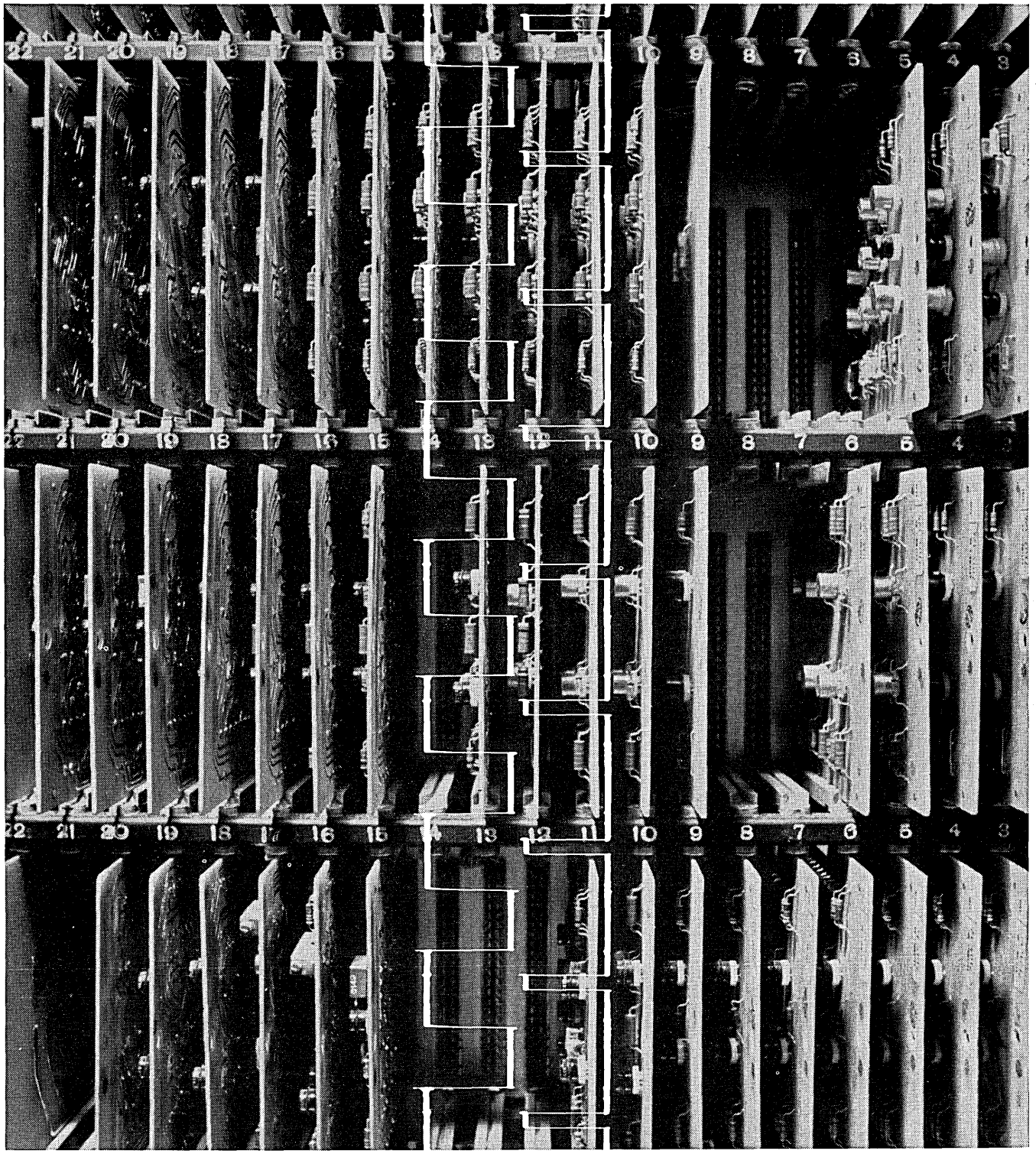
DATAMATION®

62

June

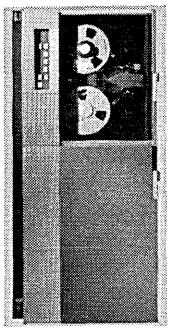
Adelard Darnell, Sys Engr
IBM Corp
3424 Wilshire Blvd
Los Angeles Calif

13-16



Now: who has added electronics to the world's most advanced tape unit? AMPEX

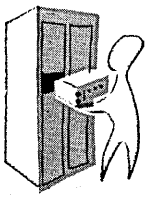
Get set to eliminate interface problems. And cut costs as well. The first Ampex complete tape memory system is here: the TM-4111. This new precision system wraps up an advanced tape transport and new solid state electronics—all in one package. It provides users and manufacturers alike with complete facility for reading, writing and checking digital data in computer formats. The electronics are compatible with the most widely used computers and are designed to operate at



maximum densities up to 600 bpi. The transport provides the fastest start/stop times yet for a medium speed tape unit with special mechanisms to prevent tape abuse. Put the two together: You have a reliable, rugged, remarkably advanced tape memory system. For more data write the only company providing tape and recorders for every application: Ampex Corporation, 934 Charter St., Redwood City, California. Sales and service engineers throughout the U. S. and the world.

CIRCLE 1 ON READER CARD

NEW: DDP-19, THE FASTEST MEDIUM-SIZED COMPUTER FOR REAL-TIME ENGINEERING APPLICATIONS!!



This new, high-speed DDP-19 **(Digital Data Processor)** is a single address, parallel, binary, 19-bit computer with a magnetic core storage of 4096 to 8192 words!

DDP-19's fully buffered input permits continuous intake of data! DDP-19's up to 16 program addressable input/output channels (operable in both **busy** or **interrupt** mode) allow asynchronous connection to any existing system!

DDP-19's extremely flexible analog input/output units permit **immediate** tie-in to any real-time man-machine simulation! DDP-19's modular construction using 3C's customer-proven S-PAC digital modules provides ample room for expansion! Compiler, assembler, and subroutines are available!

