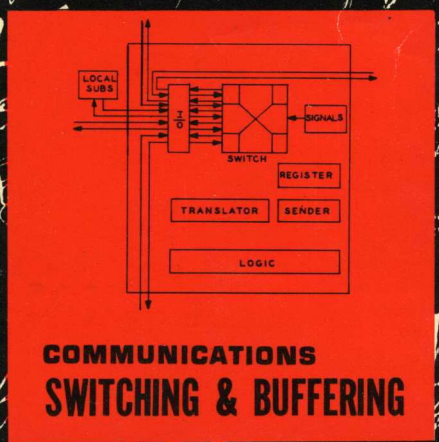
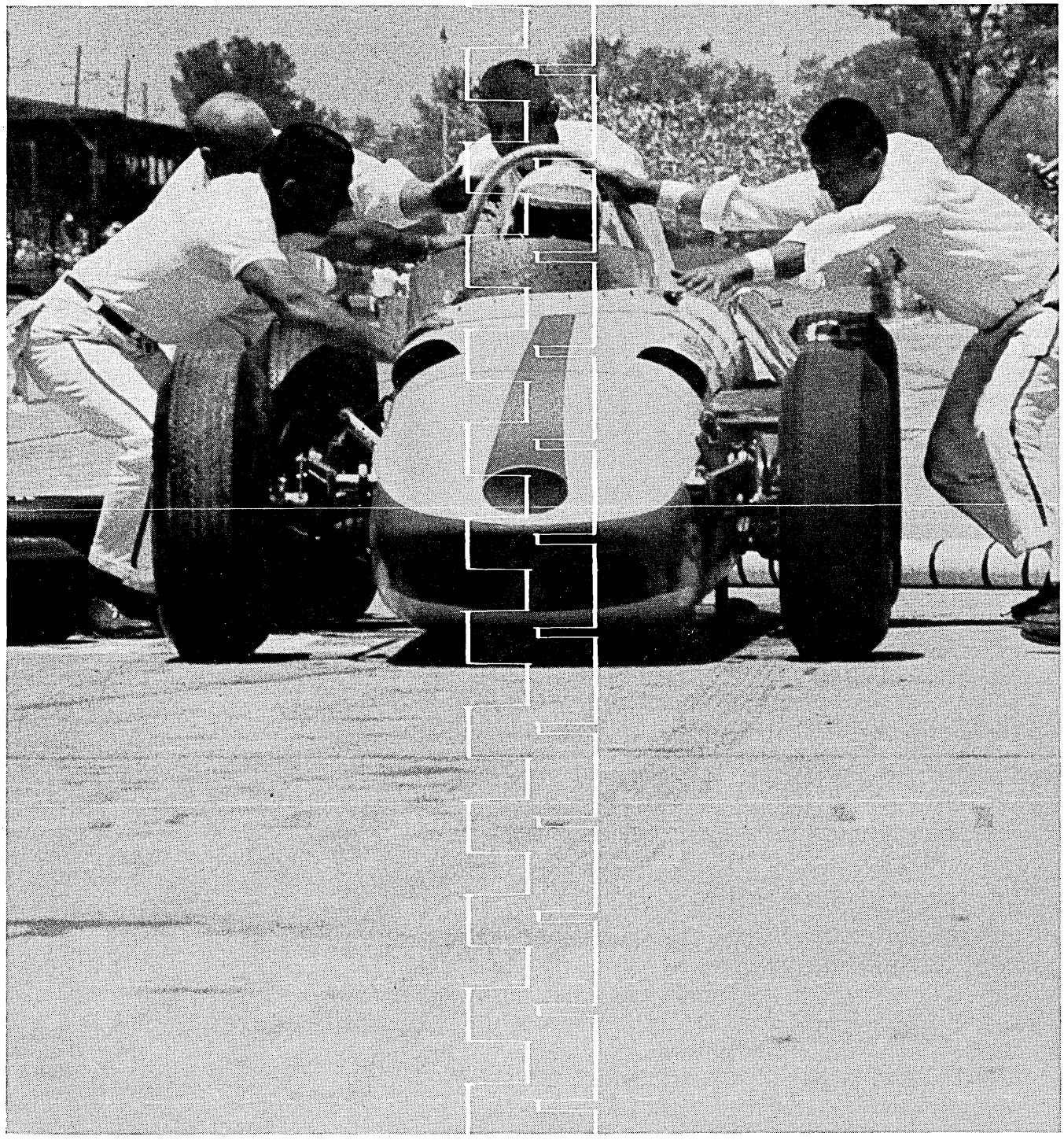
DATAMATION® 63 July

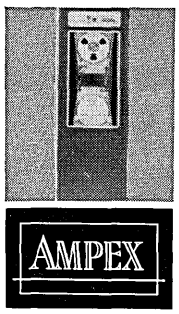


COMMUNICATIONS
SWITCHING & BUFFERING

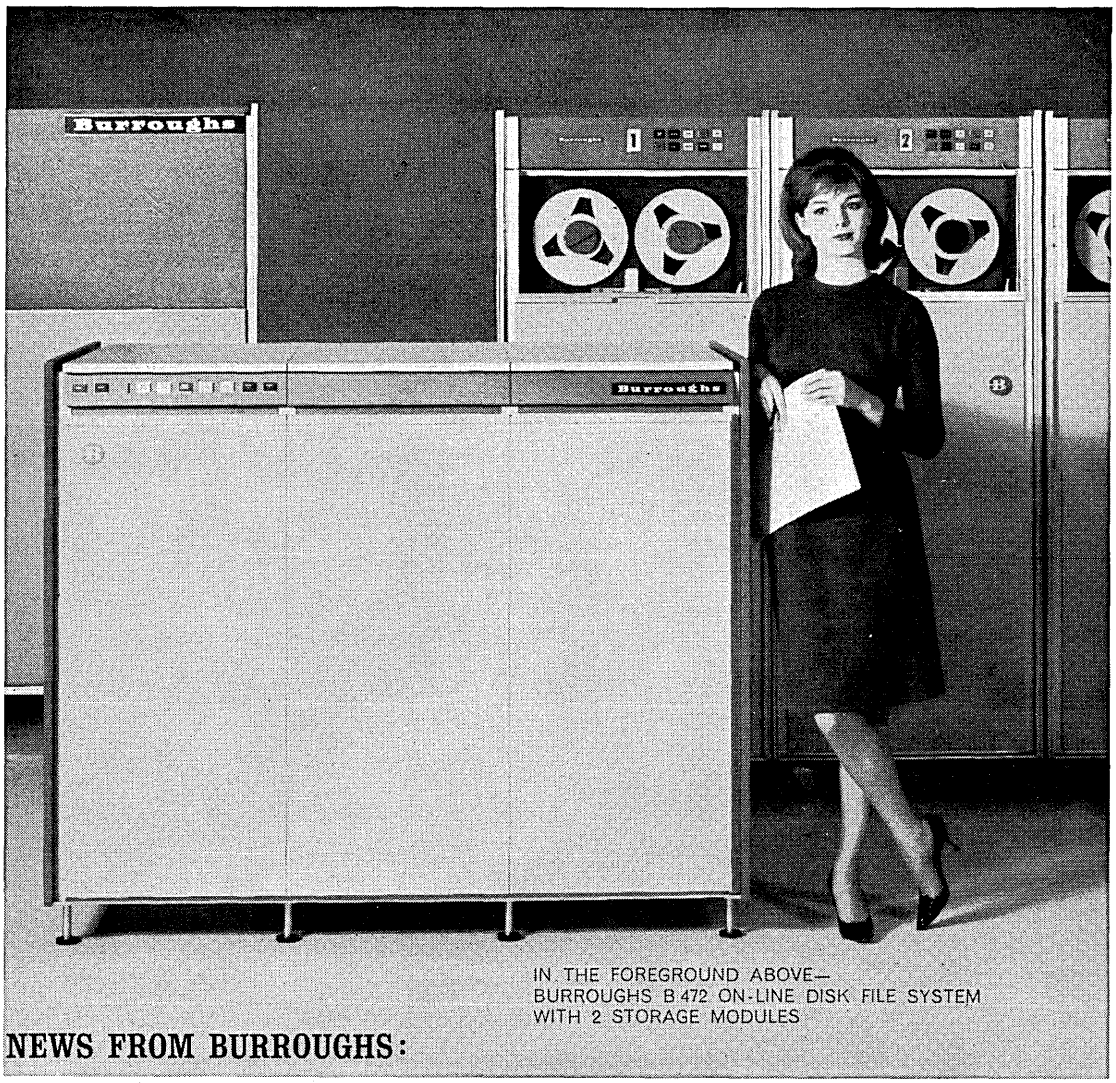


What new high speed tape transport means less down time? **AMPEX TM-5**

Here's how it's done. The highly stable, solid state servo requires less adjustment. Capstan rollers are quickly changed. Settings are quickly made. The head assembly is isolated. (This makes the tape path highly stable. In fact, dynamic skew at start time is less than dynamic skew continuous.) And precision practices reduce static skew. There's no tape flap; an erase head isn't needed. Positive safety interlocks eliminate tape damage. Instantaneous speed variation has been reduced. Plus: up to 150 ips tape speeds; 2 ms maximum start time; 1.5 ms maximum stop time; 800 bpi capability with or without clock track; available as a complete tape memory system with transfer rates up to 240 kc. And above all, there's Ampex reliability and ruggedness throughout. The TM-5 is made by the Ampex Computer Products Co., Culver City, Calif. For information write Ampex Corp., Redwood City, Calif. Worldwide sales, service.



CIRCLE 1 ON READER CARD



IN THE FOREGROUND ABOVE—
BURROUGHS B 472 ON-LINE DISK FILE SYSTEM
WITH 2 STORAGE MODULES

NEWS FROM BURROUGHS:

A SIGNIFICANT advance in random access DATA PROCESSING

Burroughs—TM

Burroughs introduces a new type of random access magnetic disk file which—with its data communications and inquiry devices—makes practical real time applications possible.

In addition, it allows significant advances in memory capacity, reliability and economy.

The new file eliminates hydraulic or mechanical read/write head positioners and gives each track of information an electronic head of its own. This head-per-track principle allows an average access speed of 20 milliseconds—five times faster than the best of its type now available.

Instant availability of data eliminates the need for artificial file organization techniques—and the programing and use problems which they impose.

Read/write head assemblies self-adjust to maintain a uniform, precision-controlled air gap between head and disk. Retraction is automatic as disks decelerate. Result: a completely reliable system.

A totally new disk-plating technique allows high packing density. Per-module capacity is 9.6 million alphanumeric characters. Thus data storage can be "built up" in small economical increments to a maximum of nearly one billion characters. Modules can be added to your system as needed.

The new disk file greatly extends the application range of our B 5000 and B 200 series, while giving both systems additional immunity to obsolescence. For additional details, write us at Detroit 32, Michigan. Remember: our business is computation for all businesses of all sizes, everywhere.

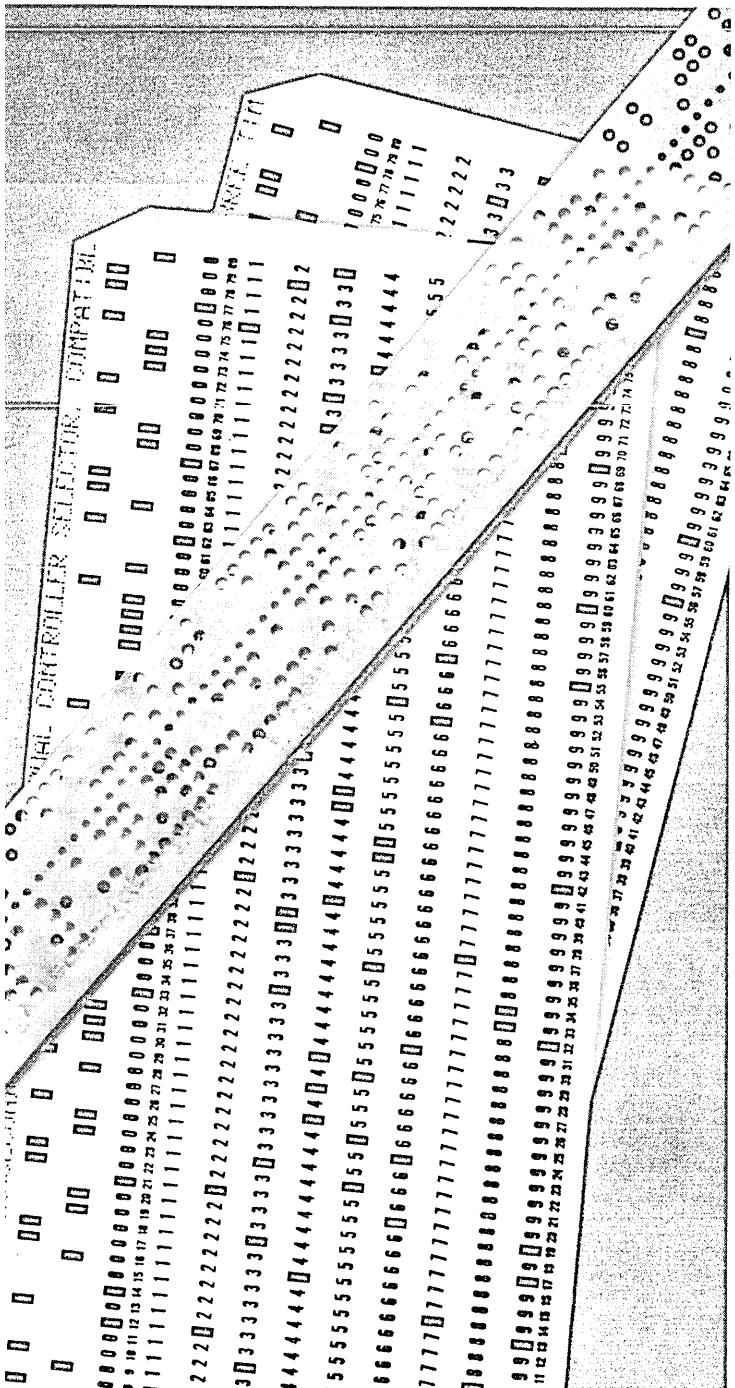
Burroughs Corporation

CIRCLE 4 ON READER CARD

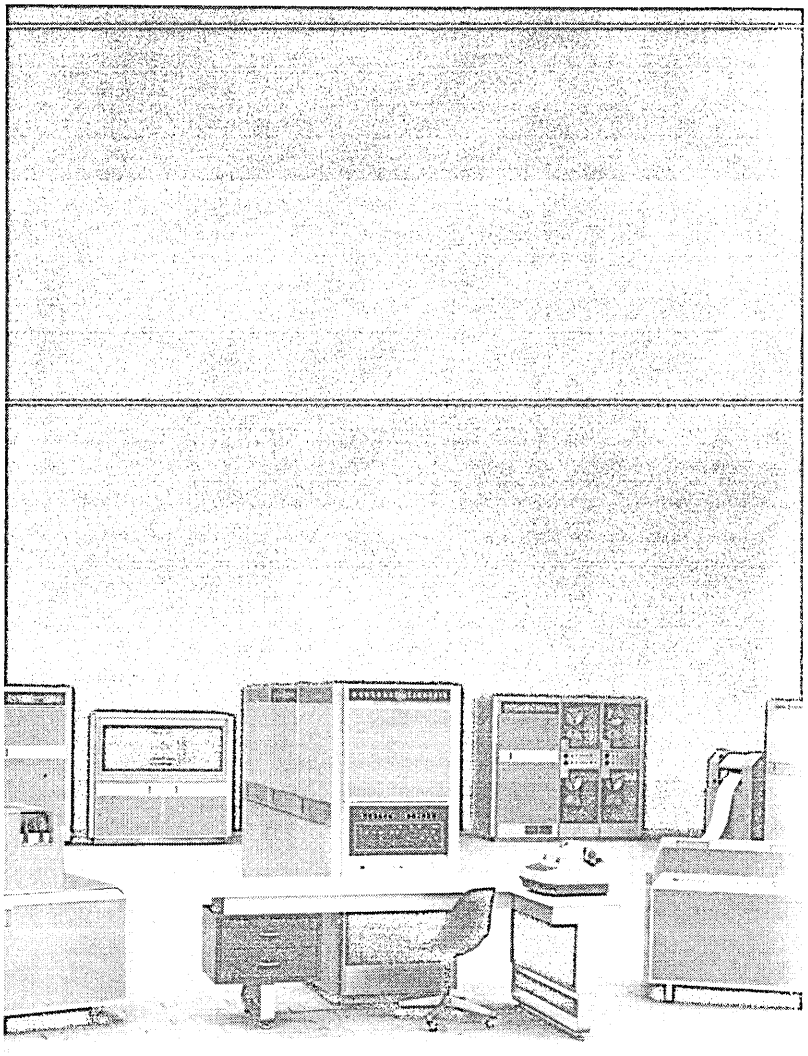
THE GEM

General Electric's new family of computers lets you

programs...



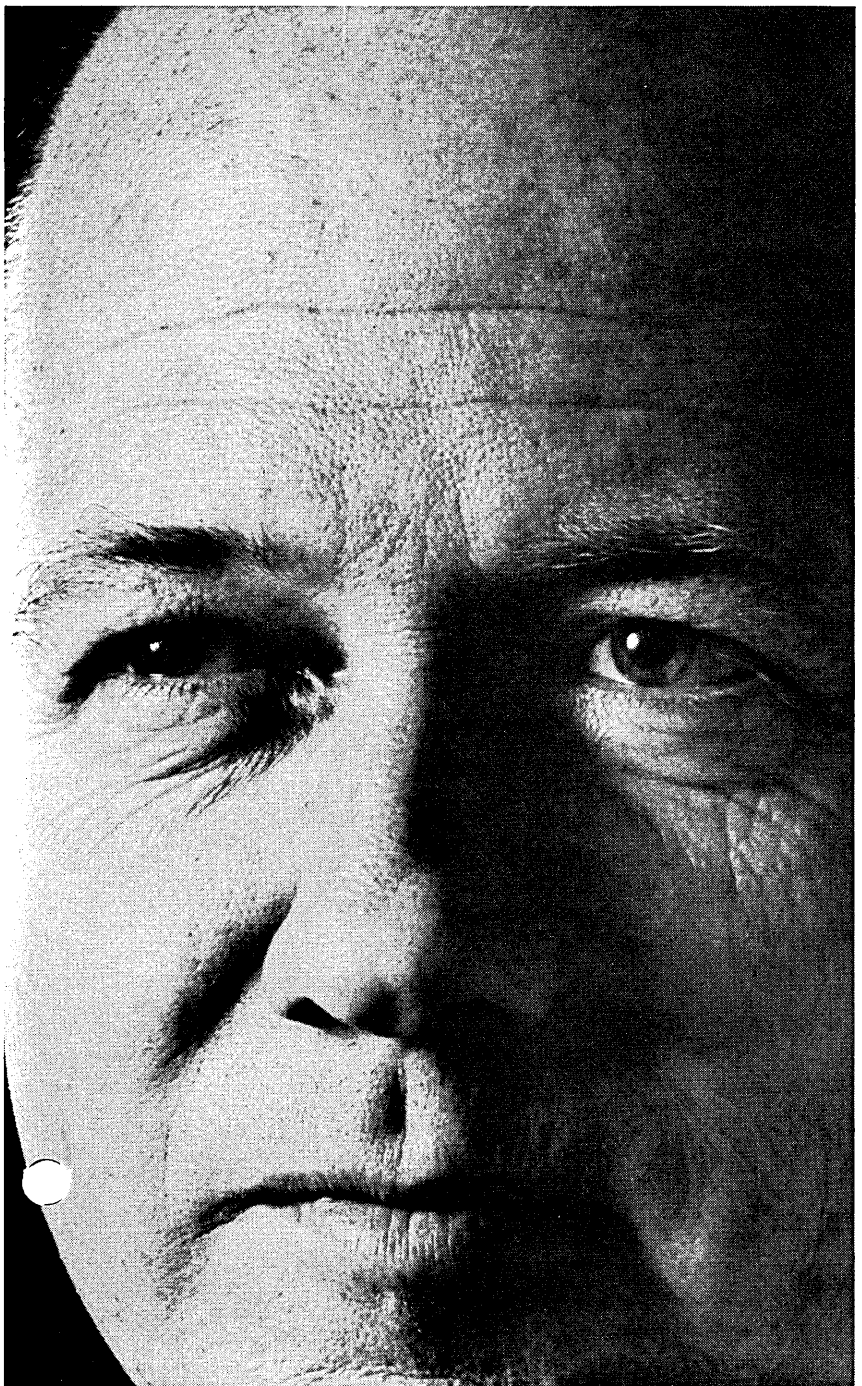
peripherals...



PATIBLES

increase your computing power without changing...

or people



You can move up from a minimum cost system to bigger, faster systems by simply changing the central processor. The programs are the same—but they run faster. The peripheral equipment is the same—only you can apply it more efficiently. The people are the same ones you trained in the first place.

So, before you buy or replace your system, investigate The Compatibles. Write General Electric Computer Department, Section J-7, Phoenix, Arizona.

GE-215	GE-225	GE-235
Tops in its price range: 36 microsecond word time	Medium-sized, versatile system: 18 microsecond word time	Most powerful in the family to date: 6 microsecond word time

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 5 ON READER CARD

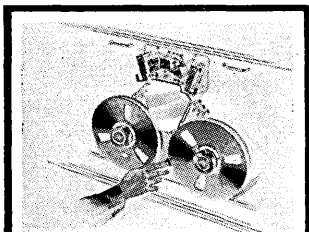
POTTER MT-120:

AN OPEN AND SHUT CASE

It doesn't require lengthy trial to determine if MT-120 is compatible with your computer system. It is. This highly advanced digital magnetic tape transport features exceptional performance in a COMPLETELY STANDARD, LOW COST PACKAGE. For example, a patented tape handling system* eliminates program restrictions—permits Start/Stop, Reverse/Stop or Forward/Reverse operation at up to 200 commands per second and at tape speeds to 120 ips.

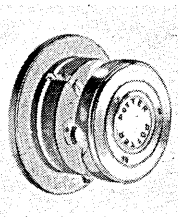
To learn more about the MT-120 and its unprecedented 1-year warranty of reliability, write to our Director of Marketing. We'll send you full specifications, then you can judge for yourself.

THE MT-120 FEATURES:

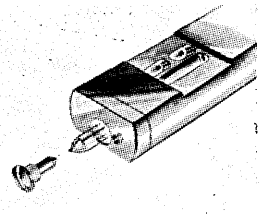


PUSH BUTTON TAPE LOADING initiates automatic electrical retraction of loop control and low-tape sensing arms...

...Special interlocking devices prevent inadvertent arm retraction when reel drive motors are energized.



Potter "quick-lock" NARTB reel hubs and IBM reel hubs are available as standard accessories.



IBM and split-post type EOT and BOT sensing amplifiers are available for positive tape control.

*Potter Patent No. 3,016,207

POTTER INSTRUMENT COMPANY, INC.
MARKETING DIVISION • *151 Sunnyside Boulevard, Plainview, New York*

T.M.

CIRCLE 6 ON READER CARD

DATAMATION 63

the automatic handling of information

volume 9, number 7

Staff

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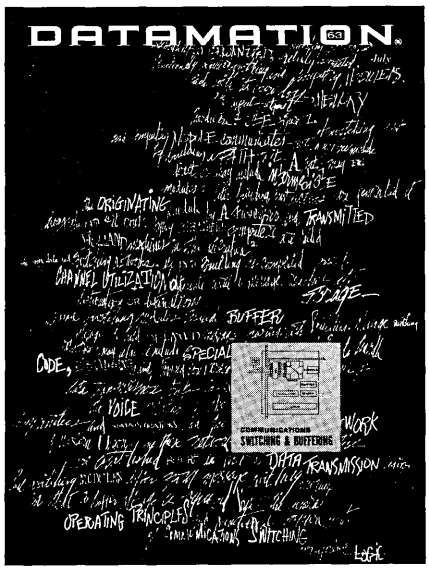
Cover



Graphically illustrated on the cover is the mad scramble of messages, incoming and outgoing, reduced to relative placidity in switching and buffering networks, this month's feature article. Art Director Cleve Boutell creates design from this seeming array of confusion.

Circulation audited by Business Publications Audit

Member, National Business Publications

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Printed by Beslow Associates, Inc.

important DATES

• The sixth annual Summer Conference, sponsored by the Northwest Computing Assoc., will be held August 8-9 at the Pacific Science Center, Seattle, Wash.

• The Western Electronics Show and Conference (WESCON) will be held August 20-23 at the Cow Palace, San Francisco, Calif. Sponsors are Region 6, WEMA, and all PGs.

• The first annual meeting of the Assn. for Machine Translation and Computational Linguistics will be held August 25, 26 at the Hilton hotel, Denver, Colo., immediately preceding the ACM conference.

• The 1963 ACM National Conference will be held Aug. 27th through 30th in Denver, Colorado.

• The second Institute on Electronic Information Display Systems will be held September 16-20 at The American Univ., Washington, D.C.

• The 12th annual Industrial Electronics Symposium will be held September 18-19 at Michigan State Univ., E. Lansing, Mich. Sponsors are PGIE, AIEE, and ISA.

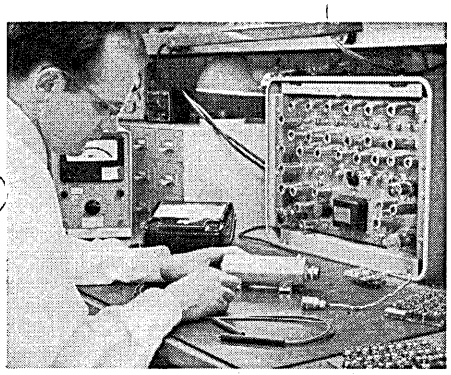
• The fourth annual Symposium on Switching Circuit Theory and Logical Design will be held Oct. 7-11 in Chicago, Ill. Sponsor is the AIEE subcommittee on Logic and Switching Circuit Theory.

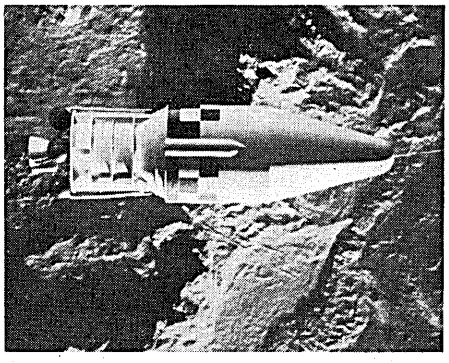
• The BEMA (Business Equipment Manufacturers Assn.) Exposition/Conference will be held Oct. 28 to Nov. 1 at the Coliseum, New York, N.Y.

• The 1963 Fall Joint Computer Conference will be held in the Las Vegas, Nev., Convention Center, Nov. 12-14.

• The annual meeting of the American Mathematical Society will be held January 20-24, 1964, in Miami, Fla.

• The 1964 Spring Joint Computer Conference will be held at the Sheraton Park Hotel, Washington, D.C., April 21-23.





Here, at Lockheed Missiles & Space Company's Space Communications Laboratory, scientists are re-investigating the possibility of using the moon to facilitate earth communications. Possibilities for the use of the moon as a relay station for earth-to-earth communications have been largely neglected because the moon's shape and rugged surface greatly distorted a return signal. But Lockheed research into the extension of communications on difficult communication channels, using techniques applicable to dispersive time variant channels, is making significant inroads into this problem.

Another area receiving intense study at Lockheed is satellite tracking of deep space probes. Since tracking accuracy depends greatly on stations being as far from each other as possible, while retaining line-of-sight communications, Lockheed is studying the use of two earth-orbiting satellite tracking stations, 8000 miles apart. Not only would great accuracy be gained by the separation, but it would be further enhanced by the positioning of the stations above the earth's atmosphere, thus eliminating atmospheric distortion.

Examples of other research projects being pursued by Lockheed in the communications area include: Random multiplexing, satellite readout techniques, scatter communications, radar mapping, submarine tracking, modulation of optical energy, communications over multipath channels, and learning systems.

LOOK AT LOCKHEED... AS A CAREER

Consider Lockheed's leadership in space technology. Evaluate its accomplishments —such as the Polaris missile and the Agena vehicle's superb record of space missions. Examine its outstanding advantages—location, advancement policies, creative climate, opportunity for individual recognition.

Then write for a brochure that gives you a more complete Look at Lockheed. Address: Research & Development Staff, Dept. M-43C, P.O. Box 504, Sunnyvale, California. Lockheed is an equal opportunity employer.

SCIENTISTS & ENGINEERS: In addition to positions in the research and development of communications and optics, other important openings include: Inertial guidance • Orbit thermodynamics • Electromagnetics • Mission & trajectory analysis • Gas dynamics • Chemical and nuclear propulsion • Systems engineering

LOCKHEED

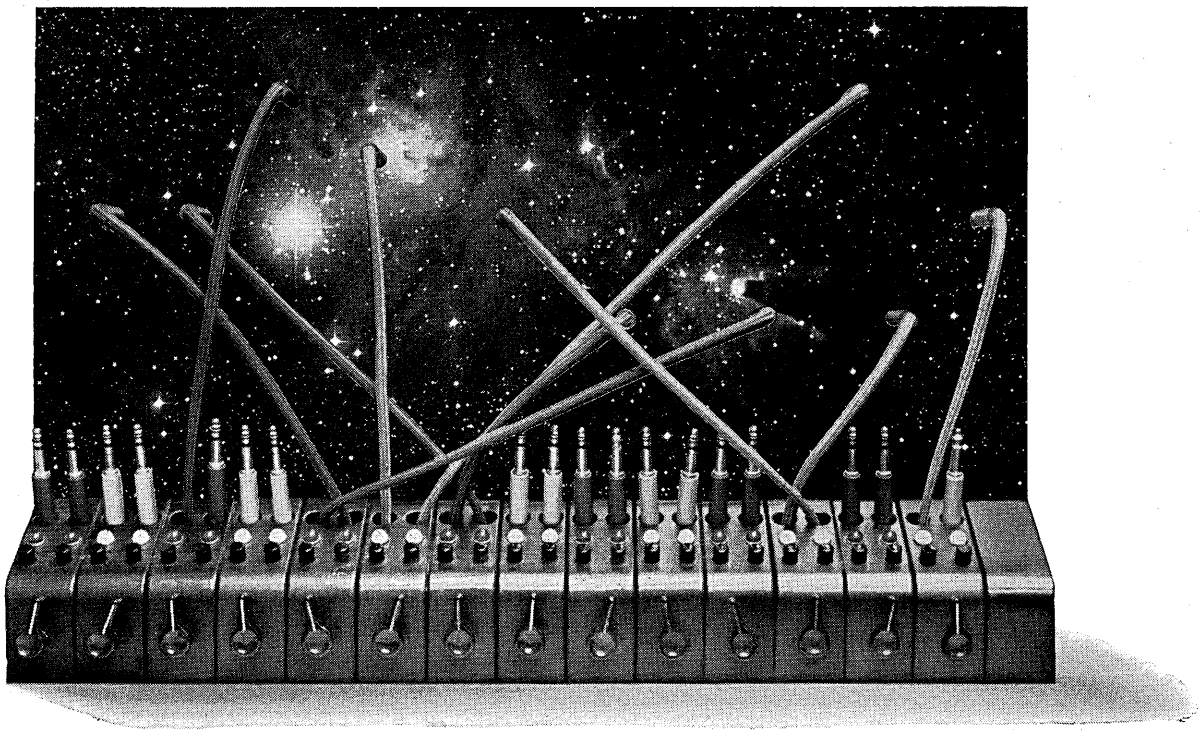
MISSILES & SPACE COMPANY

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

Sunnyvale, Palo Alto, Van Nuys, Santa Cruz, Santa Maria, California • Cape Canaveral, Florida • Huntsville, Alabama • Hawaii

LOOK AT LOCKHEED IN SPACE COMMUNICATIONS:

Where outstanding successes have created aerospace leadership

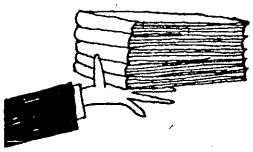


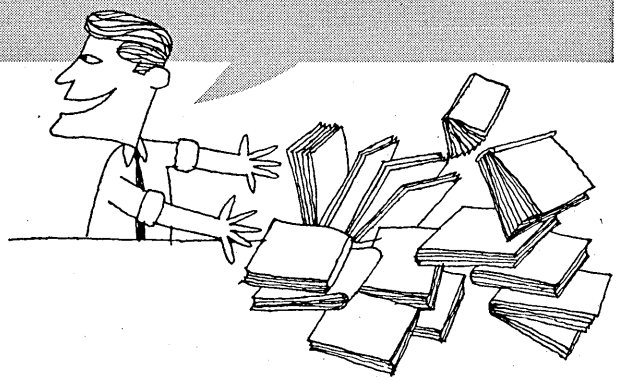
"Wouldn't it be simpler to have one reference source for just about every known computer?"

