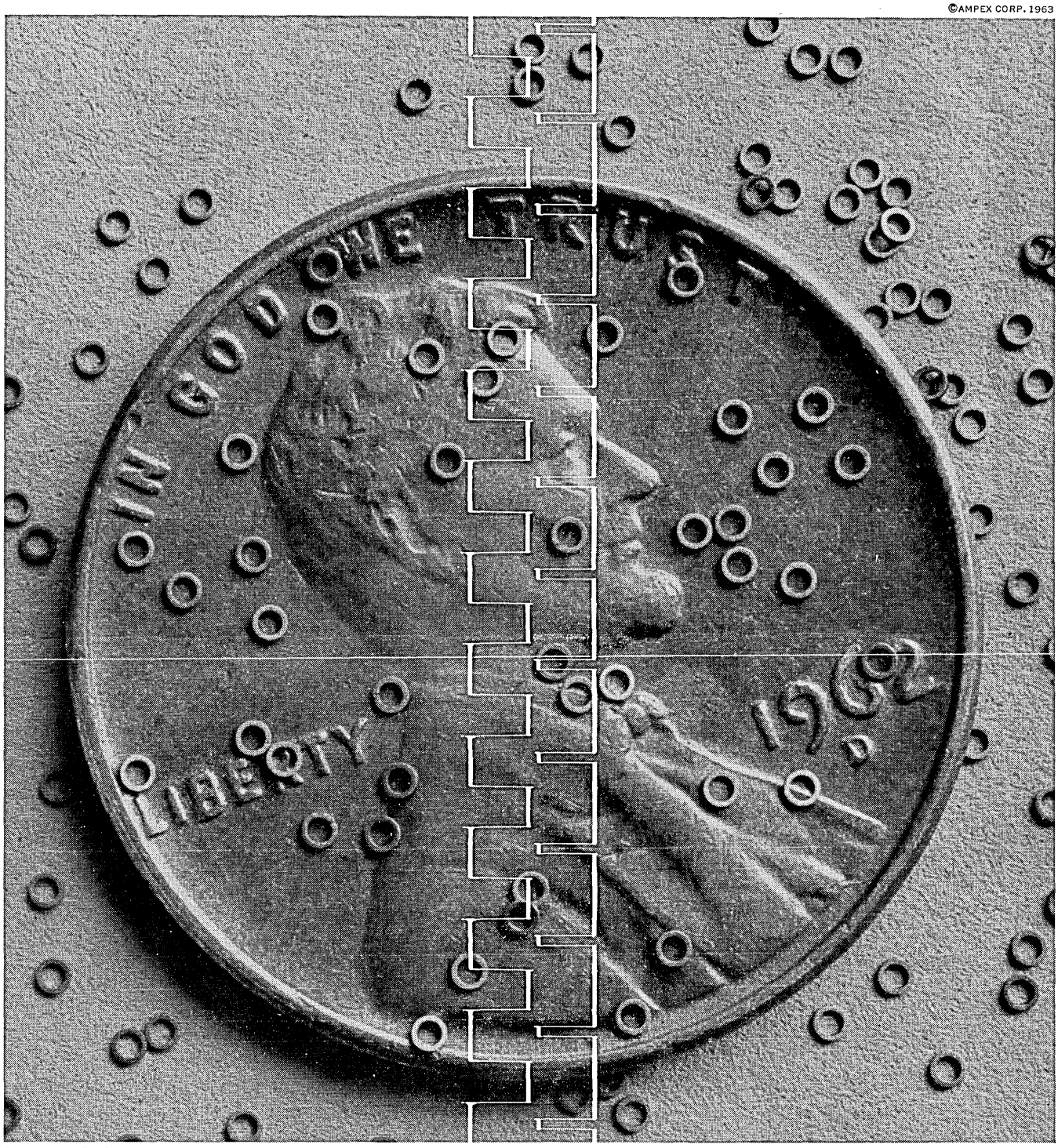
DATAMATION®

63

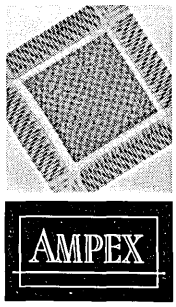
September

NON-IMPACT PRINTING



Who delivers wide-temp cores that cost no more? **AMPEX**

Ampex has developed a new core—a Lithium core. It's a wide-temp core that costs no more than ordinary cores—far less than the conventional wide-temp core. Here's what you get for your money: A 75° C temperature range with no current compensation. Drive requirements as low as 600 ma. Switching times less than 450 ns. And outputs as high as 56 mv. The new Ampex cores are 30 mil in size. They can be strung in Aztec arrays and stacks. And they will meet the requirements of 90% of your wide-temp applications. This new core is just one example of the many ways Ampex continues to pioneer new and superior products. It comes from Ampex Computer Products Co., Culver City, California. For more information on Ampex Lithium cores, write to Ampex Corporation, Redwood City, Calif. Worldwide sales, service.

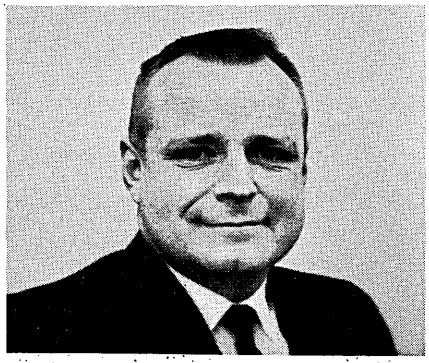


CIRCLE 1 ON READER CARD

—Advertisement—

SDS's Borgers Discusses Software Packages

Los Angeles—According to Emil Borgers, Manager of Programming for Scientific Data Systems, Inc., "the 'comprehensive software packages' available from computer manufacturers seldom live up to advertising claims. This is particularly evident with smaller computers where the 'package' may consist of little more than a simple octal loader, a sketchy assembler and a few subroutines based on reference book equations."



BORGERS

The SDS spokesman continued, "right from the start, we were determined to lick the software problem before we put the first SDS computer out the door. We ran our hardware and software programs in parallel, with each program dictating design criteria for the other. That way—refusing to simply tack software development onto the tail-end of our computer design program—we were able to offer the most efficient and comprehensive software package in the small computer field, right off the bat. That's why the $98,000 cost of an SDS 920 includes a four-level package of utility programs, assembly programs, mathematical subroutines and Fortran II, plus a continued program of refinement, improvement and software extension."

Borgers stressed the SDS Fortran capability: "Fortran II is a subset in our SDS 900-Series compiler. The SDS 920 is the only computer that, without magnetic tape units, can process Fortran II programs in one pass. Right now, considerably less than a year after our first computer was installed, SDS customers are solving a wide range of production problems using our Fortran. Comparative tests have already proved it to be a superior Fortran processor. And our unique diagnostic capability, efficiency and compilation speed are impossible to achieve with any other computer near our size."

Borgers concluded, "We at SDS feel that we've provided the efficient type of programs that users want but are frequently left to write for themselves."

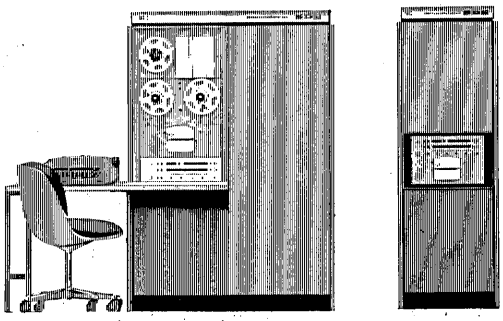
"We take our software seriously."

NOTE: Complete detailed literature on the SDS software package is available, on request from Dept. S, 1649 Seventeenth Street, Santa Monica, California.

SEVEN REASONS WHY THE UPPER RIGHT HAND CORNER OF YOUR NEXT GENERAL PURPOSE DIGITAL COMPUTER WILL LOOK LIKE THIS:

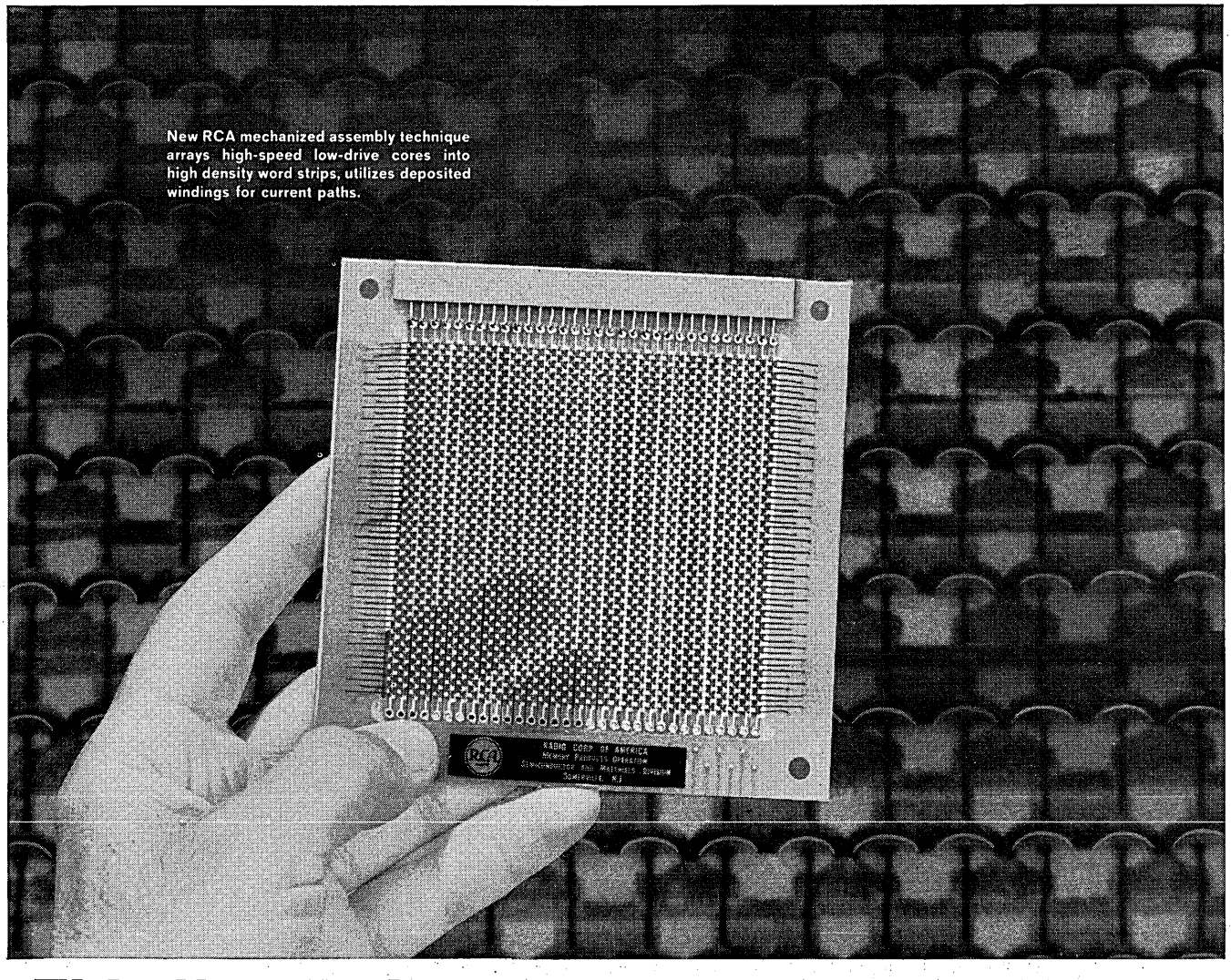
- Reliability increased by an order of magnitude
- The only high speed, low cost computer with Fortran II
- Add time: 16 μsec. Multiply time: 32 μsec.
- Silicon semiconductors used throughout
- Floating point and multi-precision operations
- Built in buffers; five integral input/output systems
- Priced up to $50,000 under comparable machines

In scientific/engineering applications, SDS 900-Series computers give more answers per dollar, more reliably, than comparable machines. The SDS 920 costs $98,000. The smaller SDS 910 costs only $48,000. Although both are new from the ground up (the first unit shipped in August, 1962), alert users such as JPL, Bell Labs., NASA, Motorola, G.E., Honeywell and RCA are already on the customer list. Care to join them?



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

CIRCLE 4 ON READER CARD



New RCA mechanized assembly technique arrays high-speed low-drive cores into high density word strips, utilizes deposited windings for current paths.

This New RCA Microferrite Memory Stack

Completes A Full Cycle In 300 Nanoseconds With Only 350 ma Drive

Now, a major advance in Ferrite Stack Design and Construction by RCA makes 65-Nanosecond Switching a reality.

Here is the industry's first commercially available Microferrite Memory Stack with complete read/write cycle time of 300 nanoseconds at drive current levels below 350 ma—bit outputs of 50 mv.

This revolutionary two-core-per-bit word-address system bypasses today's experimental memory techniques by using proved, reliable ferrite cores in a high-density array of advanced design. Check these important benefits:

- **High Packing Density**... 1,000 to 2,000 bits per cubic inch.
- **Superior Stability and Ruggedness**... Printed wiring assures positive, rigid contact to each core. Planes designed to meet Military Mechanical and Environmental Specifications.
- **Precision Uniformity**... Mechanized fabrication eliminates many hand-assembly variables.
- **Outstanding Reliability**... Mechanized production techniques permit more precise control of each fabrication step—produce a rugged, high-reliability structure.
- **Broad Capacity Range**... Available in 32 word x 32 bit size, and in any multiple of this size.
- **Plug-In-Convenience**... Each stack incorporates standard plug connections for fast, easy installation.
- **Complete Service**... Whatever your requirements, custom or RCA standard, your local RCA Semiconductor and Materials Division Field Representative is prepared to provide a completely coordinated application service for all RCA Computer-Memory Products. Call him today at your nearby RCA Field Office.

For complete technical information on new RCA Microferrite Memory Stacks, write department FD-8, RCA Memory Products Department, 64 "A" Street Needham Heights 94, Mass.

TENTATIVE DATA
TYPICAL DRIVE REQUIREMENTS AT 25°C

	Amplitude (ma)	Rise Time (nsec)	Duration (nsec)
Read Pulse	350	30	100
Partial Write Pulse	250	20	45
Digit Pulse	70	15	85

BIT OUTPUT (Two-Core/Bit Word-Address)

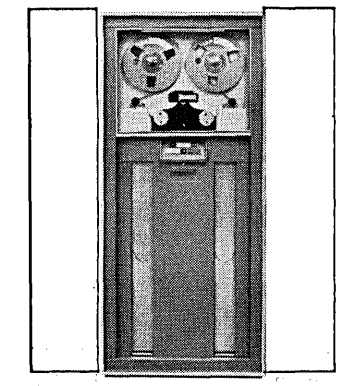
		Undisturbed '1' (mv)	Undisturbed '0' (mv)
Bit Out-Puts	Amplitude Sensing	60	12
	BiPofar Sensing	+50	−50
Bit Switching Time		70 nsec	

RCA FIELD OFFICES

...**EAST:** 32 Green Street, Newark 2, N. J., HU 5-3900 • 731 James St., Room 402, Syracuse 3, N. Y., GR 4-5591 • 605 Marlton Pike, Erlton, N. J., HA 8-4802 • Greater Baltimore Area, 1725 "K" St., N.W., Washington 6, D. C., FE 7-8500 • **NORTHEAST:** 64 "A" St., Needham Heights 94, Mass., HI 4-7200 • **SOUTHEAST:** 1520 Edgewater Dr., Suite No. 1, Orlando, Fla., GA 4-3768 • **CENTRAL:** Suite 1154, Merchandise Mart Plaza, Chicago 54, Ill., 527-2900 • 2132 East 52nd St., Indianapolis 5, Ind., CL 1-1405 • 5805 Excelsior Blvd., Minneapolis 15, Minn., WE 9-0676 • 714 New Center Bldg., Detroit 2, Mich., TR 5-5600 • 7905 Carpenter Freeway, Dallas 7, Texas, ME 1-9720 • Continental Terrace Bldg., 2785 North Speer Blvd., Room 346, Denver 11, Colo., 477-1688 • **WEST:** 6801 E. Washington Blvd., Los Angeles 22, Calif., RA 3-8361 • 1838 El Camino Real, Burlingame, Calif., OX 7-1620 • 2250 First Avenue, South, Seattle 4, Wash., MA 2-8816 • **GOVERNMENT:** 224 North Wilkinson Street, Dayton 2, Ohio, BA 6-2366 • 1725 "K" Street, N.W., Washington 6, D. C., FE 7-8500 • **RCA INTERNATIONAL DIVISION:** 30 Rockefeller Plaza, New York 20, New York, Cable Address: RADIOINTER, New York

RCA® **THE MOST TRUSTED NAME IN ELECTRONICS**

CIRCLE 5 ON READER CARD

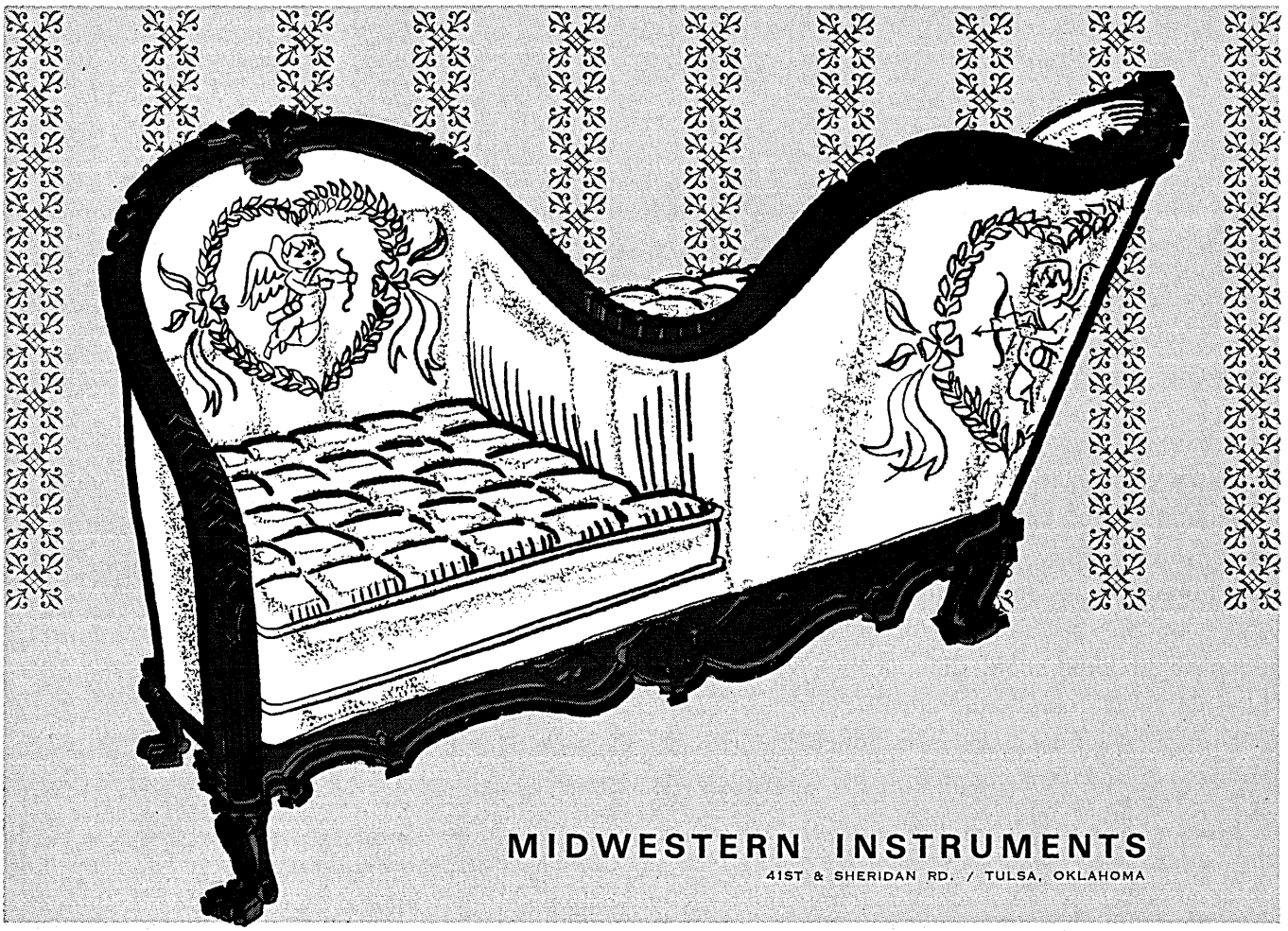


MIDWESTERN'S

M3000 DIGITAL

TAPE TRANSPORT

ALSO HAS ***compatibility plus***!



CIRCLE 7 ON READER CARD

DATAMATION 63

the automatic handling of information

volume 9, number 9

Staff

Microfilm copies of **DATAMATION** may be obtained from University Microfilms, Inc., 313 No. First St., Ann Arbor, Mich.

Feature Articles

Departments

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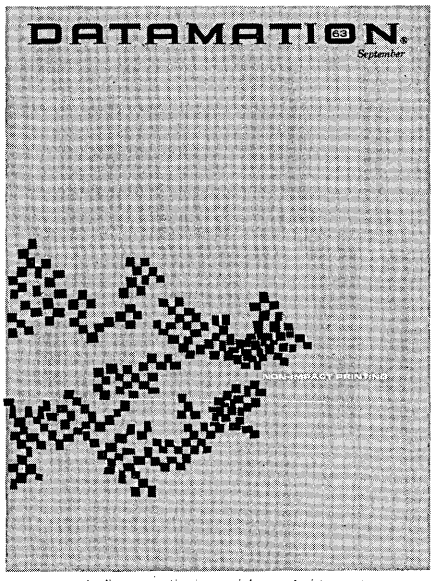

Cover

This month's cover design, by pen and ink out of free-association, is prompted by our feature article: a hardware survey and examination of factors which affect the acceptance of non-mechanical printing techniques. The hardcopy art output is by Art Director Cleve Boutell.

Circulation audited by Business Publications Audit

Member, National Business Publications

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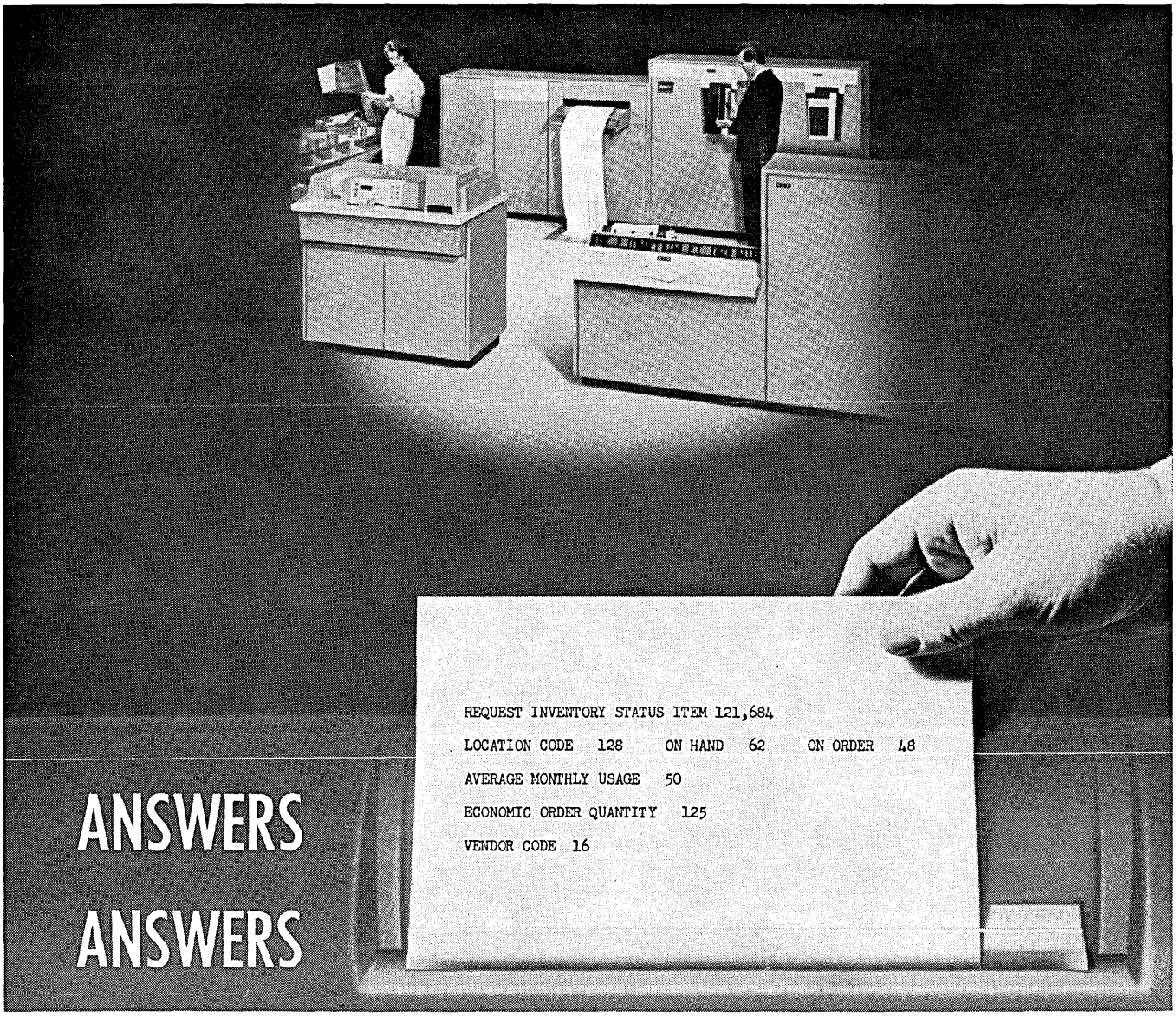


ANSWERS . . . with CRAM and Remote Inquiry

provided by the NCR 315 Computer System

The NCR 315 CRAM (Card Random Access Memory) Computer System is more than just another back-office electronic accounting machine.

In industry, for example, Inquiry Units can be located at dozens of remote locations, enabling people to communicate with the computer files . . . even from hundreds of miles away. With the NCR 315 you will be able to keep a "current finger" on the pulse of your business . . . to get immediate answers to questions about inventories, production, sales . . . and a host of other timely facts people must have to effectively manage . . . and to act while the "iron is hot."

For more information, call your nearby NCR representative or write to The National Cash Register Company, Data Processing Systems and Sales, Dayton 9, Ohio.

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 8 ON READER CARD

New heavy-duty printer for 8-level systems

Here is the new Teletype Model 35 printer. It offers a range of features that will bring new flexibility and improved efficiency to your communications and data handling systems:

☐ 8-level permutation code is compatible with many computers and data handling systems. It also provides extra code combinations for programming purposes.

☐ 4-row keyboard eliminates shifting for figures and common punctuation marks. This saves key strokes, cuts errors, and makes every typist a potential operator.

☐ available automatic character generator can serve as a station identification device—or print out 20 characters of other repetitive data at the touch of a single key.

In addition, the Model 35 is equipped with the Teletype "stunt box," a versatile remote control device. Optional features include a sprocket-feed platen for handling continuous business forms, vertical and horizontal tabulators, automatic feed-out for completed forms, and many others. Speed is 10 char/sec. Input is from local keyboard or line signals.

The "35" is available as a send-receive printer (shown), as a receive-only printer, or as an automatic send-receive set with facilities for punching and reading paper tape.

For additional information, contact: Teletype Corporation, Dept. 81J, 5555 Touhy Avenue, Skokie, Illinois.

This type of 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*

CIRCLE 9 ON READER CARD

"We'll demonstrate our computers anytime– just ask us"

Right in your office or laboratory . . . we'll show you that PACE®TR-10 and TR-48 Analog Computers are the answer to your complex design engineering problems — providing infinitely flexible electronic models to simulate your most sophisticated designs. Solutions are presented simultaneously with changes in input parameters–giving you a real "feel" for the problems–short-cutting lengthy slide-rule manipulations. You'll discover yourself programming and operating these analog computers with ease. PACE TR-10 and TR-48 computers are fully transistorized–providing the portable ruggedness and compactness that permits us to demonstrate anytime, anywhere. They can be set on your desk and plugged into any 110-volt outlet. A free training course is provided with every TR-48. ☐ *Ask for a demonstration at a place and time convenient for you. We'll do the rest.*

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

ADVANCED SYSTEMS ANALYSIS AND COMPUTATION SERVICES/ANALOG COMPUTERS/HYBRID ANALOG-DIGITAL COMPUTATION EQUIPMENT/SIMULATION SYSTEMS/ SCIENTIFIC AND LABORATORY INSTRUMENTS/INDUSTRIAL PROCESS CONTROL SYSTEMS/PHOTOGRAMMETRIC EQUIPMENT/RANGE INSTRUMENTATION SYSTEMS/TEST AND CHECK-OUT SYSTEMS/MILITARY AND INDUSTRIAL RESEARCH AND DEVELOPMENT SERVICES/FIELD ENGINEERING AND EQUIPMENT MAINTENANCE SERVICES.

CIRCLE 10 ON READER CARD

DATAMATION calendar

- The 26th annual meeting of the American Documentation Institute will be held October 6-11 at the Pick-Congress Hotel, Chicago, Ill.

- 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 International Systems Meeting will be held October 14-16 at the Hotel Schroeder, Milwaukee, Wisc. Sponsor is the Systems and Procedures Assn.

- The annual meeting of the Users of Automatic Information Display Equipment will be held October 15-17 at the Carillon Hotel, Miami Beach, Fla.

- The U. of Maryland and the Wash. D.C. Chapter of the ACM are sponsoring a one-day technical symposium at the University Oct. 17, 1963.

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

- The DPMA International Electronic Business Systems Conference will be held in Phoenix Nov. 7-8.

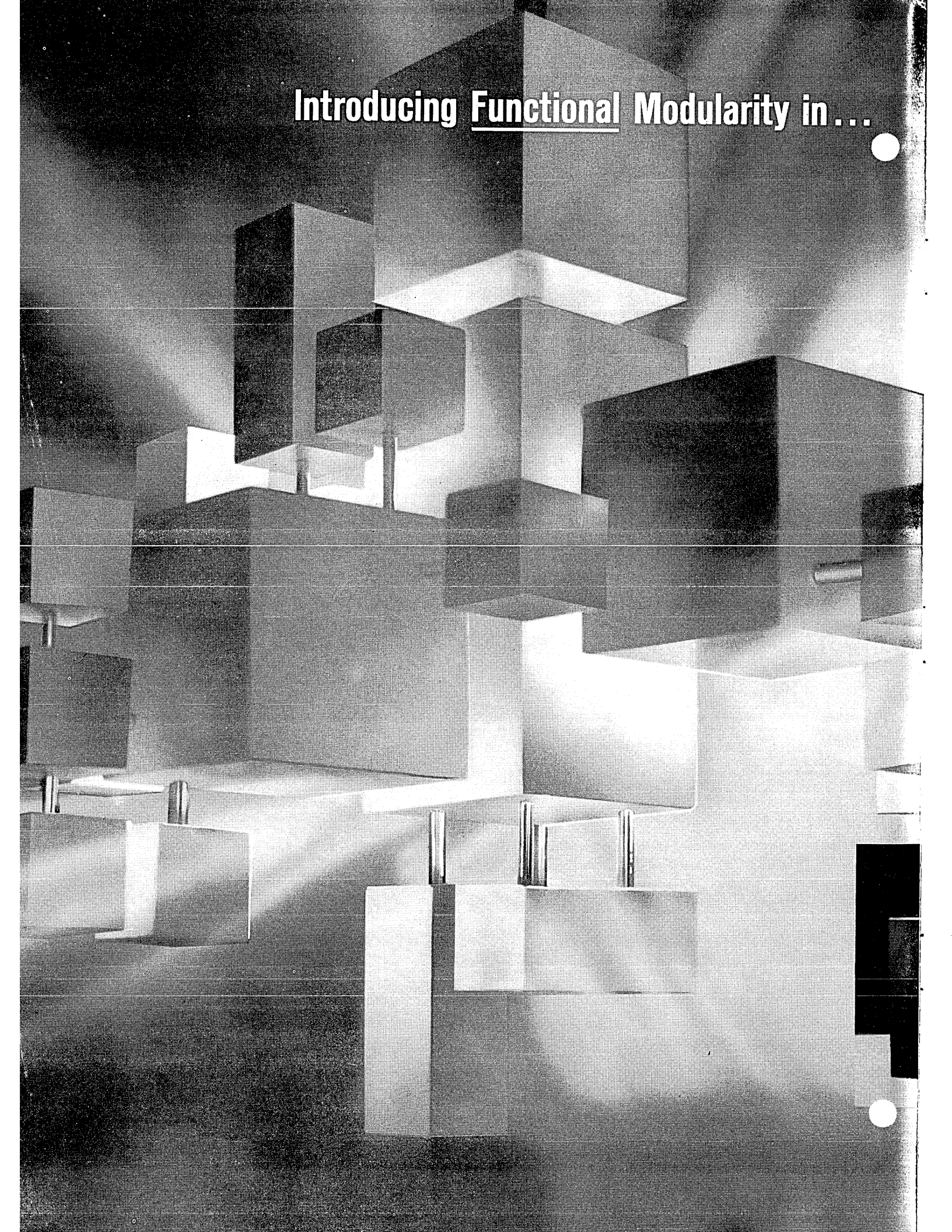
- The 1963 Fall Joint Computer Conference will be held in the Las Vegas, Nev., Convention Center, Nov. 12-14.

- The American Bankers Assoc. first national Automation Conference will be held in Chicago Nov. 13-15.

- The 11th Annual Electronics Seminar, co-sponsored by the EDP committees of the American Gas Assoc. and the Edison Electric Institute, takes place Nov 18-20 in Chicago.

- 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.


Introducing Functional Modularity in . . .

An entirely new breed of computer
RCA 3301 REALCOM

The 3301 Realcom isn't just a new computer. It's a new kind of computer. It is the industry's first all purpose, real-time communications data processor. It brings users functional modularity . . . an innovation which allows enhancement by function as well as by capacity and speed . . . eliminates costly conversion and reprogramming. Never before has such a wide range of computer capabilities been offered in one package . . . and the 3301 is in the medium price range.