DDP-19 HIGH-SPEED CHARACTERISTICS

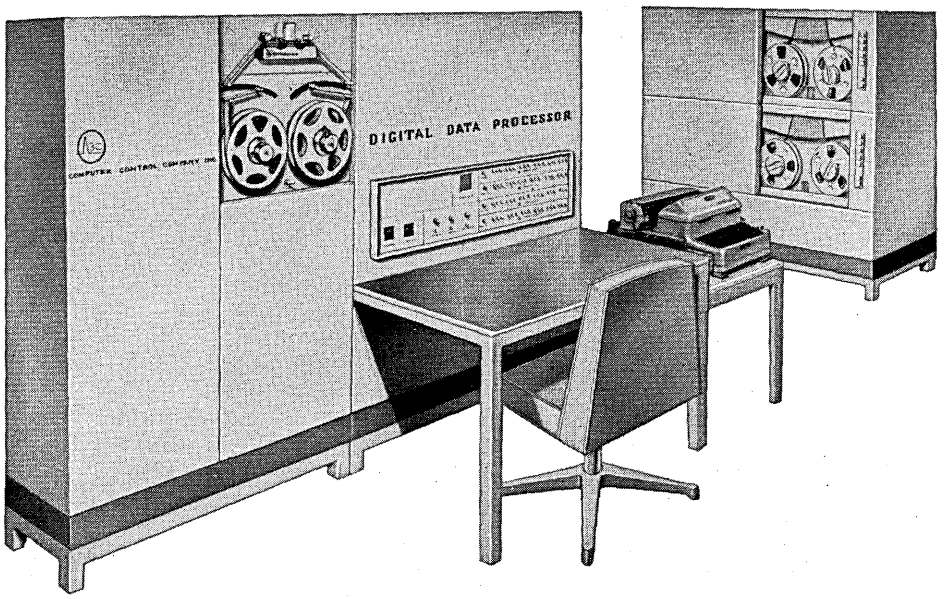
Memory cycle time
5 microseconds

Add: successive operations with instruction and operand access
10 microseconds each

Average multiply
36 microseconds

Divide
57 microseconds

Input-output
200 KC word transfer rate

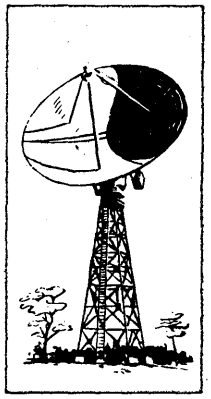


VERSATILE
(It outperforms any computer in its price range!)

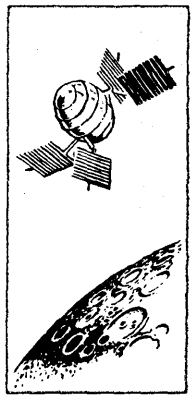
HIGH-SPEED
(It handles complex on-line data reduction faster than any comparable machine!)

ECONOMICAL
(It replaces expensive, custom-built systems and large scale computers!)

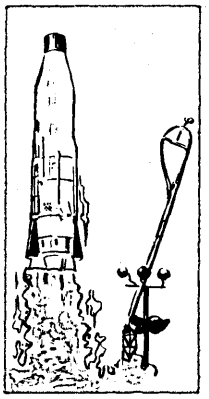
A few applications of this versatile, high-speed DDP-19 computer include . . .



. . . use as a control computer for the precision tracking of high-speed targets . . .



. . . use for real-time data acquisition and the presentation of scaled and digitally filtered results . . .



. . . use in real-time simulation problems involving analog and digital equipment and sub systems . . .

For more comprehensive DDP-19 information, please call or write to:

SYSTEMS DIVISION

COMPUTER CONTROL COMPANY, INC.

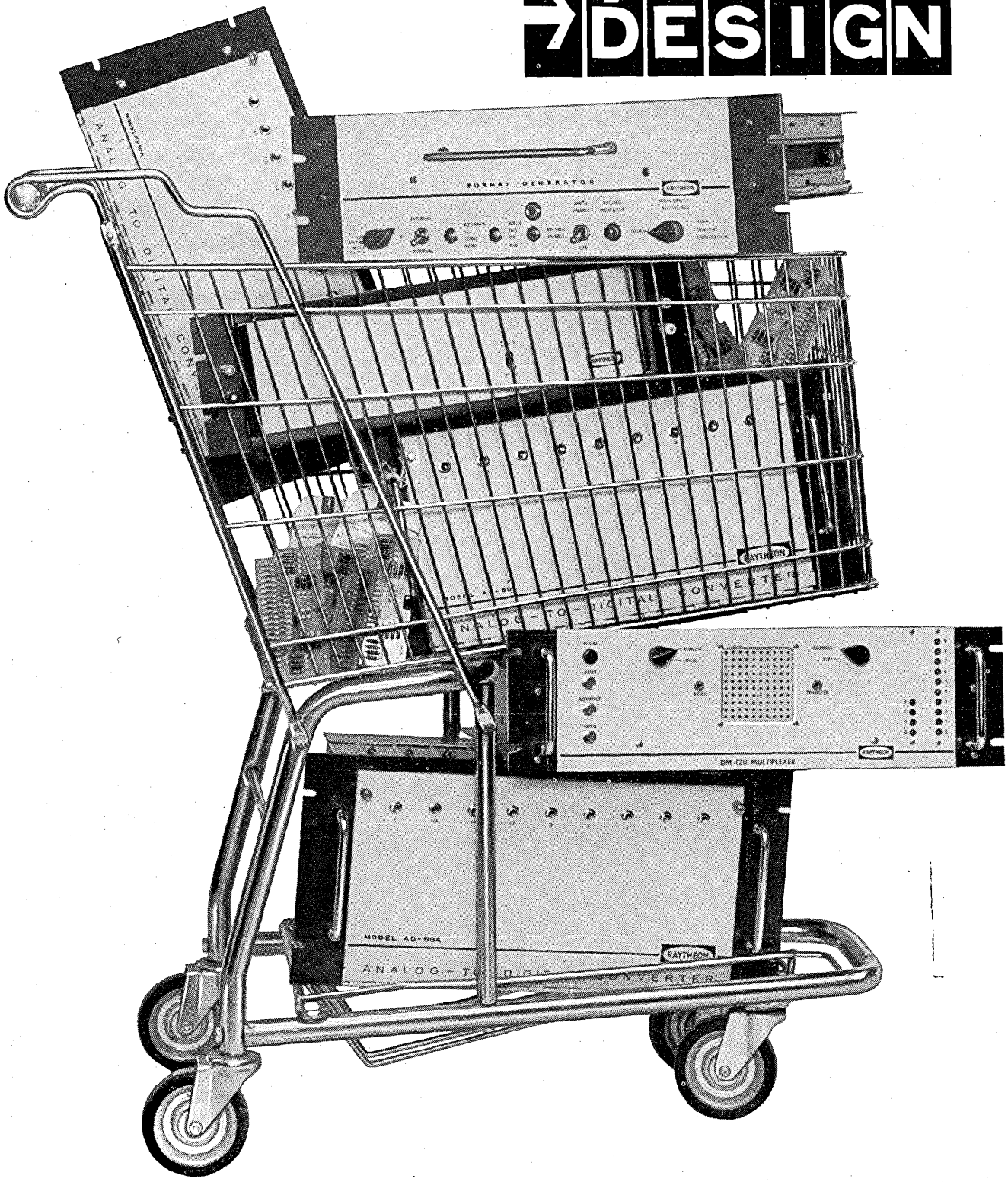
EASTERN PLANT: 983 CONCORD STREET/FRAMINGHAM/MASSACHUSETTS
WESTERN PLANT: 2251 BARRY AVENUE/LOS ANGELES 64/CALIFORNIA