"Sure—but where can I find such help?"

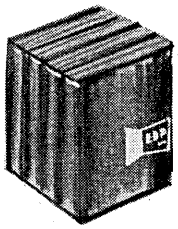
"Right here. Auerbach/BNA Standard EDP Reports cover 44 major computer systems in use in the U.S.A."

"And the price for all this is $900. Quick—how can I get Standard EDP Reports?"





"Use the convenient order form below."



Gentlemen:

Please enter our order for_____set(s) of AUERBACH/BNA Standard EDP REPORTS. Each five-volume set covers 44 major computer systems. The price per set is $900.

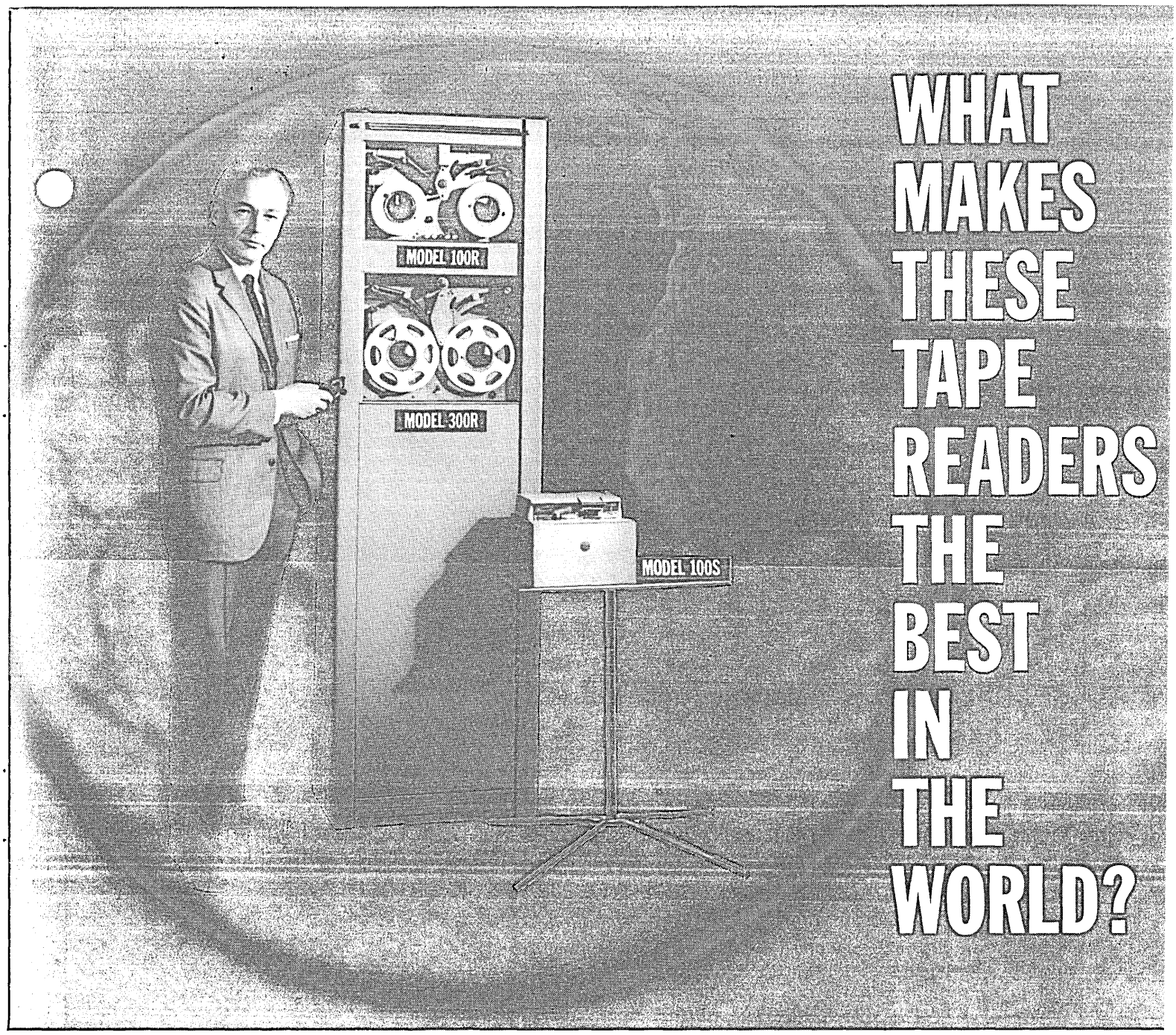
Name _____ **Title** _____

Company _____

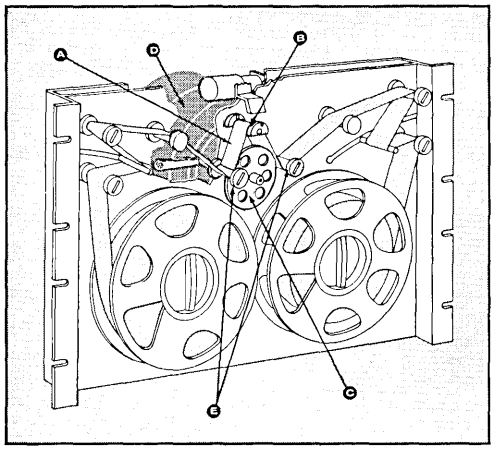
Address _____

City _____ **Zone** _____ **State** _____

For detailed information write: AUERBACH/BNA 1231 24th Street, N.W., Washington 7, D.C.



WHAT MAKES THESE TAPE READERS THE BEST IN THE WORLD?



Mechanical simplicity . . . which yields a degree of reliability unattainable by any other paper tape reader! Simplicity made possible through the utilization of the revolutionary PMI printed motor direct drive servo. Movement of the tape through the read head is achieved by merely starting and stopping a printed motor. The brakes, clutches and pinch rollers that cause big trouble and down time in conventional tape transports are completely eliminated.

Line by line cycle: movement of tape (A) over read head (B) is controlled by drive capstan (C)—attached directly to shaft of PMI printed motor* (D); spring-loaded rollers (E) hold tape gently against capstan, keeping tape movement in exact accord with capstan rotation; advance command pulse accelerates motor, capstan, and tape; as read head detects next sprocket hole, a reverse pulse to motor halts capstan and tape with next character perfectly aligned in read head. **U.S. Patents of Printed Motors, Inc. Pending.*

PHONE, WIRE OR WRITE FOR COMPLETE INFORMATION

Photocircuits
CORPORATION
TAPE READER DIVISION
Glen Cove, N. Y.

CIRCLE 9 ON READER CARD

letters

unclear comparison

Sir:

I find it difficult to understand the comparison in "The 301 and 1401 — A User's Critique" (April, p. 33). While Mr. Kurzenknabe acknowledges a specifications edge for the IBM 7330 tape drive, he claims a 30 per cent superior performance for the RCA 381. On what does he base this — the color of the tape drive? It seems to me that four 7330's would be able to replace the six (or more) 381's, and result in less user time on the system.

Another comment that appears to be above me concerns the "modular expansibility" of the 301. The 1401 mainframe holds 4K storage. To go to 16K requires another unit, but it appears that the 1401, together with auxiliary storage, could fit within the 301 mainframe — and leave space for a 7330. Nearly any manufacturer could use a packaging method which would provide space for system modification. But I was of the impression that the trend was toward taking as little floor space as the system required.

W. V. Sebesta
Johnson City, N. Y.

(Editor's note: Comparing tape drives, Kurzenknabe pointed out design features which favor the 381, saying: "So there are other advantages, aside from net performance characteristics; it's also how much labor time is involved in set-up, handling, and attrition of reruns." On the point of the commodious accommodations within the 301 mainframe, of greater significance is the resultant accessibility for servicing and the ease of system expansion.)

translation to MAD

Sir:

Regarding "Automatic Program Translation" by Ascher Opler (May, p. 45), the Univ. of Michigan executive system has a FORTRAN-to-MAD translator, MADTRAN, which has been available through SHARE for almost two years. The translator, itself written in MAD, very likely inspired the SIFT translator effort.

MADTRAN is used by MIT as a substitute for FORTRAN in its time-sharing system, in which MADTRAN output is immediately processed by MAD. The entire translation time is less than that for FORTRAN alone, although the resulting program suffers from the usual, slight MAD loss in object program efficiency.

I might add that this work was itself influenced by a FORTRANSIT-to-GAT (both on the 650) translator written in GAT and first used in 1959.

Although I don't share this view, it should be pointed out that some people call this class of programs, "transliterators." It seems likely, however, that there exists a spectrum of programs of this type, ranging from the relatively trivial to the ultra-complex.

Robert Rosin
Cooley Electronics Laboratory
University of Michigan
Ann Arbor, Michigan

on-line comments

Sir:

I have read with great interest the article, "Programming On-Line Systems," by Frank, Gardner and Stock (May, p. 29). It is regrettable that such a thoroughgoing and lucid presentation should be marred by a few apparent misunderstandings about certain facets of commercial real-time systems.

In referring to an airline reservation system's inability to achieve a particular response time, the authors note that "the delay in the response is not catastrophic since no data is lost and the additional time does not significantly affect system performance." Actually, a delay in response in such a system may well be catastrophic if it is *chronic* . . . Airline reservation systems must be designed to avoid delays.

Concern is expressed about simultaneity of file references in multi-terminal systems, such as developed for savings banks: "Thus, two essentially simultaneous transactions executed by independent functions upon the same record may invalidate both transactions . . ." As a practical matter, this does not turn out to be a significant problem in many real-time systems. The basic record has the characteristic of being called in from the system files only at the customer's request. And since the customer cannot normally appear at two counter positions at the same time, there is built-in protection from simultaneous references to the same record. Other sources of demand for these records can be classified as internally originated by the system, and subject to control by the system designer to eliminate competition for records.

Robert V. Head
IBM Systems Research Institute
New York, N.Y.

(Editor's Note: The authors reply, "Mr. Head's first comment is justified from the point of view of the system designer whose responsibility is to specify bounds on response time (deterministic or statistical), select equipment, and manage the programming implementation. The intent of the example was to illustrate the programming difference between input rates that are controllable and those, such as continuous radar data, where there is no control. Relaxation of the response time in the reservation system does not lead to lost data

while, of course, it could lead to lost sales.

"The concern expressed regarding simultaneity of file reference is intended to be just that: a concern—to indicate to the programmer that he must guard against such a circumstance. As indicated by Mr. Head the problem is usually met in the system design.")

of girls & foreign computers

Sir:

Datamation shares with Playboy the distinction of being read ahead of turn as I attack my ever growing backlog of unread magazines. But time remains to correct and supplement specs in your list of foreign computers by Adams Associates (May, p. 41). Information on the Stantec Zebra and many others could have been cribbed from Bulletin 13 of the Provisional International Computation Centre, April 1961. Or "Ask the Man Who Owns One."

On the Zebra, I submit:
Add time: 312 usec
Storage Cycle: 10 msec (random access)
Instr. Addresses: 1 drum + 1 fast
Paper Tape In: 100 cps (not 200)
Paper Tape Out: 50 cps (not 10)
Software: interpretive "Simple Code" for scientific computing
Not Supplied: Mag Tape, Buffering, Random Access File, Cards, Printer, Program Interrupt.

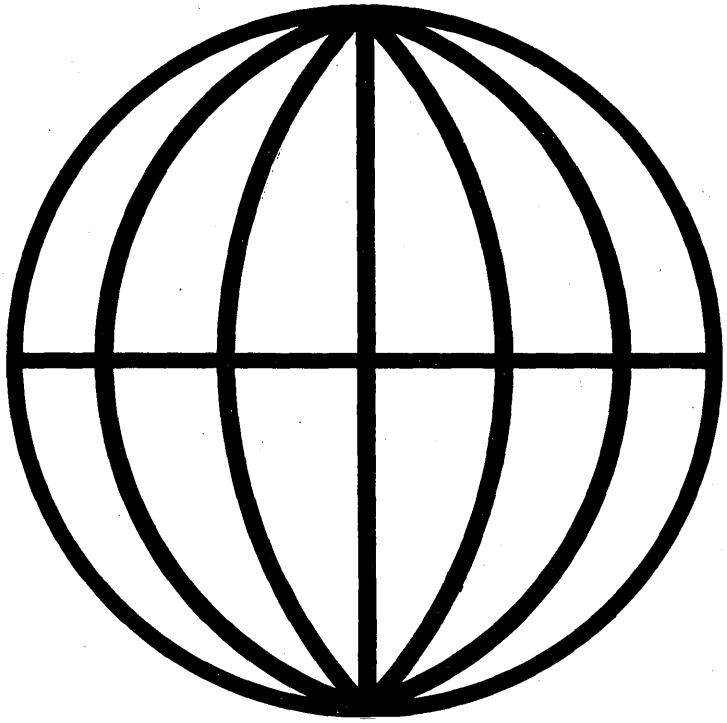
W. L. CLINK
Department of National Defence
Defence Research Board
Suffield Experimental Station
Ralston, Alberta, Canada

Sir:

I was surprised to find omitted from your list of foreign computers the Italian Elea 6001 and Elea 9003, manufactured by Olivetti. Technical specifications are as follows:

	Elea 9003	Elea 6001
First delivery	1960	1960
Storage	20-160K core 360K drum	10-100K core
Word length	1a	1a
Add time	200 usec	364 usec
Cycle time	10 usec	6 usec
Mag tape	45 KC	22.5 KC
Printer	600 lpm	600 lpm
Card reader	500 cpm	150 cpm
Card punch	50 cpm	50 cpm
Index registers	40	16

Gianfranco Biraghi
Schede Perforate e Calcolo Elettronico
Via Manara, II
Milano, Italy



...and what, in space?

what on earth
does a systems man do here?

Under our collective roofs in Paramus, New Jersey, International Electric Corporation houses one of the largest aggregations of systems specialists in the nation... and probably the largest group of programming and software experts. Here is a partial breakdown of their activities that relate to space as well as earthbound systems situations:

Command & Control Technology
- Parametric System Analysis
- Airborne, Terrestrial Data Processing & Displays
- Survivable Communications
- Distributed/Centralized Data Bases
- Weapons Systems C&C

Advanced Development Projects
- Advanced Display & Control Systems
- Advanced Information Storage, Retrieval & Distribution
- Recon. Mapping & Data Recording
- Data Acquisition Sensing & Detection Systems
- Simulation & Training Complexes

Advanced Systems Projects
- Space Range Systems
- Surveillance Systems
- Space Command & Control
- Space & Ground Military Information Handling Systems

Management Information Systems
- Control Systems
- Communications
- Data Processing Systems

Human Factors Sciences
- Man-Machine Integration
- Personnel Subsystem Analysis
- Command Staff/System Exercising & Evaluation
- Human Engineering

Systems Sciences
- Optimization Techniques in System Design & Control
- Real Time Management & Control
- System Simulation & Scheduling
- Control & Staffing of Human & Human Linked Subsystems
- Gaming Technology

Space Science
- Life Sciences – Bioastronautics, Psychoastronautics
- Manned Space Subsystem
- Integration Analysis
- Psychophysiological Support Reqmts.
- Bio-Medical Data Subsystem Reqmts.

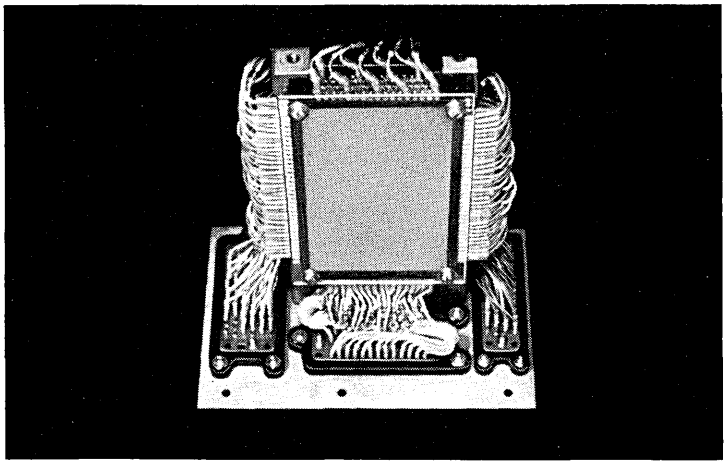
Whether your own background is largely theoretical, or design... systems hardware, or software oriented... if you'd like to join us in these efforts, we invite your early inquiry. Write fully in strict confidence to Mr. E. A. Smith, Manager of Employment, Division 35-MK, International Electric Corp., Route 17 & Garden State Parkway, Paramus, New Jersey. (An Equal Opportunity Employer)

ITT INTERNATIONAL ELECTRIC CORPORATION

CIRCLE 92 ON READER CARD

NEW RCA ADVANCES IN FERRITE TECHNOLOGY EXTEND MEMORY STACK CAPABILITIES

RCA offers Wide-Temperature-Range Stacks... Microferrite Stacks... Temperature Controlled Stacks ...Conventional Memory Stacks... in virtually any configuration to meet today's computer demands

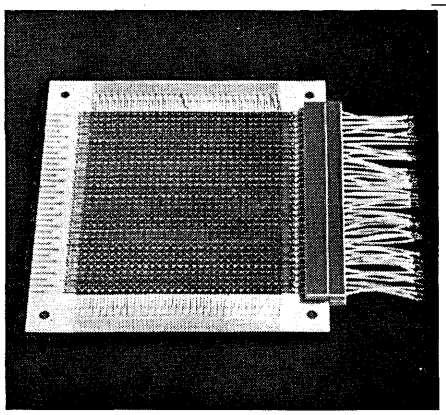


RCA's versatile line of memory stacks now includes sizes from 256 words by 8 bits to 16,304 words by 32 bits, with ferrite cores from .030" to .080" O.D. for system speeds as fast as 375 nsec.

RCA stacks can be supplied in a wide range of configurations and operating characteristics to meet your design needs, including types designed to meet stringent environmental specifications for shock and vibration. In addition, you can select from a broad range of plane constructions—new molded epoxy, phenolic, and printed-circuit types, or aluminum types designed to meet MIL specifications. All RCA stacks are 100 percent dynamically tested to assure dependability under actual operating conditions.

RCA WIDE-TEMPERATURE-RANGE STACKS COVER 80°C SPAN

New RCA wide-temperature-range ferrite cores permit the construction of planes and stacks that operate over any 80°C range within the limits of −60°C to +125°C without peripheral temperature-control equipment. In those applications where small size, minimum weight and reduced peripheral equipment are required, these devices can help you achieve vital space and cost savings.



RCA's EXCLUSIVE MICROFERRITE STACK ACHIEVES 65 nsec. SWITCHING

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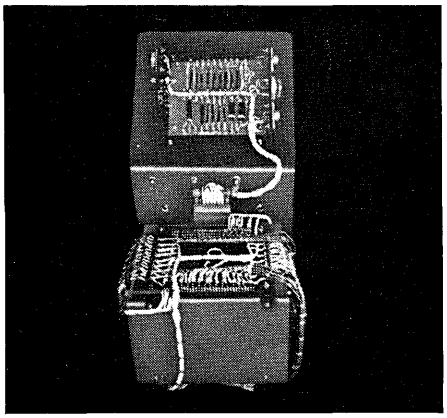

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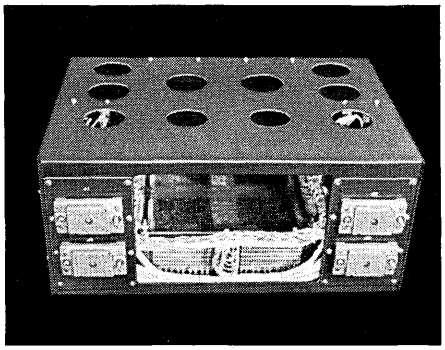

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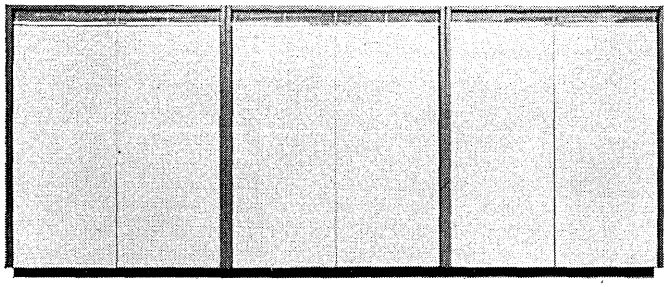
636



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Here is the full-size computer that can handle complex real-time data acquisition and control problems requiring programmed core-drum memory in capacities up to 294,912 words . . . that has excess speed capacity for simultaneous on-line and off-line use . . . that provides true direct memory access for input-output with no computation slow-down.

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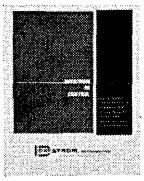

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DATAMATION

BUSINESS & SCIENCE

PHILCO REORGANIZES, NARROWS MARKETING SIGHTS

Amidst rumors and reminiscences of last year's Bendix "consolidation," Philco last May announced that it was pulling its Computer Division into the Communications & Electronics Division. Dropping the six-month-old 4000 from the line, Philco will now concentrate on the large-scale systems market, emphasizing military and scientific, areas of greatest success to date. The 1000 will be sold only as a satellite for 2000-series, which now represent, according to Philco, roughly 10% (23 systems) of those installed costing $40K/month or more. Personnel cutbacks involve only 4000 specialists, with no reduction in 2000 sales or support activities, according to newly named computer marketing manager Bill Doherty.

Philco sights are set squarely on the command and control market, centering mainly on 7090-94 FORTRAN and COBOL users, says Doherty.

Current re-structuring of 2000 prices, says the balding, beaming Philco executive, "will make us competitive." And he points to "a quite encouraging" 212 backlog as added reason for healthy optimism. Also coming up: "significant" hardware and software announcements.

FORTRAN IV: A BRIEF PROGRESS REPORT

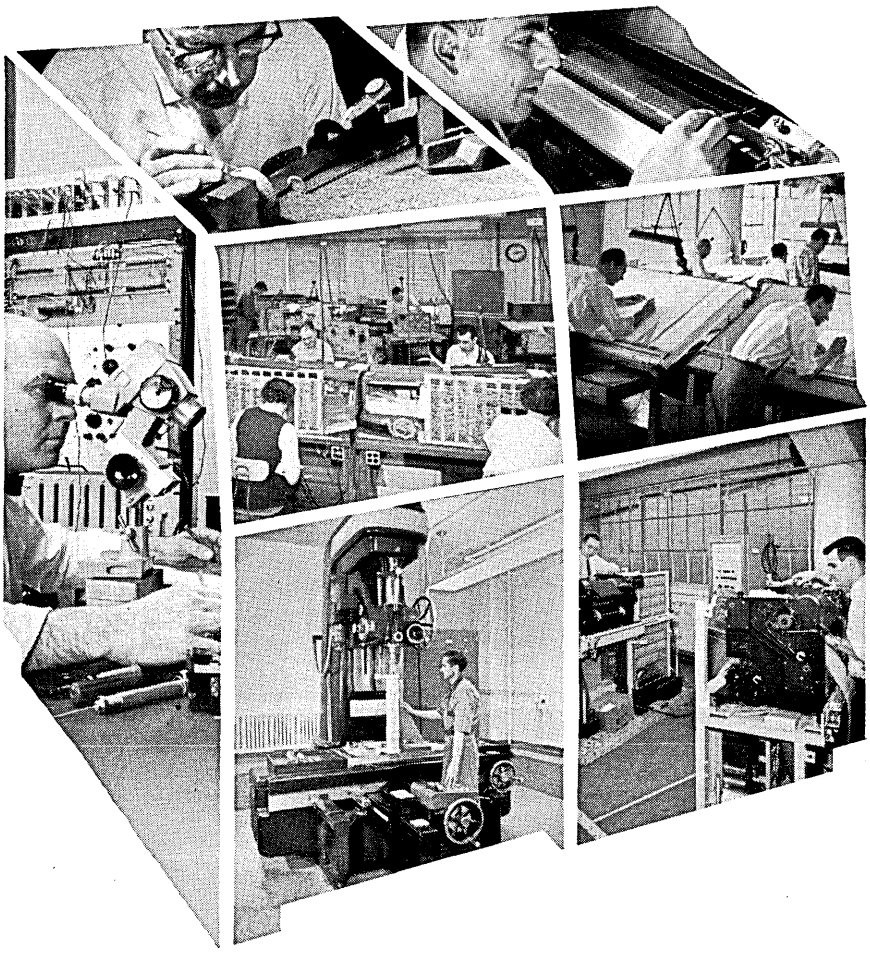
The current wait and see upgrading mode has not affected software, where the spotlight is on the FORTRAN IV race. Here's a quick run-down on present progress among some of the big boys:

Burroughs, all of its scientific language eggs in the ALGOL basket, has made no decision on a IV compiler yet.

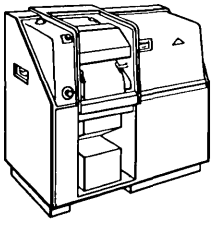
CDC says its 1604 version of "FORTRAN '63" was in field test in mid-June, with the 3600 model ready soon. The 1604 version hangs up on some statements but will eventually accept and compile all but IV data statements. Compiling speeds are about the same as earlier version; object codes are "near maximum efficiency."

GE, according to one source, will announce in August a compiler combining "II language with IV capabilities," part of a monitor system, with quoted 80% efficiency.

Honeywell's Automath 1800, already announced, contains the IBM IV language as a subset, requires 15K memory. Features include an alternate form of the data



INSIDE VIEW OF



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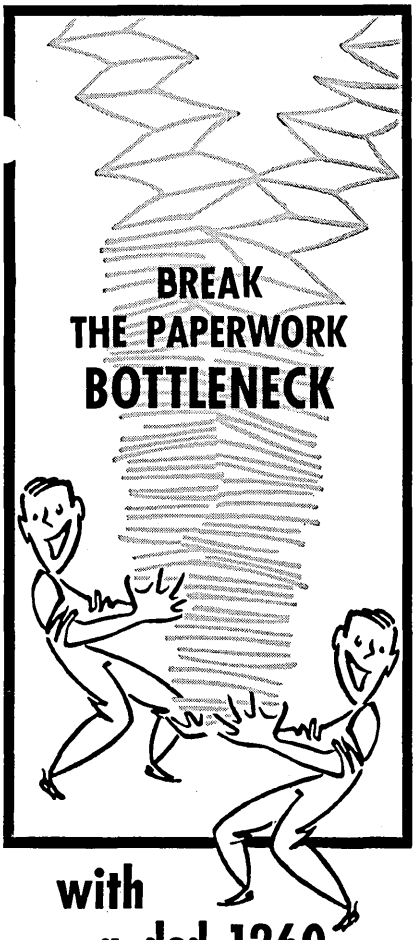

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statement, variable sized arrays, octal constants. A Honeywell SIFT for the 800 is due September 1.

FORTRAN father IBM, reportedly having trouble with its 90 IV compiler -- said to be running slower than the not-notoriously swift II -- says the IV will be part of a comprehensive 90-series IBJOB system; this makes direct comparisons difficult. One independent source says the IV is slower only on shorter programs. Trouble or not, the company has hired consultant CUC to review its 90/94 programming support program and evaluate competitive software.

Philco says work on its IV compiler is winding up; it will be available to the field "later this year."

RCA is "well down the road" on an enhanced II, scheduled for field test on the 354 (scientific 301) around the first of July.

Univac says its IV for the 1107 is in operation, has been accepted by a major gov't agency. Said to be "two to 10 times as fast as the IV on the 94," the compiler is rated by one independent consultant as the tightest, most efficient he's yet seen. A IV compiler for the Univac III will be ready this fall.

TWO COMPUTER BILLS UP; WASHINGTON THUMBS DOWN?

All that publicity about computers was bound to backfire. Now Washington is trying to do something about their proper procurement and use. Hearings have been conducted lately on two bills, one sponsored by Texas Representative Jack Brooks, the other by veteran Senate watchdog Paul Douglas.

The Brooks bill, HR 5171, wants to charge the GSA with the responsibility for all EDP purchase/lease decisions, the evaluation of their effective use, and establish a revolving fund for purchase of computers, which would be rented to agencies. The Douglas bill, S-816, would establish P/L review authority in the Executive office of the President.

Both bills reflect the growing push for more government purchasing of computers. An unspoken industry fear: purchase will strengthen the healthy IBM grip on the government market, make it harder to justify the switch to other machines. Strong opposition is also raised by department heads who consider such legislation a usurpation of cabinet secretaries' authority. Insiders feel that neither bill is likely to pass this session.

WASHINGTON AGAIN -- THE FLEET'S IN

Another hot government trend--fleet purchases of computers, with the Air Force playing the lead role. Following up the AFLC order for 30 301's (May Datamation), the Air Force has announced plans to install between 160 and 174 NCR 390's for payroll processing at some 105 US and 25 overseas bases. The two orders sandwiched a dinky order for 19 CDC 160A's for an AF Satellite Control Facility tracking network.

But the fun is only beginning. The USAF Electronic

Systems Division has asked 24 manufacturers to submit proposals "for the installation of an edp system at some 152 Air Force bases throughout the world." The application: base-level inventory control. Proposals were due July 20, and a coded benchmark program is to be turned in by high noon, August 15. Proposals will be evaluated by the ESD's Data Processing Equipment office, and the contract awarded by GSA.

And DOD, evidently getting ready to make use of beaucoup computers, has purchased rights to reproduce and distribute Auerbach Corporation's progammed course in COBOL, distributed by Basic Systems, Inc., NYC.

CLIPPINGER'S REPLACEMENT IN X3.4 CHAIR IS NAMED

Dr. Franz Alt, of the Bureau of Standards, has been named chairman of ASA X3.4--Common Programming Languages--succeeding Dick Clippinger. Dr. Alt has had no previous association with ASA, but has achieved sufficient prominence to merit mention in "American Men of Science."

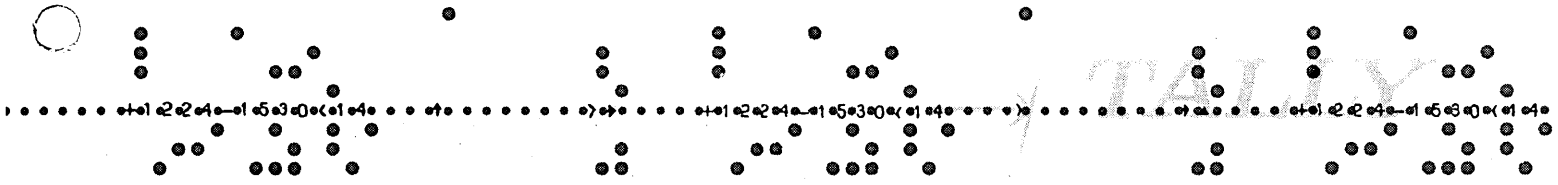
THE B 5000: HARDWARE IN, SOFTWARE FIRMING UP

A mite tardy getting off the ground, the B 5000 was flying high last month with eight installations, three within Burroughs. Two more systems are scheduled for delivery this month. Number one was delivered March 31 to United Tech. Center, Division of United Aircraft in Sunnyvale. Initial hardware tests used a prototype Master Control Program and extended ALGOL '60 5000 compiler. Using a FORTRAN translator, the B 5000 handled a rocket engine analysis problem, translated it into ALGOL, compiled and ran approximately 2.5 times as long as the original 90 program without multiprocessing on a machine about one-third the cost of a 90.

