, "the 1965 DPMA International Conference meets the Association's primary challenge of improving the data processing profession in all areas of business and industry."

DPMA is proud to present this conference and business exposition. To the publishers and editorial staff of DATAMATION I give my sincere appreciation and thanks for this opportunity to present our conference on these pages. To all interested parties, I extend an earnest invitation to the conference on behalf of the Data Processing Management Association. ■

CONFERENCE PARTICULARS

Once upon a time, computers emerging from the factory floor were categorized as either scientific or commercial machines, and the people working with them were suitably categorized—or considered a breed apart. Lately, however, this distinction seems to be diminishing.

This publication has carried a by-lined article which espouses FORTRAN on a 7090 for "business-type" applications (August '64), followed by a rebuttal favoring COBOL (April '65). Just recently, a GE 635 was ordered by Pillsbury for "business-oriented" applications, and similar orders have been placed for 360's and Spectra 70's. Erasure of what had seemed to be clear lines of demarcation seemed imminent with talk of the merging of the Assn. for Computing Machinery with the Data Processing Management Assn., discussions long since cut off.

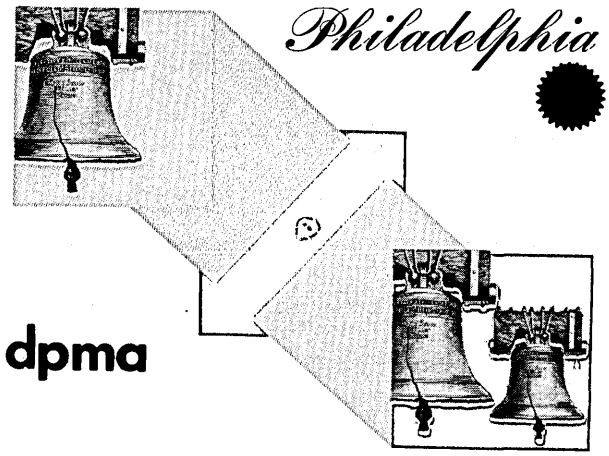
It is the DPMA that is sponsoring this international dp conference and business exposition, the latter billed as the largest under one roof. A glance at the seminar sessions reveals that audit trails replace missile trajectory computations, and FORTRAN gets but perfunctory recognition, but throughput-per-dollar and programmer productivity are still okay topics whenever computer people meet.

Accordingly, this conference, which will be held in Philadelphia's Convention Hall on June 29 to July 2, is open to everyone. Registration fees for the full program are $75 for members and $85 to others. Included for this are three luncheons and the conference banquet, scheduled tours, and a bound copy of the conference proceedings.

In addition to 40 seminar sessions, there will be a Wednesday evening panel discussion on "The Impact of Electronic Data Processing on Society." Among those scheduled to appear with moderator Dr. Morris Rubinoff, of the Moore School of Electrical Engineering, are Robert M. Solow, professor of economics at MIT; Dr. Garth Mangum, executive director, National Commission on Technology, Automation and Economic Progress; Dr. Louis Fein, Consultant, Los Altos, Calif.; and Alice Mary Hilton, president, Institute of Cybercultural Research, NYC.

The conference keynote speaker is Walter W. Finke, president of the EDP Div. of Honeywell Inc. His talk is titled, "Computers and the Great Society."

Tours include an all-day jaunt through the Fairless Works of the U.S. Steel Corp. (limited to 200 registrants), and numerous runs through the plant of the Philadelphia *Evening Bulletin* and the Franklin Institute. ■



Speakers and topics

THE SEMINARS

Without regard for the time or specific location, the seminar sessions are described briefly here. The categories into which they fall are Management Information Systems (MIS), DP Management, DP Education, Hardware, and Software.

E. R. Dickey, manager of Consultant Relations, EDP Div., Radio Corp of America, will discuss "Management Information Systems—Opportunity and Challenge for the Data Processing Manager" at this MIS seminar session. Mr. Dickey will explain his basic tenet that "systems" in a very real sense "manage," or are capable of managing, many aspects of the business operation. He will also discuss the working relationship of the data processing manager and management in arriving at a true definition of the problem. In the shape of things to come, management will be done by system, and decision will be left to man. Allen C. Dyer, manager, MIS, Baker Oil Tool, Los Angeles, also will address the session.

Robert J. Rossheim, program manager, Auerbach Corp., will explore "The Next Plateau of File Organization" by tracing the evolution of business data organization from its earliest days to the coming generation of systems. Examples will be given of data base organizations which utilize

a full range of storage devices, including large core memories, drums and discs, data cartridges and mag tape. Techniques of data maintenance, random inquiry, and serial file processing will be described. The relationship of the data base organization to COBOL and JOVIAL programming systems also will be shown along with the design and use of directories, logical position codes and list structures.

Allen Hoffman, Frankford Arsenal, Philadelphia, will discuss "Hardware Considerations for a Management Information System." The presentation will concern problems associated with the structuring and operations of management-type systems. A discussion of hardware aspects from the standpoint of the state of the art, and a projection of future requirements will round out the session.

Vincent Bannan, manager of Management Sciences, RCA, will discuss "Putting Management On-Line." Comments Mr. Bannan, "The complexity of present day industrial concerns testifies to our diligent use of specialization as the answer to the growing complexity of the business community . . . While specialization increases the power that can be applied to problems, it splinters the authority to adapt to a changing environment and to seize new profitable opportunities." he contends. "The computer, and specifically on-line management, I believe, will swing this pendulum of diminishing authority back to management." Other panelists will include J. F. Dudas, manager, Technical Operations, Tele-Computer Center, Westinghouse Electric Corp.; Richard McClain, manager, Manufacturing Marketing, Burroughs; and Bruce Taylor, vice-president, Blue Cross of Greater Philadelphia.

Questions on simulation will be aired by John A. Buckland, manager of Technical Support, Univac Div. of Sperry Rand Corp., at the "Value of Simulation and Mathematical Modeling" session. What are models? Why is Monte Carlo simulation important to studies of corporate plans? Where is simulation used in the management process? Are the new computer techniques of Monte Carlo using general purpose simulation languages profitable in simulation analysis? Examples of successful simulation models will be shown along with the limitations of the technique. H. Wayne Nelson, manager, Management Sciences, Burroughs, also will speak.

Bernard B. Goldner, director, School of Creative Thinking, LaSalle College, Philadelphia, will guide participants to greater improvement in the use of mental skills and creative thinking at the seminar, "How to Apply Creative Thinking to Systems Work."

Management Information Systems apply new software requirements to the data processing centers supporting them. In addition to the usual programming standards and automatic programming techniques, the integrated operations necessary require new operating system concepts and file maintenance systems in support of MIS. These topics will be discussed by Neil Gorchow, director, System Programming, Univac, at "Software Considerations for Management Information Systems." Other topics will include operating systems, hierarchial programming systems, special languages for file update and retrieval of information, software support of display and communications subsystems.

Recent advances in the development of computer organization and processing techniques will be reviewed by Gerard Salton, assistant professor, Applied Mathematics, Harvard Univ. Computation Laboratory, and S. E. Furth, IBM, at the "Information Retrieval in Management Information Systems" session. Considered in particular will be modern multi-user computer systems and time-sharing environments, and new methods for the automatic analysis of information by statistical and structural methods. The effect of these developments on the construction of automatic information retrieval systems, automatic technical centers, and automatic question-answering systems will be evaluated. An estimate will be made of the kind of retrieval system likely to be available in the near future.

"The programmer of the 1970's will either be a highly trained computer scientist on the one hand, or a person highly trained as a manager, organizer, or investigator in some social, scientific or engineering field. In either case, the change from the programmer of today will be a high-marked one. Most of his effort will be of a non-numeric deduction and inductive nature." This forecast of "Programming in the 1970's" will be enlarged upon by John W. Carr III, associate professor, Electrical Engineering, Univ. of Pennsylvania, Philadelphia. At this same session (a panel discussion), R. F. Clippinger, EDP Div., Honeywell, Inc., will discuss the economic aspects of the art. Mr. Clippinger predicts that the cost of on-line integrated data processing is receding and will be low enough by the 1970's to become quite popular. The third speaker at this session will be R. R. Hench, manager, Advanced Computer Projects Operations, General Electric Co.

At the seminar, "Management Information Systems—Audits and Controls," Peter D. Louderback, Peat Marwick & Mitchell, Philadelphia, will discuss specific methods in relation to their general use in modern mangement systems. Many of the techniques of controlling computer and punched card processing will be reviewed. Similarly, the control of data recorded on various types of mass storage devices will be reviewed along with reflections on the future needs for audit and control of information systems. A discussion of problems likely to develop with the sophisticated equipment of the future will conclude the seminar.

A discussion on the necessity for an overall master plan and the requisites for all phases of planning from the point of conception to surveillance of the system will be delivered by R. D. Pash, chairman Industry/Professional Council, EDP Div., Honeywell, Inc., at the "Design and Implementation of the Management Information System" seminar, another panel session. At this same seminar, Norman Statland, Manager, Business Information Systems, Auerbach Corp., will explain the steps that must be followed in designing and implementing an effective Management Information System, and Charles W. Neuendorf, president, Charles W. Neuendorf & Assoc., Washington, D.C., will outline, step-by-step, a program for providing today's and tomorrow's management information needs, emphasizing the economic factors.

dp management

"What's New in Network Planning?" At this session, R. L. Martino, president, Martino and Co., Philadelphia, will outline the resource allocation and scheduling procedure of a new technique called M.A.P. This method is applicable to a single project or to many projects simultaneously. The resources may be fixed, variable, or a combination of fixed and variable limits. There is no limit to the number of resource types or activities that can be handled.

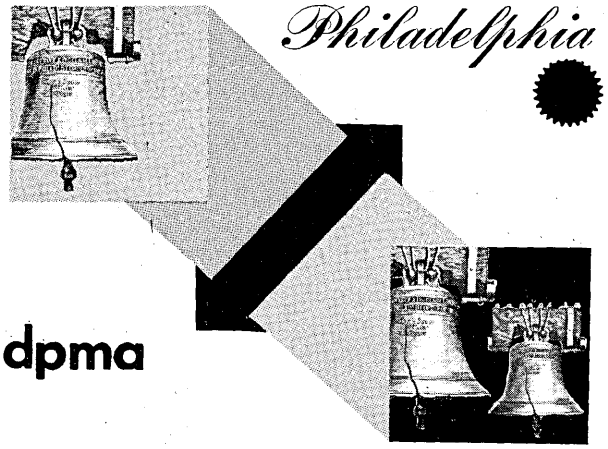
At the session on "Projection and Retention of Records," Harry V. Reid, manager, Veterans Administration, Data Processing Center, Philadelphia, and W. H. Hendriks, assistant vice-president, The Federal Reserve Bank, Cleveland, Ohio, will discuss the problems of protection and retention of storage media. Protection of historical data without incurring excessive expense, type of protection needed, security recovery programs, and legal and audit requirements will be discussed.

An authority on work measurement, E. R. Lind of the American Appraisal Co., Chicago, will explain how standards are established and maintained for keypunching, unit record equipment, and computer operations at the "Work Measurement in Data Processing" session. Such questions

as does work measurement pay? and how to control costs through work measurement will be answered.

Four subject areas—centralization of data capturing functions, programming, systems analysis, and hardware—will be discussed by a panel at the "Centralized vs. Decentralized Operations" seminar. Considered in each area will be factors involved in costs, responsiveness to the customer, effect of total information systems planning and systems standardization. The panel will consist of Thomas Dames, chief of Automatic Data Processing, Computation Agency, U.S. Army Electronics Command, Fort Monmouth, N.J.; Thomas O'Connor, director of Data Processing, New York State Office of General Services, Albany; Frank S. Powell, manager, Data Processing, Atlantic Refining Co., Philadelphia; Bernard Ziessow (moderator), manager, Operation Accounting and Data Systems, Engine and Foundry Div., Ford Motor Co.

"Minimizing Conversion Problems"—this seminar should be of particular interest to managers faced with a conversion from manual or punched card methods to computer operation. Edward Shefer of Arthur Anderson & Company, New York City, will discuss time and cost factors, unforeseen problems, personnel reactions, relocation and retraining of personnel, and other conversion topics.



"Scheduling for Optimum Computer Utilization" will find Philip A. Doherty of Cresap, McCormick & Paget, New York City, and Monroe Fein of the IIT Research Institute, Chicago, discussing the importance of scheduling to obtain maximum efficiency and minimum cost when using a computer. The allocation of time for program testing and debugging, scheduling for current production, future workloads and unforeseen contingencies, and responsibility for determining schedules also will be discussed by these two men.

Thomas Cooper, IBM Corp., White Plains, N.Y., and Arthur Geilfuss, Univac, will let participants in on "What's New in Punched Cards." Discussed will be innovations in pre-processor card file preparation and various methods of processing. In addition, special emphasis will be placed on card file validation, editing, arranging and maintenance. New small card-processing systems, application comparisons and parallel advances in programming will be explored. A review of multi-file input utilization, high-speed card file maintenance during processing and dual processing techniques used to optimize solutions to problems will round out the program.

W. Howard Gammon, assistant to the director for ADP, National Bureau of Standards, Washington, D.C., will summarize experience in alternative ways of "Organizing for Computer Operation," emphasizing practices used in various government departments. Mr. Gammon will distinguish between the practices used in organizing for business type data processing operations and those of a scientific nature.

An evaluation of the computer as a tool in cost reduction will be theme of the "Savings Through Computer Operations" session. Douglas J. Axsmith, McKinsey and Co. Inc., New York City, will evaluate the computer as a tool in cost reduction. Mr. Axsmith also will answer questions: Do computers pay for themselves? How long does it take before a computer saves money? Can values be placed on applications? What are the intangible benefits? How should computer costs be distributed?

Methods of measuring the effectiveness of programs and programmers will be taken under discussion by Gregg Dillon, data processing section manager, Treasurers Dept., E.I. DuPont de Nemours Co., Wilmington, Del., at the "Evaluating Programs and Programmers" session. Have any advances been made in this direction? What are the techniques used? Can these be applied to both scientific and business programs?

"The Effect of New Tax Reporting Laws on Data Processing" will be discussed by Robert A. Scudder, director of sales development, Standard Register Co., Dayton, Ohio. Anyone now preparing 1099, W-2, 941 A or state unemployment forms should be interested in this session.

Can a computer installation hope to grow without top management support? How does the dp manager obtain top management support? What does management want to know about computers? How do you teach management about computers? This session—"What Top Management Should Know About Data Processing"—has been designed to supply participants with the tools to gain management's ear . . . a sound program for management education. Albert Kushner of Cresap, McCormick & Paget, New York City, will lead the discussion.

Why isn't the dp manager a part of the management team? Why aren't more dp managers promoted into management positions? These are some of the subjects to be discussed at the seminar—"Today Data Processing—Tomorrow Top Management." The session, led by Robert A. Samans, IBM, Philadelphia, will stress the importance of reducing the secrecy surrounding the dp department and the importance of educating management to recognize the value of the department and its manager.

dp education

Frederick B. Cornish, consultant, Ernst and Ernst, Philadelphia, will conduct a seminar on "Educating the Data Processing Employee." The seminar is designed to show participants how proper training of subordinates can be as big an asset as properly training oneself. This session will be moderated by Dan Andres, instructor, Moore School, Univ. of Pennsylvania, Philadelphia.

Closely in line with the above, a panel of educators will discuss "The Educator's Role in Preparing Professional Data Processors." Discussing the functions of the various types and levels of dp educational courses will be: Dr. J. McGinnis, director, Computation Center, Drexel Institute of Technology, Philadelphia; William E. Wadsworth, vice-president, Automation Institute of America, San Francisco; Joseph Paul, coordinator, Peirce Jr. College, Philadelphia; and Dr. C. Taylor Whittier, superintendent of Public Schools, Philadelphia.

Another educational session, "The DPMA Educational Program," will be conducted by Jerome W. Geckle, international vice-president—education, DPMA, and James M. Adams, educational director, DPMA. Messrs. Geckle and

Adams will present the current status and future directions of the efforts of DPMA, including the CDP, Future Data Processors, Executive Seminars and new DPMA programs in preparation. Open discussion will be held on educational needs and professional goals of the association.

advances in hardware

A session on "Advances in Computer Design" will answer such questions as: Why is computer design important? Does it affect data processing efficiency or is it just for convenience of manufacturers? How do these advances increase throughput and dp costs? What new designs have been implemented—what new advances are foreseen for the future? W. R. Lonergan, manager, Product Planning, RCA, will lead discussion.

"Advances in Input-Output Devices" will be reviewed by Irving I. Solomon, Management Services, Ernst & Ernst, New York City. Applications of a general nature as well as some specific industry-oriented systems will be reviewed. Comparisons will be made of the efficiency, accuracy, control problems and implementation requirement of this type of equipment.

Important considerations in selecting a new computer system, including systematic techniques, will be discussed at a session entitled "Hardware Evaluation." Availability and expandability of the equipment, scope and performance of supporting software, maintenance and back-up provisions will be among some of the topics discussed by John R. Hillegass, program manager, Auerbach Corp., Philadelphia.

A Bell Telephone System Panel consisting of four speakers will discuss various aspects of "Data Communications in the Design of Management Information Systems." Subjects to be covered include, low and medium speed data transmission, the evolution of dp data transmission, MIS as seen within the Bell System, and a look into the future.

A session on "Random Access Storage Devices" will include a survey of the latest storage devices offered with computer systems. A panel of experts will present the common characteristics of the three different categories of random access devices and the unique features of all those currently available. Attempts will be made to answer the questions: Why use random access? When and how to use random access? Who can use random access? The panel will consist of Howard J. Jacobs, staff specialist, RCA, San Francisco; Kimfield G Parks, Burroughs Corp., Detroit; Clarence Poland, IBM Data Systems, Poughkeepsie, N.Y.; and H. E. Staehling, product manager, Real-Time Systems, Univac.

"Optical Scanning—Developments and Applications." Discussed here will be equipment performance, economics, systems implications and design criteria of optical character recognition as a method of input to computer systems. R. E. Nelson, manager, Systems and Programming, The Readers Digest, and J. Rabinow, president, Rabinow Electronics, Rockville, Md., will discuss existing optical scanning techniques with special emphasis on future thoughts and developments.

advances in software

"An Introduction to Programming Languages" will begin with a survey of the motivations for using higher-level languages such as FORTRAN, COBOL and NPL in contrast to SPS or Autocoder. The survey, conducted by Daniel D. McCracken, president, McCracken Associates, Ossining, N.Y., will explore the variety of reasons for using higher-level languages. There will be a brief expository discussion of FORTRAN, COBOL and NPL, emphasizing the advantages of each and pointing out the differences. The presentation will conclude with an estimate of the future acceptance of new languages.

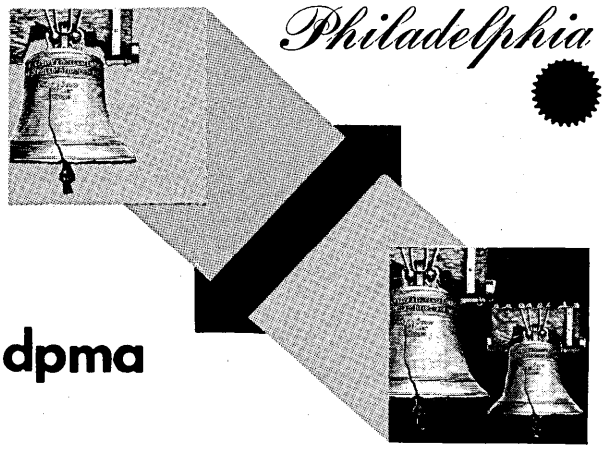
What is COBOL? Is it truly a universal programming language? Has it been successful? Are any changes forthcoming? How is it used? What methods are available for evaluating it as opposed to specific manufacturer's program languages? What effects will NPL have on COBOL? Answers to these questions and many more will be forthcoming at the session titled "COBOL—Help or Hindrance," a panel discussion. Howard Bromberg, C-E-I-R, Inc.; Vico Henriques, Div. of Standards, BEMA; Jack Jones, assistant vice-president, Southern Railway; Bob Roundtree, G.S.A., Washington, D.C.; and Dick Brandon, president Brandon Applied Systems, will comprise the panel.

"NPL," IBM's new programming language, will be up for discussion at a special seminar session. William Altman, of IBM's White Plains headquarters, will attempt to answer the questions: Why another language? Specifically, what is NPL and what will it do? Is it only for IBM equipment? When will it be available?

J. P. Mullin, RCA manager of Management Sciences, and Benjamin A. Dent, manager, Sciences Systems Development, Burroughs, will lead a discussion on "Operating Systems." Operating systems, although not new to the industry, are receiving much attention lately. This session will examine advantages and disadvantages . . . what to look for in an operating system.

A session led by Morton C. Jacobs, Millman and Jacobs, Philadelphia, will acquaint the computer programmer and user with the advantages of "Legal Protection for Computer Programs" and the problems associated with obtaining such protection. Simplified explanations of what patents and copyrights are and the procedure for obtaining registrations will be included.

"Decision Tables for Systems Design" will be discussed by a panel consisting of Donald Devine, systems engineer, Insurance Company of North America; Burton Grad, IBM, White Plains; H. I Meyer, United Gas Company,

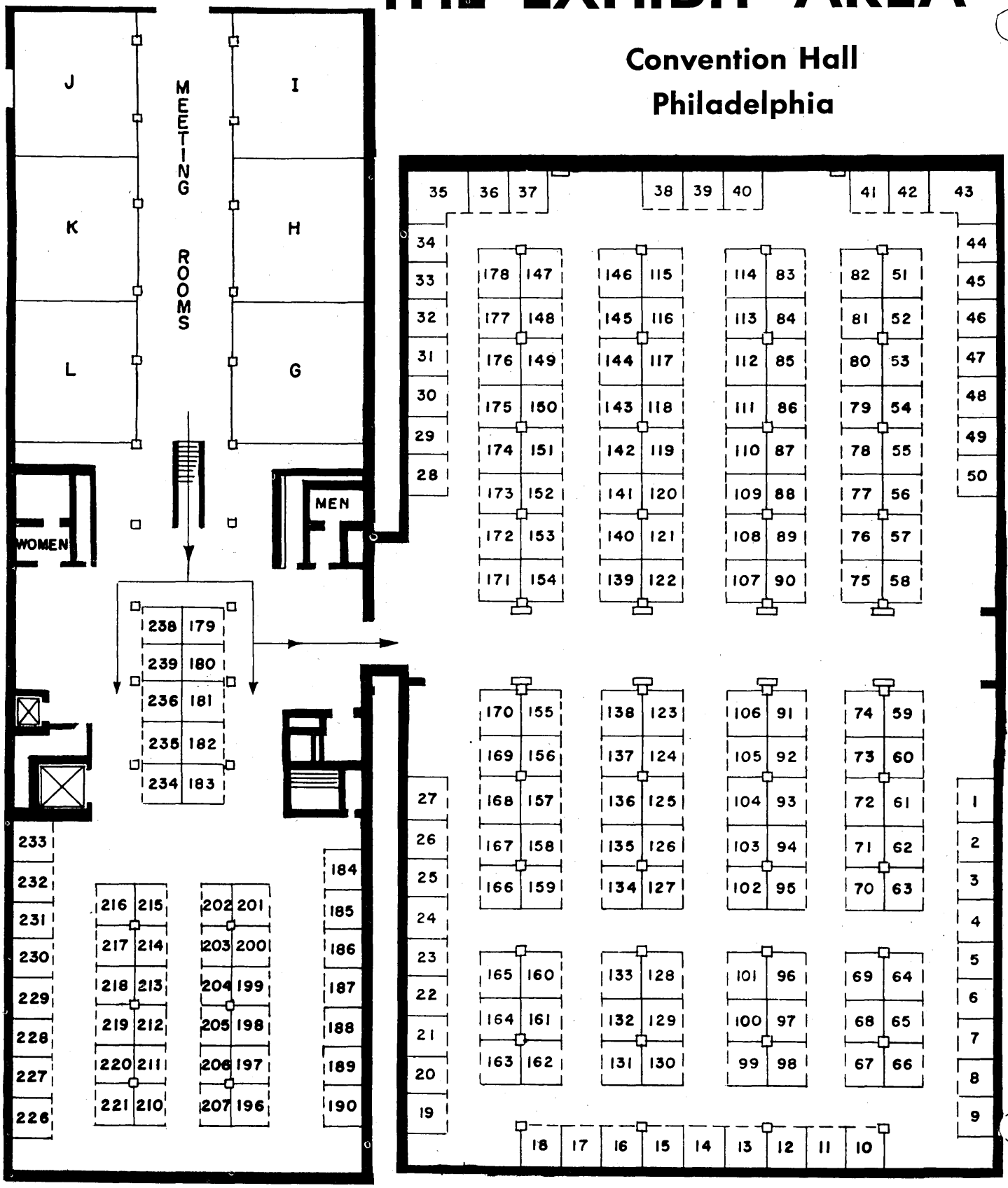


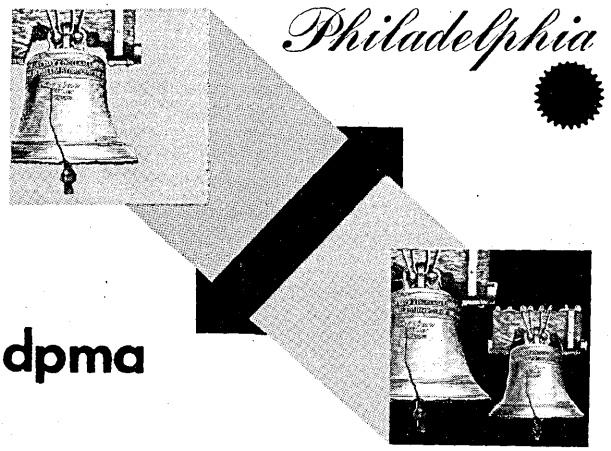
Shreveport, La.; and S. L. Pollack, North American Aviation. The structure of decision tables—extended and limited entry—their use as a systems design tool and as a programming language will be explored, and a number of applications and decision table implementations will be reviewed and evaluated.