CIRCLE 4 ON READER CARD

Off the Shelf!

Raytheon Data-Design's High Speed Digital Handling Units

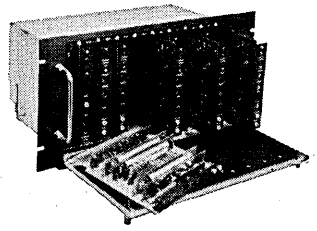
DATA-DESIGN



Complete Line . . .

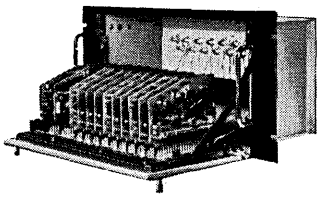
The Raytheon DATA-DESIGN units described below are unmatched in the digital field today for speed, accuracy and expandability. Together they form the fastest, most expandable data acquisition and conversion systems ever built. Each of these units is now available off-the-shelf from Raytheon, for system integration by the user.

Also available from Raytheon's unique DATA-DESIGN Service is the design and manufacture of complete digital systems or units based on your individual requirements and specifications.



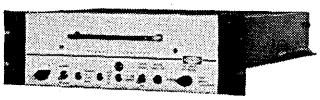
AD-50A Ultra-High Speed
ANALOG-DIGITAL CONVERTER

Up to 5 million samples/second. Up to 8-bit accuracy output, with lower bit outputs available at reduced cost. Digitizes pulses less than 0.3 microseconds wide. Direct, useable readout every 0.2 microseconds. 25 nanosecond aperture time. Every output valid and useable immediately. No need for sample and hold circuitry in most applications.



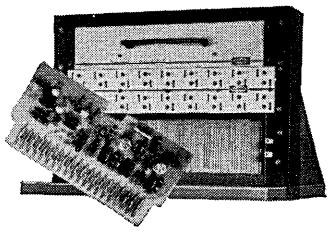
AD-10A High Speed
ANALOG-DIGITAL CONVERTER

Up to 500,000 complete 10-bit conversions/second. Serial readout at 5-mc bit rate; parallel readout at 500-kc word rate. Plug-in module construction. Synchronous or asynchronous operation.



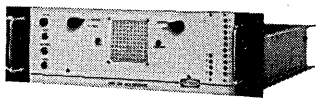
FORMAT GENERATOR

Arranges and prepares binary data from the conversion equipment in proper format for suitable entry into a computer or a tape storage unit. Also provides record identification information and parity check pulses on each character to be entered. Available in formats compatible with most major computers.



High Speed
MEGACYCLE BUILDING BLOCKS

Adaptive circuitry adjusts power requirements to load for minimum power drain. In quiescent state, draw 1/7th the power of conventional blocks. Temp. Specs. −30° to +65° C "Worst Case Analysis" criteria used in all block designs. Interchangeable wiring panels mean only one step from logical design to finished equipment.



DM-120 High Speed
MULTIPLEXER

Up to 1 million analog switchings/second. Expandable from 2 to 24 channels. As many as 576 channels obtained by stacking up to 24 Raytheon DM-120's. Compatible with both Raytheon Converters and with Raytheon Power Supply Units. For Multiplexer-Converter System, one Raytheon DPS-1A will power both units.

RAYTHEON

MAIL TODAY!

RAYTHEON COMPANY
1415 Providence Turnpike
Norwood, Massachusetts

D-6

Please send DATA-DESIGN literature on following:

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_____

Name_____

Title_____

Company_____

Address_____

City and State_____

10,000
15,000
20,000
30,000

PASSES

NEW: A LONGER LASTING COMPUTER TAPE!