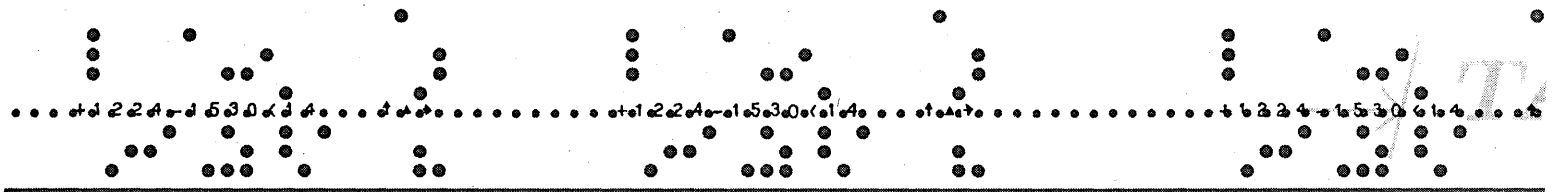
The second 5000 at NASA Huntsville includes one processor, four consoles (three slightly remote), four I/O channels, four memory modules (with four more on order), a 700 lpm printer and 12 tapes, plus some special telemetry coupling gear which acts as four pseudo-tapes. Both systems were in acceptance test in mid-June. Other 5000's shipped since include Northern Natural Gas, Dow Chemical, and L. A. Board of Education.

On the software front, Burroughs says its extended '60 ALGOL compiler was completed with the addition of I/O in early June. Goodies added to '60 ALGOL include stream procedures for handling character oriented logic, ability to handle partial word fields and symbolic monitor and dump debugging aids. COBOL, minus the SORT construction, is now being used to debug customer programs, and was supposed to be ready this month. A final-format MCP was installed in June, although more work will be done on it, says Burroughs. The FORTRAN translator is reportedly running well at both UTC and NASA.

All this programming tape was made



on the new Tally Printing Perforator.



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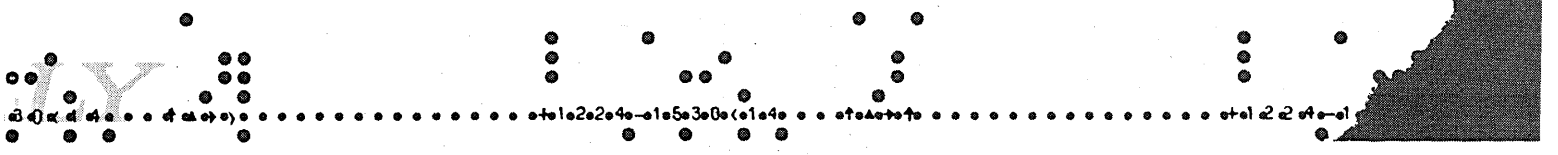

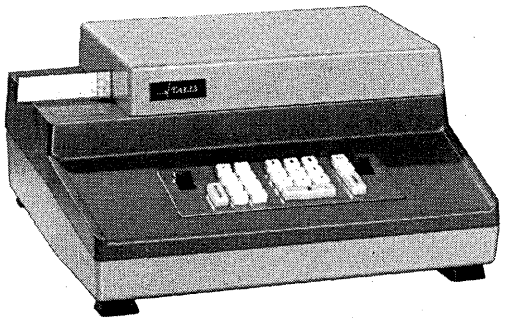

Model 430 Printing Perforator

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For a demonstration, call your Tally sales representative. For more information, please write Tally Corporation, 1310 Mercer Street, Seattle 9, Washington.

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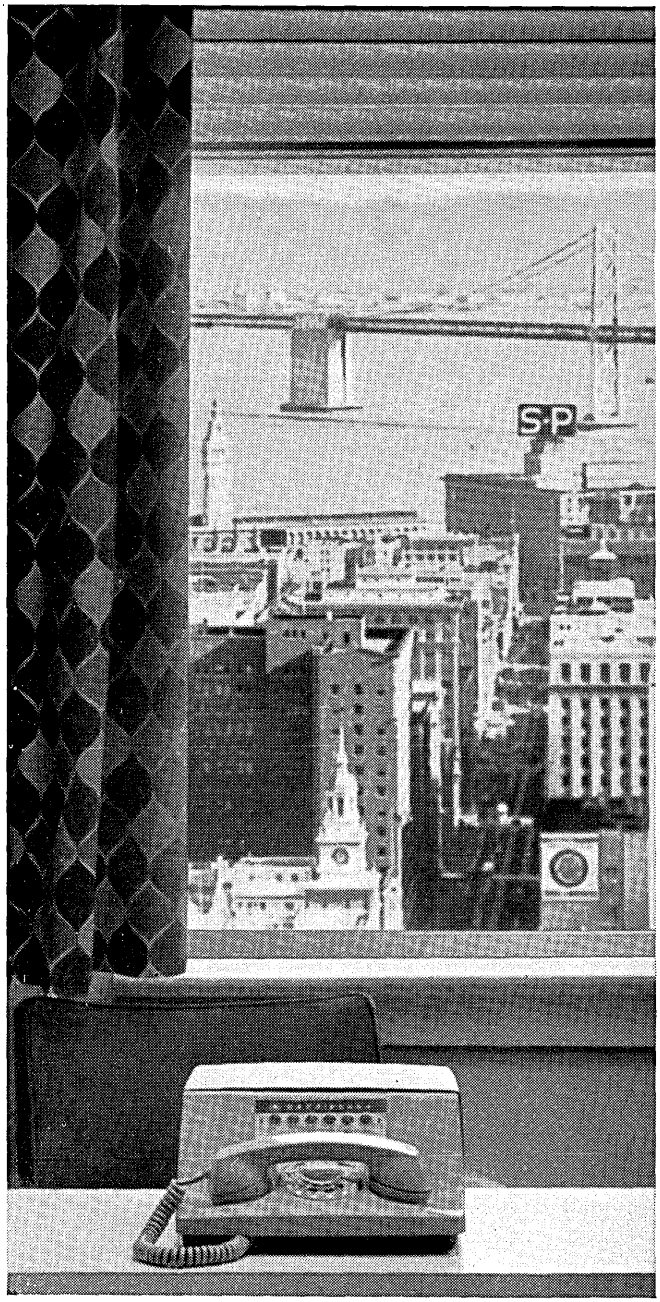

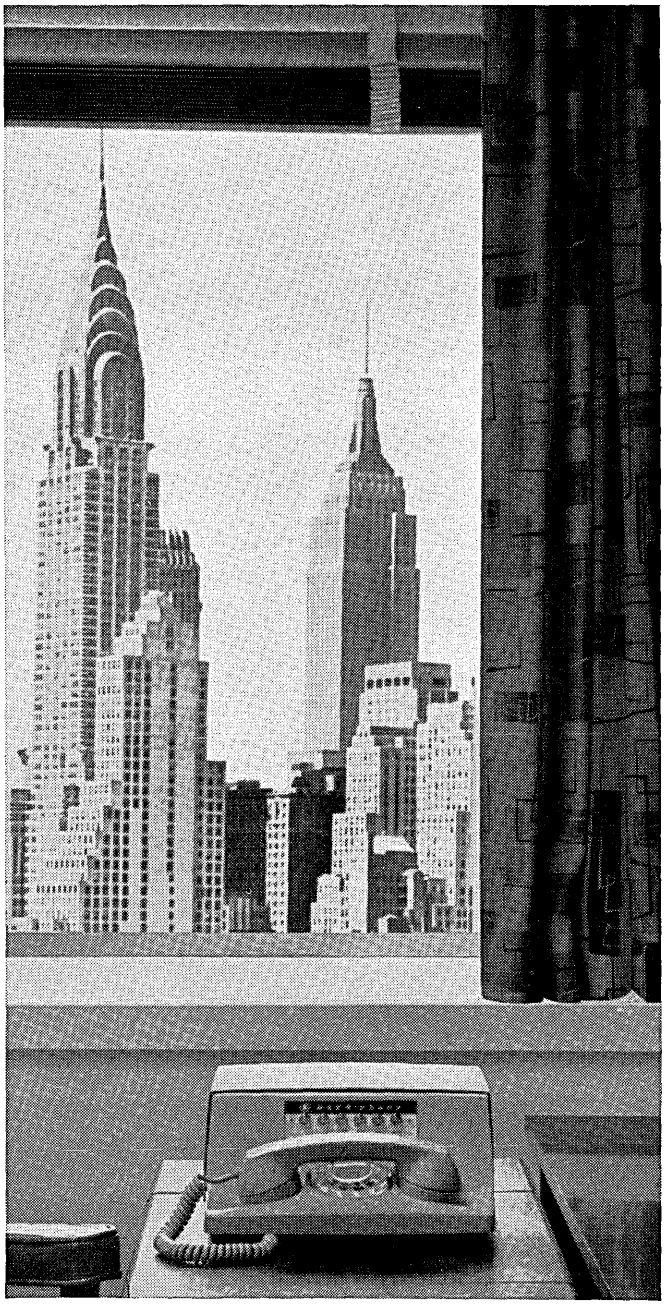

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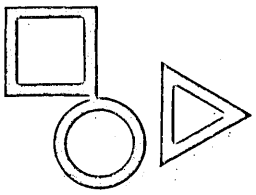

EDITOR'S READOUT

ON SCIENCE AND SOCIETY: A DEVOUT WISH FOR AFIPS

At its most recent meeting at the Detroit SJCC, the AFIPS Board of Governors decided to establish a central office in New York City, manned by an executive secretary yet to be chosen. Also still missing: a well defined public information program for AFIPS. This is understandable. Only two years old, AFIPS is still feeling its way toward a satisfactory understanding of its relationship to its member societies and to the world at large.

But it is devoutly to be wished that AFIPS does not underestimate the importance of public information – the responsibility of any scientific or technical community to inform society of its work. More important, it is the responsibility to help evaluate – and prepare for – the impact of that work upon society.

This responsibility is especially critical in a democratic society, where the general public, through elected representatives, plays so large a role in determining technical expenditures and progress. And information processing is undoubtedly affecting our society more directly, broadly and dramatically than any other single technology, even in its infancy.

Already in its short history, AFIPS has built the foundations of a sound public information program. The machinery for presenting talks on information processing to lay groups has been established; press seminars have been conducted at several conferences and relationships established with the press; the framework for a speakers' and information bureau has been set up; an eight-page pamphlet introducing information processing has been prepared. The prognosis for AFIPS public information is healthy: new chairman Don Madden is an enlightened and articulate advocate of a sound, aggressive and progressive public information program.

We hope that the AFIPS executive committee shares and supports his public information policies; and we hope that they will help him select an executive secretary capable of putting them into effect. But this isn't really enough. Members of AFIPS societies at every level must realize, too, their public information responsibilities.

This can mean writing a letter to an editor of a local paper . . . or participating in local, state or federal government citizens' committee work involving information processing. It should mean, certainly, a more direct and active participation in AFIPS and its member societies. They are what you make them. And what you make them may determine how well our free society makes use of computers and information processing.

COMMUNICATIONS SWITCHING AND BUFFERING NETWORKS

by JOHN D. BEIERLE, Automatic Electric Laboratories, Inc., Northlake, Illinois

Structurally, a communications switching network is a highly parallel computer consisting of a grid of independent, interconnected, spatially separated, functionally similar switching and computing modules, each with its own logic, memory and input-output hardware.[1] See figure 1. A switching and computing module communicates with another module by building a path to it. A path may be direct or may include intermediate modules. Path building instructions are generated at the originating module by a subscriber and transmitted along the path as it grows. Highly parallel computers are called Holland machines in the literature.[2]

In voice/data call switching networks, all path building is completed prior to channel utilization, which is then bidirectional. In unidirectional store and forward message switching networks, path building and channel utilization alternate until a message reaches its destination or destinations. Message switching modules include buffer storage to hold delayed messages during path building. Message switching networks may also include specialized buffer modules to handle code, signalling, and timing conversions.

message switching and computing modules

The functional organization of a store and forward message switching module is depicted in figure 2. The principal functions of the module are:

(a) Monitor lines for incoming messages either from subscribers or other modules.

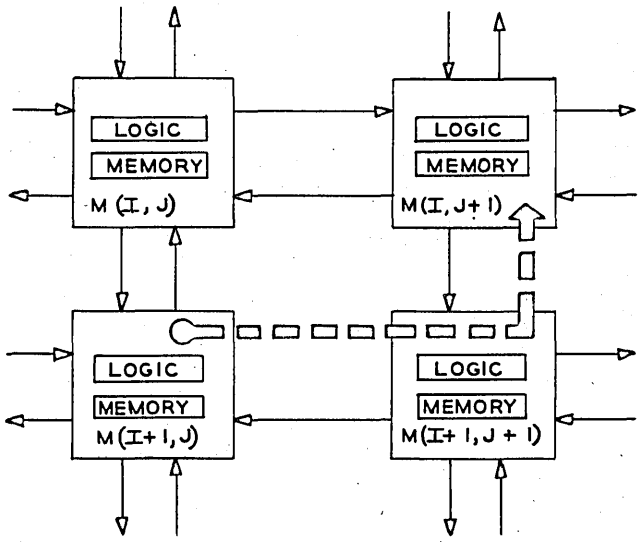

FIGURE 1

(b) Switch incoming messages into high speed buffer storage.

(c) Analyze path building instructions received with messages to determine message destination, route and priority level in accordance with message format specifications. Provide optimum routing of messages where possible.

(d) Find idle outgoing lines, make them busy, and transmit messages over them from high speed buffer memory.

(e) Perform message format, code and speed conversion, where necessary.

(f) Maintain a log of messages, including time received and time transmitted. Administer assignment of message identification numbers.

(g) Transmit messages to multiple destinations as directed by path building instructions. Buffer messages until all replicas have been transmitted.

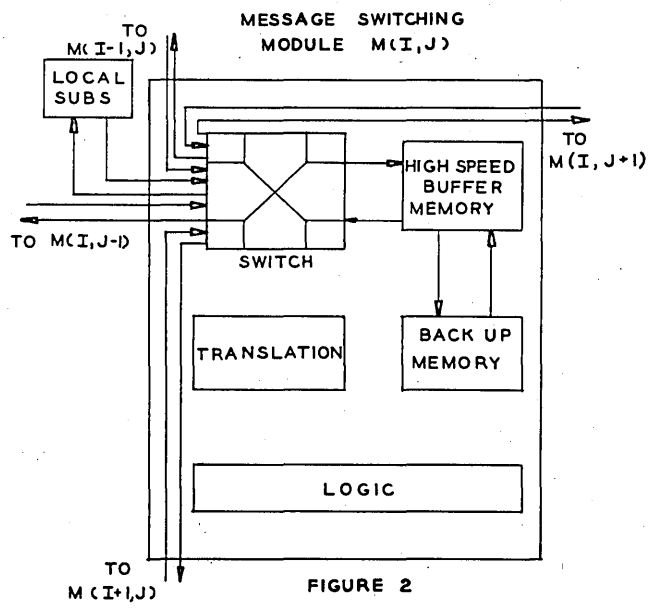

FIGURE 2

(h) Transmit messages in proper order of priority, and administer queue discipline in buffer memory for messages waiting behind busy outgoing lines.

(i) Monitor buffer memory for overflow, and divert messages in excess of high speed buffer capacity to medium speed, large scale back up memory.

(j) Monitor lines for transmission errors. Provide error detection and correction.

(k) Monitor lines and internal subsystems for errors and faults, and generate maintenance messages when faults are detected.

(l) Perform message accounting; assemble information for customer billing.

The principal functional subsystems of the module are the Switch, High Speed Buffer, Back-Up Memory, Translation and Logic.

The Switch permits local subscriber and incoming and outgoing line messages to be switched in and out of the Buffer Memory. The Buffer Memory and Back-Up Memory function in an obvious way to store messages awaiting idle outgoing lines. The Translator consists of a look up table of routing instructions for first choice and alternate routes, which is accessed using path building instructions received from local subscribers or other modules. These functions and subsystems operate under control of the Logic.

stored program message switching

Store and forward message switching has been handled in the past by electromechanical hardware. Examples of such systems are the Army's AN/FGC-30, the Navy's 82B1 System, and the Air Force Plan No. 55 Equipment.

In recent years, much attention has been paid to the possibility of handling message switching with real time, on-line digital computers. A number of such computers have been proposed, developed or installed by communications and computer equipment manufacturers.[3-7]

In a real time digital computer solution, a high speed random access core memory functions as the high speed buffer, with magnetic tape, disk file or drum memory being used for buffer back-up. The logic of the message switching module is built into the computer's stored program of instructions. The translator may use either high or medium speed memory, depending on the complexity

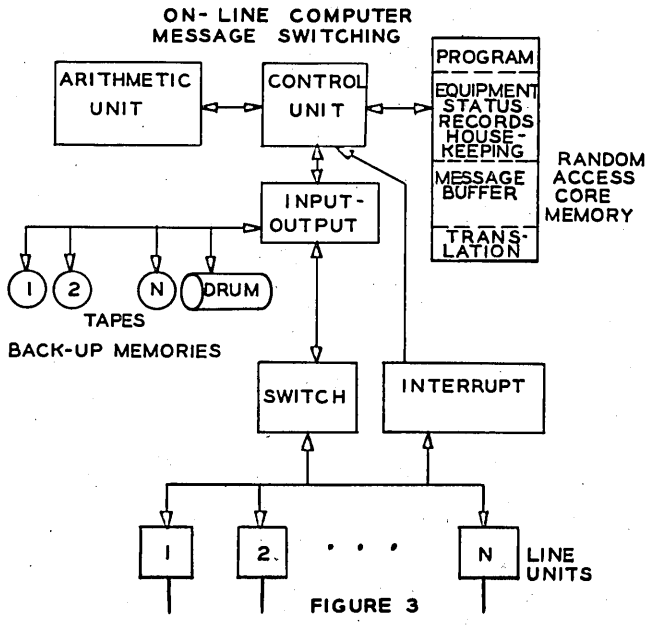

FIGURE 3

of table look-ups required. Figure 3 illustrates a typical computer application.

The line units operate as series-parallel converters and serve as a one or two character buffer between the line and the computer. Line units also handle start-stop synchronism.

program interrupt and multi-sequencing

In an electromechanical message switching installation, many identical units operate in parallel to carry the message processing traffic load. In a computer controlled message switching system, a single server time shares its control, arithmetic and memory access circuits over all message traffic, operating in a serial, one instruction at a time, mode. The computer's functions may be divided into two types: (1) complex data manipulation, arithmetic and housekeeping operations which are executed only when a message is offered for processing, and (2) simple but highly repetitive operations concerned with reception and dispatch of messages and their component characters.

Given the processing speeds available in today's generation of computers, careful attention must be given to systems and software design in order to avoid excessive real time occupancy due to type (2) functions. Some real time relief may be obtained by letting per-line hardware handle line synchronization and character construction from serial code, as indicated above. However, directed scanning of line units by the computer to detect the presence of new characters could be highly consumptive of real time. A well known solution to this problem is the program interrupt technique.

An interrupt feature enables a line unit containing a character destined for the memory buffer to stop the computer in its present task, and causes the computer to execute a short program to serve the line unit. All vital control register contents in the computer are saved in buffer memory when the interrupt occurs, and restored when the actions requiring interrupt are completed. Following restoration actions, the computer resumes its normal sequence of instructions.

An extension of the interrupt technique called multi-sequencing is particularly applicable to stored program message switching. This technique has been described in the literature by Ackley.[8, 5] In a multi-sequence system, line units are ordered in priority classes. Priority classes are independent of particular message priorities but depend on the speeds of the channels associated with the line units. Obviously, high speed lines are given a higher priority than low speed lines, since they require more frequent attention. In general, incoming lines have a higher priority than outgoing lines.

Lines may interrupt programs associated with lines of lower priority, but not lines of equal or higher priority. Any line may interrupt the main housekeeping program which has zero priority. Multi-sequence operation requires hardware which determines, among all active line unit interrupt requests, which has the highest priority, and then matches the priority of this interrupt against the priority of the program currently being executed.

alternative software techniques

Techniques for eliminating line units and multi-sequencing hardware have been reported recently by Helman *et al.*[9] These software and systems techniques presuppose digital circuitry operating at a 4 mc clock rate, and a high speed random access memory with 2 usec full cycle time and 1 usec read or write cycles.

Very high speed line scanning at a 280 usec rate replaces the line units, which are reduced to a simple level detector element. Scanning is controlled by a wired logic input-output unit which steals the system memory from the computer every 280 usecs.

A memory block assignment technique eliminates the requirement for stored program transfer of characters to memory and for multi-sequence hardware. A small number of back-up words for character storage are assigned to each line. As the input-output unit begins to fill the back up words, it puts up a flag which is scanned at a leisurely rate by the computer. When the computer observes the flag up, it finds an idle block of storage and puts its address in the first back-up word. The input-output unit then continues to fill this assigned block.

Many functions of a message switching module may be performed either by hardware or software. Functions most susceptible to software realization are those per-message functions involving relatively complex data manipulation. Hardware solutions appear most suited for the simple,

highly repetitive functions of the module. Even here, a desire for flexibility might lead to a stored program solution.

voice/data call switching modules

A large volume of data transmission traffic is expected to utilize the voice networks of the telephone operating companies and administrations and the broadband switching network of Western Union. In these networks, end-to-end paths are established before any voice or data transmission begins. Call switching modules differ from message switching modules in that no buffer storage is required, and in

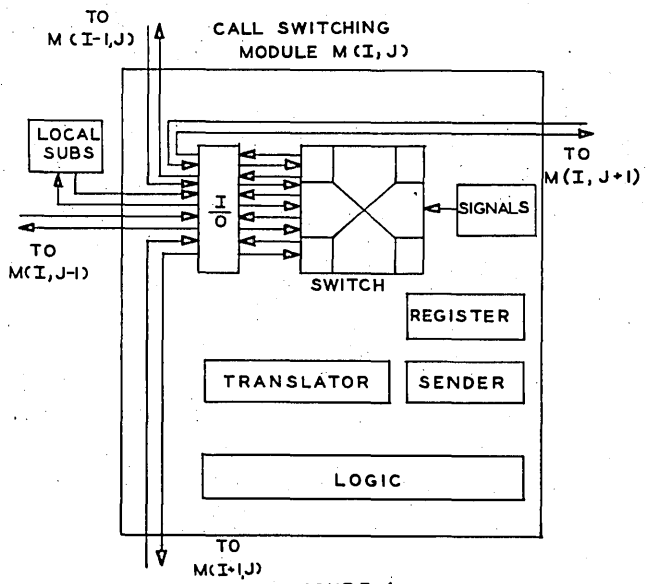

FIGURE 4

that no switching of data takes place between lines and memory. A typical call switching module is depicted in figure 4. The principal functions of the module are:

(a) Supervise local subscribers and incoming and outgoing paths for origination (seizure), answer, disconnect, and flashing. Transmit answer and disconnect supervision.

(b) Register path-building instructions transmitted over lines and paths either by d-c or multi-frequency signalling.

(c) Analyze and translate registered path-building instructions to determine call destination, route, and new path-building instructions if the path is incompletely built.

(d) If the call destination is local, test local subscriber for busy, and if idle, ring the local subscriber and return ring-back tone to the originating path or subscriber. If busy, return busy tone. Remove ringing and ring-back tone when answer is detected.

(e) If the call destination requires more path-building, send the new path-building instructions to the next module. If an idle path meeting either primary or alternate route translation specifications cannot be found, return all path busy tone to the incoming path or subscriber.

(f) Maintain traffic data on calls.

(g) Monitor lines, paths, and internal subsystems for errors and faults; diagnose faults.

(h) Record terminal identities and time toll calls from answer to disconnect. Assemble customer billing information.

The principal functional subsystems of the call module are the Switch, the Input-Output, the Register, the Sender, the Translator, and the Logic. The Switch is used to interconnect local subscribers, tones, ringing signals, incoming paths, and outgoing paths. Connections may be set up from subscriber to subscriber, subscriber to path, path to subscriber, and path to path. The Input-Output unit functions to permit the extraction of path-building instructions from subscriber's and incoming paths, and to permit the insertion of path-building instructions into outgoing paths. The Register contains memory for recording path-building instructions as they are received. Because of code differences, specialized originating registers may service local subscribers, and incoming registers may service paths. The Sender contains memory for storage of path-building instructions while they are being inserted into outgoing paths. The Translator is a look up table permitting the random association of path-building codes with internal module terminal numbers. It also stores routing instructions and path-building instructions. All functions operate under control of the Logic.

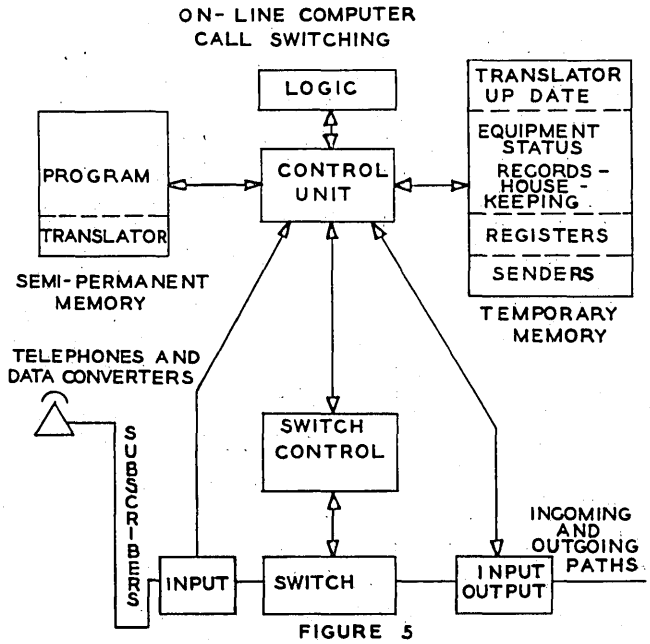

FIGURE 5

stored program call switching

As is the case with message switching, voice/data call switching has been processed using exclusively electromechanical equipment. Recently, the Bell System successfully concluded a trial of an electronic central office (ECO) in Morris, Illinois.[10] The Morris ECO consisted of an ultra-reliable, duplicated, special purpose computer operating on-line to control a switching matrix. Similar systems, either projected or under development, have been described in the literature by other organizations.[11,12] There can be no question that real time computers will come to have increasing importance in the operation of voice/data call switching exchanges.

A typical stored program computer call switching system is illustrated in figure 5. In the computer solution, high speed random access semi-permanent memory (mechanically but not electrically alterable) is favored for storage of programs and translation information. The choice of semi-permanent memory is dictated by factors of cost and reliability. Temporary memory (for example, core) is used for up-dating the translator between major changes, busy-idle status records for subscribers and paths, housekeeping records for switch control, traffic records, maintenance status, and message accounting, and for register and sender memory. Input-output equipments are used for insertion and extraction of supervisory signals and path-building instructions, but not as channels for the data being switched. The call switching computer contains no

high speed buffer memory or back-up memory for storage of messages.

software considerations in call switching

The logic of all system functions, including line and path supervision, registration, translation and sending, is imbedded in the stored program of instructions. Analogous to the case of message switching, programs may be classified into: (1) those performing complex logical manipulations in connection with calls offered to the system, and (2) those performing simple but highly repetitive operations in connection with the detection and transmission of supervisory signals and path-building instructions.

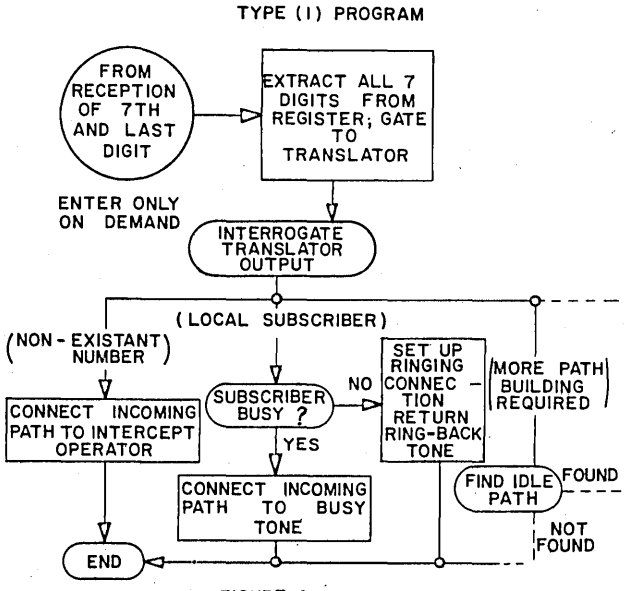

FIGURE 6

Figure 6 illustrates the functions of a typical program of type (1). The figure shows just a few of the processes which must be included in the program which is entered when a final digit of a path-building instruction is detected and registered. Figure 7 shows an exceedingly simple program of type (2) used to detect subscriber origination. Such programs can consume heavy percentages of the available real time in the computer. In switching modules serving small numbers of subscribers and paths, a single processor can handle these programs. In larger applications, relief can be obtained by implementing type (2) programs with:

(a) Wired logic input/output units.
(b) Auxiliary computers with simple order structures for input/output processing.

In either case, flag or interrupt hardware is used to permit intercommunication of the computer and auxiliary equipments.

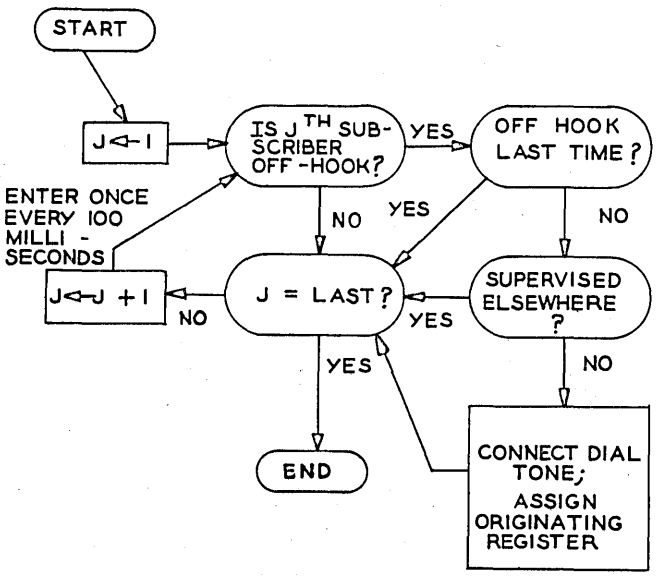

FIGURE 7

summary

Some of the general operating principles and functional requirements of communications switching and buffering networks have been presented. A distinction has been drawn between call and message switching systems.

The last few years have seen an increased interaction between the communications switching and data processing industries—interaction which is certain to accelerate in the next decade. Recent years have seen successful applications of digital computers operating on-line to control call and message switching. Message switching computers will find additional applications in the on-line connection of centralized general purpose computers to data terminals.[4] Increased use of digital computers in communications switching applications gives promise of a new generation of low cost, flexible, fast and reliable data and voice communications systems. ■

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This article was written, and is based upon experience gained, while the author was a programmer at General Electric's Missile and Space Division, Philadelphia, Pa.