A Super-Fast Business Data Processor . . . efficient batch processing . . . large volume, fast random access . . . fast, versatile input/output devices . . . buffered where advantageous . . . memory cycle of 1.75 microseconds . . . fastest in the commercial field.

A Real-Time, On-Line System . . . with an extremely flexible priority interrupt system . . . keeps management aware of important events as they occur . . . permits closer control, more centralized processing.

A Communications Processor. . . for management control of dispersed operations . . . performs message switching, message-in-transit editing and priority transmission . . . receives and transmits data over 160 conventional communications lines . . . accepts variety of speeds and codes . . . can be connected memory-to-memory with local or remote computers.

A Scientific System . . . performs complicated scientific calculations . . . provides high-speed fixed and floating point arithmetic in addition to inherent high performance features . . . optional circuitry capable of 148,000 additions or subtractions, 32,000 multiplications or 18,300 divisions per second.

Provides up to Five Levels of Simultaneity . . . offers the efficiency of performing five operations simultaneously . . . buffered input/output devices give extra dimensions of simultaneity . . . never any featherbedding.

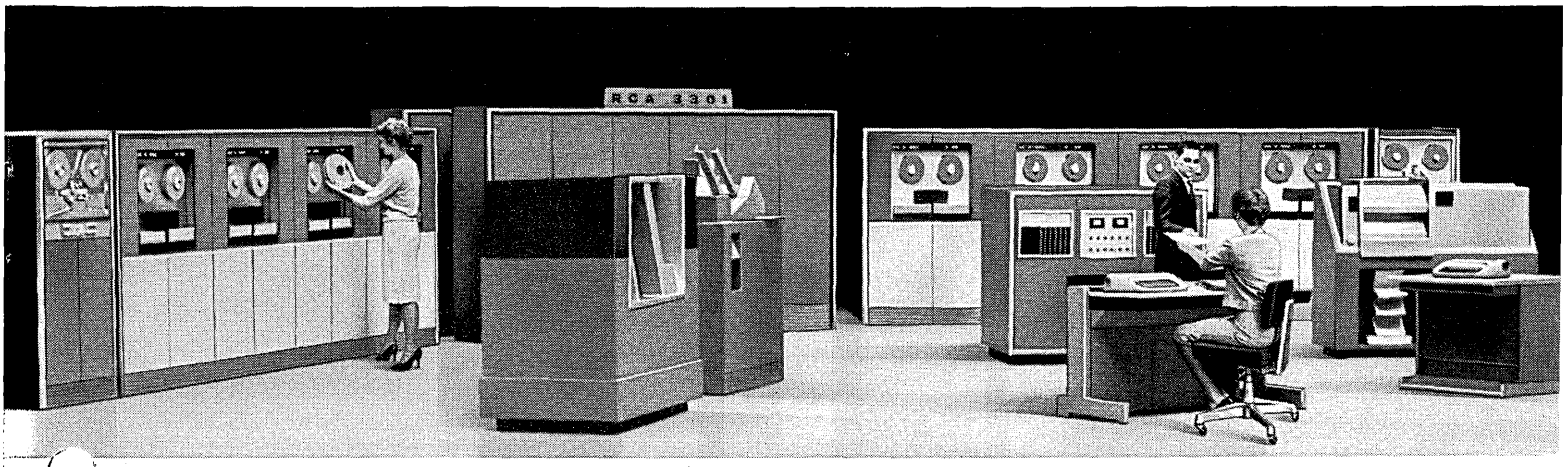
Compatible with RCA 301 and Other Systems . . . saves user's investment in tape files through tape compatibility.

New Scope and Concepts in Software . . . to make the 3301 work harder . . . operating system for efficient execution of real-time communications and data processing . . . problem oriented languages, including COBOL and FORTRAN, to minimize programming expense.

Two Memories . . . for faster, more flexible operation . . . ferrite core scratch pad (250 nanosecond cycle) . . . large magnetic core (1.75 microsecond cycle).

All this capability in a single EDP system inaugurates a new level of efficiency for computer operations: *Dimensional Data Processing*. Can one medium-priced computer provide such scope? Yes—and more! Call us and see.

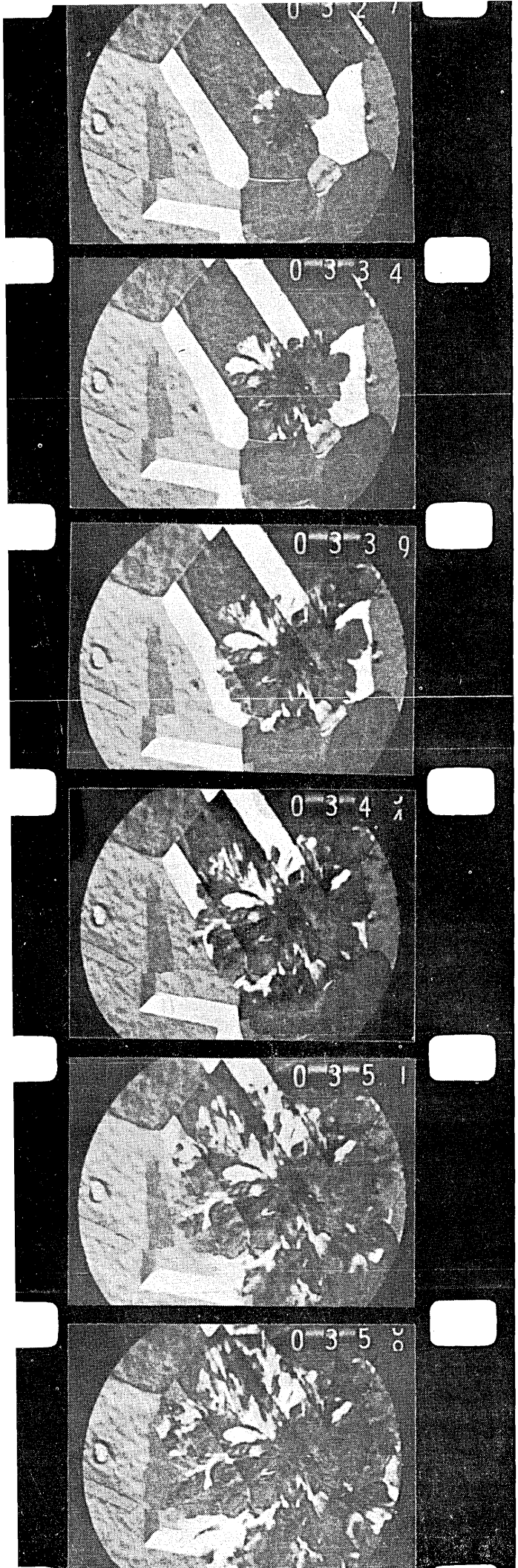
RCA ELECTRONIC DATA PROCESSING, CHERRY HILL, N.J.



RCA®

The Most Trusted Name in Electronics

CIRCLE 12 ON READER CARD



One of a series briefly describing GM's research in depth

HOT

Don't touch. At 650°C a red-hot metal is transforming from one solid state to another. And careful observation of its change in phase can tell us more about the influence of thermal history on the mechanical properties of metals. Strength. Hardness. Toughness.

Here at the General Motors Research Laboratories, our understanding of metals and the ancient art of heat treating is being extended by basic studies of solid state transformations at elevated temperatures.

Aiding the experimental side of these investigations is the thermionic emission microscope. With it, our metal physicists can study dynamic processes in metals *as they occur*.

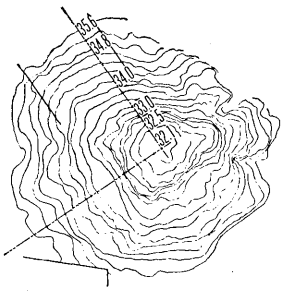
Here's how. Electrons "boiling off" a heated metal sample serve as the image source in this special electron microscope. Changes in the metal—phase transformations, recrystallization, and grain growth—are recorded by motion picture camera.

Results are being analyzed in several ways. For one, rates of micro-structural changes are being directly measured—some for the first time. For another, observations of the nucleation and growth of annealing twins have suggested a way of measuring the stacking fault energy of the austenite phase in plain carbon steels.

These studies, of scientific import today, will provide information helpful in fabricating the materials of tomorrow. They typify General Motors' continuing search for a better way.

General Motors Research Laboratories

Warren, Michigan



Time-contour map used for growth rate measurements.

Austenite transforming to pearlite in steel over a 3-second interval.

CIRCLE 13 ON READER CARD

letters

the living machine

Sir:

Reference was made to the film, "The Living Machine," shown at the '63 Spring Joint (July, p. 45). Could you tell us where it can be procured in this country?

WILLIAM M. O'CONNOR
Internal Revenue Service
U.S. Treasury Department
Lawrence, Massachusetts

Editor's Note: In answer to numerous other similar requests, the film may be obtained from Sterling Educational Films, 241 E. 34th St., New York 16, N. Y. Costs: $130 for each half-hour part; $250 for both parts. Rental rate is $15 per single showing.

stand corrected

Sir:

There was an error in your July issue (p. 58). Carl H. Reynolds is manager of Programming Systems for the IBM Data Systems Div. The manager of Systems Planning and Development is Maxwell O. Paley.

ROBERT W. SLADE
IBM Data Systems Division
Poughkeepsie, New York

Editor's Note: Thanks. And, in our haste, we failed to mention that Don Madden was named manager of Programming Technology.

improved compiling in English

Sir:

Jerry Schwalb's "Compiling in English" (July, p. 28) reflects experience with GECOM up to December 1962. Subsequently, improved and extended compiler systems were released, and a new comprehensive system is at field test sites now. Significant improvement has been made in object running speeds, and 80-90 per cent of the speed of comparable hand-coded programs is more common than Mr. Schwalb's 60-70 per cent. In particular, maximum or near-maximum card reader and printer speeds are now realized.

The Report Writer, mentioned under "future expectations," has been released for over six months. Available also are "compile" and "go" operating characteristics, overlay segmentation, and use of disc files.

JOAN V. CANNON
Programming Research & Development
General Electric Computer Department
Phoenix, Arizona

paper dolls automated

Sir:

The Dura Business Machines ad (July, p. 6) proved provocative. The enclosed listing of characters, punched into a paper tape doll using the standard Control Data code, will cause a Flexowriter to print TAKE ME TO YOUR READER.

Code	*Character*
36	K
22	D
64	3
33	8
17	V
45	Carriage Return
47	Upper Case
01	T
30	A
77	Code Delete
77	Code Delete
36	K
20	E
04	Space
07	M
20	E
04	Space
01	T
03	O
75	Carriage Return + W (illegal)
04	Space
25	Y
03	O
34	U
12	R
04	Space
12	R
20	E
30	A
22	D
20	E
12	R
73	6 + T (illegal)
77	Code Delete
70	2
33	8
03	0
46	+
17	V
12	R
54	( )
24	S
72	6
06	N

ALVIN NELSON
George Washington High School
Denver, Colorado

Editor's Note: Readers may recognize doll-cutter Nelson as one of the protagonists in Albrecht's article, "A Modern-Day Medicine Show," (July, p. 31).

What every DP department head should have!

We mean our colorful new 36-page Datacase book. In it you'll find over 50 different Datacase auxiliary units — some of which you may need right now. ■ A computer console, perhaps? See page 24. Card handling and storage units? There are several pages of these. Tape storage equipment, key punch desks and transport trucks, too. ■ We could go on, but space won't permit. Anyway, we think you should send for our book. It's yours, free. Just fill in and mail the coupon. You'll get your copy promptly.

DATACASE/BY STEELCASE

With your free copy of the Datacase book, we'll send the name of your local Datacase-Steelcase dealer. He's a man you should know because he can take care of your auxiliary equipment requirements quickly and efficiently—including installation and service. Local service is just one Datacase exclusive. There are more you should know about. Why not see for yourself?

Steelcase Inc., Dept. D, Grand Rapids, Michigan

Gentlemen:

Please rush me a copy of your new 36-page Datacase book.

Name_____

Company_____

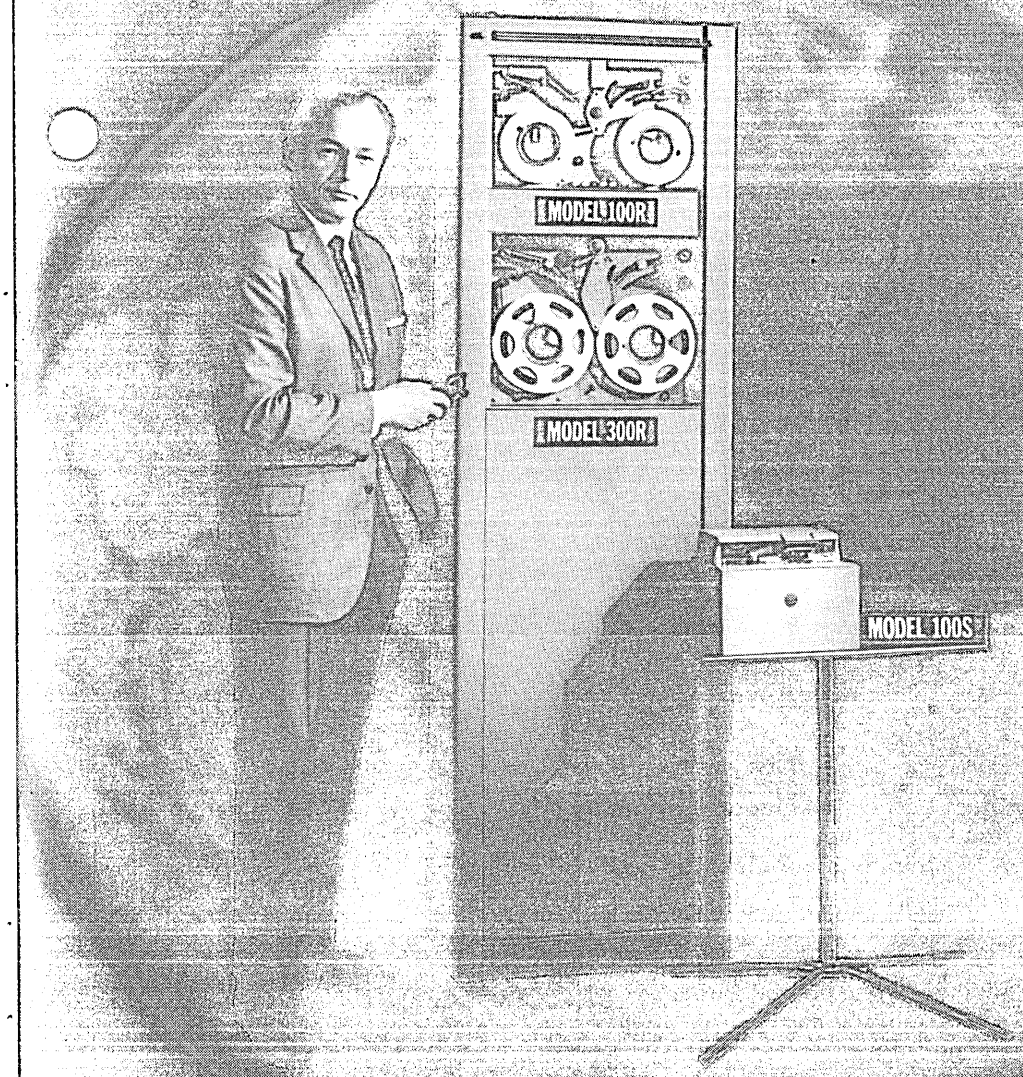
Title_____

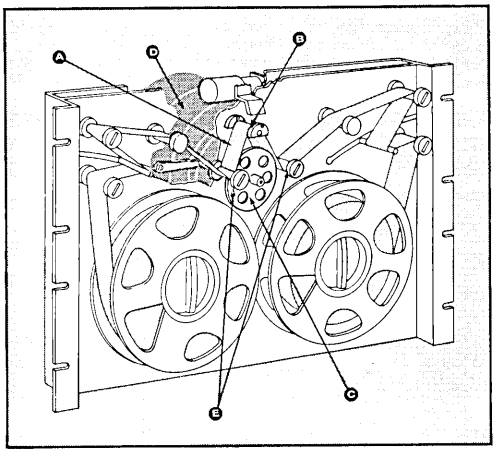
Address_____

City_____ State_____

CIRCLE 15 ON READER CARD

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.

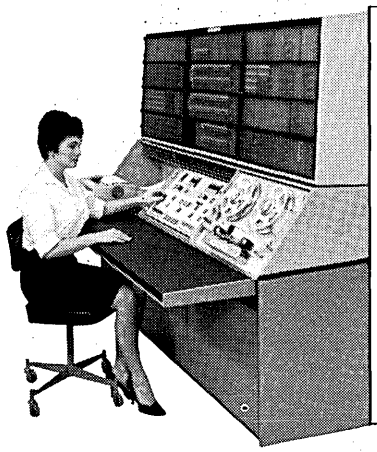
Line by line cycle: movement of tape (A) over read head (B) is controlled by drive capstan (C)—attached directly to shaft of PMI printed motor* (D); spring-loaded rollers (E) hold tape gently against capstan, keeping tape movement in exact accord with capstan rotation; advance command pulse accelerates 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 16 ON READER CARD

PB440
THE FIRST REAL SYSTEMS COMPUTER
?

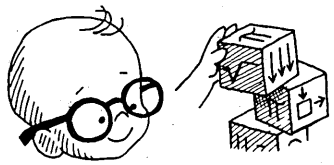


SOME TYPICAL PB440 SYSTEMS APPLICATIONS

- Telemetry data reduction
- Communications switching and data formatting
- Hybrid analog/digital computing
- Real-time data acquisition
- Command and control
- Automatic checkout
- Launch control
- Antenna steering
- Nuclear reactor control
- Process control

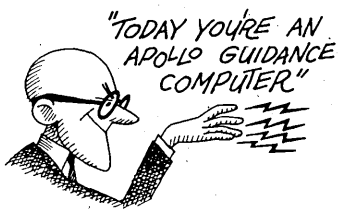
WE THINK SO, but we put the question mark in so you wouldn't accuse us of unabashed arrogance. What we mean is we have a computer that isn't restricted by the fixed logic wired in by the manufacturer. The PB440 has a separate logic memory—distinct from its conventional memory—and commands and word formats are specified by information stored in this logic memory and can be readily changed. In other words, commands and word formats can be tailored by the user to fit the systems problem at hand. Packard Bell provides several command sets and the user can create additional commands as required.

A single PB440 can, in the fraction of a second it takes to reload logic memory, switch from one command set to another and thus from one application to another. No other computer can do this, and that's why we think it is the first real systems computer. Now, the system designer can adapt the computer to the problem, not the problem to a fixed command list and format.



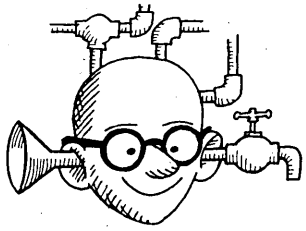
FOR THE SYSTEMS ENGINEER the PB440 can be a special-purpose computer designed (to his specs) for his specific system. But he still has the reliability, versatility, expandability and speed of the PB440 as a general purpose computer. This is all made possible by the Dual-Memory Stored-Logic organization of the PB440.

SPECIFICALLY, the systems engineer should consider the following features:

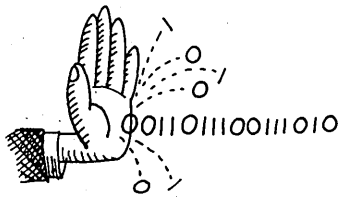


MICROPROGRAMMING the logic memory provides ability to duplicate command lists and formats of other computers. For example, digital guidance computer command structure and format can be developed before hardware prototypes are built. Similarly, you can duplicate the guidance computer in a hybrid simulation of a missile guidance and control system.

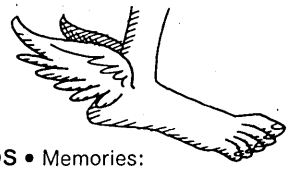
SOFTWARE • More than 100 systems-oriented commands written, more every day
170 scientific commands
FORTRAN compatible with 7090



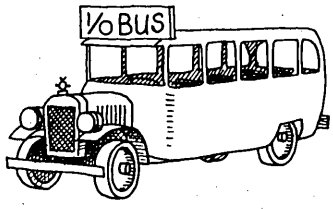
MEMORY ACCESS
Direct memory access from external devices
Simultaneous computation & I/O data transfer
Shared memory feature that permits multiple processor configurations



PRIORITY INTERRUPT • Multi-level, minimum response time



SPEEDS • Memories:
1 μ sec non-destructive logic memory (256 to 4096 words)
5 μ sec main memory (4096 to 32,512 words)
I/O rate to 9.6 million bits per second
Typical execution times, with memory access:
Compare data against upper & lower limits—13 μ sec, including two memory references
Floating point multiply 8 bit exponent,
16 bit mantissa—36 μ sec
24 bit mantissa—42 μ sec
39 bit mantissa—110 μ sec
Fixed point add—3 μ sec
Relocate data within memory—10 μ sec/word
Polar to rectangular coordinate conversion—435 μ sec

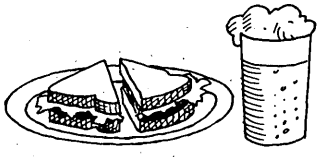


I/O VERSATILITY • Unique I/O bus design means more flexible arrangement of peripheral equipment. User need only add interface electronics as needed; does not pay for hardware capability he will never use. I/O system designed to accept next generation of higher speed peripheral equipment.

GENERAL CHARACTERISTICS • Parallel data handling mode... 24 bit word length, can be programmed for 12 & 48 bits... 400KC I/O character transfer rate, 800KC optional ... I/O bus handles up to 64 controllers.

PRICE • Basic computer with 256 word logic memory, 4096 word main memory: $110,000.

PERIPHERAL EQUIPMENT • Magnetic tape at 83.4, 41 or 25KC... punched cards at 800/min. in and 250/min. out... 1000 lpm alphanumeric printer... paper tape at 500 char/sec read, 110 char/sec punch... Selectric typewriter. Also Packard Bell A to D and D to A converters, multiplexers, commutators, and other data systems equipment.



THERE'S MUCH MORE to be said about the PB440 and its unique concept of Dual-Memory Stored-Logic. We have shelves of technical literature that can handle most of your questions, representatives who should be able to take care of the rest. If you are in Los Angeles, try and drop in for a demonstration. We might even pop for lunch.

Packard Bell *Computer*

A DIVISION OF PACKARD BELL ELECTRONICS

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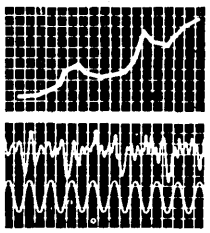
CIRCLE 17 ON READER CARD



BUSINESS & SCIENCE

ASCII ABOUT FACE FOR IBM

After leading last-ditch fights to derail ASCII (p. 39), IBM has completely about-faced. In a special issue of "The Data Processor," its magazine for "customer management," the company says, "We as a corporation are determined to move ahead with ASCII at the most rapid pace possible so that our customers can gain the benefits of standardization across the industry."

Another interesting statement: "This new standard can make intercommunications between all manufacturers' equipment and, ultimately, interchangeability of different manufacturers' equipment a reality."

IBM is also reportedly pushing for the implied collating sequence of ASCII, calling for letters higher than digits, the direct opposite of the IBM code. This may mean a bill of between $15-30 million for the reconversion of existing IBM customer files. This undoubtedly means the new IBM gear will incorporate the new code. Three cheers for IBM, standardization and interchangeability.

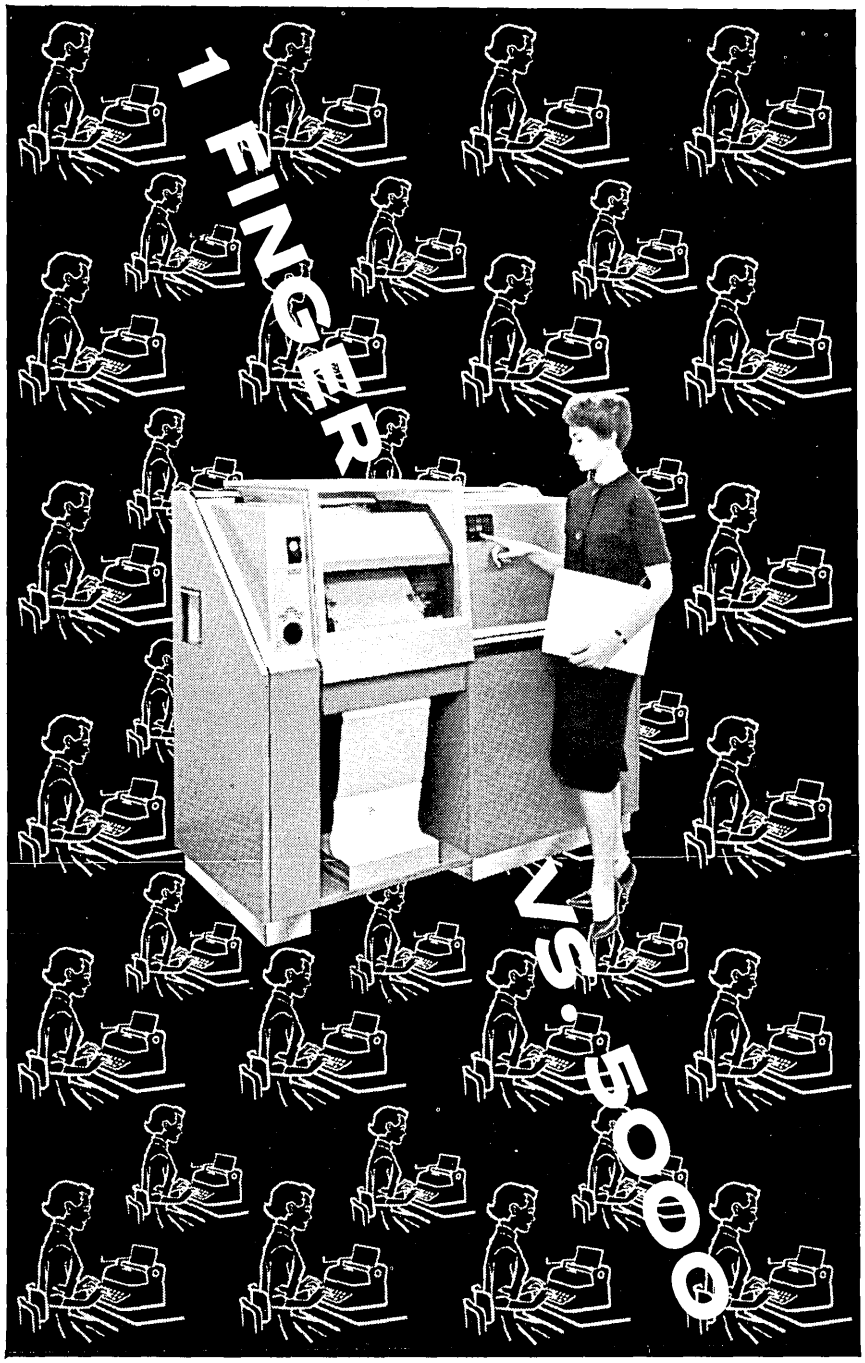
ARPA, MAC AND TIME SHARING

Still pretty much of a blue sky idea, time sharing -- simultaneous use of a single computer by many people at remote consoles -- is getting concentrated attention at a handful of universities and research organizations.

Best known so far is MIT's Project MAC (Machine-Aided Cognition/Multiple-Access Computer), an 18-month study funded by the Office of Naval Research "on behalf of" DOD's ARPA (Advanced Research Projects Agency). Headed by Prof. Robert M. Fano, MAC has wound up a six-week summer study involving some 60 people...will swing into high gear with the installation of a 7090 which will have 20-25 remote inquiry stations initially, over 100 eventually. MAC is considered the first phase of a really big effort.

ARPA, through its Behavioral Sciences & Info Processing group -- headed by time sharing expert Dr. J.C.R. Licklider -- is also sponsoring TS work, the bulk of it under the direction of Jules Schwartz at SDC, where a PDP-1 joined a Q-32 this month.

Licklider's two-man operation says it doesn't break down its contracts, so there's no way of telling the value of current TS research. But here's a list of current contracts from his office, founded last October: SDC: $4,352,000; U. Cal.: $797,000;



High Speed Printers and typewriters would never be in direct competition, but this is one way of showing the capability of Anelex equipment. Actually, if 500 girls could type without rests or breaks, errors or corrections, their 5,000 fingers couldn't keep up with one Anelex High Speed Printer... not at the rate of 10,000,000 words in an 8-hour day. What's more, once the start button is pressed, the Anelex Printer operates automatically until each job is done.

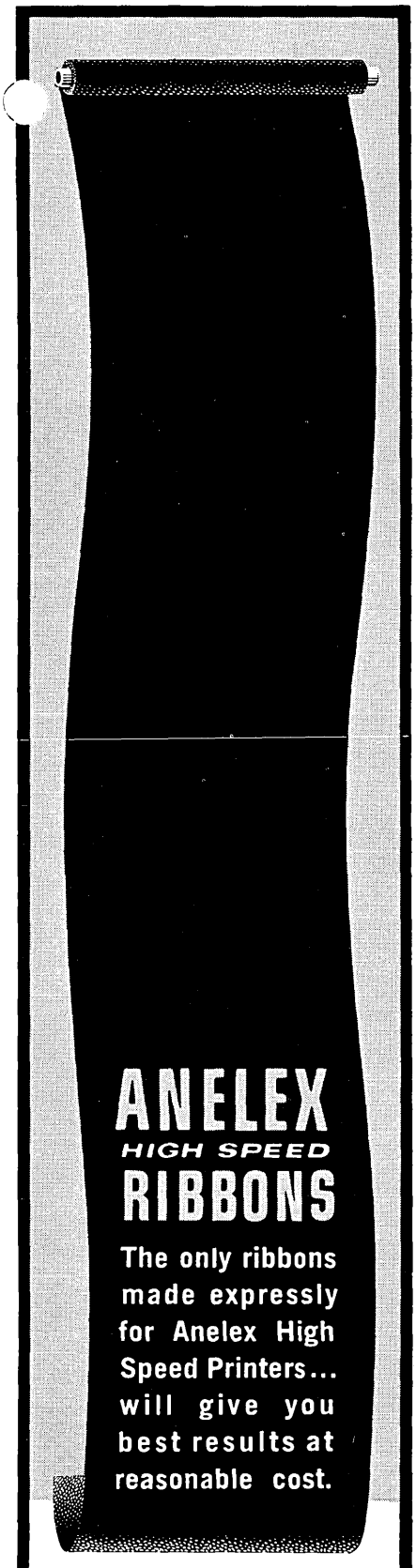
It is this large capacity and maximum reliability that has led almost every leading computer manufacturer to specify Anelex High Speed Printer Systems... first choice for important installations since 1950. Shouldn't your next system include an Anelex Printer? We invite your inquiry.

ANELEX
SYMBOL OF QUALITY

ANELEX®

155 CAUSEWAY STREET, BOSTON 14, MASSACHUSETTS

CIRCLE 18 ON READER CARD



ANELEX
HIGH SPEED
RIBBONS

The only ribbons made expressly for Anelex High Speed Printers... will give you best results at reasonable cost.

For a better impression, write

ANELEX®

ANELEX
SYMBOL OF QUALITY

155 CAUSEWAY ST.
BOSTON 14, MASS.

CIRCLE 38 ON READER CARD

UCLA: $675,000; Stanford: $420,000; SRI: $195,000. Carnegie Tech, doing limited TS research, has a $397,000 contract. The SDC contract covered FY '63; Cal, UCLA and Stanford hold three-year contracts; the others are for one year. Excluding MAC, Licklider's computer research contracts add up to $6,836,000.

BIDDERS SHUDDER AT 10-MEGABUCK CONTRACT

Bids are out for an on-line, real-time information system for the L.A. County Sheriff's Dept., and the specs are enough to frighten all but the most hardened salesman and promise-maker. Among them: 100% accuracy for file conversion (five million records), and 100% uptime, seven 24-hour days a week. The "winner" must foresee a 10-year growth, post a $2-million bond for faithful performance, agree to a 10-year lease -- with the county able to pull out at any time -- and face an 18-month implementation period during which he collects no rent.

The specs, drawn up by Computer Usage Co., follow perforce departmental and local laws and regulations which are stiff and, in some cases, anachronistic. Some of the county's caution stems from past edp "burnings," including a recent $135-million duplication error in printing assessments.

Reportedly real eager for the real-time job is Hughes Dynamics, which wants to prime it with a Univac 490. H-D, by the way, gallantly offered the county a free study of its edp systems, an offer which was graciously accepted. One noteworthy absentee from the bidder's conference: CDC.

BIG PLANS FOR LITTLE CLARY

Clary Corp. says its DE-60, admittedly more a glorified desk calculator than a computer, is moving well enough to encourage it to open new offices -- 10 of them in the last 14 months. First produced early in '61, the DE-60 now claims a little over 100 installations (40% of them lease), with some 60% of them in civil engineering. The company offers some 10 pre-wired CE programs at around $200 ea. for the machine, which sells for $20K.

Clary vp Ed Small says the company is in the black on the 60 for the first half of '63. He estimates a production rate of 100 machines a year within six months, and an increase after that.

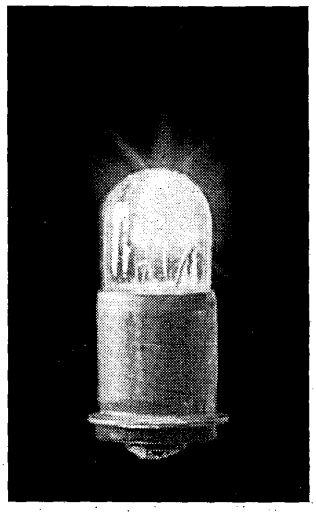
REQUIEM FOR A BANTAMWEIGHT

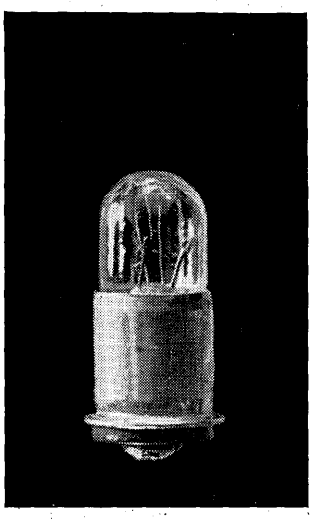
The ALWAC computer facility, source of many a colorful tale, called it quits late last month, the third this year. In mid August, five unordered computers remained on the floor; about 40 were installed. Users have been referred to the nationwide Techniserv Corp., Los Angeles, which was recommended as "most able to maintain" ALWAC's.