SOUNDCRAFT TYPE LWD HEAVY DUTY/HIGH DENSITY

Longer life, flawless performance! These are the advantages of Soundcraft LWD heavy duty/high density tape—the most advanced computer tape available today! In specific tests, Soundcraft new LWD achieved more than 20,000 passes across recording heads with absolutely no sign of breakdown. Heretofore, 15,000 passes had been considered maximum for a heavy duty magnetic recording tape. Soundcraft combines a unique binder system with Mylar*base, producing superior adhesion and cohesion. Result: a heavy duty tape with blemish-free oxide coating, superior surface characteristics and a pulse packing capability that exceeds the requirements of all existing computer systems. Furthermore, Soundcraft LWD more closely approaches the ideal hysteresis curve than any competitive computer tape. Its improved square BH characteristic makes the computer system less susceptible to non-repetitive errors. For an LWD "confidence—level" test in your system, write:

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Main Office: Great Pasture Road, Danbury, Connecticut • New York: 10 East 52nd St.
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R-165

*DUPONT T.M.

CIRCLE 6 ON READER CARD

DATAMATION 62

the automatic handling of information

volume 8, number 6

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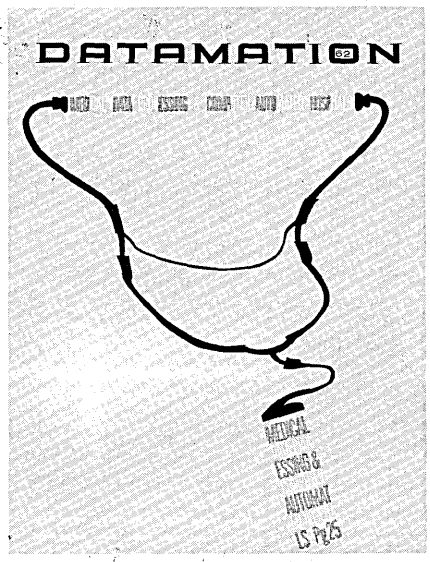

Cover

Symbolic of a rudimentary form of automated medical data processing is one of the profession's more venerable instruments — the stethoscope and its ability at magnifying sound into educated ears. Cover design is by Art Director Cleve Boutell and major feature treatment of this subject begins on page 25.

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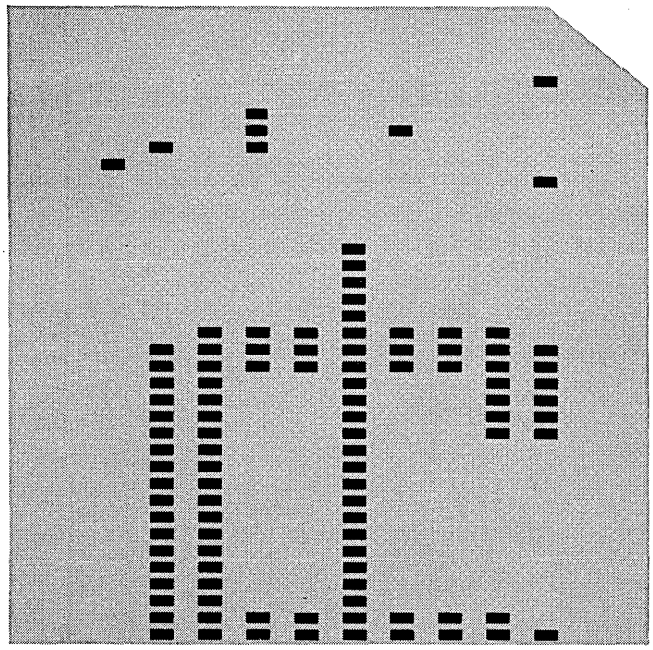
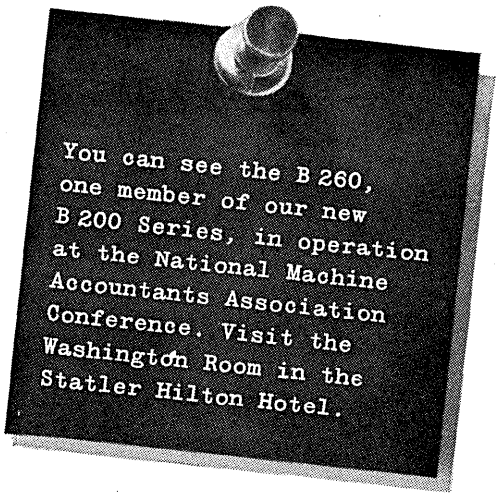
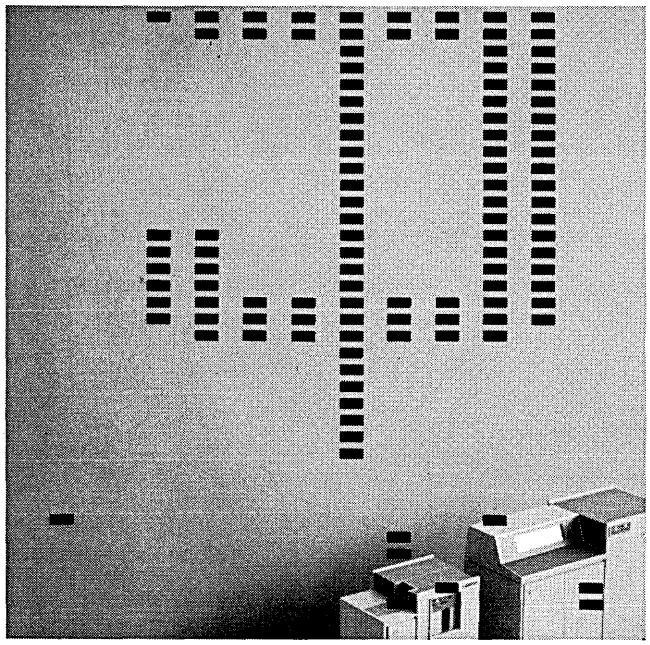