COMPILING IN ENGLISH

experiences at GE

by JERRY SCHWALB, Advanced Programming, RCA-EDP, Camden, New Jersey

In March 1961, the Business Data Processing Operation at the Missile and Space Division (MSD) ordered a GE 225 which was installed in December 1961. The original configuration consisted of a central processor with 8,192 words of core storage, four magnetic tape units, a card reader, card punch, and high-speed printer. In September 1962, two additional tape units were installed.

Ninety-nine per cent of the programs for this computer have been written in the 1960 GECOM (GEneral COMpiler) source language, an English language programming system for the 225. The specifications of this compiler language are similar to those of COBOL.

The factors influencing an early decision to use English language programming were as follows:

1. Due to the volume and complexity of applications at MSD, a language which would be flexible, easily modified, and reasonably efficient was needed. It appeared that GECOM would fulfill these requirements.
2. It was expected that, with no change, GECOM programs could be compiled on future General Electric computers.
3. It was felt that experienced English language programmers could readily modify existing GECOM programs for other COBOL-like compilers.

applications

From May 1961 until December 1962, eight full-time programmers had been involved in writing GECOM programs. These programmers have developed a total of 200 English language programs.

In order to more fully appreciate the flexibility offered by a COBOL-like language, a brief description of a few of the applications which have been programmed with an English language compiler will be presented.

Vendor Rating

The purpose of this system is to compute a vendor and commodity quality rating based on inspection of parts and components of a product. Inspections are inputted to the system in the form of punched cards. Each inspection is tested against a table of previously defined sampling criteria to determine quality rating. The system has the ability to monitor the procedures for inspection and to suggest changes in these procedures where applicable. This is a nine-phase system; approximately 900 inspections are processed weekly against a master file of 10,000 items. Processing time is 90 minutes per week.

Information Retrieval

The purpose of this system is to retrieve technical information in the Division's technical documents library upon request. The information retrieval master file includes approximately 10,000 document references and is growing at the rate of 1,000 per month. Requests for information consist of an unlimited number of descriptors which are logically connected by the following relationship (or any combination thereof):

"AND"
"OR"
"AND NOT"

This system consists of five phases, and is capable of processing 60 requests per hour.

Receiving Control

The purpose of this system is to maintain inventory control over incoming material and supplies ordered from vendors. The inventory master file includes approximately 6,000 records. The system processes a daily input of 600 receiving vouchers. Processing time, including updating of the master file and outputting of three reports, is 1¼ hours. The three reports include two complete inventory listings in different sequences, and a listing of material received with no supporting purchase vouchers.

Facilitates Reporting

This system is used in the area of plant and facilities maintenance and special building projects. The system is intended to aid management in allocating available manpower and supplies to areas demanding specialized skills. This purpose is accomplished by correlating planned hours and supplies with available manpower and supplies.

The facilities master file contains 9,000 records. Weekly

input is approximately 1,200 records. Processing time to update the master file and output four reports is 3½ hours. A separate reporting system is maintained for two plant locations. Each location receives a variance report showing the variations between actual and planned dollars and hours, and a forecast report showing planned labor hours and dollars for five future weeks.

advantages and disadvantages

Operating the computer during compilation is a comparatively simple matter. The operator need only place the source program cards in the card reader and depress the computer start button. No further operator action is required until compilation is complete. At the conclusion of a compilation, the operator removes the source and object listing from the printer and the object deck from the card punch. He is then ready to compile the next program. Experience has shown that individual compilation time is excellent. Eighty per cent of the programs compile in less than 20 minutes. Of the 200 programs compiled, less than 12 exceeded a half-hour and none more than 45 minutes.

Object Program Efficiency

In order to obtain the advantage of a compiler language MSD has been willing to forego the optimum efficiency possible but rarely, if ever, achieved with hand coded programs. In using a COBOL-like language, however, reasonably efficient programs are expected. The compiler has not lived up to expectations in this respect. In some of the worst cases, reports have printed at the rate of 250 lines per minute compared to the rated printer speed of 900 per minute. One program reads cards at the rate of 150 per minute which is less than one-half of card read speed. It is probable that, at best, GECOM-produced object programs run at 60 to 70 per cent of the speed attained by the comparable hand coded program. With additional English language programming experience it is likely that this efficiency ratio would approach 90 per cent.

Analysis has shown that lack of efficiency is due in the main to the generalized nature of conversion and character move subroutines. Fields requiring simple editing pay a time penalty because they must use these subroutines.

programming considerations

Training—Experience with assembly languages has shown that the average trainee requires at least two months before producing simple programs. With the introduction of English language programming, this time has been decreased to one month.

An experienced programmer, on the other hand, will become productive almost immediately, whether programming in machine or compiler language. However, his amount of production will be significantly larger when programming in a language like COBOL or GECOM.

Debugging—The debugging tools offered by the compiler are excellent. The diagnostics during compilation quickly pinpoint the source language errors, thus decreasing the number of compilations required to produce a running program. The object program listings produced during compilation may be easily traced to the source program. This has been a great help in determining source language statements which generate improper coding. From time to time, changes have been made directly to object programs. Because of the ease of change, many unnecessary recompilations have been avoided.

In the past, program testing has been concerned with both problem and machine logic. GECOM has, to a large extent, eliminated the tedious tracing of machine instructions. At present, 90 per cent of the programs can be debugged at the source language level. Debugging runs today are much more effective because of the decision to use English language programming.

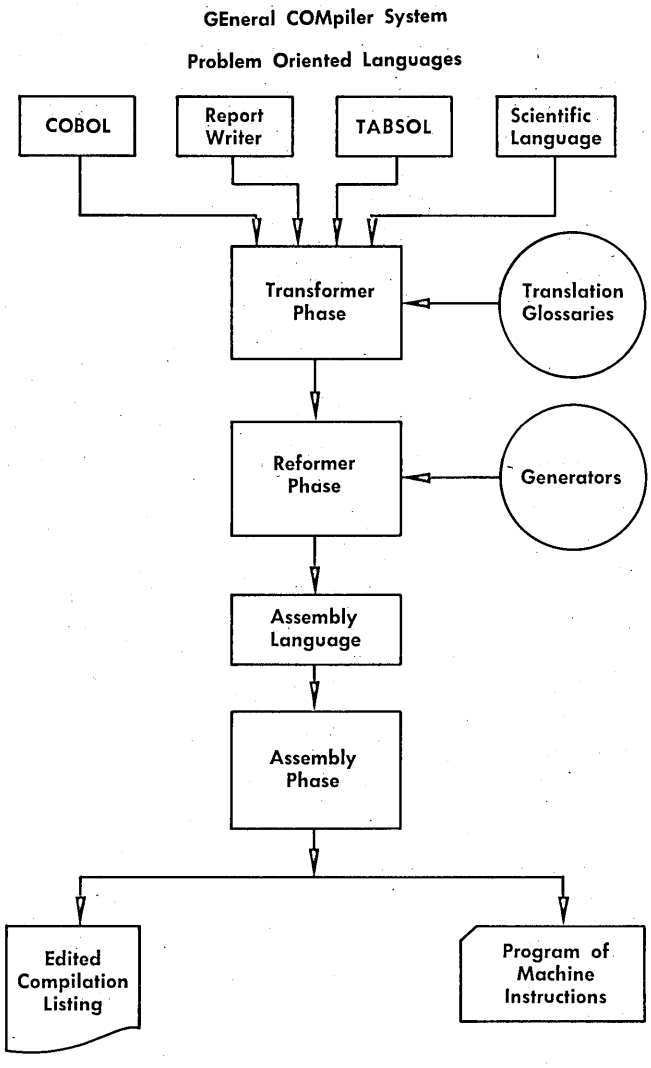
Knowledge of Machine Language—It has been found definitely not necessary for all of the programmers to be familiar with machine language. At MSD, three of the eight GECOM programmers are proficient GE-225 language programmers. The functions of the three programmers include analysis of the coding produced by GECOM and the correction of erroneous coding. These programmers have been able to handle the problems of the entire programming staff satisfactorily.

Documentation—The use of English language programming has allowed a standard method of documentation. Communication between programmers has improved considerably. Programmers have circulated, among themselves, various programming techniques and source language pitfalls. Program maintenance and change are no longer the problem they have been in the past. It is now relatively simple for one programmer to change a program written by another.

Program Implementation Time

For the purposes of this discussion, program implementation time will be defined as the elapsed time from the initial writing of a program until that program is ready for production. The implementation cycle for an object program consists of the following:

1. Writing of the program;
2. Keypunching of the program;



3. Compilation;
4. Eliminating source language errors (if necessary);
5. Testing of the object program;
6. Correction (if necessary) of the object program. This may include recompilation.

During the period from February 1962 until August 1962, program implementation time had been poor. In this seven months' period GECOM required six tapes for compilation, which was the total configuration of tape units. In order to save set-up time and therefore increase machine utilization, it was decided to compile batches of programs at one time and then to batch checkouts at another. This meant that the programmers had to wait one day between each machine run of their programs. The result was that program implementation time for the very simplest of programs, even assuming no error, was two days.

In September 1962, two additional tape units were received. Also, an improved GECOM system which allows compilation with less than six tapes is now in use. With the availability of additional tape units, savings through batching of compilations and checkouts are no longer realized. Therefore, checkouts are presently being run concurrent with production. Programmers now are able to compile and execute on the same machine run; this has reduced program implementation time considerably. The minimum implementation time for a simple program with no errors is presently one day.

to improve the use

During the early days of GECOM at MSD, there was no great concern with object program efficiency. Emphasis was placed mainly on writing programs which would compile and execute successfully, and on improving program implementation time.

To further these aims a GECOM workshop which met weekly was established. Each programmer on the staff attended these meetings. The main topic of discussion included GECOM statements and data descriptions which, in certain cases, halted compilation or caused incorrect coding. At this time, a list of procedural verbs which were working successfully was drawn up and distributed to the programmers. These workshops proved invaluable as a means of communication among programmers. As a result, the number of compilations per successful program decreased from six-to-one to five-to-one.

It was felt that the most direct method of decreasing program implementation time was to eliminate object listings of source programs. This approach was experimented with for a two-week period. During this time, individual compilation decreased by a time factor of 25 per cent.

It was discovered, however, that in some cases debugging from the source language alone was not possible. In these cases it was found necessary to recompile merely to obtain an object listing. These additional compilations cost more computer time than the savings realized by eliminating the object listings. At the end of the two-week period, the experiment was discontinued and MSD returned to the former method of compiling.

After most of the early bugs had been corrected in GECOM, successful program compilation and execution became more certain. At this time, the three programmers familiar with machine language proceeded to examine methods to increase object program efficiency. They developed a generalized subroutine for the high-speed printer. This subroutine, which was written in assembly language, speeded up printing time for double-spaced reports as much as 100 per cent. Another important contribution was an analysis of data description and file designs. It was found that unpacking files will result in a time saving of about 25 per cent when these files are processed.

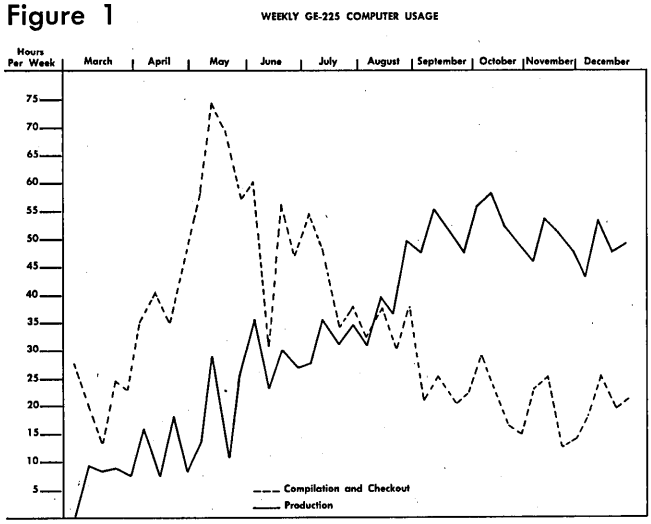
time comparison

Only two programs have been written in General Assembly Program (GAP) language. The following is a comparison of these with GECOM programs of similar size:

	GECOM I	GAP I	GECOM II	GAP II
Number of Instructions	5,500	5,250	4,950	4,800
Man hours for Programming	184	328	160	304
Number of Assemblies/ Compilations	4	10	4	8
Machine hours for Assemblies/Compilations	1.4	1.2	1.2	1.0
Machine hours for Debugging	0.8	1.1	0.7	0.9

For the user the true measure of a compiler is its effect on the amount of production attained in a particular time period. As of December 1962, MSD had compiled, debugged, and executed 200 programs. Of these, 140 are on a regular production basis and the balance have been specials. As may readily be observed (See Fig. 1), production has increased steadily. The increase is due to improvements in the GECOM system and additional experience in its use. For the last week of December 1962, production runs consumed 49 hours a week, and 20 hours of the week were spent in compilation and checkout. These figures reflect a notable achievement in machine utilization. It is difficult to estimate what total productive time would be without an English language compiler. Most assuredly, productive utilization would be considerably less than half of what it is today.

Figure 1



future expectations

As a result of experience with COBOL language, this installation has led to some conclusions regarding certain features that would be desirable in GECOM and in future compilers. The first of these is a Report Writer. Today it is found that programmers are recompiling because of simple format errors. A Report Writer should reduce these types of relatively useless recompilations. The second is a Compile-and-Go option. This feature will facilitate the running of compilation and checkout concurrently.

A MODERN-DAY MEDICINE SHOW

by ROBERT L. ALBRECHT, Control Data Corp., Denver, Colorado

During the summer of 1962, the Denver, Colorado, office of Control Data Corporation gave a course in the use of computers to a group of gifted mathematics students from Denver's George Washington High School (GWHS). Emphasis was placed on the use of a computer as a computational tool to assist students in solving mathematical problems. We had so much fun that we continued the course at GWHS throughout the 1962-63 school year, and extended the program to eight other schools in Denver and Jefferson counties. So far, more than 200 students have been introduced to the hardware as a handy device for getting answers to mathematical problems.

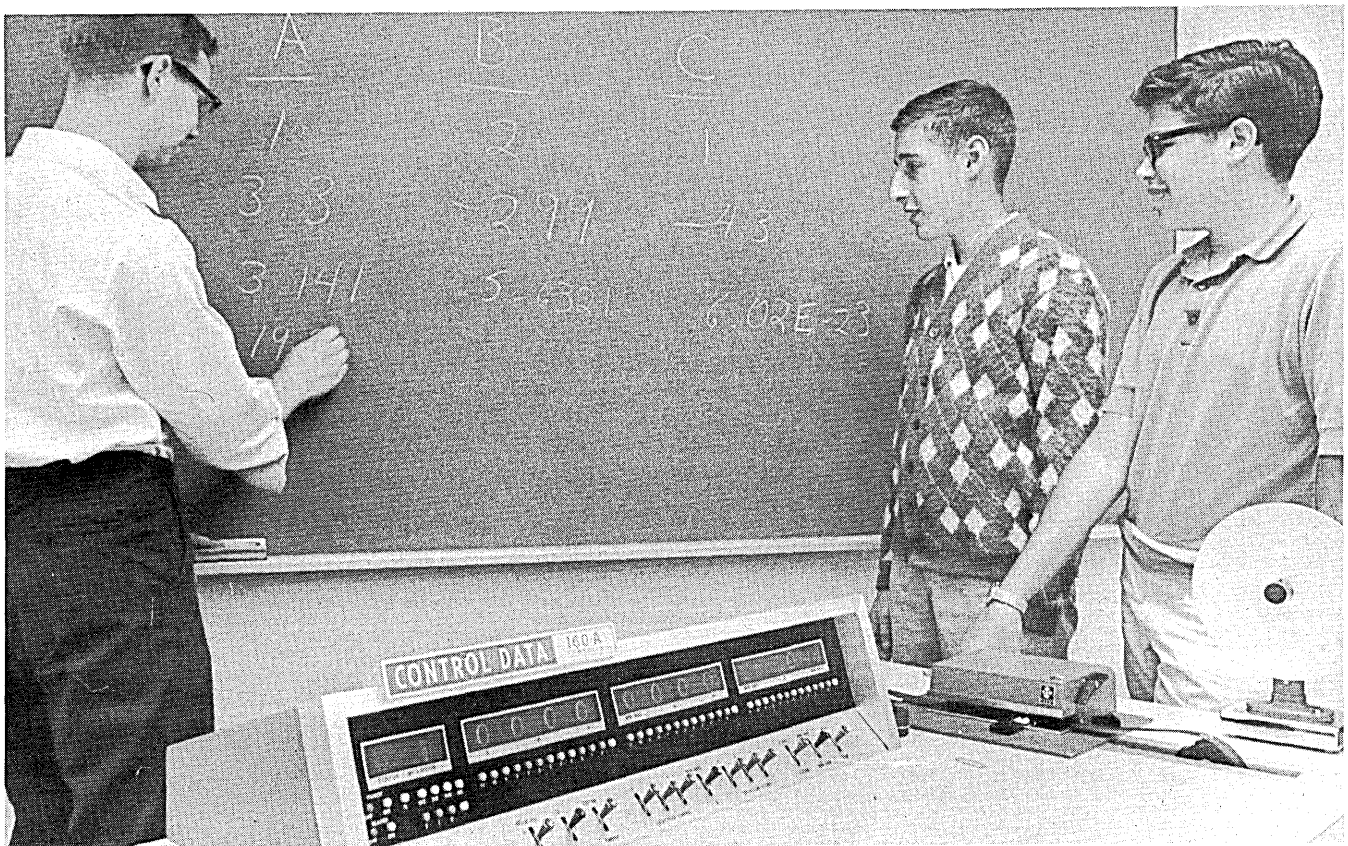
On March 24, a CONTROL DATA 160A and a Flexowriter were moved to GWHS and placed in charge of four students. For the next four days, these students put on a computer demonstration which had many of the characteristics of a "Medicine Show". The show was promoted, produced, and directed by the four students, who were also the stars.

The medicine show at GWHS was the high point of a computer educational program which began quite by accident. In the spring of 1962, I acquired a new neighbor, Irwin Hoffman, a mathematics teacher at GWHS. Irwin invited me to speak to the Math Club at his school on the use of computers for the solution of mathematical problems. Following this talk, several students inquired about the possibility of receiving computer training. I conferred with Irwin and we decided to organize and teach a course during the summer.

In this initial course, 35 students from GWHS met every Wednesday evening from 7 to 10 P.M. at the Control Data Denver office. We spent the first few meetings discussing computer fundamentals and describing the FORTRAN programming language for the 160A. By mid-summer, the students had become reasonably proficient at writing programs and operating the computer. For the rest of the summer, the Wednesday evening meetings were used primarily for the analysis, programming, and computer solution of mathematical problems. Of the 35 students who began the course, 25 were still going strong at the end of the summer.

The summer course was merely an appetizer for many of the students. They clamored for more training. During the fall semester we set up an advanced course for 12 students. (The rest had graduated.) A bleary-eyed mathematics teacher (Hoffman), a bleary-eyed Control Data instructor (me), and 12 bright-eyed young scholars met every Thursday morning from 7:30-8:30 A.M. before regular school hours. This course was conducted on a seminar basis, using the algebra of polynomials as the mathematical subject. The instructors posed problems. The students did the required mathematical analysis, developed problem solving procedures, programmed their solutions in FORTRAN and ran their problems on the 160A. Introductory courses were set up for beginners. The courses were conducted on an auto-instructional basis with seminar students serving as instructors.

In March, we decided to put on a medicine show at



GWHS. We decided that it would be done entirely by students without any adult supervision. By this time we had about 40 students at various levels of proficiency. We picked Bob Kahn, Al Nelson, Randy Levine, and Fred Ris to run the show. (Bob, Randy, and Fred were juniors, Al was a senior.) We outlined our project to the students and sat back to watch the fireworks.

During the week before the show, the four students arranged for the use of a room, obtained the equipment and supplies needed, and began an intensive promotional campaign. They drew up a master schedule for the 20 math classes which were to attend, and distributed the schedules to the teachers who were responsible for the classes. After some haggling, they agreed upon a demonstration program, wrote the source program, and checked it out after the 160A had arrived at the school.

Figure 1

```
0
0
C          GWHS TEACHER DEMO PROGRAM
C          PROGRAMMED BY RANDY LEVINE
1          FORMAT (45Hi ;have ;heard ;you ;do ;not ;like ;assistance ;. ;. ;.)
2          FORMAT  (36Hhere ;is ;your ;iddy ;biddy ;answer. ;. ;. ;)
3          FORMAT  (50Hhere ;is ;ye ;olde ;easy ;answer ;. ;. ;. ;lazy ;tiger ;. ;. ;.)
4          FORMAT  (38Hi ;will ;be ;a ;more ;courteous ;gw ;patriot.)
5          FORMAT  (27Hname ;the ;new ;baby ;after ;me.)
6          FORMAT  (39Hyou ;coach ;. ;. ;. ;let ;me ;teach;the ;class.)
7          FORMAT  (45Hwhan ;that ;aprille ;with ;his ;shoures ;shoote. ;. ;.)
8          FORMAT  (43Hwhen ;i ;consider ;how ;my ;light ;is ;spent ;. ;. ;.)
9          FORMAT  (35Hi ;have ;to ;be ;excused ;from ;the ;room.)
10         FORMAT   (I5, 4E16.8)
11         FORMAT  (4E16.8)
500        READ 10, JWHICH, A, B, C
           GO TO (15, 25, 35, 45, 55, 65, 75,  85, 95, 105), JWHICH
15         PUNCH 1
           GO TO 105
25         PUNCH 2
           GO TO 105
35         PUNCH 3
           GO TO 105
45         PUNCH 4
           GO TO 105
55         PUNCH 5
           GO TO 105
65         PUNCH 6
           GO TO 105
75         PUNCH 7
           PUNCH 8
           GO TO 105
85         PUNCH 8
           GO TO 105
95         PUNCH 9
105        DSCRIM = (B'B) — (4'A'C)
           IF (DSCRIM) 100, 200, 200
200        X1  = (—B + SQRTF(DSCRIM))/(2'A)
           X2  = (—B — SQRTF(DSCRIM))/(2'A)
           PUNCH 11, A, B, C
           PUNCH 11, X1, X2
           PAUSE 500
           GO TO 500
100        X1REAL = (—B)/(2'A)
           X2REAL = X1REAL
           X1IMAG = (SQRTF(DSCRIM))/(2'A)
           X2IMAG = —X1IMAG
           PUNCH 11, A, B, C
           PUNCH 11, X1REAL, X1IMAG, X2REAL, X2IMAG
           PAUSE 500
           GO TO 500
           END
           END
```

Articles, plugging the show, appeared in the school paper, and daily spot announcements over the P.A. system reminded the student body of the forthcoming event. By opening day, our students were indeed prepared.

the medicine show

The 160A was moved in on the afternoon of Monday, the 24th, and turned over to the students the next morning. The demonstration program, chosen in the hope that it would be meaningful and entertaining to the attendees, was checked out. Their source program, shown in Figure 1, was a procedure to compute the real or complex roots of the quadratic equation, $AX^2 + BX + C = O$. However, it had a gimmick.

By means of a code number entered with the data, the computer could be directed to precede the answers with a Hollerith message. These messages were terms favored by the instructors in their classroom presentations, and which had become cliches familiar to students. During demonstrations, students were asked to provide data for processing; for these results, no Hollerith message was punched. Then the teacher was asked for a set of data; when his results were listed, he was confronted by a familiar phrase preceding the answers. Some samples are shown in Figure 2.

The formal demonstrations were held Wednesday and Thursday, about every half hour, from 8:45 to 3:30 P.M., with a few left over for Friday morning. Because many of the classes were discussing the quadratic formula, a frequently heard request was, "Would you please ask the computer to do the odd exercises on page 263 of our text?" Bob Kahn accommodated one class by running one night's homework on the 160A, and using the Flexowriter to cut a Ditto master of the output tape. He presented a copy to each member of the class.

When the hardware was not being used for demonstrations, it was in constant use by students in the computer educational program. They practically fought over it. In fact, they coerced Irwin Hoffman into arriving every morning at 6:30 to let them into the school, and the custodian had to practically throw them out every evening at 6:00 in order to lock up.

The four "barkers" were excused from classes during most of the show. On Friday morning, Fred Ris rejoined his algebra class just as it began a discussion of the problem, "Given a set of N people in a room, what is the probability that two of them have their birthdays on the same day of the year?" The class set up some specific cases, and began hand computing the results. Fred jumped up, mumbled something about a computer, and dashed out the room. He ran downstairs, wrote a FORTRAN source program to tabulate the desired probabilities for N=2 to N=150, then compiled and executed the program. He managed to get back to his algebra class before the end of the hour to display his results.

Friday noon, the students were informed that they would have to move the computer to make room for a meeting. They rolled the 160A out of the room, down the hall, and set up shop in the main lobby, There, they were immediately surrounded by curious students, and ran informal demonstrations until the middle of the afternoon. At that time, a moving van rolled up to the front door, the gear was packed up, and the medicine show moved on to the next stop.

the show gets results

Well organized and conducted with imagination and showmanship, the performance was a tremendous success. It generated a great deal of interest in additional introductory computer courses. Anticipating this, the boys had already arranged for the use of our classroom facilities and the 160A during spring vacation. Sixty students were signed up during the show, the results of a flyer which they printed and distributed, inviting spectators to enroll in introductory FORTRAN classes.

Sessions began a week later, organized into four sections of 15 students each. The courses were run on an auto-instructional basis. We provided 60 copies of a workbook, *Introduction to FORTRAN Programming*, which we are writing and reproducing in our office to teach the use of computers for mathematical problem-solving in the secondary schools. For a week, the student instructors answered questions and tutored individuals. During the second week, spring vacation, the instructors brought each section to our office for a day of problem-solving on the 160A. Every student had executed at least one FORTRAN program by the end of the week, and several had run more. They chose their own problems, most of them coming from their mathematics text books.

At Washington High, as a result of this activity, we now have nearly 100 students who will be clamoring for additional training during the next school year.

plans for next year

We are sold on medicine shows. In fact, the second show was put on by five students at Denver's Abraham Lincoln High School, and more are anticipated during the next school year.

It will be a year of growth. In adjacent Jefferson County, public school officials are making arrangements to train high school teachers in computer methods, and have invited several universities in the area to assist in implementing an extensive program in computer education. During the next school year, we expect to have courses there in computers and computing, as well as the present courses in problem-solving and answer-getting with FORTRAN. Recognized as a leader in evaluating and adopting new ideas, the Jefferson County public school system's program should provide us with some data for evaluation of several approaches to computer education in the secondary schools. ■

Figure 2

```
4/9./0./-16./
6/5./4./3./
7/1./10./25./
i will be a more courteous gw patriot.
   .90000000e 01   .00000000e-32  -.16000000e 02
   .13333333e 01  -.13333333e 01
you coach . . . let me teach the class.
   .50000000e 01   .40000000e 01   .30000000e 01
  -.40000000e 00   .66332496e 00  -.40000000e 00  -.66332496e 00
whan that aprille with his shoures soote. . .
when i consider how my light is spent . . .
   .10000000e 01   .10000000e 02   .25000000e 02
  -.50000000e 01  -.50000000e 01
```

BUILDING INTERNAL ACCOUNTING CONTROLS

for daily accounts receivable processing

by S. M. SALVINO, The Peoples Gas Light & Coke Co., Chicago, Illinois

With the increased speed of computers, "on time" or nearly on time accounts receivable systems are possible for even some of the largest receivable operations. At Peoples Gas in Chicago, a daily updating system for approximately one million customers is currently in operation, utilizing an IBM 7070. In this operation all accounts recorded on our Main File, which consists of 50 reels of magnetic tape, are processed each evening, updating the file to include transactions generated during the preceding daytime hours.

In designing this system, many new and different accounting control problems were encountered. Probably the most formidable problem was created by the rapid processing of the entire file. This allows only a few hours to isolate and correct out-of-balance conditions before the entire file is processed again during the next evening, to avoid the compounding of any unresolved error condition.

We decided to provide the maximum amount of controls, consistent with the economics of the operation, to allow immediate or almost immediate resolution of error conditions. The programming is such that an error is brought to hard copy as soon as it is detected. Thus the source of the error (type of input, area of program, etc.) is isolated. This approach was particularly advantageous during conversion, when a minimum of personnel was available for dealing with computer system controls. Conversion of some four million card records to the computer system was accomplished in the relatively short period of four months.

The Main File is designed with a control record at the end of approximately 1,000 customer records. Included in the control record is a count of active accounts and a complete distribution of the outstanding receivables. As each account is processed, the outstanding items are cross-footed and checked to the total due for the account. In addition, the distribution of input items, and outstanding items before and after posting are accumulated for proving to the control record. In processing the control record, the sums of the transactions plus the previous outstanding balances are proven to the new outstanding totals. Any out-of-balance condition causes a type-out on the console log. Immediate corrective action is required, since a serious programming error or machine error condition is indicated.

Thus far, few instances of console out-of-balance typing have occurred. However, in each case detection and correction at that point avoided re-doing a considerable amount of computer work. A check of this type while the system is in operation assures us that the accounts are being processed properly. To determine an out-of-balance condition at a later point in such a system may not allow sufficient time for corrective measures without serious delay in related clerical areas.

separate control run

In addition to the account-by-account and control record check as the Main File is being processed, a separate control run processes all the various input and Main File totals to prove out the overall computer system including distribution. In addition, this control run isolates any error condition to a particular input, program, or other area. Rapid location of errors allows for corrective measures to be taken before the next system operating day.

Within the system the two levels of control, one over the Main File accounts as they are processed, and the other over all computer operations, assures proper processing. In addition, we have a manual ledger control with which the daily totals of the computer system must balance. This precludes the possibility of not detecting input tapes that may not have been processed, or of updating a Main File tape other than the current one, or other such operating errors. Available each day from the system are total receivables by type, number of active customers, number of meters, amount of cash posted, amount of cash received, number and amount of bills rendered, and several other significant control statistics.