S. M. Naftaly, senior technical specialist, Lockheed Aircraft, will discuss, "Application Languages" and in particular the meta-language, XPOP, and the means it provides for overcoming the problems associated with language implementation. Mr. Naftaly will go on to point out the value of and the place for programming languages oriented toward particular applications in the business data processing shop. ■

THE EXHIBIT AREA

Convention Hall
Philadelphia

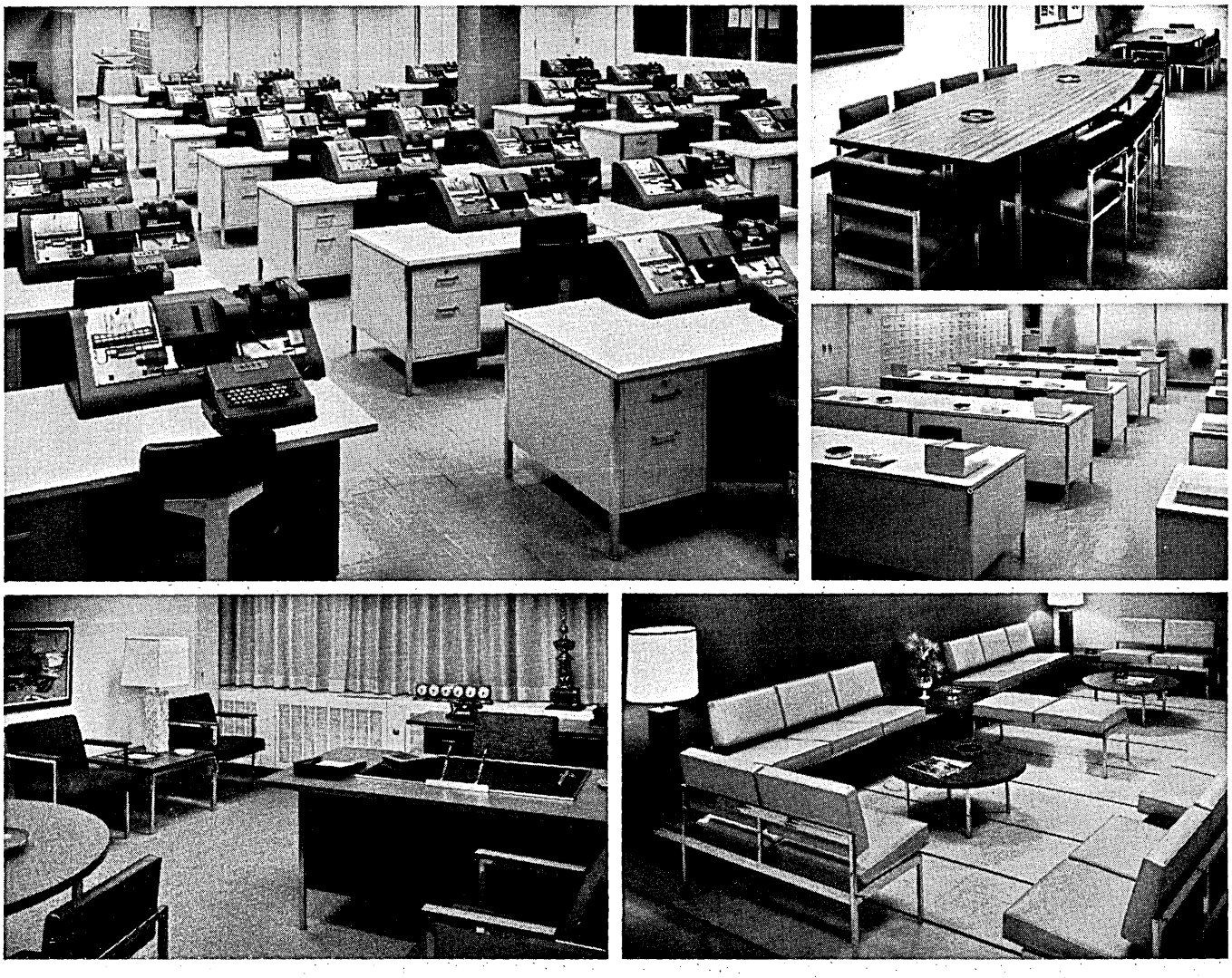


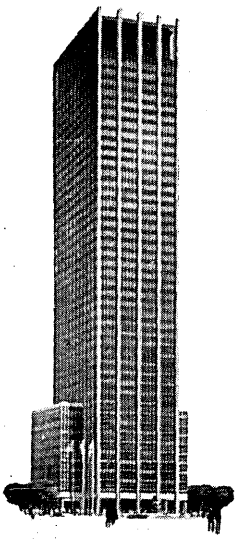


THE EXHIBITORS

■

We go farther than the DP department





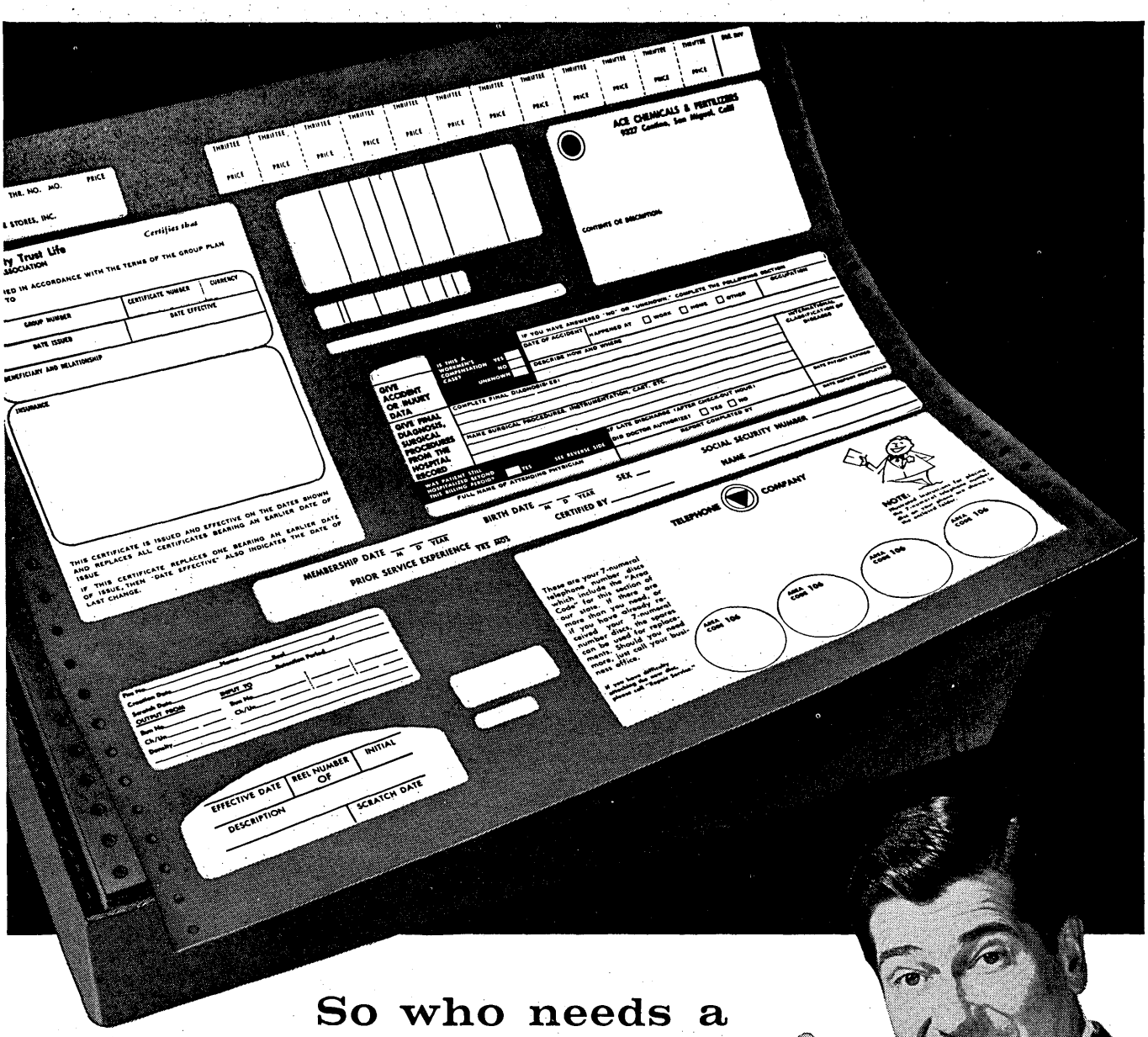
Steelcase/Datacase recently furnished offices in J. C. Penney Company's new 45-story headquarters building in New York

Data processing department, executive offices, general offices, reception areas —almost any place you look in J. C. Penney Company's handsome new building, you'll see furniture by Steelcase/Datacase. All perfectly coordinated in design, color and function—and so durably constructed that the entire office complex will retain its fresh appearance for years. Your local Steelcase/Datacase dealer offers you a broad choice of furniture and data processing auxiliary units. And, he delivers, installs and services quickly and knowledgeably. Call him, he's in the Yellow Pages. Or, write Dept. D, Steelcase Inc., Grand Rapids, Michigan; Los Angeles, California; Canadian Steelcase Co., Ltd., Don Mills, Ontario.

DATACASE®/BY STEELCASE

OFFICES AND SHOWROOMS: NEW YORK • CHICAGO • GRAND RAPIDS • ATLANTA • DALLAS • LOS ANGELES • PHILADELPHIA • PORTLAND, OREGON • TORONTO • MONTREAL

CIRCLE 20 ON READER CARD

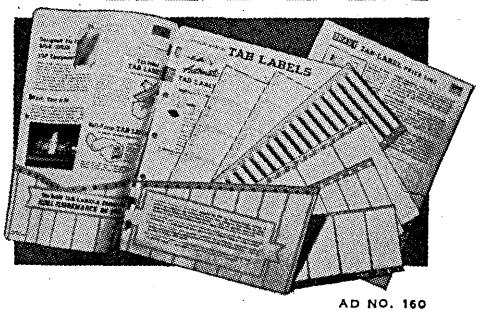


So who needs a Tab Label setup like this?

Probably no one! But your program for total computer utilization *will* require made-to-order pressure-sensitive Tab Label forms of different sizes, shapes, colors, wordings . . . and in some cases, grouped with two or more *different* labels in a Multi-Tab "set."

The point is: When you need Tab Labels of *any* description made to your specifications, see Brady first . . . for complete self-adhesive Tab Label engineering, manufacturing know-how and (oh, yes!) down-to-earth price.

Blank Tab Labels? We have them, too. Half-a-hundred stock sizes and styles in both fanfold and rolls.



See us in Booth 169 at the D.P.M.A. Show!!

Get our big, new bulletin and samples free for the asking. Write

W.H. BRADY® CO.
EST. 1914

745 W. Glendale Ave., Milwaukee, Wis. 53209 • Phone: (414) 332-8100 Teletype: 414-964-4814 Telex: 026-677 Cable: BRADYCO

Manufacturers of Quality Pressure-Sensitive Industrial Tape Products, Self-Bonding Nameplates, Automatic Machines for Dispensing Labels, Nameplates, Masks and Tape.

AD NO. 160

CIRCLE 21 ON READER CARD

approaches to tailored systems

WHAT'S SO HARD ABOUT SOFTWARE?

by FRANK P. LAMBERT

More and more, current technical literature is expounding on the various aspects of software characteristics and performance. This mass of technical data is, in itself, indicative of a shifting focus in data automation research and a growing recognition of the impact of software on total system performance. Previously, conversational points of reference in round table discussions have been such things as "nanosec" storage, modular expandability, "black box" conversion, and speed ratios of I/O components. The current trend of discussion groups is to kick around such things as the efficacy of oscillating sorts, parameters of monitor/executive routines, parallelism, time-sharing, and the pros and cons of procedure and problem-oriented languages.

This conversational trend is understandable. The mystery of the flashing lights on the console has gone. Moreover, all major computer manufacturers are producing reliable hardware configurations with comparable speed, capacity, and circuitry logic and can propose a good configuration mix to handle a scientific computational system, a complex management system, or a real-time system, with equal ease. With the hardware state-of-the-art on a temporary plateau (I suspect there will be some dissenters to this statement), it is natural for investigators to turn toward greener pastures and more pressing problems.

In turning toward these more pressing problems, computer manufacturers, spurred by customer needs, have taken the initial step. Recognizing that customers are now more interested in ease of programming and program conversion than add time or cycle time, a concerted effort is being made to satisfy this need. Announcement of a broad spectrum of software now goes hand in hand with hardware announcements. Concurrently, both industrial users and government agencies are performing a considerable amount of independent software research. There are many excellent professional papers dealing with compilers, source and object programming packages, library routines, multiprogramming, and parallel processing techniques. Most of these, however, are slanted in the direction of one selected software function. The interrelationship between software functions and the dependencies on hardware configurations or environmental conditions are not adequately treated. The findings are informative and invaluable as they pertain to the specific area, *but* and this is an important *but*, they do not provide a set of values for assessing the impact of software on the totality of system effectiveness.

Mr. Lambert is head of the Software Group of the EDP Equipment Office of the Electronic Systems Div., AF Systems Command, Bedford, Mass. This is the centralized agency for selection of computers for the Air Force. In dp since 1955, he has been engaged in programming, systems analysis, and management positions. He has a masters in counseling psychology from Boston College.

defining terms

"The impact of software on the totality of system effectiveness": this is a general statement of a basic concept. Let me get more specific and define the terms as I see them. "Software" can be defined as the total set of programs designed for and used with a particular set of computer hardware to extend the capabilities of the hardware in the performance of system processing. "Totality of system effectiveness" can be defined as the optimum use of men, equipment, and time toward the accomplishment of system objectives. I am using optimum in the sense of a predetermined level of expectancy based on a range of requirements and economic factors. Now let me re-examine this concept and apply it to a real life situation.

A computer evaluator, for example, is faced with this problem every day. He must attempt to measure the degree to which compilers, sort generators, monitor/executive routines and diagnostics *interacting* together within the framework of a proposed configuration extend the capabilities of the personnel and the computer in the accomplishment of a particular data automation task. It is in this context that the computer evaluator sadly shakes his head at the question, "What's so hard about software?" and responds, "Everything."

This is not pessimism but a realistic appraisal of the scope of the problem connoted by the phrase *"interacting together within the framework of a proposed configuration."* When he looks at a compiler, he recognizes that he cannot evaluate it as a discrete software package with discrete characteristics such as speed of compilation, core storage requirements, object program speed, etc. True, the evaluator can get quantitative data in these areas and he can compare one vendor's compiler versus another in terms of the discrete measures. Further, on the basis of best judgment, he can assign a weighted value to these characteristics and accumulate them into an additive index. But what would the evaluator have? How meaningful would such an index be and how valid a measure for predicting comparative software capabilities? At most he would have an additive sum of singular value.

This total would be of doubtful validity since many of the elements have a factoral effect on the total software value. To expand on this factoral effect, one has only to look at the difficulties of determining tradeoff values between a slow compiler with good diagnostics and a fast compiler with minimum diagnostics. A similar situation exists in evaluating tradeoffs of library routines versus hand-coded routines, of simple IOC systems versus complex monitor/executive systems. Anyone who has struggled with the evaluation of software would agree with the situational problems indicated above and could, in fact, double or triple the examples given.

defining software needs

I do not think, however, that the situation need be as grim as I have pictured it. Two basic deficiencies contribute to our present predicament, both of which are curable to some extent. The first deficiency is lack of well-defined requirements. We need to analyze and define system and user requirements as they relate to software with as much thoroughness as we describe system requirements in terms of hardware.

For example, we inform the vendor of the parameters of system data files so that he can estimate the amount of computer storage components required to hold this data. We rarely provide enough data on the expected magnitude of our programs for him to evaluate in terms of his compiler limitations. We inform the vendor of the system responsiveness requirements so that he can propose components with speeds adequate to meet our criteria. We rarely provide information relative to levels of programming skills available or levels of diagnostics and debugging procedures considered necessary. In other words, we either do not attach sufficient importance to a definitive set of requirements which specifies the system/user environment in terms of software or we just don't know how to identify and express these factors.

The second deficiency is lack of flexibility in compilers and other software programs proposed for a given equipment configuration. The basic design criteria of a compiler can take one of several directions but cannot go in all directions at once. You cannot have a fast compiler with full diagnostics and an optimized object program operating within a minimum amount of memory. Something has got to give. Here is where the vendor has to make a criteria tradeoff decision. In addition to the above, he must also consider the hardware characteristics and circuitry logic of the configuration for which the compiler is planned. What is the result of all this? Optimistically, it is a specific hardware configuration-oriented compiler which the vendor proposes to satisfy all requirements of all customers. Realistically, it's pretty sure to lack what some customers need most and provide too much of what some customers need least. This same principle applies to sort generators, report generators, monitor/executive systems as well as compilers.

optimum software support

To say that these two considerations alone constitute the software problem would be an over-simplification. It can be said, however, that we will never attain optimum software support for a particular user/system environment until the inter-related pattern of requirements is more clearly delineated and the software system provided is hand tailored accordingly.

To accomplish the first objective, the user must carefully analyze such factors as competence levels of programming manpower and translate such levels into qualitative specifications of diagnostic routines and source programming language. He must also assess workload differentials and establish such relationships as the ratio of compiler workloads to object program workloads. This analysis will provide a base for determination of the comparative value of fast compiler time versus fast object program running time. In the same manner, other software packages such as report generators, sort generators, and monitor/executive routines should be thoroughly investigated and a set of values established on a judgmental basis.

With such a picture of the user requirements and the corresponding set of values, the vendor is in a good position to evaluate the adequacy of his available software. This does not mean, at this point, that the vendor can provide better software but merely that he can evaluate his software against a set of definitive user requirements. This structuring of definitive requirements, however, represents the expression of a need or *demand* on the part of the buyer. We now have the proper climate for competitive action on the part of the computer industry to meet the demands of the customer.

Certainly, a review and analysis of software design criteria would be a first step. As a follow-on, compiler design structures should be investigated in terms of discovering an economic and effective technique for the development of variable compiler structures oriented toward different criteria patterns. I would like to emphasize here that I am not talking about modular software. Modularity, basically, provides up and down compatibility within families of computers and gives the customer additional "goodies" on the larger configurations. What I am talking about is an adaptable compiler which can give two users with exactly the same configuration mix a completely different

compiler subset based on different criteria patterns. One user needs the maximum amount of diagnostics while the second places a higher priority on an optimized object program. One wants a standard IOCS system while the other is more interested in library call routines, etc. Is it economically feasible to provide such custom-made software? Is it technically possible? I think the answer to both questions is "yes" and I suggest the following approach.

compiler design generator

Why not examine the potential of a compiler design generator, not for the generation of compiler instructions but for the linkage of the desired mix of compilers' subroutines—a sort of meta-compiler. This meta-compiler or compiler design generator would operate on a large number of subsets of routines to selectively organize a compiler structure specifically oriented toward the user's design requirements. This design generator is a control program which manipulates a data base of subroutines and linkage. It would operate in accordance with predetermined specifications for diagnostics, tag tables, IOC control, etc. It would consider pre-established tradeoff values for compile time versus optimization of object program. How far can we go? I don't know.

It should be added that in proposing this approach, I am aware of activities directed toward making compilers more adaptable. Applied research in the development of syntax-directed compilers and the availability of optimization options in some FORTRAN compilers are certainly a step in the same direction. These are, however, evolutionary; but the situation requires revolutionary tactics. Conceptually, the proposed plan, if successful, would provide the user with ideal software support. In fact, with such a generator, a heuristic approach to the operational use of compilers is possible. The user would have a second-guess opportunity after, say, a six-month tryout, or it might even be desirable to give him several compilers oriented toward different design criteria.

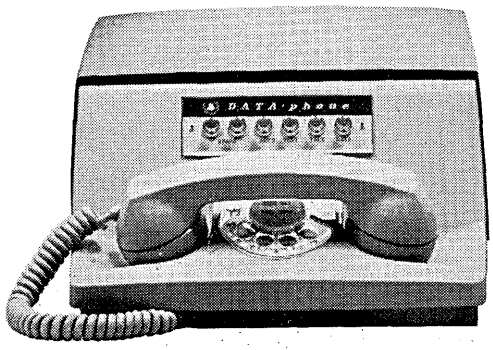
software vs. hardware problems

On the other hand, the magnitude of the technical effort involved, the stumbling blocks that will undoubtedly obstruct progress, and the costs to be incurred in supporting such a project will give rise to pessimism in some quarters. True, the proposed approach may not be the best answer, but at least let's recognize software as our biggest problem and the development of a flexible software system as our most critical need. While we still have hardware problems, the fundamental needs of the user are adequately satisfied. If he needs faster print-out he can get a 1000-lpm printer instead of a 600-lpm printer. If he needs an extra module of core, he just orders it. Special features—what does he want? The vendor will design it. This is the way it is in hardware. Why not the same for software?

In conclusion, with a little more foresight on the part of the user and a greater potential for adaptability on the part of the vendor, we shall have software tailored to the system/user environment. When this millennium has been reached, the evaluation of software will be a matching of potential against need. Further, it will be based on a set of values which realistically reflects what the user considers important to him. Then when they ask, "What's so hard about software?" the answer will be, "Nothing, just order what you want."

Color me hopeful. ■

10 cps
250 cps
5100 cps
62,500 cps



No problem

Bell System data communications services can move your business data at a wide range of speeds; speeds that are compatible with your data processing equipment.

Transmission can be over regular or private-line telephone circuits, across town or nation, by day or by night.

Data communications services can add new scope and usefulness to your present EDP system, or to one you may be planning.

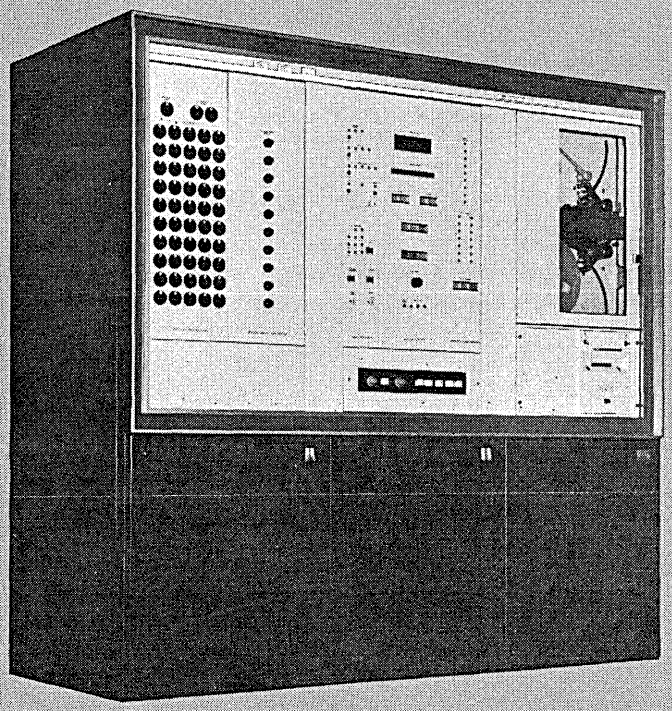
Discuss it with one of our Communications Consultants. He's a trained specialist in data communications. Just call your Bell Telephone Business Office and ask for his services.

Bell System
American Telephone and Telegraph
and Associated Companies

CIRCLE 23 ON READER CARD

SEL MAKES

SEL 600 SERIES DATA ACQUISITION SYSTEMS



- HIGH SPEED DATA ACQUISITION TO 220,000 SAMPLES/SECOND
- SLOW SPEED DATA LOGGING FOR LARGE INPUT CHANNEL CAPACITY
- DIRECT LOW LEVEL OR HIGH LEVEL INPUTS
- COMPUTER CONTROLLED RANDOM ACCESS SAMPLING

SEL 600 BASIC SYSTEM SPECIFICATIONS	
NUMBER OF CHANNELS	1 to thousands
INPUT VOLTAGES FULL SCALE	± 4 MV to ± 100 volts
ACCURACY	to ± 0.05% ± ½ bit
RESOLUTION	to 14 bits binary or 17 bits BCD
SYSTEM SAMPLING RATES	to 220,000 samples per second

SEL 600 OPTIONS

On-line reduction with SEL 800 computers
Computer programmable channel sampling
Computer addressable gain and offset
Quick-look displays
Auto self-test features

NOW YOU CAN PURCHASE TOTAL SYSTEM CAPABILITY FROM ONE SOURCE — COMPATIBLE ACQUISITION AND COMPUTER SYSTEMS REPRESENT THE ULTIMATE IN AN ENGINEERED APPROACH TO YOUR REQUIREMENTS FOR . . . . . .

OR MORE INFORMATION WRITE FOR THESE BULLETINS

9032 — SEL 810 General Purpose Digital Computer
9042 — SEL 600 Data Acquisition Systems
9056 — SEL 840 Scientific Digital Computer

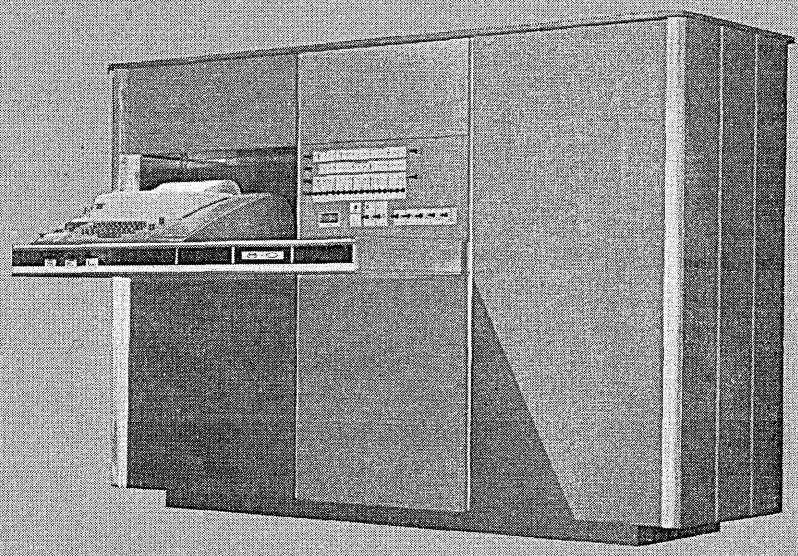
IMMEDIATE OPENINGS FOR LOGIC DESIGN ENGINEERS

SEL is an equal opportunity employer

BOTH ••••••••••••••••

SEL 800 SERIES GENERAL PURPOSE DIGITAL COMPUTERS

- ALL SILICON MONOLITHIC INTEGRATED DIGITAL CIRCUITS
- COMPLETE SOFTWARE INCLUDING FORTRAN IV COMPILER AND LIBRARY
- 1.75 μSECOND — FULL CYCLE TIME — FULLY PARALLEL OPERATION
- HARDWARE MULTIPLY, DIVIDE AND FLOATING POINT CAPABILITY



BASIC CHARACTERISTICS

SEL 810 COMPUTER	SEL 840 COMPUTER
WORD SIZE ..... 16 bits	WORD SIZE ..... 24 bits
STORAGE ..... 4096 words	STORAGE ..... 4096 words
Hardware multiply Included	Hardware multiply and divide included

Two independent I/O channels
Typewriter, tape reader and punch
Hardware index register and program counter
Complete software package for real-time applications

810 AND 840 OPTIONS

To 32,768 word core in main frame—all directly addressable
External drum or disc storage
Up to 8 I/O channels
Up to 6 direct memory access channels
Any standard peripherals

- REAL TIME DATA READOUT IN ENGINEERING UNITS
- CLOSED LOOP DIRECT DIGITAL CONTROL
- INDUSTRIAL PROCESS PRESET CONTROL
- OFF-LINE GENERAL PURPOSE COMPUTATION

SEL

SYSTEMS ENGINEERING LABORATORIES, INCORPORATED

P. O. BOX 9148 / FORT LAUDERDALE, FLA. 33310 / AREA CODE 305 / 587-2900

CIRCLE 45 ON READER CARD

THE BUSH RAPID SELECTOR

by PHIL HIRSCH

A high-speed microfilm retrieval system that adds some new wrinkles to the state of the art has been operating for about a year at the U. S. Navy's Bureau of Ships in Washington. Known as the "Bush Rapid Selector" (after Dr. Vannevar Bush, formerly of MIT, who developed the basic concept and built the first model), the equipment scans a 6,000-ft., 60,000-frame reel of microfilm in 12 minutes and automatically reproduces on a second film those frames containing desired information.

There is a series of dots above each frame on the source microfilm; they identify the title, subject, author, and other indexing facts about the adjacent document. Material is retrieved by feeding into the Rapid Selector a dot pattern which contains the indexing information describing the item wanted. The equipment then scans each frame and when it finds a similar pattern, copies the image of the corresponding document onto the output film.

Like other retrieval systems, this one provides a means of locating documents automatically when the searcher has only a few clues. He may, for example, want information on a certain subject, but lack a specific bibliographic reference. The retrieval system, when fed the proper subject codes, will search the documents stored in the library, then locate and reproduce all those that fit the subject specifications.

The Rapid Selector at the Bureau of Ships is installed in the Publications Division; it was developed, under Navy sponsorship, at The National Bureau of Standards.

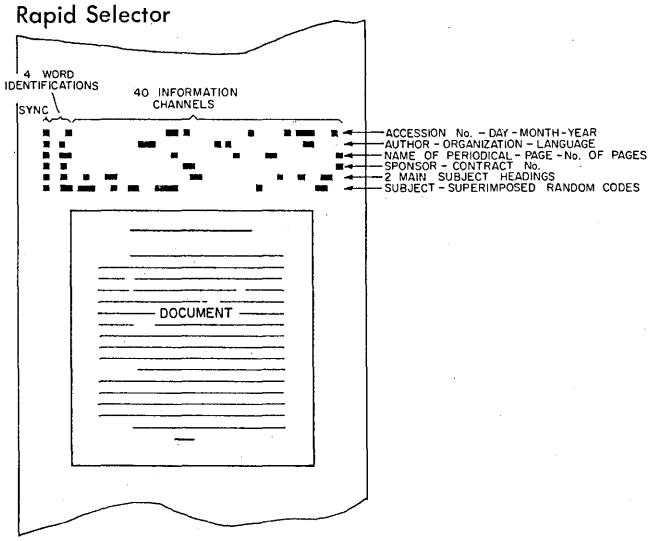
The Rapid Selector's microfilm library accommodates 3 x 5-inch cards, blueprints measuring up to 2 x 3 ft., and just about any document in between capable of being photographed. This is one feature that distinguishes the device from two commercially available microfilm retrieval systems—Recordak's "MiraCode" and FMA's "FileSearch." Both of the latter are designed for legal-size documents.

There is one other important difference. The Rapid Selector re-photographs "on the fly." No matter how many documents it locates and copies, the scanning operation doesn't slow down. MiraCode and File-Search, by comparison, stop scanning when they have found a desired document. They provide a "browsing" capability which isn't built into the Bush machine.

Actually, although all three systems operate in basically the same way, they aren't competitive because they're designed for different kinds of retrieval work. The real significance of the Rapid Selector installation at BuShips is that it expands the potential application of the microfilm concept, for government as well as commercial users.

The documents being put into the Rapid Selector's microfilm library include R&D reports, ship plans, ship specifications, and technical manuals. All of this material is photographed by a Photo Devices planetary camera. Normally, the film image is 1/15th the size of the original, but a maximum 20x reduction is possible. The microfilm picture provides a resolution of 120 lines per millimeter.

Code area of film for the Rapid Selector



Before being photographed, each document is read by an information specialist, who then codes the significant index facts on a mimeographed form. The coding operation consists essentially of assigning numbers to the document that stand for its date of issuance, security classification (e.g., classified, unclassified, secret), author, subject matter, and so on. The numeric equivalents for each item in this bibliographic profile are listed in previously-prepared guidebooks.

The codes are punched into an IBM card, which is then placed in a reading device connected to a set of lights located behind the microfilm camera. Essentially, this hookup converts the holes in the card into dots on the film. After the code has been recorded, the document itself is photographed.

A standard 35-mm acetate-cellulose base film is used in the camera. After processing, it is put through a Kalvar printer-processor and a second generation film copy is made on Mylar. The original becomes a master record copy and the Mylar copy is used for document searching.

Documents are retrieved by punching the identifying codes into an IBM card. The code card is fed into a reader which controls a photocell array in the Rapid Selector's search unit. The holes in the card produce a distinctive electronic pattern in the photocell complex. Any microfilm frame that has a similar dot pattern is automatically re-photographed onto the output film. This latter image is a third-generation (negative copy) of the original document.

A conventional 35-mm film, stored in 100 ft. lengths on daylight reels, holds the output. This film usually is processed by a commercial firm to obtain better control, although the Bureau of Ships has equipment to do the job itself. The copy film, after being processed, can be viewed directly, or reproduced onto paper, with the help of a microfilm reader-printer.

The Rapid Selector scans about 10 ft. of film—approximately 100 frames—per second. When a match is made, it takes about 12 milliseconds for the frame containing the desired document to travel from the reading head to the photo head. During this interval, the output film is accelerated from zero to a speed of 10 ft. per second. Thus, when the image is reproduced, although both films are moving, they are stationary with respect to each other.