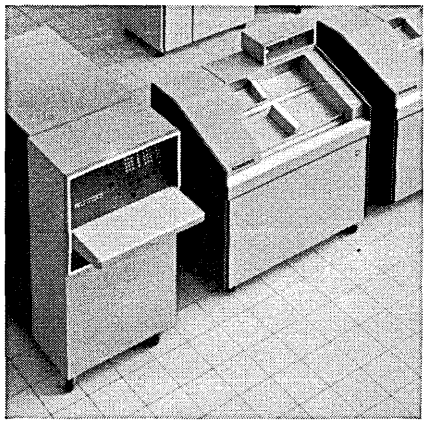


the main reason your punched card system is so costly is because Burroughs didn't make it



Maybe other computer manufacturers could make as productive and as low-cost a system as the B 200. ■ But more often than not, a so-called low-cost system is merely a stripped-down version of higher priced equipment. And that would be fine—IF the results didn't get stripped down, too. ■ But there are no "ifs" about Burroughs B 200 systems. ■ They were designed from the ground up so the components of each system work together as a completely integrated unit. The result: more work for less money. In fact, up to twice as much work as you've been getting out of your present system. ■ A B 200 has buffers (intermediate data storage stations) to keep it operating at top speed at all times. A B 200 is the only low-cost system with dual card readers—readers that handle 1,600 cards in a single minute. ■ And a B 200 is a system you can learn to program in only two days. ■ Another reason your punched card operation is so costly is because you most likely haven't talked to your Burroughs Systems Counselor recently. How about tomorrow morning? Or write us at Detroit 32, Michigan. **Burroughs Corporation**

Burroughs—TM



so many business problems end with Burroughs B

CIRCLE 7 ON READER CARD

important DATES

• A Symposium on Mathematical Programming sponsored by the Graduate School of Business of the University of Chicago, the ACM, and USAF Project RAND, will be held June 18-22 at the University of Chicago, Chicago, Ill.

• The Ninth Annual Symposium on Computers and Data Processing sponsored by the Denver Research Institute of the University of Denver is scheduled for June 27-28 at the Elkhorn Lodge, Estes Park, Colorado.

• The 1962 Rochester Conference on Data Acquisition and Processing in Medicine and Biology is set for July 17 and 18 for the Whipple Auditorium, Strong Memorial Hospital, Rochester, N.Y.

• The Northwest Computing Assoc. will hold its fifth annual conference Aug. 9-11 in Seattle, Washington. The conference is being held in conjunction with the Century 21 exhibit.

• The 1962 WESCON will be held Aug. 21-24 in the California Memorial Sports Arena and Statler-Hilton Hotel, Los Angeles.

• The 1962 IFIP Congress is set for Aug. 27-Sept. 1 in Munich, Germany.

• The ACM National Conference will be held Sept. 4-7 at the Onondaga County War Memorial Auditorium and Hotel Syracuse, Syracuse, N.Y.

• The 3rd annual Symposium on Switching Circuit Theory and Logical Design will be held Oct. 7-12 in Chicago, Ill. under the sponsorship of the AIEE Computing Devices Committee.

• The 1962 Fall Joint Computer Conference will be held on Dec. 4, 5 and 6th at the Sheraton Hotel, Philadelphia, Pennsylvania.

• The 1963 Spring Joint Computer Conference will be held May 28, 29 and 30th, 1963, at the Cobo Hall, Detroit, Michigan.

• The 1963 ACM National Conference will be held Aug. 28, 29, and 30th in Denver, Colorado.

• The IFIP Congress 65 is scheduled for New York City in May, 1965. It is the first International Congress scheduled for the United States.

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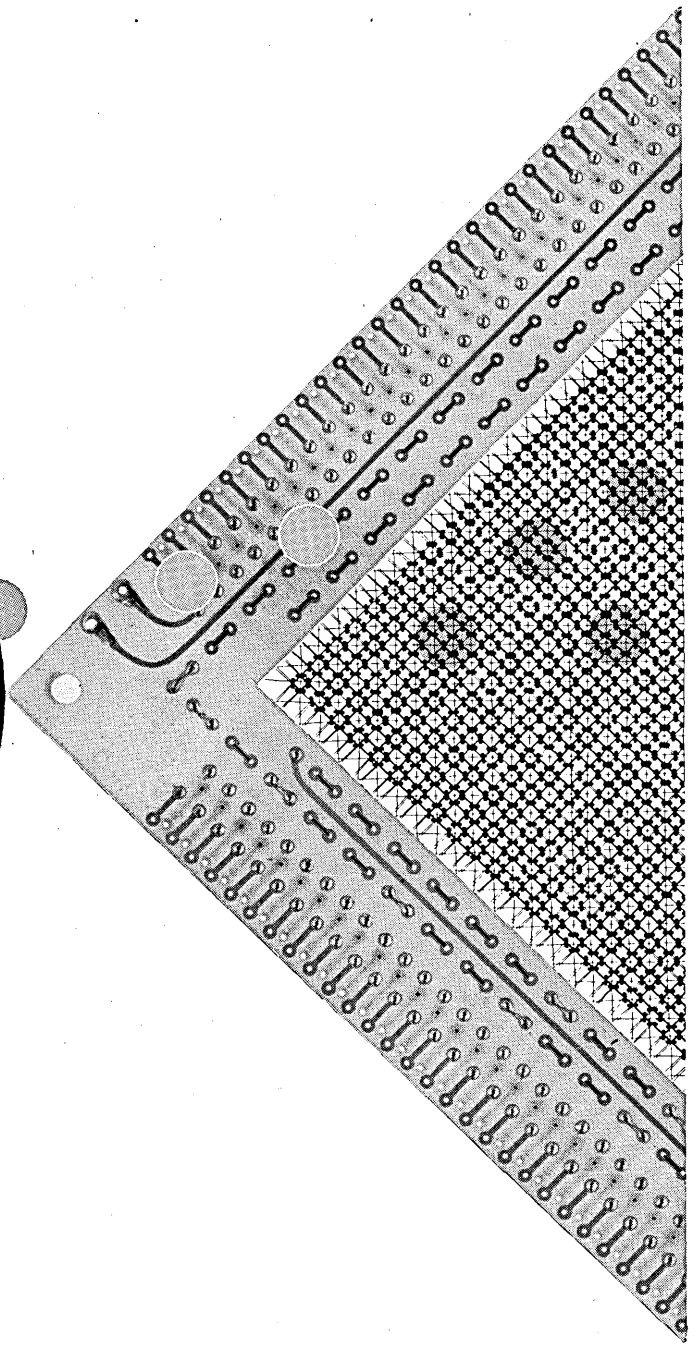
CIRCLE 8 ON READER CARD

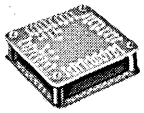
don't waste our memory experience!