Only 10 years ago, Logistics Research Inc., under the late Swedish industrialist Axel L. Winner-Gren, built the first ALWAC (A.L. Winner-Gren Automatic Computer), and the company's name was changed to Alwac Corp. The one-only model I was followed by the II and III, production of which was counted on one hand. Since 1955, 42 III-E's were built. The firm was purchased in 1957 by El-Tronics Inc., Warren, Pa., which halted production more than a year ago to concentrate on the solid-state IV.

Repeating the pattern of its picturesque past, the company flubbed again: it failed to promote and advertise a paper computer.

THE PROCESSOR IDLE LIGHT:





On other computers it shows you're wasting hundreds of dollars per hour

On the Burroughs B 5000 it shows you're wasting 90¢ for an unused lightbulb

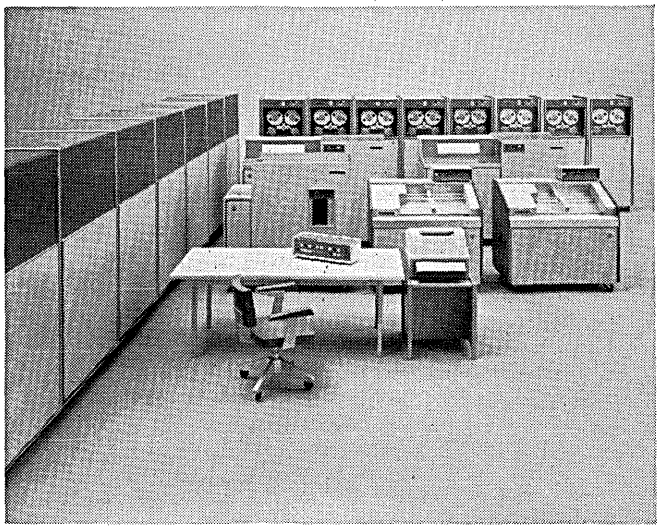
In the vital area of *economical* computer operation, the B 5000 shines. Or, to put it another way, it has the only processor idle light that almost *never* shines. The B 5000 is busy processing right through those periods when comparable computers (which are all higher priced, incidentally) are temporarily out of breath. And, based on operating costs for computers the size of the B 5000, every hour's worth of expense that goes to work instead of to waste means a saving of around $250.

To start with, there's the B 5000's unique way of handling interrupts. To all outward appearances, it simply ignores them. What really happens, though, is this: Through interrupt detection that's built right into the hardware, interrupt conditions are fielded and electronically tossed to the MCP (Master Control Program) for appropriate handling. Meanwhile, the current program goes right along, uninterrupted. Or, if preferred, another program is run instead. Either way, it all happens so fast that the processor idle light is left completely in the dark.

Then there's multiple processing, B 5000 style—which is *real* multiple processing. Several different programs run at the same time, all time-sharing the processor and the input-output facilities—and all do so without a single bit of advice from a human programmer as to sequencing and scheduling. For all that is handled automatically by the MCP. No hitches, no running up of expenses and no chance for human errors.

Parallel processing is another advantage that contributes to system operating efficiency. In fact, the B 5000 is the only computer that can take, without costly reprograming, the second central processor required for true parallel processing. It's also the only system that can utilize ALGOL and COBOL without resorting to some form of spoon feeding.

For complete details, send for a copy of our booklet "The B 5000 Concept." It will tell you all the other things the B 5000 does to make sure nothing about the system is idle—except, of course, the processor idle light. Burroughs Corporation, Detroit 32, Michigan.



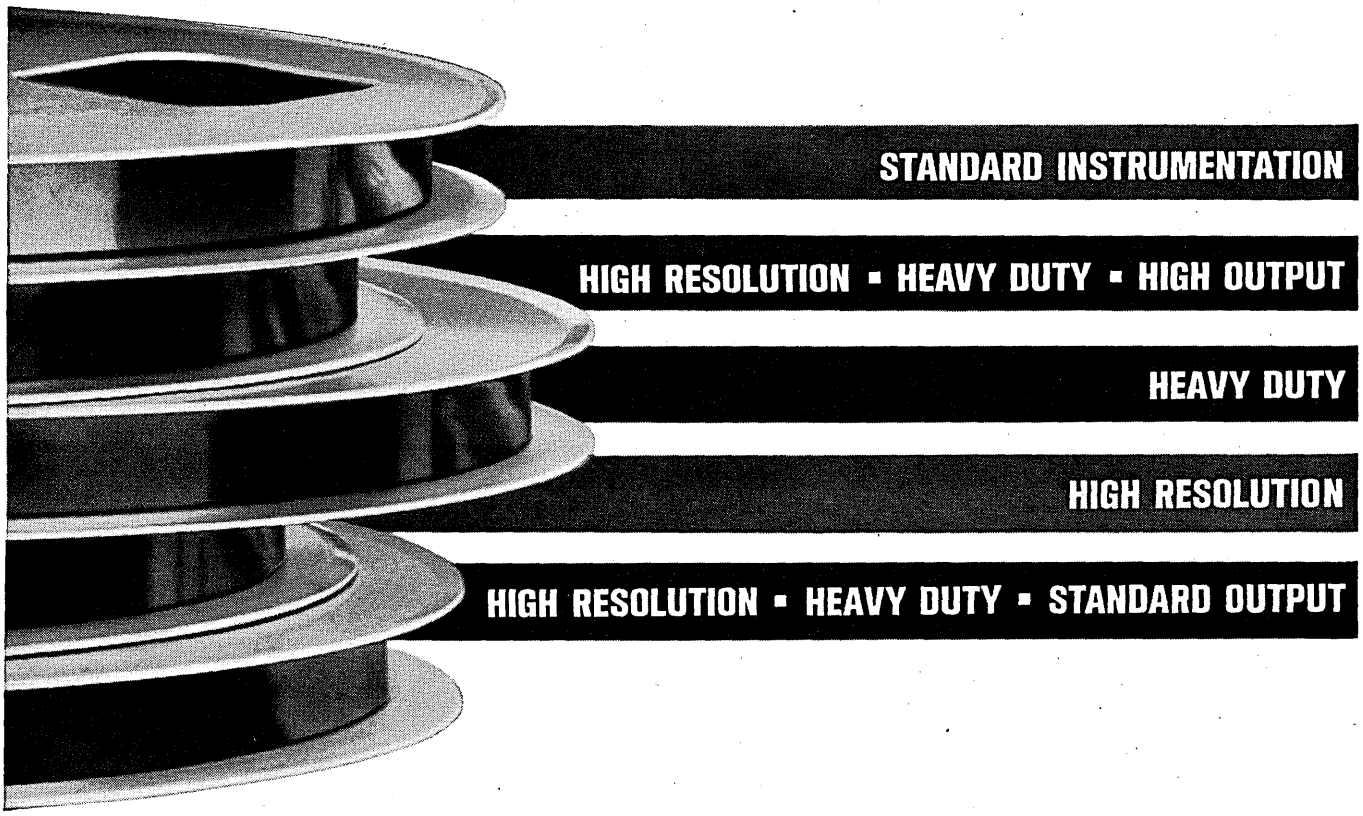
Burroughs—TM

Burroughs Corporation

CIRCLE 19 ON READER CARD

Your instrumentation tape supplier should be a complete source.

Soundcraft is!

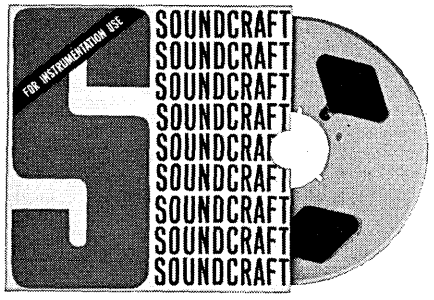


With Soundcraft Instrumentation Tapes, you can meet every data recording need. Sixteen combinations of coatings and base materials are available to fulfill the recording time, resolution, wear-life and output characteristics required by your data recording equipment.

Common to each instrumentation tape is Soundcraft's technical competency. This is demonstrated by the unique oxides and binder systems which are engineered to provide superior physical and magnetic qualities for all recording applications. The Soundcraft plant is one of the newest and best-equipped in the industry—where advanced manufacturing processes and control methods produce superior instrumentation tapes. Reliable data recording is assured.

In military and space facilities . . . among industry leaders . . . Soundcraft Instrumentation Tapes are meeting the most exacting performance standards. They can meet yours, too.

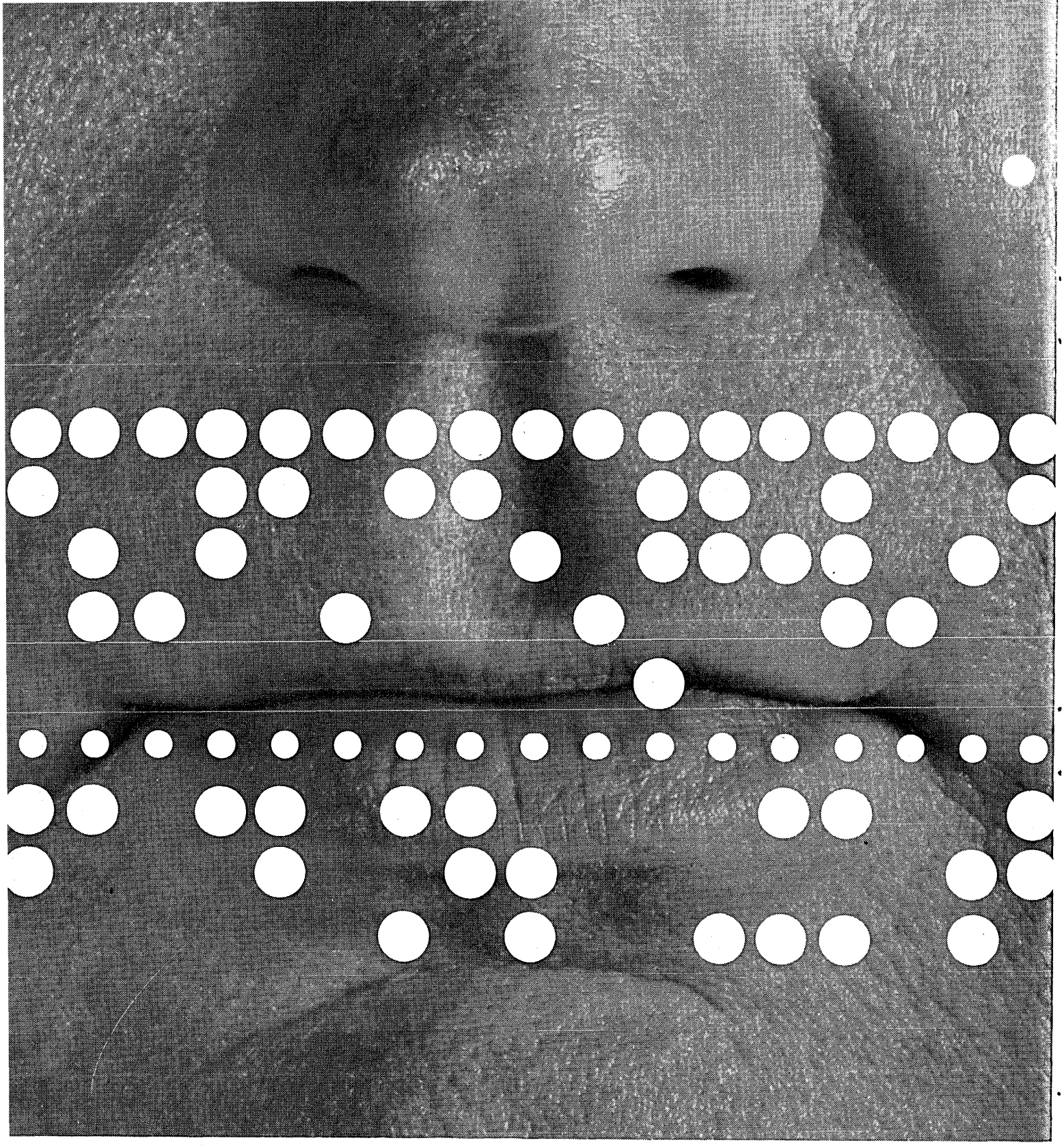
Soundcraft Instrumentation Tapes are available from stock for immediate delivery. Write for literature.



REEVES SOUNDCRAFT

Division of Reeves Industries, Inc., Danbury, Conn. • New York • Chicago • Los Angeles • Foreign Division: 25 Warren St., N.Y.C. • Canadian Reps: Vancouver • Toronto

CIRCLE 20 ON READER CARD

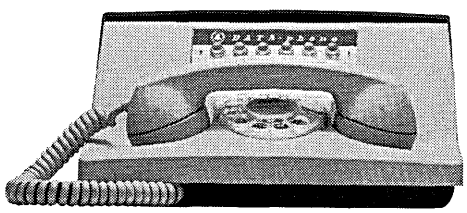


YOU DON'T HAVE TO SAY A WORD to send great masses of business data to any location by telephone. New Bell System DATA-PHONE service is the reason why.

Machines do the talking – 16 times faster than people can talk.

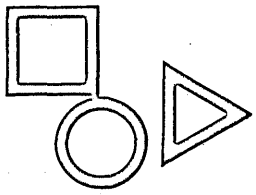
Almost any kind of word or figure data in any amount can be transmitted immediately any time you want–at regular telephone rates.

There's no faster, safer and more economical way to ship data than by DATA-PHONE service. Have a talk with one of our Communications Consultants about it. Just call your Bell Telephone Business Office and ask for him.



CIRCLE 21 ON READER CARD

BELL TELEPHONE SYSTEM



EDITOR'S READOUT

IT'S THE LITTLE THINGS

In the course of his somewhat relatively brief but tempestuous stay on earth, man has conquered and survived disaster, disease, and his own inventions. As any reader of the Bible or Li'l Abner knows, it isn't the big problems that make life difficult. It's the little things.

This profound truth has somehow escaped the information processing community, which continues its blind, hurried scramble to solve monumentally huge problems: simulating entire economies, controlling vast weapons systems, catching tax evaders, etc. Oh, there's been some tic-tac-toe and chess playing, true. But these are usually self-consciously explained as first inroads into understanding the processes of the human mind.

In an effort to overcome this strange oversight, *Datamation* herewith offers a partial beginning list of applications and research topics representing truly significant trivial problems so far neglected.

For instance, we'd like to know the frequency of appearance of the word "heartwarming" on the covers of certain women's magazines. What percentage of *Playboy* readers have ever been out with a girl? How many *Datamation* readers have ever seen a computer? Do blondes *really* have more fun? How many women are really blondes? And how many men care?

In the world of transportation, we'd like to see an airlines system which rejects all reservations for flights before 9:30 a.m.; a built-in automobile computer which will accurately diagnose and predict failures, as well as accurately interpret the strange signals of the fellow ahead. Everybody will agree upon the need for more efficient baggage-smashing equipment at airline terminals.

There ought to be research to find a number small enough to express the chances that a New York taxi driver will say "Thank youse" when tipped. A compilation of the x^{nth} meanings of the word "system" is desperately needed.

Hardware needs include a means of getting black coffee at a NY automat; a telephone which will tell you if it will ring long enough to warrant getting out of bed to answer it; a phone which tells you if it's just another salesman calling; a telephone which rings only for calls you want to receive.

Someday we've got to create a program which will translate the statements of politicians, military brass, bureaucrats and computer manufacturers into meaningful-ese. Another program should simulate the American League pennant "race" so the Yankees can save their strength for the World Series.

And so it goes. There are so many things to be done. And they will be done . . . if people will only remember to Think Trivial.

vaulting the mechanical barrier

THE IMPACT OF NON-IMPACT PRINTING

by EDWARD WEBSTER

Technology tends to run its course from mechanical activity, through electro-mechanical, and finally to pure electronics. Computation has its bead-counters, its tabulators, and now electronic computers. But where documents are involved it seems inevitable that some mechanics remain, if only to move the paper, and that printer-bound processors shall remain with us. The question, then, is simply: How far can we go in minimizing the gap?

In pursuit of electronics, or at least tape character transfer rates, mechanical printers have accelerated from the 100 lpm of the IBM 402 or UNIVAC Tabulator to speeds approaching 1500 lpm. With reduced character selection, the best of today's on-the-fly printers can attain over 2000 lpm. Printer people themselves admit that this seems to be close to the absolute limit for machines which require that the paper be at rest at the moment of impact. Impressive though these speeds may be, clearly the control unit and tape transport which feeds the conventional line printer is not working to capacity.

Techniques other than mechanical for optically resolving variable information have been known for a long time. Photography is over a hundred years old. Electrostatic principles were first exploited by Xerox more than a decade ago. And television, child of the war, became common in the late 1940's. In the search to find ways of printing without whacking the paper with metal type, one or more of these elements has been invariably used.

First of the "non-impact" or "electronic" printing devices appeared circa 1956 in the form of the Burroughs Whippet. Since that time techniques have improved to the point that speed is often limited by problems in paper handling. Should the fastest printers image paper from roll to roll, the bottleneck will then be in processing the rolls after they are removed from the machine.

The development and acceptance of input equipment such as scanners has been somewhat parallel to non-impact printers. The scanner has been much publicized and is generally recognized in one form or the other to be the computer input of the future. In contrast, electronic printing systems seem to be veritable wall flowers; little is heard of them, and few placed into operation. This is still more surprising when one considers the early date of their introduction and the wealth of equipment now on the market.

More than a score of non-impact systems have been developed since 1956. Although differing widely in speed, cost, and function, most fall into three rather well defined groups.

matrix-electrostatic/electrosensitive printers

Perhaps the eldest, and certainly the simplest, matrix printers are produced by Burroughs, Motorola, Radiation, Omnitronics (Borg-Warner), and Hogan Faximile. Characters are formed on the paper by an arrangement of dots created by charges emitted by wire styli. When certain types of electrosensitive papers are used, the charge forms a black dot without further processing. Alternately, in electrostatic systems, the charge forms a latent image which is developed by passing the paper through a cloud of ink particles which are attracted only to the charged areas, then bonded by heat and pressure.

According to R. H. Jones, a Burroughs engineer who helped develop the Whippet, electrostatic printing offers the highest potential of any system, since its speed is limited only by the ionization rate of a gas. "In theory," he states, "an electrostatic printing process could theoretically print, in one minute, a quantity of material equivalent to 500 copies of the New York Times!"

Burroughs electrostatic printers were first introduced in 1956 and have been variously called the Whippet (Weather HIgh-speed Page Printer Electrostatic Technique) or Electrographic. Models S202 and S203 are in the field at this time, functioning primarily within military communications systems. A few have been applied commercially in such areas as bank bookkeeping operations. Speeds are usually geared to the communications system within which they operate, the maximum being around 360 lines per minute.

Printing is by means of a bank of 72 five-by-seven arrays of styli, one for each printing position. Although in speed and operation the device appears to be a true line printer, characters are actually formed serially, individual styli being pulsed and the charge attracted to the paper because of its special conductive rear coating. The paper, bearing a latent image, then passes successively through a chamber containing a cloud of toner which is

Presently manager of Editorial Services for Management, Concord, Mass., Mr. Webster formerly was a systems and procedures man, programmer, and systems analyst. For several years, he has been involved in the comparison and evaluation of hardcopy output equipment for the Printing Industry of America Inc., Washington, D.C. He was awarded a liberal arts degree magna cum laude from Gettysburg College, and has had papers published by several computer publications.

attracted to the charged areas, over a heating element which softens the plastic surface coating, and finally through a set of bonding rollers.

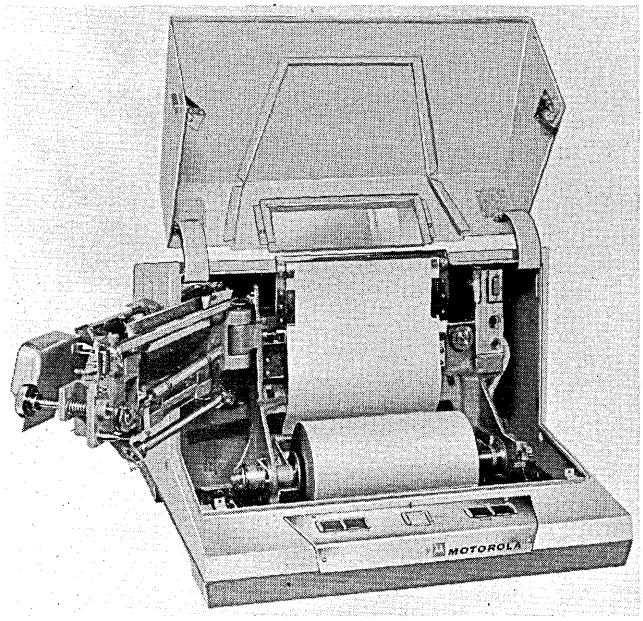
In terms of units delivered, the Whippet may be regarded as the most successful such device to date: nearly one hundred have been taken by various branches of the military. As might be expected of a truly pioneer device, users have reported several problems, especially with the first few models delivered. Among these were a somewhat whimsical paper advance assembly and a tendency for the paper to stick to the bonding roller when too hot. Burroughs has been rather incommunicative about any future designs for this series of printers and production is believed to have been discontinued.

Motorola entered the arena with its TP3000 in 1962 (Fig.1). Again applications have been confined primarily to military communications. The system goes at up to 200 lpm and costs just $9500 for the printing unit alone. Using an ingenious technique which offers high reliability, the device probably holds the record for dearth of moving parts. Printing is by three heads mounted on a continuous belt which rotates across the page. Paper motion is continuous; characters are printed serially. The paper also moves at a steady speed and to compensate for its motion, the belt holding the print heads is inclined at the proper angle. Characters are formed in the usual five-by-seven dot matrix. A minute spark from the stylus destroys the white surface of what the manufacturer describes as a "highly conductive, carbon-loaded electromarking paper," revealing a black layer beneath (and reportedly at the same time generating a noticeable burning plastic odor).

At the other end of the scale from the modest teleprinters stands Radiation, Inc. of Melbourne, Florida. Since its inception around 11 years ago, this firm has been active in the development and application of electrosensitive recording. Their printers are all built around a patented plug-in stylus module which according to the manufacturer is capable of adjustment-free recording over literally miles of paper. Among the Radiation hardware is the Radicorder printer-plotter, Model 6110 Strip Printer, a 16,800 lpm High Speed Alpha-Numeric Printer, and the High-Speed Printer-Plotter.

For their newest printer (Fig. 2), which to date marks the culmination of matrix-electrostatic printing, Radiation felt it had outrun the term "high-speed."

Figure 1



Destined for Lawrence Radiation Lab is the Radiation Series 690 "Super Speed" Alphanumeric Page Printer which achieves 31,250 120-character lines per minute, with a 64-character selection. (Datamation, June, 1963, p. 38.)

Printing is performed by a single row of 600 individual wire styli arranged across the paper in groups of five. Characters are printed in the normal five-by-seven matrix, the selected styli being pulsed at seven timing functions to produce each line of printing. The Lawrence system is designed for off-line operation in a configuration consisting of two IBM tapes, a control unit, and the printer itself. Two tapes are required to maintain continuous printing. The printer controls tape unit selection. Input is in six-bit IBM code, arranged in records of up to 7,200 characters which form a full page of 67 lines. Alternating from one 120-character buffer to the other, data is ingested at 62,500 characters per second. In order to get full utilization without information loss, the printer's skip over the paper perforation must coincide with the inter-record gap on tape.

In appearance the system is closer to a continuous web press than the box-shaped unit normally associated with digital computer printout. At the feed end are two large rolls of paper, either of which can be active while the other is being loaded. Apparently heavy enough to require a small lift truck to position, each roll holds enough paper for forty-five minutes of printing at top speed. The paper is 11 inches wide with perforations every 12 inches. At the receiving end the form is zig-zag folded and accumulations of convenient thickness easily removed manually for binding as is without bursting.

Omnitronics, Inc. of Philadelphia (part of Borg Warner) markets a fast little strip printer which produces a single string of characters at up to 2400 per second. The device works on the electrostatic principle. Paper is a tape with a black, conductive layer behind and a plastic coating for the printing surface. Powdered ink is attracted to the surface where charged by the styli and bonded into the plastic by pressure (no heat required in this case). Omnitronics is marketing their printer, among other areas, as an on-line message printer for computers. If one is considering simply cost in dollars/characters per second, it is tough to beat the ATR-7's 600 cps for $9950. Using the same basic print head but rotating each character ninety degrees, Omnitronics has a strip or page printer. Line length can be from five to 72 characters; since the price for units with the longer line length gets very steep, the manufacturer is not actively marketing in this area.

Hogan Faximile, now a subsidiary of Telautograph Corporation, has been marketing for a number of years "multiple stylus recorders" which produce an image by means of an electrolytic process. Special Hogan "Faxpaper" is dampened then passed between a row of styli

Figure 2

(up to 100 per linear inch) and a reciprocating stainless steel print bar. When a negative voltage is applied to the styli, a mark is formed on the paper by metal ions (iron) deposited from the positive print bar. The stronger the negative charge, the darker the mark. The print bar reciprocates across the paper to distribute wear. According to the manufacturer, this process offers the following advantages: low voltage requirement, high resolution, high speed (paper speeds up to ten inches per second), and the ability to print shades of grey. Hogan delivers these recorders usually sans logic—they are incorporated into diverse systems and the hardware for converting digital signals to compatible format varies with the user.

video-electrostatic printers

Use of the cathode ray tube for digital output is not new. Display in the form of characters as well as any other graphic data can be developed. Points on the face of the tube may be selected under program control in conjunction with the right hardware. Special-purpose systems may pass the beam through a tiny mask within the tube itself which holds the characters and symbols available for display. In printing systems, the display is either projected onto sensitized paper or passed on through the face of the tube by means of an array of fine wires. In either case the latent image is developed within the machine by powdered ink bonded to the paper by heat and pressure, or by liquid developer. Alternately a selenium plate or drum is used as an intermediary. The image is passed on to the paper, again, by heat and pressure. In some cases such a unit is manufactured by Xerox Corporation; in all cases the process is closely akin to xerography.

A. B. Dick Company's Videograph has been on the market for several years and is now offered in a variety of systems, all of which employ the same basic technique. Heart of the process is an "Electrostatic Printing Tube" driven by a character generator which may be adapted to convert digital signals of almost any type. Rather than being displayed on the face of the tube, the image is carried to the paper by an array of wires embedded in the tube itself which are activated by the video beam. Since the density of these wires is about 250 per linear inch, there is not necessarily any matrix effect visible in the printout. One special-purpose system, the Model 911/922 Railroad Car Reporting System, produces on a continuous strip actual pictures of railroad cars as they pass by remote scanning stations; in clarity of printout the results are not really far from the photographically produced halftone (Fig.3).

Model 9041 Videograph Printer-Plotter prints on an 8½-inch to 11-inch-wide strip of paper moving at from one to 20 inches per second. The latent image is developed by a wet process, but the form is automatically squeegeed and heat-dried so that copy may be delivered dry and cut to length. Printing at up to 7200 lpm with a sixty-four character selection, the printer is offered at $88,000. Most successful of the Videograph family have been the Address Label Printers, Models 910 and 915, which can spew forth printed labels on a continuous strip at more than 2000 per minute. These systems are being used for magazine mailings by Time, Inc., Curtis Publishing Company, and Readers Digest. Systems have been ordered by TV-Guide for use with its new UNIVAC III, and by National Publishing Division of McCall Corporation in Washington, D.C.

Based on its patented "Charactron" shaped-beam tube, General Dynamics/Electronics now offers a medium-speed printer, the S-C 3070. Characters of fairly high quality (Fig. 4) are formed by passing the video beam through a mask within the tube. Normally the mask holds the 64 printable symbols in an eight-by-eight arrangement. True lines can be formed by "panning" the beam through the aperture which forms the decimal point or period. Unlike the Videograph, the image is projected optically onto the paper. The latent image which results is dusted with toner and bonded under heat and pressure. Output is an "inherent" offset master and may be duplicated without further ado. This printer is modest in price (around $15,000) and speed (around 350 lpm). It has been touted both as a communications terminal and output device for medium-range computer systems.

Genral Dynamics has several other systems on the fire which operate upon similar principles, designated Series 5000 and Series 3000. These systems should offer higher speeds and more versatility than the 3070.

video-photographic printers

Once again a video tube is employed to form characters or display from digital input; this time, however, the image is projected onto microfilm. The camera itself is quite simple, since a shuttering system as we know it is not required, the entire interior of the system being light safe. Each frame of microfilm may remain exposed to the image on the tube face until a film advance signal is received. Due to the small size of the recording medium and its high photosensitivity, extreme printing speeds are possible—ten or more frames ("pages" if you will) per second in some cases.

If the film is considered only the intermediary to hard

Figure 3

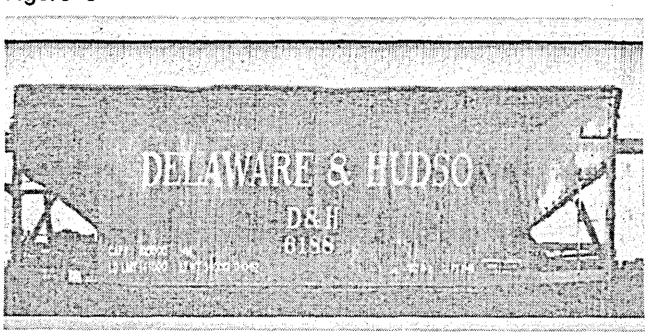


Figure 4

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Ø123456789+=*-() /STUVWXYZ|- ·'" JKLMNOPQR .  ABCDEFGHI ,  \Ø1234567
Ø123456789+=*-() /STUVWXYZ|- ·'" JKLMNOPQR .  ABCDEFGHI ,  \Ø1234567
Ø123456789+=*-() /STUVWXYZ|- ·'" JKLMNOPQR .  ABCDEFGHI ,  \Ø1234567
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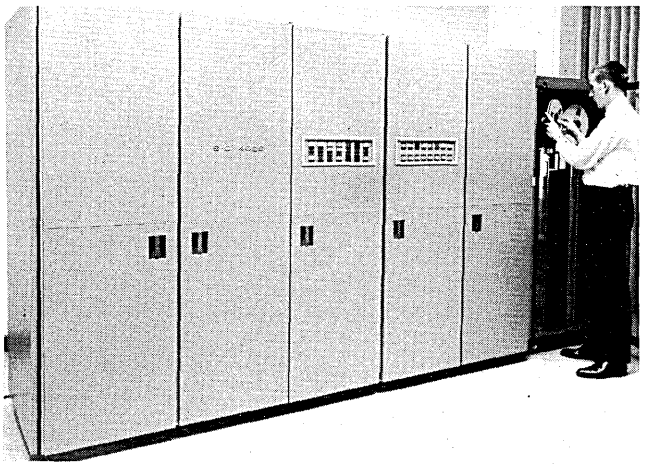
copy, however, printing speeds reached by such systems are considerably lower. The film must be processed off-line or stored as is to be retrieved when required by any of a variety of viewing systems. Alternately, photosensitive paper may be exposed instead of, or in addition to, film. General Dynamics offers an option of on-line or off-line processing of this paper; image quality and speed are reported to be better with off-line developing. The Benson-Lehner version offers on-line hard copy only. In spite of obvious problems, the video-photographic approach is considered by many the most desirable because it ranks high in flexibility, speed, and quality of output. The fact that General Dynamics has delivered twenty-four of its S-C 4020 Microfilm Recorders during the short time since its debut indicates that such systems may soon dominate.

Both Recordak and IBM have produced microfilm printers operating on these principles, but neither manufacturer has offered its system as a production item. Recordak's machine is the Dacom (for DAtascope Computer Output Microfilmer), which contains a display tube called the Datascope. The unit first produced was geared to the speed of the associated IBM 727 tape drive,

Figure 5



around 15,000 characters per second. The manufacturer states, however, that with only slight modifications it could handle speeds up to 90,000 characters per second. IBM's printer was built for the Social Security Administration to transfer tape files to microfilm. The system uses 16 mm film and handles input at speeds up to 6000 characters per second. Neither of these output devices produce hard copy directly.

General Dynamics/Electronics has teamed its Charactron tube with microfilm to get the 4020 Computer Recorder. (Fig. 5). This flexible system can expose either photosensitive paper or microfilm from mag tape or directly from the computer. A form projector can project constant information over the variable for forms printing "as you go". In the typewriter mode the system will produce "hardcopy" at up to 3840 lpm or on microfilm at 8700 lpm. The S-C 4010, an earlier version of the 4020, is provided by Univac for high speed output for its king-sized LARC computers.

Recently General Dynamics has developed a dual-yoke version of its shaped-beam tube which has been incorporated into the S-C 1090 data display. The second yoke is used to take pictures from the rear of the tube face; the resultant output is said to be unusually distortion-free.

The Benson-Lehner 943 and 944 (Fig. 6) Microfilm Printers employ a technique not unlike that of the 4020. The 943 accepts binary input while the 944 is designed to handle BCD coding and may be used as is with IBM tapes. Character image is developed by dots rather than with a shaped beam. This method permits almost unlimited character selection and orientation and, since the matrix is 15 x 16, character definition is apparently quite good. When recording on film the manufacturer states that the system can accept data at up to 62,500 characters per second and produce 30,000 lpm. Hard-copy output is 900 lpm. The first of these was recently shipped to Kwajalein Island by MIT's Lincoln Laboratory for printout and display in connection with orbital and trajectory studies.