In a utility billing system, billing amounts are calculated from "meter reading differences," rates, and other information. ("Meter reading difference" is the quantity of gas used between two consecutive meter readings.) Since billing is an internal operation, we must rely on certain checks to prove that bill calculations are accurate and that we are billing each account once, but not more than once. Bill calculation is verified in a separate statistics run, in which the total quantity of gas billed at each "block" of the various rates is re-calculated and compared with the total amount actually billed. As to duplicate or missing bills, our overall statistics prove no mass errors exist. The presence of a meter reading input document, with or without a reading, is required to generate a bill. The absence of a meter reading input document is reported in a memorandum issued by the computer, and prompt investigation is made to insure against failure to issue and record a proper bill. Pre-printed serial numbers on the bill forms are used to prove that the number of bill forms used is in agreement with the number of bills rendered as shown in the computer system statistics.

batch input techniques

All inputs involving accounts receivable are "batched" separately by type of entry, and are balanced to predetermined totals at the point of entry into the system. Cash receipt input (approximately 28,000 items per day) is optically read by an IBM 1418 scanner, is batch-listed and is simultaneously recorded on magnetic tape. The total number of items and amount of cash, by batch, are developed during the processing of cash receipts, and are also recorded on magnetic tape. Other charges and credits are similarly batch-listed and balanced. The batch totals written to tape are verified on the initial input runs to establish that all items charged to the computer system were actually received. The input totals of cash and other entries are posted to a manual ledger for overall computer system balancing. For auditing purposes, all entry input to the system is available on batch listings in the same sequence as the original documents.

semi-annual runs

As of June 30 and December 31, a special run of the entire Main File is made, using a special program to audit the file, extract certain infrequently used data, prepare special reports, and fulfill many one-time requests for data from the file. The special, semi-annual run is a relatively inexpensive means of protecting against file deterioration, and of developing management information which would be too expensive to produce daily. For auditing purposes, such a run is capable of producing numerous meaningful statistics, developing information for circularization of accounts receivable, reviewing for file deterioration, testing accounts for a variety of conditions, and selecting accounts for audit follow-up. The cost of the additional audit programming and additional machine time is insignificant.

control system performance

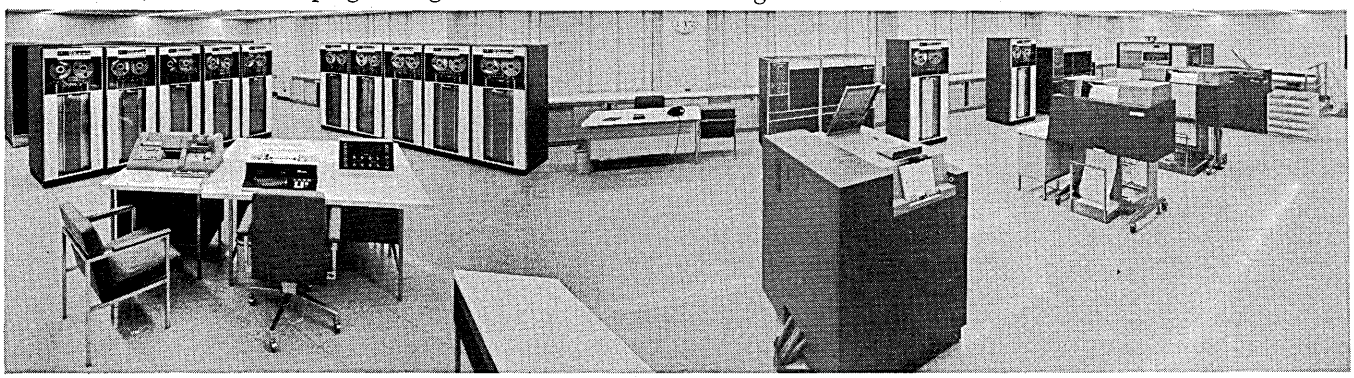
Our experience with the system controls has been excellent. We have had out-of-balance conditions, but in each instance the condition was readily recognized and corrected. Computer system error conditions have been handled well within the hours available before the system is scheduled to operate again. The emphasis placed on adequate controls, with the computer used to isolate the areas out-of-balance, has allowed us to convert to our computer system on schedule, and to operate with assurance that the accounts are well protected.

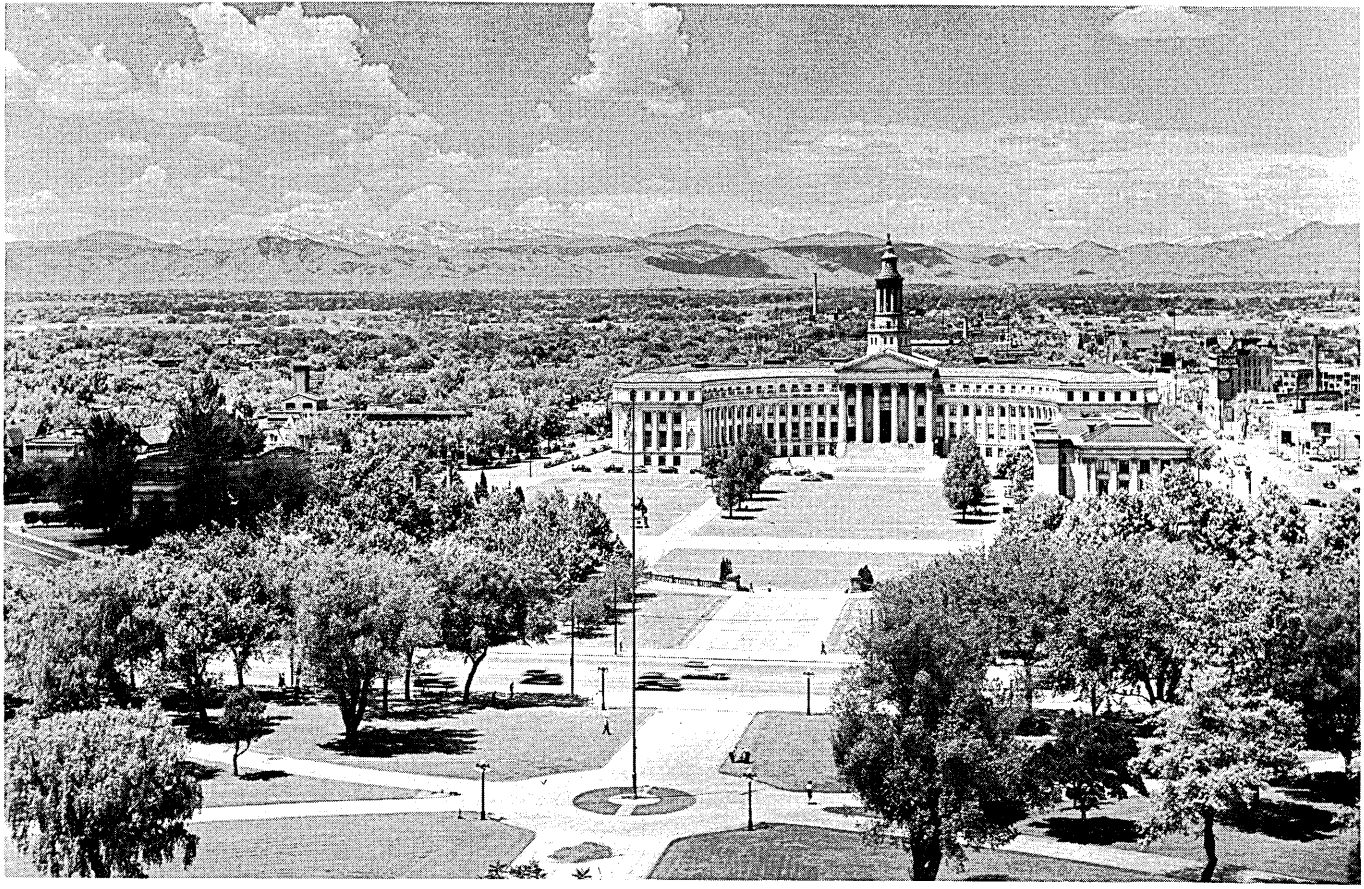
One particularly difficult problem involves the control of transactions not acceptable to the computer system. All input to our system must pass certain validity checks before it is allowed to reach the point of being posted to the file. Failure to pass the validity tests creates a printed memorandum giving notice of the item's rejection and the reason for rejection. At the point of posting, the transaction is further subjected to comparisons with data on the Main File to prove that the item is for the proper account, or in some cases to prove that the item is consistent with previous data recorded for the same account. For example, meter readings are screened to prove that the "meter reading difference" is in reasonable agreement with previous consumption. It is the entirely manual control of the rejected items which creates problems. These are the exceptional items and, as in most systems, they create a disproportionate amount of work since they require some "look-up" and corrective action. Our auditors, both internal and external, are aware of the need for scrutinizing this area of the overall system. Fortunately, the volume of such items is relatively small.

There are many other control features which are relatively standard in computer systems. For physical file protection, we use a storage company to pick up and store, out of the city, one "generation" of the Main File each week. By this technique we are adequately protected from fire, tampering, and other local hazards. Through the use of magnetic tapes, remote storage of some 360 million characters of customer information is economically feasible. (Recently, a plan was adopted whereby an additional generation of the Main File is stored in a Kansas "Salt Mine." Rotation of this file is on a bimonthly basis, permitting us to have major disaster protection at a reasonable cost.)

system design and accounting controls

Adequate accounting controls are inherent in good system designs. As control features have evolved in manual accounting systems, so also in computer systems, multi-level checks, controls within files, and facilities for error location and correction can and are being established. Auditors, evaluating internal controls to assure management that the company's assets are being protected, have begun to consider the competency of the systems staff, particularly in terms of its ability to interpret management policy and directives in systems design. ■





ACM MEETS IN DENVER

August 27-30

The Mile High City and the Univ. of Denver will host the '63 ACM conference, August 27 to 30. Conference headquarters will be the Denver Hilton hotel. The technical program, under the chairmanship of Fred P. Venditti, Univ. of Denver, will consist of 33 sessions, including 80 contributed papers (from among 165 submitted), eight invited papers, seven panel discussions, three Halls of Discussion, and three evening tutorials. Abstracts of all papers are available in booklet form to attendees in advance of the conference.

The registration fee is $10 for members, $12 for non-members, and $5 for students. Rooms at the Hilton are being reserved until August 17.

Special reports will be presented by G. G. Heller, IBM, Washington, D.C., "Report on Information Processing Education," and by Victor Yngve, MIT, "Report on Annual Meeting of Association for Machine Translation and Computational Linguistics."

Speaking on "The Computer Industry — A Look Toward the Future," will be the keynote speaker, William C. Norris, president, Control Data Corp., Minneapolis, Minn. There will also be a tour of the United States Air Force Academy at Colorado Springs, and the National Bureau of Standards scientific laboratories at Boulder, Colo.

The 14 subject categories of the conference are logic, compilers, numerical analysis, pattern recognition, mathematical programming, bio-medical programming and processing, education and programmer training, information retrieval, hardware, programming languages, software, language and learning, simulation and graphical output, and merging and sorting.

Topics of the panel sessions are information retrieval, multiprocessors, social aspects of computers in politics, business dp, programmer training, computer science curriculum, and medical diagnosis.

Evening tutorials will be "On the Construction of a Compiler for ALGOL 60," Arthur Evans Jr., Carnegie Tech., Pittsburgh, Pa.; "COBOL, Up-Dated," William L. Donally, IBM, New York, and "PERT/CPM," James W. McCauley, Control Data Corp., Denver.

Hall of Discussion sessions and their chairmen are "Phase-in of New Systems," G. M. Fitzgerald, Tennessee Gas Transmission Co., Houston, Texas; "Decision Tables," Sol Pollack, The RAND Corp., Santa Monica, Calif., and Michael Montalbano, IBM, San Jose, Calif., and "Mathematical Programming," Robert L. Graves, Systems Programming Inc., Arlington, Va.

ACM technical sessions . . .

TUESDAY

August 27

Tuesday, August 27, Senior Ballroom, 2 p.m.
Session 1A: Information Retrieval
Chairman: James E. Feeley, Martin-Marietta Corp.
1A.1: New Methods in Automatic Abstracting, H. P. Edmundson, TRW Inc.
1A.2: Effective Information Searching Strategies Without "Perfect" Indexing, R. J. Tritschler, IBM
1A.3: FIRE Information Processing System, J. R. Berry, North American Aviation Inc.
1A.4: The Effect of Varying Word Lengths on the Accuracy of Matching Documents with Readers' Interests, A. B. Barnes, A. Resnick, IBM
1A.5: Computer-Produced Indexes, D. C. Roper, W. D. Timberlake, IBM.

Tuesday, August 27, Junior Ballroom 2 p.m.
Session 1B: Mathematical Programming I
Chairman: David M. Smith, Systems Programming, Inc.
1B.1: Computational Techniques for Scheduling Problems with Deferral Costs, E. L. Lawler, University of Michigan
1B.2: Tests on a Computer Method for Constructing Time Tables, J. Csima, C. C. Gotlieb, Univ. of Toronto
1B.3: A Double Parametric Algorithm for Linear Programming, Peter Sandor, KCS Ltd.
1B.4: A Procedure for Determining the Convex Hull of A Set of Points or Hyperplanes, A. J. Goldstein, Bell Telephone Lab.
1B.5: Optimization by Function Contouring Techniques, Gary A. McCue, North American Aviation Inc.

Tuesday, August 27, Silver Room, 2 p.m.
Session 1C: Hall of Discussion Phase-In of New Systems
Chairman: G. M. Fitzgerald, Tennessee Gas Transmission Co.

Tuesday, August 27, Senior Ballroom, 3:40 p.m.
Session 2A: Invited Papers
Chairman: W. F. Miller, Argonne National Lab.
2A.1: Programmed Memory Organization and Data Bases for Retrieval, A. W. Holt, Applied Data Systems
2A.2: The Illinois Pattern Recognition Computer, B. H. McCormack, Univ. of Illinois

Tuesday, August 27, Junior Ballroom, 3:40 p.m.
Session 2B: Numerical Analysis I
Chairman: Paul Hultquist, Univ. of Colorado
2B.1: Simplified Predictor-Corrector Methods for Ordinary Differential Equations, M. Alan Feldstein and Hans J. Stetter, U.C.L.A.
2B.2: Higher Order Approximations of Runge-Kutta Type, E. Baylis Shanks, Vanderbilt Univ. and Marshall Space Flight Center
2B.3: An Efficient Composite Formula for Multidimensional Quadrature, Henry C. Thacher, Jr., Argonne National Lab.
2B.4: Computational Procedure for the Calculation of the Subdivisions of the Components of the Analysis of Variance, M. C. Miller, III, Univ. of Oklahoma Medical School

2B.5: A Fast Direct Solution of Poisson's Equation Using Fourier Analysis, R. Hockney and O. Buneman, Stanford Univ.

Tuesday, August 27, Junior Ballroom, 8 p.m.
Session 3B: Tutorial
3B.1: On the Construction of a Compiler for ALGOL 60, Arthur Evans, Jr., Carnegie Tech.

WEDNESDAY

August 28

Wednesday, August 28, Senior Ballroom, 9 a.m.
Session 4A: Panel on Information Retrieval
Moderator: Louis C. Ray, System Development Corp.
Panelists: Jack Belzer, Western Reserve Univ.; John C. Costello, Jr., Batelle Memorial Institute, Ronald E. Wyllys, System Development Corp.

Wednesday, August 28, Junior Ballroom, 9 a.m.
Session 4B: Numerical Analysis II
Chairman: Glenn E. Lewis, National Center for Atmospheric Research
4B.1: A Comparison of Methods for Determining Optimum Paths in the Problem of Bolza, Frank D. Faulkner and E. Warren Seibel, U.S. Naval Postgraduate School
4B.2: Interpolatively Generated Iteration Functions, J. F. Traub, Bell Telephone Laboratories Inc.
4B.3: Matrix Symetrization Methods for the Algebraic Eigenproblem, James L. Howland and Francis J. Farrell, Univ. of Ottawa
4B.4: Rapid Methods of Structural Change Analysis, Bertram Klein, Hughes Aircraft Co.
4B.5: On the Numerical Solution of Certain Classes of Boundary Value Problems, Lewis E. Hulbert and Francis W. Niedenfuhr, Ohio State Univ.

Wednesday, August 28, Silver Room, 9 a.m.
Session 4C: Logic
Chairman: Dan Slotnick, Westinghouse Electric Corp.
4C.1: An Algorithm for Boolean Simplification, J. J. Rothmeier, Cornell Aeronautical Laboratory Inc.
4C.2: Relationships Between Groups of Isomorphisms and Sets of Equivalence Classes of Input for Automata, Bruce Barnes, Pennsylvania State Univ.
4C.3: A Multi-Layer Iterative Circuit Computer, Rudolfo Gonzales, Univ. of Michigan.
4C.4: Incremental Data Assimilation in Man-Computer Systems, Lionello A. Lombardi, M.I.T.
4C.5: Test for Synchronizability of Finite Automata and Variable Length Codes, Shimon Even, Sperry Rand Research Center

Wednesday, August 28, Grand Ballroom, 10:40 a.m.
Session 5A: Panel on Multiprocessors and Multiprocesses
Moderator: Frank Wagner, Informatics Inc.
Panelists: Fernando J. Corbato, M.I.T.; Nance Drummond, IBM; Clark Oliphant, Burroughs Corporation; John McCarthy, Stanford University.

Wednesday August 28, Junior Ballroom, 10:40 a.m.
Session 5B: Mathematical Programming II
Chairman: Ivan Hebel, Colorado School of Mines
5B.1: Alternative Systems of Linear Equations in the Minimization of Quadratic Functions, Alex Orden, Univ. of Chicago.
5B.2: A Reduced Version of the Simplex Quadratic Programming Algorithm for Solutions Using a Medium-Size Digital Computer, R. E. Murphy, Stanford Univ.
5B.3: Geometric Programming in Manufacturing and Engineering, R. N. Little and B. Mittman, Illinois Tech. Research Institute
5B.4: Vehicle Secheduling by Computer, J. W. Wright, Univ. of Manchester, England
5B.5: Shared Waiting Space Distribution of Single Server Queues, Gerald Harrison, Teleregister Corp.

Wednesday, August 28, Silver Room, 10:40 a.m.
Session 5C: Language and Learning
Chairman: Herbert Bailey, Colorado State University
5C.1: A procedure for a Transformational Decomposition of English Sentences, Aravind K. Joshi, Univ. of Pennsylvania
5C.2: ALMS — Analytic Language Manipulation System, Frederick W. Blackwell, Space Technology Laboratories Inc.
5C.3: An Association Scheme for Artificial Intelligence, K. N. Leibovic, Cornell Aeronautical Laboratory Inc.
5C.4: A Simple Computer Program with Learning Capability, J. H. Ahlberg and J. E. Hutchison, United Aircraft Corp.
5C.5: Thinking—Human vs. Machine Process, Posheng Yen, Western Electric Co.

Wednesday, August 28, Senior Ballroom, 2 p.m.
Session 6A: Invited Papers
Chairman: S. D. Conte, Purdue University
6A.1: Growing Applications of Linear Programming Places, New Demands on Computer Systems, J. S. Aronofsky, Socony Mobil Oil Co. Inc.
6A.2: The Design of Data Processing Compilers for Large-Scale Computers, Roy Nutt and Charles J. Swift, Computer Sciences Corp.

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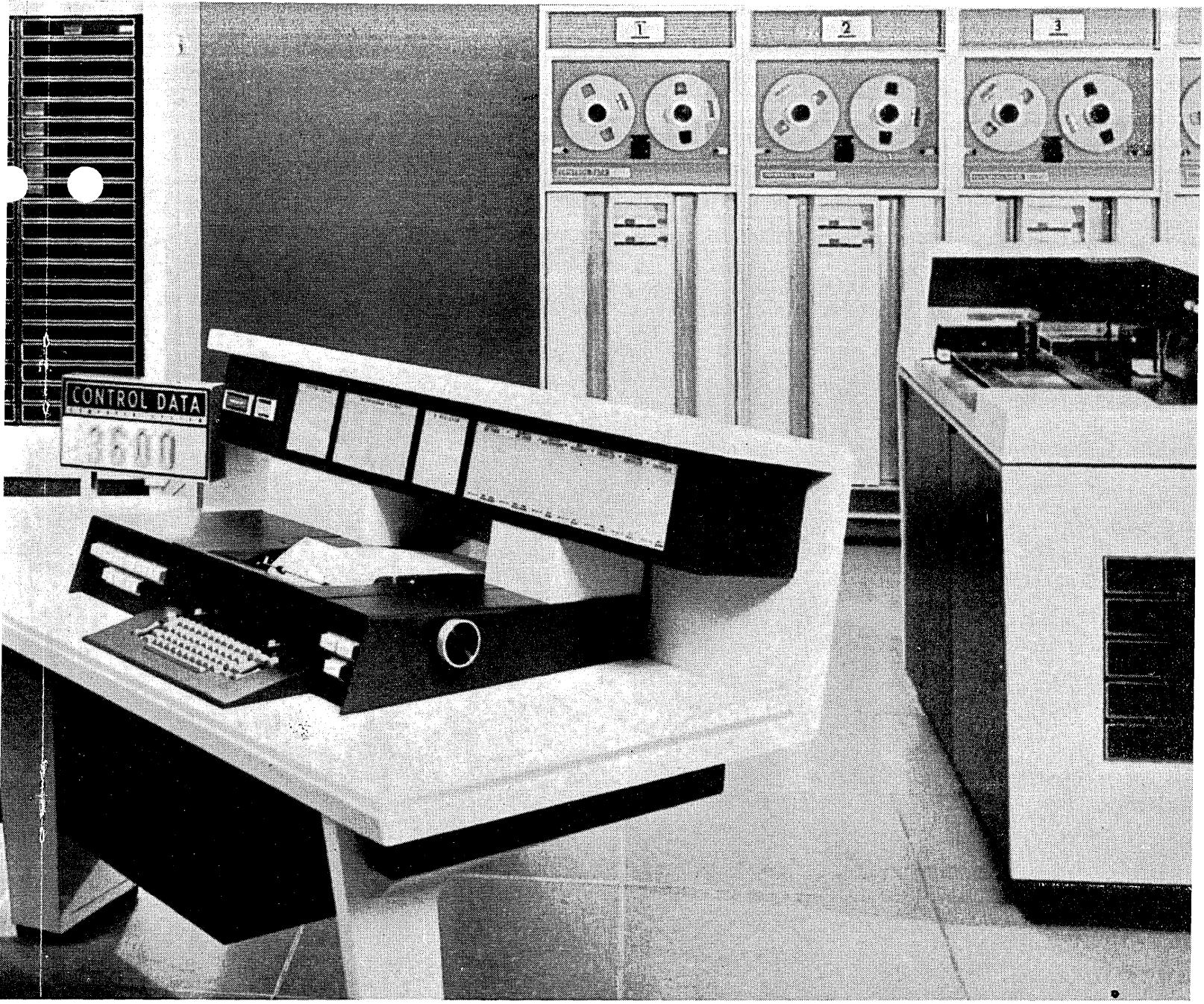

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channels can easily be included to handle increased data processing requirements as needed. This means that the Atlantic Missile Range will start out with a system commensurate with their requirements. As AMR's data processing needs grow in size and complexity, additional units can be included without replacing the original equipment. □ Control Data's total system capability for this real-time system is provided by the Company's **Government Systems Division**...and includes problem analysis, system design, hardware implementation, system integration, programming, installation and maintenance. □ To learn more about the 3600 and Control Data's total system design capability, contact the Control Data representative nearest you.

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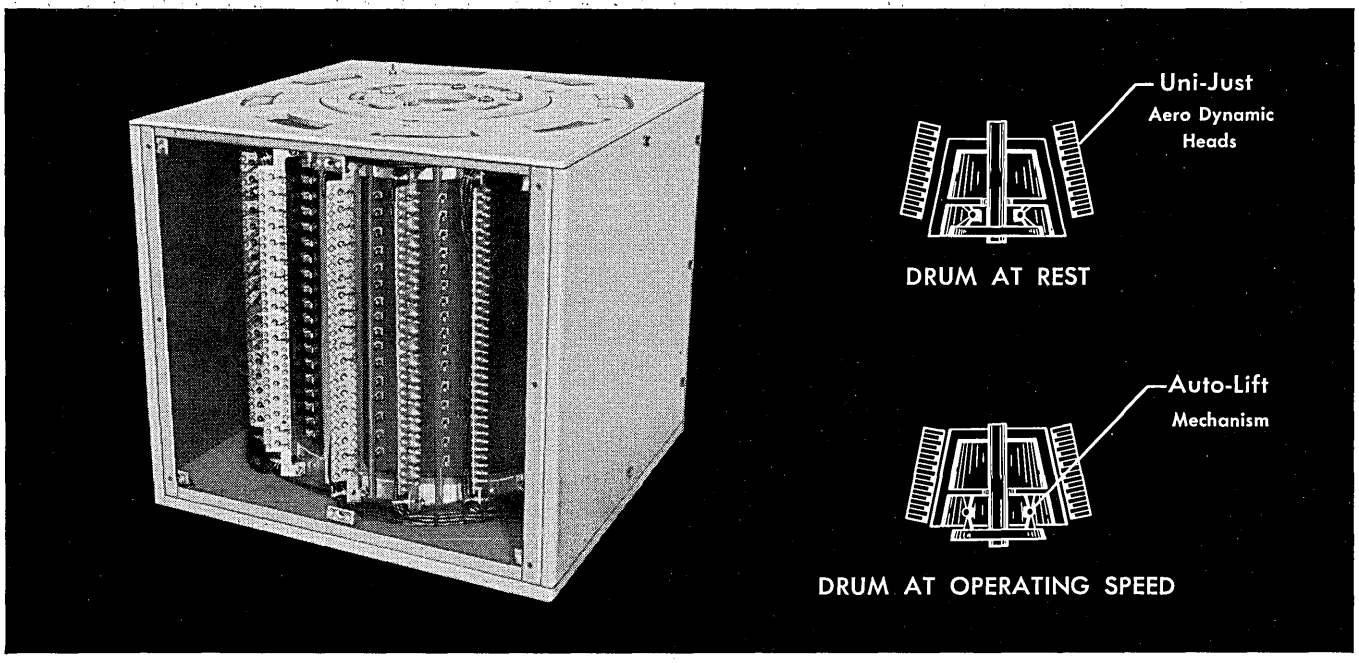

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- Motor and bearings field serviceable without loss of data.

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Individually adjustable, true aerodynamic heads.

ENVIRONMENT:
Storage: — 65°F to + 160°F.
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Thermal shock: Drum with covers in place will withstand 50°F step change in operation.
Altitude: Operating to 15,000 feet.
Humidity: to 95% RH.
Shock: 5 G's any plane with standard mounts.
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CIRCLE 20 ON READER CARD

ACM
technical sessions . . .

Wednesday, August 28, Junior Ballroom, 2 p.m.
Session 6B: Sorting and Merging
Chairman: John Flynn, Martin-Marietta Corp.
6B.1: Selective Dessemination of Information (SDI-4): An IBM 1401 & 7090 Data Processing System, A. B. Barnes, H. Fallon, C. B. Hensley,

M. E. Kane, A. Resnick and A. J. Sowarby, IBM; T. R. Savage, Documentation, Inc.
6B.2: A Tree Structure System for Sorting, Search and Maintenance, Leon Bloom, Litton Systems Inc.
6B.3: Sorting by Replacement Selecting, Betty Jane Gassner, Dept. of the Air Force
6B.4: The Organization of Structured Files, B. J. Dzubak and C. R. Warburton, IBM
6B.5: An Economical Subroutinized Sorting Technique, J. L. Kenney, IBM

Wednesday, August 28, Grand Ballroom, 3:40 p.m.
Session 7A: Panel on Social Aspects of Computing: The Responsible Use of Computers in Politics
Moderator: Edward Bailey, University of Colorado
Panelists: William McPhee, University of Colorado; Father Harry E. Hoewischer, Regis College, Denver; Louis L. Sutro, M.I.T.

Wednesday, August 28, Junior Ballroom, 3:40 p.m.
Session 7B: Hall of Discussion—Decision Tables
Co-Chairman: Sol Pollack, RAND Corporation; Michael Montalbano, IBM

Wednesday, August 28, Silver Room, 3:40 p.m.
Session 7C: Hardware
Chairman: George Heyliger, Martin-Marietta Corp.
7C.1: Timing Simulation of a Large Asynchronous Computer, R. L. Chew and A.J.R.G. Milner, Ferranti, Ltd.
7C.2: Internal Forces in a Wound Reel of Magnetic Tape, H. Tramposch, IBM.
7C.3: Random Generation of Test Routines, Richard D. Eldred and Bruce Donaldson, Minneapolis-Honeywell
7C.4: Magnetic Permanent Storage: The Rope Memory, P. Kuttner, Burroughs Corp.
7C.5: Unate Codes for Data Retrieval and Display Devices, Joseph A. O'Brien, Mitre Corp.

THURSDAY
August 29

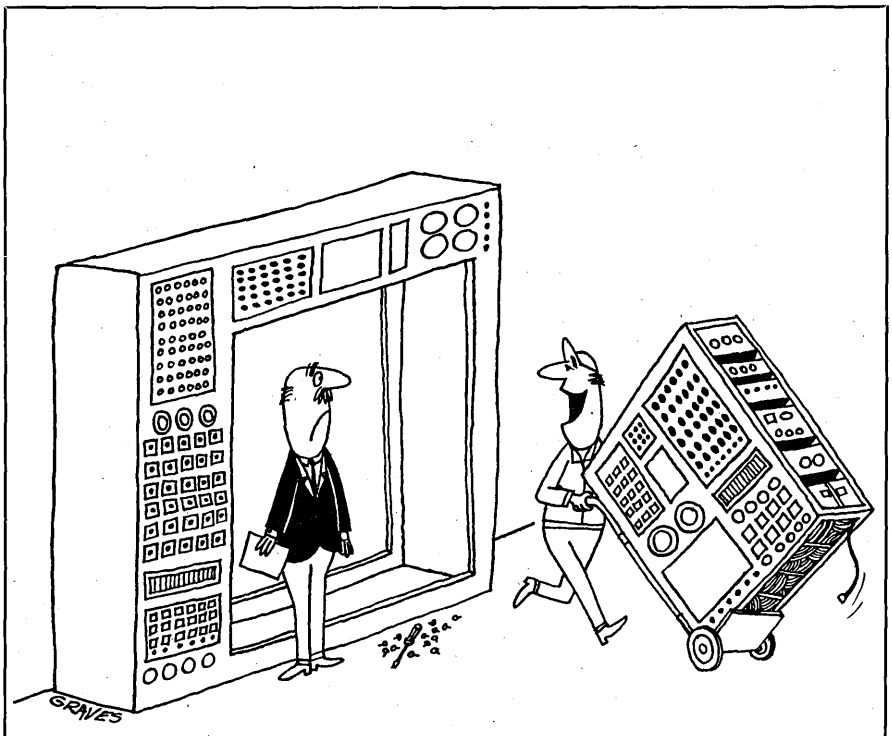
Thursday, August 29, Grand Ballroom, 9 a.m.
Session 8A: Invited Papers
Chairman: L. R. Lavine, Philco Corporation
8A.1: The Real Problem in Programmer Training, Daniel D. McCracken, McCracken Associates Inc.
8A.2: Expanding the Editing Function in Language Data Processing, L. B. Doyle, System Development Corp.

Thursday, August 29, Junior Ballroom, 9 a.m.
Session 8B: Pattern Recognition
Chairman: Robert Albrecht, Control Data Corp.
8B.1: ARGUS — A Handwritten-Character Recognition Program, Warren Teitelman, M.I.T.
8B.2: GIT—A Heuristic Program for Testing Pairs of Directed Line Graphs for Isomorphism, S. H. Unger, Columbia Univ.
8B.3: The Use of List-Structured Descriptions for Programming Manipulations on Line Drawings, Thomas G. Evans, Air Force Cambridge Research Laboratories
8B.4: Optimal Decision Functions for Computer Character Recognition, J. T. Chu, Univ. of Pennsylvania
8B.5: A "Fact Organizer" for Pattern Recognition and Language Manipulation, J. Philip Benkard and Leonard Uhr, Univ. of Michigan.

Thursday, August 29, Junior Ballroom, 10:40 a.m.
Session 9B: Hall of Discussion, Mathematical Programming
Chairman: Robert L. Graves, Systems Programming Inc.

Thursday, August 29, Silver Room, 10:40 a.m.
Session 9C: Education and Programmer Training
Chairman: Gloria Silvern, North American Aviation Inc.
9C.1: A Conversational Teaching Machine, Wallace Feurzeig, Bolt Beranek and Newman Inc.
9C.2: Report on COBAL Training Through Programmed Instruction, Carl A. Powers, Burroughs Corp.
9C.3: The Auerbach Programmed Course in COBOL, Martha B. Bullard, Auerbach Corp.
9C.4: Simulating Socrates, R. E. Packer, Thompson Ramo Wooldridge.
9C.5: Computer Education in the Secondary Schools, R. L. Albrecht, Control Data Corp.
Thursday, August 29, Junior Ballroom, 3 p.m.
Session 10B: Invited Papers
Chairman: A. M. Paster, Sperry Rand Corporation
10B.1: Applications of Computers to Clinical Medicine, Theodor D. Sterling, Univ. of Cincinnati
10B.2: UNCOL — Progress and Prospects, T. B. Steel, Jr., System Development Corp.
Thursday, August 29, Silver Room, 3 p.m.
Session 10C: Panel on Business Data Processing
Moderator: John A. Postley, Advanced Informations Systems Inc.
Panelists: Ascher Opler, Computer Usage Co.; Gary Carlson, Bringham Young Univ.