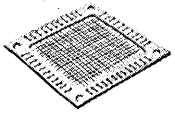
Whatever your system needs — or what you'd like it to have, you owe it to yourself and the project to see how we can help. ■ From complete memories to multi-aperture cores, magnetism is our business. For the record, we discovered and patented the first ferrite memory core, have pioneered developments in miniaturization, temperature control, switching times, logic circuitry, resistance to severe environmental conditions, and the application of multi-aperture devices to logic functions. This experience, backed by complete, specialized production and testing facilities, can help you build maximum reliability into your systems. **For a complete file of engineering data on our memory products, phone or write** Electronics Division, Keasbey, New Jersey.

INDIANA GENERAL

FERRITES



MEMORY PRODUCTS



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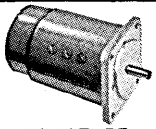

MINIATURE MOTORS

PERMANENT MAGNETS

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PHILCO ANNOUNCES

OUTSTANDING ADVANCEMENTS IN ITS PHILCO 2000 COMPUTER SYSTEMS

1.0 μs MEMORY / 0.5 μs read access

240 KC TAPE SYSTEM / Unrestricted 4-way read-write multiplexing

960 KC FILE / 40 million character disc file

SATELLITE COMPUTER / Newly designed—completes the Balanced Philco 2000 System

ALTAC IV / Increase compilation efficiency for most popular algebraic language

COBOL 61 / Available for all Philco 2000 System configurations

REPORT GENERATOR / Greater flexibility with reduced programming effort

For detailed information, write or phone (OLdfield 9-7700, Area Code 215) today.

COMPUTER DIVISION Willow Grove, Pennsylvania

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CIRCLE 14 ON READER CARD

NOW/ AN OFF-THE-SHELF MIL SPEC ALL SOLID STATE CORE COMPUTER

AN/UYK-1 (TRW-130) DIGITAL COMPUTER

6 microsecond memory cycle

900 hours Mean Time-To-Failure

Asynchronous I/O, NTDS compatible

Wide variety of peripheral devices

Real time interrupt system

Maintainable by military personnel

Being installed on many major programs such as TRANSIT and AMR Radar chain for Real Time Data Processing

PRICE: $83,500

For detailed information, contact Computer Product Manager at

TRW

Thompson Ramo Wooldridge Inc.

RW *DIVISION*

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RW means Computer Technology Leadership

CIRCLE 11 ON READER CARD

RW COMPUTER TECHNOLOGY LEADERSHIP

COMMAND CONTROL INFORMATION SYSTEMS FOR THE MOBILE MODERN FIELD ARMY

THE PROBLEM To assure the superiority of U.S. Army tactical combat forces by maximizing the effectiveness of firepower, mobility, communications and logistics.

THE SOLUTION A system of mobile, dispersed computer complexes to gather and display changing tactical information at electronic speeds for Command, Control and Support of battlefield operations.

THE SYSTEM The Command Control Information System—consisting of the highly advanced FIELDATA family of mobile electronic data handling units—will process all information used by the Field Army for command, control, and support of combat forces. The FIELDATA equipment will automatically store, classify, sort, summarize, transmit and display the necessary information on a continuous basis.

System design, simulation and field testing of the Command Control Information System is under the direction of the U.S. Army Electronic Proving Ground at Fort Huachuca, Arizona, in accordance with the needs of Army user groups. Technical assistance is being provided by Thompson Ramo Wooldridge Inc., RW Division.

To simulate actual combat conditions, a Computer Test Center, one of the most powerful complexes in existence, was placed in operation at Fort Huachuca.

Major subsystems in the Proving Ground program are defined to cover the critical information handling functions vital to the Commander and his staff in planning and controlling tactical operations:

PERSONNEL AND ADMINISTRATION SUBSYSTEM To aid in efficient utilization of manpower resources.

INTELLIGENCE SUBSYSTEM To aid in the rapid assessment of the tactical situation.

FIRE SUPPORT SUBSYSTEM To achieve effective first round artillery accuracy and tactical surprise.

LOGISTICS SUBSYSTEM To aid in efficient management of material resources.

Major milestones in this long-range evolutionary program have already been passed, with results which definitely establish the feasibility of technical concepts involved.

THE PEOPLE Subsystems are being designed by a combined military-industry team to meet realistic tactical requirements. RW's project team at Fort Huachuca is staffed by highly qualified specialists working in close support of Army technical and user commands.

IMMEDIATE OPENINGS AT RW, SIERRA VISTA, IN THE MILE-HIGH FOOTHILLS OF BEAUTIFUL COCHISE COUNTY, ARIZONA.