Being able to copy a picture on the fly represents an important advance in the development of microfilm retrieval systems. With a large library of documents, used frequently, it could make possible increased utilization of equipment and film, and reduce capital and operating expenses.

It takes about 20 minutes for the information analyst to read, code, and photograph a document going into the Rapid Selector's microfilm library. The time required to search a 6,000-ft. reel is about 12 minutes. According to an estimate made a few years ago by the National Bureau of Standards, the total cost of the Rapid Selector's hardware is about $85,000. Operational costs were estimated at five cents per page for file input and three cents for each page retrieved.

The big data-storage capacity of the Bush machine may turn out to be its most important advantage: 77 characters, recorded in binary coded digit (BCD) form, can be accommodated on a section of 35-mm film ⅜ths-inch long. By comparison, the typical microfilm aperture card holds only 55 characters, and it measures 3¼ x 7⅜ inches.

Actually, there's no limit to the Rapid Selector's storage capacity. If the amount of indexing information related to a particular document is too much for one ⅜ths-inch code frame, it's a simple matter to appropriate additional frames when the document is under the planetary camera.

Abstracts, as well as entire documents, can be coded, microfilmed, and then retrieved by the Rapid Selector. The search can be programmed so that either abstracts, or documents, or both together, can be photo-copied on a single pass of the source film. This feature may make the Rapid Selector a more efficient retrieval system for many applications that now require a computer.

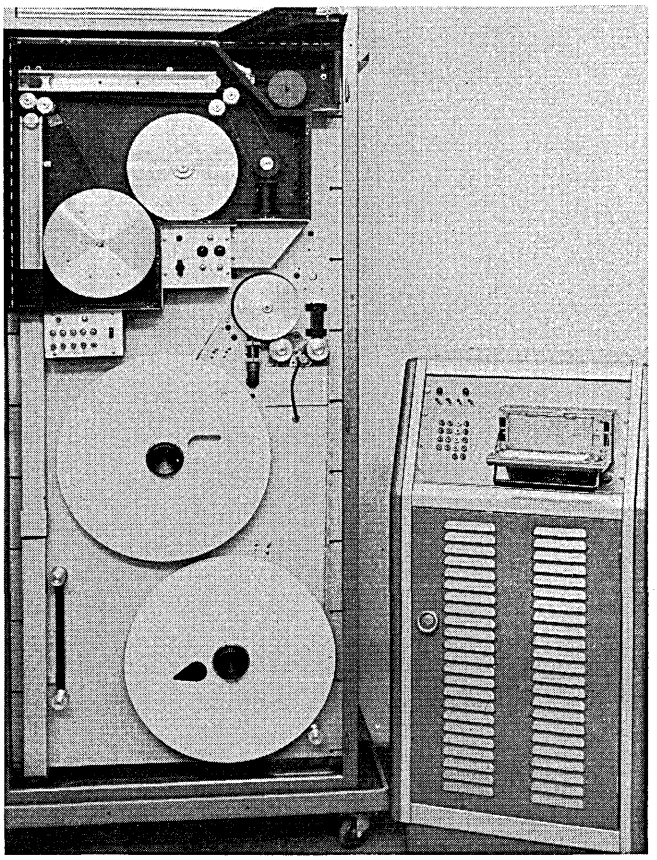
For example, various specialized libraries around the country have computers which can produce technical abstracts automatically. The data needed for the abstract is culled from the original document, translated into machine language, then stored on magnetic tape. When a request is made for information on a particular subject, the tape cycles through a computer and the pertinent abstracts are printed out on a high-speed typewriter.

The Rapid Selector probably could handle this job much more economically. Far less coding would be required because only a relatively few index terms, rather than every word of the abstract, would have to be put into machine language. The Rapid Selector equipment also costs far less than the computers now being used for information retrieval operations.

Another conceivable application involves commercial documents—such as invoices, business correspondence, freight manifests, and inventory forms. Now, many companies store such forms on microfilm and put the pertinent figures from each document on punched cards, paper or magnetic tape. The latter media provide the input for data processing. The Rapid Selector offers a way of telescoping these two kinds of storage into one.

In such a system, the input to the data-processing equipment would consist of microfilm, rather than punched cards or tape. The data needed for accounting operations would be in the code adjacent to each document. There would be a substantial space saving, possibly a considerable increase in data processing speed. ■

The Rapid Selector hardware



IBM vs REMRAND

part 2

by GEORGE SCHUSSEL

The different methods by which the two companies entered the computer field can be analyzed in terms of the internal effects on the companies. The organization problems that IBM faced were much simpler than those of Remington. Remington was faced with the problem of assimilating two different companies in different locations into a parent company that did not have qualified people in computers. Rand chose to sidestep the problem by running the companies, Eckert-Mauchly and ERA, as separate divisions that operated somewhat autonomously of each other and the parent. On the other hand, IBM had already been doing work in the area of computers and they had only to set up a department staffed with qualified people, whom they already had. IBM did have to hire many people, but they were directly hired into the main organization.

The results that IBM wrought from its setup were far superior. One comment, constantly heard in interviews, was that the interdepartmental communication at IBM far excelled that at Rand. The probability that a salesman's idea would end up on the drafting table was much greater than at Remington Rand.

There were some other inherent company differences that proved to be very important, not because of anything directly associated with computers, but because of the different histories of the companies.

One important contrast was the difference in inherited reputations. The record of reliability and customer service that IBM had built up was unequalled. This was more than just a small advantage for IBM, because in the year and a half that it did not have a computer to compete with the Univac, reputation was the only thing that IBM had to sell. IBM's salesmen were selling blueprints of a future machine while the Rand people were showing a machine actually working on problems. Because of prior experience with the company, many of IBM's customers contracted to acquire future IBM computers instead of the then available Univac. Had not IBM had an excellent reputation for reliability, it is obvious that they could not have marketed in this fashion so successfully.

In marketing, another inherited advantage for IBM was apparent—the large sales organization. IBM was built by Thomas Watson, Sr., who was first and foremost a salesman. Marketing was stressed very heavily and IBM's salesmen were comprehensively trained before they were put out into the field. Since IBM had been the foremost company in the area of data processing card systems, the computer fit right into the portfolio of these same salesmen. While Remington Rand had a good sales organization, most people in the field think that it was not comparable to IBM's.

Of course, the large and well trained maintenance staff that IBM acquired from its earlier days was just another phase of the marketing superiority mentioned above. A recurring complaint heard about early Univac installations was that RemRand simply did not have the people to keep its machines running. The better service organization that IBM did inherit made the transition into computer maintenance much simpler for it than it was for RemRand. The result was a superior setup at IBM for several years.

One other point often heard is that IBM had a superior research organization to draw on. While IBM had been doing research of sorts almost since its inception, until about 1951 the research work on computers that had been done by the Eckert-Mauchly division of RemRand was superior in quality and quantity. But as soon as its executives realized that the company was going into this area, people were brought in from outside to do research and engineering in vacuum tubes, cathode ray tubes, magnetic cores, and other computer elements. However, it is the opinion of people not associated with either company that through 1960 research work by Remington Rand (and then Sperry Rand) was of greater quality and quantity than that done by IBM. As a result, RemRand was able to offer the first commercial computer, the first computer to use core storage, the first commercial solid state computer, and the first thin film memory. This is an impressive list and although IBM is given credit for excellent engineering, up through 1960 it had not contributed as much to the advancement of the state of the art as had RemRand.

company policies

Company attitudes and policies also played an important role in the competition. It is not difficult to find evidence of IBM's attitude toward the product it was selling. It appears several times in statements by Thomas Watson, Sr., and it shows up clearly in IBM's defense against the antitrust suit that was brought against it by the Justice Department in 1952. The consent decree

that IBM signed in 1956, ending the antitrust action, required it to sell computer equipment as well as lease it. It had been an IBM policy to lease the computers because its managers did not feel that their principal business was making and selling calculating machines. IBM sold a service—a computing service. Their view was that a computer only had value for the service or function that it could perform. This function could not be performed properly without the full support of the IBM system, including setup, maintenance, programming, etc. Therefore, as IBM men reasoned, the machine by itself was useless and nobody should want it. Since most people did lease the computers, even when both options were available—as from RemRand—this policy itself did not really have a material effect. It was the attitude that led to the policy that was important, however. With every machine that went out from the IBM plant, the company attempted to deliver a complete computing service. IBM salesmen often stayed up all night writing out a company's payroll because the IBM computer was not working and the job had not been done. Although RemRand men attempted to provide the same service, they did not have sufficient personnel. This difference in service reputation spread through the business community rapidly and undoubtedly harmed RemRand's market position, relative to that of IBM, for several years.

As mentioned before, the research work that had been done by the RemRand company was fairly impressive in both amount and importance. However, Univac apparently had trouble prospering commercially from the innovations that the RemRand scientists made. This is a very interesting point and one which is hard to make generalizations about. Several case situations where the technical differences weighed heavily in the purchase decision were studied, and although these technical differences will be discussed later, a very interesting pattern that was seemingly one of company policy emerged from these studies.

Whether or not it was conscious company policy, there seemed to be a difference in approach. IBM, and this was especially true in government installations, would engineer their computer to the customer's needs. Although research had not been stressed, IBM's attitude toward their engineering was as pragmatic as their sales approach. On the other hand, the RemRand engineers would apparently attempt to engineer the customer's problem to the existing equipment at Remington Rand.[15]

This difference in attitude would often lead to a situation where the two companies would be competing for one installation and although the RemRand computer would have more uses and be able to do a much more thorough job of generalized computing, the IBM computer would be able to do the specific job that the company was interested in more efficiently than the Univac. At other times the IBM engineering staff would make special equipment, even for jobs that looked as though they were only one of a kind. The following cases, although slightly disguised, illustrate this point.

After Remington Rand had developed the Univac, the federal government decided to restructure the system that was used to make out government paychecks. The new system was to be computerized and since Remington Rand was the only one in the market with a computer at the time, it was invited to help set up the system. Bids were taken from all interested companies, but it was obvious that only RemRand had the necessary equipment to do the job. This particular application required a business type machine since the computer's principal responsibility would be to do the tremendous amount of sorting that would be necessary when the checks were cashed and returned to the government. Very soon after the RemRand engineers started working with the government in setting up the system, IBM completed the development of the IBM 702, which was IBM's first large scale business type of computer. It was competitive with Univac I but not generally considered superior to it. Even before they had completed work on the 702, however, the IBM engineers had already started work on a substantially improved version. This new model, the 705, was completed at about the time that the modifications on the payroll were ready for a computer. IBM bid for the installation and the government chose the IBM 705 over the Univac I, in spite of the fact that Remington Rand engineers had spent two years in working out the new system. The government lives in a glass house and its decisions have to be based on objective reasons. Here, cost was the applicable comparison.

Another government project required a card-to-tape conversion of about 1½-million cards per day. This job was a straightforward unordered storage of checks on tape. Remington Rand had a regular card-to-tape converter that could do the job at about 200 cards per minute. IBM had a comparable machine; however, their engineers sensed that this was a special job which did not need many of the features that were built into the ordinary installation. This problem required just numeric conversion; there was no need for the alphabetic conversion that both the RemRand and IBM machines provided. The IBM engineers modified their machine by installing a numbering head that automatically put a file number on each card, something that would have had to be done separately before the modification. By eliminating the superfluous alphabetic conversions they also managed to increase the speed of the card-to-tape conversion up to 450 per minute. Since this was the bottleneck of the system, the cost savings realized were substantial and IBM got the job, even though the rest of its equipment was in no way superior to Remington's.

These two cases are representative of the type of situation that arose over and over again. The RemRand equipment would often have extra sophisticated features that would recommend it highly for some job, but not the job under consideration.

The two cases also illustrate another point. IBM management felt that the ability to be able to react rapidly to a situation was all-important. In studying the IBM history one is impressed with the company's ability to do just that.

technical comparisons

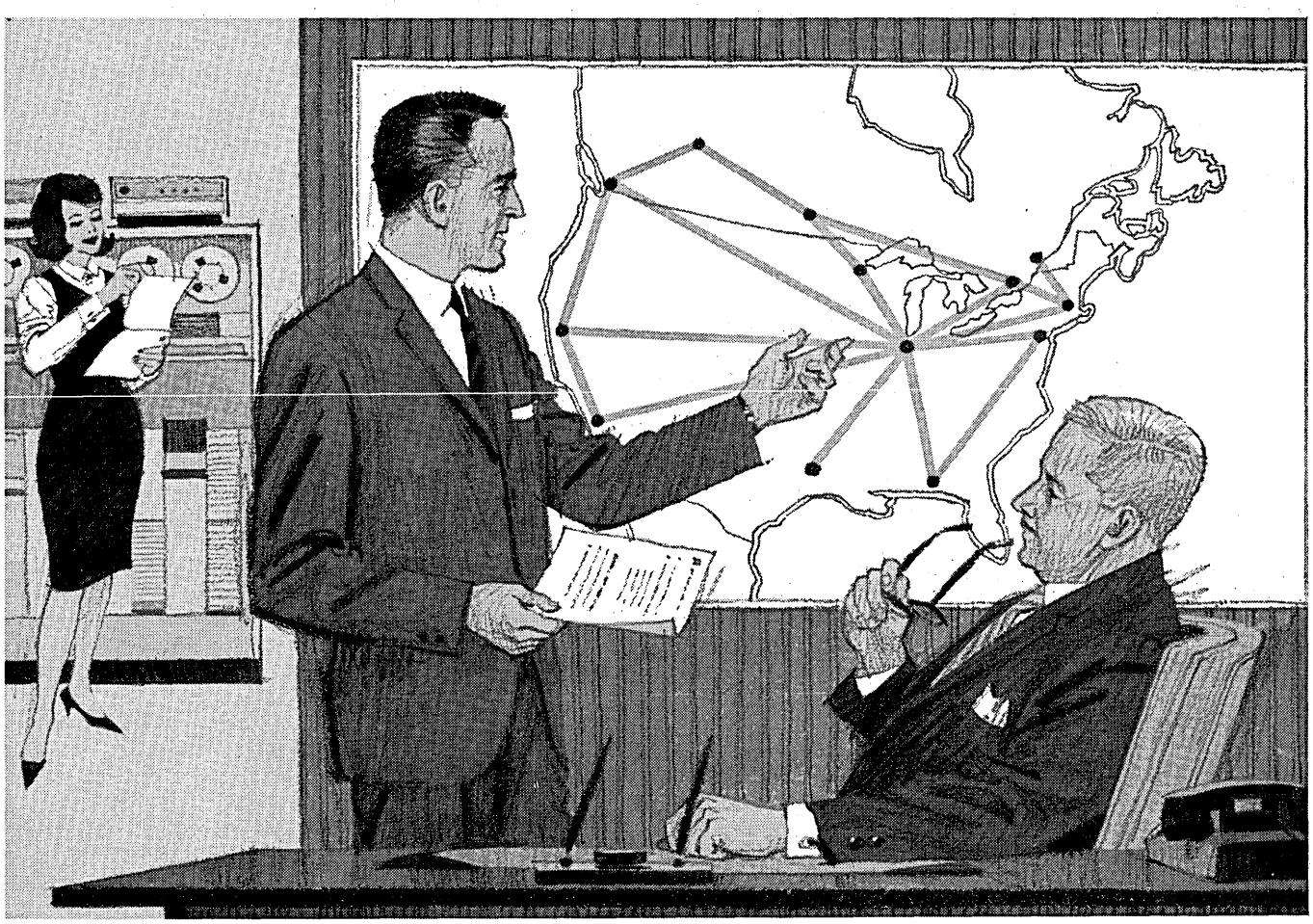
The technical differences between the computers offered by RemRand and IBM played an important role in determining the outcome of the competition. While the same type of problems could be solved on both the IBM and the Univac computers, IBM and RemRand had engineered differences into their models that made one or the other superior for various applications.

The Univac computers were superior in input-output speeds. One-tenth of the time on early computers was taken up in solving a problem while nine-tenths of the time was typically taken up by card input-output and printing. This time-consuming process was soon superseded by the use of magnetic tapes.

From the start the Univac I used tapes for input-output; however, the 701, while equipped with tapes,

[15] Necessarily this is a precarious generalization to make, so several people who had worked with engineers from both firms were interrogated about this point. This opinion was very substantially corroborated.

Looking for a **LOW COST** Data hook-up between head and branch offices?



Here's the unique cae Telepath* CODE TRANSLATOR

This low-cost unit that breaks the data transmission barrier between head and divisional offices is now in use with major telephone companies.

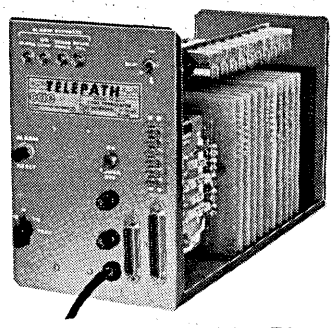
With a computer in head office and a Telepath Code Translator at each branch or divisional office, electronic data flows as freely as if each branch were computer equipped.

The Telepath Code Translator takes punch card data and turns it into teletype code for transmission. Or takes teletype code and feeds it as punch card data for the computer.

Integrating distant offices into EDP systems, CAE translators quickly repay their costs through increased utilization of expensive computers and more economical use of wire.

CAE Telepath data processing peripheral equipment is in wide use over the world: translators; selectors; supervisory, control and telemetry systems. **Fast delivery.** CAE translators are available *now* for adaptation to any data processing system, old or new. Our field experts in system analysis and design will recommend equipment that's exactly tailored to your needs.

* *CAE Registered trade name*



TELEPATH CT-512-X TRANSLATOR is an on-line device that receives 5-level serial data and transmits 12-level punch card data. Five-level serial code is taken directly from the line, translated to 12-level parallel code and fed to a business machine card punch. Or 12-level parallel code is taken directly from card punch, translated to 5-level (8 unit) serial code for direct transmission. Built-in power supply. Available for any transmission speed.

For full information write or call:

CANADIAN AVIATION ELECTRONICS LTD.

P.O. Box 6166, Montreal 3, Quebec, Canada. Phone 514-631-6781

in the U.S.: **ONEIDA ELECTRONICS INC.,** Utica, New York

CIRCLE 25 ON READER CARD

did not initially use them for input and output. IBM's tape drives were also inferior in quality and speed to the Univac's, so that even later when IBM modified the 701 to handle input and output through magnetic tapes, the system still was not comparable to Univac's. Input-output, while very important, is the only technical feature in which the Univac showed marked superiority over the IBM 701.

For high internal computing speeds, the 701 was far superior. On a typical operation the 701 would be about 3 to 10 times faster than the Univac.

TYPICAL COMPUTATION TIMES IN MILLISECONDS

	UNIVAC I	IBM 701
transfer	404	40
addition	525	45
multiplication	2150	450
division	3890	450

On problems that involved little input-output and much calculation the 701's speed made quite a difference in the cost of computing and so the 701 often was considered more desirable for scientific applications. For business problems, on the other hand, Univac had the advantage. IBM was competing with the 702, their first large-scale business oriented computer, which had an input-output setup similar to the 701.

The 701's fast internal memory was about twice the size of Univac's. IBM used an electrostatic cathode ray memory system that was not overly reliable and was very expensive to manufacture and maintain. The Univac, however, which used acoustic delay lines, was not much better. The access time on the Univac was from four to 20 times slower than that of the 701. However, users of electronic data processing equipment who were familiar with both systems feel that this difference in the memory systems was rarely a deciding factor.

With the delivery of the first IBM 704 in January of 1956, IBM took a large lead in the technical area. The 704 had much higher speed than its predecessor; it had a magnetic core memory, improved input-output, several other new features, such as floating point and indexing. From this date until the end of the 1950's, there is little question but that IBM's large-scale computers were better technically than their Remington Rand competitors. IBM followed up the 704 with the 709 in 1958 and the 7090 in 1959. Up through 1962 the 7090 was the most widely used large-scale scientific computing system in the world.

What happened to Remington Rand as far as the continuing development of their Univac I remains an enigma. The Univac I, with minor modifications, remained the standard large-scale system that Rand sold until 1958, even though it was already obsolete by 1956. In November of 1957, the first Univac II, the successor to Univac I, was delivered to the John Hancock Mutual Life Insurance Company to replace a Univac I.

The fact that this happened, even though RemRand had the requisite technology to build a modern computer at least a couple of years earlier, is doubly surprising. Remington Rand's staff of scientists, mathematicians and engineers continued the research that had been going on in the early 1950's, and the merger with Sperry, in 1955, added the facilities of the excellent Sperry research organization. Perhaps most of the development time of the RemRand people was taken up by the engineering that was necessary to develop the medium size computers (the Univac File Computer, the Univac Solid State 80/90), which RemRand needed to round out its line for competition against the much fuller line of IBM. Perhaps, as some people have suggested, Remington Rand weakened its engineering staff by using these people as salesmen and not providing for the technical losses. The fact that the Univac technology fell behind during the middle '50's and then made a startling comeback toward the end of the decade is general knowledge; the reasons for it remain a question to be researched.

Technical considerations, such as those mentioned above, were almost always considered by prospective customers. However, technical compatibility with existing data processing equipment that a firm might already have was often the deciding factor in acquiring a computer.

Punched card systems, RemRand's 90-column units and IBM's 80-column models, were in very widespread use by 1950. RemRand's systems were mechanically activated and controlled, whereas IBM's units were electromechanical. The latter, although slightly less reliable, were far more versatile. An IBM punched card system could be altered to do another job simply by changing the wiring connections in the machine. To change the control sequence on a Remington machine, one had to send it back to the factory for an expensive rebuilding job. For this reason, the IBM system was the more popular of the two and the number of IBM installations far outnumbered those of Remington Rand.

Punched card equipment owners provided a natural market for computers. Since IBM had many more card installations, they had a "sales in" with many more customers than RemRand did. Although both companies made converters so that competitors' cards could be run on their own computer systems, the effect of IBM's sales edge was not altered. Businessmen, especially when they are dealing with something that they don't understand, such as a computer, would rather have an entirely integrated system from one manufacturer than have to rely on combining equipment from different suppliers.

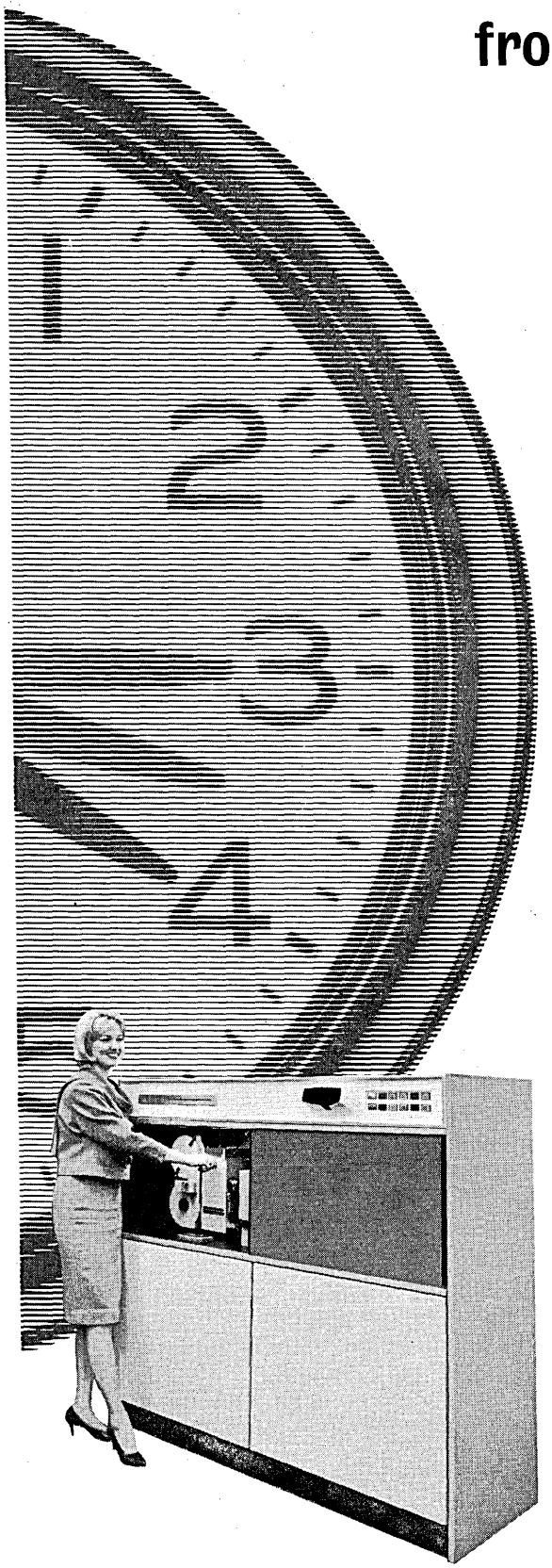
marketing

Technical differences, organizational differences, background differences, and different company policies were the battles. Marketing was the war. And this was the war that IBM won.

In 1951 IBM announced the 701, its first large-scale system designed primarily for scientific calculations.

More than any other single field, marketing was IBM's forte. Thomas Watson, Sr., had started off his career as a salesman and if there was one area of business that he knew and liked best, it was selling. As a young man, both before and during his days with National Cash Register, he was exposed to the methods and results of good and bad salesmanship and these lessons always remained with him. At IBM he built up a large sales staff that was well

The S-C 4400 document recorder has to work only one hour per day to cut $3,000 a month from computer printing costs!



If you now operate two mechanical computer printers, the S-C 4400 can save you thousands of dollars a month. At the same time it speeds output, increases retrieval rates and reduces data storage problems by recording all or part of your data on microfilm. The S-C 4400 can do all of this by operating as little as one hour per day.

For the second printer you pay approximately $200 per day or more. An S-C 4400 can do the same job in less than an hour, making a million line entries every sixty minutes. The cost? Approximately $182.00 based on one hour per day usage; the actual hourly rate will of course decrease with increased usage. Besides cutting printer costs by $400.00 per month, the S-C 4400 can usually replace one operator per shift as well as eliminate several thousand dollars a month or more in business forms inventory. The total result is a conservative $3,000 a month savings.

The S-C 4400 simplifies mass data processing by taking information from a computer and recording it directly on 16mm or 35mm microfilm. Today's automatic microfilm systems permit finding one document out of a million in 15 seconds.

Operation—In the S-C 4400, computer data is displayed on the face of a CHARACTRON® Shaped Beam Tube and then photographed automatically. It saves time and money by eliminating the costly step of producing paper output before microfilming. The S-C 4400 can operate on-line with a computer or off-line from magnetic tape. Magnetic tapes and paper need not be manually transported to other machines to get microfilm output. When you desire selected paper copies, they can be produced easily on a microfilm reader/printer.

No Forms Needed—Large inventories of pre-printed business forms are no longer necessary. Instead, forms are photographed on slides and inserted in the S-C 4400 projector. As needed, forms are projected by program control directly to the microfilm for recording with the computed data. One company estimates the S-C 4400 system can save more than $25,000 per month in business forms alone.

Codes Film—Film coding for retrieval systems is accomplished automatically by the S-C 4400. Line indexing marks, image count blips and MIRACODE retrieval codes can be imprinted on the film at electronic speeds.

Typical Applications—S-C 4400 can simplify data processing by recording customer histories; account, payroll and personnel records; route and rate information; credit figures; stock transfers; transaction journals; inventory reports; configuration management reports, etc. on easy to use and easy to store microfilm.

If you are interested in obtaining additional information on how to reduce your computer output costs and at the same time expand the capabilities of your computer operation, write Stromberg-Carlson Corporation, Data Products—San Diego, Department F-35, P. O. Box 2449, San Diego, California 92112.

STROMBERG-CARLSON
CORPORATION
DATA PRODUCTS-SAN DIEGO

CIRCLE 26 ON READER CARD

trained and extremely effective. Watson was one of the first people to recognize the advantage in sending the members of a sales staff to company organized schools covering both selling techniques and the machines that they were selling. IBM salesmen were well rewarded and a successful one could soon be living very comfortably.[16]

The Remington Rand sales organization was typical for a company of its size but in both numbers and training of sales personnel, it did not compare with the IBM organization.[17] Selling electronic computers was an entirely new field and the two companies took somewhat different approaches to the situation. Remington Rand took some of the engineers who had been doing technical work on the Univac I and put them to work as field salesmen for the company, amplifying the regular sales staff. Very often, although these people would be well qualified technically, they would not know about selling methods.

The following case from one New England firm is typical. This firm had an IBM CPC installation and was thinking of moving up to a more modern type of computing system. When the head of the company's computation department talked to the Remington salesman, he asked to see the Univac programming manual so that he could familiarize himself with the type of programming techniques that would be necessary with the RemRand system. The salesman refused to supply this information, claiming that, since the company was an IBM installation, it might get back to IBM somehow. The computing department head then proceeded to show the salesman some notes taken from a lecture class at a New England university. These notes contained much of the material that the salesman claimed he could not give out. Even after this, the salesman would not give out the desired information on the programming for the Remington system. Obviously, this incident resulted in one more unsuccessful sales attempt on the part of Remington Rand. RemRand suffered from many incidents of this type and, considering that they were competing against one of the most sales-oriented companies in the U.S., the outcome was foreseeable.