Thursday, August 29, Grand Ballroom, 4:30 p.m.
Session 11A: Panel on Programmer Training
Co-Moderators: Gloria Silvern, North American Aviation Inc.; Marvin Wofsey, American University
Panelists: Martha B. Bullard, Auerbach Corp.; Carl A. Powers, Burroughs Corp.; R. L. Albrecht, Control Data Corp.; Robert E. Packer, Thompson Ramo Wooldridge; Wallace Feurzeig, Bolt Beranek and Newman Inc.



"... BETTER BRUSH UP ON THE OL' MULTIPLICATION TABLES FOR AWHILE."

ACM
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Thursday, August 29, Junior Ballroom, 4:30 p.m.
Session 11B: Bio-Medical Programming and Processing
Chairman: Glenn Dalrympl, University of Colorado Medical Center
11B.1: A Mathematical Model of Neuron Behavior For Computer Simulation, E. E. Nelson and H. F. Wolf, Astropower, Inc.

11B.2: Establishing an Integrated Statistical Program Library, Seymour V. Pollack, Univ. of Cincinnati
11B.3: Programming the CDC 160-A for Brain Research Data Processing, John R. B. Whittlesey, Univ. of California Medical Ctr.
11B.4: Computer Analysis of Cystic Fibrosis Transmission Patterns, Theron L. Smith, General Dynamics Corp.
11B.5: Digital Computers and Problems of Cellular Regulation, Robert Rosen, Univ. of Chicago

Thursday, August 29, Silver Room, 4:30 p.m.
Session 11C: Automatic Programming Languages
Chairman: Don Thurneau, Marathon Oil Co.
11C.1: An Improved Equivalence Algorithm, Bernard A. Galler and Michael J. Fischer, Univ. of Michigan
11C.2: EULER: A Generalization of ALGOL, And Its Implementation, Niklaus Wirth, Univ. of California
11C.3: Translation Algorithm for a Multiple Processor Computer, Jon S. Squire, Univ. of Michigan.
11C.4: A Syntax-Structured Compiler, Herbert Kanner, Paul R. Kosinski and Charles L. Robinson, Univ. of Chicago
11C.5: A Tree-Structured Symbol Table for An ALGOL Compiler, Paul R. Kosinski, Herbert Kanner and Charles L. Robinson, Univ. of Chicago
11C.6: An Efficient Structure for Compiled ALGOL 60 Programs, Charles L. Robinson, Herbert Kanner and Paul R. Kosinski, Univ. of Chicago.

Thursday, August 29, Junior Ballroom, 8 p.m.
Session 12B: Tutorial
12B.1: COBOL, Up-Dated, William L. Donally, IBM

Thursday, August 29, Silver Room, 8 p.m.
Session 12C: Tutorial
12C.1: PERT/CPM, James W. McCauley, Control Data Corp.

FRIDAY
August 30

Friday, August 30, Grand Ballroom, 9 a.m.
Session 13A: Panel on Computer Science Curriculum
Moderator: W. F. Atchison, Georgia Tech.
Panelists: Bruce W. Arden, Univ. of Michigan; Alan J. Perlis, Carnegie Tech.; George E. Forsythe, Stanford Univ.; David E. Muller, Univ. of Illinois; Saul Gorn, Univ. of Pennsylvania; Robert R. Korfhage, Purdue Univ.

Friday, August 30, Junior Ballroom, 9 a.m.
Session 13 B: Compilers for Small Computers, Chairman: Edward L. Manderfield, North American Aviation Inc.
13B.1: Implementation of a Symbol Manipulator For Heuristic Translation, Lee O. Schmidt, Beckman Instruments Corp.
13B.2: A Syntax Directed SMALGOL For the 1401, V. A. Schorre, U.C.L.A.
13B.3: A SMALGOL Compiler for the ALWAC III-E At Oregon State University, Philip H. Hartman, Harvard Univ.
13B.4: A Parameterized Compiler Based on Mechanical Linguistics, Howard H. Metcalfe, Planning Research Corp.
13B.5: 1620 ALGOL — A Hardware Representation of ALGOL 60 for the IBM 1620, William Blose, Stanley Pope and Charles Wright, Jr., Southern Illinois Univ.

Friday, August 30, Grand Ballroom, 10:40 a.m.
Session 14A: Use of Computers for Medical Diagnosis
Chairman: Robert S. Ledley, National Biomedical Research Corp.
Panelists: Theodore D. Sterling, Univ. of Cincinnati; Clifton F. Mountain, Univ. of Texas; Caesar, Dept. Health Education and Welfare; C. Stanley Woodson, Lovelace Medical Clinic; Joseph Balintfy, Tulane Univ.

Friday, August 30, Junior Ballroom, 10:40 a.m.
Session 14B: Software, I/O Buffering
Chairman: R. S. Essert, National Center for Atmospheric Research
14B.1: Data Flow and Storage Allocation For the PDQ Program on the Philco-2000, C. J. Pfeifer, Westinghouse Electric Corp.
14B.2: A Non-Sequential Buffering System Using a Variable Number of Tapes, D. W. Barron and D. F. Hartley, University Mathematical Laboratory, Cambridge, England; C. R. Spooner, Ferranti, Ltd.
14B.3: Data Processing System Delays Due to Magnetic Tape Storage, Marvin Gang, International Electric Corp. and Samuel Gorenstein, System Development Corp.
14B.4: Multiprogramming Concepts, Laurence Press, IBM.
14B.5: An Analysis of Merging from Random, Access Storage Devices, George U. Hubbard, IBM

Friday, August 30, Silver Room: 10:40 a.m.
Session 14C: Simulation and Graphical Output
Chairman: Jack Schultz, Dow Chemical Co.
14C.1: Computer-Made Perspective Movies as a Scientific and Communication Tool, E. E. Zajac, Bell Telephone Laboratories, Inc.
14C.2: Mesh of Points, John F. Dollries, General Electric Co.
14C.3: A Program for a General-Purpose Digital Computer to Perform Analog Type Simulations, Edward R. Byrne, Bell Telephone Laboratories Inc.
14C.4: Hypervelocity Interceptor Simulation, Carlton E. Gebhart and David H. Brandin, Illinois Tech Research Institute
14C.5: An Incremental Algorithm for Digital Plotting, J. E. Bresenham, IBM. ■

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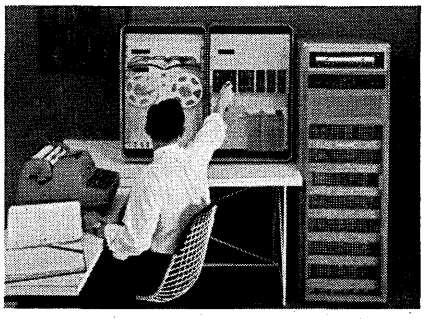

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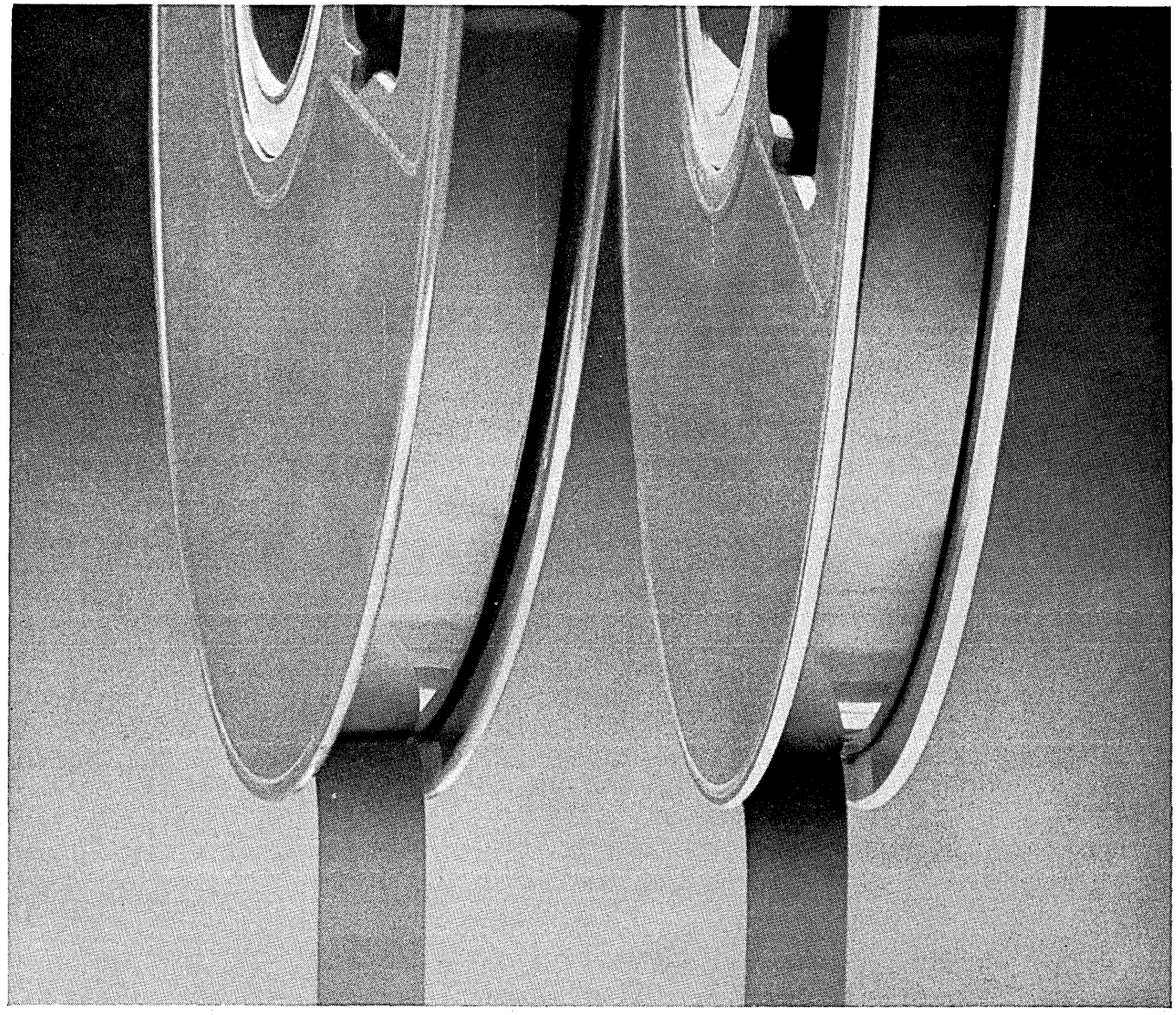

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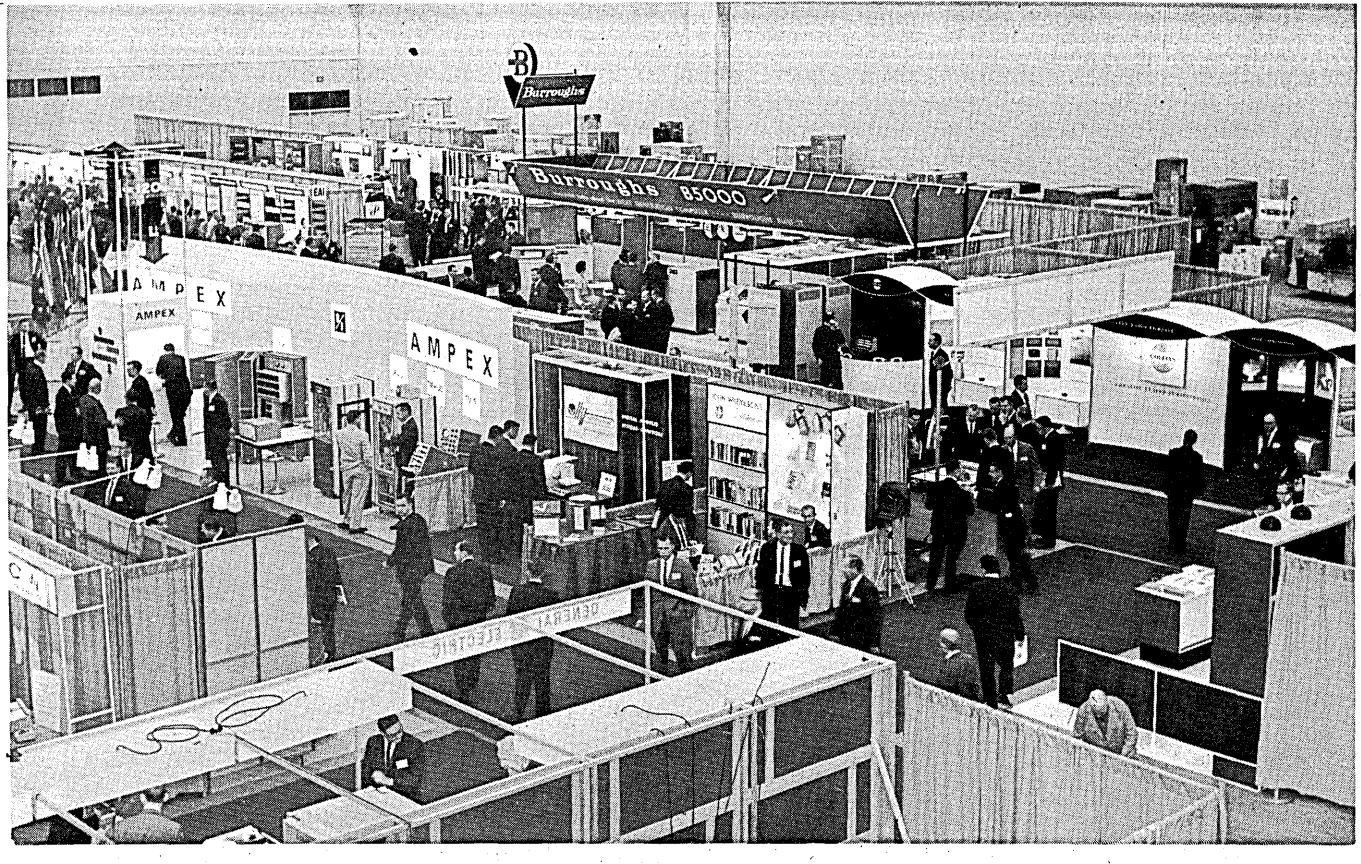

THE '63 SPRING JOINT

Detroit revisited

In a movie shown at the recent SJCC, one of the "stars"—a champion checker player—notes of the computer he is playing against, "Gee, it's a real glutton for punishment."

The same might be said for the some 2000 attendants, who spent three days talking and listening computers and related topics with quite a bit of drinking and walking—and very little sleeping—thrown in.

The movie—a production of the National Film Board of Canada entitled "The Living Machine"—may have been the most significant single event at the show. It is a masterful and frightening hour-long exploration of the wonders and worries of computers, posing the most important and basic questions of all: What is the difference between man and machine, and what is their relationship? Joining the computer in lead roles are MIT's Dr. Warren McCulloch and Margaret Mead. *Datamation* rates it as a four-star must see.

In the living color, three-D world of the display floor, most attention went to the Burroughs B 5000, on exhibit for the first time. Many touched it, earning buttons so announcing. Outside of the B 5000, there was little new in main frames. One exception: the DSI 1000, roughly 3800 cubic inches, featuring 1.6 usec cycle time and a 2,048-word (12 bits) glass acoustic delay line memory with an average access time of 100 usec. Multiply and divide are programmed, but hardware versions for extra dollars are available. Prices begin at $9980. DSI stands for Data Systems, Inc., a 12-man outfit in Grosse Pointe Woods, Mich., which says it has a $400K backlog. The company will offer a "sophisticated macro assembler with limited FORTRAN capabilities," according to DSI president Sam Irwin.

As prominent by their absence as many were in attendance were Honeywell, RCA and RemRand Univac. IBM made a token appearance, both on the floor and in the technical sessions, where only three out of 37 papers, and one out of 63 panelists were represented by the industry's biggest company.

The technical sessions ranged the usual gamut of excellence and interest. The session on list processing was rated so-so by our sources; the two sessions on analog and hybrid systems were reported as excellent, with healthy attendance, pretty well divided between analog and digital types, few of whom raised their hands in answer to the chair's request for those who know both fields. The degree of interest was evidenced by the fact that the discussion continued at one of the sessions 45 minutes after it had been officially adjourned.

A big crowd which came to see fireworks in the evening panel conducting "critical analyses of the current state of the art," were generally disappointed. One comment: "I'm afraid there's not much courage up there," which maybe meant "not much criticism." The panel, headed by Ted Glaser of Burroughs Paoli, included DOD's Campaigne, Lincoln Lab's Selfridge, Wilkes of Cambridge University, Dick Hamming, Bob Barton and D. F. Blumberg, of Pennsylvania Research Associates.

Blumberg tried to get things going by stating that the "one man most influential in moving the computer

industry forward was the IBM salesman." Wilkes was applauded for saying that manufacturers could save money by forgetting software and "giving away 8 or 16K of memory." Barton said simply, "It's time to set up standards for machine languages. Period." (See Editorial Readout in the June '63 *Datamation).* Campaigne stressed the transitional status of the industry at present, while Hamming claimed that his field of computing was dull and would remain so.

It was Selfridge who tried to put the discussion on the track of more basic issues, to frame it in the context of larger questions. "The real purpose of computers and science," he said, "is to help people govern themselves and to work together properly." But, he added, the subgoal of science is too often treated as a primary goal.

The rest of the session divided itself amongst questions from the floor concerning the standardization of machine languages—"Are you kidding" types, mostly — and the witty wisdom of Selfridge.

The luncheon speaker, Walter A. Rosenblith — MIT Professor of Communications Biophysics — blended learning and clarity in his discussion of "Computers and Brains — Competition and/or Coexistence." Providing a brief historical background to his topic, he argued that this is not an "either-or" problem — that researchers must not try to imitate all of the brain, but attempt to use machines to "perform part of a function better, differently than the brain." He concluded, "Cooperation, and/or coexistence? The ideal model will represent a reasonably monogomous marriage. May the offspring be not too well adjusted so that evolution won't stop."

He was preceded at the luncheon by George Romney, who was thanked for his interest in the conference by Chairman Calvin Johnson, after the Governor had paeaned his glorious state. Keynoter Ray R. Eppert, Burroughs president, used the podium to mount an attack upon administration taxation of overseas manufacturers.

Winning the award for the best paper (content) were D. T. Ross and J. E. Rodriguez of the MIT Electronic Systems Laboratory, for "Theoretical Foundations for the Computer-Aided Design System." Proposed prizes: two all-expense-paid tours of Poughkeepsie, or perhaps some CDC stock.

A final note: Cobo Hall is a grand setting for a conference, although it could use some more spots for sitting and talking. The less said about the hotel accommodations and their non-handling of communications the better. Las Vegas, anyone? ■

WESCON '63

a preview

Technical papers of interest to computer personnel will be among those presented during four special and 20 regular sessions at the 1963 Western Electronic Show and Convention (WESCON), August 20-23, in San Francisco's Cow Palace.

It is sponsored by the San Francisco and Los Angeles sections of the IEEE, and the Western Electronic Manufacturers Association. The computer-oriented sessions include the following:

Trainable Systems: Realization and Simulation. In this session, August 21, 10 a.m. to 12:30 p.m., are the following papers: "A Large Self-Contained Learning Machine," A. E. Brain, G. E. Forsen, D. J. Hall, C. A. Rosen, Stanford Research Institute, Menlo Park, Calif. "Design of a Magnetic Variable-Gain Component for Adaptive Networks," H. S. Crafts, Stanford Research Institute. "Influence of Component Imperfections on Performance of Trainable Systems," P. R. Low, IBM, Poughkeepsie, N.Y., and Stanford Univ. "Simulation of Adaptive Linear Decision Functions Using the IBM 7090," J. S. Griffin Jr., J. H. King, C. J. Tunis, IBM, Endicott, N.Y.

Information Processing in Living Systems. August 21, 2 to 4:30 p.m. "Unit Properties in Nervous Intergration," Donald Kennedy, Stanford Univ. "Rod and Cone Receptor Potentials from Monkey Retinas," Kenneth T. Brown, Univ. of Calif. Medical School, San Francisco. "Methods Used by a Simple Eye to Improve Its Spatial and Temporal Resolving Power," Charles S. Stevens, Univ. of Washington Medical School, Seattle, Wash. "Tactile Perception with Electric Stimuli," Robert H. Gibson, Carnegie Tech, Pittsburgh, Pa. "Sensory Perception — Focal Point of Interdisciplinary Research by Biologists and Engineers," C. D. McCann, Caltech, Pasadena, Calif.

Trainable Systems: Theory and Applications. August 22, 10 a.m. to 12:30 p.m. "The Artificial Intelligentsia — A Critique of Various Camps in Artificial Intelligence," Louis Fein, Palo Alto, Calif. "Simulation Studies of Four-Layer and Cross-Coupled Perceptrons," Frank Rosenblatt, Cornell Univ., Ithaca, N.Y. "An Adaptive Prediction Technique and Its Application to Weather Forecasting," Richard O. Duda, Jack W. Machanik, Stanford Research Institute. "Some Applications for Adaptive Data Processing Systems," Bernard Widrow, Lee Talbert, Gabriel Groner, Fred Smith, Michael Hu, Donald Specht, Stanford Univ.

Among papers in the session on Switching Circuits will be "Application of Nanosecond Logic Circuits," J. S. Jamison, T. E. Gilligan, J. Bacon, Burroughs Corp., Paoli, Pa.

Among other sessions are Component Reliability, August 20, 10 a.m. to 12:30 p.m.; Control Theory, August 22, 10 a.m. to 12:30 p.m.; and Data Coding & Switching Theory, August 23, 10 a.m. to 12:30 p.m.

Eleven tours are scheduled, including the Univ. of California Electronic Research Lab, Systron-Donner Co., and NASA's Ames Laboratory. ■

If the growth of COBOL users is not rivalled closely by the number of COBOL translators, there is reason to believe that it soon will. This increasing activity presages an interest in COBOL and compatibility, a subject which warrants the scrutiny exhibited here by a member of the ASA's X3.4.6 Glossary subcommittee.

further thoughts

COBOL AND COMPATIBILITY

by ROBERT M. GORDON, Arthur D. Little, Inc., Cambridge, Mass.

Variants of the word "compatible" are very fashionable in the computing world today if one is to judge by the ubiquitousness of them. It is surprising, therefore, that "compatible" can be found in no glossary of terms in widespread use by computing people. On the other hand, *everyone* knows what the word means; as it turns out, no one *knows:* one gets as many definitions as there are people to be asked.

Hence, it makes sense to begin this discussion with a definition of "compatible:"

(1) An element A is said to be compatible with an element B over a set of characteristics S if A and B are indistinguishable—i.e., are interchangeable—with respect to the members of S.

Let us make the definition more particular for our universe of discourse, COBOL compilers:

(2) A COBOL compiler, C_1, is said to be compatible with a COBOL compiler, C_2, over all programs written according to the rules known as Required COBOL 61, if C_1 and C_2 are indistinguishable with respect to such programs.

It is not difficult to verify that the set of compatible COBOL compilers is void (at the time this sentence is written: 9 April 1963). That is to say, there do not exist even two COBOL compilers which are compatible in the sense of definition (2)! This conclusion may come as a surprise—even a shock—to some readers; it may be regarded as a catastrophe by others. Surprise it may be; catastrophe it is not.

Consider this simple obstacle to compatibility: the alphabets used by computers—and, hence, COBOL compilers—of the several manufacturers are not identical. This difference imposes the requirement that some uniform substitution of acceptable characters be made for the unacceptable ones. Although this is a trivial requirement, nevertheless it means that the definition of compatibility is violated.

Or, consider another obstacle. The Environment Division of a COBOL program exists for the purpose of informing the compiler what computer is available for compilation, what computer is to be used for execution of the so-called object code. Is it really surprising that the COBOL compiler for the Burroughs B5000 will not accept—without any alteration, even in the Environment Division—programs originally intended to be both compiled and executed on the RCA 301? But, it almost goes without saying, it is a trivial act to modify the Environment Division of a COBOL program if it is to be compiled by a computer different from the one for which the program was written initially. Granting the triviality of the effort does not mitigate the incompatibility!

Let us admit, therefore, that compatibility, according to definition (2) is a chimera. Such an admission will not preclude consideration of the many benefits that COBOL—the language—and COBOL compilers confer on their users. Of course, we can weaken the constraints imposed by the set S—in this case, Required COBOL 61—until we get a definition which allows compatibility to exist. We contend that to follow the latter course is futile: like the philosopher's stone, a "meaningful" compatibility does not exist.

Let us now consider the matter of compatibility as the term might be applied separately to the four divisions of Required COBOL 61; afterwards we will consider how compatibility is affected if elective features of, and extensions to, Required COBOL are available and used. Then we shall consider possible benefits to the user of COBOL irrespective of any effect due to compatibility—or incompatibility, for that matter.

First of all, let us dispose of the matter of the alphabet, consideration for which applies in all of the divisions of COBOL: until a universally accepted set of characters is found, the COBOL compilers of the several manufacturers will likely be trivially incompatible. Of course, agreement on a restricted set of characters might be had, but this does not seem very probable at this time.

The source of incompatibility with respect to the Identification Division is in the alphabet. This is a trivial difficulty.

With respect to the Environment Division the sources of incompatibility are two, the alphabet and the computers. The alphabetic incompatibility is trivial; in a sense, so is that of the computers. Changes required because a different computer is used for compilation and execution are easily attended to. One question often asked is whether Computer 1 could compile programs to be executed on Computer 2 for an arbitrary choice of computers 1 and 2. It is unreasonable to expect an affirmative answer to this question, as even a little thought will disclose. This facet of

incompatibility has an effect on the writing of the Data Division, as will be pointed out below.

In the Data Division the difficulty of the alphabet is easily attended to. Herein, however, arise the first and most demanding questions that emphasize the machine-dependent aspects of the use of COBOL: the structure of the data can have a profound effect on the "efficiency" of the object program created by the compiler. Although "efficiency" is unrelated to "compatibility", it is probably of concern to the writer of a COBOL program. For reasons of efficiency, therefore, it is likely that the Data Division will be given careful attention when it is first written; and it will be examined in detail if the program is to be recompiled on a computer in which representation and manipulation of data are different from those features of the original computer.

In the Procedure Division the problem of compatibility —so long as S is Required COBOL 61—is the trivial one of the alphabet.

The implementation of either elective features or extensions by compiler writers, and the use of these elements by writers of programs raise the first serious questions of compatibility. Suppose we denote by S_1 all those programs written according to the rules of Required COBOL and by C_1 a compiler which accepts such program; denote by S_2 all those programs written according to the rules of Required COBOL plus any elective features and extensions and by C_2 a compiler which accepts such programs.

We assert that C_1 and C_2 are incompatible; that is, not all programs which can be compiled by C_2 can be compiled by C_1 (even making exception for the trivial incompatibilities previously noted). It should be clear, however, that all programs which can be compiled by C_1 can be compiled by C_2 (except for the trivial instances).

The writer of COBOL programs is faced with a dilemma: does he wish to write programs which can be altered with minimal effort to be executed by more than one computer? Or does he wish to take advantage of all the richness provided by any language which includes—and is more than—Required COBOL (in which case he will almost certainly write programs which can be recompiled only after considerable revision)? We do not presume to resolve this difficulty for the reader, but merely wish to say that it merits his closest attention.

Even allowing for the shortcomings of COBOL which have been highlighted above, is there any merit in the argument that the user of COBOL—the language—has much, if anything, to gain? The answer must be that there is substantial advantage; the following discussion will illuminate some of the benefit:

1. COBOL provides standards of documentation which, if they do not comprise a complete set, represent a substantial foundation on which to build. In the case of the novice, this set of standards offers the possibility of sharing the benefits of standardization where more experienced data processing organizations have already reaped them.

2. COBOL programs are easy to read. If there is a lot of easy-to-read literature available, people—programmers *are* people, after all—may be inclined to read some of it. People who read a lot tend to be critical readers; critical readers have a better chance to write good literature. Since most of the people who read programs also write them, there is a fair chance that the installation using COBOL will witness an improvement in the quality of its programming as well as in the quality of its documentary literature.

3. Good documentation—the chance for which is improved by the use of COBOL—will encourage users of computers to do for themselves many of the tasks which they now insist be performed by the manufacturers—to the mutual disservice of both groups. It is a mistake to believe the computer manufacturer can do for all of his customers all of the things customers need to run a good shop: the manufacturer

   a. doesn't have the human resources to do the optimum job for each of his customers; and
   b. even if he did, he couldn't afford to do it under present pricing policy or practice; besides
   c. he cannot and should not be expected to act in the *best* interests of all his customers all the time.

4. The widespread use of COBOL will promote program exchanging. What is the equivalent result, the use of the language can ease the burden of replacing a computer with a better one. How much relief will be afforded is a function of many variables: the quality of the programs to be converted, the need or desire to redesign the "system," structural and functional similarities — and dissimilarities — of the two computers involved, etc.

5. So far, no importance has been attached to the questions of availability and "efficiency" of machine translators — i.e., compilers — for COBOL programs. We assert that the benefits described here accrue to the user of COBOL irrespective of the availability of a compiler which satisfies him. Only a little reflection is required to satisfy the reader of the merit of this argument. While it is true that the availability of a compiler offers added advantage to its users, no universally acceptable criteria have been advanced for what constitutes a "good" compiler. Arguments still rage in hotel corridors and on conference and convention floors regarding the desired attributes of a compiler.* A few of the important attributes might be mentioned here.

   a. Program testing facilities in the source language must be provided. In the case of COBOL, for instance, this means that COBOL must contain linguistic elements which make it possible to monitor the execution of the compiled program.
   b. Fast compilation.
   c. "Efficient" object code.
   d. Comprehensive diagnostic facilities. That is, the compiler must be able to help the programmer locate errors in his code, errors in syntax as well as violations of other rules.

6. One of the complaints about COBOL and COBOL compilers is a direct result of our ignorance concerning formal languages and machine translation. We may expect to learn more about formal procedure-oriented languages — like COBOL — and their translators from attempts to use them. The use of COBOL for this reason constitutes an investment, the return on which can only be imagined; it is not unrealistic — in the light of the preceding discussion — to expect the gain to be substantial. The profit will be measured not only by money standards, but also by the power of a tool to control our environment.

A principal purpose of this paper has been to point out the error of focusing attention on the name-of-the-thing at the expense of the-thing-itself. In our case a poorly defined term, compatibility, has been used to obscure the case for consideration of the merits of a particular procedure-oriented language, COBOL. Benefits from the use of COBOL have been sacrificed to fatten an irrelevance:

All COBOL compilers are compatible;
Some COBOL compilers are more compatible than others.

Let the bickering cease; let us get on with the important business at hand. ■

*See, for example, John A. Blatt's Comments from a Fortran User, *Communications of the ACM*, September, 1960. In subsequent issues, in letters to the editor, the dispute is continued.

IBM reports on the field of applications programming. Who trains computers for new jobs?