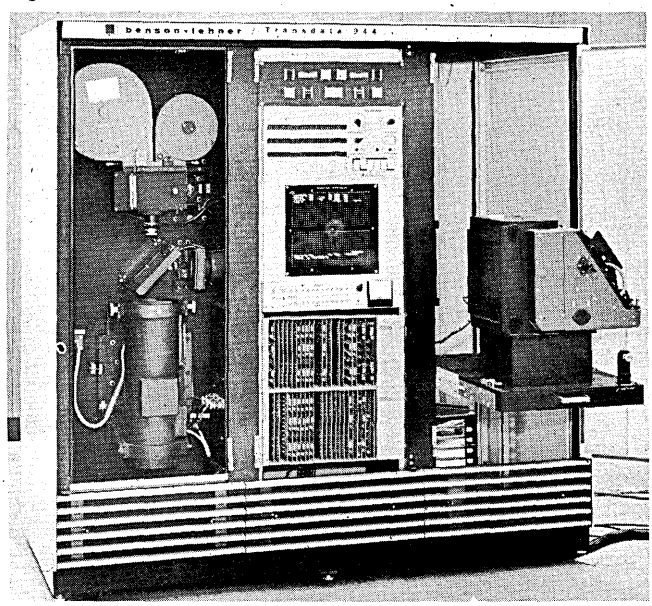
why military?

Systems described in the foregoing are neither experimental nor in all cases of especially recent vintage. Their demonstrated capability marks them as the next step beyond conventional devices. Yet with the exception of General Dynamics, marketing efforts have been directed almost exclusively toward the military. Manufacturers of conventional printers, such as Anelex, show little interest in venturing in this direction. Just why is this?

The following premise may be helpful: commercial acceptance tends to hinge upon trial and acceptance by scientific and military users. Certain aspects of the brief history of electronic computation would seem to verify this. In all cases pioneer systems were developed to cope with critical scientific and military problems. There was once a time when IBM turned down a plan to acquire UNIVAC (then Eckert-Mauchly Corporation) because IBM felt that computers were, after all, scientific tools rather than business machines. A UNIVAC computer was not applied to business data processing until 1954, three years after the first UNIVAC I delivery.

Acceptance of the non-impact printer shows signs of following a similar pattern. The fact that business, both as a cause and result of its acceptance of computers, is

Figure 6



becoming more scientific tends to somewhat blur the line between the business and scientific application. The resultant increased demand for new types of output in both communities should help accelerate the demand for new types of output systems.

In that moment of truth—the balancing off of cost against capability—any prospective user must weigh myriad factors, both objective and subjective. Determin-

ing present printing costs may be more difficult than it first appears. Off-line processor time can be clocked and costed as easily as main frame time. So can labor. Recovering the costs of expendables may be a little more difficult. Finally there are the intangibles—what is the cost of delay in returning output to programmers or reports to management? How much does it cost *not* to be able to draw a picture? How much to store dead records on tape rather than on film, and what are their relative retrieval costs? Is it possible to exist without multi-copy printout?

Neither equipment cost nor printing speed necessarily work in favor of the non-impact printer. Not much can match Motorola's little printer in ratio of words per minute to original cost. Most of the other non-impact teleprinters cost somewhat more than conventional equipment and are chosen for their additional speed, quiet operation, or ease of adaptation to special applications. The Whippet and TP3000, for instance, permit savings by accepting characters serially, yet maintaining respectable line printing speeds. Conventional high performance printers with their control units can cost as much as $150,000. Non-impact systems which offer greater speeds are more or less in the same ball park. In a minimal configuration without maintenance the Benson-Lehner machine is offered at $79,000. In the mill is another version expected to be marketed for less than $50,000. General Dynamics is encouraging lease rather than purchase of their equipment since maintenance is part of the package. The one 4020 installation reporting significant down time is the one purchased without General Dynamics maintenance. Under the lease plan, the 4020 goes for between $5300 and $8000 per month.

Due to inherent limitations, *effective* hardcopy speeds of most non-impact machines are substantially below the

WHAT's WHAT IN NON-IMPACT PRINTING

	Matrix-Electrostatic or Electrosensitive	Video-Electrostatic	Video-Photographic
Page Printing	Radiation Series 690 31,250 lpm $400,000 Omnitronics ITR-7 (5 character line) 18,000 lpm $21,000 ITR-7 (72 character line) 1,800 lpm $220,000 Hogan Faximile Multiple Stylus Recorders up to 6,000 lpm up to $92,000	A. B. Dick Videograph Model 9041 7,200 lpm $88,000 Gen'l Dyn S-C 3070 350 lpm $15,000	Gen'l Dyn S-C 4020 3840 lpm (hardcopy)[1] $240,000 Benson-Lehner 943-4 900 lpm (hardcopy) $79,000
Strip Printing	Radiation Series 6110 40 cps $10,000 Omnitronics ATR-7 600 to 2400 cps $9950 (600 cps) $18,950 (2400 cps)	A. B. Dick Videograph Model 910 11,250 lpm $175,000 Model 915 (Videog.) 11,250 lpm $145,000	
Film Only			Recordak Dacom[2] IBM Microfilm Printer[2] Gen'l Dyn S-C 4020 8700 lpm $214,500 Benson-Lehner 943/4 30,000 lpm $79,000
Teleprinters	Burroughs S202/3 360 lpm $20,000 Motorola TP3000 200 lpm $12,500	S-C 3070 (see above) A. B. Dick Videograph Several models offered; speeds compatible w/existing systems	Transdata TD900[4]

Notes:
1. Further processing required
2. Not commercially available
3. Cost of separate translating unit not included
4. Discontinued

Figure 7-A

PART 1

INDEX NO.	FEDERAL STOCK NO.	ITEM IDENTIFICATION

BUSHING, ELECTRICAL CONDUCTOR-CONTINUED

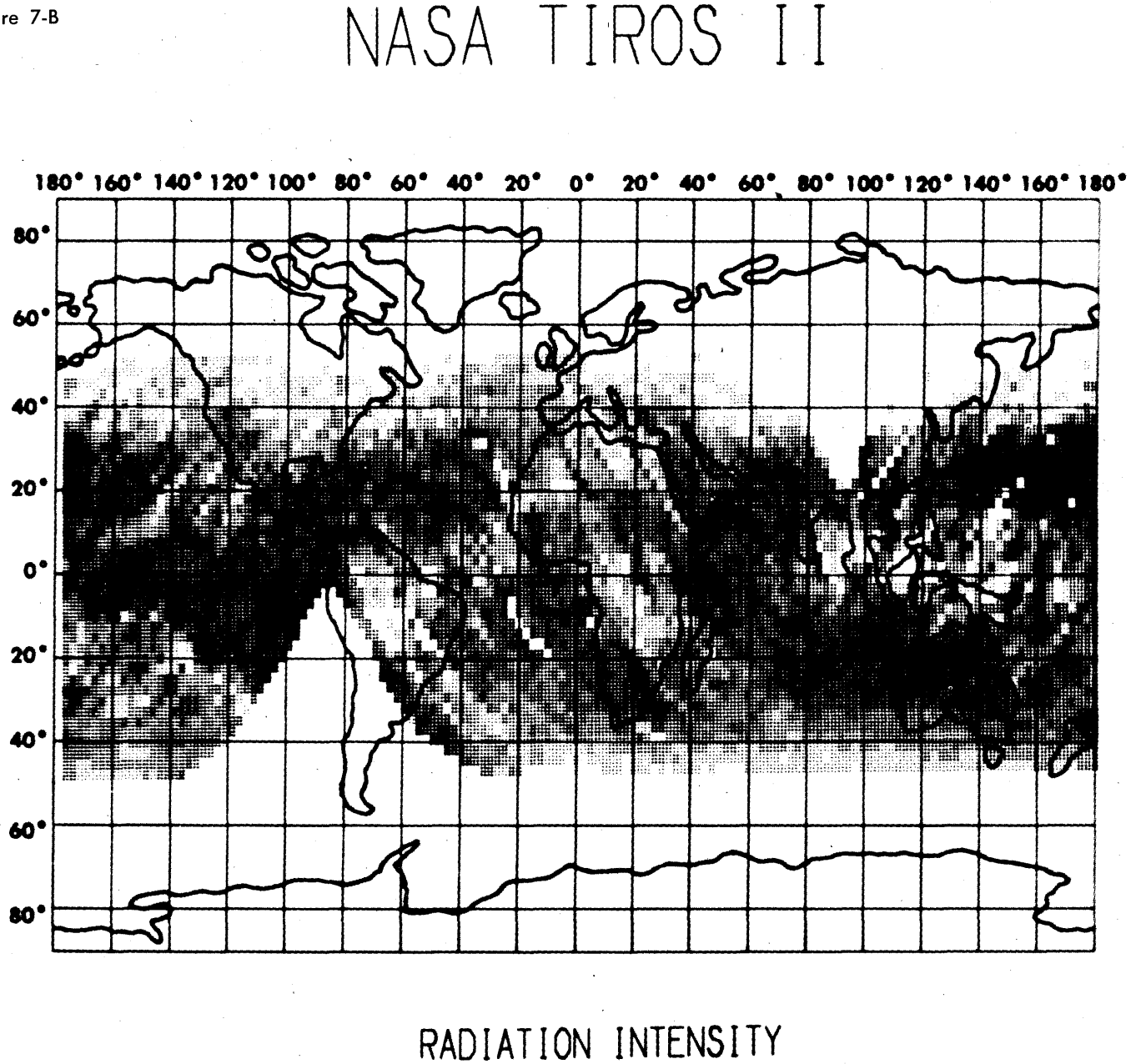
32-250 5975-556-9743 ALUMINUM ALLOY, ANODIZED FINISH, OVER-ALL DIM., 1.188 IN. LG, 1.062 IN. W, 0.925 IN. H, 0.812 IN. ID, EXTERNAL THD, 1 IN. LG, 1 IN. DIA, 20 THD PER IN., MFR FED CODE 76301, PART NO. 5M13-8

32-300 5975-583-8625 ALUMINUM ALLOY, ANODIZED FINISH, OVER-ALL DIM., 1.188 IN. LG, 1.250 IN. DIA, 0.812 IN. ID, EXTERNAL THD, 1.000 IN. LG, 1.000 IN. DIA, 20 THD PER IN., MFR FED CODE 76301, PART NO. 5813-10

ostensible speeds. Microfilm printers may require that paper and film be processed off-line. All of the equipment introduced to date is furthermore limited to one-ply printout. Multiple copies are usually obtained by copying with xerography or diazo, or by reruns; either solution reduces effective speed. Form projection, as developed to date, does not in all cases greatly increase speed or convenience. In the 4020, for instance, changing the form may have to await removal of photosensitive paper and, if registration is crucial, an optical alignment procedure. Under such conditions changes on the conventional printer would usually be a bit faster.

Paper in almost all cases is especially treated or constructed, resulting in higher cost than for the conventional carbon-interleaved form. The 4020, for instance, consumes Kodak photosensitive paper which sells for close

Figure 7-B



to $30.00 per 420-frame roll which brings the per-page cost to about seven cents.

that human factor

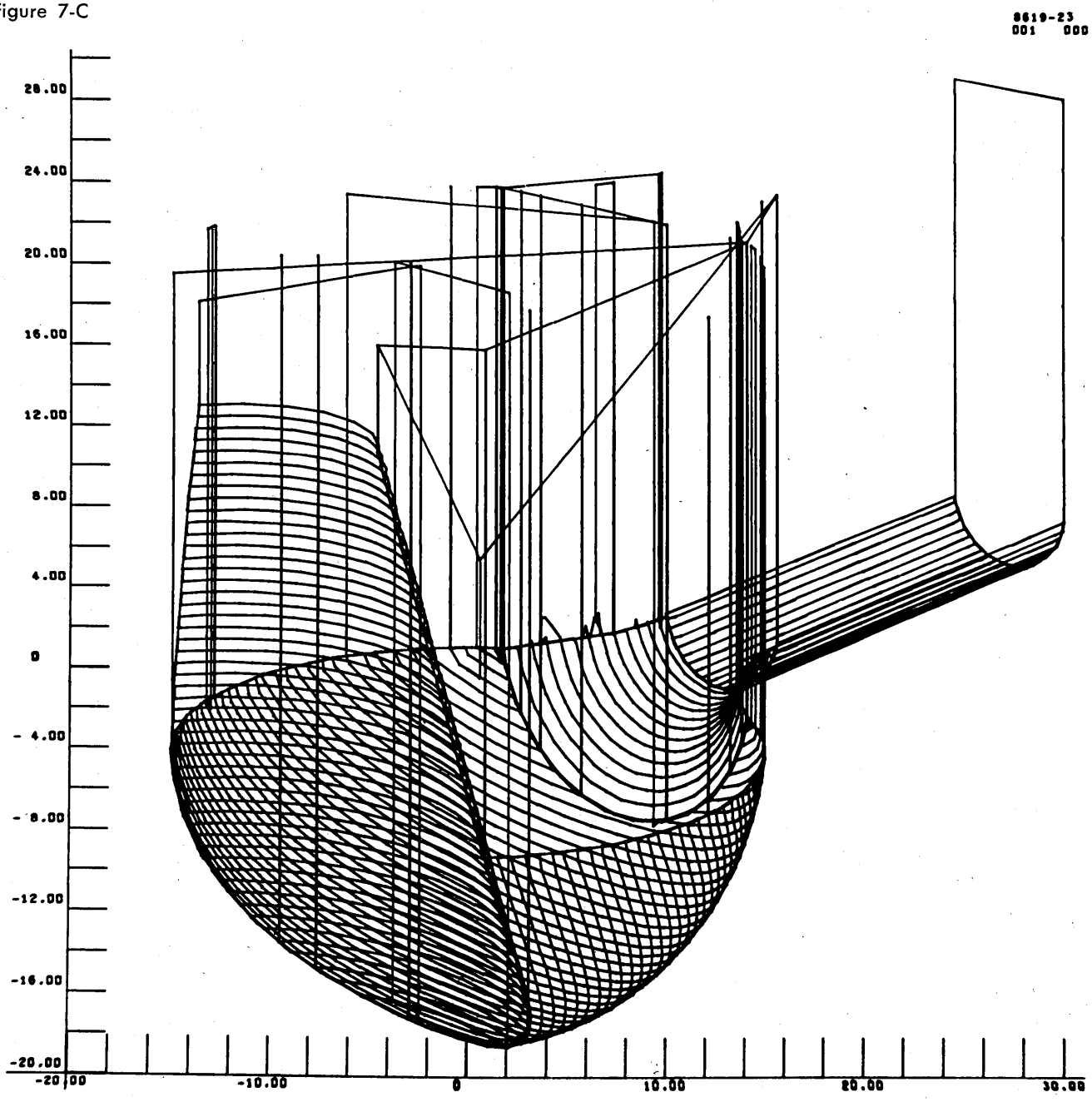
In the final accounting it is probably none of these factors which impede or catalyze the acceptance of electronic printing. Most important is the subjective factor of printing quality—the human being, irrational creature that he is, can be extremely finicky about what he reads. This is evinced by the preference for the proportionally spaced typewriter, the use of offset printing when ditto might do just as well, and the often arbitrary but religiously followed rules for word hyphenation. This sensitivity is one reason why the IBM 720 Matrix Line Printers never really caught on, even though they offered 1000 lpm printing at a time when nothing else did.

Of the non-impact printers, the microfilm approach produces the highest quality, both on film or paper. The printout, though quite sharp, however, will not stand up against that of the really well adjusted conventional printer with respect to character formation, intensity, or alignment. Furthermore, the page size of both the General Dynamics and Benson-Lehner systems is limited to 9½ by 9½ inches. Other types of machines have their own limitations, any of which will evoke outcry when attempts are made to enter documents so printed into the typical business system.

Except when used to transfer large volumes of records from tape to film, inroads into data processing shall be made when non-impact printers are around anyway because they can print what the conventional machine can't. Versatility is the key to acceptance. Variety of output, especially that of the video-photographic recorders, approaches the spectacular (see Fig. 7 A-D).

People in spite of themselves have a way of adjusting to machines; conversely, as machines reach higher levels of performance, people find it increasingly difficult to avoid using them. There is little doubt that the non-impact printer will improve somewhat in speed and quite a bit in quality of its output. There is little doubt that the trend toward electronic printing for computer output will not only continue, but accelerate. ■

Figure 7-C



the twain must meet

THE PROGRAMMER ENCOUNTERS AUDITING

by HAROLD WEISS

Computer programmers and systems analysts with few exceptions are stable, honorable, and proud practitioners of their chosen profession. The great majority of them are dedicated to the efficient utilization of a new and rapidly changing technology in the service of business and industry. Most of these individuals would become highly indignant if told that the applications they were developing potentially exposed their company to substantial future expenses or delays in achieving desired management information systems. They would probably be very skeptical if told that their systems might be summarily thrown out some day regardless of their efficiency, or that because of their negligence the survival of the business enterprise itself might at some future date be in jeopardy because of the destruction of key files. These, however, are very real dangers.

I am not referring here to the legal implications of computer use[1] (a subject worthy of major attention by computer professionals), although many of the statements made above could similarly apply. I am referring instead to the audit and control questions raised by the application of computers to business problems, and the adequacy of file and program protection, record retention, and system description.

Some computer specialists with an accounting background or those with extensive financial experience may already be highly aware of the subject under discussion. Others working on certain sensitive applications, such as payroll or demand deposit accounting, may be exposed to strong pressures for necessary protection from personnel in these operating areas or occasionally from an alert internal audit staff, external auditor, or consultant. It is my belief, however, that many computer specialists are not sufficiently aware of these audit and control problems or their responsibility for forestalling or minimizing these problems. This article will attempt an introduction to the subject. I shall try to state what the auditor needs, what Uncle Sam has to say about it, the problems computer people can pose for auditors, and how relationships between data processing personnel and auditors can be improved for the benefit of the business enterprise. I write as a computer professional with prior public accounting experience but not as a member of the General Electric Company's Auditing Department. The views expressed here are purely my own and not those of the General Electric Company.

what the auditor needs

Before discussing what the auditor needs, let me try to describe in simple fashion what the auditor does. The management of a company has the responsibility for safeguarding the assets of the company, recording all transactions properly in books of account, and preparing accurate and adequate financial statements (balance sheet and profit and loss statement). An internal audit staff exists in most large companies with responsibilities set by management, ranging from performing certain line accounting or checking functions to duties similar to those of the independent auditor to be described. There is a trend

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[1] R. N. Freed, "The Legal Implications of Computer Use," *Communications of the ACM*, December, 1962.

for the internal auditor to do more than just check on financial transactions, but to emphasize what is variously termed "management, systems, or operational auditing." Essentially this is a review of operating practices to see how top management's policies are being implemented.

The independent or external auditor (public accountant) conducts investigations so as to be able to express an opinion on the fairness of management's financial statements, the end-product of all record-keeping. The usual external examination, contrary to popular opinion, is not primarily or specifically designed to detect fraud. The external auditor has to make certain that an adequate system of internal controls exists. By this is meant a segregation of duties such that no single individual can authorize a transaction, handle the recording of the transaction, and retain custody of any assets or valuables that may be involved. If the system of internal control is poor, the auditor may have to do an excessive amount of work before he can certify to, or more accurately render an opinion on, the financial condition of his client. Some external auditors furnish a formal report to management on the adequacy of controls in addition to the conventional report.

Besides the internal and external auditors, there are a host of federal, state and local government agencies, regulatory bodies and other organizations which may have a right to audit or conduct reviews of a company's books and records.

Any auditor must be able to interrogate the accounting records and be able to locate basic information. He wants to make certain that valid items – and all of them – are entered into the system and that they are processed accurately once entered correctly. Traditionally the auditor has wanted to be able to go from original documents to end results and from end results to original documents. He expects to be able to reconstruct what has happened in the accounts from one period to another. He wants to be certain that the information summarized on the financial statements as a result of data processing is fully and fairly disclosed.

This ability to go from source documents to end results or vice versa, and to reconstruct the activity of accounts is commonly referred to as the "audit trail". Perhaps a better term is that of "management trail," because the information and records which management needs to control the business properly are quite close to what the auditor truly needs. We also must recognize that the people we sell to and buy from, the employees of the business, the government agencies previously mentioned, and others place demands on our information systems much like those of the auditor.

IRS guidelines

To clear the air about what the auditor needs, the following five points represent "Suggested Guidelines for Record Requirements for Taxpayers Utilizing Automatic Data Processing Systems."[2] These have been released by the Audit Division of the Internal Revenue Service and are dated March 25, 1963.

1. A general ledger, with source references, should be written out to coincide with financial reports **for tax reporting periods.** In cases where subsidiary ledgers are used to support the general ledger accounts, they should also be written out periodically.
2. The audit trail should be designed so that the details underlying the summary accounting data, such as invoices and vouchers, may be identified and made available to the Internal Revenue Service upon request.
3. The records must provide the opportunity to trace any transaction back to the original source or forward to a final total. If printouts are not made of transactions at the time they are processed, then the system must have the ability to reconstruct these transactions.
4. Adequate record retention facilities must be available for storing tapes and printouts as well as all applicable supporting documents. These records must be retained in accordance with provisions of the Internal Revenue Code.[3]
5. A description setting forth the ADP (Automatic Data Processing) portion of the accounting system should be available. The scope of operations should be sufficiently detailed to indicate (a) the application being performed, (b) the procedures employed in each application which, for example, might be supported by flow charts, block diagrams or other satisfactory support of input or output references, and (c) the controls used to insure accurate and reliable processing. Important changes, together with their effective dates, should be noted in order to preserve an accurate chronological record.

One of the goals of the IRS was to minimize users' doubts about the adequacy of their computer produced records. The IRS sought the advice of large computer users and appropriate professional organizations, which has led to the current guidelines being generally well received. The original guidelines appeared in October, 1961 and had a somewhat rigid approach. It is encouraging to note that this is the sixth revision, although the last few have been in the nature of clearer language rather than material changes. In my opinion further changes will be required in the guidelines as more sophisticated use is made of computer technology and as auditors develop new techniques in response to the demands of this new technology.

The guidelines would not appear to impose major burdens on current data processing systems. I am particularly responsive to the fifth point, since it may help to correct inadequacies in system documentation, a bad practice which it is easy to adopt in the face of the many pressures present in the development of most computer applications. Since the "revenooers" come in relatively late on tax audits, computer people should not be too complacent about the lack of problems currently being experienced with their systems. The prime responsibility for record-keeping policies clearly lies with higher management, but the computer specialist, if he is a true professional, must be aware of the problems which he may be helping to create. Unfortunately, many managements have been too permissive with their computer groups either because of the mysteries surrounding computer activities or because of management's preoccupation with "more important things."

auditor's problems

This leads to a discussion of the problems that computers can pose for auditors. I shall ignore the many benefits which computers can bring to the auditor, such as unparalleled accuracy and reliability, the use of the computer by the auditor himself as a powerful auditing tool, etc.

[2] The information offered herein as guidelines is not the official position of the Service on this subject pending issuance of an official directive. As a result, it is requested that any comments on these guidelines be sent to: Director, Audit Division, Internal Revenue Service, Washington 25, D.C., Attention: CP:A:UA.

[3] Usually at one or more convenient and safe locations accessible to IRS personnel, for at least four years after the due date of the tax for the return period to which the records relate, or the date the tax is paid, whichever is later.

The data processing specialist must still face up to a variety of problems as the auditor sees it, including the following:

1. Non-visible records. This is probably the simplest problem and requires a change in auditor attitude that comes from familiarization with the new recording media. Punched cards triggered similar responses a few decades ago. Key printouts can usually be readily made. Non-visible records are really one aspect of a broader problem of ease of interrogation of information stored in EDP systems. New technology is easing this problem with less expensive buffering, higher speed printers, remote inquiry devices, etc. System approaches may reduce the need for hard copy; for example, a good tape retention plan with auditors' needs in mind.

2. Loss of historical information. It is relatively inefficient in EDP systems to carry much previous activity in current files. In random access files previous status usually gets written over. In sequential files intermediate processing results are usually not retained. These characteristics of EDP may significantly affect the audit trail. A brute force solution of greatly increasing storage of historical information may be very costly. There is a great challenge here to the auditor to develop feasible alternatives, such as more concurrent auditing, performing some aspects of the audit at the time of processing or very soon thereafter.

3. Difficulty of access to source documents. There is strong pressure not to sequence source documents purely for future physical retrieval since this is costly. In fact, there is a trend to processing at a location remote from that of the document and even for elimination of hard copy source data in certain applications. Compromise approaches are available which do not require physical sequencing of the documents but which facilitate retrieval for audit purposes. Examples include transaction journals, the carrying forward of the batch or other transaction identification, or carrying date of last transaction in a master file in certain applications.

4. Loss of human inspection. People, besides creating errors, provide a useful review and control function and can prevent apparently stupid computer output (resulting from inferior controls). We are all aware of homeowners receiving ridiculously large utility bills, for example. Actually, a computer can be programmed to do extensive input validation and editing, carry very significant controls, and make reasonableness tests of output. A good system can to a considerable extent be made "self-auditing." Loss of this human review and control function may validly lead the auditor to demand more or stronger controls in the edp system than he apparently had before.

5. Centralization and concentration of processing. All the informational blood of the business tends to flow through a few electronic black boxes. Sophisticated and highly integrated systems become possible. This potentially weakens internal control. It also makes the enterprise more vulnerable to disaster. There are alternative means for strengthening internal control such as segregation of input, processing, and output phases of operations, separating programming from operations, and other possibilities. The 1959 Pentagon fire in which 5200 magnetic tapes were destroyed is an example of the need for fire prevention and records preservation disciplines. Many techniques have been developed to reduce risk of disaster to a minute level. A good tape expiration plan, remote storage of backup and duplicate tapes in a fire-resistant area, and other formal tape library procedures and disciplines are examples that come readily to mind.

6. Documentation. This is obviously of prime concern to the auditor who does not relish the prospect of encountering only a program listing if he wants to dig into some phase of a system. Here his need is close to that of management, which should not tolerate a system recorded primarily in a programmer's head. Also documentation once current will not automatically remain so under the changes which usually occur.

This has been a relatively superficial treatment of some of the auditor's problems resulting from EDP. I have attempted to indicate that at the minimum feasible solutions exist for most of these problems, as well as considerable potential benefits to the business enterprise if enlightened approaches are taken.

current practices

In late 1962 I conducted an informal survey on audit, control, and operational practices of a small group of recent computer users. I received 50 replies. A detailed quantitative analysis of the responses to this questionnaire might be misinterpreted since it was decidedly not a scientific sample. I do feel that one can draw some valid qualitative conclusions from this survey.

Almost all respondents had internal auditors, but almost none showed a significant amount of planning involvement by the internal auditor. Review of the system for satisfactory controls by the internal auditor was a little more common. The external auditor also showed little participation in control planning or review of the system before installation. Few internal auditors had attended a computer training course. There was a wide variety of input, processing, and output checking or controls, but most of the users had apparent deficiencies in this regard. There were few controls in evidence on machine room employees. Usually there was some attempt at program and file protection, but again serious deficiencies were frequently apparent. The great majority of the professional computer personnel at these installations, however, felt that the audit and control plans for the EDP operation were adequate.

I have noted in the past year much greater interest and concern about EDP in the audit profession. This results from the recent heavy increase in the number of computer installations, the educational effort by various professional organizations in the field, American Management Association seminars, the availability of more realistic periodical literature, computer manufacturers' courses, and other factors. Many more auditors have had a programming course in the past year, for example. More auditors are reviewing and commenting on EDP systems as part of their regular audit procedures, I believe. More auditors are considering use of computer equipment to increase the efficiency and effectiveness of their audits.

gaining the auditor's confidence [4]

Most internal auditors and many public ones are not very sophisticated about computers at the present time, although the situation is changing fairly rapidly, as I indicated in the last section. The auditors need the help of computer people with what, by any criteria, are complex problems. Similarly, many data processing specialists are not highly knowledgeable about the audit and control problems associated with their work. It would seem an obviously intelligent approach for the two professional groups to work together to achieve each company's objectives of an efficient management information system that provides an adequate system of internal control and which can be audited on a realistic basis.

Several suggestions to data processing personnel may help to promote this marriage:

1. Approach the auditor the same way you approach

[4] For the auditor's viewpoint on this subject, see K. G. Cadematori, "Gaining the Auditor's Confidence," *Data Processing, Vol. VI,* Data Processing Management Association, p. 92.

other groups in your company who are to be affected by the computer. If you keep the auditor in the dark, he is likely to become suspicious and obstructionistic. People naturally oppose what they do not understand.

2. Bring the auditor into the initial planning phase of the system. Audit requirements are a legitimate part of the system design specifications. A great deal of later grief can be avoided if the auditor is consulted early. It is much more expensive to patch a system than to do the job properly in the first place. Communications is simpler while information is fresh in computer people's minds and key people are still available.

3. I suggest that you encourage the internal auditor to participate in system implementation and testing. This can help the computer specialists develop much better systems and ease subsequent auditing. In my opinion it need not be a threat to the auditor's independence. I am aware of some instances of a degree of auditor involvement in computer applications work that would make most computer professionals shudder.[5]

4. Recognize that the plans and activities of the computer group are subject to the same review, controls, and challenges by company management and other components as any other area of the business. Investments in your activities must be as fully justified as any other. The auditors should be concerned with the efficiency of this portion of the business. Audit of the work of the data processing group is a reflection of the increased importance of this function and should be welcomed by computer specialists . . . some of whom tend to be overly immersed in their own work, and wanting to be exempt from the normal restraints and disciplines of a business — schedules, costs, company security, etc.

5. Give the auditor the good documentation he and other areas of the business require and which the IRS guidelines point up. You may not always be around to answer questions. Keep the documentation as current as possible and discuss all significant system changes with the auditor.

6. Help in the training of the auditor about EDP, possibly by setting up a programming course. Try to understand his problems and what he has to accomplish. Help him develop alternative and creative approaches to the audit and control problems posed by EDP. Be realistic with him in assessing the cost and value of some of the controls he may want. Encourage him to use the computer in his audit work, wherever appropriate.

7. Enlist the auditor's help in the training of data processing personnel about audit and control requirements.

conclusions

Data processing management, systems personnel, and programmers must be highly concerned about the auditability of their computer application systems. They literally risk the destruction of such systems because of inadequate control. By working more closely with auditors, better systems are developed and fewer unrealistic or unjustifiable audit demands will probably be made. In a well-balanced system the distinction between an adequate audit trail and good operational control is virtually non-existent. With or without auditor participation data processing personnel must develop such balanced systems. ■

[5] Walker, W. H. "Auditing EDP," *The Internal Auditor*, Fall 1962.

NORTHWEST COMPUTING CONFERENCE

men & computers

The two-day, sixth annual Northwest Computing (Assn.) Conference included speakers from MIT, Univ. of Texas, and—where else?—Boeing. It was held in August at the Pacific Science Center (formerly the U.S. Science Exhibit, complete with lacelike concrete arches, at the World's Fair) in Seattle, Wash. Conference theme was "Men & Computers: A Decision Team."

Possibly the two outstanding papers were by Dr. Oliver Selfridge, MIT Lincoln Labs, who spoke on Machine Learning and Decision Models, and by Prof. Marvin Minsky, MIT. The latter spoke on Computer Manipulation of Complex Pictorial Diagrams, dealing with pictures made up of several parts. The parts might be overlapping and carelessly drawn, requiring hardware to recognize analogies between the parts and their internal relationships. The work is carried a step beyond character recognition, to pictures of several objects.

The eventual purpose of a machine's learning, Dr. Selfridge said, is to make decisions about its behavior—to produce certain kinds of output or to modify its program in a fundamental way. For effective modifications, changes must be expressed in a language relevant to those decisions.

Keynote speaker of the conference was Fletcher Jones, Computer Sciences Corp., El Segundo, Calif. Jones spoke on the human aspects of man-machine relations, in terms of both dp personnel and the public at large. He noted that federal government committees on automation include no one cognizant in the subject and, hence, that such bodies are apt to come to rather strange conclusions. Conference attendees, he urged, should be "social-minded" about their work—a topic that can be over-stressed but never minimal.