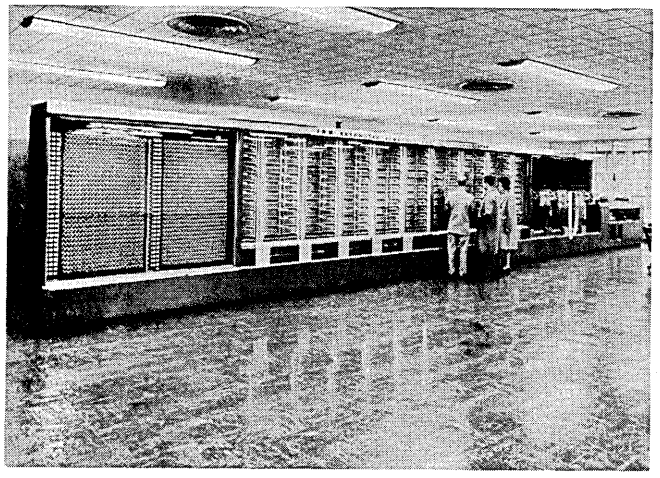
IBM took a different approach to the selling of computers. It also felt that it was necessary to have technical experts to help sell the machines but it used these people as backup consultants to their regular sales force. During the early 1950's, IBM started hiring Ph.D.s from all over the U.S. and using them in what was called a technical services department. IBM's regular sales force was given special training at company schools in the new computers and then they were sent out to sell. Once a salesman had established an interested contact, he could call in the technical specialist from the Applied Science Department. This system worked very well for the company and is still used today.

The IBM salesmen had three very important advantages working for them that were not shared by RemRand salesmen. First of all, IBM had a much wider line of computers than RemRand. Until the very end of 1956, RemRand did not bring out any commercial computers that were of smaller capacity than their Univac I. IBM, on the other hand, quickly realized that there was a large potential market for commercial applications of smaller computers and directed engineering and sales efforts along this line. Their 650 model was first installed in 1954 and "was considered a workhorse of the industry during the late 1950's."[18] This computer was then the most successful ever built and well over a thousand were put into operation. It provided a stepping-stone for many businesses that did not want to make the big jump from a punched card system directly to a large-scale computer.

Thus IBM salesmen could first install the 650 and then, as the customer's needs increased, move the customer up to a larger model. The Remington salesmen would have a more difficult job. More often than not, they would be trying to sell to a company that already had an IBM card system. Then, instead of being able to offer a small change and upgrading of the system, RemRand people would be selling a large, entirely new installation. The tremendous success of the 650 was an astonishment to the IBM management, and one result of the ensuing unexpected profits was that more money was spent for automatic programming techniques and other developments than had originally been planned.

The second advantage stemmed from IBM's lead in the punched card field. For most companies, the same person who had been in charge of the punched card

IBM's first large-scale computer, the automatic sequence controlled calculator, or Mark I, was presented to Harvard University.

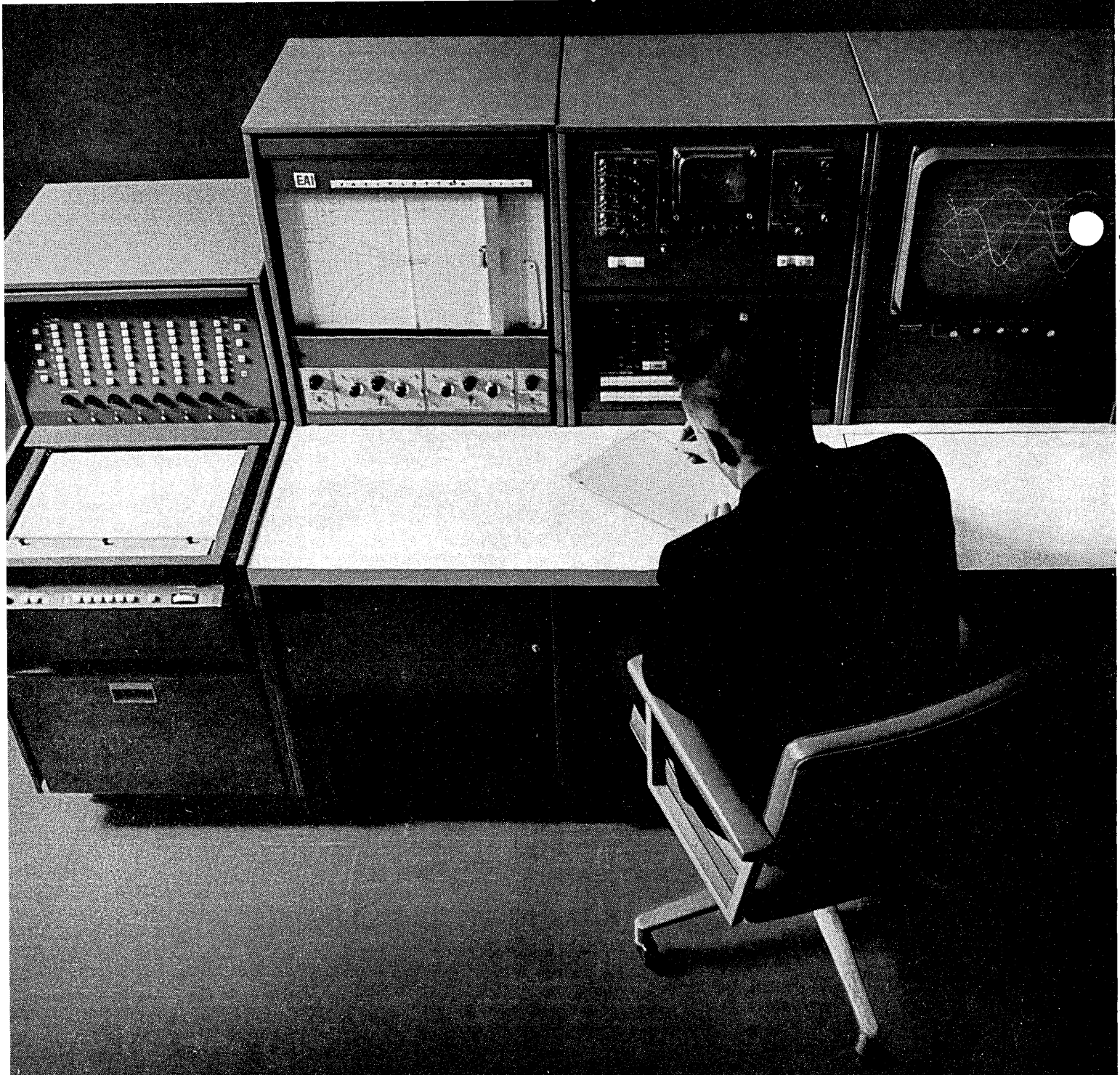


World's first commercial electronic computer, Univac I, serial 1, was installed at the Census Bureau in 1951. The computer is now retired in the Smithsonian Institution.

[16] Belden & Belden, op. cit.

[17] Opinion of several qualified people who dealt with and worked for IBM and RemRand—supported by the available documentation.

[18] Serrell, op. cit.



THAT PRIVATE MOMENT OF PRIDE

It's a nice feeling... knowing that another complex simulation problem has been solved successfully—thanks to your capable team and the new EAI 8800 scientific computing system. As an experienced analog user, you appreciate the EAI 8800 design innovations: its compact solid-state amplifiers mounted directly behind the patch-bay, providing unprecedented dynamic performance—its new fully integrated readout and display devices, making solution output truly efficient—its self-contained air conditioner, providing the proper environmental control for maximum precision—and its separate power module, keeping heat and noise away from the computing components. Best of all is the reliability of solid-state, worst-case design, and the special circuitry that makes patching errors harmless. You take satisfaction in knowing you have the most advanced equipment in analog computation and that you can count on it for state-of-the-art simulation for years to come. The complete facts are available on request.

EAI® ELECTRONIC ASSOCIATES, INC., *West Long Branch, New Jersey*

CIRCLE 27 ON READER CARD

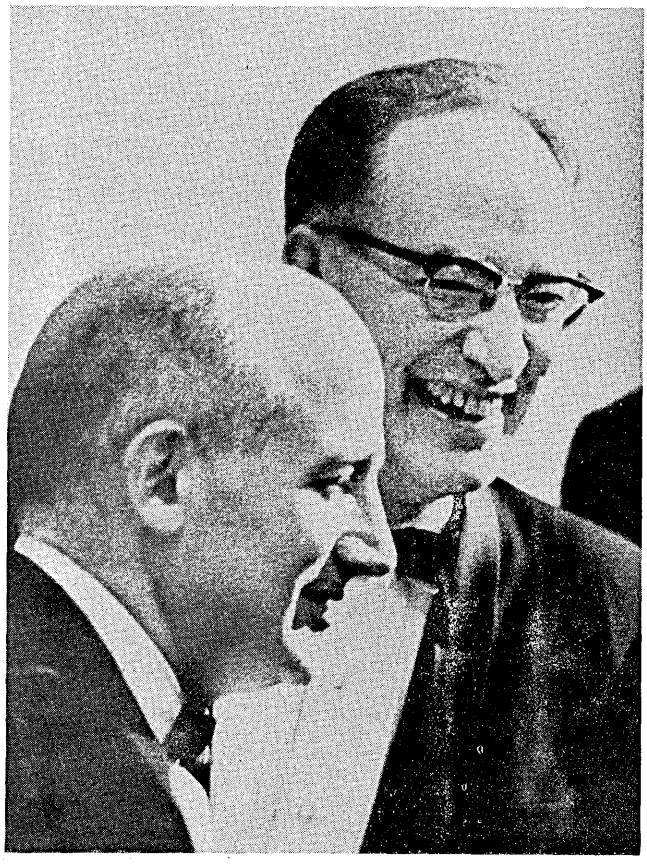
system would be the person who was directed to determine the feasibility of acquiring a computer. Since IBM's computer salesman was the person who had been around to sell the company their card system, he was already acquainted with the company contact, be he controller or someone else. The effect of this type of situation does not need to be elaborated on. Even on RemRand punched card installations, the IBM salesman would usually be on at least a par with the Remington representative, since most of the RemRand salesmen were new faces to the customers.

The third factor that the IBM salesmen had in their favor was the tremendous technical reputation that IBM had built up. Because of IBM's reputation for accurately meeting deadlines, many possible Univac sales were turned into IBM sales during the period when RemRand had the Univac and IBM had nothing. IBM adopted the sales practice of selling a computer before it was in production. This practice, which proved to be very successful for IBM, was made into a regular policy. Out of self-defense, RemRand initiated the policy, thereby making what was perhaps one of its worst mistakes. Time and time again, the IBM engineers would come through and have their machine ready on the promised date. RemRand, however, failed very badly in meeting promised deadlines, thereby damaging its reputation. Consequently, the policy was outlawed at RemRand soon after the merger with Sperry. Even today Sperry Rand shys away from this selling technique, although IBM has continued it successfully. The classic example of this failure to meet deadlines was the Univac File Computer. Although this machine was announced in 1955, Rand was not able to make deliveries of their Model I until 1958. They produced an inferior temporary model which was available in August of 1956, but it did not have internal programming and was not the planned configuration. The Model I of this computer was an excellent machine—witness the following U.S. Army evaluation:

> . . . accepts alphanumeric and numeric characters without loss of half the work size . . . capable of absorbing additional workload with or without additional basic equipment . . . least amount of processing time of the systems examined . . . permits off-line tape and printing operations . . . offers multiple means of input to the system . . . requires less additional peripheral equipment . . . Recommendation: Acquire . . . for installation.[19]

And yet the machine was a sales flop because of the miserable reputation that it had acquired by missing promised delivery dates.

Co-inventors of ENIAC, completed in 1944, are J. Presper Eckert (1), vp, Univac Div. of Sperry Rand Corp., and John W. Mauchly, president of Mauchly Associates.



Although it had been a Remington Rand policy to offer their computers on a sale or lease basis, IBM did not have the purchase option until 1956, when the Justice Department consent decree forced them to. At first blush one might think that this less flexible policy hurt IBM in the market. This, however, was not the case. The proof can be found in the fact that even after IBM started offering their computers for sale, almost all of the installations were still on the lease contract. The reasons for this are fairly clear. Aside from the obvious one, that these machines were very expensive and a leasing arrangement would provide much less of a strain on the capital budget of a company, the psychological factor of not having to be the owner of an extremely complicated machine that required constant maintenance weighed heavily.

first g.e. installation

The consequences of the installation of a Univac I at General Electric's Appliance Park in Louisville, Kentucky, had a very significant effect on RemRand's market image. Through no fault of Remington Rand or Univac, the reputation of the Univac I was seriously damaged by the events surrounding this installation. GE was one of the pioneering companies in the uses of computers for business applications; this installation at Louisville was the first ever made with the ambitious objective of complete automation of complex tasks. GE's first goal was to completely automate the payroll for the entire plant. As soon as this was accomplished the computer was to be made available to the various departments of the plant and used for various problems, including workload balance and annual budgeting and forecasting. The July, 1954, issue of the *Harvard Business Review* carried an article entitled *GE and UNIVAC*,[20] which described the plans that had been set up and gave the general impression that the installation was just about ready to commence operation. The plans as described in the article seem to have been very realistic and, judging from what was printed, one had every reason to believe that this would be the first large-scale successful installation of an automated system.

The people who set up the system, including Arthur Anderson & Co. consultants, had guessed wrongly on the amount of time it would take to write the programs and run them. Even when the computer was run 24 hours a day, there was not enough time to get out the payroll. The first group who worked on the project at GE was fired, and a new group was brought in. By the time the installation was working, late in 1956, the whole area of

[19] ADPS - Proposal, U.S. Army Chemical Center, Chemical Corps Material Command, July, 1958 pages 14 to 16.

[20] R. F. Osborn, "GE and Univac," *Harvard Business Review*, July, 1954.

automated business computing, and Univac especially, had become very questionable in the eyes of many businessmen.

Looking back we can easily spot the mistakes that were made. The programming that was attempted was too ambitious in that all exceptions were machine handled through the use of table-lookup procedures. A good example of this point was the payroll application which deducted withholding tax from the paychecks. The Internal Revenue Code provides a large table which gives the correct amount that should be deducted for each salary level. The programmers of the Univac stored this entire table on magnetic tape and the machine had to search the tape to determine the correct deduction for every single paycheck. A preferable alternative procedure would have been to program an algorithm to calculate the proper deduction from each check. The algorithm could have been a simple polynomial approximation to the table and special discontinuities could have been taken care of by tests. This method of handling the problem would be an obvious thought to anyone who works with computers today; however, the people at GE were pioneering and ran into trouble.

In the long run, the most serious resulting repercussion was the damage to Univac's reputation. In almost no way was the machine or its builders responsible for the trouble that GE had. The difficulties were the result of inexperience and yet, in technically uninformed business circles, much of the blame for the failure of the installation was attributed to the particular machine, Univac.

One of the reasons that Remington Rand had received this contract was that at the time the decision was made to acquire the computer, IBM did not yet have its 701 developed. The General Electric management had decided not to depend on a machine that might not be ready on time. The Univac was already developed and available; therefore, it was the logical choice. Thus, at least in this one example, it is somewhat ironic to see that Remington Rand was penalized for being the leader in the field.

government contracts

Until about 1956 or 1957 RemRand was fairly successful in competing with IBM for government contracts. Of course, many of the first sales made by Remington Rand to the government were made for the simple reason that the Univac was the first computer available. In fact, the first six installations of this model were made for the government. The Atomic Energy Commission received two; the Bureau of the Census, the Air Force, the Army, and the Navy Bureau of Ships each got one.

In the business world much of IBM's success was due to a superior job of marketing. When competing for government contracts, marketing was less important than it was in the industrial world. Very often a RemRand installation would be warranted on the basis of cost (witness the Army evaluation presented earlier). Under these circumstances friendships, software superiority, or other similar reasons were not as effective as they were in private commerce. In the government, IBM and RemRand competed on a different ground and, as a result, Remington was able to compete more effectively.

punched cards + marketing = success

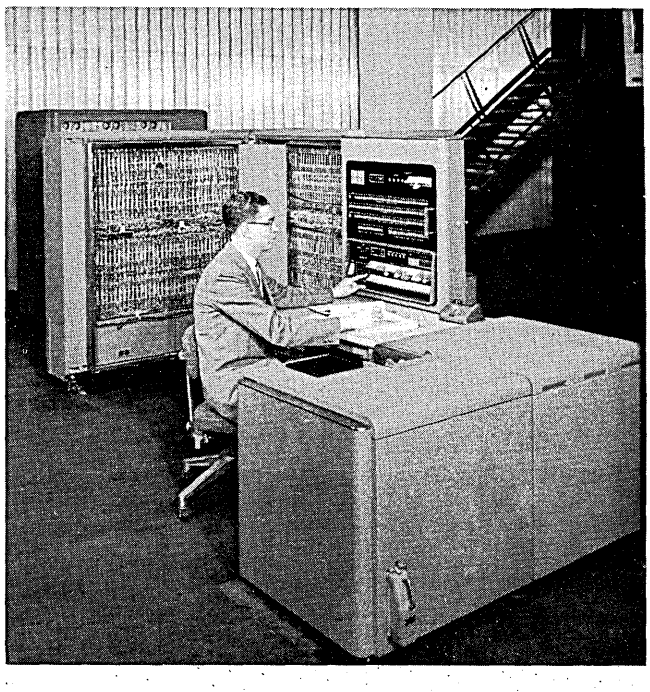
In retrospect, the answer to why IBM managed to become foremost in the computer field is fairly clear. There was a market and a demand; IBM, more than any other company, was able to satisfy this demand.

The above is fact; however, if we allow ourselves the luxury of drifting away from the world of fact, one question looms large. Did Remington Rand, or any other company for that matter, possess the power and capability to substantially change what happened? Although this is a moot question, it is an interesting one. It is the author's opinion that even if Remington's management had avoided the obvious mistakes that were made, the outcome by 1960 would not have been substantially different from what it was. The combination of background, organization, capabilities, and objectives of the International Business Machines Corp. presented a formidable challenge.

Many reasons, some more important than others, contributed to IBM's success. The technical differences between Remington Rand and IBM machines were not important until IBM actually brought out a machine that was clearly superior in many respects (the 704). By this time, however, IBM had already assumed a commanding lead. The difference in the way that the companies were organized was important, but there is a limit to how important an internal difference such as this can be. Customers are more interested in a company's product than its organization. IBM's sales and manufacturing policies were also important, but it is easy to look back, pick the winner, and say that his policies and attitudes were superior and, hence, the reason for his success. These and the other causes presented were certainly relevant but it was the interaction of two main forces that was the deciding factor.

First of all, the head start that IBM had acquired by being the leading company in the punched card field was something that no other company could have quickly overcome. In 1950, IBM was the punched card industry

IBM's selective sequence electronic calculator (SSEC) is also known as the Mark II.



in the same way that it was the computer industry in 1960. Had another company been able to match IBM in every phase of competition, they still would not have had the head start that IBM had with its punched cards. This lead plus the excellent job of marketing that was done by the IBM organization produced the interaction that was the most important single reason for this company's pre-eminence at the end of the first decade of the computer age. ■

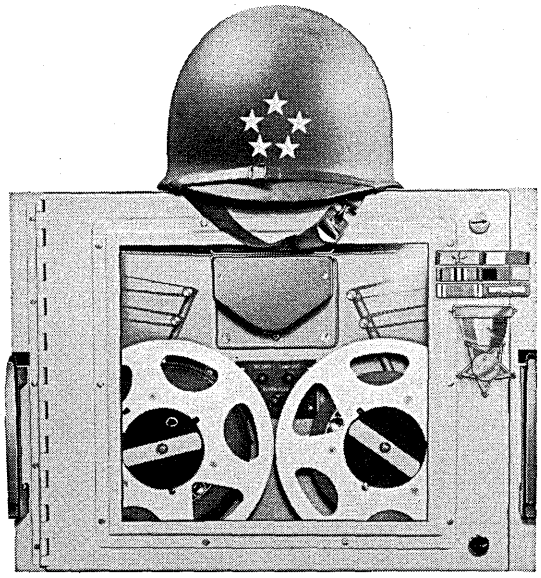
Photocircuits' fully-militarized

500 RM TAPE READER

is the only reader to pass the tests for:

HEAT, COLD, VIBRATION, EXPLOSION, SHOCK, ALTITUDE, RFI, SALT, SAND AND DUST!

(as required by MIL-E-16400 Class 3 and MIL-T-21200 Class 2)



Still...the top military performer

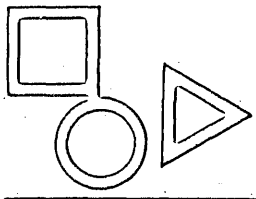
Users of the 500 RM fully-militarized Tape Reader will not be surprised that it passed successfully a complete "campaign" of military environmental tests. Its speed, accuracy and reliability provide a performance that meets all the worst case conditions of the above MIL specs.

Specifically designed as a military unit, the 500 RM is a high-speed photoelectric reader providing speeds to 1,000 char/sec. — with 8" reels to give you maximum data-storage. Its smooth power comes from a unique printed-motor, direct-capstan drive. This means that all tape-reading modes are electronically controlled. The 500 RM has none of the clutch, pulley, brake or pinch-roller problems inherent in conventional or hybrid tape readers, since all of this high-maintenance hardware has been eliminated.

If your department or agency requirements demand top performance with MIL spec reliability — find out about the 500 RM Tape Reader today. Simply write or phone: Photocircuits Corporation, Tape Reader Division, Glen Cove, New York. Telephone: (516) ORiole 6-8000.

Photocircuits
CORPORATION
TAPE READER DIVISION
GLEN COVE, NEW YORK

CIRCLE 30 ON READER CARD



WORLD REPORT

PHILIPS ANNOUNCES NEW GP COMPUTER

Philips has made its first move in the general and scientific computer market through Philips Industries, France, with a machine labelled PR 8000. This is a basic 4K (24-bit) word machine with a 7-usec cycle time. Main core can be extended in 4K modules to 16K for a processor that includes double-precision arithmetic. In addition, an auxiliary ferrite store of 4-16K can be linked in as a second-level memory.

Software includes a FORTRAN compiler for a 4K system and an 8K ALGOL 60. For on-line processing and industrial control work, up to 49 program priorities can be specified. Three basic input channels allow concurrent processing of I/O units.

COBOL CHAOS, APT SUBSETS REPORTED

Software development men in Europe are desperately trying to rationalise ideas on future progress. Main concern has come from reports that CODASYL is wrapping up its development function of COBOL, coupled with criticisms from major manufacturers over here of specs of COBOL 65.

As a result a group of CODASYL members were in Europe, reportedly in response to queries from ECMA's (European Computer Manufacturers Assn.) COBOL study group. Although some technical differences between the transatlantic software communities were clarified, but not resolved, the main dilemma still remains of who is to take long-term implementation and development responsibility.

It's only in the past 12 to 18 months that COBOL and European subsets have been introduced to users. Return on investment by some of its main manufacturer supporters, like ICT, is only just being realised. In addition COBOL packages have only recently been worked out for firms new to this software area, such as Siemens and Electrologica.

Numerical machine tool control is slowly gaining ground in Europe, and computer makers building up experience in this area are regarding APT III in the same light as they first viewed COBOL: a monument to U.S. endeavour but too monolithic an approach to the problem. Post processors are expected to be running soon for locally made machines for subsets of APT. First firm expected to surface is ICT, who are also rumoured to have generated interest in the States over the specs of their package.

POST OFFICE BANKING GOES INTO AUTOMATION

Gradually automating is the Giro system of Post Office banking, used widely in Europe, excluding the U.K. It provides manufacturers with one of the most promising and lucrative markets. Hot in pursuit are IBM Germany, Telefunken, and Standard Electrik Lorenz, all working on fully automated cheque-handling schemes (see Sept. '64 Datamation).

Telefunken has been the first to surface with a public demonstration of the complete article, a system to be installed later this year at the Ludwigshabven Post Office. Incoming envelopes with cheques are

(Continued on page 103)

Raytheon Computer's 520 System is the new price/performance leader in the industry.

It starts at $94,000 and outruns competition.

These figures prove it.

OPERATION	DERIVED TIMES IN MICROSECONDS INCLUDING MEMORY CYCLE			
	RAYTHEON 520	SDS 930	CDC 3100	IBM 360/40
SCIENTIFIC/ENGINEERING FUNCTIONS				
FLOATING POINT ADD (24-BIT MANTISSA)	21-36*	81	NA	43**
FLOATING POINT ADD (39-BIT MANTISSA)	34-45*	NA	210	NA
FLOATING POINT MULTIPLY (24-BIT MANTISSA)	25-28*	59	NA	105**
FLOATING POINT MULTIPLY (39-BIT MANTISSA)	74-76*	NA	340	NA
REAL-TIME DATA SYSTEMS FUNCTIONS				
ADD REGISTER-TO-REGISTER	1	NA	1.8	7.5
CONVERT TO ENG. UNITS (12-BIT DATA) (ax+b)	15.5	19.25	21.5	81.26
NORMALIZATION $\left(\frac{X-Z}{F}\right) \longrightarrow Y$	20.5	31.5	22	216.26
CONVERT ANY 6-BIT CODE TO ANY OTHER CODE	2	8.75	5.25	17.5+6.25/CH.
BINARY TO BCD CONVERSION (4 SIX-BIT CHAR.)	36.5	112	77.5	<50
BCD TO BINARY CONVERSION	28	80.5	72	<45
DATA QUALITY CHECK (MATCH 24-BIT WORD AGAINST REFERENCE WORD AND COUNT UNMATCHED BITS)	23	69	108	108

**Times for subroutines in fast memory and calling sequence in main memory.*
***Short format (24-bit mantissa and 7-bit hexadecimal exponent) with floating point option.*

The Raytheon 520 System has a substantial speed advantage in scientific and data systems computing. It's equipped with a 200 nanosecond access, NDRO memory for table, sub-routine and executive program storage. Memory accesses are reduced by 1-microsecond register-to-register instructions using seven programmable registers. A variable length multiply can provide 8-bit execution in 2.5 μsecs, 12-bit in 3.5 μsecs and 24-bit in 6.5 μsecs. Input-output features include direct memory access and a standard controller for low-cost interface to A/D-D/A converters and other real-time data sources.

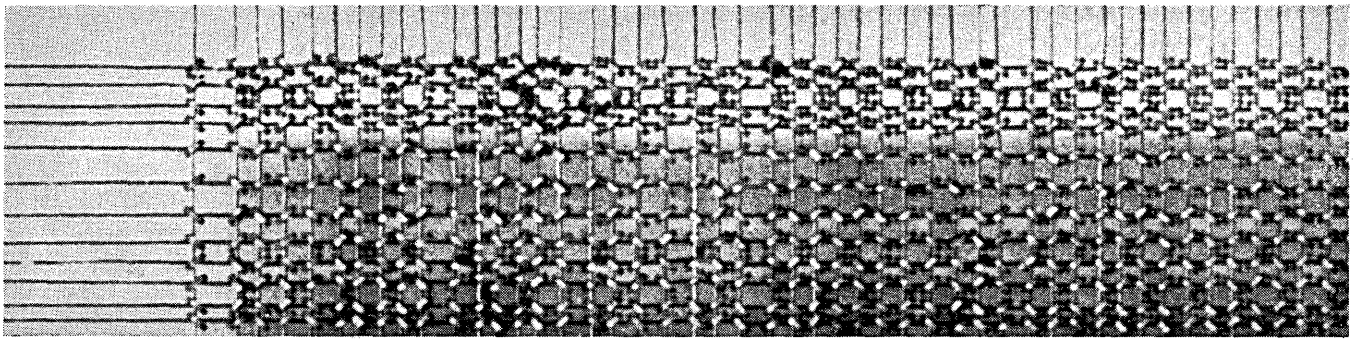
Automatic programming aids for the 520 System include the BOSS operating system; an advanced assembler with macro instructions oriented toward real-time systems, a simulator that will allow users of IBM 1620 computers to switch to the Raytheon 520 and process their machine language programs up to three times faster; and 520 FORTRAN, a fast and powerful compiler (benchmark comparisons invited.)

Write or call today for the whole story. It's in Data File C-108J. Raytheon Computer, 2700 S. Fairview Street, Santa Ana, California 92704

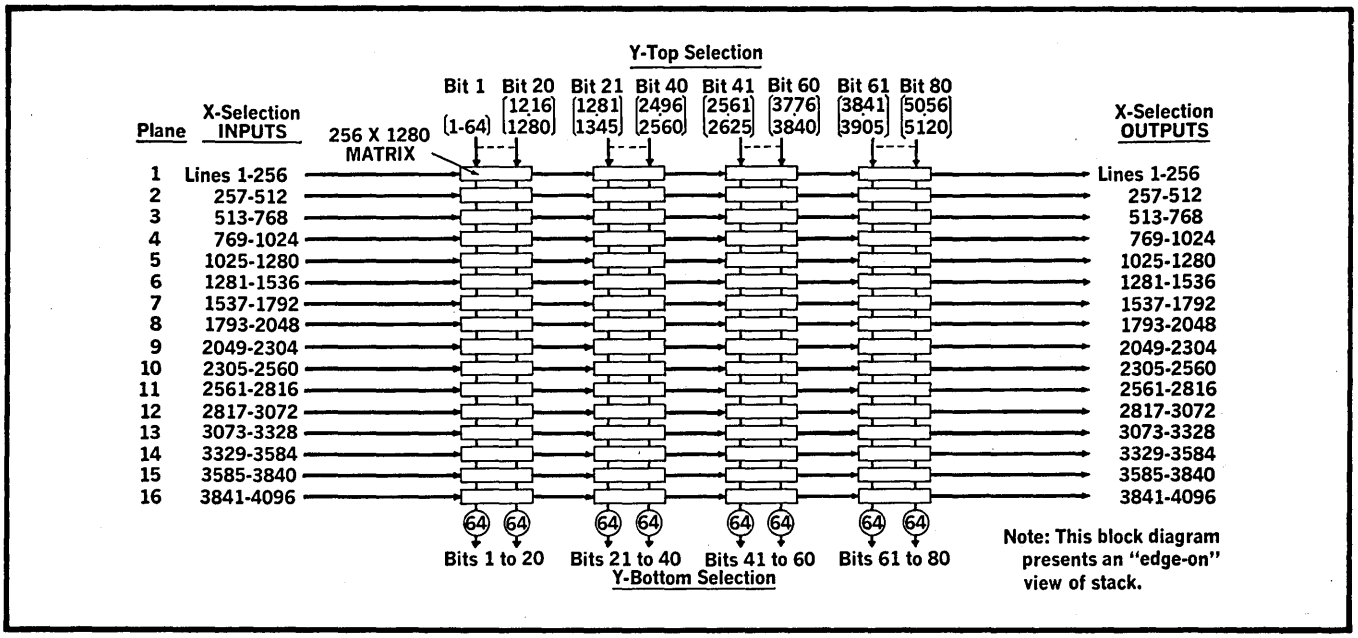
RAYTHEON

CIRCLE 32 ON READER CARD

A 20-million-bit mass core memory can be economical, reliable, and fast! Here's how:



Coincident-current versatility with only two wires!
(Cross-section of Fabri-Tek's simple and reliable orthogonal mass core memory plane.)