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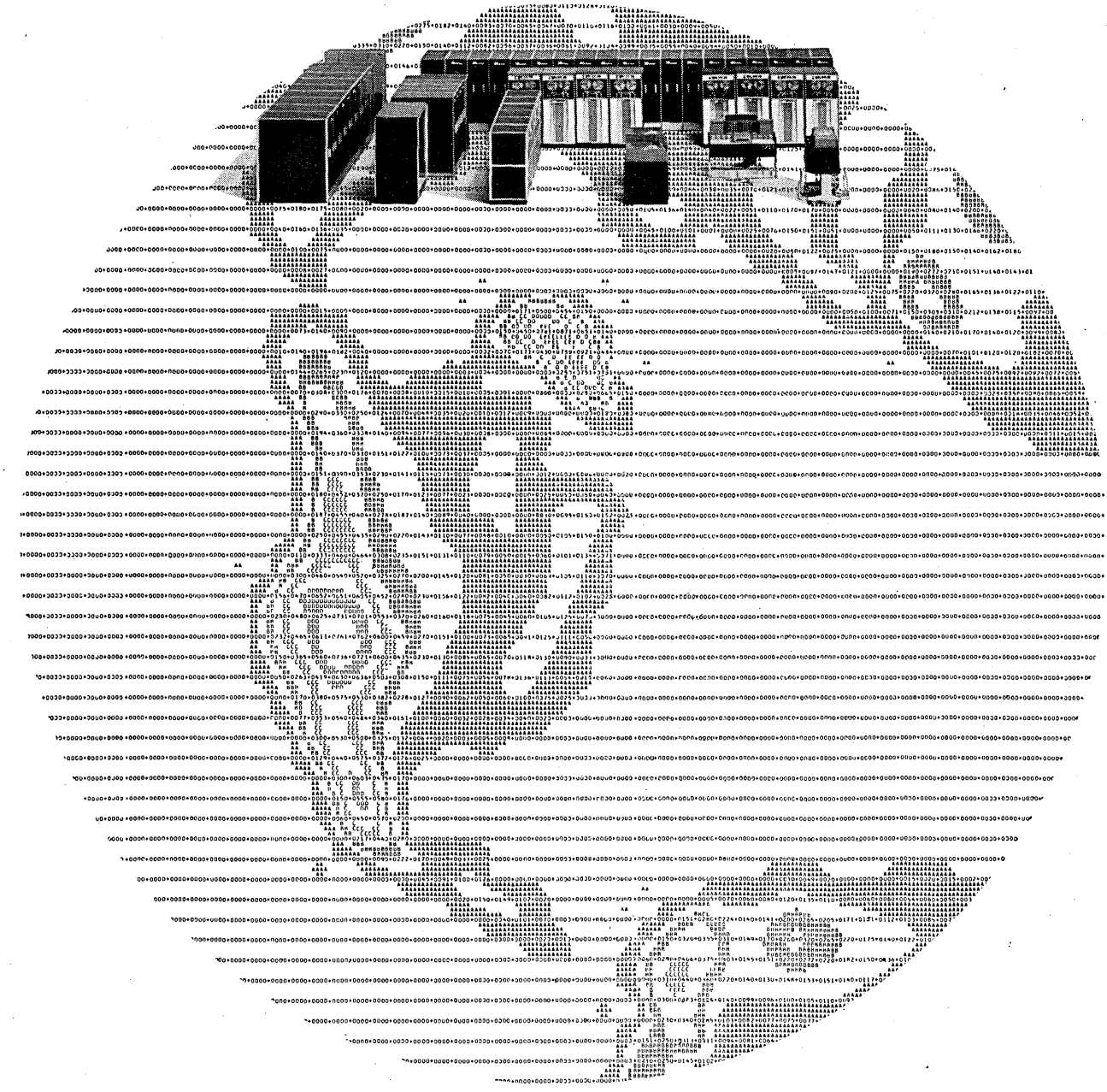


ELECTRONIC RETINA CHARACTER READER

a modular optical system

A modular, gp optical character reading system has been announced by Recognition Equipment Inc., Dallas, Texas. It is based upon an Electronic Retina Character Reader, supplied with a variety of I/O devices and a gp computer.

The configurations range from a single-font numeric reader to a system capable of recognizing six or more type fonts intermixed with numerals, upper and lower case alphabetic characters, and special symbols in each. A mark-sensing capability is optional. Available input devices to the reader include a page carrier, document carrier, card punch, and journal tape carrier. A microfilm carrier is being readied. Output devices from the control computer would be a mag tape unit, card punch, large scale computer, data transmission devices, and paper tape punch.

The reader operates at up to 2,400 cps, and has the ability to sense black, white and, reportedly, infinite shades of gray.

The page carrier operates at a speed of 15 8½" x 11" pages per minute when 60 lines are read from each page. Information is scanned alternately from three drums which secure the pages, reducing time lost from the handling of paper. Documents from 3¼" x 4⅞" to 11 x 14, from nine to 30-pound stock, can be handled.

The document carrier handles intermixed documents in two size ranges, 2" x 2" to 3¼" x 8¾", and 3¼" x 3¼" to 5" x 8¾". It will read two full printed lines from each document, and operates at 600 to 1,200 items per minute. Intermixed paper and card stock from nine pounds to punched cards, with staples, dog-ears, and tears up to ½" long, are accommodated. Output pockets and collating/sorting modules are available.

The journal tape carrier is designed to handle cash register and adding machine tapes from 1⁵⁄₁₆" to 6" in width. Effective operating speed is 1,200 to 1,800 lpm. The maximum width of printing which can be read on a line is 4½".

The card punch is for use when the information to be read is printed on one or two lines of a tab card. Each line of characters on an 80-column card may be up to 8" long. Punching speed is 600 to 1,200 cpm.

A microfilm carrier, operating much as the journal tape carrier, accepts standard width microfilms.

More than one document handling machine can be in a system. The principal function of the computer is to convert the output from the recognition module to machine language, while also enabling the reader to perform context editing, accumulate totals and balance against controls, control document sorting, and accomplish check digit computations. It is included in the system at the same price as a single-function conversion unit. ■

For information: **CIRCLE 100 ON READER CARD**

THE DATANET-30 AND 600

communication switching and terminal devices

Two new products combining high-speed communications with electronic data processing have been announced by General Electric Company's Computer Department.

Datanet-30, a stored-program data communications processor, is a solid-state, binary, digital processor that handles both messages and data over two or four-wire voice or telegraph-quality lines at selected speeds, ranging from 60 to 3,000 words per minute.

The Datanet-600 paper tape terminal automatically sends, receives and monitors binary digital data over two-wire, voice-quality phone circuits at 500 words per minute. Both units employ five, six, seven or eight-level codes, and are compatible with GE-215, 225 and 235 computers and with each other.

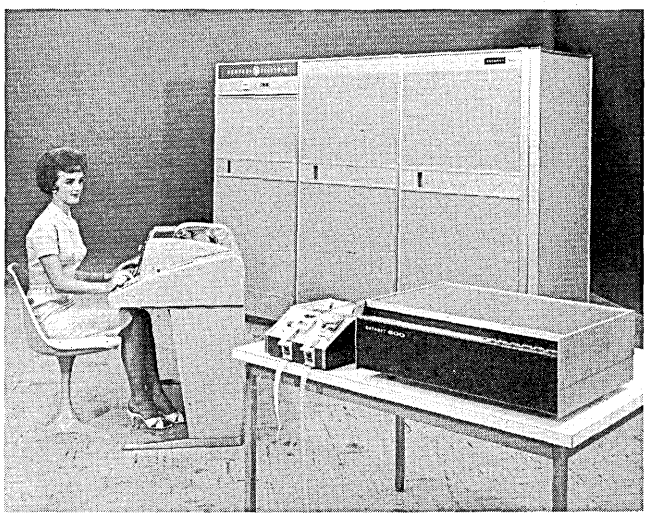
The Datanet-30, which will handle intermixed data speeds as well as a mixture of all digital transmission codes, automatically stores data in memory and routes messages to correct destinations according to address and priority. It can address 127 full duplex lines. Core memories available with the unit are 4K, 8K or 16K. Eighteen-bit words are used, with seven-usec access time.

Optional equipment for the Datanet-30 are the GE Disc Storage Unit, storing up to 34 million numeric digits or 18 million alphabetic characters, and a mag tape system having a storage capacity of 11 million characters on-line. Disc and tape storage may be used for message overflow, intercept or journal storage, data accumulation and on-line file storage.

Purchase price of a typical Datanet-30 with 8K-word memory system is approximately $163,000, or monthly rental of $3,500. Delivery is 12 months.

Datanet-600

Comprising a compact electronic controller and combination reader/punch, Datanet-600 is used with a Dataphone 202A, or equivalent, for access to the communications circuit. When not handling data, the suitcase-size Datanet-600 can be used off-line to duplicate tapes, combine short tapes into longer ones, purge faulty areas, and produce clean tapes. Purchase price of a Datanet-600 is approximately $8,200. Monthly rental is $275. Delivery is on a six-month schedule. ■



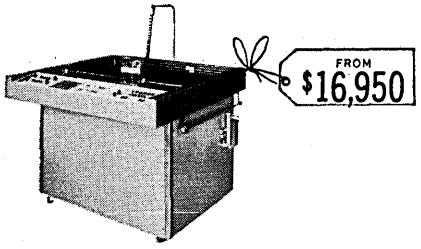
3 NEW DIGITAL PLOTTERS TAGGED FOR TOP VALUE

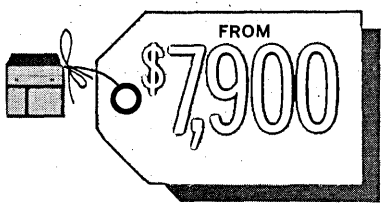
SOUNDS EXPENSIVE!!!

Until you compute the value in productivity of electronic printing and plotting at computer speeds: This new Benson-Lehner/Transdata 944 is 3 times faster, yet ⅓ the price of systems already proving their worth in actual operation. ■ Input: BCD Magnetic tape. Compatible with most tape drives. Accepts 200, 500 and 800 CPI record densities at speeds up to 62.5 KC. Binary on-line units available at same price ■ Output: 35MM Microfilm. Optional quick look (4 second) 9 inch wide hard copy. ■ Speed: 30,000 lines per minute; 62,500 characters per second; 33,000 points per second. ■ Accuracy: Characters are distinct, uniform and precisely registered; Plotting/drawing resolution and accuracy have introduced new standards for digital CRT recorders. 3 character sizes and 4 orientations.

NOW COMPUTERS ARE DRAWING IN 4 COLORS THROUGH THE ALL NEW ELECTROPLOTTER II

Here is the finest digital plotter made, offering higher speeds, increased accuracy and flexibility. This unit can be tailored to changing needs as its modular construction allows field installation of all options. The Electroplotter II features 4 pen option (4 color—4 line width), 48 character alpha-numeric printer and variable speed line drawing, all under input control. Inputs include punched cards, punched tape, mag tape, or computer on-line. Outputs are final multi-colored and/or multi-line-width drawings of engineering precision and quality. Reliability? Benson-Lehner's exclusive New Double Warranty Policy gives you six months of factory service at no charge. It's backed by the nation's largest field service organization specializing in graphic input and output devices!





Miniplotter: For quick yet economical conversations with your computer—the all new 11 x 17 Miniplotter ■ Inputs: Magnetic tape, paper tape, cards.

Over 70 sales and service engineers to serve you both here and in Europe.

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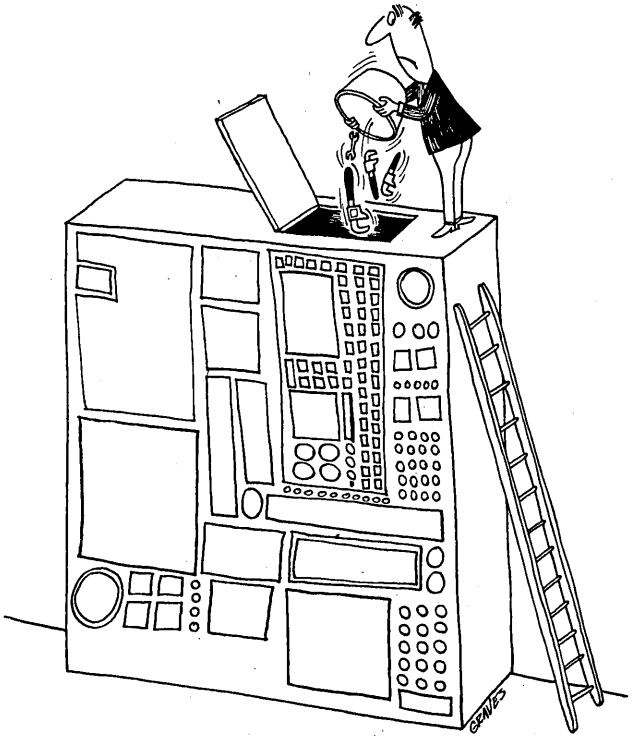
CIRCLE 28 ON READER CARD

THE PROGRAMMER . . .

. . . AS SEEN BY MANAGEMENT



. . . AS SEEN BY THE FIELD ENGINEER

Why a Teletype 4-Row Keyboard?

Simple. The new top row of keys makes it unnecessary to shift for numbers and common punctuation marks.

Now when your operator wants to type a "6," she just touches the "6" key—instead of having to shift first, type "6," then unshift. Isn't it easy to see that this typewriter-like keyboard saves key strokes, cuts errors, and means that every typist in your office is now a potential operator?

The Teletype 4-row keyboard makes it easier to send payrolls, make reservations, print out data, order a part, report a theft, take an order . . . even cancel one! It provides important operating benefits, whether your communication requirement is for integration into a computer system or to send plain ordinary messages.

Check the many new advantages offered by Teletype printers. Contact: Teletype Corporation, Dept. 81-G, 5555 Touhy Avenue, Skokie, Illinois.

This equipment is made for the Bell System and others who require dependable communications at the lowest possible cost.

TELETYPE®
CORPORATION SUBSIDIARY OF *Western Electric Company* INC.

CIRCLE 30 ON READER CARD

NEWS BRIEFS

STAFF CONTROL PROGRAM FOR 7090 IS DEMONSTRATED

A school management decision program for professional staff control was demonstrated recently by its designer, Dr. Frank A. Yett, Pasadena, Calif. The school district version was said to be applicable to management in private industry, as well. The 7090 program serves as a simulator of probable outcomes which are functions of personnel policies imposed by management, the training and experience of the staff, and the interaction of the two.

Input to the program includes the imposition of personnel policies on hiring, retention, dismissal, salary schedules, fringe benefits, experience or hypotheses concerning staff turnover, and differences between sexes and age groups within sex. The output, in cycles of one year, is a number of tables with a summary description of staff, salary schedule distribution (by training and experience), analysis of promotions, and summaries of demand for staff in terms of grade levels, school sites, and job descriptions.

Originally prepared on a 7094, the program can be parcelled for a 1620, or run in its entirety on a 1620 with disc file.

COMPUTER COURSES INCLUDED IN WAYNE STATE'S MBA

Establishment of a master's degree in Administrative Sciences in the School of Business Administration, with emphasis on ADP and the computer, has been announced by Wayne State Univ., Detroit, Mich. It is open to students in business administration, liberal arts, engineering, education, or social sciences.

The course of study will include "Principles of Automatic Data Processing," "Organization, Management and Computers," and "Computer Systems Design." Prerequisites include at least one course in accounting, economics, math, statistics, philosophy or psychology, and computer programming.

Practical experience will be gained in the recently completed computer center and the Administrative Sciences teaching laboratory.

NBS DEVELOPS MACRO-INSTRUCTION SYSTEM

A macro-instruction system for the 7090 has been developed at the Boulder Laboratories of the National Bureau of Standards. Called BOUMAC — Boulder Laboratory Macro System — it is an elaboration of an earlier version conceived and established about five years ago by Dr. Sopka of the Boulder staff.

BOUMAC was programmed by John H. Devenney and includes a repertoire of 13 mnemonic codes for such functions as matrix inversion, transposition, linear correlation, solution of simultaneous equations, and variable input format.

RCA 501 USERS OFFERED SPEED MODIFICATION

RCA has announced Speed-Pak modifications which can be applied on site to its 501's. It includes an increase in memory cycle speed from 15 usec to 12 usec, a three-character adder, left-to-right comparison of two numbers, and three-way simultaneity.

Users reportedly can produce "30 hours of work in 22 hours" with the modification. No program change is required.

H-400 COBOL IS ANNOUNCED

A Honeywell 400 COBOL compiler which will operate with a 2K memory and a minimum of four mag tape drives has been announced. It is said to have all the language elements of COBOL '61 plus such electives as segmentation, MOVE corresponding, the ENTER verb, the USE verb and a variety of I/O techniques such as DEMAND READ and DEMAND WRITE.

The compiler will operate under control of the 400 monitor. Object programs may be combined with EASY assembly system programs to create a mixed COBOL and EASY master program tape.

● Delivery of two TRICE digital differential analyzers to NASA for Project Apollo's space orbital and trajectory simulation studies has been announced by Packard Bell. The 1.4 megabuck order represents the largest TRICE systems ever developed. Each hybrid configuration includes a PB250, console and typewriter, four computing modules,

INFORMATION INTERCHANGE CODE APPROVED BY ASA

The American Standards Association has given final approval to a new code for information interchange, developed by the X3.2 subcommittee on coded character sets and data formats.

The seven-level code has assigned some 64 graphic characters and 30 control functions to its 128-character set, with the remainder yet to be assigned.

Approval ends an uphill fight for the code, which is the first American standard to be established over the objection of its sponsoring committee (BEMA). Final ASA approval was won, however, after BEMA decided not to appeal the overriding. The final decision was aided by early support for the code provided by the DOD, which has announced that the new code will eventually replace Fieldata as the official military standard . . . and by European moves toward a 7-level code which will include a transitional standard 6-bit subset.

The Bell System cut over to the new code for its TWX network in January of this year. And Teletype, with mixed bravery and foresight, announced last year a new equipment line conforming to the requirements of the new code.

The big question now: how rapidly will industry members move to implement the new code? Dick Utman, BEMA's Data Processing Group Director of Standards, expects a perforated tape proposal embodying the new code will be available to X3 in three months, with proposals for mag tape ready in nine months, and punched card "sometime in '64."

NEWS BRIEFS . . .

two racks of a-d and d-a converters, and a linkage rack to connect the system to large-scale digital computers.

● The first major academic computer center in the Near East is being established by the American University of Beirut. Equipment will include IBM 1401 and 1620 computers and tab equipment.

● NCR says it has developed a programming instruction course for its 390 which makes combined use of a workbook and a tape recorder.

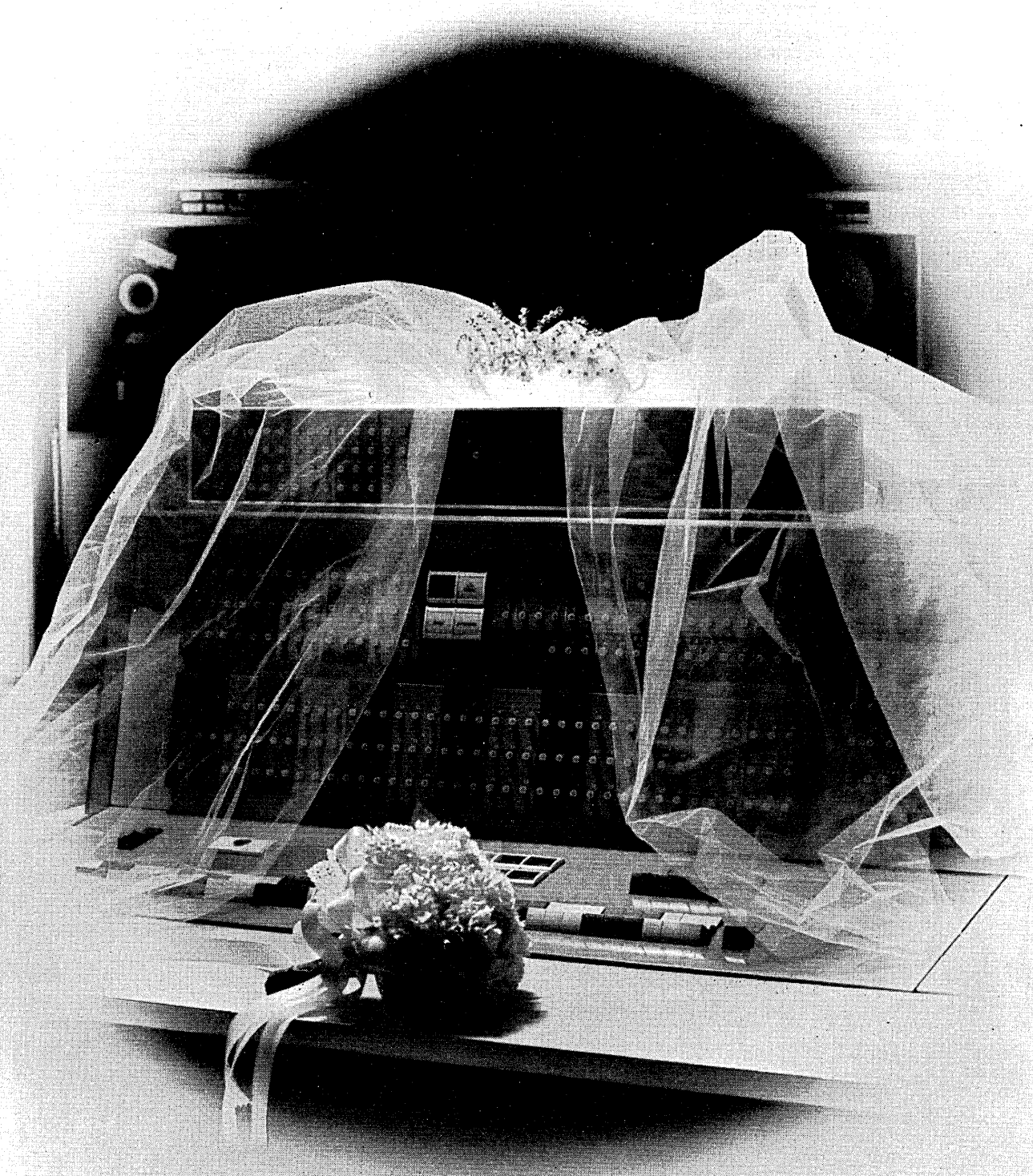
● Magnavox has received a $1,299,630 contract from the U.S. Army Missile Command at Redstone Arsenal for an Automated Engineering Drawing Storage and Retrieval System, an outgrowth of the company's MEDIA and Magnacard systems.

The system will be installed at the Missile Command's Directorate Documentation Branch, which currently has a file of 1½ million frequently called for drawings of missile parts and assemblies.

● A $240K hybrid computer has been delivered by Computer Control Co. Inc., Framingham, Mass., to North American Aviation, Columbus Division. The system, to be used in real-time simulated navigation problems, is built around a DDP-19 and the DR-19 digital resolver. The analog device is NAA-supplied.

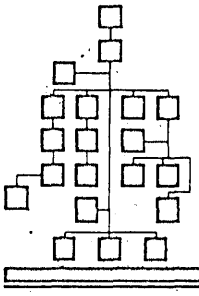
● The Teleregister Corp., Stamford, Conn., has become the 44th member of BEMA and its Data Processing Group. The company reported a net income of $864,284, or $0.30 per share, during 1962, up from $819,864 or $0.29 the previous year. Stockholders' equity was $4.11 per share, compared with $3.81 for 1961.

● A program utilizing the 1401 to generate its own patch cards of corrections to an assembled program deck has been announced by Datatrol Corp., Silver Spring, Md. It is called DPG (Datatrol Patch Generator). Corrections, listed in a format similar to Autocoder or SPS, are generated on cards which are placed in front of the final transfer card of the program deck.



I love you

Don't laugh ♡ Plenty of programmers are wedded to their machines. ♡ Now if you're my kind of programmer, let's set the date soon. Then we can settle down with Computer Concepts, Inc., nation's fastest growing computer consulting firm. ♡ In this soft-ware-house of problem-solving ingenuity, promising young programmers as well as systems analysts can function creatively in such areas of information processing as machine translation, computer efficiency studies, management information systems, computer applications programming and operations research... ♡ Salaries range to $20,000 annually and relocation expenses are paid... send resume to **COMPUTER CONCEPTS, INCORPORATED,** 1012 14th Street, N. W., Washington, D. C.... branch offices are located in Los Angeles and New York City. ♡ PS: don't forget the ring. (area code 202: 783-7215)



people IN DATAMATION

■ AFIPS Chairman Don Madden has left System Development Corp., Santa Monica, Calif., to join IBM as an assistant to C. H. Reynolds, manager, Systems Planning & Development, Data Systems Div., Poughkeepsie, N.Y. In the Data Processing Div., Dr. Louis Robinson has been promoted to director of scientific computing. He was formerly manager of systems engineering.

■ With consolidation of the Philco Computer Division into the Communication and Electronics Division, control has transferred to Henry E. Hockeimer, VP and general manager. Dr. S. Dean Wanlass, who had held that position in the Computer Division, has been appointed VP-technical planning on the corporate level. Named computer marketing manager was William Doherty, formerly head of the Eastern regional marketing office in Willow Grove, Pa.

■ Dr. Gary Carlson has been appointed director of the computer center, Brigham Young Univ., Provo, Utah. He was formerly a senior research specialist at Advanced Information Systems Inc., Los Angeles.

■ Dr. Charles E. Stewart, Aeronutronic Div., Ford Motor Co., Newport Beach, Calif., has been named manager, Scientific Applications, Systems Programming Corp., Santa Ana, Calif.

■ Malcolm D. Smith, manager of special programming projects, Honeywell EDP, has been elected chairman of the data processing committee, National Office Management Assn.

■ International officers of the Systems and Procedures Association have been announced. Arthur Weiss, Altschuler, Melvoin & Glasser, Chicago, was elected president; N. Louis Senensieb, Space Technology Laboratories Inc., Los Angeles, VP; Allen M. Motter, J & L Steel Corp., Pittsburgh, secretary, and Michael Miskulin, Computer Methods Corp., White Plains, N.Y., treasurer.

PSA

PACIFIC SOUTHWEST AIRLINES "THE NATION'S LEADING INTRA-STATE SCHEDULED AIRLINE"

"WHY WE CHOSE THE NCR 390 COMPUTER."

PACIFIC SOUTHWEST AIRLINES, SAN DIEGO, CALIFORNIA

"The NCR 390 Computer provides us with the fastest, most accurate system for travel agency billing, for corporate account billing, for maintaining ticket inventory, and for writing our payroll records.

"By improving service to our customers and to our employees, the NCR electronic system helps PSA maintain an edge in the highly-competitive air travel industry.

"Information on flight tickets is automatically punched in code in strips of paper tape each day. Information about each travel agent and corporate customer is printed on a unique magnetic ledger card that also carries the data in strips of magnetic tape on the back of the card. The program of the NCR 390 enables us to post our statements and ledgers electronically, and keep our ticket inventory automatically.

"In addition to handling this specialized data processing job, the NCR 390 also handles the payroll records for our entire organization."

J. Floyd Andrews

J. Floyd Andrews, President
PSA (Pacific Southwest Airlines)

NCR PROVIDES TOTAL SYSTEMS – FROM ORIGINAL ENTRY TO FINAL REPORT –
THROUGH ACCOUNTING MACHINES, CASH REGISTERS OR ADDING MACHINES, AND DATA PROCESSING
The National Cash Register Co.•1,133 offices in 120 countries • 79 years of helping business save money

NCR

CIRCLE 27 ON READER CARD

I must be getting smarter, Computape.
Suddenly, I can see right through you!

You'll have to pardon Computape's exuberance, but he's all wound up about his new LEXAN reel—a very important first in the computer tape field. LEXAN reels cost more than conventional polystyrene reels. They are worth it. Much tougher and stronger. Much higher impact strength. Much more resistance to heat distortion and warpage. Extra fire resistance. (LEXAN is self-extinguishing.) *You just don't get this kind of protection with any other reel of tape.* And by the way — what's wound on the reel is still the same Computape. (556 or 800 bits per inch. No drop-out.) Which is to say, the best there is. Investigate today. Better still, *immediately*.

*REG. T.M. GENERAL ELECTRIC CO.

COMPUTRON INC.
122 Calvary Street, Waltham, Massachusetts

CIRCLE 32 ON READER CARD

NEW PRODUCTS

gp computer

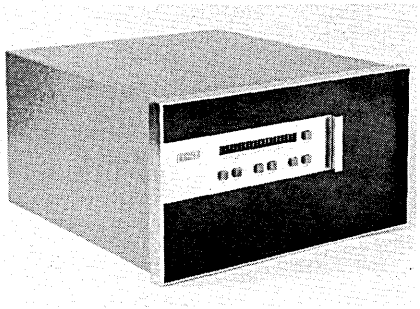
The DSI 1000 is a serial, binary, real time computer with a 2K, 12-bit word, glass acoustic delay line memory. The average random access time is 100 usec. The instruction repertoire has 38 commands, including double-precision arithmetic. It can automatically process up to 64 individually priority-rated, real-time interrupts.

The 1000 has provisions for 64 I/O devices, and accepts one, three, six, eight or 12-bit bytes, serial or parallel input or output. The power consumption is 100 watts. It is operable from 0 to +55°C. Size is 10½" x 19" x 19¼". Prices begin at $9,980. DATA SYSTEMS INC., 20535 Mack Ave., Grosse Pointe Woods, Mich. For information:

CIRCLE 200 ON READER CARD

digital decommutation system

Model 4400 is able to receive up to 144 channels of telemetered data and reproduce the data to within 1/10 of one per cent of its original characteristics. The system accepts telemetered data in analog form, screens out noise and converts the



data into a digital format for immediate display or evaluation by digital computers. The system is priced from $15K to $40K. BECKMAN INSTRUMENTS, INC., SYSTEMS DIV., 2400 Harbor Blvd., Fullerton, Calif. For information:

CIRCLE 201 ON READER CARD

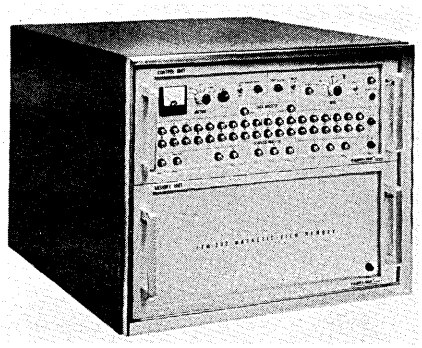
miniaturized filing system

DOCUFORM is a microfilm system that is able to cut filing space by a 200 to 1 ratio. DOCUFORM uses a single, flat, transparent sheet of film which can contain reproductions of over 100 pages of standard-size documents, permitting instant selection from the file and speeding up of retrieval time. DOCUMENTATION, INC., 4833 Rugby Ave., Bethesda, Md. For information:

CIRCLE 202 ON READER CARD

mag film memory system

The FFM-202 features a 300-nanosecond time for total memory cycle and a read/write time of 200 nanoseconds. The system has a capacity



of up to 512 words of 36 bits each; address selection can be either random or sequential. FABRI-TEK INC., Amery, Wis. For information:

CIRCLE 203 ON READER CARD

chart & map making

The Electroplotter II translates numerical data into graphic form for visual interpretation and can receive its design and color instructions from magnetic tape, punched cards or tape, or directly from a computer. It will accommodate graphs as small as 8½ by 11 inches and charts as large as 42 by 58 inches. The basic unit is priced at $16,950. BENSON-LEHNER CORP., 14761 Califa St., Van Nuys, Calif. For information:

CIRCLE 204 ON READER CARD

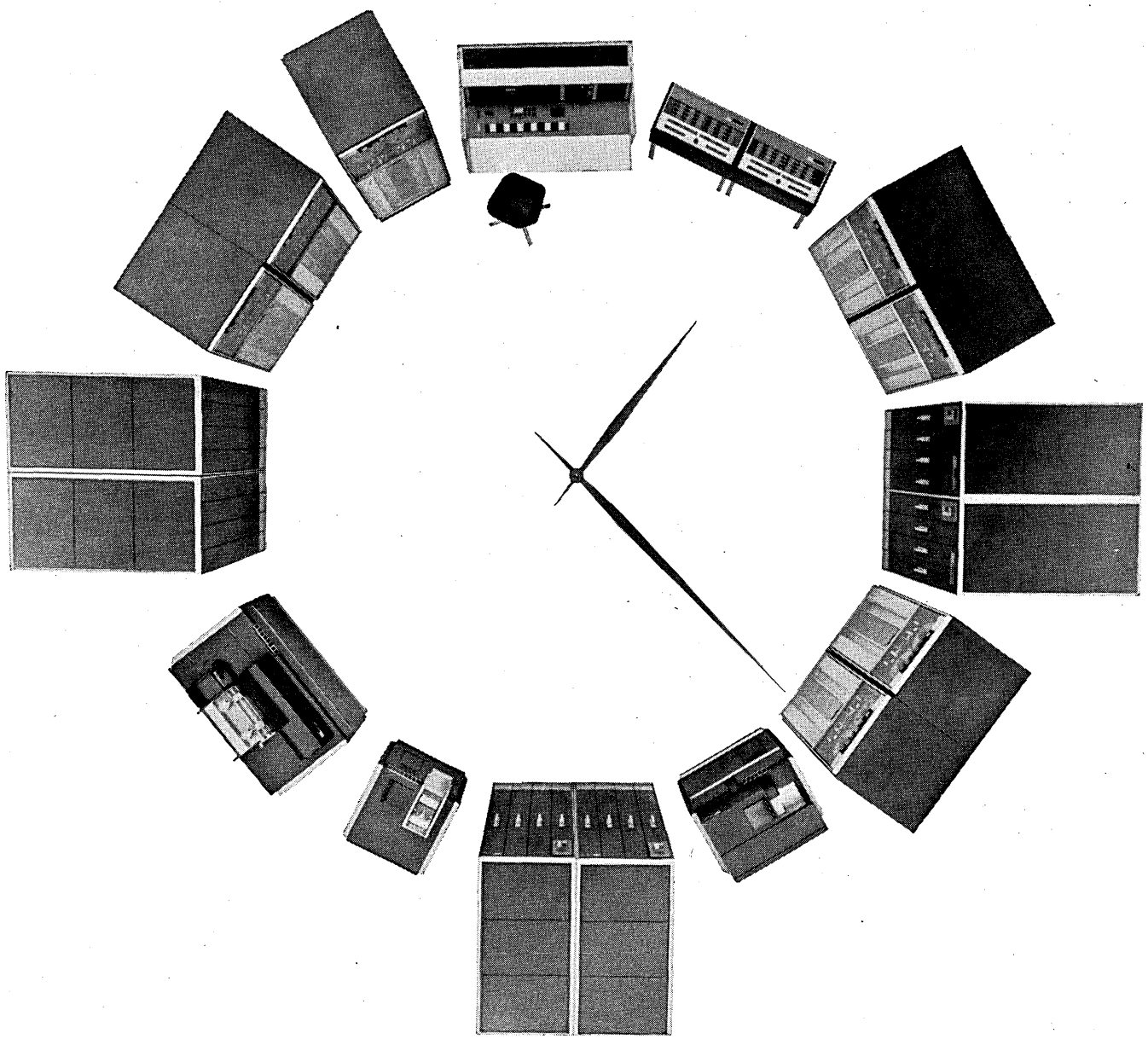
tape transport

The TM-5 reduces static and dynamic skew through precise stop and start characteristics and precision tape guiding. It delivers 800 bpi packing density at 120 ips. AMPEX CORP., 934 Charter St., Redwood City, Calif. For information:

CIRCLE 205 ON READER CARD

card reader

The 405 is a 1200 card-per-minute punched card reader which features individual card reading on demand, and a halt reading operation with



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SBC data processing service is the fast, efficient, and economical way for getting computing done—without investing in equipment or personnel. Our offices turn your time-consuming work over to computers. You get management facts and figures as you need them, when you need them.