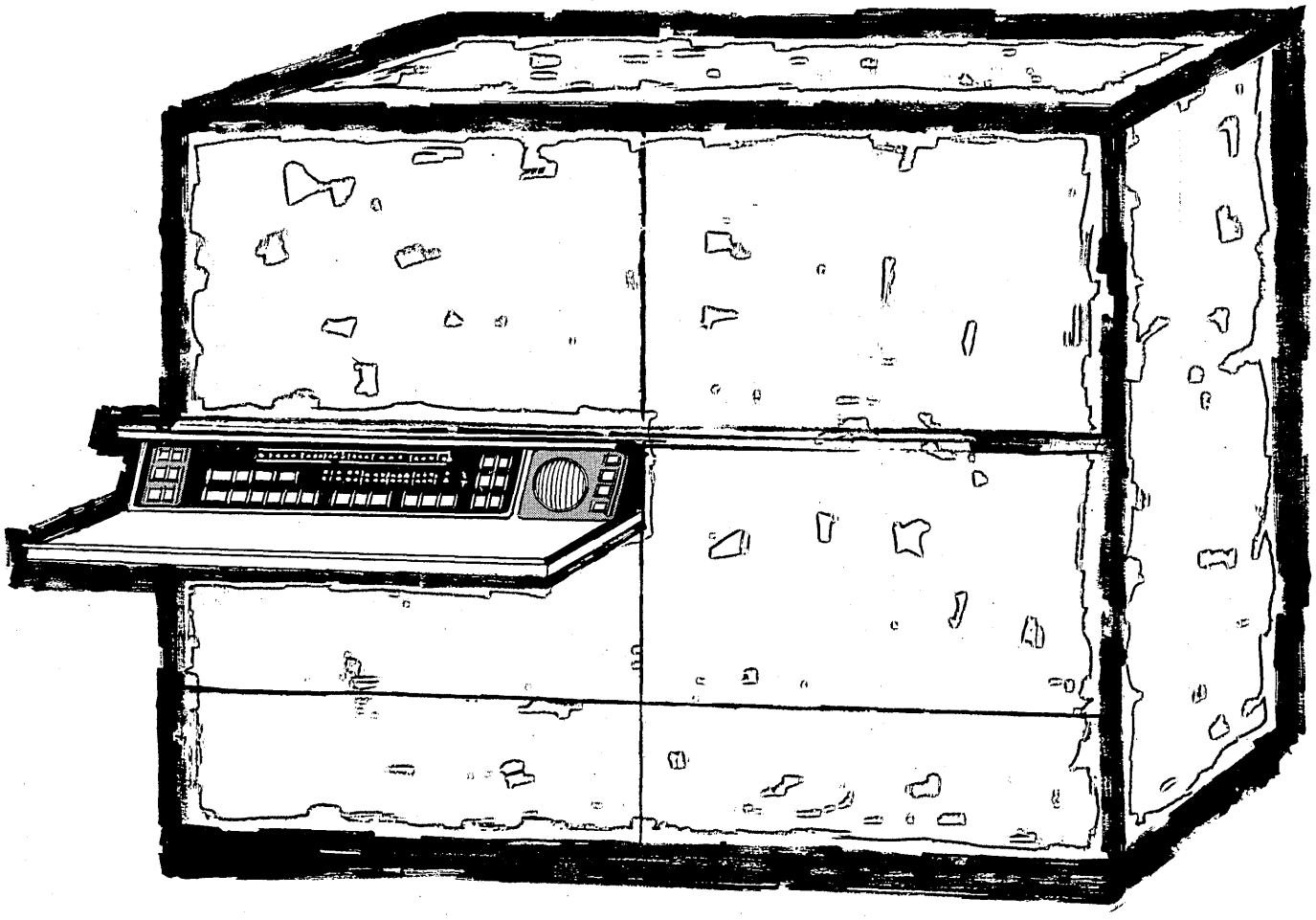
tomorrow's management

A frightening picture of management of the future was drawn by Roger K. Summit, Lockheed Missiles, who discussed how management games may be used to bridge the gap between today's administrative dp applications and the advanced management control system envisioned by Leavitt, Whisler, and Simon ("Management in the 1980's" *Harvard Business Review*). He also described what Lockheed has done with these concepts, and what management of the future may look like.

The first afternoon session, in the auditorium near the reflecting pools amid the building complex, included a presentation on Adjunctive Military Gaming by Dr. Paul Brock, Hughes Aircraft. Dr. Brock described gaming techniques which can be employed to investigate the effectiveness of military organizations, strategy, logistics, and tactics. Dr. Harold P. Van Cott, IBM, spoke on the Synergetic Concept for Command Systems.

Following this were afternoon workshop sessions on Recent Advances in Numerical Analysis, Geometric Computing, Logical Analysis of Systems Through Simulation, and Data Transmission and Source Recording. Friday's workshop sessions were on Recent Trends in Compilers and Language Translators, Measuring System Effectiveness, and Customer-Programmer Communication Problems.

Last speaker was William R. Lonergan, Univac, who spoke on Design for Information Processing—developing trends, and Univac's methods for deriving requirements for hardware and software design.



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CIRCLE 22 ON READER CARD

First, it was the RCA 501. This was followed by the 301, then the 601. Everyone knew the next computer would fill the numerical gap, be labelled the 401, and set anxious hearts at rest. Industry pundits, however, remain restless. As disclosed in last month's DATAMATION (p. 19), the fourth RCA computer is the 3301, a two-address, bit-parallel, character serial processor.

THE RCA 3301

something for everyone

by T. A. FRANKS

The RCA 3301 is compatible with the 301 system; however, the 3301 provides a faster and larger main memory, higher-speed circuitry, enhanced input-output capabilities including program interrupt, and a more powerful command structure. The internal representation of data is identical with the 301, whose instruction repertoire is a subset of the 3301's.

The major 3301 hardware features include:

1) a compact 200-character micromagnetic memory, used in lieu of flip-flop registers;
2) a program-interrupt feature, permitting efficient use of input-output and error-recovery capabilities;
3) a high-speed main memory, organized in 70-bit words, and available in a basic size of 40,000 characters with optional modules to raise total capacity to 160,000 characters;
4) a flexible input-output bus interface for adding various combinations of control modules; and
5) an advanced circuit and packaging design concept that balances operating speeds and design margins against ease of manufacture.

basic processor and micromagnetic memory

Fig. 2 shows the basic processing unit and illustrates how the micromagnetic memory has replaced many of the hardware registers normally required in a processor. The fast cycle time is effectively employed for the same tasks normally assigned to flip-flop registers. This memory is significantly less expensive and more compact than the total number of registers it replaces.

The micromagnetic memory consists of 200 seven-bit characters (six bits of information and parity) arranged in 50 locations of four characters each. It is a word-oriented, two-core-per-bit, linear-select configuration with three wires threaded through each core. Two are used for the driving system (one for read, one for write) and one printed wire is used for the digit-sense circuits. The independent read or write cycle time is 250 nsec. This permits reading one micromagnetic memory location into the micromagnetic memory register, or writing from the micromagnetic memory register to one micromagnetic memory location within one time-pulse period. The micromagnetic memory is functionally used for address registers, control registers, various indicators, and as temporary storage during instruction execution and program-interrupt sequences. All of the contents are addressable by specific instructions.

The equality detection between the micromagnetic register and the main-memory address register is required

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A graduate of Rensselear Polytechnic Institute and Stanford Univ., Mr. Franks was project leader coordinating engineering of the 3301 system, a position he has held since joining RCA-EDP in 1962. He joined the parent RCA firm in 1956, taking part in the development of solid state memory circuitry, as project engineer on several computer programs, and working on system organization of advanced computers.

to determine the termination of address-controlled instructions and input-output service sequences.

multilevel program interrupt

Another unique feature of the RCA 3301 is the multilevel program interrupt system. This facilitates real-time programming, servicing of multiple input-output devices, error-recovery procedures, program debugging techniques, and compatibility routines for execution of other RCA computer programs.

The three levels of program priority, in order of their priority, are: 1) real-time interrupt, 2) general interrupt, and 3) normal processing. Thus (1) cannot be interrupted, (2) can be only by (1), etc. There are 18 conditions which will cause an interrupt process to take place, of which five are designated as real-time and 13 as general interrupt conditions. The mechanization of the interrupt process involves:

1) interrupt sequence (all hardware);
2) interrupt routine (software using hardware indicators and instructions);
3) return after interrupt (an instruction); and
4) program control of interrupt (an instruction).

Step 1, the interrupt sequence, is initiated when a bit of the interrupt register is set, the appropriate inhibit-interrupt interlock indicator is clear, and the execution of the current normal processing instruction is completed. The interrupt sequence automatically stores the appropriate registers in standard micromagnetic-memory locations, one set for a general interrupt, another set for a real-time interrupt. The associated inhibit-interrupt indicator is set, i.e. general or real-time. The automatic interrupt sequence then obtains the *jump* address from another standard location in the micromagnetic memory and transfers control to the interrupt routine.

In Step 2, the interrupt routine determines which condition(s) of the 18 caused interrupt. As a result of a programmed scanning operation, this routine branches to the appropriate program. Further instructions test the various status conditions for proper recovery. After the interrupt condition has been dealt with, the software interrupt routine scans the interrupt register again to determine if another bit is set. If so, that condition is dealt with. This cycle is repeated until all conditions have been accommodated. Then the interrupt routine exits by means of a return-after-interrupt instruction.

Step 3, return-after-interrupt instruction, automatically restores all the register and flip-flop settings that were stored in the micromagnetic memory by the most recent interrupt sequence and clears the appropriate inhibit-interrupt indicators. Then the instruction addressed by the instruction-counter register is fetched and normal processing continues.

Step 4, program control of interrupt by the programmer is affected by another instruction which allows the selective setting or clearing of the two inhibit-interrupt indicators.

main memory

The RCA 3301 random-access main memory is a magnetic-core design available in a basic size of 40,000 alphanumeric (7-bit) characters, with optional 20,000-character modules available for increased capacity (up to a total of 160,000 characters). Each location is individually addressable and can store one character. The main memory cycle is designed for 1.75 usec and is subdivided by the basic processing unit into seven 250-nsec slots. The machine cycle, however, can be either 1.75 or 2.25 usec, depending on the amount of control and data manipulation required during a given cycle. The 2.25-usec cycle consists of nine 250-nsec time pulses, and is required for operations such as instruction fetch or input-output service.

The multiplicity of connections shown between the main memory register and the central bus in Fig. 2 are a logic network. This allows the 10 character positions of the memory to be interchanged with the four character positions of the bus, thus providing the selective character-oriented operation of this system. Address incrementing (or decrementing) is performed by the bus adder in order to properly sequence instructions and operands located in the main memory.

input-output devices

A broad range of input-output devices are available for any given 3301. The basic processing unit incorporates

Figure 1

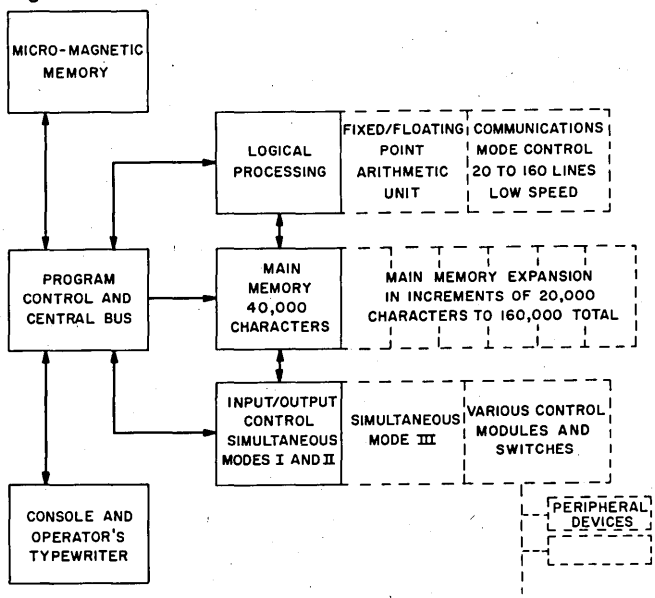
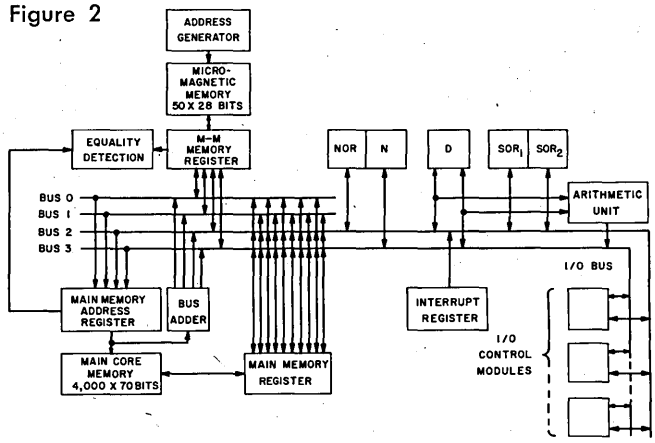


Figure 2



the essential control logic necessary for generalized operation of peripheral devices and, by means of an extension to the central bus (Fig. 1), a standardized interface for connection of control modules. Thus, enhancements can be added to an operating system by simple field modifications. The system design provides for accommodating up to six input-output control-module racks.

programming features

The 3301 operates by character-oriented, two-address instructions. The instruction format consists of ten characters interpreted as follows:

OP	*N*	*A*	*B*
X	X	XXXX	XXXX

The first character, *OP*, specifies the basic operation to be performed. The second, *N*, indicates a count, a specific symbol, or a device identification number depending on

the operation character. The next four specify the first address (*A* address field); the remaining four specify the second address (*B* address).

Indirect addressing is indicated by a bit in the least-significant character of the address. After instruction fetch, if this bit is present in either (or both) the *A* or *B* address field, the processor will automatically replace the contents of the *A* or *B* locations in the micromagnetic memory with the contents of the main-memory location addressed by the previous value of the *A* or *B* field. This process will repeat for as many levels of indirect addressing as necessary until this bit is zero.

Similarly, indexing of either (or both) the *A* or *B* address fields is indicated by two bits of the second least significant address character. There are three address fields, each with an associated increment field and all are located in the micromagnetic memory. Indexing always precedes indirect addressing. Identification of indirect addressing and indexing are indicated by the original instruction, but the effect of indirect addressing occurs on the address formed after indexing.

For descriptive purposes, the instruction repertoire may be classified into four general categories: 1) input-output, 2) data handling, 3) arithmetic, and 4) decision and control.

Input-output instructions link the processor with the peripheral devices (through the control modules) to position and/or search tapes and disk files, bring data from an input medium into the processor, or send data from the processor to an output medium. Five basic functions are provided that can be executed in any one of the two (or optionally three) simultaneous modes (plus one special instruction for specifying operation of the communications mode control). These functional varieties are: 1) input-output control, 2) read, 3) read reverse (magnetic tape only), 4) write, 5) erase (magnetic tape only), and 6) communication mode control (one instruction only). Operations such as tape rewind, track select (disk file) and paper advance are initiated by the processor (via an input-output control instruction), but once underway, are completely independent in execution.

The data-handling instructions are nonarithmetic operations for manipulation of data stored in the main memory. The instructions included in this group permit control of data fields by symbol, address, or count. Instructions for edited manipulation of varied fields are also included in this group.

The arithmetic instructions include: 1) four decimal operations, add, subtract, multiply, or divide; 2) three operations used to alter the bit configuration of an operand through the use of logical commands; and 3) three operations for arithmetically manipulating four character fields in accordance with the rules of addressing. The decimal instructions operate in accordance with standard arithmetic rules and are designed to handle operands of mutually equal lengths. Three instructions, *logical or, logical and,* and *exclusive or* constitute what may be considered as a separate arithmetic category. They can alter the bit configuration of an operand by the employment of a second operand to "mask out," or insert 1 bits. The three address-oriented instructions allow operations of address add, address subtract, and address compare on four-character operands consistent with the progression rules of memory addresses.

The decision and control instructions influence the sequence of operation. Four instructions enable the programmer access to registers of machine indicators directly and one instruction provides conditional control; that is, it chooses a path according to selected conditions. Another instruction either halts or causes a program interrupt in the processor's operation. A *repeat* command enables the execution of loops a designated number of times. The *compare* instruction enables the programmer to determine the relative magnitude of two operands of equal length. The last two instructions in this group enable program control and restoration of machine conditions after interrupt sequences, as described in a previous section.

In addition to this command structure, the overall system efficiency is further improved by:

1) built-in and programmed accuracy controls;
2) automatic storage of the contents of various working program-control locations in the micromagnetic memory;
3) character addressability providing completely variable data organization; and
4) machine code covering the full range of numerics, alphabetics, and special symbols.

The accuracy-control philosophy of the RCA 3301 system includes not only error detection, but also error recovery. When an error occurs and is detected by wired-in parity and invalid-code checking circuits, program control is transferred (by the interrupt feature) to an executive error-recovery routine. Appropriate actions can be taken at this time. Transient processor malfunctions, as well as input-output-equipment errors, can be handled by these techniques.

Facilities for automatically storing various program-control address fields are included in the basic processing unit. These are called STA, STP, and STPr.

STA automatically occurs at the conclusion of selected instructions. In STA, the final contents of the *A* field located in micro-magnetic memory are automatically stored in standard main memory locations. This permits the subsequent use of the final *A* field contents and is a convenient programming technique to eliminate memory searching time.

STP occurs whenever program control is to be transferred out of immediate sequence; STP automatically stores the contents of the instruction-counter field in another set of standard main-memory locations at the conclusion of those instructions that would cause transfers of control. The stored address is the address of the instruction that would have been executed if the transfer of control had not taken place.

STPr similarly automatically stores in standard main-memory locations the instruction address immediately following the repeat instruction, and is used for looping control reference during a repeat sequence. ■

RCA 3301 Peripheral Devices

Magnetic Tape Stations	
alphanumeric character rate options	33, 66, 120KC
Disk Files	
total capacity	528 x 10^6 alphanumeric char.
min-max access times	70-120 milliseconds
transfer rate	32KC
Punched Cards	
reading	1500 cpm
punching	300 cpm
Paper Tape	
reading	1000 cps
punching	100 cps
Line Printers	
asynchronous mode (64 printable symbols)	800 lpm
synchronous mode (47 printable symbols)	1000 lpm
Communication Mode Control	
capacity	20, 40, 60, 80, 120-40-60 lines
data rate	10,000 cps maximum total
Computer-to-Computer Exchange Channels	
High Speed Communications Channels	
Interrogating Typewriters	
Custom Real Time Interfaces	
Real Time Clock	

part two

THE AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE

by R. W. BEMER, UNIVAC Division, Sperry Rand Corp., New York, N.Y.

Synopsis—In the first of this two-part article, Mr. Bemer covered the inglorious history of information coding which led to the ASCII, becoming an official ASA Standard No. X3.4 on June 17, 1963. He also covered its salient features, and explained the seven-bit code with provisions to expand to eight bits.

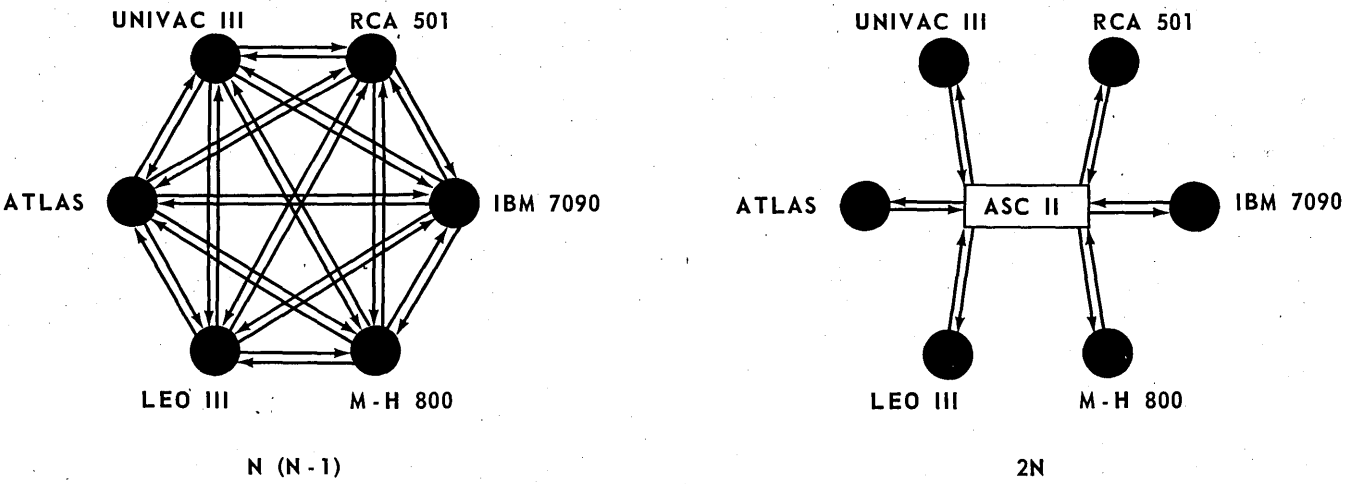
the conversion problem

The major argument against the new code seems to be the cost of converting the vast amounts of equipments and customers, with resulting obsolescence (at least of the equipment). The intent is apparent in the title of the standard – "for INFORMATION INTERCHANGE." This does *not* say that computers of external devices must be built to use this code internally, now or ever. All it demands is that whenever the computer talks with strange equipment, *not of its own kind,* that it do so through the medium of this code.

Certainly this results in fewer translation mechanisms than the present chaotic situation requires. Given N computers or other devices with various and different internal codes, each might need to talk with all the others (N-1). Thus N times (N-1) translations would be required for full intercommunication. With ASCII, however, each device needs to talk only to the standard code and back again, a total of only 2N translations required! The value of N is presently about 60 (internal codes). Although one would hardly expect that all possible 60 times 59 combinations would be used, it is certainly enough larger than 60 times 2 to say that even if every present day machine retained its own code forever, it would still be more economical to use ASCII just for interchange! Thus each machine would have to talk only to ASCII instead of 59 other codes. (See Figure 4.)

Furthermore, the possibility should not be overlooked

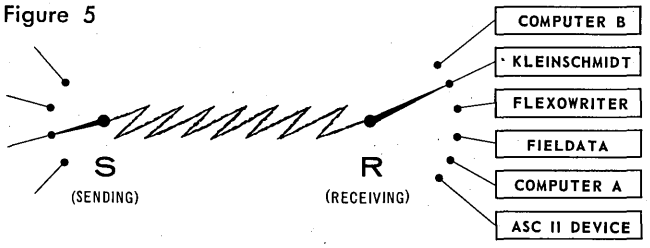
Figure 4



that some other internal code *plus* the translation mechanisms required might be more economical for some equipment than would ASCII internally. Of course, the economic pressure for future equipments to use the code internally as well as externally would be more likely. Thus the 2N combinations might even be reduced to *one* some time in the future. The new code has so many inherent economies that it might pay for the redesign itself. IBM has perhaps the least problem of any manufacturer; with 9 different codes already in their various computers, ASCII presents only an 11 per cent additional problem.

During the conversion period, the ESCape character allows most existing codes to exist simultaneously with ASCII. Assume a communications link as in Figure 5. When a message comes along that is not in ASCII, the first character is ESCape, the next is that which selects the alternative code. The message in alternative code then follows until the next ESCape character signals either another alternative code or return to ASCII. Physically the receiving terminal R will be alerted for switching by ESCape; the following character actually performs the switching to different receiving equipment for the alternative code. This concept is much simplified, of course, and in practice might be applied only to long distance links.

Figure 5



It would seem a practical thing for X3.2 to assign a block of codes (to follow ESCape) to indicate the codes of existing equipments. As these become obsolete, the particular selector code may be reassigned for other purposes.

advantages for programming

If ASCII were to be built in as an internal computer code, the programmer might expect to see some of the following benefits:

1. Manipulation of graphics by classes. Since all characters of a certain class (such as letters, digits, etc.) are grouped contiguously, they may be classified with very few instructions. In working with strings it may be useful to create a corresponding class string in parallel for syntax analysis. This could open some interesting doors in library work and information retrieval in general.

2. Fewer instructions in scans, due to regularity and unique codes. A count once made of 709 FORTRAN showed that something like 53 instructions were required to decipher the syntactical meaning of a left partnthesis. As no other brackets were available, parentheses were used for subscripting, normal mathematical nesting and other purposes. With unique codes, the combination can form the address of the starting instruction of the routine for processing that character. Consider that the IBM FORTRAN market amounts to about $150,000,000 a year in just machine time used. The figure commonly accepted for translation from FORTRAN to machine language is 35 per cent of total time. Thus about $50,000,000 a year is spent on nothing but FORTRAN translation. Certainly

OCTAL CODE	ASCII GRAPHIC	IBM				FIELDATA	UNIVAC				RCA
		SIC A	SIC H	COLL. SEQ.	7090 CORE		1050 A	1050 H	490	1107	501
00		00	00	00	60	05	00	00	05	05	00
1	!	52	52	43	52	55	43	43			
2	"					52					05
3	#	13		24			35	37	04		36
4	$	53	53	07	53	47	42	42	47	47	07
5	%	34		17			61	17	52		10
6	&	60		06			20	63	46	46	12
7	'		14	25	14	72	15	56	72	72	13
10	(		34	17	74	51	17	61	51	51	
1	)		74	02	34	40	01	75	40	40	04
2	*	54	54	10	54	50	41	41	50	50	15
3	+		60	06	20	42	63	20	42	42	
4	,	33	33	16	73	56	62	62	56	56	35
5	–	40	40	14	40	41	02	02	41	41	14
6	.	73	73	01	33	75	22	22	75	75	16
7	/	21	21	15	61	74	64	64	74	74	22
20	0	12	12	66	00	60	03	03	60	60	23
1	1	01	01	67	01	61	04	04	61	61	24
2	2	02	02	70	02	62	05	05	62	62	25
3	3	03	03	71	03	63	06	06	63	63	26
4	4	04	04	72	04	64	07	07	64	64	27
5	5	05	05	73	05	65	10	10	65	65	30
6	6	06	06	74	06	66	11	11	66	66	31
7	7	07	07	75	07	67	12	12	67	67	32
30	8	10	10	76	10	70	13	13	70	70	33
1	9	11	11	77	11	71	14	14	71	71	34
2	:	15	15	26		53	21	21	53	53	06
3	;	56	56	12		73	16	16	73		11
4	<	76	76	04		43	36	36		43	76
5	=		13	24	13	44	37	35		44	
6	>	16	16	27		45	76	76		45	75
7	?	72	72	31	32	54	23	23			

OCTAL CODE	ASCII GRAPHIC	IBM				FIELDATA	UNIVAC				RCA
		SIC A	SIC H	COLL. SEQ.	7090 CORE		1050 A	1050 H	490	1107	501
40	@	14		25			56	15			
1	A	61	61	32	21	06	24	24	06	06	40
2	B	62	62	33	22	07	25	25	07	07	41
3	C	63	63	34	23	10	26	26	10	10	42
4	D	64	64	35	24	11	27	27	11	11	43
5	E	65	65	36	25	12	30	30	12	12	44
6	F	66	66	37	26	13	31	31	13	13	45
7	G	67	67	40	27	14	32	32	14	14	46
50	H	70	70	41	30	15	33	33	15	15	47
1	I	71	71	42	31	16	34	34	16	16	50
2	J	41	41	44	41	17	44	44	17	17	51
3	K	42	42	45	42	20	45	45	20	20	52
4	L	43	43	46	43	21	46	46	21	21	53
5	M	44	44	47	44	22	47	47	22	22	54
6	N	45	45	50	45	23	50	50	23	23	55
7	O	46	46	51	46	24	51	51	24	24	56
60	P	47	47	52	47	25	52	52	25	25	57
1	Q	50	50	53	50	26	53	53	26	26	60
2	R	51	51	54	51	27	54	54	27	27	61
3	S	22	22	56	62	30	65	65	30	30	62
4	T	23	23	57	63	31	66	66	31	31	63
5	U	24	24	60	64	32	67	67	32	32	64
6	V	25	25	64	65	33	70	70	33	33	65
7	W	26	26	62	66	34	71	71	34	34	66
70	X	27	27	63	67	35	72	72	35	35	67
1	Y	30	30	64	70	36	73	73	36	36	70
2	Z	31	31	65	71	37	74	74	37	37	71
3	[	75	75	03			55	55			
4	\	36	36	21			40	40			
5	]	55	55	11			77	77			
6	↑										
7	←										

SIC = STANDARD INTERCHANGE CODE

all of this is not due to the left parenthesis problem, but it ought to run to at least a million.

3. Faster and cheaper sorting, when the collating sequence is identical to the binary sequence of the codes for the graphics. Sorting is also big business, with commercial users quoting an average of 40 per cent of total machine time used for this one function. The elimination of special hardware for comparisons would save more than a million dollars a year.

4. Reduction in the number of routines required to be programmed, particularly for satellite equipment. The chart of Figure 6 indicates the complexity of routines that must be provided for a multiplicity of codes. The ASCII code is taken as the base code in binary sequence. The corresponding octal codes for the same graphics are given for the various other internal codes. Obviously the same procedure could be followed using any particular code as the base code. The totality of such charts provides the basic information for generalized code conversion among various equipments.

5. Fewer tables for mixed codes in communications, particularly those controlled by store-and-forward message switching systems. An IBM spokesman stated that the 7750 communications unit rents for $8,000 a month with a single code, up to $13,000 a month to handle all codes, since additional core storage is required for programs and tables to handle these other codes.

6. Clarity of printed output, particularly the reproduction of the source program in the printed record of processing. Unavailability of the exact graphic desired makes for costly mistakes in the diagnostic process. It takes quite a bit of practice to get used to reading FORTRAN with the per cent sign and lozenge used instead of parentheses.

7. A tendency for keyboards to be identical with typing communications equipment. Thus hard copy can be available immediately as a record of the program being keypunched. It is conceivable that this might extend to halfline spacing for subscripts and superscripts, a feature which might have a considerable effect in relaxing restrictions in the rules of programming languages.

the future for the ASCII code

X3.2 is presently going full steam ahead in implementing the code in the various media. This will not be a simple problem, particularly in punched cards. Presumably the binary code could be duplicated directly, a punched position standing for a 1, an unpunched position standing for 0. But there are 12 positions on the card, not 8, and that is a little wasteful. Besides, certain punching equipment will not perform up to specification when punching more than three or four holes in a column. It is possible to represent 256 codes by combinations of 0, 1, 2, and 3 punches (and no more), but this is not easy if it is required to make the combinations consistent with present punched card practice. A difficult problem, surely, but a look at the references following this paper will indicate that much work has already been done.

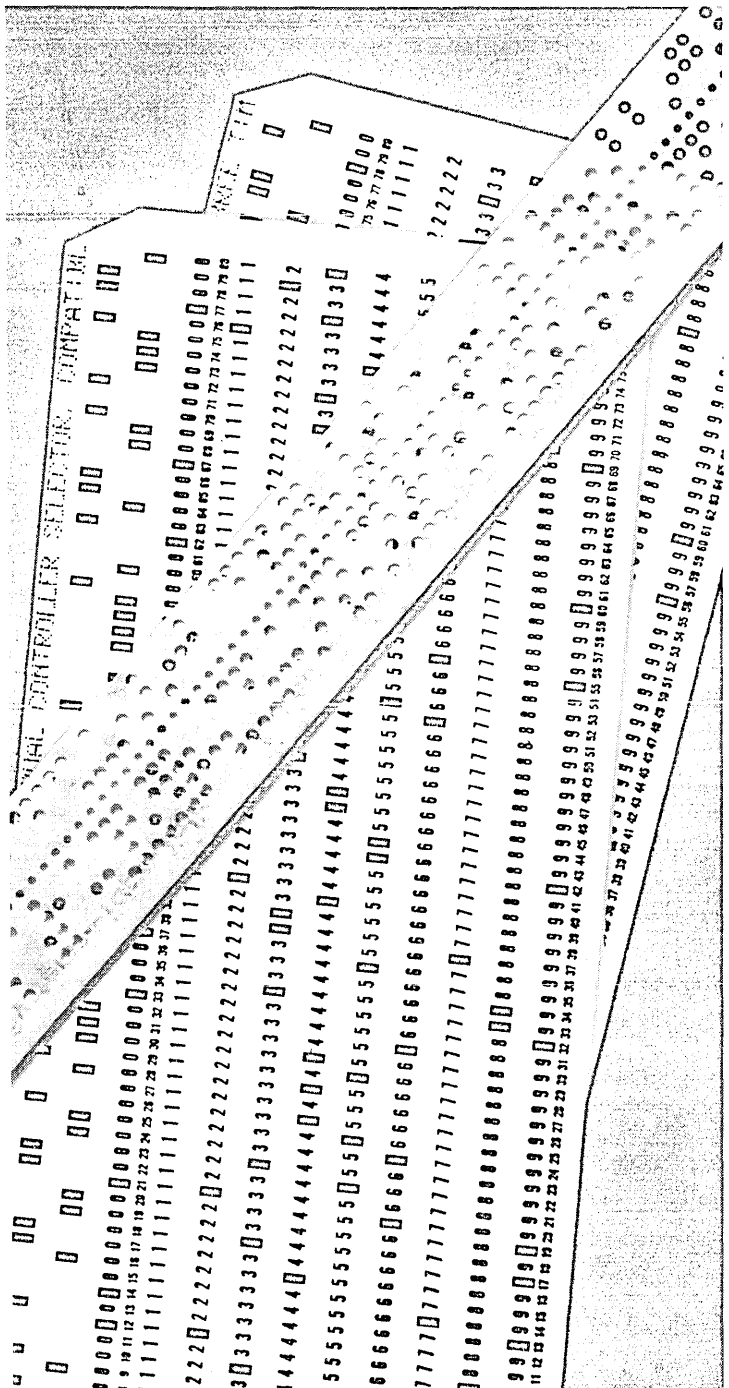
What will happen now to other contenders? It seems clear that Fieldata, even though implemented already in many computers, will gradually be replaced by ASCII. Indeed, Fieldata representation on X3.2 was very strong and valuable. Fortunately the Department of Defense is committed to national and commercial standards wherever they exist, even in preference to some military standards, and so Thomas Morris, Assistant Secretary of Defense, has been instrumental in the completion and adoption of the ASCII code.

It is not likely that the code will be adopted internationally in the exact form that it is in now. However, the

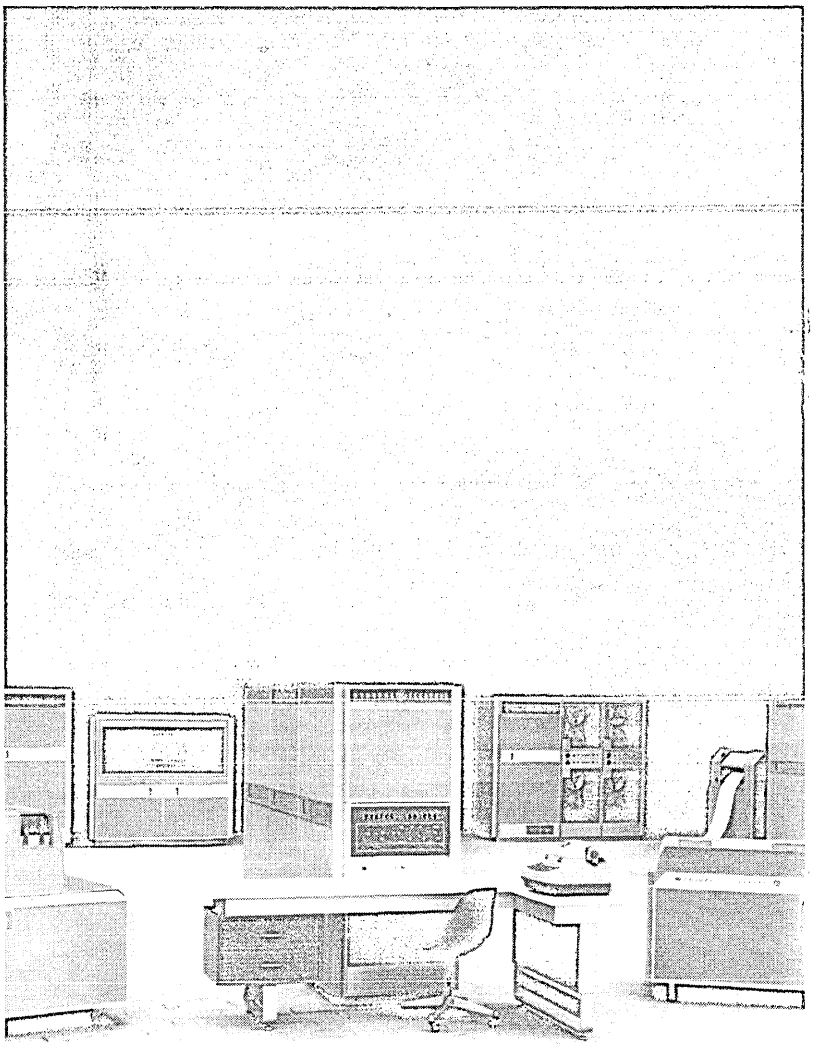
THE COM

General Electric's new family of computers lets you i

programs...