Here is the road-map to reliability!
(Core-selection block diagram for Fabri-Tek's mass core memory stack.)

In extremely large capacity core memory systems such as Fabri-Tek's new Series MT mass core memory, the stack and core selection circuit costs become the major system cost consideration. The illustrations above show the key factors which make the Series MT a truly practical mass core memory.

A simple and reliable orthogonal array uses only X and Y wires to reduce the stack stringing cost and to reduce X and Y drive line soldered connections by a ratio of more than 4:1.

The core-selection block diagram shows how a 20-million-bit array is divided into 4,096 X lines and 5,120 Y lines. A total of 327,680 cores is wired into each frame.

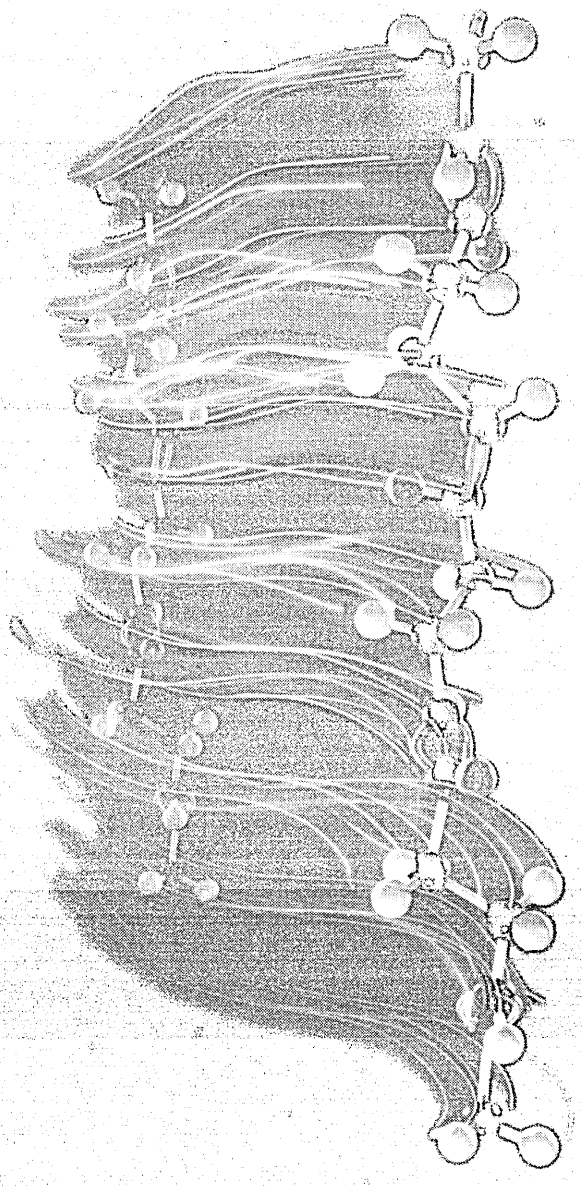
If conventional 128 X 128 matrices were used, a total of 1,280 frames would be required instead of 64. This would mean a total of 655,360 X and Y-line to frame connections compared to the 196,608 connections used in this Fabri-Tek memory.

Special Fabri-Tek circuit techniques, using all-silicon semiconductors, give reliable memory speeds of 4 to 8 microseconds. Interface is compatible with discrete or integrated circuitry.

If you'd like more interesting facts about the Fabri-Tek mass core memory, write, call, or wire Fabri-Tek Incorporated, Amery, Wisconsin. Phone: 715-268-7155. TWX: 510-376-1710.

FABRI-TEK
INCORPORATED

CIRCLE 33 ON READER CARD



Tales of Restless Nuclei

The molecules in a solid may be tumbling, rotating, or jumping. Or just quietly vibrating. What they do can affect the characteristics of bulk matter. This is not news . . . but the way we can relate specific motions to physical properties *is*.

Physicists at GM Research are using Nuclear Magnetic Resonance (NMR) to study molecular motion as temperature or composition is changed. This new branch of spectroscopy uses magnetic nuclei to probe many phenomena on a molecular scale. From it, for example, our NMR physicists are developing new knowledge of electron densities, molecular configurations, and the basic nature of that strange squishy state of matter—the plastic crystal.

In addition, they are associating specific molecular motions with the macroscopic properties of polymers. And they're learning to predict properties for the engineer.

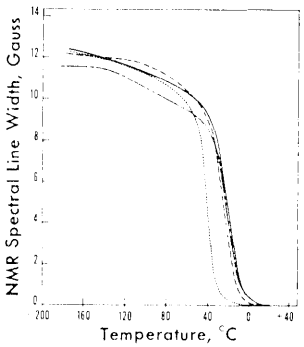
Take neoprene, for instance. Engineers wanted to know what plasticizers might keep it flexible at low temperatures . . . without having to run physical tests on a number of samples.

NMR found out. How? By detecting changes in molecular motion. A hard, solid polymer allows molecules only limited movement. Addition of a plasticizer, or an increase in temperature, allows more complex motions as the rigid structure relaxes. The increased motions cause narrowing of the NMR spectral line which can be correlated with flexibility.

The motions of the nuclei tell the tale . . . and help General Motors find a better way.

General Motors Research Laboratories

Warren, Michigan



Effects of plasticizers on NMR spectrum of neoprene. The best plasticizer produces spectral line narrowing (due to increased molecular motion) at lowest temperature.
– From a recently published GMR paper.

CIRCLE 34 ON READER CARD

NEWS BRIEFS

UNIVAC COMES UP WITH A 490 FAMILY

Capitalizing on circuitry development used in the 1108, Univac has announced a 494 processor with a 750-nanosecond cycle time. Using an optional overlapped memory, it goes down to 375 nsec. Compatibility is maintained with the 490, announced in '61, as well as with two other processors, the 491 and 492.

The latter two maintain the 4.8-usec cycle time. The 491 achieves a lower price with fewer I/O channels, and the step-larger 492 features the ability to use Fastrand drums at a reduced cost—reduced, that is, over the original and still marketed 490. The three newer processors have a memory lock-out feature which reserves 64-word memory segments for program-debugging, eliminating the possibility of memory erasures through overlap of other programs. Deliveries of the 494 are scheduled to begin in 15 months; the 491 and 92 start in 12 months. No prices have been announced.

MORE CHANGES ANNOUNCED FOR SYSTEM/360 LINE

IBM is replacing some models of System/360 and adding a new disc file unit to the range of peripheral equipment. Models 60 and 62 are replaced by Model 65. It will offer memory sizes up to over a million characters, with eight-character retrieval in 750 nanoseconds for a cycle time per character of about 94 nanoseconds. The "old" Model 70 is superseded by a new Model 75, also with memory capacity to over a million characters and with a 750-nanosecond rate.

In for the 64 and 66 is the new Model 67, designed for time-sharing applications. It's described as being available on a "special bidding basis."

The new disc unit is labeled 2314 and is an application of the interchangeable disc pack plan already used with smaller files. This one can hold up to 207 million characters in one eight-module unit; a ninth module is built in for use as a replacement for one of the eight. These modules are the disc packs, each containing 18 recording surfaces. Average access time for the file is 85 milliseconds and transfer rate is 312,000 characters/second.

Deliveries of Model 65 are scheduled to begin in the first quarter of 1966. System price range is from $40,000 to $65,000 per month. The Model 75 will be delivered in place of the 70, starting in the fourth quarter of this year. It will rent for $50,000 to $80,000. The 2314 disc unit has a monthly rental of $5250, and will be ready in the first quarter of 1967. For the Model 67 time-sharing system, the company is not quoting prices on the grounds that installations will vary so much in amount of equipment that bidding will be indicated. The variety of systems possible might fall anywhere between $50,000 and $200,000 a month.

CBS GETS COMPUTER TO PLAY BALL

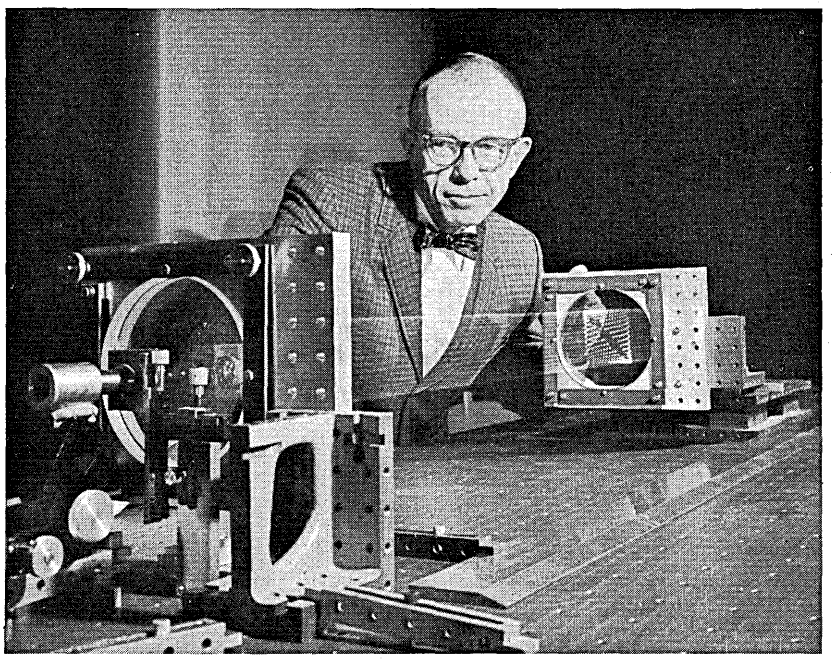
If Walter Cronkite can refer to voter profile analyses, there's nuthin' wrong with Dizzy Dean and Peewee Reese using a computer to figure the probability of a batter "hitting in the clutch," based on earlier performance

BELL LABS ON TRAIL OF OPTICAL DELAY LINES

An experimental device developed at Bell Telephone Laboratories by Donald Herriott and Harry Schulte (shown) raises the possibility of optical delay lines used as sequential computer storage.

A laser beam that would be two miles long has been reflected between two mirrors, folding it into a ten-foot space. Information can be modulated onto the beam for retrieval 10 microseconds later. Capacity would be 10,000 bits, which could be read out serially one bit every nanosecond.

The mirrors are shaped in such a way that several laser beams could be accommodated with one set of mirrors. Scattering of the beam is low enough that the present 1000 reflections, creating the 10-microsecond delay, could be upped to two or three thousand. ■



figures from the precincts. Actually, it's not the batter's capabilities that are being taken into consideration by CBS in its Yankee Game of the Week telecasts, but rather the field situation.

For instance: It's the seventh inning, score tied, bases empty, and two outs. Pressure factor: 34%. If the batter singles, the next man has a pressure factor of 52%. Issued a walk, the next batter faces a 72% situation. Load the bases and, man, that's 100% pressure. Now, if he hits a grand slam, the anti-climactic next man is in a 6% situation.

The clutch rating system being used by CBS with a GE computer was developed by Chuck Mullen, and is based on the season's first month of play. Mullen figures there are about 52,800 possible situations that a batter could face, based on the inning, score, bases occupied, and number of outs. The only thing not figured is the odds being quoted in the centerfield bleachers.

ITT LAB DEVELOPS NEW FERRITE STORE

An experimental waffle-iron configuration of ferrites that reportedly combines the advantages of thin films and cores has been announced by Standard Telecommunication Labs, London, British facilities of IT&T. The unit has 196 (30-bit) words with a 0.5-usec read/write cycle time. The printed-circuit boards form read-and-write diode access matrixes, with grooves of 127 microns wide on 380-micron centers. With four storage points per bit, there are over 1,000 bits/square inch.

The design has a closed flux path, the flux returning through a soft ferrite structure. Driving and sense conductors are laid in grooves in a ferrite plate; the plate is pressed into contact with the thin film, which has a square-loop magnetization characteristic. The thin film is an isotropic iron-nickel alloy electroplated on a polished substrate.

CARNEGIE TECH TO GET COMPUTER-DRIVEN DISPLAY

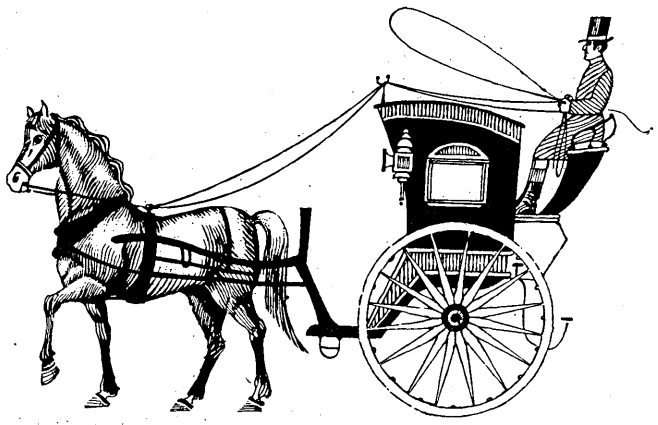
The Carnegie Institute of Technology Computation Center in Pittsburgh will get a visual display system built to order from Philco this summer. Based on Philco's Real-Time Electronic Access and Display System, the unit will be an adaptation developed by Jesse T. Quatse, manager of engineering development at the center.

Three consoles are included and the operator will be able to manipulate high resolution alphanumeric and graphic data on the face of CRT's. Planned use is for programming and debugging, engineering and scientific calculations, and classroom instruction. The system will have access to 8000 words of computer memory and each console is fitted with a light pen and two typewriter keyboards. Keyboards include all characters in English, Greek, and Russian plus mathematical and special symbols.

LABORATORY AUTOMATED AT MISSOURI MEDICAL CENTER

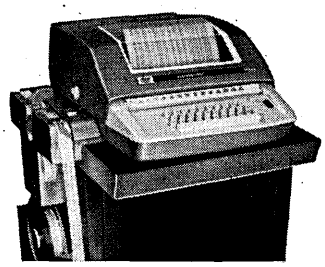
The University of Missouri Medical Center has installed an IBM 1410 with IBM 1092 data transmission terminals in each of the hospital's five laboratories. Supported by a grant from the U.S. Public Health Service, the system will evaluate laboratory tests, automatically report test results to the proper floor, accumulate test results, and supply this information on demand for teaching, statistical, diagnostic, and research purposes.

If tests are considered normal by



IS YOUR TAPE CONVERSION STILL WORKING AT HORSE AND BUGGY SPEEDS?

THINK AHEAD...THE NEW KLEINSCHMIDT *321 ADS* CONVERTS TAPE TO HARD COPY AT 400 WORDS PER MINUTE!...TODAY



Think of tape conversion four times faster than you may be getting now. Think of less tape backup. Think of the Kleinschmidt™ 321™ ADS. Whether it's used "on line" or "off line," the 321 ADS gives you complete and reliable facilities for tape preparation, tape duplication and hard-copy print-out. For further information on the efficiency of the 321 ADS and other Kleinschmidt Electronic Data Communications equipment, write: KLEINSCHMIDT, Division of SCM Corporation, Lake Cook Road, Deerfield, Illinois.

THINK AHEAD ... THINK SCM

SCM KLEINSCHMIDT® DIVISION OF SCM CORPORATION

CIRCLE 35 ON READER CARD

the computer, results are transmitted and printed for inclusion in the patient's chart. If not, they undergo review procedures to determine the proper action.

For teaching use, IBM 1014 remote inquiry terminals are provided in the hospital and on the campus. With patient care details and other medical information available in disc storage, students will be able to make inquiries that include comparison of test results on a given patient to norms.

● Western Union has been demonstrating its data transmission facilities in Atlanta with a link to an IBM 1440 at the Financial Datacenter in New York. Circuits are automatically selected by pushbutton telephone, with toll charges based on distance, bandwidth, and time. There is a one-minute service minimum.

● Westinghouse Electric Corp. has opened a behavioral technology laboratory in Albuquerque, N. M., to develop and test programs for computer-based educational systems and related instructional techniques. A staff of 11 psychologists, programmers, and support personnel will be headed by Dr. Lloyd Homme of the Dept. of Psychology of the U. of New Mexico.

● Mauchly Associates and Planalog have announced their "technical association" to offer a complete package of consulting services, together with desk-top, mechanical, analog computers. Specializing in CPM planning, using the Planalog, the two firms will also offer training, software, and other services.

● IBM says that they now have 250 computers hooked into a nationwide communications network connecting 16 IBM plants, laboratories, and computing centers. A transfer rate of 5100 characters/second is maintained using 7711 communications units for tape-to-tape and tape-to-computer conversions.

● A study that projects economic growth and potential for 25 years into the future of two upstate New York counties is being conducted by CEIR's New York center. Under D. David Brandon, a mathematical model of the Herkimer-Oneida counties' economic environment has already been constructed. Now being accumulated is historical, current and forecast data about businesses in the area; this will be followed by studies of economic growth in five-year increments. The study is scheduled for completion this month. The method is said to be applicable to many long-range municipal and regional planning efforts.

● A one-check payroll plan, in which an employee gets not a paycheck but an "advice of credit" to his account with his earnings statement, is to be instituted by the Pittsburgh National Bank for a large corporate customer, not yet announced. It presages the checkless society and the "financial computer utility," which will have a record of the credit-deposit-loan history of each company or customer who enters into the plan. The utility would then handle all transactions for customers. Some transactions would be pre-authorized by the customer as to amount, date, "not to exceed" information, and the payee. Other transactions would be with a personal identification card that enters infor-

mation via a remote terminal at a drugstore, say, linked to the computer center.

● The Chicago School Board, working toward a total information system on the almost 600 schools within its area, has installed an Electronic Retina Character Reader to do the job of entering about 50 billion characters of data a year into its computer system. The 2000 cps optical reader, produced by Recognition Equipment Inc., will help the Board maintain extensive organization records on students, staff personnel, finances, materiel, administration, instruction, and research. A major purpose of the system is to analyse the individual student's progress and potential to help the teacher work more effectively with him.

● Close on the heels of the New York Stock Exchange, the American Stock Exchange has announced plans to install, by 1966, on-floor keyboard terminals which will be on-line to stock tickers. The system, which is being developed by Bunker-Ramo Corp., will initially have 40 terminals, each with a five-inch CRT for pre-entry message validation. Eventually the units will be on-line to a computer system which will store data and transmit validated and corrected transactions to the tickers.

● To evaluate data processing applications to Defense Department library functions, Booz-Allen Applied Research, Inc., has been awarded a nine-month $100K contract by the Defense Construction Supply Center, Columbus, Ohio. The study is expected to lead to standardization and improvement of systems of the DOD Library and Information Analysis Centers. The Defense Documentation Center of Alexandria, Va., will monitor the contract.

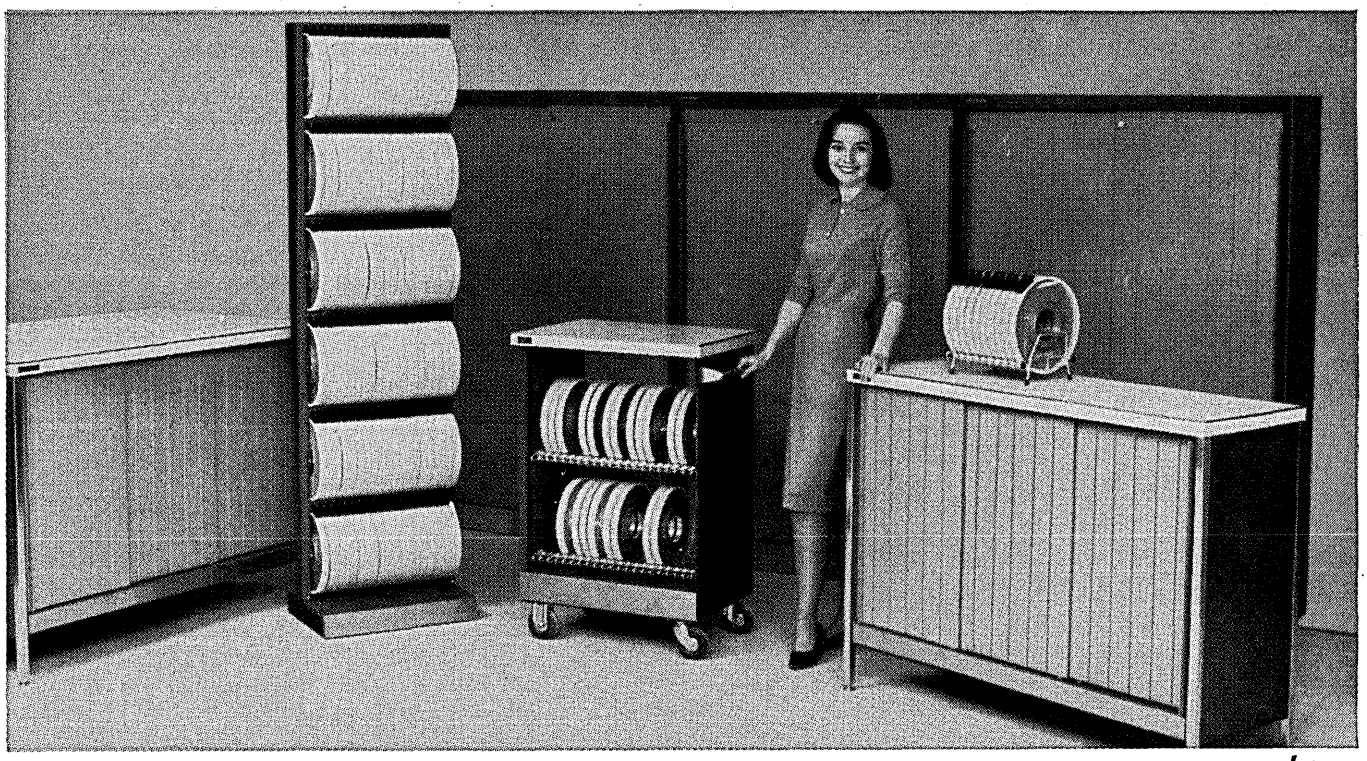
● The JOHNNIAC computer, developed in the early '50's at the Rand Corp., is being retired in favor of a PDP-6, which will handle the JOSS system (see Nov. '64 Datamation). JOSS is being extended and modified to allow permanent storage of programs, and will be available to the Rand staff 24 hours a day, seven days a week. The system will include a Data Products disc file and 30 remote terminals, up from the present 10.

● A computer-controlled aerial surveying and photomapping system has been developed and delivered to the Air Force by Kollsman Instrument Corp., Elmhurst, N. Y. Consisting of an inertial navigation system, SHIRAN electronic distance-measuring gear, and a light source for long line azimuth measurements, an aerial camera records the landscape and an airborne digital computer collects and compiles navigational and supporting data for surveying, mapping, and control of the aircraft. The system is reportedly capable of photomapping 30- to 40,000 square miles/day, and collecting detailed data about where the photos were taken, from what altitude and angle. Shipment of the prototype is to be followed this year by three more.

● A 5-megabuck system that will handle seat reservations, message switching, and accounting functions has been ordered by Continental Airlines. It will consist of two IBM 360/50's and the 2260 display terminals. In addition to flight and fuel planning and maintenance and shop scheduling, the system is said to be amenable to the computing of fares and writing of tickets in the future.

New TAPE-SEAL™

COMPUTER TAPE STORAGE SYSTEM



A complete tape storage and handling system from Wright LINE

This exciting, new system from Wright Line can double your tape capacity while it minimizes tape damage and dust problems. The system's outstanding feature is the Tape-Seal Belt*, a unique device which is wrapped tightly around the reel flange edges, sealing out dust and preventing tape damage. 90% lighter and 45% narrower than a conventional container, the belt permits tapes to be suspended from a patented lifetime hook-latch, eliminating wire supports and easing retrieval. Permanent identification labels are automatically visible . . . always in the same spot.

Rounding out the system are: 1) a mobile truck featuring the new and unique Rak/Shelf™, which carries tapes in the vertical position and provides a flat surface for forms, cards, run-books, and other supplies; 2) five-tier storage cabinets (44″ wide x 16¼″ deep x 69⅞₁₆″ high) that hold 200 tapes, expose 100 when one door is open; 3) six-tier library units only 20½″ wide and 14″ deep that can be installed along a wall or back-to-back; 4) six varieties of Compustoralls™ — custom work stations with capacities up to 208 reels; and 5) ten-reel desk racks which incorporate the Rak/Shelf insert design principle.

Write or phone now for complete details about Tape-Seal Computer Tape Storage System and a brief, dramatic demonstration in your office.

*patent pending

Wright LINE DATA PROCESSING ACCESSORIES

170 GOLD STAR BOULEVARD, WORCESTER, MASS 01606

A division of Barry Wright Corporation (BW)

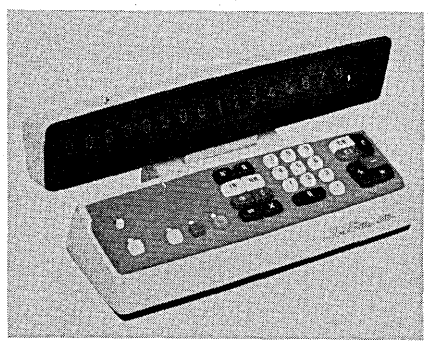
IN CANADA: Wright Line of Canada, Ltd., 600 Eglinton Ave., East, Toronto 12, Ontario

CIRCLE 37 ON READER CARD

NEW PRODUCTS

satellite calculator

Centralized desk calculator system is linked to four solid-state satellite keyboards, each having an electronic readout panel. Each remote unit can query the central system for "machine time,"



and a keyboard not used for a pre-set time releases its hold on the central unit. Other features: 27-pound console, 10-key keyboard, manipulation of numbers up to 16 digits. IME/USA, INC., Los Angeles, Calif. For information:

CIRCLE 130 ON READER CARD

computer tape

Type 224 mag tape uses firm's Micro-Plate process, is certified at 556 bpi on seven channels. It comes on plastic or aluminum hubbed reels. With a 1.5-mil polyester base, it comes in 2450-foot length on 10½-inch reel and 1250 feet on 10½ and 8½-inch reels. REEVES SOUNDCRAFT, Danbury, Conn. For information:

CIRCLE 131 ON READER CARD

electronic calculator

Second unit for the company is the 132, which has a square-root key and the ability to hold a second constant in the top register. Automatic transfer of terms or intermediate answers permits a logical flow of calculations. Other features: 11-key keyboard, automatic decimal control from 0 to 13 places, multiple registers. FRIDEN INC., San Leandro, Calif. For information:

CIRCLE 132 ON READER CARD

ruggedized tape drive

The SC-1150M is a single-capstan transport operating at bidirectional speeds to 150 ips at 800 bpi with no program restrictions. It is adaptable to all major formats, and is 7- or 9-channel compatible. MTBF is more than 1,000 hours with 109 start/stops, and the unit withstands 50 g's shock. Maximum start and stop times is 3 msec. POTTER INSTRUMENT CO. INC., Plainview, N. Y. For information:

CIRCLE 133 ON READER CARD

construction software

CONSTRUCTS (Control Data Structual System) produces steel fabrication detail drawings, using a CDC 3600 and an off-line Electronic Associates 3440 plotter. The system reportedly has potential also in mechanical and electrical drawing work. Currently-acceptable practices for shop detailing are said to be followed, and bill of materials is printed. MEISCON CORP., Chicago, Ill. For information:

CIRCLE 134 ON READER CARD

display terminal

The Datanet-760, for the GE-400, 600, or Datanet-30 processors, also has a keyboard for data entry and modification. In addition to alphanumerics, the 64 symbols include four that create

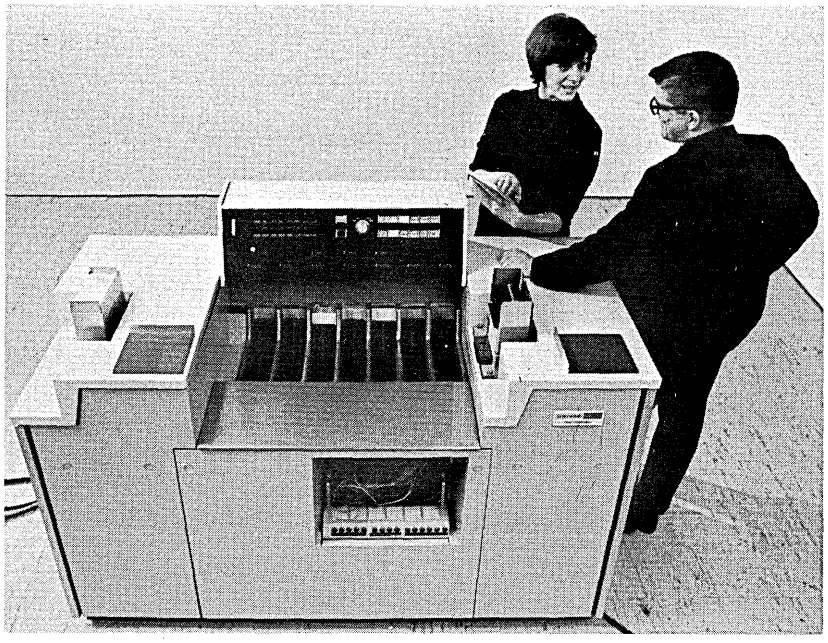
PRODUCT OF THE MONTH

The 1001 Card Controller performs such functions as collating, card editing and proving, sorting, statistical sorting and counting. It also adds, subtracts, and has programmed multiplication capabilities, in addition to 256 (6-bit) words of core to compare, classify data, store constants used for range comparison, and store totals and statistical counts.