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CIRCLE 33 ON READER CARD

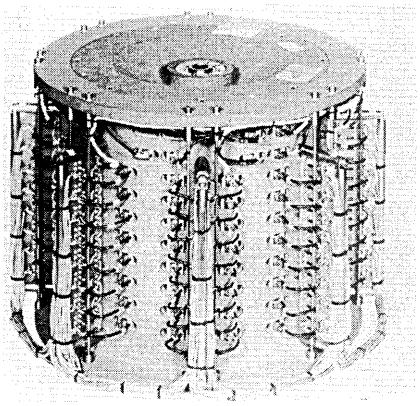
NEW PRODUCTS . . .

the next card in a retrieval position; fail-to-pick signal and margin checks for timing, card sorting to a 240-card capacity secondary receiving tray, and addition or removal of punched cards from any tray while the reader is in operation. CONTROL DATA CORP., 8100 34th Ave., South, Minneapolis 20, Minn. For information:

CIRCLE 206 ON READER CARD

magnetic drums

The D500 series has packing densities to 1200 per inch NRZ and total storage capacities from 475,000 bits NRZ to 16,650,000 bits NRZ. The new series features a magnetic medium of hard nickel-cobalt plate for surface



hardness and has a maximum speed of 12,000 rpm at a diameter of six inches. MAGNE-HEAD DIV. OF GENERAL INSTRUMENT CORP., 3216 W. El Segundo Blvd., Hawthorne, Calif. For information:

CIRCLE 207 ON READER CARD

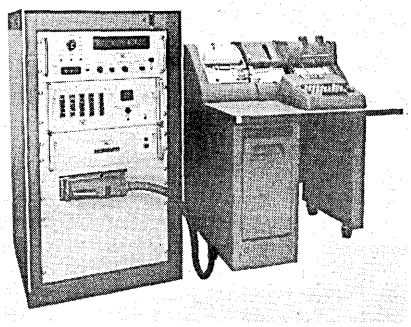
tape reader

Model 625 uni-directional perforated tape reader operates at up to 25 cps asynchronously and 55-60 cps synchronously. Areas for application include code converter, typewriter, digital-to-analog converter, data processing and numerical control systems. The 625 is priced at $395. TALLY REGISTER CORP., 1310 Mercer St., Seattle 9, Wash. For information:

CIRCLE 208 ON READER CARD

data acquisition system

By combining a new input scanner/programmer and card punch coupler with the DY-2401A integrating digital voltmeter, the DY-2010E data acquisition system offers input flexibility with computer compatible output. The input scanner/programmer can be set-up to scan up to 25 different types and levels of three-wire inputs. The system measuring instrument pro-



vides a 5-digit in-line visual readout and BCD outputs to the card punch coupler. DYMEC, DIV. OF HEWLETT-PACKARD CO., 395 Page Mill Rd., Palo Alto, Calif. For information:

CIRCLE 209 ON READER CARD

data conversion

The DY-2030 series digital data plotting system is able to convert digital information stored on punched cards or perforated tape to x-y point plots. The DY-2030B and D systems accept all standard format computer tapes and plot at up to 120 points per minute. The DY-2030A and C are able to read punched cards produced by parallel or serial at speeds up to 50 points per minute. DYMEC, DIV. OF HEWLETT-PACKARD CO., 395 Page Mill Road, Palo Alto, Calif. For information:

CIRCLE 210 ON READER CARD

mag tape unit

The D 2020 computer mag tape unit has data transfer rates ranging from 600 cps to 25,000 cps. The units are available with electrically-selectable dual speed operation. Price range is from $4,000 to $9,000. DATAMEC CORP., 345 Middlefield Rd., Mountain View, Calif. For information:

CIRCLE 211 ON READER CARD

magnetic core memories

The TCM-32 is a new series of compact five-microsecond, random access, magnetic memories which are available in parallel word lengths from 8 to 48 bits and word capacities from 128 to 4096. COMPUTER CONTROL CO., INC., Old Connecticut Path, Framingham, Mass. For information:

CIRCLE 212 ON READER CARD

tape reader-spooler system

Model RRS-101 photocell punched tape reader and spooler system operates at a speed of 100 cps continuously or 60 cps line-at-a-time mode. The unit has a rewind rate of 40 inches per second. RHEEM ELECTRONICS, 5200 W. 104th St., Los Angeles 45, Calif. For information:

CIRCLE 213 ON READER CARD

Decision-Making: Logistics Support, What, Where, When?

Centuries ago the critical factor in logistics support was providing basic supplies—food, armaments, raw materials for simple industries. A few decades ago, carrying capacity—sea and land transportation—ruled as the decisive element. Within the last decade, a new critical element in logistics support has emerged. It has been created by the complex, interfacing governmental, industrial and military structure of today. This new factor is up-to-the-minute information—gathered from afar, varied in content, immense in volume.

To help provide and control this flow of information, SDC scientists, engineers and computer programmers have helped create a new technology: information systems which aid managers in determining the "what, where and when" of logistics support for world-wide and continental activities and forces.

In developing these systems which provide information processing assistance, SDC scientists, engineers and computer programmers have evolved an interdisciplinary approach. Teams of computer programmers, operations research scientists, engineers and human factors scientists work together in these major system development steps: analyzing the system, synthesizing the system, instructing computers within the system, training the system, evaluating the system—and helping adapt the system to the changing needs of its users. The system itself, not the hardware within the system, is their concern.

*Computer programmers, scientists and engineers interested in joining this growing field, are invited to write Mr. A. H. Granville, Jr., SDC, **2401** Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D.C., Lexington, Massachusetts; Paramus, New Jersey; Dayton, Ohio. "An equal opportunity employer"*

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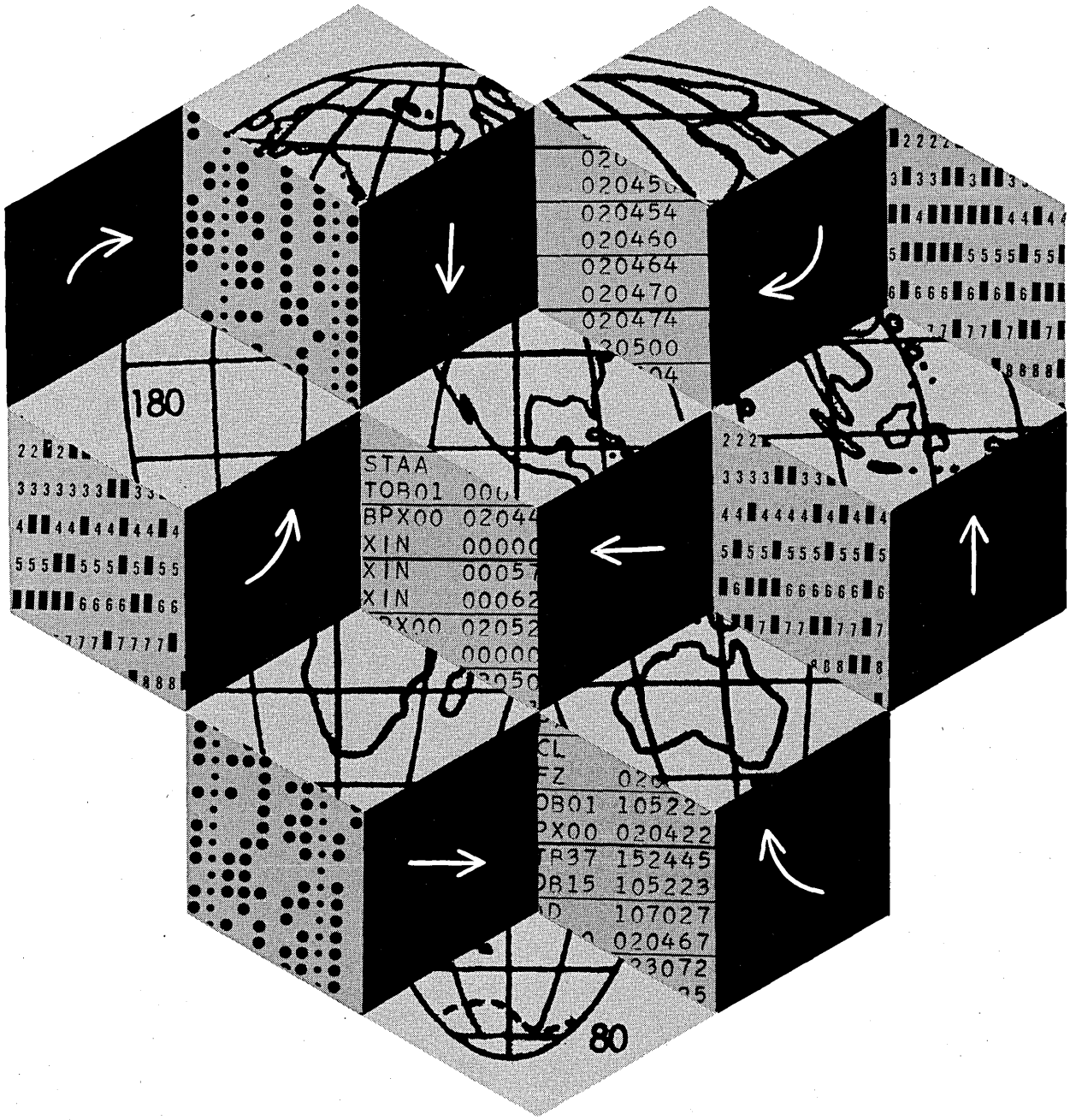

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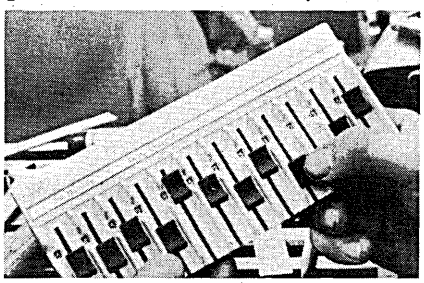
COMPONENT PRODUCTS

recording device

The 1030 data collection system is able to transmit product information, entered by use of a pocket-size recording device, directly to a computer for immediate analysis. This



data cartridge can be carried in a pocket until ready for data transmission. IBM CORP., DATA PROCESSING DIVISION, 112 E. Post Rd., White Plains, N.Y. For information:

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delay line

The SD-4 magnetostrictive delay line can store up to 7,000 bits at a digit rate of 1.5 Mc in an NRZ mode. Price of the SD-4 is $125. SONIC MEMORY CORP., 494 Oak St., Copiague, N.Y. For information:

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digital clock

This transistorized digital clock is applicable in data logging systems, process control systems, time display systems, high speed computer systems or other digital systems utilizing programming or timé control. Cost of the clock begins at $1,100. PARABAM, INC., 12822 Yukon Ave., Hawthorne, Calif. For information:

CIRCLE 242 ON READER CARD

tape adapter

This new high-density tape adapter allows the S-C 4020 to accept data from mag tape at rates up to 62,500 six-bit cps. This unit, the F-53, acts as a buffer to the 4020 and its data source. The F-53 is also compatible with the IBM 729 II, IV, V, VI, and 7330 tape transports using high density tapes. GENERAL DYNAMICS/ELECTRONICS, P.O. Box 127, San Diego 12, Calif. For information:

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Marketing Division—Nationwide Locations

Computer Sales Engineers: Openings exist now for persons with digital computer experience in sales, engineering and/or applications programming.

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SEND RESUME TO H. K. TRADER, CONTROL DATA CORP., 8100 34TH AVENUE SO., MINNEAPOLIS 20, MINNESOTA.

Computer Division—Palo Alto, Calif., Location

Systems Programming: Participate in the development of advanced programming systems, including compiler development, monitor and executive routines and language analysis. Digital computer experience and BS degree required.

Systems Evaluation: Participate in the development of quality assurance techniques for general purpose programming systems. These positions require a good understanding of systems programming techniques and creative imagination. Large-scale computer experience and BS degree required.

Software Documentation: Development of reference manuals, teaching aids, sales aids and other forms of documentation for programming systems.

Technical Applications: Technical programming for applications such as nuclear reactors, general simulation, information retrieval, linear and non-linear programming.

Computer Division—Nationwide Locations

Systems Installation: Technical representative at customer site. Responsibilities include orientation, training, programmer consultation and software systems installation for large-scale Control Data 3600 and 1604 computer customers. (Various locations in continental United States.) Large-scale computer experience and BS degree required.

SEND RESUME TO: B. A. CRIPE, CONTROL DATA CORPORATION, 3330 HILLVIEW AVE., PALO ALTO, CALIFORNIA.

LIBRARIES AND AUTOMATION

scientists confer

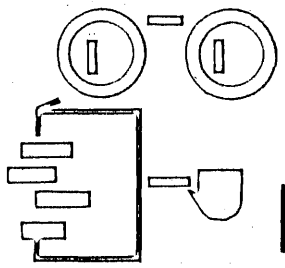
Amid the picturesque setting of the Airlie Foundation in the hunt country of Virginia, 103 invitees gathered at the behest of the Council on Library Resources, the National Science Foundation, and the Library of Congress to confer on libraries and automation. After a warm welcome by L. Quincy Mumford, the Librarian of Congress, the session got off to a rousing start with an address by Don R. Swanson (ex-TRW, now Dean, Graduate School of Library Science, University of Chicago).

Swanson described the library of the future, a computer-based system with on-line consoles for public use. He described consoles which worked in a "conversation mode" with the computer. A few buttons, a display tube, a keyboard, a printer, and a whale of a lot of programming will allow a user to describe a document, to refine this description through a conversation with the computer and finally to request his selection(s) from automated stacks. The system was said to be both a teaching machine for the neophyte and a learning device so that successful search trails could be followed again. The system could further supply the library administrator with dynamic usage statistics and cost data for the management of the store.

In the following three days, papers were presented concerning the organization and establishment of the basic files necessary to such a system; how such files could be accessed (on-line consoles); the part microfilm might play in such a system; what the printed outputs might be; how a communication network might be tied in to provide remote interrogation and response; and finally a closing summary. As might be expected the attendees rapidly fractionated into two groups, the INs and the OUTs. The ins were still struggling with EAB procedures and their first 1401 program. The outs retained the antiquated methods of the turn of the century, but were willing to "go along, if sufficient benefits accrue." Thus the outs were so far out they were way out.

The three days of discussion involved the size of the character set involved for output printing, how this affected the input problem, batching vs on-line operations, centralized vs decentralized operations, and turn-around time on service requests. Two salient points stand out: a) Unless the library community standardizes and presents a united front, a sufficient demand may not exist for any manufacturer to develop the required equipment. b) The community has been debating relative cataloging schemes since 1938, and agreement is not yet in sight.

In the end, sober heads prevailed. The grand vision of Swanson was revered as a goal. In the meantime the attendees were invited to learn something of computers, to try and state their requirements, and to obtain some current cost data. The session adjourned to await the forthcoming report on the automation of the Library of Congress (10^7 volumes) and a bound report of the proceedings to be published by the Government Printing Office in Fall, 1963. ■



NEW LITERATURE

PATCH GENERATOR: This illustrated leaflet explains the uses for and specifications of DPG 1401 patch card generator. DATATROL CORP., 8115 Fenton St., Silver Spring, Md. For copy:
CIRCLE 130 ON READER CARD

SYSTEM REPORTS: The latest supplement of Standard EDP Reports offers a review in depth of the Univac 1107, IBM 7010 and 1401. THE BUREAU OF NATIONAL AFFAIRS, INC., 1231 24th St., N.W., Washington 7, D.C. For copy:
CIRCLE 131 ON READER CARD

'62 IFIP CONGRESS: The official Proceedings of the Congress contain the full texts, along with abstracts, of 82 submitted papers, the full texts of 23 invited papers, and accounts of 26 symposia and panel discussions. Topics include business information systems, scientific information processing, information retrieval, artificial perception, language translations, and advanced techniques in programming languages and systems design. The volume is priced at $46. NORTH-HOLLAND PUBLISHING CO., P.O. Box 103, Amsterdam, The Netherlands.

PROGRAMMING AIDS: An illustrated bruchure contains information on a magnetic visual system of arrows and programming boards to facilitate the establishment and use of PERT, CPM and LESS program networks. METHODS RESEARCH CORP., 103 Willow Ave., Staten Island 5, N.Y. For copy:
CIRCLE 133 ON READER CARD

REFERENCE WORKS: APT Language Dictionary, APT Postprocessor Standards, Postprocessor Input Data Format are three works available at a nominal cost to companies planning to implement and maintain the ADAPT system. ARMOUR RESEARCH FOUNDATION, ILLINOIS INSTITUTE OF TECHNOLOGY, Technology Center, Chicago 16, Ill.

MAG TAPE & PERFORATED TAPE SYSTEMS: A product data sheet presents features, specifications, and accessories for the MT-36 magnetic tape transport. Another data sheet describes the PTR/PTS-500 perforated tape system and includes descriptions of mechanical design, features and specifications. POTTER INSTRUMENT CO., INC. 151 Sunnyside Blvd., Plainview, L.I., N.Y. For copy:
CIRCLE 135 ON READER CARD

636 COMPUTER: This brochure fully describes the 636 digital computer, designed principally for the central unit of real-time data acquisition and control systems. DAYSTROM, INC., CONTROL SYSTEMS DIVISION 4455 Miramar Rd., La Jolla, Calif. For copy:
CIRCLE 136 ON READER CARD

OMNI-DATA DIGEST: Issue No. 8 contains a chart for determining the length of paper tape remaining on a given reel at any given time. Also included is an article on a photoreader system for the NASA orbiting-observatory program. OMNITRONICS, INC., 511 N. Broad St., Philadelphia 23, Penna. For copy:
CIRCLE 137 ON READER CARD

DATA TONE TRANSMISSION SYSTEM: This eight-page bulletin highlights the B770 solid state, frequency-shift, narrow band carrier communication system designed for transmission of digital data, control and teletype information. LYNCH COMMUNICATION SYSTEMS INC., 695 Bryant St., San Francisco 7, California. For copy:
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THE 7094 II
upgrading the 90

The recently announced IBM 7094, model II, features increased speed through the use of overlapped memories and a new instruction processing unit which reduces the number of cycles for multiplication and division. Its memory access time is 1.4 usec, compared with two usec for the 7094, and 2.18 for the 90. The add time is 2.8 usec.

It now appears that two 7090's can be replaced by one 94 II, with a significant (about $40K per month) saving to the customer. Renting for some $12K per month more than the 90, the system offers 2½ times as much performance, and becomes competitive with the CDC 3600 and the Philco 212. The interleaved addressing feature provides, in effect, two 16K memory banks, allowing simultaneous accessing of two instructions or retrieval of an instruction while the previous instruction is being executed.

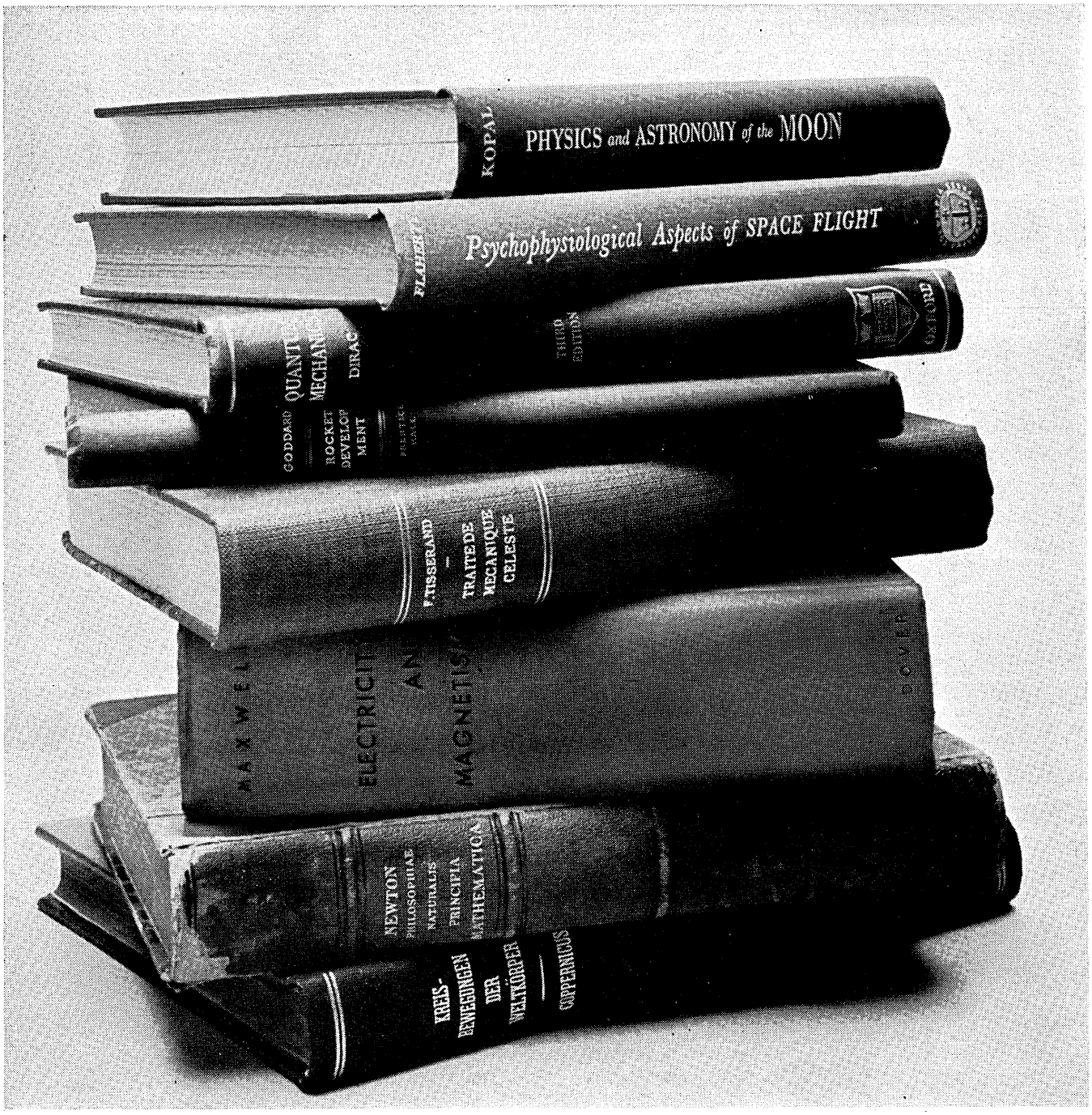
Users currently renting a 7094 are being offered modifications at the installation within 96 working hours, including system testing. A 90 is said to be expandable to a 94 II within 120 working hours, including a display panel on the console for the additional index registers. The three systems are program compatible.

Peripheral devices which can be used with the 7094 II include up to five 1301 disc and/or 7320 drum files, up to 20 Hypertape units, and 80 729 tape drives.

Software support includes FORTRAN, COBOL, the IBJOB processor, and a monitor program.

A typical 7094 II configuration sells for $3,225,000, and rents for $76K per month. Initial delivery is scheduled for the spring of 1964.

ADVERTISERS' INDEX



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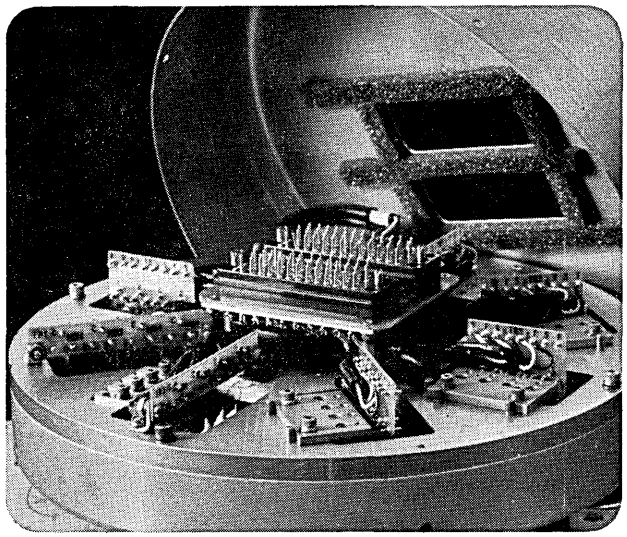
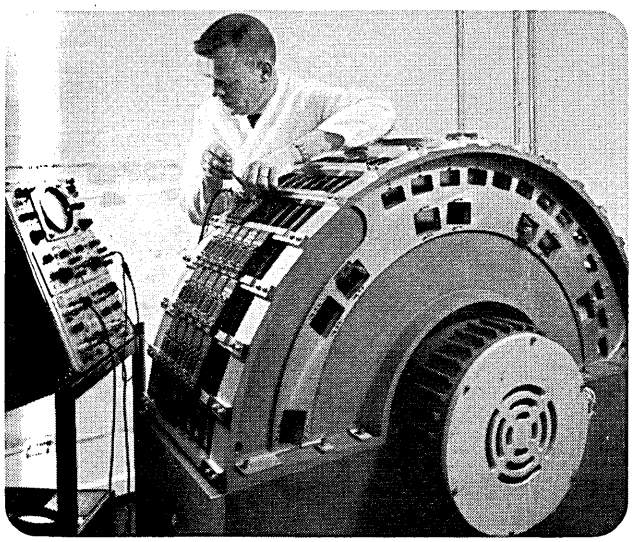
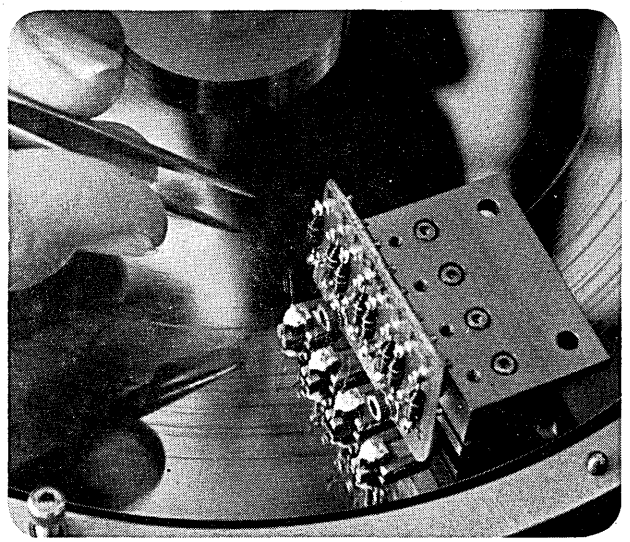
CIRCLE 90 ON READER CARD

Computer and Data System Designers:

rotating magnetic memory devices from General Precision







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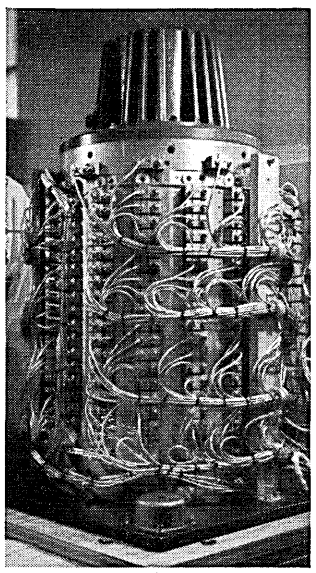
L108	8″	32	4800	153,600	1800-12,000
L111	11″	64	6600	422,400	1200- 8000
L116	16″	128	10,000	1,280,000	900- 3600
L124	24″	256	15,000	3,840,000	900- 3600



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L211	11″	128	6600	844,800	1200- 8000
L216	16″	256	10,000	2,560,000	900- 3600
L224	24″	512	15,000	7,680,000	900- 3600

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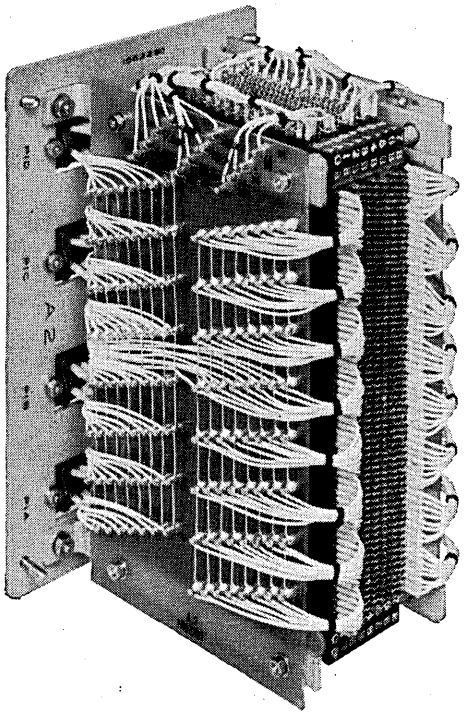

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