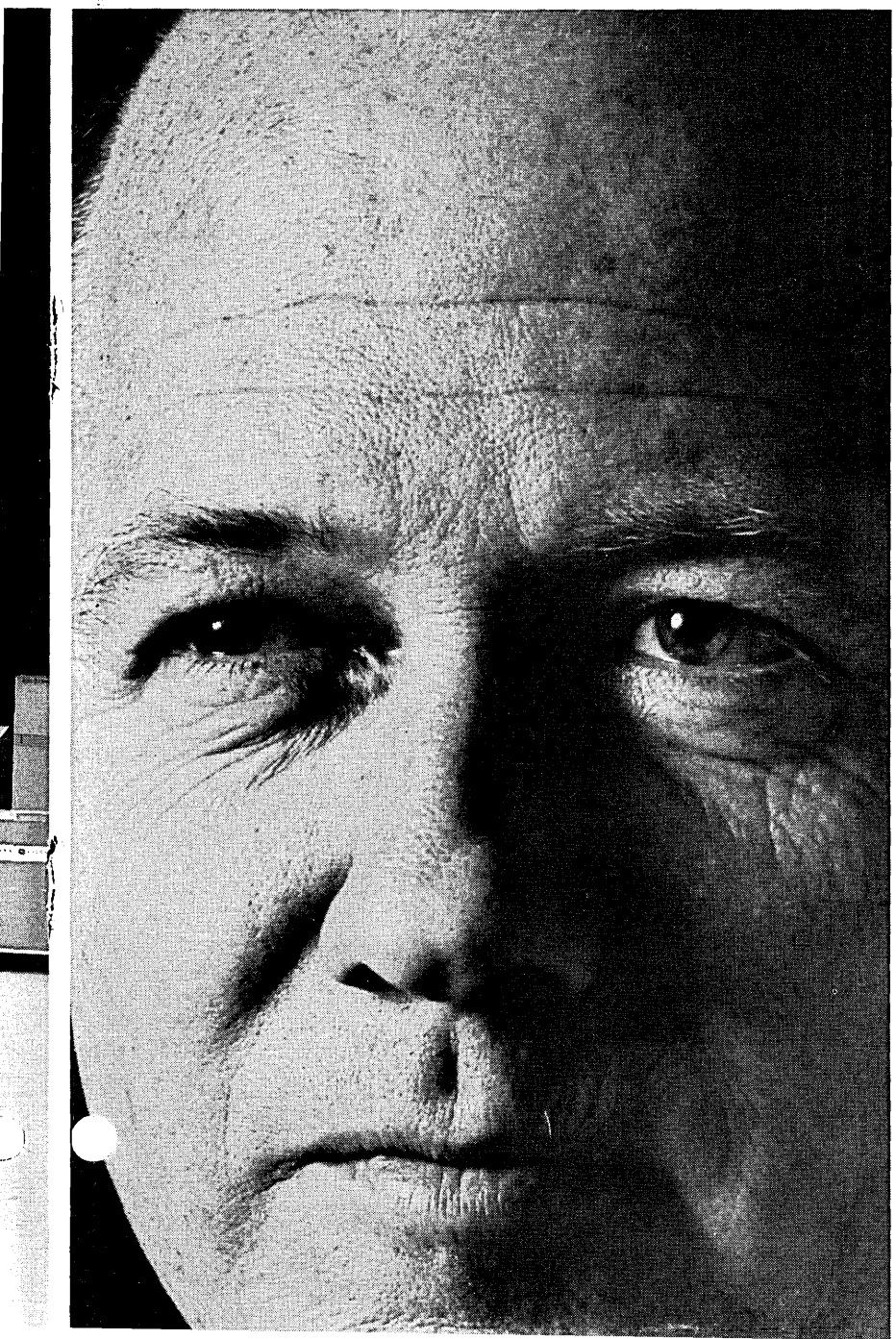
peripherals...



PATIBLES

u 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-9, 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

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GENERAL ELECTRIC

CIRCLE 23 ON READER CARD

AMERICAN STANDARD . .

U.S. has taken considerable pains to meet international requirements and plan ahead. It is likely that a closely related code will become an international standard, in which case the ASA must simply make some modifications. Don't forget, standards are not cast permanently in bronze; they must adapt to the time and circumstances. Actually the degree of cooperation with international standards bodies and consideration of their requirements has been rather a milestone in the case of this code and other computer standards. Formerly the U.S. has either ignored or minimized international requirements. In the case of ASCII the international implications are such (satellite transmission, etc.) that full cooperation was mandatory, if only for the mundane reason that if another war were ever fought in Europe it would be a considerable advantage to be able to use existing communications equipment.

It is also a fact that the computer and information processing market outside of the U.S. is expanding greatly, and U.S. manufacturers must consider the expense of rebuilding such costly things as computers to match non-U.S. standards. It may be that the Russians will ignore this code, even though their requirements have been considered. My guess is that economic motivations of a less controlled society will win again in the American Standard Code for Information Interchange. ■

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FALL JOINT PREVIEW

Sixty-three papers have been scheduled for the technical program of the 1963 Fall Joint Computer Conference on Nov. 12-14, at the new Convention Center, Las Vegas, Nev. Some 3-5,000 registrants are expected, in addition to more than 60 exhibitors.

Sponsored by AFIPS and its representing groups, the FJCC-63 registration fee is $8 for members of ACM, IEEE, and SCi, $12 for non-members, and $2 for students. Conference headquarters will be the Riviera Hotel. Room rates for hotels and motels in the area range from $8-20 for doubles and singles. Early reservations for both rooms and flights to the oasis-town are being recommended. Indeed, some Eastcoast contingents are assembling groups to charter planes to Vegas.

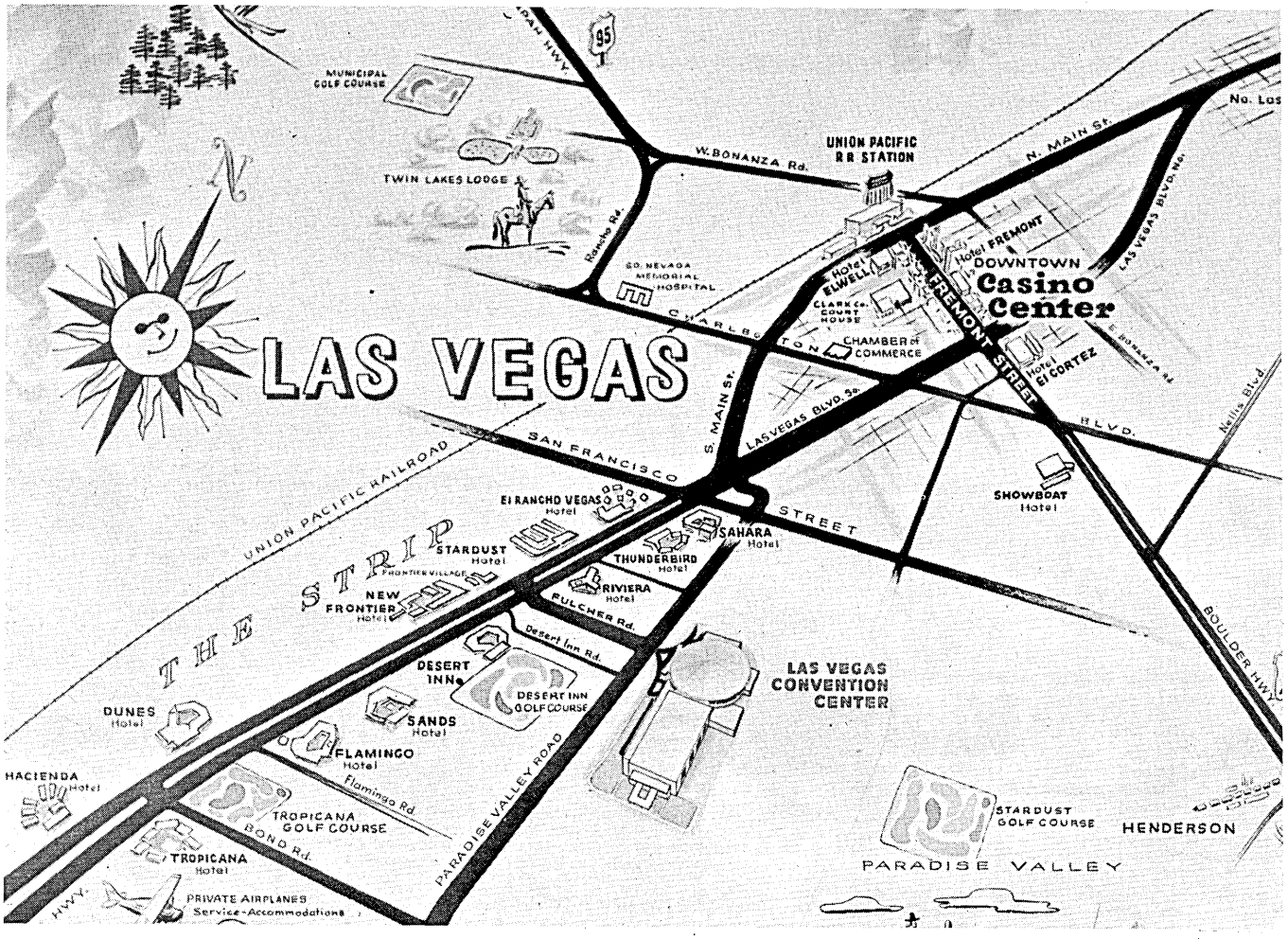
Included in the technical program are two panel and two tutorial sessions, plus a session on Computers as a Social Force. A three-man panel session chaired by George A. Bekey, Univ. of Southern California, will discuss Real-Time Simulation. A panel of five, led by Prof. E. O. Thorp, New Mexico State Univ., will discuss Computers Applied to Games of Skill and Chance.

In addition to tutorials on Hardware for Software Types and Software for Hardware Types, chaired by Richard I. Tanaka, Lockheed Missiles and Space Co., and Walter Bauer, Informatics Inc., respectively, papers will also be presented on (chairmen in parentheses): Experimental Programming (Ascher Opler, Computer Usage Corp.), Computer Memories (Milton Rosenberg, Electronic Memories Inc.), and Multiprocessor Computer Systems (G. L. Hollander, Hollander Assoc.). Also: Information Retrieval (John Postley, Advanced Information Systems), Computer Organization (D. L. Stevens, TRW Computer Div.), Hybrid Analog-Digital Computation (Granino A. Korn, Univ. of Arizona), Mass Storage Systems (Irving L. Wieselman, Data Products Corp.), Natural Language Processing (Frank Marzocco, System Development Corp.), Memory-Oriented Computers (D. L. Slotnick, Westinghouse Electric Corp.), Applied Programming (Robert L. Patrick, Northridge, Calif.), and Input-Output Equipment (Howard Gates, Teledyne Systems).

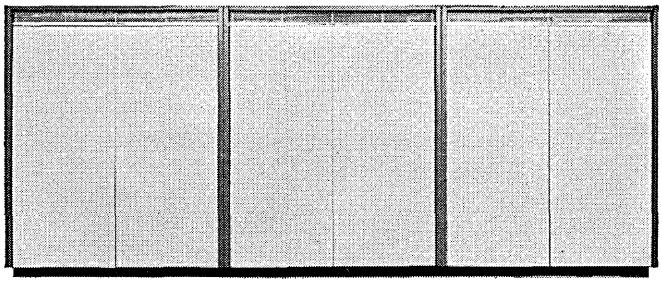
General chairman of FJCC-63 is James D. Tupac, The RAND Corp., Santa Monica, Calif., and program chairman is Paul M. Davies, Abacus Inc., Santa Monica.

Computer science films will be shown on all three days of the conference, Wednesday's showings being of general interest to conference visitors. Published copies of the FJCC proceedings will be available without cost to member and non-member registrants; students will be asked to purchase them.

While no field trips are scheduled, a Ladies Program of non-technical talks, demonstrations, and movies on computers will also include tours of Hoover Dam and Lake Mead and one of the casinos—where ladies will learn "the inside facts about a gambling casino." (See next month's *Datamation* for more "inside facts about . . gambling.") ■



636



the computer that experience built

These few facts tell the reliability story for Daystrom's new 636 General Purpose Digital Computer:

- The 636 is the product of more than a quarter century of experience by Daystrom computers in actual on-line operation.
- During this accumulated span of almost 26 years, Daystrom computers have set an average availability record of better than 99.5 per cent. Each of the computers listed must operate 24 hours a day, 7 days a week.

In addition to providing the assurance fostered by this proven record of reliability, the Daystrom 636 gives you the problem-solving speed you require for today's complex computing applications.

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.

The 636 merits your attention for on-line monitoring and control . . . off-line conversion . . . engineering and scientific problem-solving . . . telemetering . . . any applications requiring a full-size computer.

Getting the facts is as easy as circling the reader service number for this booklet, or calling your local Daystrom office.

BASIC 636: $95,000.

	1958 JUNE	1959	1960	1961	1962	1963	YEARS ON-LINE
Louisiana Power & Light Company							4.90
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Average availability: 99.5 per cent.

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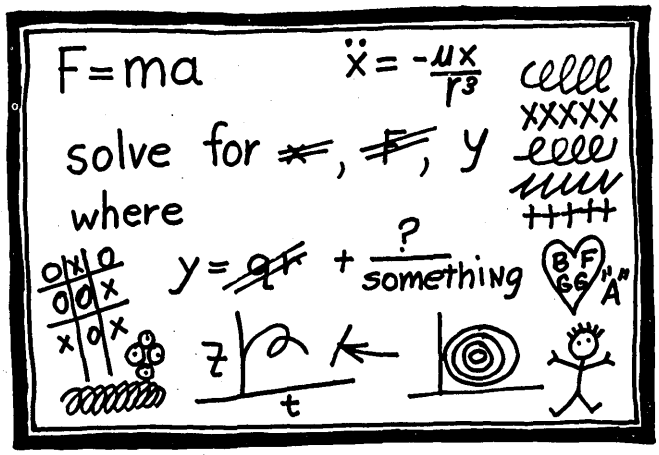
CIRCLE 24 ON READER CARD

Programmer's Primer and COLORING BOOK

ideas by PAUL Des JARDINS
drawings by DAVE GRAVES

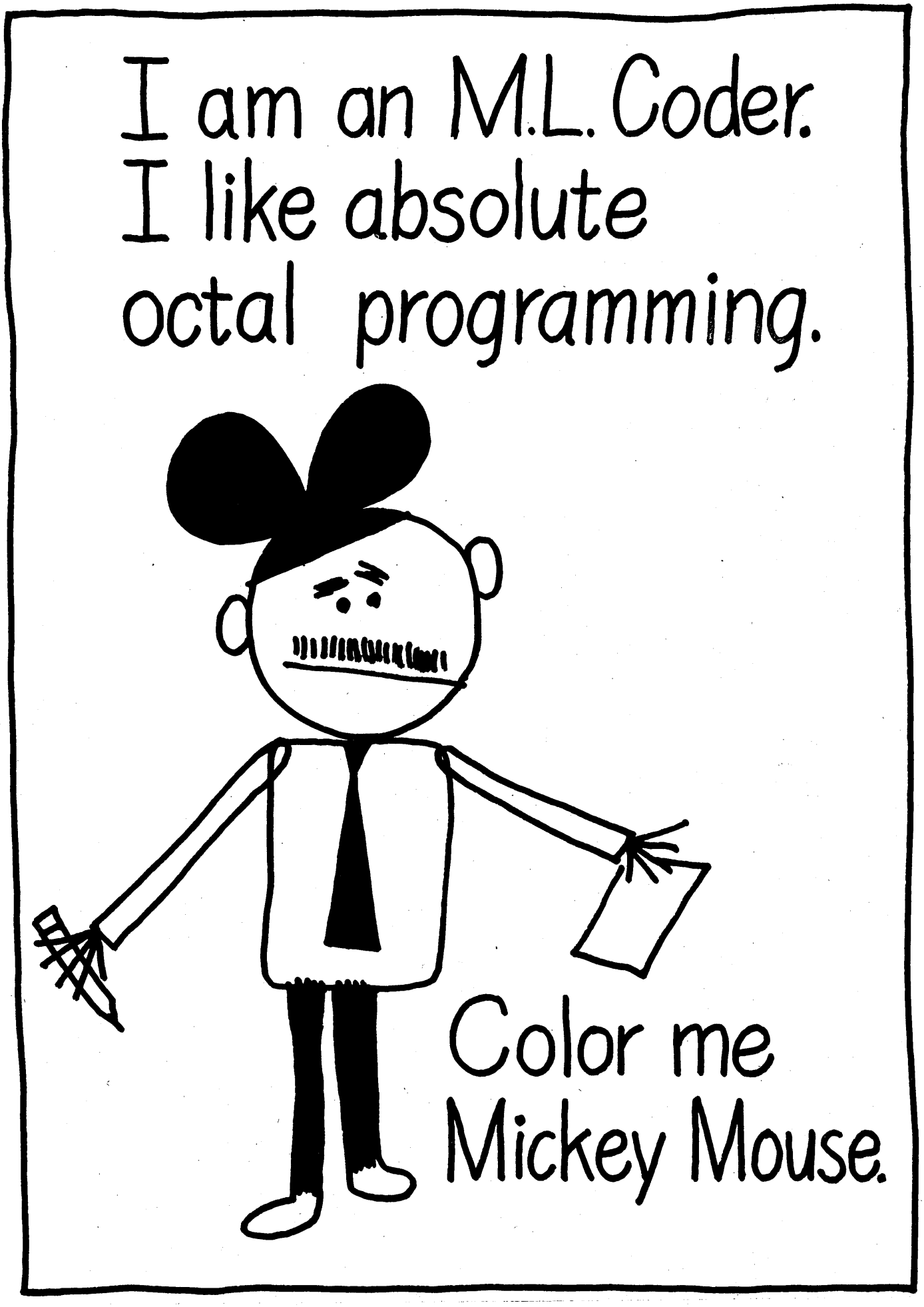
This is a problem definition. We see them every day.

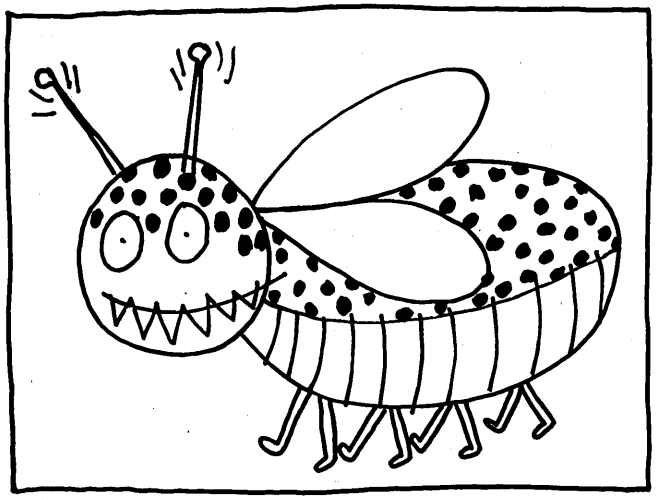


Color it hazy.

This is a FØRTRANNER. He doesn't know much. Color him Naive.

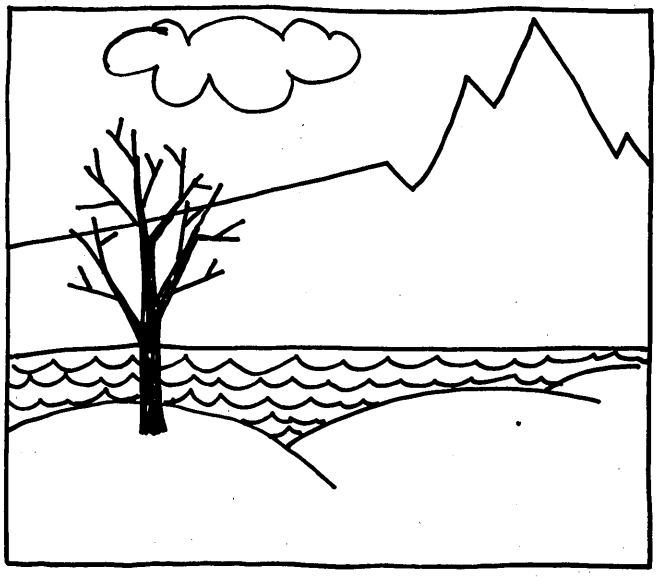
See the computer.
It is dumber than a human...
But smarter than a Programmer.


I am an M.L. Coder.
I like absolute
octal programming.
Color me
Mickey Mouse.



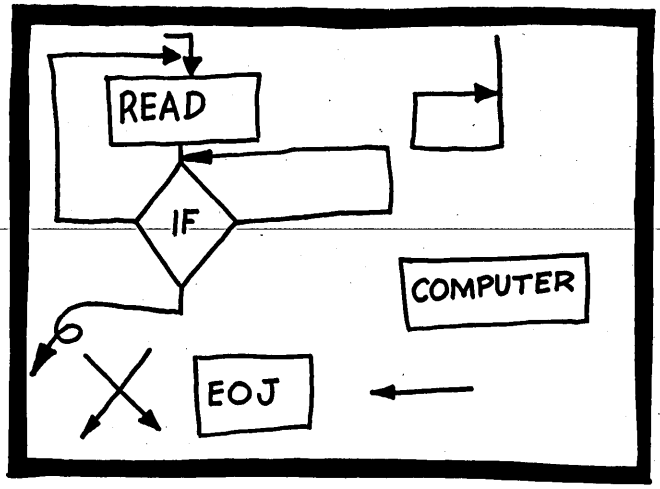
See the program Bug.
He is our friend!!
Color him swell.
He gives us
JOB SECURITY.

Here is an Outlook.



Color it **BLEAK.**

Here is a Flowchart.
It is usually *wrong.*



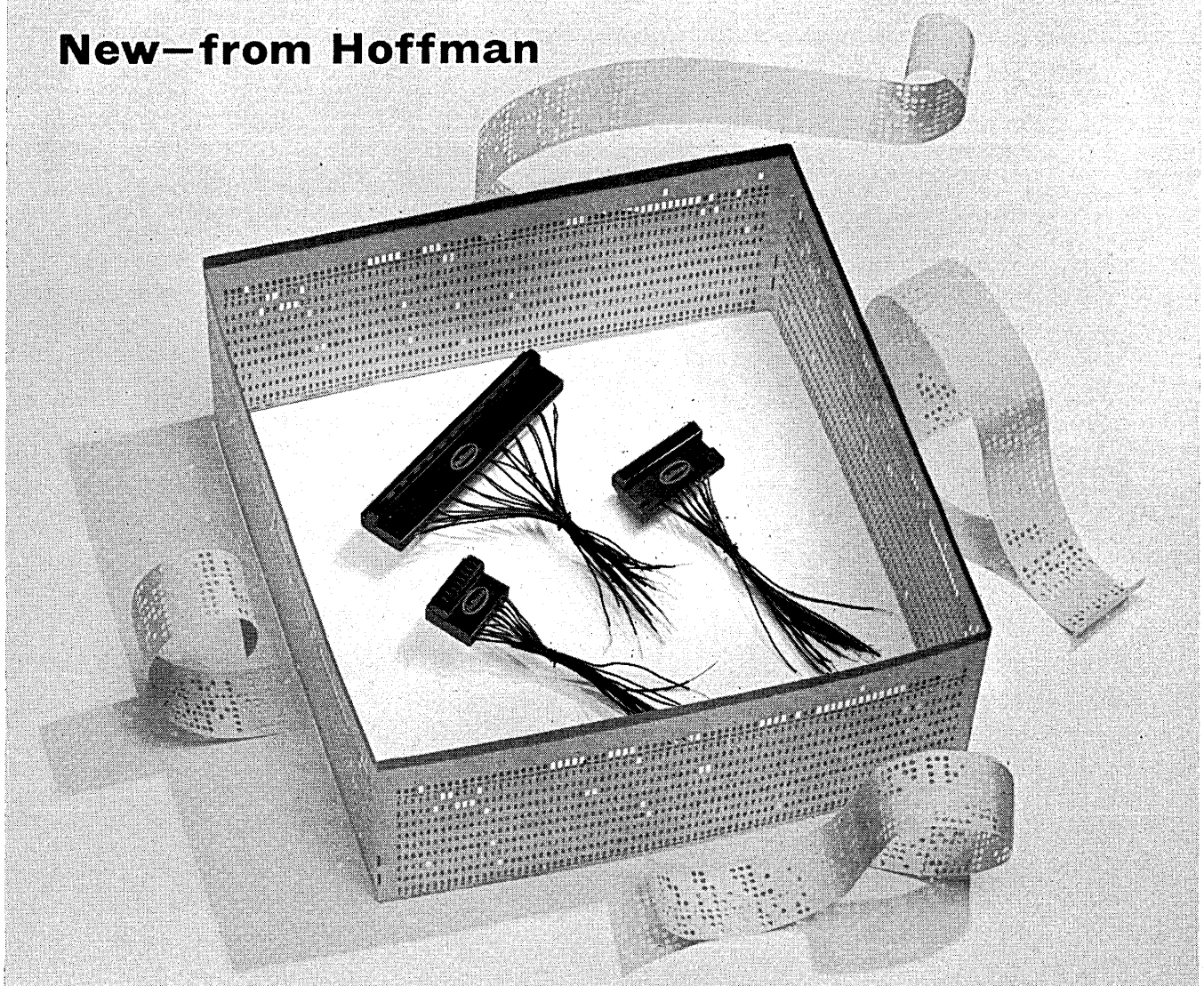
Fill in the missing lines.

This is a core Dump...
it is
GIBBERISH!!!!

00010	20000000	76300000	22 41586
00020	12345678		
00030			
00040			
00050			
00060			
00070	98777777½	00000000	00 00000
00080			
00090			
00100	01111111111⅓	7777777	xx $000
00110			
00120			00
00130			
00140			

Color it ØCTAL.

New—from Hoffman



Pre-packaged Solar Cell Read Out Assemblies

For the first time, here are standardized 9-, 10-, 12- and 80-position head end read outs...for 5/8", 7/16" or 1" tape...and punched cards, either row or column reading. And because these assemblies are pre-packaged, you can get the whole thing for about what you've been spending for the solar cells alone. And get them in a matter of hours. And install them in a matter of minutes. With the assurance that their simple, modular construction means fast, easy maintenance—even in the field.

This leaves the computer engineer free to concentrate on the entire read out system, knowing that the head end has been designed-for-reliability by a company long experienced in the field of solar cell read outs. Coincidentally, this helps out in a lot of other problem areas. Inventory can be sharply reduced; the extra cost of "specials" is eliminated; long installation time is significantly shortened; and what used to be the inordinate gap between order and delivery is cut to almost nothing.

What's more, we've built in some pretty neat design characteristics. Such as:

Glass encapsulation of each cell to hermetically seal out contaminants. **Modular single channel construction** so that each cell is replaceable. **Low dark reverse current** minimizing the danger of circuit overload. **No cross talk** because each cell has its own deep culminated channel access. **Close electrical match** of each cell in the assembly to ±5% of rated voltage. **Glass assembly cover** providing a clean, more-permanent-than-plastic supporting surface for cards or tape.

Give us a call. We have complete information, including all the specs. Pre-packaged.

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CIRCLE 25 ON READER CARD

Why they chose TALLY® for the LGP-21

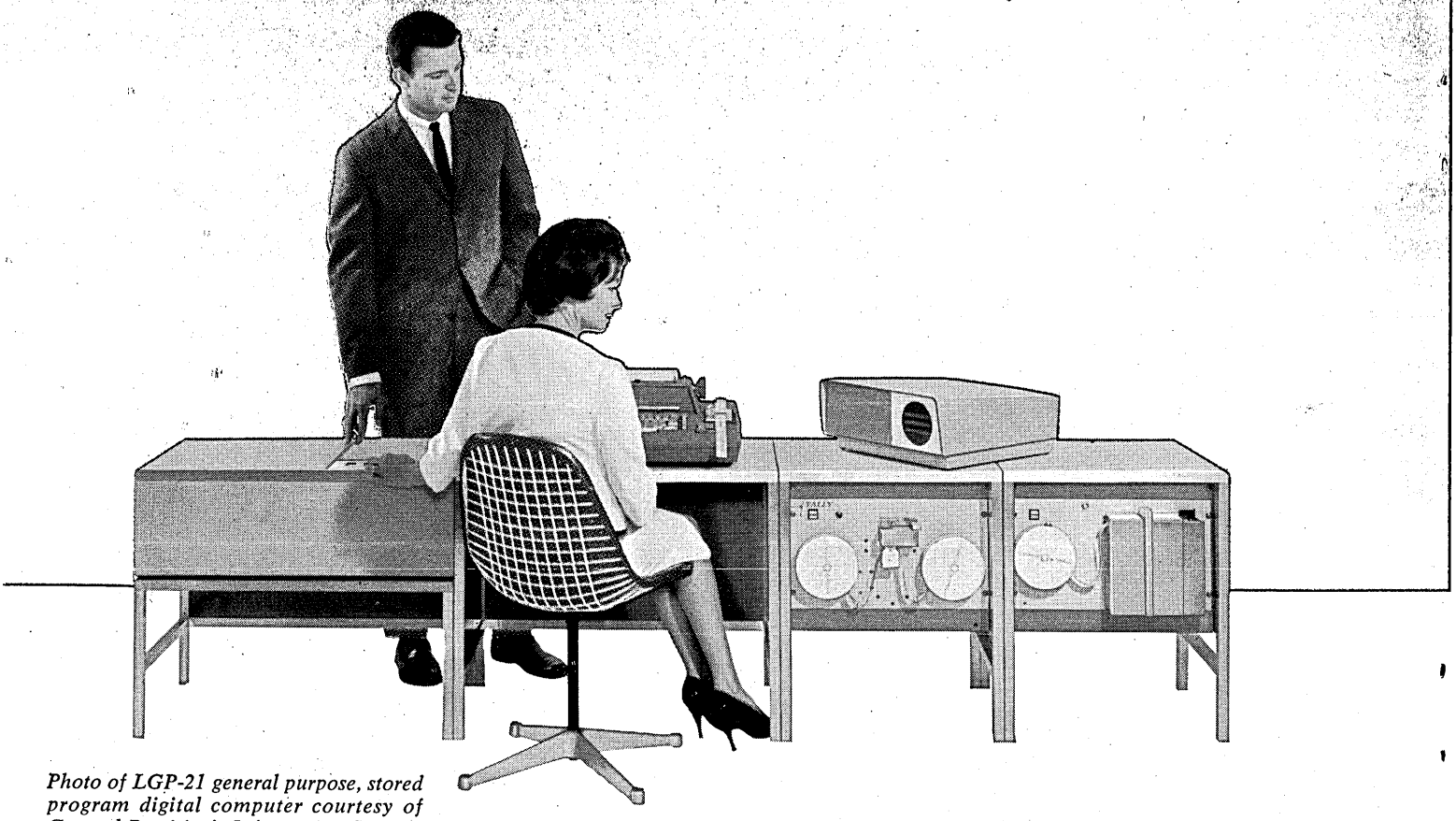


Photo of LGP-21 general purpose, stored program digital computer courtesy of General Precision's Information Systems Group, Commercial Computer Division, Burbank, California.

When it came time to choose the paper tape readers and perforators for this stylish new digital computer, General Precision/Commercial Computer Division found that Tally's equipment cost more* than some competing equipment. But GP still picked Tally, and wound up paying less.

This is why: it cost less to incorporate Tally into the computer, so the total cost was lowest using Tally. (A not uncommon result. It usually costs less because Tally's asynchronous design is wonderfully compatible with other data processing equipment.)

According to GP engineers, Tally also satisfied these important considerations (a) clean styling (b) good human engineering (c) good tape handling features (d) proven reliability.

New Tally readers and punches are even more adaptable. And faster—perforators up to 75 characters/second, readers up to 120 cps. To learn how you can use them, please write us at 1310 Mercer Street, Seattle 9, Washington. Phone: (206) MAin 4-0760.

**But not a lot more. Readers' prices start at $395; perforators at $1,100. Quantity discounts available.*

CIRCLE 26 ON READER CARD

TALLY®

NEWS BRIEFS

CHICAGO BOARD OF ED BEGINS INTEGRATED SYSTEM

An integrated dp system which includes accounting functions, personnel studies and payroll, inventory, scheduling and attendance records, and research in education has been designed by the Chicago public school system. Computer courses at the post-graduate and junior and teacher college levels have been held, with a pilot programming course proposed for the high school fall term.

Hardware configuration will include a 10K IBM 7074 with eight tape units and two 1301 II disc memories, three 1401's, and an REI optical reader with a page carrier and an SDS 910 computer. Total rental will exceed $32K per month; a saving of 3½ megabucks per year is expected when the system is fully operating.

AIR FORCE MOVES TOWARD CENTRAL DP SYSTEMS GROUPS

Dp barriers between Air Force commands are slowly falling with the organization of centralized computer application development groups. A central group of 10 systems and 10 programming personnel is being assembled for an AF base supply dp system at 152 bases throughout the world. They will be joined by 12 programmers to be supplied by the manufacturer whose equipment is selected this fall.