Memory cycle time is 12 usec, and operating speed is 2,000 cpm (two card feeds each run at 1,000 cpm). There are seven output stackers with capacity of 1,500 cards each, and comparing and sequencing capacity is 64 card columns. A pre-wired program panel is used to select any one of 18 different collating functions by a flick of a switch. The unit is available in 80- and 90-column models.

Used with the U-1004, it forms a multi-file input, serves as a dual processor, for concurrent processing, and as an independent unit. A "look ahead" feature enables the 1001 to search files for the next transaction while the 1004 processes the current record. There is compatibility of peripherals. UNIVAC DIV., SPERRY RAND CORP., New York, N.Y. For information:

CIRCLE 135 ON READER CARD



NEW PRODUCTS . . .

lines for charts and tables. Unit can display up to 1196 characters at a time, any one or more of which can be erased. Deliveries begin April '66. GENERAL ELECTRIC COMPUTER DEPT., Phoenix, Ariz. For information:

CIRCLE 136 ON READER CARD

data acquisition

Unit accepts punched cards and badges, and transmits information from remote locations to data collection system. Transmission speed is 100 cps. PHILCO INFORMATION SYSTEMS DEPT., Philadelphia, Pa. For information:

CIRCLE 137 ON READER CARD

portable card punch

The 311 has punch settings 0 through 9, plus a no-punch position, and takes standard 51- or 80-column cards. Numeric data is selected by any of 12 variable selectors, and 12 positions may be set for simultaneous punching. There is also automatic interpreting over each column. Weight is 6 pounds. DASHEW BUSINESS MACHINES INC., Los Angeles, Calif. For information:

CIRCLE 138 ON READER CARD

data logger

Compact, modular system reportedly is in same price bracket as a general purpose lab instrument. Basic system includes digital voltmeter, command range unit, scanner, output drive unit, and output module. Scanning for 20 channels, expandable to 50 or 100, is at four rates from three to one-half per second. Provided are five ranges: 20 and 200 millivolts, 2, 20, and 200 volts. Interchangeable output drive modules operate with electric printer-adding machine, tape punch, and electric typewriter. WESTON INSTRUMENTS INC., Newark, N. J. For information:

CIRCLE 139 ON READER CARD

data acquisition/computation

The Series 1200 enables editing and formatting of data on location for immediate analysis and action. The basic system includes a scanner, a-d converter, control and buffer unit, 1K-word digital computer, and I/O gear. Memory is expandable to 4K Among applications are performance analysis, process monitoring, and testing and checkout functions. ELECTRONIC ASSOCIATES INC., Long Branch, N. J. For information:

CIRCLE 140 ON READER CARD

point plotter

The 6550 recorder plots small excursions at 1,200 points/minute, or typical record at 1,000/minute. A 10-watt output servo drives the character printer at 45 ips. Typically, records with frequent large excursions are said to be plotted at an average of 16 channels/second. Accuracy and resolution are provided by an incremental advance chart paper drive that automatically advances the chart 0.025 inch, .050, .075, or .100 inch/channel. HOUSTON OMNIGRAPHIC CORP., Bellaire, Texas. For information:

CIRCLE 141 ON READER CARD

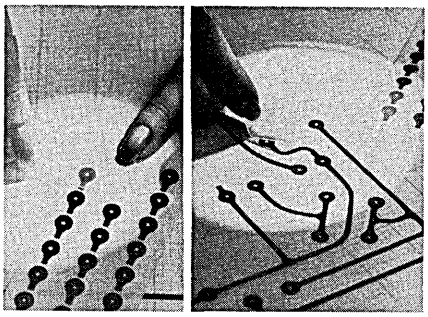
digital strip printer

The MC 13-80 is for data-logging applications, prints at 23 lines/second. Models have 4, 8, 12, or 16 printing positions, each with numerals 0 through 9, and self-contained power supply, timing circuitry and conversion matrix. Registers for 250-usec transfer time and high-order zero suppression are available. MONROE DATA/LOG DIV., San Francisco, Calif. For information:

CIRCLE 142 ON READER CARD

drafting aid

"Tape-Life" centerless pad is of press-and-peel variety for printed circuit drawings. Using Scotch-type tape prevents distortion in moving pad to



proper position. Shapes available include teardrops, donuts, elbows, tees. BY-BUK CO., Los Angeles, Calif. For information:

CIRCLE 143 ON READER CARD

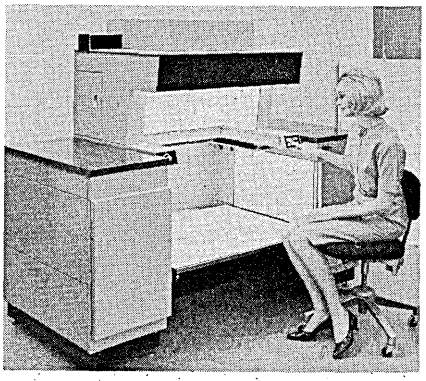
process automation

GE/PAC data loggers are modularly expandable to log and monitor from 20 to 600 points at scanning rates from 1 to 15 points/second. A notch below the process computer in cost, speed, and flexibility, they enable acquisition of sufficient data for programming for the closed-loop system, will alarm when limits are exceeded, and provide records for maintenance schedule. GE INDUSTRY CONTROL DEPT., PROCESS COMPUTER SECTION, Phoenix, Ariz. For information:

CIRCLE 144 ON READER CARD

one-shot aperture cards

The Filmsort 200 films documents on aperture cards, which are produced in 45 seconds. The unit consists of a planetary camera, processor unit, and card mounter. No chemical mixing is necessary, the three solutions coming in squeeze bottles. Two copyboards are available; one accommodates documents to 24x36 inches for a 24:1 reduction ratio, the other reduces 16:1 and holds four 8¼x11 documents. 3M CO., MICROFILM PRODUCTS DIV., St. Paul, Minn. For information:



CIRCLE 145 ON READER CARD

tape drives

The 2415, packaged with two, four, or six drives, is for the 360/20 and 30 computers. Transfer rate is 15KC, densities are up to 800 characters/inch, and speeds up to 18.75 ips. Holding 2400-foot reels, the unit reads tape backwards. IBM DATA PROCESSING DIV., White Plains, N.Y. For information:

CIRCLE 146 ON READER CARD

card shredder

Stacks of punched cards, checks or coupons are shredded by model 20-S, which is fed by conveyor belt leading to 20-inch throat. Steel rotary slitters cut paper clips, staples, and ACCO-type fasteners, all to adjustable and uniform widths. Drive motor is 7½ h.p. INDUSTRIAL SHREDDER AND CUTTER CO., Salem, Ohio. For information:

CIRCLE 147 ON READER CARD

NEW PRODUCTS . . .

tape reel labels

Applicable to a reel, can, rack, document or bin, these self-adhesive labels come in continuous form, packed 2500/box, and are in variety of shapes and sizes. AVERY LABEL CO., BUSINESS SYSTEMS DIV. T, Monrovia, Calif. For information:

CIRCLE 148 ON READER CARD

cartridge disc files

The DS-10 and DS-15 have removable discs, are modularly expandable. The former has two discs, each storing 1.5 million (8-bit) characters. Average access time is 445 msec, and transfer rate is 190KC. The DS-15 (shown) has 7.8 million characters

per disc, has a transfer rate of 259KC, and a head positioning time of 70 msec. Each 16-inch disc is enclosed in a carrying case. The latter is for the 400-series computers. GENERAL ELECTRIC COMPUTER DEPT., Phoenix, Ariz. For information:

CIRCLE 149 ON READER CARD

tape punch

The P-120, with asynchronous operation and unidirectional advance punches up to 120 cps. The unit can punch 5, 6, 7, or 8-level codes. Error control is optional. TALLY CORP., Seattle, Wash. For information:

CIRCLE 150 ON READER CARD

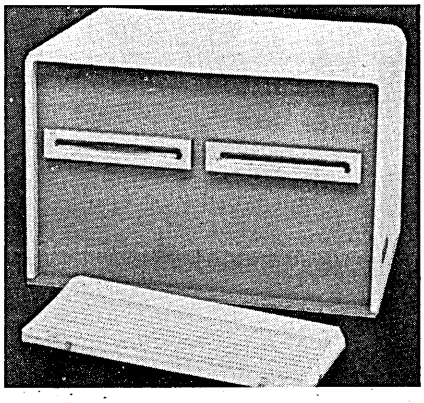
data logger

Modular addition for the firm's Telememory control systems produces a printout in English, rather than coded numbers of letters, can even produce programmed instructions to the operator. The logger operates through a stored program; storage medium is a punched tape, which controls acquisition of data, format of the log, and search and reset functions of the tape reader. MOTOROLA INSTRUMENTATION & CONTROL INC., Phoenix, Ariz. For information:

CIRCLE 151 ON READER CARD

card duplicator

The model 400 duplicates 80-column, 12-row cards at 10 columns/second. Duplication can be complete or partial, at user option. Applications



also include correction and updating. DATA TRENDS INC., Parsippany, N. J. For information:

CIRCLE 152 ON READER CARD

computer trainer

The CT-501 consists of six basic units that show operation of a manually-switched processor with 4-bit words, 10 basic instructions, 100-word drum, and 5-word scratchpad memory. Units are an encoder (input) that converts decimal to binary; decoder (output); arithmetic unit that adds and subtracts; drum and core storage, and control unit. ARKAY INTERNATIONAL INC., Brooklyn, N. Y. For information:

CIRCLE 153 ON READER CARD

card envelopes

Quikvelope holds paper tapes, tab cards, microfilm to the outside of traveling record folders and route sheets. Gummed on three sides, it forms a pocket carrier when stuck to a surface. Envelope sizes and paper stock vary. DENNISON MANUFACTURING CO., INDUSTRIAL PRODUCTS DIV., Framingham, Mass. For information:

CIRCLE 154 ON READER CARD

aperture card retriever

System consists of a rotary file and retriever which selects a randomly filed card, elevates it on a cushion of air for projection on a viewing screen, and automatically refiles it. Hard copies can be made at touch of a button. Entire operation takes 10 seconds. Unit takes up 11 square feet of floor space. MOSLER SAFE CO., BUSINESS PLANNING DEPT., Hamilton, Ohio. For information:

CIRCLE 155 ON READER CARD

speedreaders

The 800 reads 80-column punched cards, column by column, at an asyn-

NEW PRODUCTS . . .

chronous rate of 800 cards per minute. Input capacity: 2500 cards, output: 2000 cards. The 400 reads column by column at 400 cards per minute asychronously. Input: 1500 cards, output: 100 cards. 51-column card operation and card reject hopper are available on both readers. UPTIME CORPORATION, Golden, Colo. For information:

CIRCLE 156 ON READER CARD

paper tape reader

The 119R operates bidirectionally up to 30 cps. Features are separable plastic 5-inch reels, star wheels for tape sensing, and bidirectional stepping. OHR-TRONICS INC., Montvale, N.J. For information:

CIRCLE 157 ON READER CARD

card punch/verifier

The 29 punch and 59 verifier feature typewriter keyboards, storage of two standard punching formats, and internal circuitry made of glass encapsulated reed switches. Verifier uses solar sensors which enable an automatic verification speed of 80 columns/second. IBM DATA PROCESSING DIV. White Plains, N.Y. For information:

CIRCLE 158 ON READER CARD

imprinter-detacher

The Series 400 is designed to slit, imprint, detach, and stack business forms or tab cards in one continuous operation at speeds up to 300 feet/minute. A lever permits conversion from paper forms to tab card forms. MOORE BUSINESS FORMS, New York, N.Y. For information:

CIRCLE 159 ON READER CARD

tape winder

This winder handles perforated, chad or chadless, and printed tapes at speed of 150 characters/second (15 ips). Motor is energized only under take-up conditions; mercury start-stop switch does not wear out. J. H. BUNNELL & CO., New York, N.Y. For information:

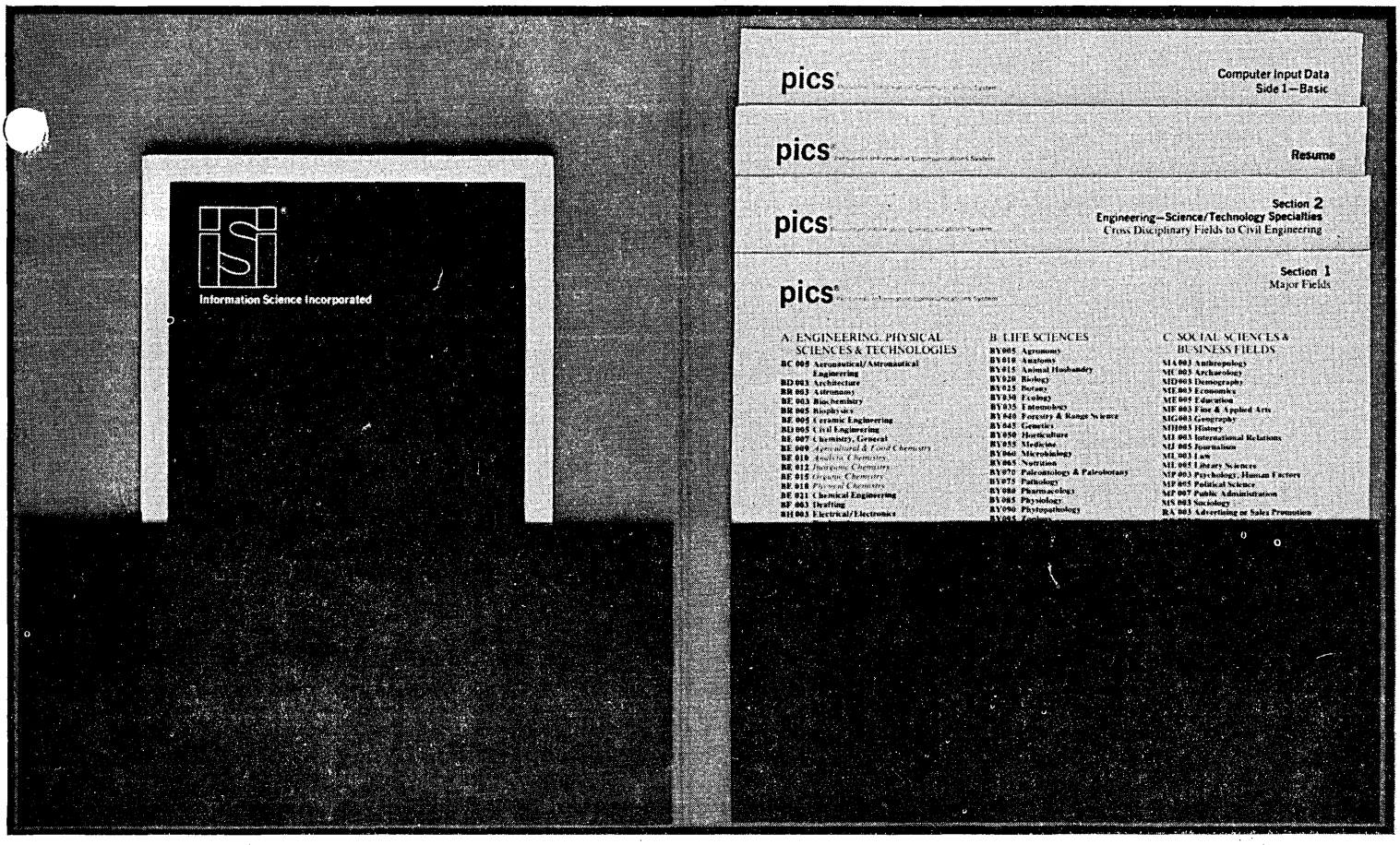
CIRCLE 160 ON READER CARD

memory control

This solid-state memory control accepts, stores, then reproduces data at desired intervals. Signals are fed into a magnetized drum, and the speed of the drum and the angle subtended between the record head and reproduce head determine the delay time of the signals. The control is available with up to 500 channels and will transmit digital or analog information, or voice instructions, ELECTRON OHIO, Cleveland, O. For information:

CIRCLE 161 ON READER CARD

You may not be looking for a better job,



but you ought to know about PICS®.

You may be satisfied with your job and the progress you are making, but wouldn't it be reassuring to know whether your professional capabilities are being challenged and compensated to their full extent?

That is why you ought to know about PICS®, the Personnel Information Communications System, and the direct approach it takes to give you important analyses and financial information about your profession —whether it be engineering, programming, the physical sciences or the life sciences—information that up to this time has been fragmentary.

What sets this service apart is its ability to compile accurate, current and comprehensive reports analyzing the high, low and average salaries in your profession by education, experience, company size and geographic area.

PICS will send you four of these reports during a subscription year. For the first time you will be able to compare your compensation and rate of increase against that of others with similar qualifications and experience. For the first time you will know exactly where you stand, professionally and financially.

PICS can do this for you because it is a powerful and sophisticated computer-based information retrieval system designed to provide experienced professional people with the valuable career information they have long desired.

In addition, PICS can inform you of new opportunities on a nation-wide basis because it has the precision, the memory and the flexibility to select your qualifications and match them with industry requirements that represent professional advancement for you. You have the option of authorizing PICS to send your resume in strict confidence and without risk to your present position to inquiring companies when suitable matches occur. If you choose to have your resume forwarded, PICS will send you the corresponding job descriptions.

From that point on any negotiations with the company are entirely up to you. PICS supplies only the information—it is not an employment agency. You incur no obligations, and may pursue an opportunity or reject it as you see fit.

Act now. Return the coupon for your PICS Resume—Data Pak. All information sent to ISI is confidential. If you do not wish to retain this service after you have seen what PICS can offer you, return the Data Pak and your money will be immediately refunded.

Information Science Incorporated
305 Central Avenue
White Plains, New York 10606

SPECIAL 15 MONTH INTRODUCTORY OFFER

Please send me a Resume—Data Pak and enroll me for a 15 month subscription in PICS, Personnel Information Communications System. If, within ten days, I decide not to retain this service, I will return the Resume—Data Pak and my money will be immediately refunded.

☐ Enclosed is my check or money order for $15.00.

☐ **Bill me in 10 days.**

6

Name_____

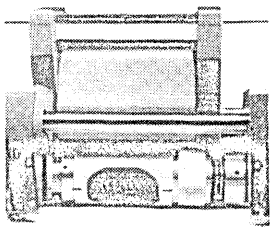
Street_____

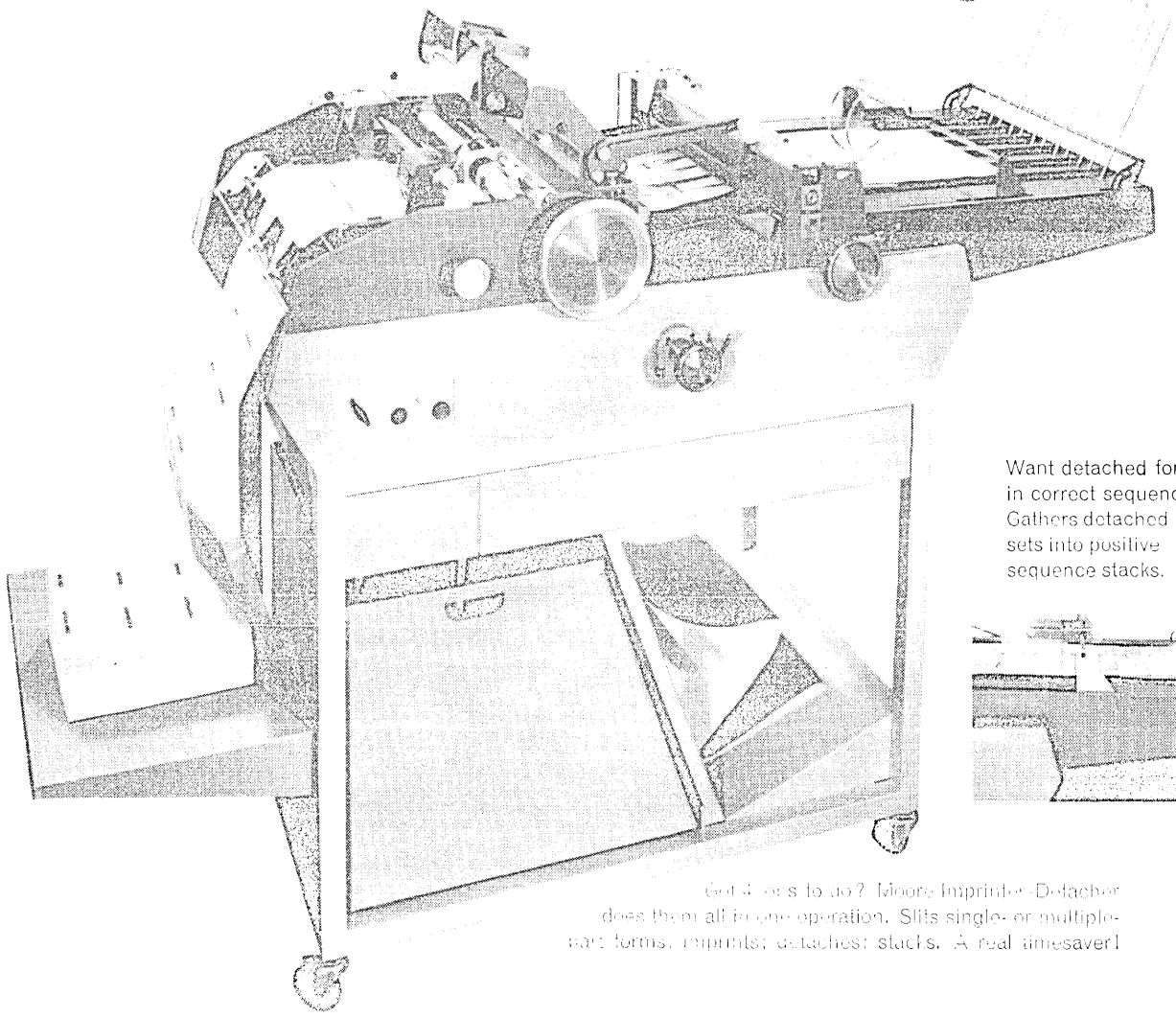
City_____ State_____ Zip Code_____

Information Science Incorporated

CIRCLE 43 ON READER CARD

Easily handles output of one or more high-speed printers. Imprints signatures, dates, other fixed data.





Want detached forms in correct sequence? Gathers detached sets into positive sequence stacks.

Got 3 jobs to do? Moore Imprinter-Detacher does them all in one operation. Slits single- or multiple-part forms; imprints; detaches; stacks. A real timesaver!

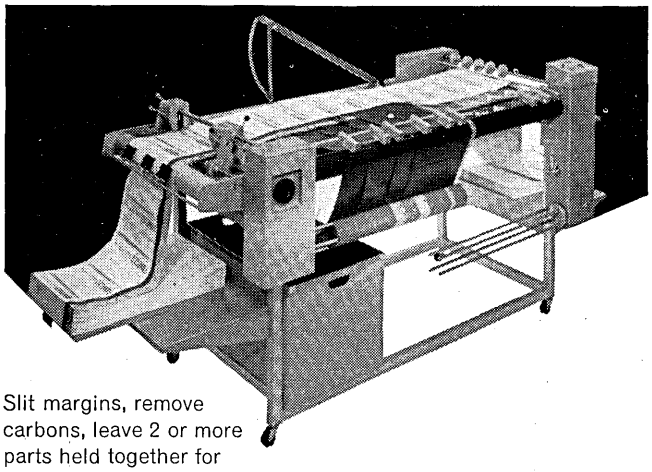
What's new for you...

These timesavers from Moore! They lighten forms-handling loads; save expensive machine time; cut clerical operations.

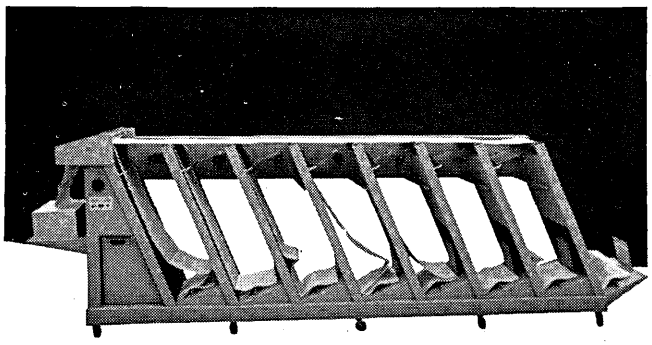
Whatever your problem—from margin-slitting, detaching, decollating, sorting, imprinting, stacking, to converting your typewriters into continuous typing production—Moore has just the right equipment to do the job faster, easier, more economically.

These dependable timesaving units are manufactured to precise specifications by the world's oldest and largest producer of business forms and forms-handling equipment.

With 80 years' experience behind it, Moore has the highly specialized research engineers and the technology to provide the finest line of efficient equipment for after-writing forms processing.

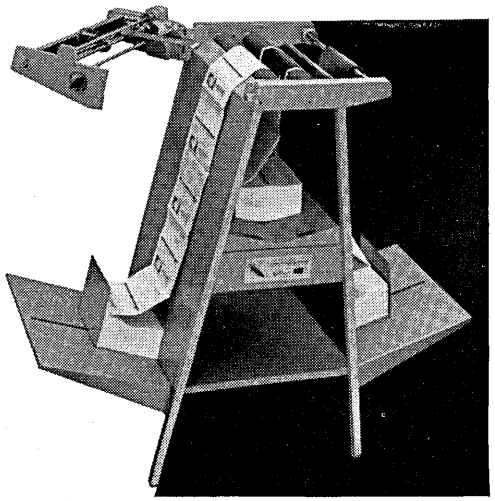


Slit margins, remove carbons, leave 2 or more parts held together for subsequent handling. Moore Power Deleaver removes carbons from continuous forms up to 8 parts.



For high-speed decollating, this Moore Multi-Web Decollator does the job. Slits margins; removes carbons; separates opaques; refolds. In 4-web, 6-web, 8-web units. A real timesaver!

Get continuous production from typewriters or bookkeeping machines. Moore Flexible Formaliner permits use of continuous forms in typing; Vertical Spacer skips forms past non-write areas.



Where forms are to be decollated, carbon neatly rolled for clean, easy disposal, this Moore Decollator does the fastest job. Slitter attachment available to remove one or both margins.

at Moore?

Attractive in appearance, Moore timesaving equipment lightens handling for forms-processing loads, makes the job easier.

In addition, Moore offers special equipment that can be designed and engineered to your specific forms-handling requirements.

These timesavers are also space-savers, taking minimum floor footage for each unit of effective modern design. Whatever your need, ask the Moore man for details. If you work with forms, we can show you how to make forms work for you.

MOORE BUSINESS FORMS, INC.

'The right business form for every form of business.' Niagara Falls, New York • Park Ridge, Illinois • Denton, Texas • Emeryville, Calif. • Over 500 offices and factories in North America.

CIRCLE 24 ON READER CARD

Do You Have To Go Fishing While Waiting For A Report?

YOU HAVE NO WAIT WITH **CLEAR!**

CLEAR is the most versatile generalized information retrieval and reporting system for use on a 16-k 1401, 1460, and 1410 tape system.

- No compilation, uses only object programs.
- Simple control cards that can be filled on a clerical level.
- No special input format required.
- Minimizes program preparation time.
- Applicable to all computer applications.

For further information contact:

Mr. Clear Area Code 713 Mi 4-2222
Computer Laboratories, Inc.
7015 Gulf Freeway
Houston, Texas 77017

CIRCLE 46 ON READER CARD

PROGRAMMERS PROGRAMMERS

Think twice . . . about the work you are doing . . . and the opportunities RCA has to offer.

If you seek greater challenge on varied, vital projects, consider these immediate openings.

SCIENTIFIC PROGRAMMERS

Positions developing computer programs for unusual prediction applications. Challenging assignments which include development of new concepts as well as application of current disciplines. You should have at least 3 years experience, one of which must have been in real-time programming, communications, information retrieval or scientific applications on computers such as 501, 3301, 7090, 7094, B-5000, 1604, H-800, C-8000, 7300 ADX, 1103, 3600.

COMMUNICATIONS PROGRAMMERS

These positions are on the new Automatic Data Information Network. This is one of the largest real-time store and forward data communications systems in existence. Entails programming and implementing operational and utility programs. Experience with large-scale data switching systems desirable.

BUSINESS PROGRAMMERS

These positions involve work with large-scale business problems. There will be future opportunity for training on new RCA equipment if you have actual programming experience on the 501 or 301 systems. Some of these positions involve travel.

In addition to excellent salary, RCA offers an outstanding benefit plan including company-paid medical coverage for you and your family.