SYSTEMS ANALYSTS | **PROGRAMMERS** | **TEST ENGINEERS**

To arrange an interview with an RW technical representative, call or send resume to R. J. Kremple at:

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RW DIVISION

An Equal Opportunity Employer

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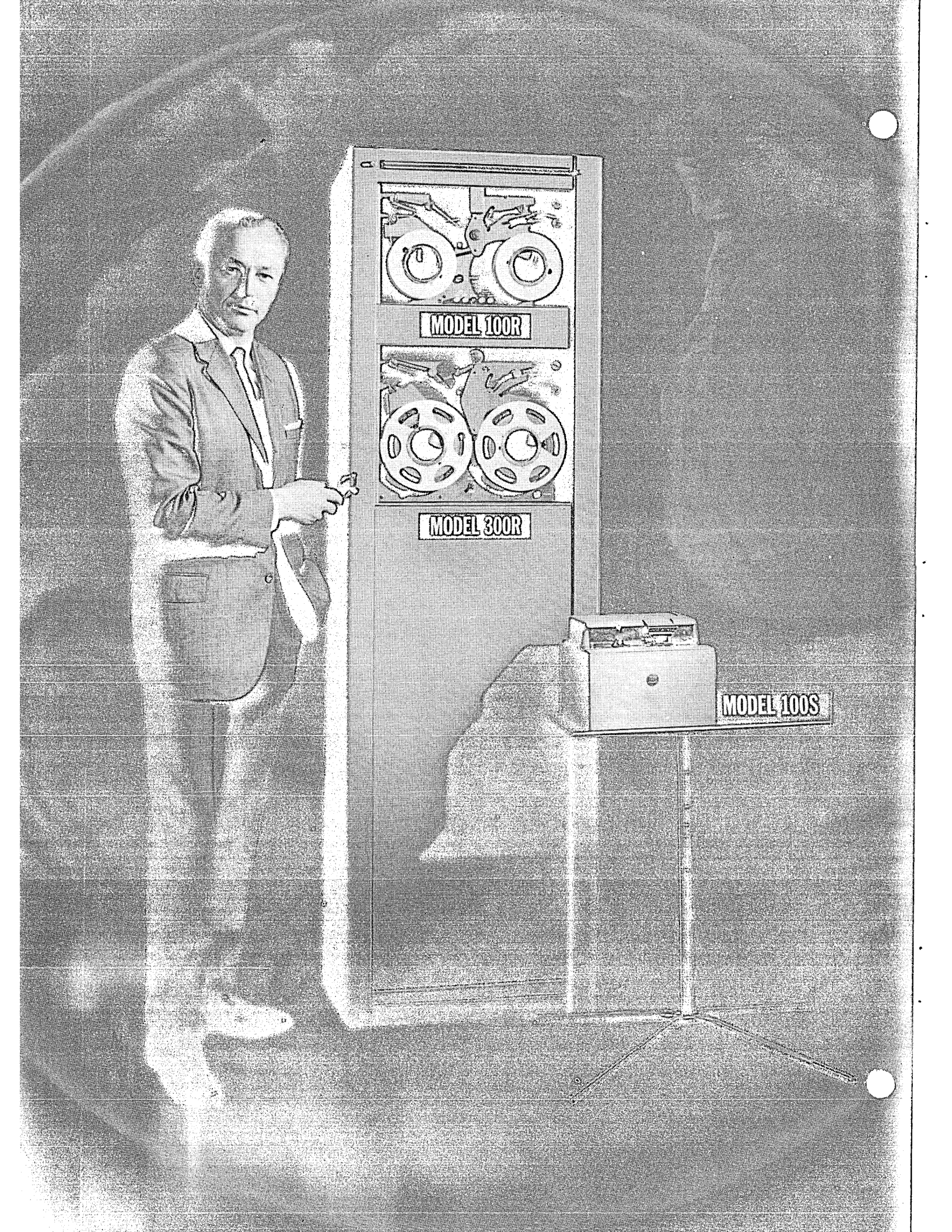
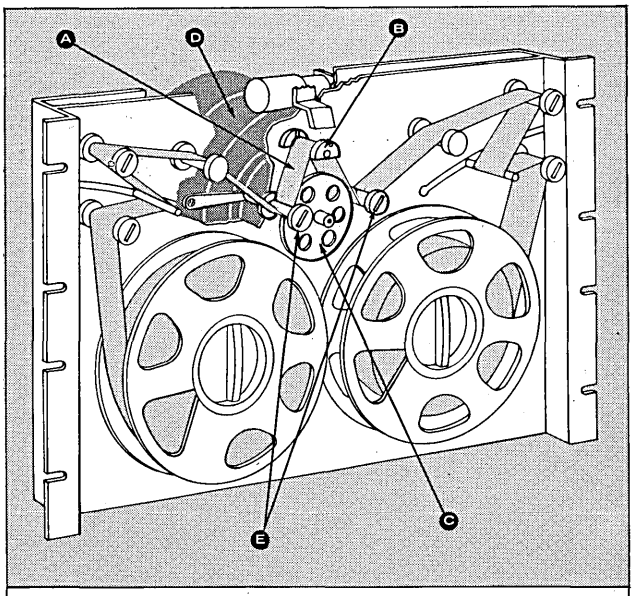

MODEL 100R
MODEL 300R
MODEL 100S

• 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.*

Photocircuits' 100% solid state readers perform positive line-by-line reading at up to 300 c/s; can change speed and alter it infinitely from 0 to 300 c/s without mechanical adjustment; are easily loaded; will transport and read crude splices; and can be clock synchronized with a computer up to 300 c/s, eliminating the need for buffer storage.

Console, rack-mounted, reel-servoed, uni- or bi-directional transports in a low (up to 60 c/s) and high (free-running at up to 400 c/s) speed range are available. Strip readers and separate spoolers, various tape widths, block type reading, special input-output ratings, militarized units, and remote control can be supplied.

Phone, wire or write for complete information.