The organization hopes to overcome retraining problems incurred when personnel are transferred between commands. After four to five months, when the system is instituted, a core of HQ command programmers will be retained for system maintenance, reportedly a problem greater than the implementation.

Hardware will be installed at the supply school, Amarillo AFB, Texas, for on-site training of all supply personnel. Programmers are being instructed at Shepherd AFB, Texas.

UCLA OPENS LARGEST MEDICAL COMPUTING CENTER

Medical research at UCLA was given impetus recently with a 3.3 megabuck computer center placed on the air, compliments of the National Institutes of Health. Hardware includes an IBM 7094, 1410, and two 1301 disc files. Facility director is Dr. Wilfrid J. Dixon.

Current blood research activity involves construction of models of complex biochemical systems for experiments in the chemical responses of blood samples to stress conditions. A general medical file is being prepared for a hospital information system, which is also to analyze the probabilities of disease in the presence of sets of established symptoms, and to evaluate therapeutic results and make comparison of alternative treatments. Similar work in heart research is aimed at finding causal factors, and comparing results with findings of similar studies in other parts of the U.S.

One problem being faced is the coding of diseases for input. When asked when medical terms, instead of math terms, will be used for input, Dr. Dixon answered, "The question is, when will medical terms be more widely expressed in, or nearer to, math terms."

The dp staff, under Stanley R. Patton, includes 20 systems designers, 20 programmers, and 30 operating personnel. The school system is the nation's second largest, employing 21,000 teachers and 9,000 operating and administrative personnel, and teaching 550,000 students.

ON-LINE DATA SYSTEM ANNOUNCED BY LOCKHEED

A data gathering system utilizing two-wire telephone lines throughout has been developed jointly by Lockheed and RCA. It has facilities for automatic retransmission when errors are detected, and responds to inquiries in seven seconds. Lockheed facilities in Van Nuys and Sunnyvale, Calif., 400 miles apart, are currently on-line.

At Sunnyvale, where 200 RCA EDGE terminal devices are on-line with two 301's and a disc file, the system is being used for the location of parts in production and the status of specific job operations. Potential applications include payroll, personnel and labor logistics studies, progress of material from ordering to disbursement, tool control and shop load in tool development, and plant maintenance programs. The system is being programmed for more than 20 applications by June 1964.

Presently, 65,000 active shop orders are stored on the discs, and some 25,000 transactions are handled by the system daily. When employees clock in and out each day, 3,000 messages are input in three minutes, using 150 EDGE devices. The system is shut down twice daily for 15 minutes for maintenance. An undetected error rate of .05 per cent is reported by Lockheed. Visualized for the far future is a management display room for planning and control.

Although the system investment at Sunnyvale was 2.5 megabucks through December 1962, an annual saving of 2.8 megabucks is anticipated beginning in September 1964 – over and above developmental and operating costs. Current monthly rental is $60K.

ICT TO BUY FERRANTI'S COMPUTER DEPARTMENT

The long-rumored merger of England's International Computers and Tabulators Ltd. and Ferranti Computer is becoming reality. ICT has agreed to purchase the Computer Dept. of Ferranti, subject to the approval on Sept. 29 of ICT's shareholders. Purchase price is said to be 4.2 megabucks in cash and 1.9 million "fully paid Ordinary Shares"—an estimated 23 megabucks. (The U.S.'s Bendix Computer Div. reportedly was sold for just under 10 megabucks.)

Ferranti, with its Orion and Atlas, is known for its scientific hardware. ICT, referred to as "a marketing organization searching for products to market" (see August DATAMATION, pp. 24-28), has a more commercial line, ranging from tab equipment to small and medium scale computers.

Reportedly not involved in this

transaction are Ferranti's Digital Systems or Industrial Control Systems Departments, which manufacture digital and data transmission equipment and special computers and systems for automatic control and monitoring. Past R&D effort applicable to the Computer Dept., however, is being acquired.

ASI 210, IBM 704 USED IN BIOLOGY STUDIES

Using an ASI 210-controlled film scanning system (CHLOE) and a 704 for data analysis, statistical studies of chromosomes — their distribution, shape, and chromosome pairing—are being made by biologists at the Argonne National Lab, Argonne, Ill.

CHLOE was developed by Donald Hodges, computer engineer, and James Butler, mathematician. Butler and his wife programmed both the 210 and 704. The laboratory plans to use the CHLOE system also for the analysis of spark chamber film data.

GE ANNOUNCES SPEEDED-UP 225, 235 ARITHMETIC UNIT

An Auxiliary Arithmetic Unit for the GE-235 which cuts add times to 18 usec for fixed point double precision and 24-36 usec for normalized floating point has been announced. A free-standing unit which is auxiliary to the arithmetic unit in the main frame, the AAU uses a combination of three 40-bit registers to add, subtract, multiply and divide.

Under programmer control, it operates in the normalized and unnormalized floating point, and fixed point modes. Available for the 225 without modification, and for the 215 with additional gear, the AAU for the 235 leases for $1.5K monthly.

● A nationwide lease-maintenance program for users and manufacturers of data systems, including computing, simulation, data acquisition and reduction systems, has been announced by Techniserv Corp., Los Angeles. Although intended primarily for new systems, the service is said to include also used equipment and the conversion of systems presently being leased. For information:

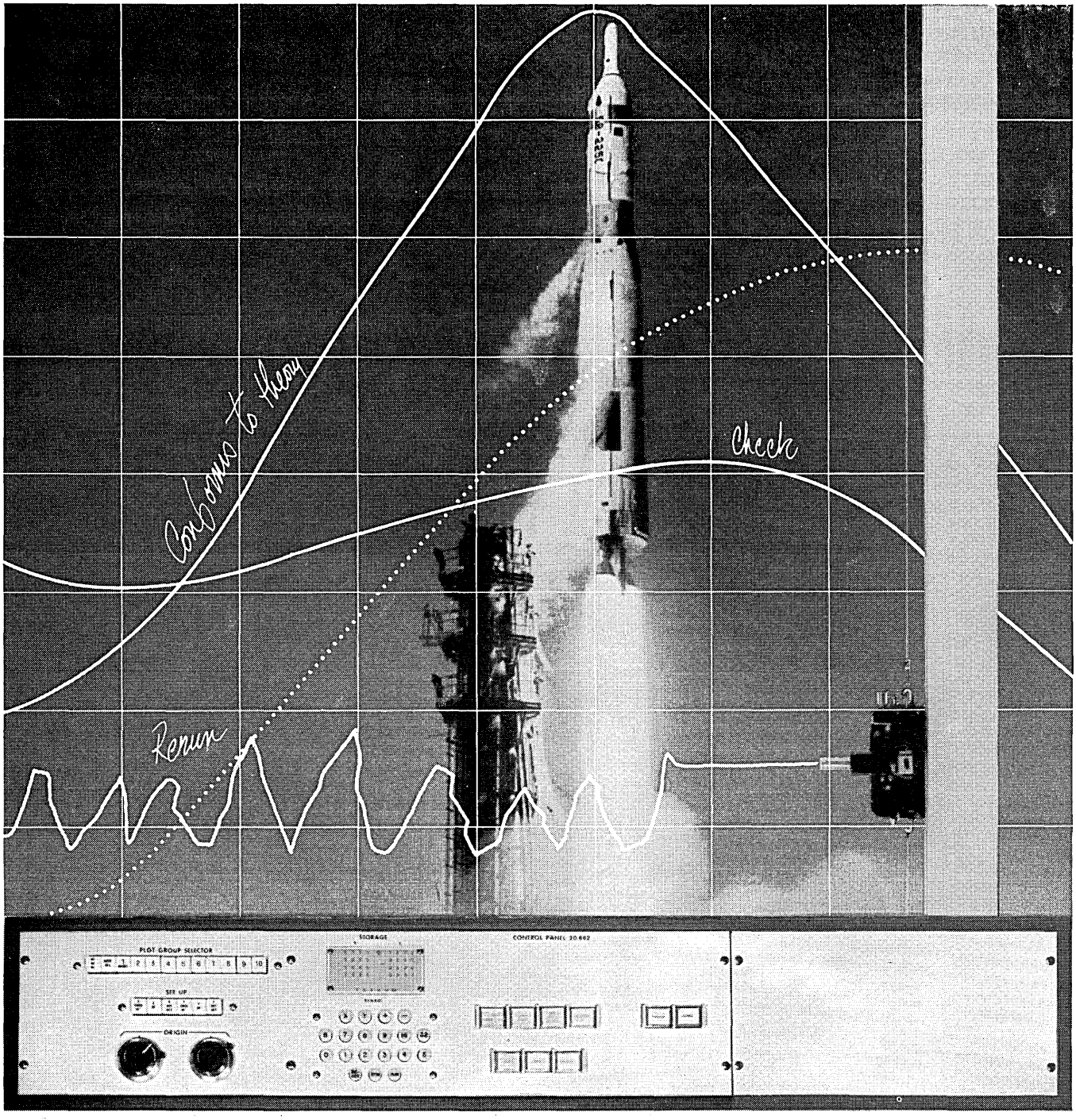
CIRCLE 100 ON READER CARD

● Submission of candidates has been invited for the first Harry Goode Memorial Award by its sponsor, AFIPS. Review of candidates will be based on contributions to the field within the scope of AFIPS in the form of theory, design, or technique, academic activities or writings, publications or outstanding papers on theory or practice, or as editor of material influential to significant developments. Deadline is Jan. 15, 1964. Forms for candidate recommendations are available from Claude A. R. Kagan, Awards Committee, P.O. Box 900, Princeton, N.J.

● Among Computerland's Jet Set, Australia is now "in." The latest marketing agreement down under has ICT handling Univac's complete line of computers, in addition to the 1004 already being marketed there under an earlier agreement. Meanwhile, English Electric-Leo Computers Ltd. announces its fourth sale there, which will bring their installations to three Leo III's and one KDF 9.

● A mobile, digital data acquisition system has been announced by Datacraft Inc., Los Angeles, Calif. The trailer-housed 100-channel system is said to be capable of recording at 1,000 samples per second in a format compatible with the IBM 7094. The firm also has analog-on-wheels systems, either of which is available on a short-term rental basis. For information:

CIRCLE 101 ON READER CARD



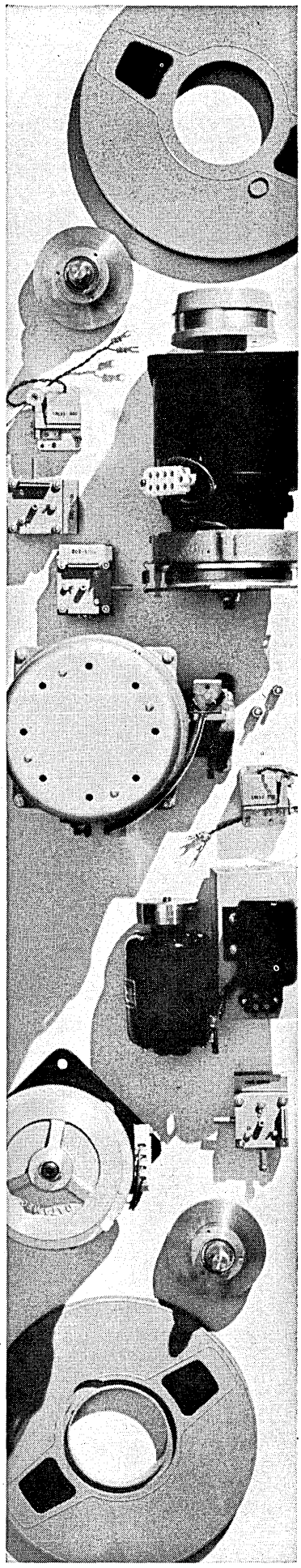
HOW TO "REDUCE" AN ORBIT TO 30" X 30"

You can graphically reduce mountains of telemetry data to an easy-to-read curve with an EAI DATAPLOTTER®. As many as 4500 line segments can be plotted on a 30" x 30" surface in one minute. The EAI DATAPLOTTER will accept inputs directly from most digital computers, from magnetic or punched tape, punched cards or from manual input keyboards. Plotting accuracy is .05% with repeatability of .01%. Reliability is assured by solid-state electronic circuitry. ☐ EAI DATAPLOTTERS can "reduce" your telemetry data-problems. Write for details today.

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

ADVANCED SYSTEMS ANALYSIS AND COMPUTATION SERVICES/ANALOG COMPUTERS/HYBRID ANALOG-DIGITAL COMPUTATION EQUIPMENT/SIMULATION SYSTEMS/ SCIENTIFIC AND LABORATORY INSTRUMENTS/INDUSTRIAL PROCESS CONTROL SYSTEMS/PHOTOGRAMMETRIC EQUIPMENT/RANGE INSTRUMENTATION SYSTEMS/TEST AND CHECK-OUT SYSTEMS/MILITARY AND INDUSTRIAL RESEARCH AND DEVELOPMENT SERVICES/FIELD ENGINEERING AND EQUIPMENT MAINTENANCE SERVICES.

CIRCLE 31 ON READER CARD



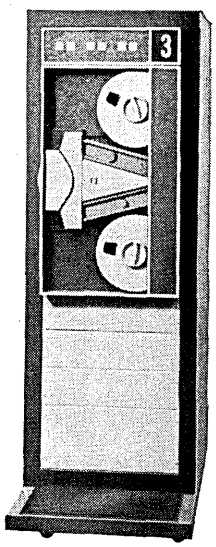
MOVING PARTS

...Vital Elements in the Datamec D2020

Moving parts are the vital elements in reliability of a computer magnetic tape unit. Datamec D 2020 moving parts are few in number, and each has been given meticulous attention in its design, testing, evaluation, and production standards. All D 2020 moving parts carry operating time warranties. The D 2020 preventive maintenance schedule shows the pay-off for this concentration on moving parts: Continuous up-time on your data system at lowest operating cost.

And that's only one reason you should select the Datamec D 2020 for your digital data processing systems. It uses the compatible 200, 556 and 800 bpi computer tape formats. Tape speed is 45 ips. Start time is 5 ms, bi-directional. Thorough reliability and low cost are fundamental in D 2020 tape units and D 2020 multiple tape unit systems.

Contact your local Datamec representative for complete information, or write Datamec Corporation, 345 Middlefield Road, Mountain View, California.



1 DATAMEC

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computer careers

Our clients have present critical needs in the $9,000-$25,000 class for Managers and Seniors and men who can accept management responsibility and professional growth.

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Contact us if you have experience or interest in any one of the following:

- ☐ **Scientific Computation or Analysis** — For unusual Aerospace and Lunar programs. IBM 7000 type experience & strong Mathematics
- ☐ **Real Time** — Programming
- ☐ **Software Development** — Languages, Compilers, Assemblers, Monitor Systems, Etc.
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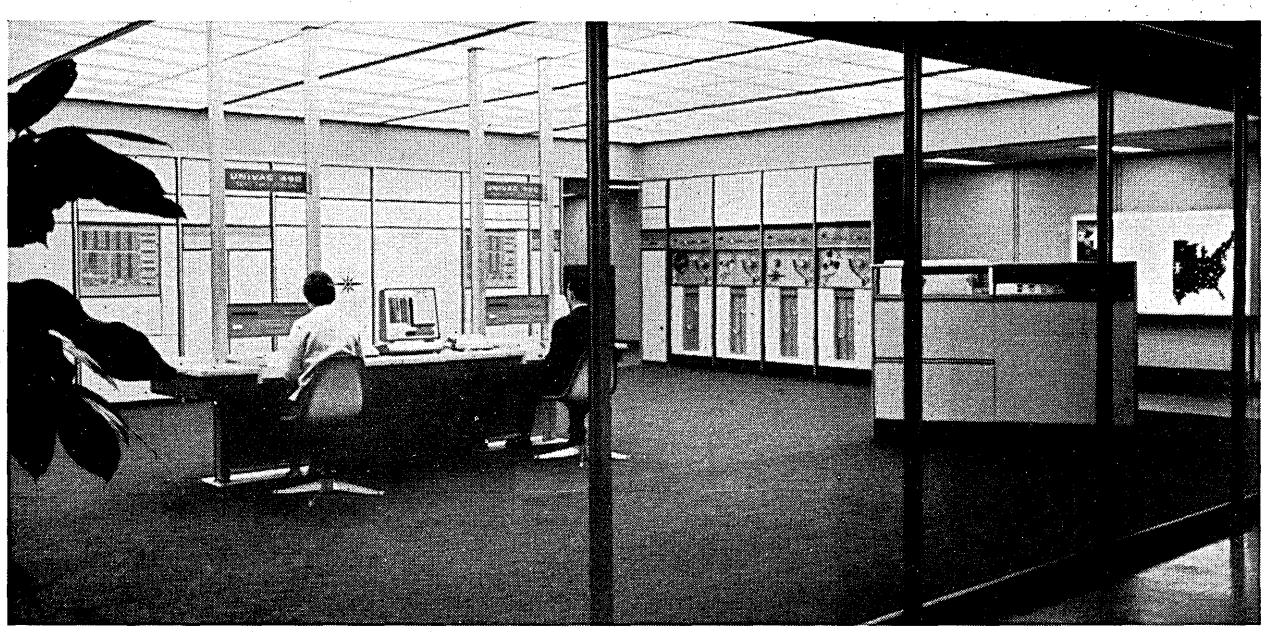


In its first 12 months of operation, this real-time computer system handled over 33,800,000 transactions for Eastern Air Lines and transmitted over 400,000 teleprint messages to reservation offices and airports in 15 different cities.

Quick! What company makes it?

UNIVAC, of course. The computer? The famous UNIVAC® 490 System.

This first year's performance record is just the beginning. A continuing program of additional applications promises even greater performance in the years to come.

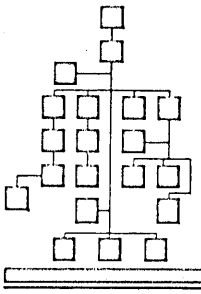
Latest innovation is automatic preparation and teleprint transmission of "Air-Shuttle" flight plans, containing flight number, scheduled departure time, type of equipment, true air speed, altitude, preferential routing and elapsed time.

Next: a "wheels up" routine—automatic recording of flight departure times—to relay precise flight arrival and departure data to Eastern's customers and for more accurate records of flying time and parts usage.

If you have a requirement for simultaneous control of remote communications operations combined with concurrent processing of vast quantities of data, the UNIVAC 490 Real-Time System is the system you've been looking for. Here is an extremely high-speed, fully automatic, commercially available electronic system designed to meet the message switching, communications and data processing requirements of modern business and industry for years to come.

The UNIVAC 490 is flexible, versatile and modular. It can handle almost any assignment, no matter how large or complex. Interested? Better call your UNIVAC sales engineer, quick!

UNIVAC DIVISION OF SPERRY RAND CORPORATION



people IN DATAMATION

■ Robert S. Barton, consultant-at-large, is joining CDC as Manager of Applications in Australia. He will be stationed in Canberra, where he will serve in a consulting/liaison capacity for the forthcoming 3600 complexes at the Commonwealth Scientific and Industrial Research Organization and the Bureau of Census & Statistics.

■ John H. McLeod, Jr., an authority in the fields of analog computation, simulation and instrumentation, has joined Hollander Associates, Fullerton, Calif. The editor of the Simulation Council Newsletter, McLeod was most recently a project engineer at General Dynamics/Astronautics, San Diego.

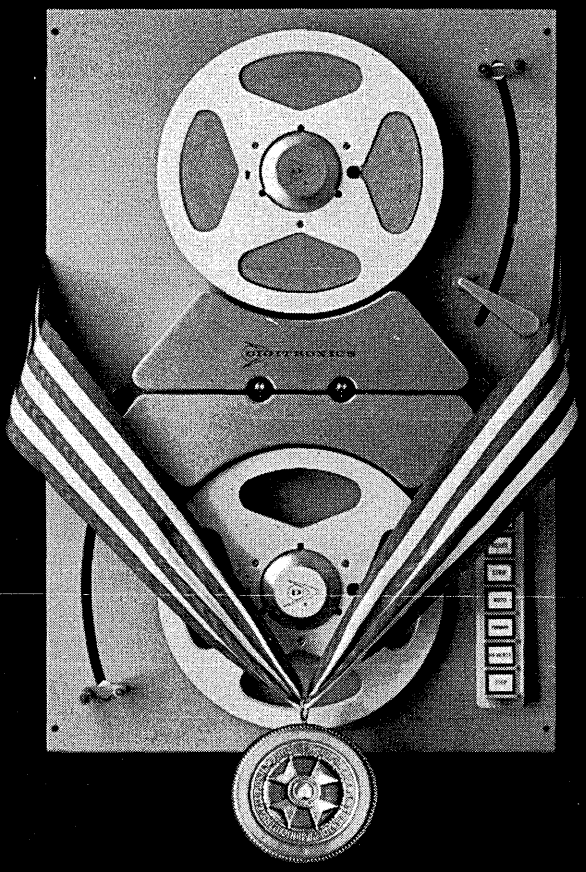
■ Thomas V. Cooper has resigned as vp & director of marketing of Datatrol Corp. to form his own marketing consultant firm in Washington, D.C. He will continue to serve Datatrol as a dp and marketing consultant.

■ David Ferguson, author of the 709 and 7090 FAP and the LARC scientific compiler, is one of four founders of Programmatics, Inc., Palos Verdes software consulting firm. He was most recently associated with Computer Sciences Corp.

■ Brooke P. Taylor has been appointed a vp for Benson-Lehner, and will establish that company's European operations for the marketing there of Dura Business Machines equipment. Taylor was formerly manager of Monroe's Electronic Computer Division.

■ CEIR president Dr. Herbert W. Robinson has been elected president of ADAPSO, the Association of Data Processing Service Organizations.

■ Lynn C. Hayward has been named manager of computer operations for the Univ. of Texas' Anderson Hospital & Tumor Institute in Houston. He was formerly associated with the UCLA Health Sciences computing facility.



My Hero

In the great army of tape readers this trooper stands out with extraordinary distinction. A most commanding instrument, particularly with digital computers, machine tool controls, ground support equipment and other instrumentation. It's Digitronic's Model 4500A Bi-Directional Photo Electric Tape Reader. It handles 5 to 8 level tapes interchangeably at speeds up to 1000 cps. Stops before the following character at 1000 cps. Includes all electronics for transport controls and channel amplifiers. But then all 10 models of Digitronics perforated tape readers and handlers are giving distinguished service and "winning medals" in numerous companies and public and private agencies throughout the country. We invite you to review the troops. For immediate action, see your local Digitronics representative or write to Digitronics Corporation, Albertson, New York.

DIGITRONICS

when every bit counts

CIRCLE 33 ON READER CARD

NEW LITERATURE

TECHNICAL NOTE: NBS report explains coding and data preparation required for printing of tabular data in the form of mag tape output from a computer. Six pages, 10 cents. SUPT. OF DOCUMENTS, U.S. Gov't. Printing Office, Washington 25, D.C. For copy:

DIGITAL COMPUTER: 16-pp brochure describes the Series 350, digital processor of the hybrid HYDAC 2000. Bulletin AC-6297 available from ELECTRONIC ASSOCIATES, INC., Long Branch, N.J. For copy:
CIRCLE 131 ON READER CARD

ANALOG PROGRAMMING: 16-pp pamphlet describes use of bipolar amplifiers in programming analog computers. APPLIED DYNAMICS, INC., 2275 Platt Rd., Ann Arbor, Mich. For copy:
CIRCLE 132 ON READER CARD

DISC FILE: Anelex Model 800 random access disc file with a capacity of 20,160,000 bits is described in four-page brochure available from ANELEX CORP., 150 Causeway St., Boston 14, Mass.
CIRCLE 133 ON READER CARD

GLOSSARY: GET-3397 defines nearly 200 process computer terms, includes terms used with frequent exception to original meaning. GE INDUSTRY CONTROL DEPT., Process Computer Section, Phoenix, Ariz., For copy:
CIRCLE 134 ON READER CARD

TECHNICAL BOOKLIST: New catalog of technical books covering computers and other topics available from HOWARD W. SAMS & Co., Technical Book Division, 4300 W. 62nd St., Indianapolis 6, Indiana. For copy:
CIRCLE 138 ON READER CARD

PERIPHERAL GEAR: This booklet describes all peripheral equipment available for the 250 computer, including graph recorder, A/D converter, and memory extension chassis. PACKARD BELL COMPUTER, 1905 Armacost Ave., Los Angeles 25, Calif. For copy:
CIRCLE 135 ON READER CARD

X-Y RECORDER: Dimensions, features, specifications and typical performance curves of the HR-96 x-y recorder are offered in this illustrated bulletin. HOUSTON INSTRUMENT CORP., 4950 Terminal Ave., Bellaire 101, Texas. For copy:
CIRCLE 136 ON READER CARD

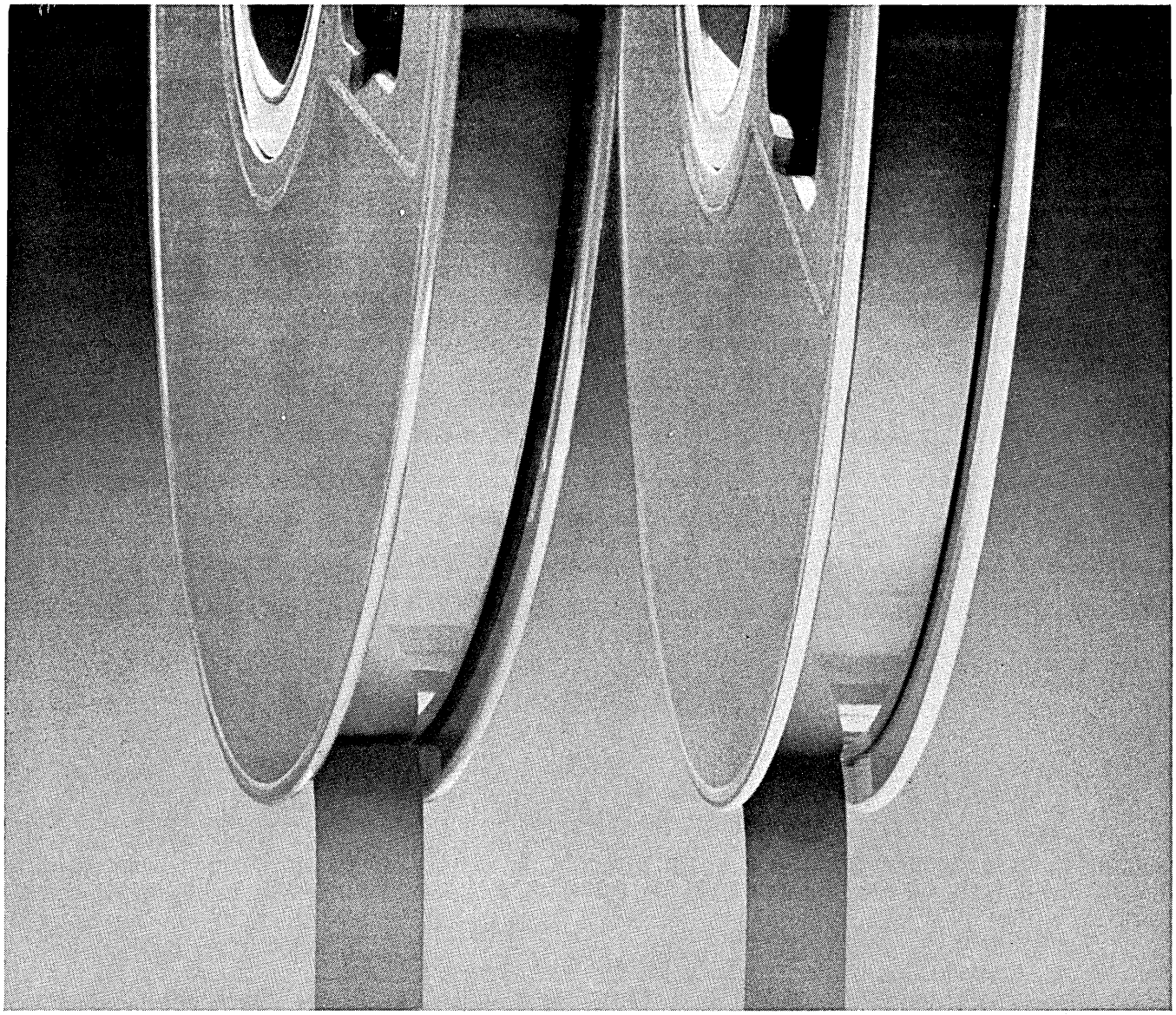
PAPER TAPE PUNCH: This bulletin presents specifications of the Tapewriter electronic paper tape punch, and a description of a remote control keyboard. NAVIGATION COMPUTER CORP., Valley Forge Industrial Park, Norristown, Pa. For copy:
CIRCLE 137 ON READER CARD

next month in DATAMATION

Next month, DATAMATION again showcases the upcoming Fall Joint Computer Conference, with detailed coverage of the scheduled events (talks, technical sessions) and an eye toward the unscheduled (strategy and money management at the blackjack table).

Additionally, there'll be a lowdown on a new, uplifting philosophy of dp management currently in effect at Northrop. And that peripatetic observer, R. L. Patrick, applies pointed pen to place in proper perspective another area of computer research which is drawing increasing attention.

Good morning, George—How did your program test go last night?



BOTH THESE MAGNETIC TAPES HAVE A POLYESTER BASE ...BUT ONLY ONE IS MYLAR® (8 YEARS PROVEN)

Eight years ago computer tape of Du Pont MYLAR* polyester film appeared on the scene and set new standards of reliability. Naturally enough, people whose needs called for a magnetic tape of highest performance couldn't risk a tape other than MYLAR. ■ Now, other polyester films are beginning to appear. They are not all the same: MYLAR is a polyester film, but other polyester films are not MYLAR. In the past you could safely assume you were getting MYLAR when you specified "polyester base". *Today you cannot.* ■ There's only one way to be sure you're getting the MYLAR you've used and trusted for magnetic tapes of proven reliability: specify **MYLAR** by name. E. I. du Pont de Nemours & Co. (Inc.), 10452 Nemours Bldg., Wilmington 98, Delaware.

*Du Pont's registered trademark for its polyester film.

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

only **DU PONT** makes
MYLAR®
POLYESTER FILM

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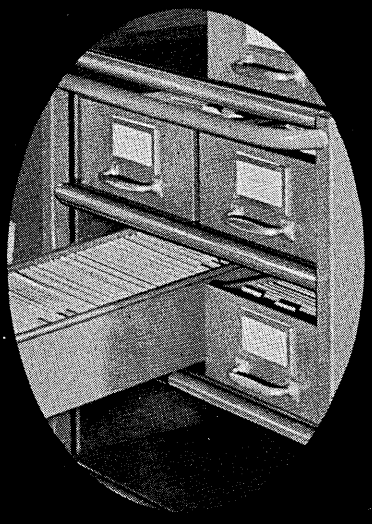
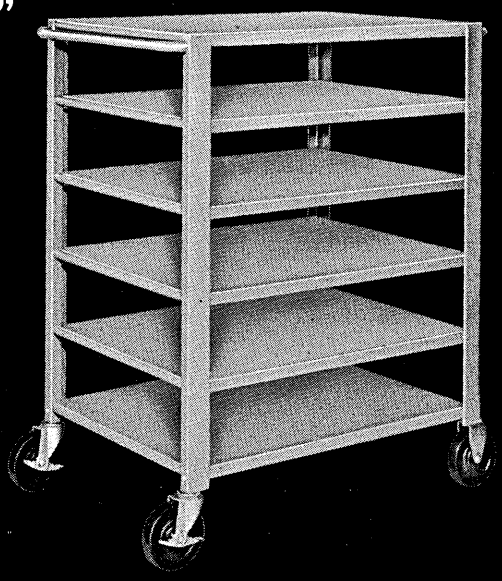
DESIGN

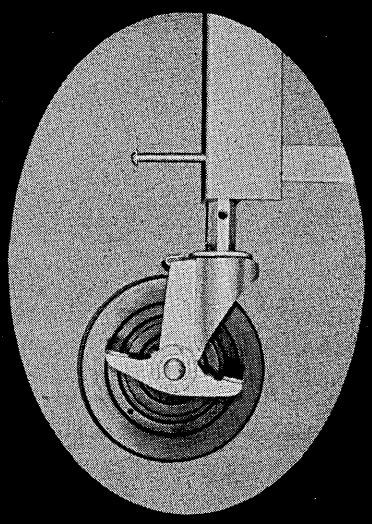
makes the difference*

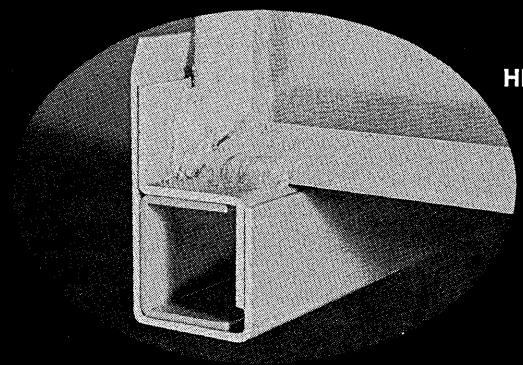
"CARTABOUTS"

MODEL 0505









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SHELF ROLLERS (Exclusive)
Create a virtual suspension file on wheels.

HEAVY-DUTY 5" CASTERS (Exclusive)
Press Fit, then Bolted into Posts

STRONGEST POST CONSTRUCTION (Exclusive)
Plus 16" of Arc-Weld per Shelf

*ALL Systems Metal Products are unconditionally guaranteed for FIVE YEARS, under normal usage.
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CIRCLE 37 ON READER CARD

...but where are all the adjustment knobs?

They just aren't. Because the new 300-line-per-minute *data products* LINE/PRINTER doesn't need any adjusting. It's that simple. And that far advanced over other medium speed printers.

For example, this maximum-reliability printer has single action print hammers, electromechanically controlled (no linkages) and completely free of friction. So not only is there nothing to adjust, but there's far longer operating life with precise, constant timing no matter what the environment is.