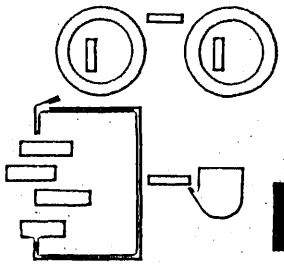
To arrange confidential interview, send your resume to:

Mr. J. H. Barnes, Jr., Mgr. of Recruiting
RCA Service Company, Dept. Y-110
Cherry Hill, Camden 8, New Jersey

An Equal Opportunity Employer

The Most Trusted Name In Electronics

CIRCLE 94 ON READER CARD



NEW LITERATURE

PROCESS CONTROL: Systems which provide control from transmitter to power device are described in 12-page illustrated brochure. Analog computing system is tailored to meet specific requirements of processes including power plants, cement mills, and steelmaking facilities. BAILEY METER CO., Wickliffe, Ohio. For copy:
CIRCLE 162 ON READER CARD

FACSIMILE RECORDER: RJ-4 weatherfax, explained in brochure, reproduces weather maps on plain white paper and features continuous recording, automatic level control and automatic start and stop. Also accepts writing, and can be erased without smudging. WESTREX COMMUNICATIONS, DIV. OF LITTON INDUSTRIES, New Rochelle, N. Y. For copy:
CIRCLE 163 ON READER CARD

ACCOUNTING SYSTEM: 12-page brochure describes features of accounting system which provides computation of price extensions, discounts, taxes, interest, dividends, commission rates. THE NATIONAL CASH REGISTER CO., Dayton, Ohio. For copy:
CIRCLE 164 ON READER CARD

TAPE READER/PUNCH STATIONS: Specifications on series 500 paper tape reader/punch stations are described in data sheet. Timing charts and price information are included. ROYAL MCBEE CORP., INDUSTRIAL PRODUCTS DIV., Hartford, Conn. For copy:
CIRCLE 165 ON READER CARD

MEMORY EXERCISER: Model SEE-1100 tests complete core memory systems and employs integrated circuits to perform all logic, timing and error checking functions. Eight-page booklet includes photos of the system, functional modules that make up the major sections, and a photo of a typical plug-in integrated circuit logic card. Overall system block diagram also is shown with description of system operation. COMPUTER TEST CORP., Cherry Hill, N. J. For copy:
CIRCLE 166 ON READER CARD

EDUCATIONAL COMPUTER: Four-page brochure describes features and capabilities of the DIGIAC 3080 educational computer designed specifically for training students at all levels in programming, maintenance, use and operation of digital computers in business and science. DIGITAL ELECTRONICS INC., Westbury, L.I., N.Y. For copy:
CIRCLE 167 ON READER CARD

SELECTOR SWITCHES: Four-page brochure illustrates and describes a line of crossbar type selector switches for programming, circuit design and testing, sequencing automatic equipment and other applications. Data includes engineering drawings, dimensions, ordering information and prices. CHERRY ELECTRICAL PRODUCTS CORP., Highland Park, Ill. For copy:
CIRCLE 168 ON READER CARD

DIFFERENTIAL EQUATION SOLVER: 44-page brochure with illustrations and block diagrams details operation and theory, and eight-page brochure presents description of the characteristics of DES-1. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For copy:
CIRCLE 169 ON READER CARD

DESK SIZE TELEPRINTER: Data sheet lists characteristics and features of TP-4000 series teleprinter. MOTOROLA, MILITARY ELECTRONICS DIV., Chicago, Ill. For copy:
CIRCLE 170 ON READER CARD

PUNCHED CARD PROGRAMMER: For use with automatic systems, programmer uses standard RemRand cards, which include all programming information. Information on materials, finishes, reliability, warranty, performance ratings, dimensional diagrams, and pricing are included. DREXEL DYNAMICS CORP., Horsham, Pa. For copy:
CIRCLE 171 ON READER CARD

DIGITAL DATA RECORDING: Four-page brochure details the DDR-2 for conversion of analytical instrument output to a format suitable for digital computer entry. Applications are described and an installation diagrammed. PERKIN-ELMER CORP., ELECTRONIC PRODUCTS DIV., Norwalk, Conn. For copy:
CIRCLE 172 ON READER CARD

PRINTING CALCULATOR: Four-page brochure describes high speed calculator with perpetual action keyboard. Problems are accepted in continuous entry as fast as human skills permit, while the machine prints answers in an uninterrupted flow. MONROE INTERNATIONAL INC., Orange, N. J. For copy:
CIRCLE 173 ON READER CARD

TAPE MANAGEMENT PROGRAM: Six-page brochure presents the importance of tape maintenance. Chart demmonstrates how a center for rehabilitation and maintenance functions as part of a computer installation to keep poor quality tape out of the operations area. GENERAL KINETICS, INC., Arlington, Va. For copy:
CIRCLE 174 ON READER CARD

SOURCE ORIENTED DATA ACQUISITION: 10-page brochure covers and illustrates all hardware and flow charts comparative systems, and 25 major applications for using SODA digital recording equipment as source data capture devices for computer input. UGC INSTRUMENTS INC., Houston, Tex. For copy:
CIRCLE 175 ON READER CARD

INDUSTRIAL CONTROL THROUGH ELECTRONICS: Folder gives summary form of line of electronic counters, transducers, converters and controls, as well as capabilities for custom design and manufacture of special electronic products such as process automation and control systems. VEEDER-ROOT INC., ELECTRONICS CONTROLS DIV., Danvers, Mass. For copy:
CIRCLE 176 ON READER CARD

REAL-TIME COMPUTER: Brochure describes ITI 4900 for system control and engineering computation. Organization, command list, expandable sys-

NEW LITERATURE . . .

tem, and information storage and retrieval system are covered. INFORMATION TECHNOLOGY INC., Sunnyvale, Calif. For copy:

CIRCLE 177 ON READER CARD

PROCESS COMPUTER: In 12 pages booklet describes role of process control computer in industrial automation, its features, function and capabilities, where and how used, and distinguishing points from gp computer. GE INDUSTRY CONTROL DEPT., PROCESS COMPUTER SECTION, Phoenix, Ariz. For copy:

CIRCLE 178 ON READER CARD

OSCILLOSCOPES CATALOG: Listed are over 50 oscilloscopes plus both general-purpose and highly specialized oscilloscope plug-in units, including spectrum analyzers. TEKTRONIX, INC., eBaverton, Ore. For copy:

CIRCLE 179 ON READER CARD

PRODUCT SUMMARY: Systems and units presented include data recording, a-d converters, analog multiplexers, random and sequential access memories, mag tape adapters and format control buffers. ELECTRONIC ENGINEERING CO., Santa Ana, Calif. For copy:

CIRCLE 180 ON READER CARD

DIGITAL STRIP PRINTERS: Bulletin contains descriptions of operating principles, complete with simplified schematic and a graphic presentation of the timing cycle of Series 1200. Specifications give a detailed price breakdown. FRANKLIN ELECTRONICS INC., Bridgeport, Pa. For copy:

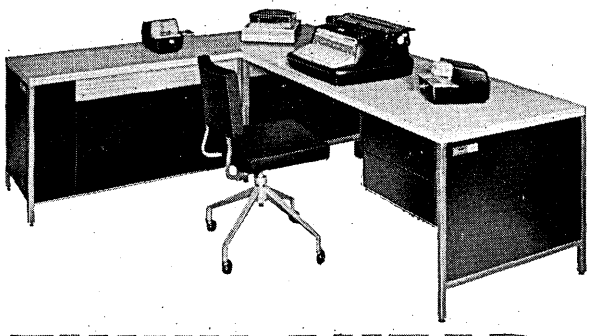
CIRCLE 181 ON READER CARD

SCHOOL ATTENDANCE RECORDS: 81-page report summarizing development of the system and a detailed procedures manual, with sample forms, description of the codes, instructions for local school personnel and the central attendance office, card layouts, and machine processing instructions. Cost: $5. STANFORD RESEARCH INSTITUTE, Menlo Park, Calif.

ANALOG-DIGITAL CONVERSION TECHNIQUES: 73-page handbook consists of seven chapters covering basic elements of conversion, measure of converter performance, special analog-digital conversion techniques, typical converter logic, basic circuits, interconnection and calibration, testing an analog-digital converter. Also included are appendices, illustrations and tables. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:

CIRCLE 182 ON READER CARD

WHOLESALER:
DISTRIBUTOR:
MANUFACTURER:



THINK AHEAD

WHEN YOU THINK OF PAPERWORK AUTOMATION, THINK SCM

The Wonderful Typetronic 7816 built by SCM Corporation is the revolutionary data computing system that puts paperwork automation within reach of all Businessmen.

Your regular typist operating this system can furnish you with all these business controls and reports. When you want them — and for less than $350 per month.

- A daily or weekly costed inventory report.
- Your billing clerk automatically stopped if she attempts to prebill an item not in stock.
- A weekly report on items that a computer determines should be purchased, based upon a minimum level formula.
- Your shipping department automatically notified not to ship if an order exceeds your credit requirements.
- The knowledge that your customer's name, address and your product description are always typed accurately.
- A gross profit report on each item and on each invoice.
- A complete analysis of each of your salesmen's activities.
- The knowledge that all your invoices are automatically and accurately calculated.

And many more.

Easy programming and solid state electronic design insures maximum reliability. The future's built in. Modular design permits the addition of other components at any time, by simply plugging them in. That's why today, more and more people who think ahead, think SCM — JUST ASK US.

SCM® **DATA PROCESSING SYSTEMS**
DIVISION OF SCM CORPORATION

410 Park Avenue, New York, New York 10022

TYPETRONIC 7816 CREATED BY THE MAKERS OF SMITH-CORONA TYPEWRITERS AND MARCHANT CALCULATORS. ALL TRADEMARKS OF SCM CORPORATION.

CIRCLE 49 ON READER CARD

Many of the outstanding achievements in science and technology during the past 10 years have been recorded, analyzed and preserved on tapes of "Mylar."* When reliability counts, count on "Mylar."

*Du Pont registered trademark for its polyester film.

DU PONT
REG. U. S. PAT. OFF.

only DU PONT makes MYLAR® POLYESTER FILM

BETTER THINGS FOR BETTER LIVING ... *THROUGH CHEMISTRY*

CIRCLE 53 ON READER CARD

THE DATAMART

PROFESSIONAL SERVICES

MANDATE

Management Data Engineering for Business and Industry

Computer Systems — Consulting — Design — Development — Applications
Batch Processing — Real Time — Time Sharing
Programming — Language Development — Implementation — Documentation

J. B. WIENER
Director

R. KORFF
Applications Manager

Management Data Engineering

3033 N. Central Avenue
Phoenix, Arizona 85012
Phone 60-277-6178

JUSTIN A. PERLMAN
PRESIDENT

THE LAMELLAR CORPORATION OF AMERICA

1011 SWARTHMORE AVENUE
PACIFIC PALISADES, CALIFORNIA 90272
TELEPHONE (213) 454-7244

B. GINSBERG & CO.
BUYERS OF SCRAP TAB CARDS

JERRY GINSBERG

66 E. CANTON STREET
BOSTON 18, MASS.
HANCOCK 6-5698

BUSINESS OPPORTUNITIES

EXCLUSIVE FRANCHISE
Amazing new liquid plastic coating used on all types of surfaces interior or exterior. Eliminates waxing when applied on Asphalt Tile, Vinyl, Linoleum, Vinyl Asbestos, Hard Wood, and Furniture. Completely eliminates painting when applied to Wood, Metal, or Concrete surfaces. This finish is also recommended for boats and automobiles.

NO COMPETITION
As these are exclusive fromulas in demand by all businesses, industry and homes. No franchise fee. Minimum investment—$300. Maximum investment—$7,000. Investment is secured by inventory. Factory trained personnel will help set up your business.
For complete details and descriptive literature write:
CHEM-PLASTICS & PAINT CORP.
1828 Locust, St. Louis 3, Mo.

NEW EQUIPMENT

We have available MAGNETIC LEDGER CARDS for IBM 6400 systems. Any size available from stock. K Service, 95D High Street, Newark, N.J. 07104 Area code 201 623-8911.

USED EQUIPMENT

IBM 7070 System for sale. 5K memory, floating point, five 72911 tapes, card reader, punch, printer, tape switching capability. Delivery Jan. 1966. Past usage one shift. Reasonable price Box 6-1.

Wanted . . . Used EAM Equipment 024, 026, 056, 083, 084, 088, 407, 519, 521, 604, 548, 557, 1401 Furnish specifications, age of machine and asking price. Cash transaction. Inquire Box 6-3.

UNIVAC File Computer General Storage Drums for sale. Type 6912 Drum only.

1,260,000 bits of storage, 300 channels, 1750 RPM's. Average access 17 milliseconds. Excellent for use as a Fast Random Access File.

Like new condition. Will warrantee. Reasonable price. Inquire Box 6-2.

IBM 402, #19962-AZ, 100/150 speed, 56 counters, 43 Alpha, 30 Num. 110 Volt AC. $3485.00 or $104.55 monthly for 40 months.

FLEXOWRITER, Model SPD #19954, 8 Chan Tape In and out. Used for program preparation only. $2120.00 or $63.60 monthly for 40 months.

Both machines warranted to operate properly. F.O.B. Detroit. R. R. Stofflett, 89 Vernier Road, Grosse Pointe 36, Michigan, 313 884-7277.

HELP WANTED—educational institutions

SYSTEMS ANALYSTS AND PROGRAMMERS Positions available for research oriented senior systems and programmer personnel. Will assist in development of computer-based publications and services for a unique chemical information center. Growth potential in an expanding organization. Liberal employee benefits, including four week vacation for established employees. Call or Write: Personnel Department, The Chemical Abstracts Service, The Ohio State University, Columbus, Ohio 43210, Phone: 293-4168, All inquiries treated confidentially. An Equal Opportunity Employer.

Programming Analyst with engr/scientific experience. Research and staff aid in numerical and statistical applications. Non-numeric interest desirable. Doctoral work in Info Science, Engr, Math, Ind. Eco., available. Write Computing Laboratory, Lehigh University, Bethlehem, Pa. Inquiry confidential. Equal opportunity employer.

POSITIONS WANTED

Experienced Analyst/Programmer Independent, desires contract work in design and/or implementation. Quality performance at reasonable rates. Inquire Box 6-4

SITUATIONS WANTED

Meet Your Programming Commitments. Large pool of qualified personnel to work evenings and part time. All languages, any computer. Immediately available Los Angeles area. Results are guaranteed. Send requirements to Box 6-5.

Address all replies to box number advertisements as follows:

Box.....
DATAMATION
F. D. Thompson Publications, Inc.
141 East 44th St.
New York, N. Y. 10017
Classified Advertising

DATAMATION

Classified Advertising

The classified section is open for the following advertising categories: Used equipment; positions wanted; help wanted, educational institutions; maintenance services; professional cards; hobby products; business opportunities and educational courses. Rates are based on total number of insertions used within each contract year.

Minimum for all advertising—1 column inch. Exception—for Situations Wanted we will accept ½ inch column. See rates below. Maximum vertical space—4 column inches*. Maximum horizontal 2 column inches deep. Larger units are billed at display rates. Rates for advertising (classified only).

	1X	6X	12X
1 column inch ..	40.00	37.00	34.00

* 1 column inch is defined as 1 column wide by ¾" deep.

Classified rate cannot be earned in combination with display advertising.

Rates for Situation Wanted—payable in advance.

For Situations Wanted only:

	1X	3X
½ inch column (4 lines of type) ..	20.00	18.00

Plus $2.00 for box number. Box number counts 1 line. Situations wanted accepted from individuals only.

Mechanical requirements:

1 column inch .....2-3/16"
½ inch column .....2-3/16"
Depth
¾" (1 column width 2-3/16")
⅜" (2 column width 4-9/16")

Issuance and closing dates: Issued 15th of month. All copy must be in New York. N. Y., by 10th of preceding month. All copy subject to publisher's approval.

For further information please contact: DATAMATION Magazine, Classified Advertising Dept., 141 East 44th Street New York, N. Y. 10017—212-MU 7-5180.

KEY MAN FOR G. E. LINEAR PROGRAMMING EFFORT

Positions calls for a technical heavyweight capable of carrying full responsibility for the development of extensive linear programming packages in support of G.E.'s new family of large scale computers. This isn't purely an "inside" desk job —it calls for someone with the capacity for working well with recognized experts in the field as well as consulting with G.E. customers—some of whom are the most sophisticated users in the nation.

There is also opportunity to continue in development work in the area of integer programming, non-linear programming and optimization.

REQUIREMENTS: Advanced degree in operations research or equivalent experience.

ALSO:
Some openings exist on the intermediary level for individuals with experience preferably in such areas as design, implementation and application of large scale programming systems.

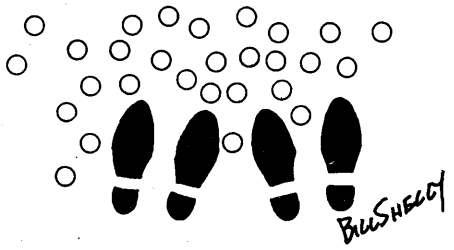
Please write full details, including salary requirements, to: Mr. K. L. Hill, Administrator, Professional Placement, General Electric Co., Computer Dept. Room 42-F, P.O. Box 270, Phoenix, Arizona.

COMPUTER DEPARTMENT

GENERAL ELECTRIC

an equal opportunity employer

CIRCLE 97 ON READER CARD



"It was bound to happen—this computer was built by a firm that used to manufacture slot machines!"

PROGRAMMERS • ANALYSTS • ENGINEERS

Our clients offer immediate professional career opportunities to qualified men who are ready to further their goals.

Locations are currently available in New England, New Jersey, Philadelphia, Washington, D.C., Florida and the Midwest.

Consult with us to plan the full use of your professional potential—whether at Junior, Senior or Management levels. Important assignments require experience and interest in any of these areas:

- **Scientific Programming**
- **Digital or Logic Design**
- **Real Time Systems**
- **Circuit Design**
- **Software Development**
- **Operations Research**
- **Mathematics**
- **Applied Systems**
- **Development Engineering**
- **Systems Design**
- **Commercial Programming**

Starting salaries range to $25,000, according to your experience level; all fees and expenses are assumed by our client companies. Please forward your resume in strict confidence, including salary and geographic preference, to Mr. R. L. Keilholtz or Mr. Donald Wayne.

NATIONAL EMPLOYMENT ASSOCIATION SERVICE MEMBER

EVERETT KELLEY ASSOCIATES

Consultants to the Computer Industry

121 So. Broad Street (Suite 1300) Philadelphia, Pa. 19107

EKA

CIRCLE 98 ON READER CARD

OPPORTUNITIES FOR PROGRAMMERS

Engineering and Scientific Programmers

Positions are available for engineering and scientific programmers with a minimum of a BS Degree and 2 years' experience in symbolic programming for large-scale digital computers. Assignments will involve engineering and scientific programming applications. In addition, programmers are needed to program a real-time tracking and navigation problem for the Apollo Instrumentation Ships project. The tasks include real-time program organization, multi-channel input/output for peripheral equipment, utility and diagnostic routines, data simulation, and programs for analysis and synthesis of the tracking and navigation data. Equipment utilized is an IBM 7094-44 directly coupled system.

Business Data Processing Programmers

Positions open for creative EDP programmers with minimum 2 years' experience with 1460, 7010, 7074 tape systems. A systems background and college degree are highly desirable, but not essential, if experience demonstrates a high level of ability in the field. The department is in the process of converting its business applications to systems/360, and is also pursuing an active role in the design and implementation of a total information system. If you desire to become an integral part of the company's management systems organization, this is a genuine opportunity for professional recognition, rapid career advancement, and technical challenge for years to come.

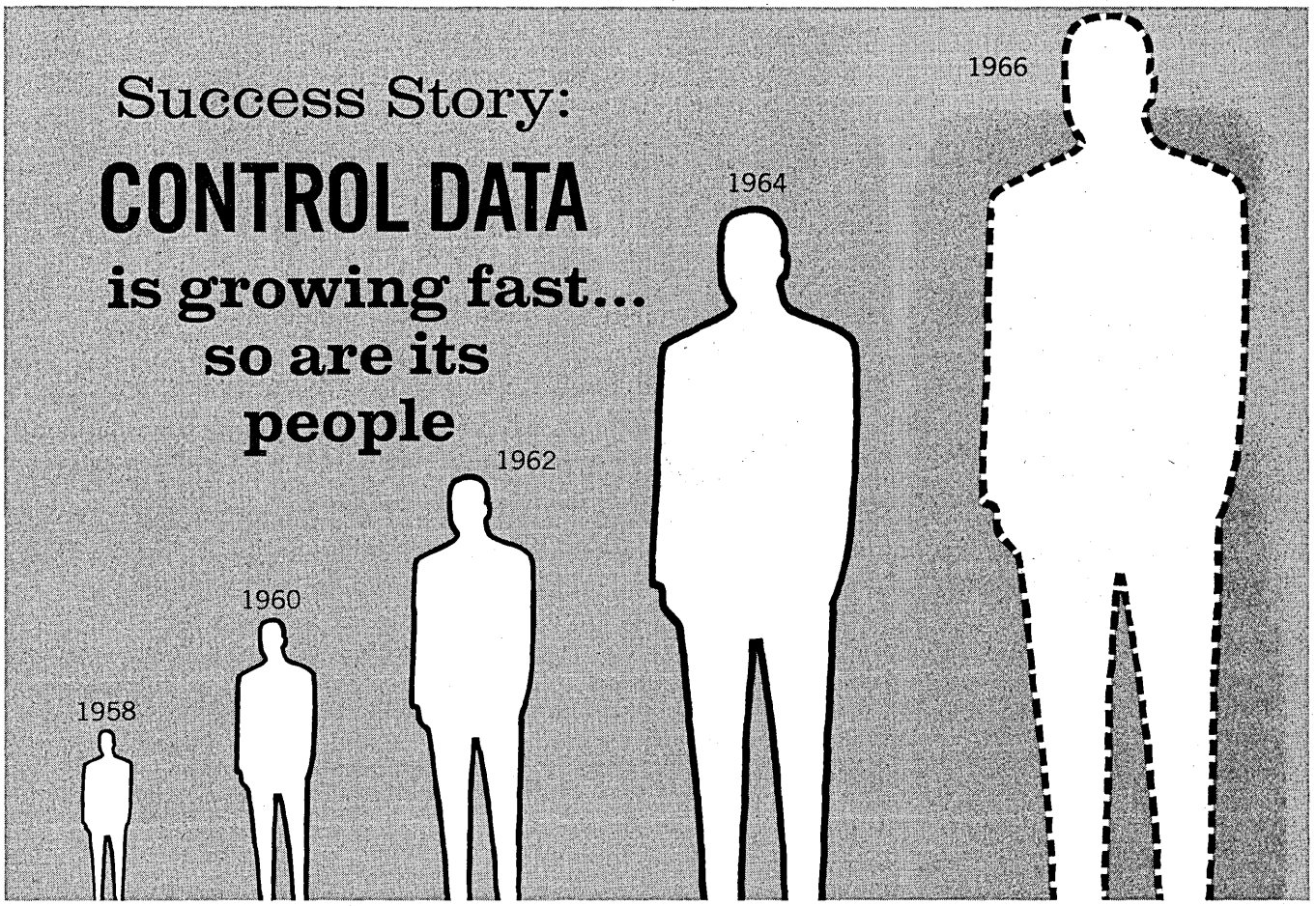
Send resume, at once, to:
H. E. Pasek
Chief of Professional Placement and Personnel

GENERAL DYNAMICS/CONVAIR

5501 Kearny Villa Road
San Diego, California 92112

An Equal Opportunity Employer

CIRCLE 99 ON READER CARD



Investigate these opportunities for your personal growth and success

Control Data is growing rapidly. The number of people now employed is 5 times what it was in 1963. We have grown by giving our employees exceptional freedom to develop and reach their full potential. They enjoy a strong measure of personal success based on the unprecedented growth of the corporation.

If you would like to be a member of one of the fastest growing teams in the business world, then talk to us at Control Data. Our continuing success is creating opportunities which may be the beginning of your personal good fortune.

Check these career opportunities and air mail us your resume. Interviews arranged at Employment Centers around the nation.

PROGRAMMER ANALYSTS: Analyze Data Center Customer problems for customer's computer applications. Responsibilities also entail work in sales support and the preparation of programming proposals. Experience on large-scale machines in either commercial or scientific programming is necessary. Commercial applications background should include payroll, A/R, A/P, inventory control, school scheduling, etc. Los Angeles, Palo Alto, Washington, D.C., Minneapolis, Houston and Long Island locations.

SYSTEMS PROGRAMMER ANALYSTS: New application areas for high-speed digital computers and programming systems. Positions require varied backgrounds in command and control, real time, monitor systems and knowledge of scientific programming languages. A degree in math, physics or engineering and a minimum of three years' experience are required. Los Angeles location.

PRODUCT MANAGEMENT: Openings in advanced planning require a technical degree and a minimum of two years experience in technical market requirements, programming systems design, systems organization, management information systems, or time sharing systems. Keen interest in computer advances and management communication ability desirable. St. Paul location.

ENGINEERING SOFTWARE: Diagnostic and Acceptance Test Programming—Develop software capable of detecting logic faults and marginal operation in equipment. Mechanized or Automated Design—Develop software to aid the design process and to produce the necessary manufacturing documentation. Hardware/Software Analysis—Develop software to evaluate systems performance. Familiarity with benchmark problems, instruction mixes, compilers and monitors. Minneapolis location.

SALES SUPPORT ANALYSTS: Pre-Sales Support—Assignments include customer and prospect contacts, presentation and proposal preparation. A knowledge of industry-compatible software required. Installation Support—Requires a knowledge of monitors and software systems. Assignments include on-site customer support. Training—Assignments include customer training and development of training aids and presentation materials. Travel necessary. On-Line Application—Experience in real-time programming, message switching, process control or data transmission preferable. Assignments will include pre-and post-sales support. Nationwide locations.

Employment Centers in New York, Washington, D.C., Minneapolis, Palo Alto, Los Angeles will promptly review your qualifications and interests.

Rush resume and indication of positions of interest to:

R. G. BROSTROM
Dept. 1M
CONTROL DATA CORPORATION
8100 34th Ave. So., Minneapolis, Minn. 55440

Where success creates opportunities

CONTROL DATA CORPORATION

An equal opportunity employer

CIRCLE 51 ON READER CARD

Continued from page 71

fed into the machine, which extracts them for sorting at up to 90,000/hour. Sorting is achieved by reading CMC7 or E13-B codes. Account processing and file updating are then handled by a TRP computer, special model of Telefunken's TR4.

BUY BRITISH AND WIN VOTES

Indications that U.K. manufacturers can expect to get the bulk of outstanding government orders came from Prime Minister Wilson. Under pressure from opposition jibes that he'd sold the British aircraft industry down the river and was about to do the same for computer makers, Wilson said the government had won a hard fight to save the British computer industry.

Mystified but interested parties read this as a guarantee that long-awaited decisions on megabuck contracts from the Ministry of Pensions and National Engineering Lab, plus current university awards, must be coming to home-based firms. By mid-June, at least two hardware houses should be gleeful. For, as prime contenders in these fields, ICT and English Electric-Leo-Marconi have high expectations for 1907's and Leo 326's, all $1-million systems. There could still be disappointments.

The sensitive political climate here is shown by the resignation of an ICT public relations man from the Bow Groups Automation Committee, the Conservative party's club of young intellectuals that often formulates ideas adopted by Tory Parliamentarians. The resignation came after the PR man told his employers of an Automation Committee meeting attended by Edward Heath, one of the "shadow cabinet" men due for a top post if the opposition ever regains power.

In normal politico-industrial relations, it is difficult to find precedence for such an event. But after a 13-year run in office that ended last November, Conservatives are still smarting from defeat by a party running on a "modernisation and technology is our future" ticket.

T-S SERVICE BUREAU OPENS IN ENGLAND

Computer Services (Birmingham) Ltd., situated in the heart of England's industrial Midlands, has joined with a Rotterdam consultancy in a scheme labelled Data Linkage. This uses the bureau's U-1107 for time-sharing around 1004's via telephone lines. Links have been established with users up to 150 miles away. By fall of this year, a further hook-up is expected across the North Sea to a Dutch customer.

ODDS & ENDS

Resignation of AEI Ltd. from ECMA is interpreted as the company's withdrawal from the dp market, an activity reported to have cost the company about $10 million. AEI Automation is still building its process control activity...A new company, English Electric Automation, has been formed to coordinate all activities of Marconi, EE-Leo Computers, and the industrial and electronic divisions of English Electric...The Canberra Computer Society has been formed in the Australian capital, site of the Bureau of Census & Statistics and the CSIRO. Next step: formation of a national society...Digital Equipment is considering building the PDP-8 in Britain. The machine reportedly accounts for more than half the some-60 DEC orders in Europe...Discussions are in progress for ICT to take the Univac 1001 on a non-exclusive marketing basis.

PHYSICIST or MATHEMATICIAN

PARTICLE ACCELERATOR, Sponsored by the AEC Operated by Princeton Univ. & the Univ. of Pennsylvania; located at Princeton Univ.

This new basic research tool has positions for PROGRAMMERS with some experience, having strong theoretical background. The work concerns a program of pattern recognition and digitizing of bubble and spark chamber film. Strongly versatile persons capable of high level independent work are required. They will participate in the conception, design and execution of this program.

Work in suburban Princeton area. Salary comparable to industry. Unusual benefits include 4 weeks vacation, tuition loan program with loan forgiving feature and generous retirement plan.

Write to A. C. ALLEN

ACCELERATOR

P.O. Box 682, Princeton, N.J.

An equal opportunity employer

CIRCLE 100 ON READER CARD

OPERATIONS RESEARCH

One of the country's largest producers of energy offers a challenging opportunity in Operations Research in an expanding research program. Since 1957 Consol's Research Division has been engaged in a multimillion dollar research program to develop major new coal outlets in the electrical, fluid fuels, steel, and chemical markets. This effort is being intensified.

Our current opening is for a B.S., M.S., Ph.D. Chemical Engineer for Operations Research. This position requires strong mathematical training for work in our computer center (digital and analogue computers). Assignments include development of programs and the coaching of other scientists and chemical and mining engineers in the use of computer technology.