Example. The dual tractor paper feed is controlled by a digital stepping motor for positive response to fast single space and skip operations. No clutch, no brakes – and nothing to adjust.

Example. Not only does this printer handle all standard form sizes, but it makes from one to six copies without any penetration or phasing adjustment.

The simple, clean operation of the LINE/PRINTER also includes many other interesting features. Like easy maintenance. And precise alignment controls for the operator. And up to 132 columns. Yet the price tag is competitive with – or lower than – even near-comparable equipment. Even the ribbon costs only a little more than $4 – and is replaceable in seconds.

We've got complete technical data on this Model dp/p-3300 and, by arrangement, a demonstration of a production unit. Contact us.

data products corporation 8535 Warner Drive/Culver City, California/Phone: 837-4491

THIS IS NOT AN EASY CHAIR In fact, from where we sit, the programming of a computer is grueling, long-houred, trial-and-error work; of course, it can also be brain-tingling, ample-salaried and a labour of love—especially when the creator of computer soft-ware sits in concert with the seasoned professionals who staff Computer Concepts, Inc., with offices in Washington, D. C., New York City and Los Angeles. These programmers, esteemed by the mushrooming computer industry, are steeped in such information processing activities as machine translation, computer efficiency studies, systems programming, business data processing, and advanced scientific and logistic programming . . . If you have a minimum of 2 years experience on IBM computers, and you yearn to scan the soft-ware horizons of computery — pull up a chair; it won't be easy, but then, nothing worth while ever is.

1012 14th Street, N.W., Washington, D. C.

COMPUTER CONCEPTS, INC.

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

It's the Computron people who are getting smarter, Penelope. This new transparent LEXAN* reel is the most sensational, fabulous, and otherwise terrific thing that's ever happened to computer tape!

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.

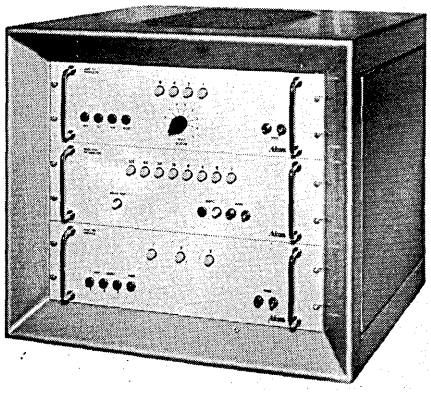
COMPUTRON INC.
122 Calvary Street, Waltham, Massachusetts

CIRCLE 40 ON READER CARD

NEW PRODUCTS

a-d converter

Model 601A-10 will accept 10 high-level analog inputs and digitize them to 8-bit accuracy at up to 100,000



words per second, matching maximum input rates of the CDC 160A. ADCOM CORP., 9732 Cozycroft Ave., Chatsworth, Calif. For information:

CIRCLE 200 ON READER CARD

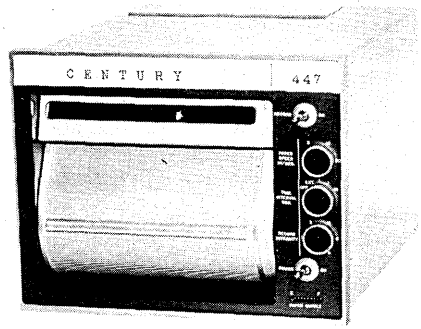
annotating plotter

Model 1065-1-ONL features resolution of 100 points per inch, paper speed of 10 ips. It will accept, decode and mark up to 100 10-bit plot words per millisecond, according to the manufacturer. On-line plotting time must include computer cycle time; off-line plotting– with print and plot buffers plus tape transport–produces five plot points per trace at 10 ips, using 200 bpi tape moving at 150 ips. DREXEL DYNAMICS CORPORATION, Horsham, Pa. For information:

CIRCLE 201 ON READER CARD

analog recorder

Direct writing unit handles up to 36 channels with flat response to 5000 cps; choice of tungsten light source (writing speeds up to 5000 ips), or the 50K ips Xenon lamp. Handles paper



eight inches wide, up to 475 feet long. Price, less galvonometers: $1575. CENTURY ELECTRONICS & INSTRUMENTS, Inc., 6540 E. Apache St., Tulsa 15, Okla. For information:

CIRCLE 202 ON READER CARD

plotter

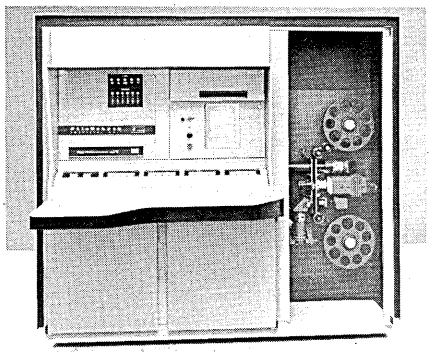
Series 1000 offers 5 x 12-foot display surface, drawing speed of up to 300 inches per second on standard

models, with higher speeds available. Basic line drawing is "better than ± 0.015" divergence from a true straight line." Point plotting, at 90 points per minute, is "better than ± 0.010" of true position." GERBER SCIENTIFIC INSTRUMENT CO., P.O. Box 305, Hartford, Conn. For information:

CIRCLE 203 ON READER CARD

retriever

New FileSearch retrieval unit (Model 112) electro-optically scans index code on phototape, features "more sophisticated" search capability than its predecessor, and a new float-



ing method of moving tape said to reduce scratch and wear. The unit searches at the rate of 100 pages of stored material per second. FMA, Inc., Dept. F., 142 Nevada St., El Segundo, Calif. For information:

CIRCLE 204 ON READER CARD

data transmission

New 25A DATATEL is classified as an intermediate-speed transmission system which sends data over private telephone lines at a top speed of 200 bits per second, or 11 punched cards (roughly 140 words per minute). Average error rate of 1 per million bits is claimed. GENERAL TELEPHONE & ELECTRONICS Corp., 730 Third Ave., N.Y. 17, N.Y. For information:

CIRCLE 205 ON READER CARD

plotter series

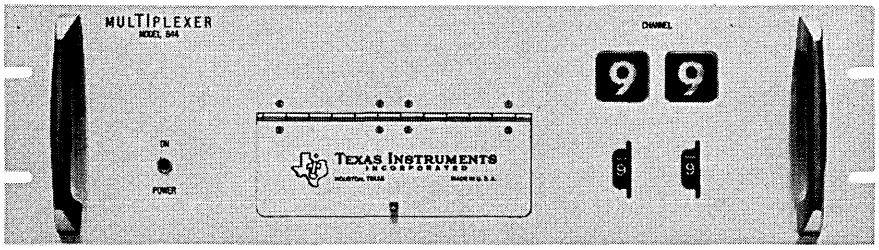
Series 3110-20-30 operate on-line or from punched card or tape readers. Maximum speeds: 100 points or 70 lines per minute, on 10 x 15" surface. Input information is three decimal digits plus sign. Prices start at $6500, with deliveries 120 days after receipt of order. ELECTRONIC ASSOCIATES, Inc., Long Branch, N.J. For information:

CIRCLE 206 ON READER CARD

tape transport

Honeywell 6200 produces 200 bpi, half-inch tape for 7-track computer

...up to 160 channels in a $5\frac{1}{4}$" panel!



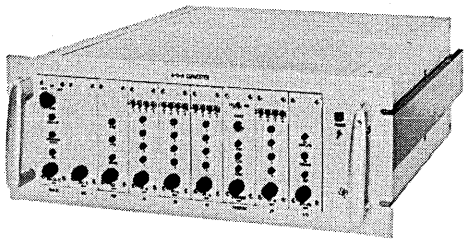
versatile addressable or sequential

Multiplexers

features

- Sampling rate to 50,000 channels/sec
- Variable frame length
- Accuracy ± 0.02% full scale
- Input levels to ± 10 V

Texas Instruments Multiplexers are all solid state units providing accurate, high-speed bipolar operation with low dynamic crossfeed, fast settling time, and variable strobe. Manual channel select switches facilitate system set-up and check-out. Frame length is selectable from front panel. Expandable to 160 channels by means of plug-in printed circuit cards. Case size 5¼ by 19 by 18 inches for standard relay rack mounting.



TI's high speed Model 834 Analog-Digital Converter, ideal companion instrument to the TI Multiplexer.

High speed: 1.5 μsec per bit
Built-in sample and hold
Accuracy: ± 0.05% full scale
Automatic zero stabilization

Ask a TI Application Engineer for further information on digital data handling equipment for your specific needs.

INDUSTRIAL PRODUCTS GROUP

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CIRCLE 44 ON READER CARD

How high is your goal?

Ours are out of sight—in the labyrinth of space. But your opportunities are a tangible reality, here and now at North American's Space and Information Systems Division.

Trained, creative engineering minds, attuned to the research, development and production of manned spacecraft, large booster systems, inflatable winged recovery systems and missile weapon systems will find fertile fields to grow in at S&ID.

COMPUTER SIMULATION

To analyze needs and requirements for simulated spacecraft trajectory and relation mechanics and simulated spacecraft systems. To evolve diagnostic and check out methods for simulation and trainer complexes (equations and programs). To design automatic process systems for operation and control of trainer and simulation complexes.

LOGIC DESIGNERS

To perform conceptual analysis and trade-off studies resulting in logic designs of command data systems.

ELECTRONICS CIRCUIT DESIGN

To carry out design and development of digital interface equipment required for controls and display compatibility.

Interested? Please Contact:
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All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

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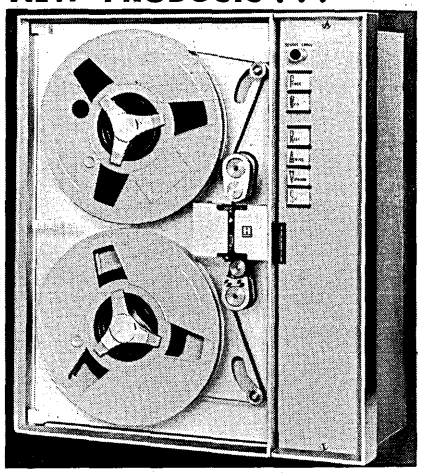
NORTH AMERICAN AVIATION

NEW PRODUCTS . . .

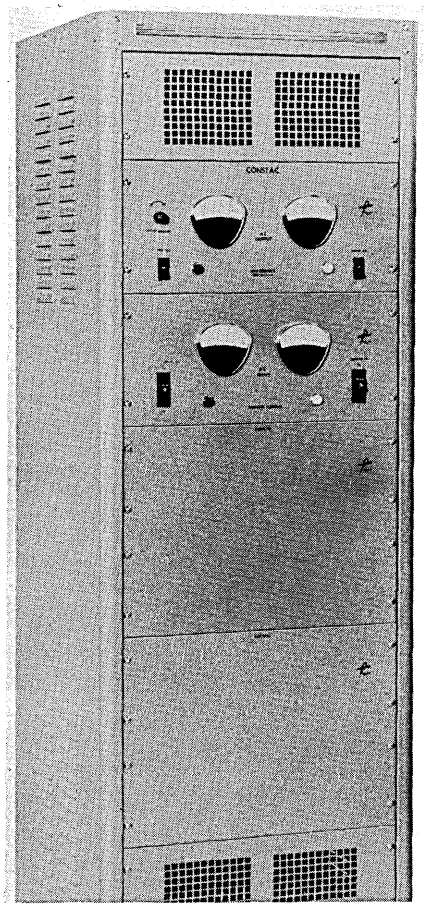


tape units, moving tape at a maximum rate of 100 0.005-inch increments per second. Rewind and fast forward speeds are 100 feet per sec. Price: $5200. HONEYWELL, Denver Division, 4800 E. Dry Creek Road, Denver 10, Colo. For information:

CIRCLE 207 ON READER CARD

standby power system

ConstAC is said to provide uninterrupted power with no break in the sine wave when line power falters or fails, and prevents power overshoots



from reaching the load when power returns. It features automatic battery charge. Prices begin at $2,500. PARAMETRICS, P.O. Box 629, Costa Mesa, Calif. For information:

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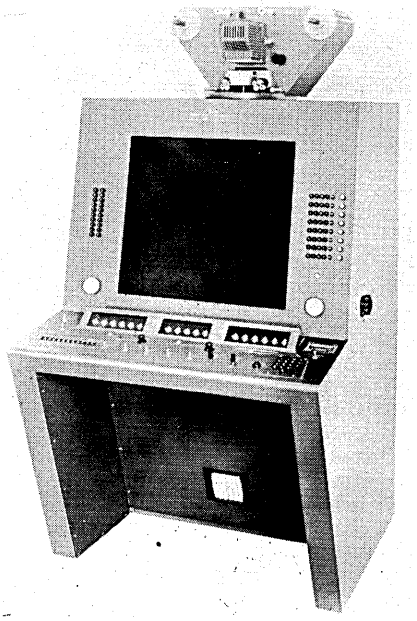
COMPONENT PRODUCTS

data conversion

Projection data reduction system converts 16, 35 and 70 mm film data to punch cards or columnar typewriter format, with pushbutton reading of eight channels of X, Y,



and Theta information. Unit will handle strip chart records up to 16 inches wide. GERBER SCIENTIFIC INSTRUMENT CO., P. O. Box 305, Hartford, Conn. For information:

CIRCLE 209 ON READER CARD

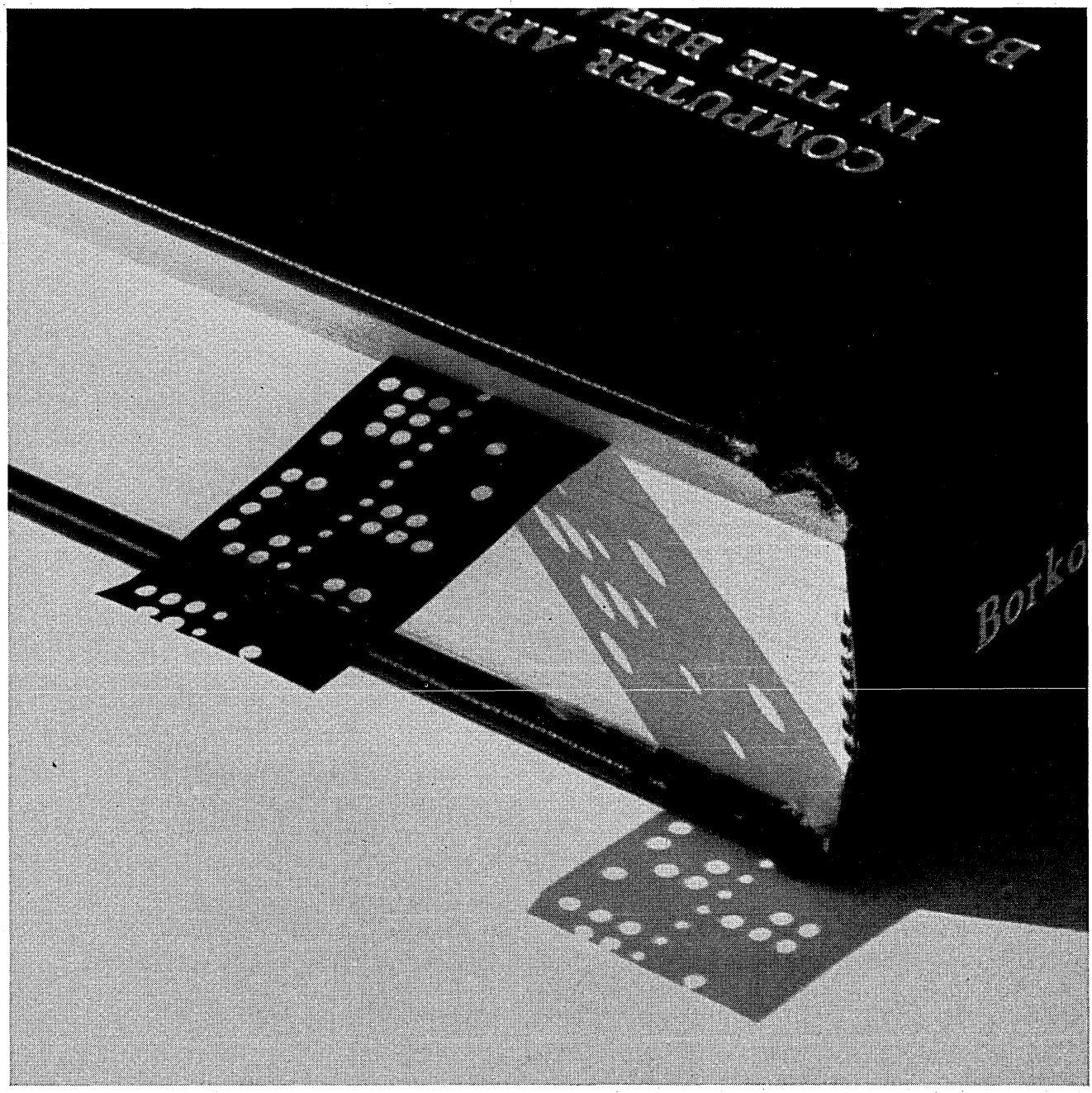
microfilm reader/printer

Model 530D microfilm unit creates 8½ x 11" black and white print from microfilm in 25 seconds, uses three-digit indexing for location of the document to be copied. Lenses range in magnification from 10.5x to 37x. Another model—530H—produces half-size facsimilies. BELL & HOWELL Micro-Data Division, 612 N. Michigan Ave., Chicago 11, Ill. For information:

CIRCLE 210 ON READER CARD

clock/calendar

Chrono-log 729 is a programmable clock/calendar system which reads date and time (in hours, minutes, seconds and 1/60th of a second)



Information Retrieval

Instant Bookmark

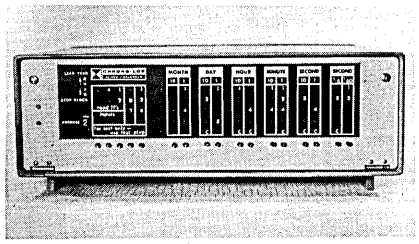
The technology of information retrieval is one of the major concerns of SDC. For some time, our Satire system (semi-automatic technical information retrieval) has been capable of quickly pinpointing, at widely separated SDC facilities, desired technical documents and authors' names. Satire can be operated by remote control, the only such system that can be so operated. A still newer SDC development is Protosynthex I, which is a phase of Synthex, our long-range project to teach computers to read and write English. Protosynthex is now able, almost instantly, to find single paragraphs within the complete text of an article or document. Next will come the ability to extract individual sentences and facts. As SDC continues to make noteworthy progress in many areas of information-systems technology, a number of new positions have been created on several of these major projects. Human factors scientists, operations research scientists, systems-oriented engineers, and computer programmers interested in joining this rapidly expanding technology are invited to write Mr. A. I. Granville, Jr., SDC, 2401 Colorado Avenue, Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D.C.; Lexington, Massachusetts; Paramus, New Jersey; and Dayton, Ohio. An SDC brochure on information retrieval also is available. Requests for this new brochure should be sent to Mr. Granville at Santa Monica. "An equal opportunity employer."

System Development Corporation

SDC

21-905

CIRCLE 81 ON READER CARD



into any IBM computer using 729-II, IV, V, VI or 7330 tape drives under program control. Priced between $2500 and $3000; delivery in eight weeks. CHRONO-LOG CORP., 2583 W. Chester Pike, Broomall, Pa. For information:

CIRCLE 211 ON READER CARD

transmission terminal

GE mag tape-mag tape data transmission terminal, TDS-91, features transmission rates between 150 and 28,000 cps for standard tape transports with densities of 200, 556 or 800 bpi. Delivery is between 90 and 120 days. GE COMMUNICATION PRODUCTS DEPT., Lynchburg, Va. For information:

CIRCLE 212 ON READER CARD

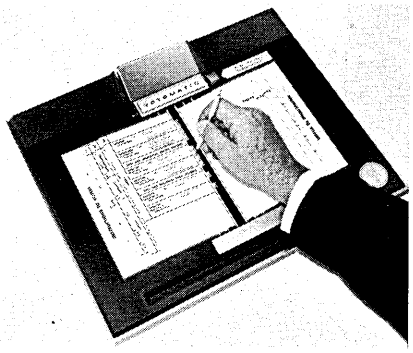
separator

Unit separates eight-part interleaved forms, rewinds carbons in one pass; operates at up to 250 feet per minute. Handles forms up to 18½" wide by 11" long, with a special adjustment allowing refolding of 14"-long forms. Motorized carbon rewind spindles will take 500-600 feet of carbon tissue before unloading is required. Deliveries begin this month. STANDARD REGISTER CO., Dayton 1, Ohio. For information:

CIRCLE 213 ON READER CARD

vote recorder

Votomatic uses stylus to punch out pre-perforated spaces in tab ballot cards; write-ins can be accommodated. Unit weighs less than five lbs., mea-



sures 13 x 16 x 2"—is said to allow reduction of vote tallying costs to less than ½¢ per ballot. HARRIS VOTOMATIC, Inc., PO Box 1272, Berkeley 1, Calif. For information:

CIRCLE 214 ON READER CARD

BOOK capsules

guide

People who are PAVEing the RAMPS to new BEST PERT and other acronyms can find out if somebody else has beaten them to the punch by consulting this handy dandy alphabetized list of acronyms. Invaluable for those seeking to enter the military title maze, and for one-upping. *Dictionary of Modern Acronyms & Abbreviations,* by Milton Goldstein. Howard W. Sams & Co., Inc. and Bobbs-Merrill Co., publishers. Over 6000 entries, 158 pages, $4.95.

computers & psychology

Papers and formal discussions presented at computer simulation and personality conference held at Princeton and Educational Testing Service in 1962. Part one is an introduction to the field and discussions of general problems; Part two, psychoanalytic theory, includes a paper intriguingly entitled "Programming People to Simulate Machines;" Part three concerns cognition and effect. *Computer Simulation of Personality,* edited by Silvan S. Tomkins and Samuel Messick. Published by John Wiley & Sons, Inc., New York. 325 pages, $5.00.

dp/programming

An introductory survey of computers and programming for business, this new book includes chapters on data representation, hardware, and business information processing systems design. COBOL-1 earns one chapter, as do WORDCOM and FIELDCOM machine-oriented languages, and processing procedures (editing, sorting and file processing). Authored by two RAND men: Robert H. Gregory and Richard L. Van Horn. *Business Data Processing and Programming,* Wadsworth Publishing Co., Belmont, Calif. 403 pages, $9.25.

in introduction

The first of an informational sciences series, this book is an attempt to bridge the interdisciplinary problem of personnel with varied backgrounds and experiences working in the area of IR. It is intended for the newcomer to the field, however expert he may be in his own discipline as librarian, programmer, or hardware designer. The book covers the tools, elements, and theories of IR. The authors are a computer consultant and the head of an IR systems/software firm. Joseph Becker and R. M. Hayes, *Introduction to Information Storage and Retrieval,* Wiley, N.Y. 448 pages.

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Senior Scientific Programmers

Responsible for independently providing machine language, symbolic, or FORTRAN coding in the solution of engineering problems in connection with major missile systems and submarine guidance systems. Involves problem solution and analysis, solution of differential equations by numerical techniques, and the simulation of entire weapons systems. Requires BS or MS degree and experience with digital computers, particularly large-scale machines.

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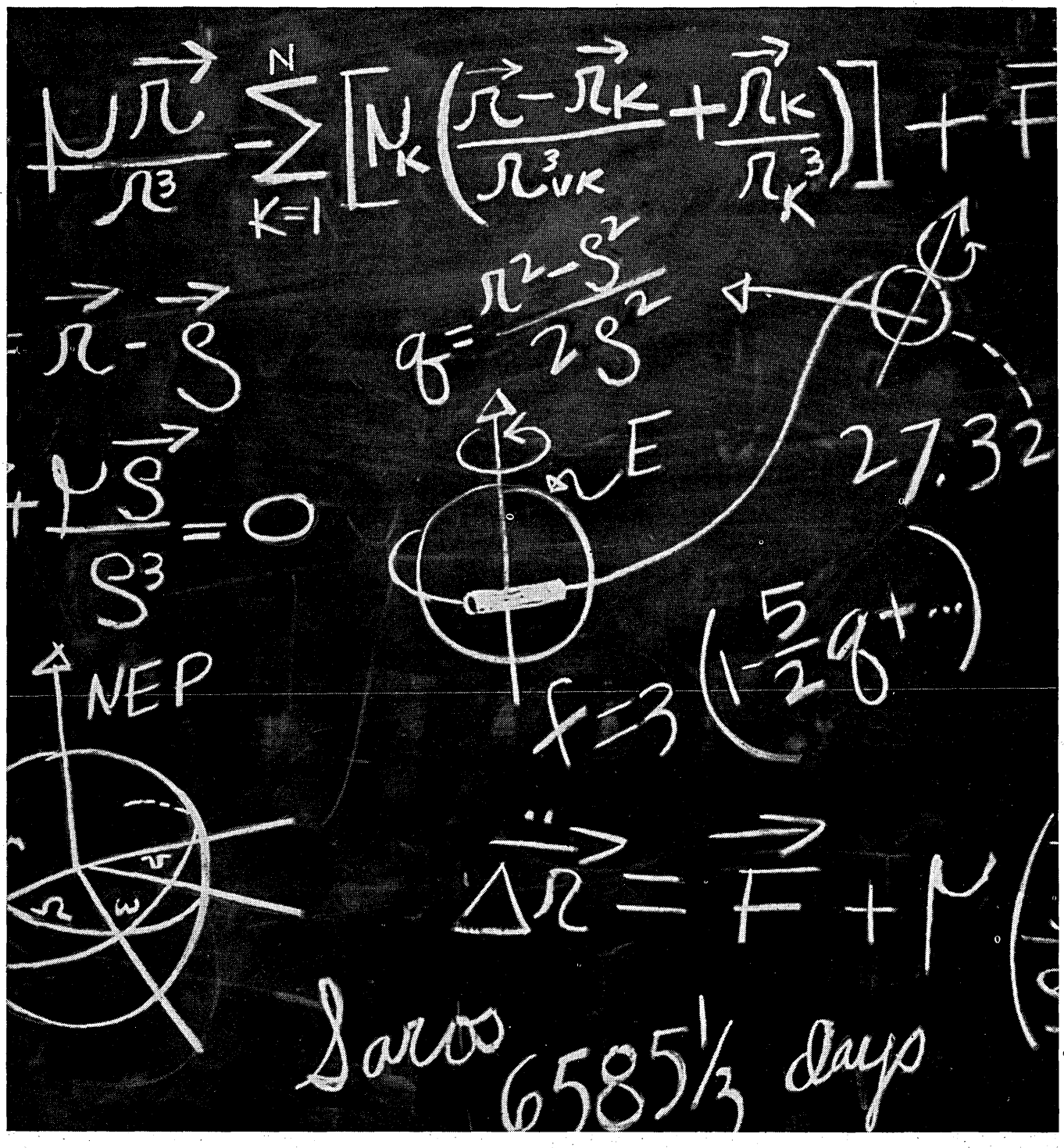
CIRCLE 93 ON READER CARD

ADVERTISERS' INDEX



How the moon looks to Bellcomm

The moon is more than our nearest celestial neighbor. To Bellcomm it is a proving ground for work in the environment of space – meteoroids, radiation effects, magneto-hydrodynamic phenomena. It is a study in heat transfer, thermodynamics, combustion. It is a laboratory for application of the principles of solid state physics. It is a gigantic experiment in the life sciences, life support systems, and bio-engineering. It is electronics, propulsion, guidance, orbit mechanics ... and more.

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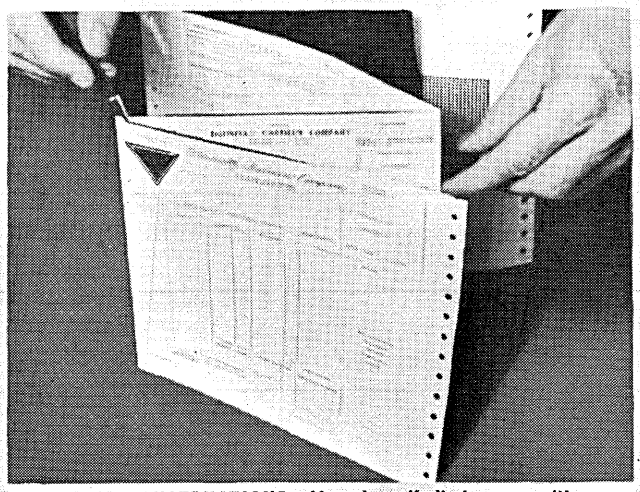
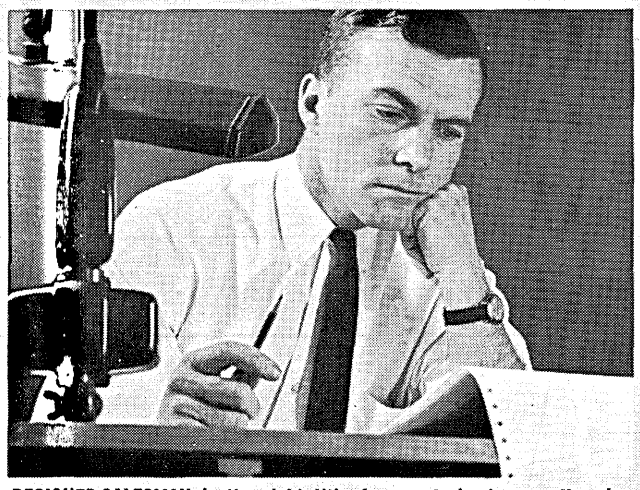
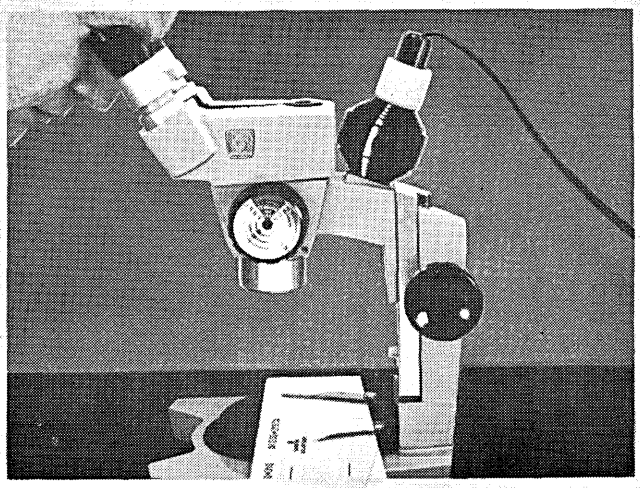


UNLIMITED CONSTRUCTIONS—Moore's unlimited range with many built-in features assures the form that's most serviceable to you.



DESIGNER-SALESMAN is the right title for our trained men. Knowing systems and knowing forms helps them make your job a lot easier.



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CONTINENTAL SCOPE—Our 32 plants are the industry's most modern and best equipped, assuring quality production and prompt delivery.

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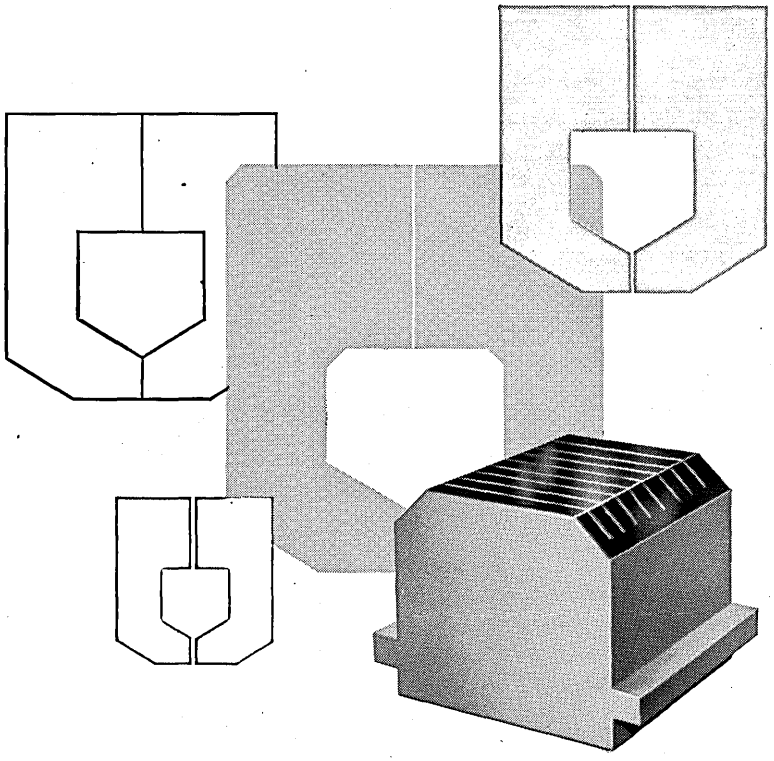

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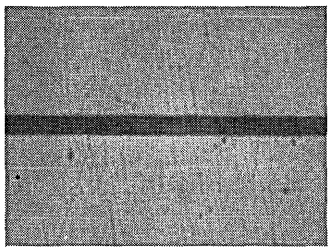
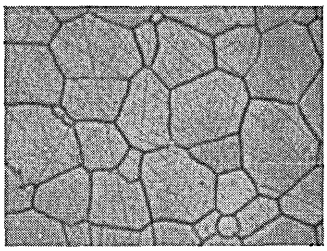
Ferroxcube now offers all the performance advantages of a high density ferrite core recording head with glass bonding at the butt and tip. New fabricating techniques provide mechanical tolerances far beyond anything available previously for both single or multi-track assemblies. The resulting superior electrical performance is wrapped up in a finished assembly, delivered to you, ready to use, to assure you maximum uniformity at optimum levels for your design.



Accurately controlled gap lengths to 1 micron. Glass-filled gap permits mirror-like polishing, for smooth, optimum contact recording operations. (60x magnification)



Special high-density ferrite core material. Permeability: 1900. Low electrical losses... virtually flat to 10 mc. (660x magnification)

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- ☐ Tip spacing accurately defined to 1 micron.
- ☐ Multi-track assemblies with new standards of precise alignment. Head-to-head variation of inductance: ± 7%.
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