Location: Library, Pa. (13 miles south of downtown Pittsburgh in suburban South Hills.)

Starting salary commensurate with education and experience. Excellent employee benefits including liberal stock purchase plan.

Please send résumé of education, experience, references and salary requirements to:

Dr. W. F. Saalbach, Personnel Director
Research Division

CONSOLIDATION COAL COMPANY

Library, Pa.
An Equal Opportunity Employer

CIRCLE 101 ON READER CARD

NCR

TOTAL EDP SYSTEMS

Continued expansion of the EDP effort of the National Cash Register Company in the United States has created outstanding opportunities for individuals with professional experience in commercial EDP systems. Due to the nature of the EDP industry, there is a strong requirement for people with flexibility in their planning, but firmness in their objectives. Key positions for your consideration are listed below.

PROGRAMMING RESEARCH

The desired background would be a college education plus two years or more of programming experience with magnetic tape and random-access systems. Challenging opportunities exist in new and diverse problem areas in commercial applications. Primary assignments would be in Dayton, Ohio; however, willingness to travel and relocate is necessary.

SYSTEMS ANALYSIS CUSTOMER REPRESENTATIVE

General requirements are two years or more experience in programming with related systems analysis in commercial applications involving medium-to-large scale magnetic tape and random-access systems. Openings are in various parts of the United States. After an initial period of orientation, every attempt will be made to assign individuals to the general region of their preference.

This is the time to investigate these opportunities. Each reply will be promptly acknowledged.

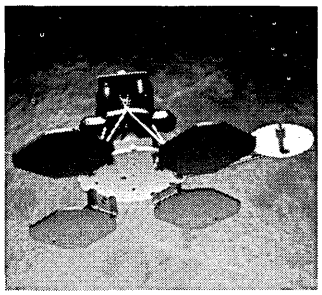
Please address inquiries to:

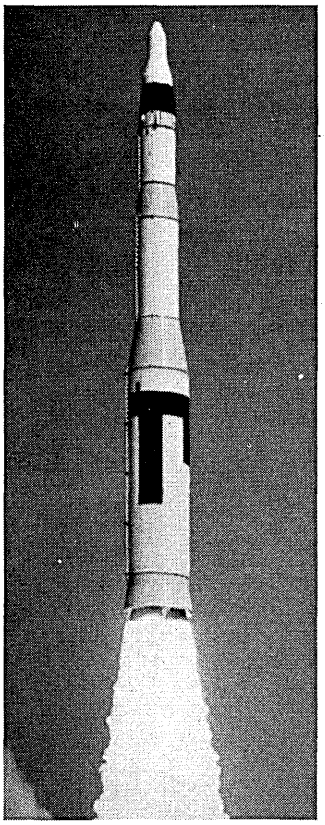
Mr. Thomas F. Wade
Technical Placement
The National Cash Register Company
Main & K Streets
Dayton, Ohio 45409

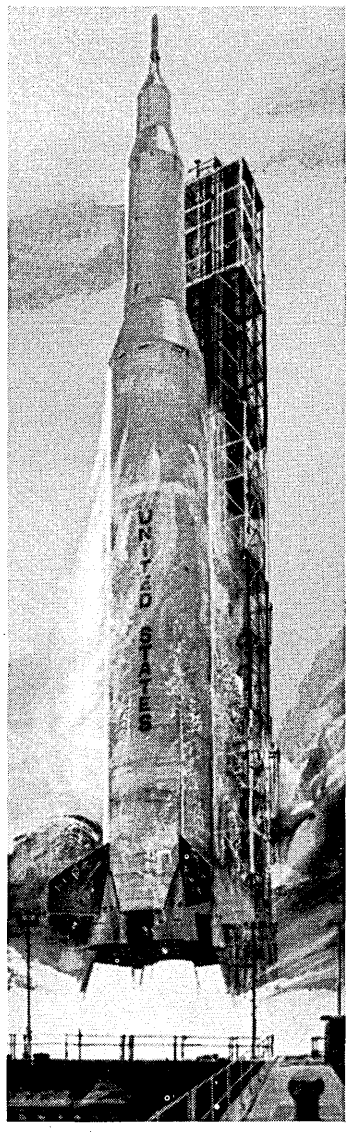
An Equal Opportunity Employer

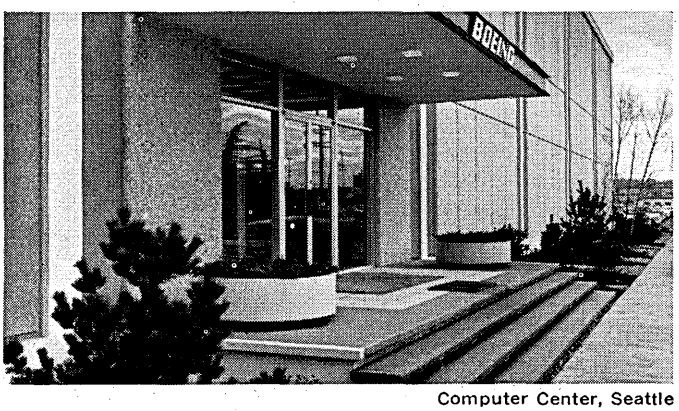
CIRCLE 102 ON READER CARD

Computer Systems Engineering Openings









Computer Center, Seattle

The Boeing Company's Aero-Space Division — major contractor for the NASA Saturn V launch vehicle, USAF Minuteman ICBM and NASA lunar orbiter — has a number of challenging openings for qualified graduate computer systems engineers. Requirements are a B.S., M.S., or Ph.D. in engineering, physics or mathematics, preferably with experience in computer applications, computer systems analysis or related fields.

These assignments are at the Boeing Computer Center in Seattle, one of the largest and most complete industry computer facilities in the free world. Additional positions are available at Huntsville, Ala. and New Orleans, La.

Computer Applications — Develop digital computer systems for calculating trajectories and trajectory optimization, guidance and control, loads and stresses, and temperature distributions,

Design and implement real time and near real time spacecraft performance computer programs. Assignment will involve coordination with other contractors and participation in space flight control.

Analyze and design computer programs and information processing systems to be used in support of operational command and control systems. Experience in the fields of information retrieval or query languages is desirable.

Computer Systems Analysis — Evaluate, develop and implement programming languages and compiler systems for scientific computing systems. Experience in large scale systems, design and development of compilers or major applications programs is desirable.

Develop and implement software systems for small and medium size computers used for on-line data acquisition and processing, military and space systems simulation and crew training simulators.

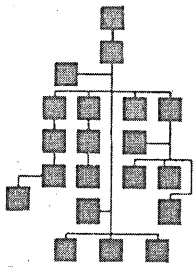
Analyze and define the requirements for digital hardware systems, specify the computer configuration required and evaluate present and proposed systems in a continuing program to advance the Division's computing facilities.

Salaries are competitively commensurate with your experience and educational background. Travel and moving allowances are paid to newly hired personnel. Boeing is an equal opportunity employer.

Send your resume, today, to Mr. Lawrence W. Blakeley, The Boeing Company, Aero-Space Division, P.O. Box 3822-DAC, Seattle, Washington 98124.

BOEING
AERO-SPACE DIVISION

CIRCLE 103 ON READER CARD



people IN DATAMATION

■ William J. Rolph, former free-lance dp editor and writer, has joined the DATAMATION staff as an associate editor.

■ A Democrat among Republican industrialists, and an outspoken opponent of technological unemployment while he, himself, headed a firm that made automation equipment, was John I. Synder Jr. The chairman and president of U. S. Industries Inc. died recently at the age of 56. A fighter for labor's cause, he taxed his own machines to finance a foundation to study automation's impact on jobs and to seek social solutions.

■ Herb Bright, ACM vp, has joined Informatics as director, Systems Programming. Formerly with Philco, he'll be stationed in Washington, D.C.

■ Russell Du Bois, formerly with Data Products Corp., is the new president of Tally Corp., Seattle, Wash.

■ Melvin M. May has been elected president of Simulation Systems Inc., Farmingdale, N.J., newly formed subsidiary of Computer Systems Inc., Richmond, Va.

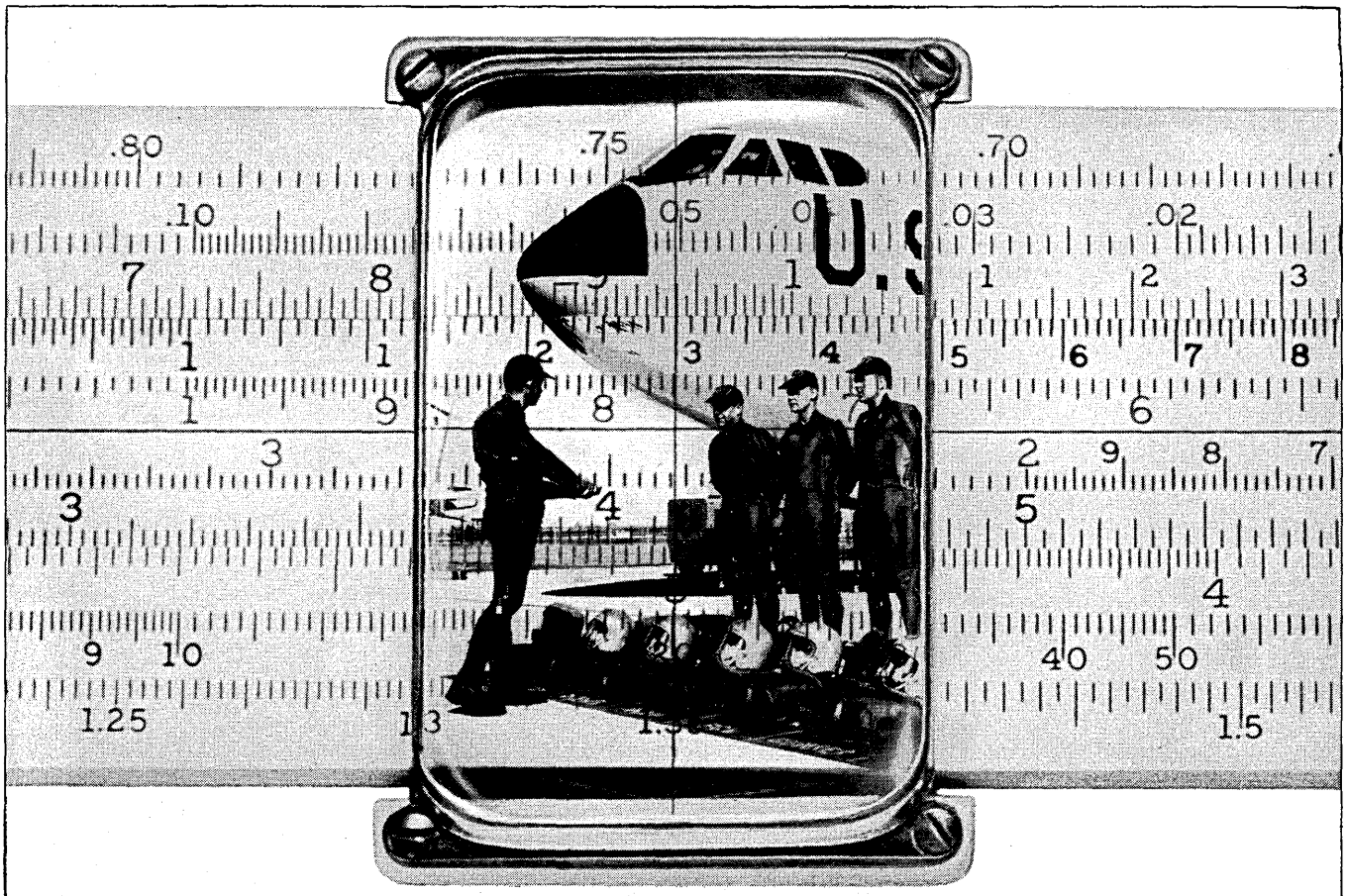
■ Univac has appointed Neil Gorchow director, systems programming. He has been manager, technical services, for Univac's federal government marketing.

■ Jules I. Schwartz and Thomas B. Steel Jr., senior technical staff members, have been named principal scientists, System Development Corp., Santa Monica, Calif.

■ Dr. Helmut M. Sassenfeld has been put in charge of GE systems engineering and programming work on the GE-635. His headquarters will be in Cambridge, Mass.

■ Robert A. Hall has been appointed vp, Pricing and Information Systems, Douglas Aircraft Co., Santa Monica, Calif.

■ R.A.C. Lane has joined Information Sciences Assoc., Cherry Hill, N.J., as study director. He replaces Ralph M. Gilmore, who was appointed district director of the Wash., D.C. office.



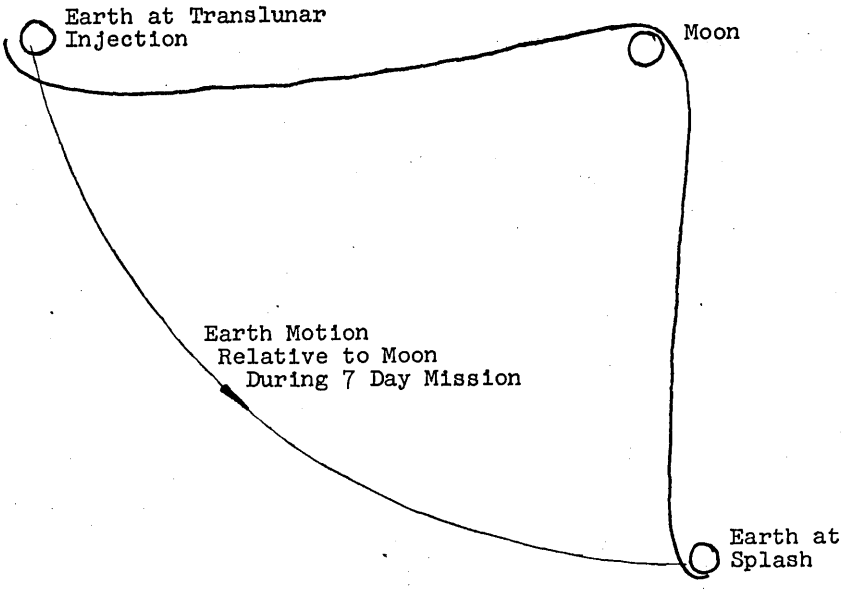
**We're not part of the crew, exactly . . .
but we're with them every moment.**

IBM computers, located at major Air Force commands, keep air-defense personnel advised of the constantly changing status of military forces and resources. IBM systems scientists are designing command, information, and intelligence systems for the Army, the Navy, and the Air Force. Through real-time computation and computer-driven displays, they translate vital details into visual images for instant comprehension.

These scientists who develop total information and control systems integrate many technologies: operations research, communications, information retrieval, human factors, and systems programming. There are outstanding IBM employment opportunities in the design and implementation of computer-aided command systems, or in other areas such as space guidance and control systems, aerospace-digital systems, and space communications systems. To explore these unusual career positions, write to Manager of Employment, Dept. 701F, IBM Corporate Headquarters, Armonk, New York 10504.

An Equal Opportunity Employer

IBM



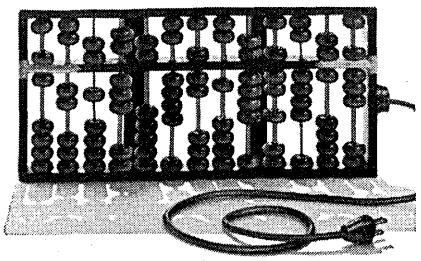
We pass this way every day

The way to the moon and back is already familiar to us. For we have made the journey many times via scratch pads, blackboards and computers. We'll do it many times more, too, because our assignment is doing systems engineering for the National Aeronautics and Space Administration's manned space flight effort.

If you would like to make this your assignment, too, we have rewarding openings in such fields as physics, mathematics, engineering, flight mechanics, propulsion, chemistry, computing and programming, guidance and trajectory analysis.

Send your résumé to Mr. N. W. Smusyn, Personnel Director, Bellcomm, Inc., Room 1305-E, 1100 17th St., N.W., Washington, D.C. 20036. We are an equal opportunity employer.

Bellcomm, Inc.
A Bell System Company



"LOOK AT LOCKHEED IN COMPUTERS AND PROGRAMMING..."

ANALOG
BUSINESS
SCIENTIFIC
DIGITAL

Lockheed Missiles and Space Company operates the largest single industrial digital computer facility in the United States. It provides exceptionally versatile and advanced computation and data reduction services to all parts of the Company.

Degree and appropriate experience are required for the following assignments:

DESIGN computer systems and evaluate equipment for information retrieval, graphic processing and real-time missile component testing.

DEVELOP advanced software operating and programming systems on IBM 1410/7094 computers and Univac 1107/1108 computers.

OPTIMIZE commercial programs for efficiency and cost reduction and adapt programs to new equipment, certifying for conformance.

DEVELOP real-time data systems for commercial applications such as source data acquisition, updating, retrieval and administrative control systems.

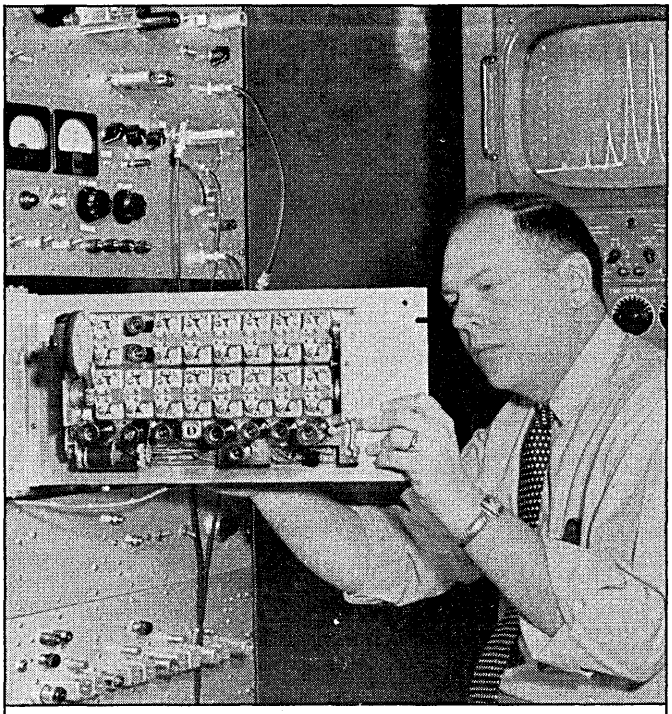
ANALYZE and program new business applications on medium and large scale computers. Develop financial, engineering, manufacturing and procurement integrated systems for real-time and off-line functions.

PROGRAM and operate analog or hybrid computers and differential analyzers. Define models for simulation of aerospace guidance and control problems and analyze results.

Please write Mr. K. R. Kiddoo, Professional Placement Manager, Lockheed Missiles & Space Company, 443 Industrial Relations Building, P. O. Box 504, Sunnyvale, California

LOCKHEED
MISSILES & SPACE COMPANY
A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION
An equal opportunity employer

Was your 1954 project this successful?

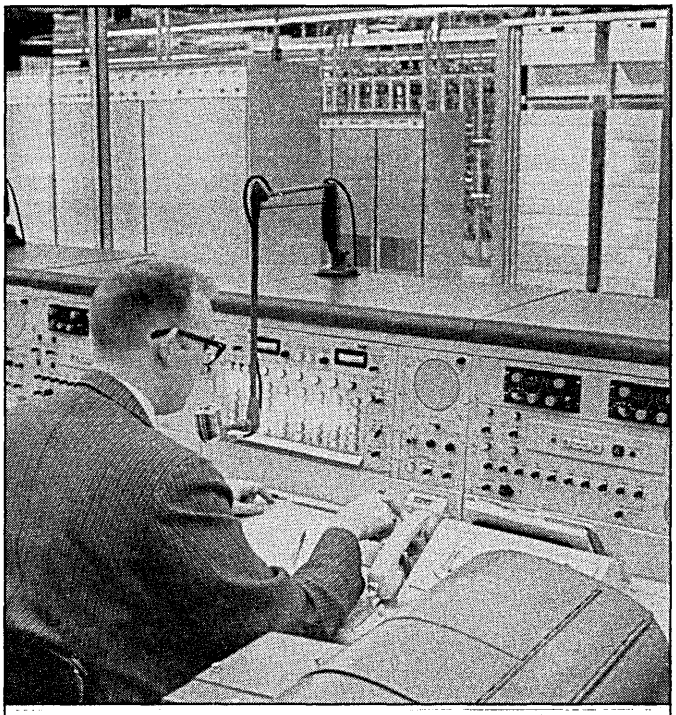


1954 was the year of the mechanical filter at Collins. It signaled the end of pioneering in the field of single sideband transmission and the beginning of a whole new line of SSB equipment for radio telephone communication systems. It ushered in a completely new concept of voice transmission under severe propagation conditions. And with it a new standard in communication reliability.

Concurrently with SSB, Collins was concerning itself with computers and with data transmission. As Collins advanced the state of the art in both SSB and data, users advanced their communication system requirements. Underlying these requirements is a need for ever greater speed and higher reliability. Basic to meeting these needs is a transmission system capable of matching the best mode to each condition in which a system might operate.

This is where we are today.

Write to Collins Radio Company at the following addresses for information on openings: L. R. Nuss, 855 35th St., N.E., Cedar Rapids, Iowa; or P. Chamberlin, 19700 Jamboree Rd., P.O. Box C, Newport Beach, California. An equal opportunity employer



Today, we are in final development stages on the first all-purpose computer designed from the ground up for high-speed information and control systems, and are looking beyond present computer techniques.

In this new era of Applied Information Science, we are working in the area of adaptive control of communications. Our new stored logic machines have the versatility to handle business and scientific data, communications switching control and process control. We are working with integrated logic circuits and high-speed memories in the 10-500 nanosecond range. We are concentrating on increasing the speed and integrity of information transfer within the computer as well as in the outside communication media. Improved system performance is achieved through the application of model analysis, simulation, switching theory, and logic synthesis.

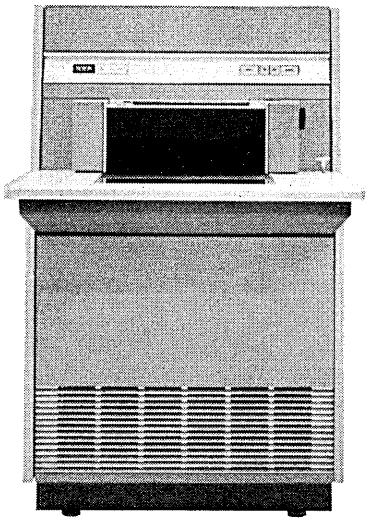
Further, we apply the experience gained from operation of the largest and fastest switching center in the world, handling some 12,000,000 words a day virtually without loss. We welcome the help that top-level, open-minded people with logic design, machine organization, or software experience can give us. Top-level people with an open mind and experience in broad areas of software and programming. People who want to stay with the most advanced project and succeed with it.

COMMUNICATION / COMPUTATION / CONTROL

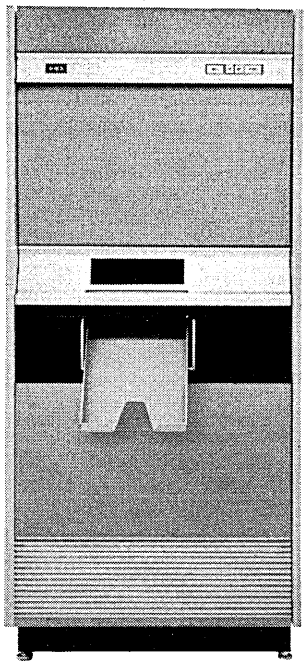
COLLINS

COLLINS RADIO COMPANY
WORLD HEADQUARTERS / DALLAS, TEXAS

CIRCLE 108 ON READER CARD



We sent an 8½″ x 11″ xerographic image 3,450 miles over broadband telephone lines in less than 7 seconds and held the resolution to 135 scans per inch.



Suddenly data systems engineers are noticing us.

On the surface, LDX stands for Long Distance Xerography. In its simplest configuration, it means a pair of ingenious electronic/electromechanical/optical machines—a transmitter and a receiver—linked by coaxial cable, telephone lines, microwave radio relay nets, or any combination of the three media. From a fact-of-life, functional viewpoint, LDX is the most advanced remote imaging system in existence today.

Yet these are surely not the most important reasons why systems engineers are noticing (and joining) Xerox today.

The more profound answers are still in our laboratories, where scientists and engineers steeped in computer technology, data systems engineering, information science and operations research are exploring LDX as one element of an approach to an entirely new regime of graphic communication and information systems.

For the moment, think of networks of LDX systems, fully integrated with real-time computers and a wide variety of peripheral equipment—capable of sensing, storing, retrieving, queueing, transmitting, receiving and translating data from one form to another... and then displaying it automatically not only in alphanumerics, but with equal facility in fully formed diagrams, drawings or pictures.

Is this a good enough reason for noticing Xerox? It's the most important reason we have for noticing you.

Please forward your resume, including salary requirements, to Mr. Robert E. Conboy, Dept. DA-6, Xerox Corporation, P.O. Box 1540, Rochester, New York 14603. An Equal Opportunity Employer.

XEROX

ADVERTISERS' INDEX

THREE STYLES

TWO SIZES

ONE GREAT IDEA

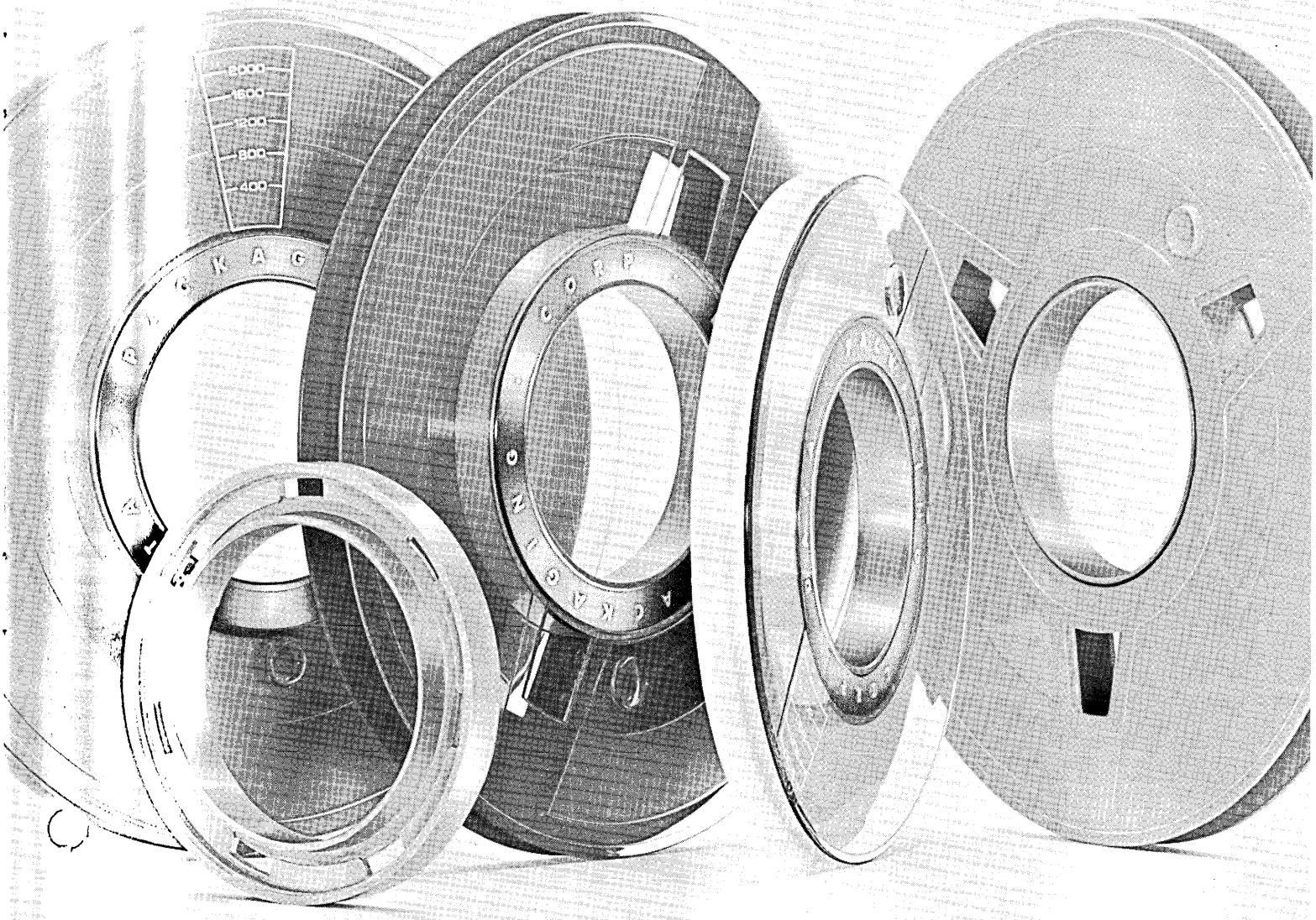
COMPUTER REELS WITH HUBS AND WINDING SURFACES OF ALUMINUMINUMINUMINU

Aluminum winding surfaces don't compress. They don't distort.
When tape pressure is relieved, aluminum hubs don't explode.
Those are three good reasons for aluminum.

Here are two more. Hub faces, machined parallel, mount square.
Plastic flanges mounted on the hubs stay parallel.

One new reason: reels are available in three styles and two sizes —
10½" and 8½" diameters. Most every computer and tape manufacturer
has them. Look for the colored Saturn ring.
Design and mechanical patents applied for by

DATA PACKAGING CORPORATION
205 Broadway, Cambridge, Massachusetts



CIRCLE 2 ON READER CARD