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

CIRCLE 12 ON READER CARD

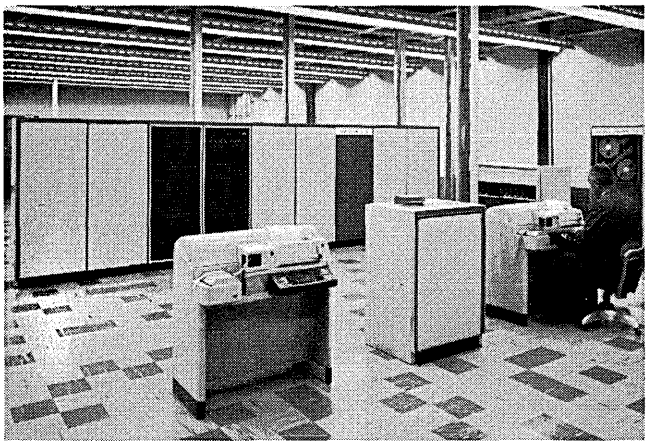
Announcing:

Collins Data Central

A fast, flexible electronic switching center for your company's communication network

Data Central offers you new advantages and economies because it is designed specifically as a communication processing system. Its direct TTY connections save you the cost of line conversion equipment. It gives you micro-second speed in switching messages from incoming to outgoing lines. It can be organized, as no other system can, to meet your own *specific* TTY requirements, and it accommodates any change in your requirements.

A unique, solid-state processor gives Data Central its flexibility. This processor has two memories — a conventional computer memory, and a *Programmed Logic Unit.* This unit performs functions handled by fixed wiring in other processors. By removing fixed wire restrictions, Data Central gives you the freedom you need to organize an automatic switching center to meet your specific communication needs . . . and to change the operation of your center as your requirements vary. All that's required are simple changes in the Programmed Logic.



Here are other features of this versatile switching system:

Conventional TTY operation — Serial, mixed speed on full or half duplex lines.

Store and forward — Messages awaiting free circuits are held in temporary storage.

Multiple priority — Immediate interrupt for no-delay priority messages.

Multiple address — From a two-station to all-station broadcast as each circuit becomes available.

Automatic conversion — Code, speed and format, concurrent with switching.

No lost messages — Automatic message accounting, queuing and check-off.

Accuracy — Internal parity check. System check optional.

Traffic analysis — Historical files permit message retrieval for analysis, logging and retransmission.

High-speed trunking — Collins Kineplex® high-speed data transmission systems operate under stored program control of the Data Central processor.

System balance — Handles peak loads efficiently.

Expandability — Processor memories, storage and input-output devices, and TTY circuits are expandable to meet changes.

Complete customer service — Includes installation, maintenance, programming and training.

Data processing, too. The Data Central processor is also capable of handling both scientific and business data processing assignments. This system is the first to be made commercially available from Collins' new C-8000 Series of communication and data systems. Find out why leading companies are turning to Data Central . . . how it can advance your own communication capabilities. Write:

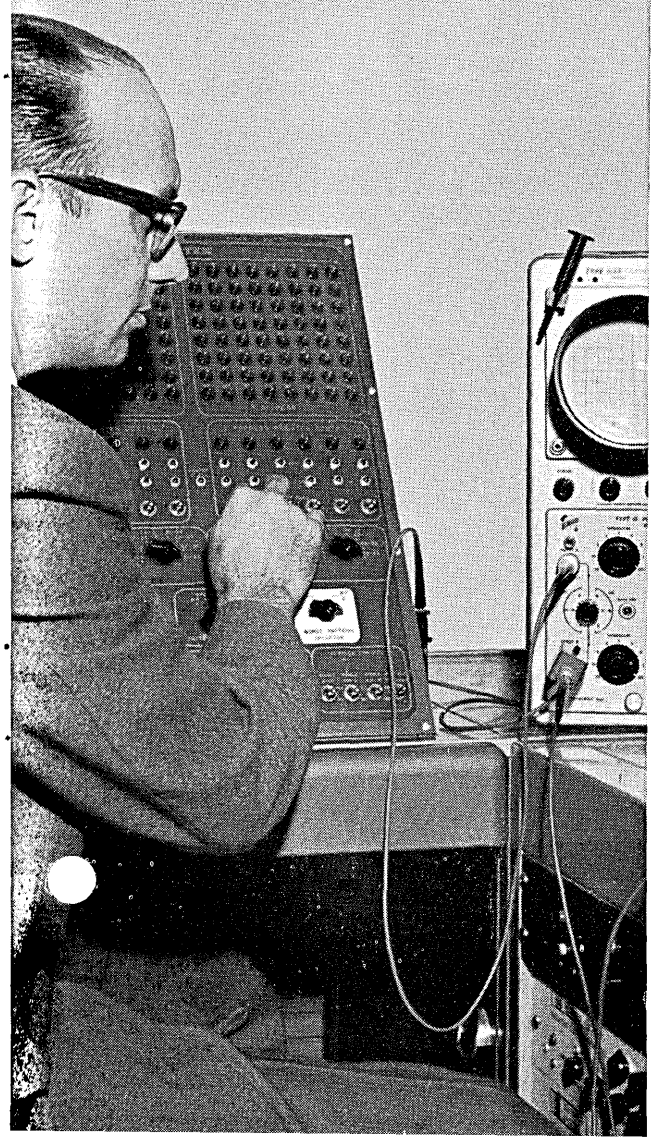
COMMUNICATION AND DATA SYSTEMS DIVISION, COLLINS RADIO COMPANY, DALLAS, TEXAS.

FOR THE BEST COMMUNICATION OF BUSINESS INFORMATION . . . CALL COLLINS

COLLINS

CIRCLE 13 ON READER CARD

Portrait of an insurance man hard at work



. . . or perhaps we should say an assurance man. He's a member of Fabri-Tek's product assurance group, a formally organized department reporting directly to corporate management. We consider his to be one of the most important of the 425 jobs at Fabri-Tek.

Reliability is our chief product. Our prime objective has always been to provide a dependable source of highest quality magnetic memory components, memory systems and printed circuits. Our many customers in data processing and related fields have come to expect the highest quality every time from Fabri-Tek. We fully intend to keep this reputation.

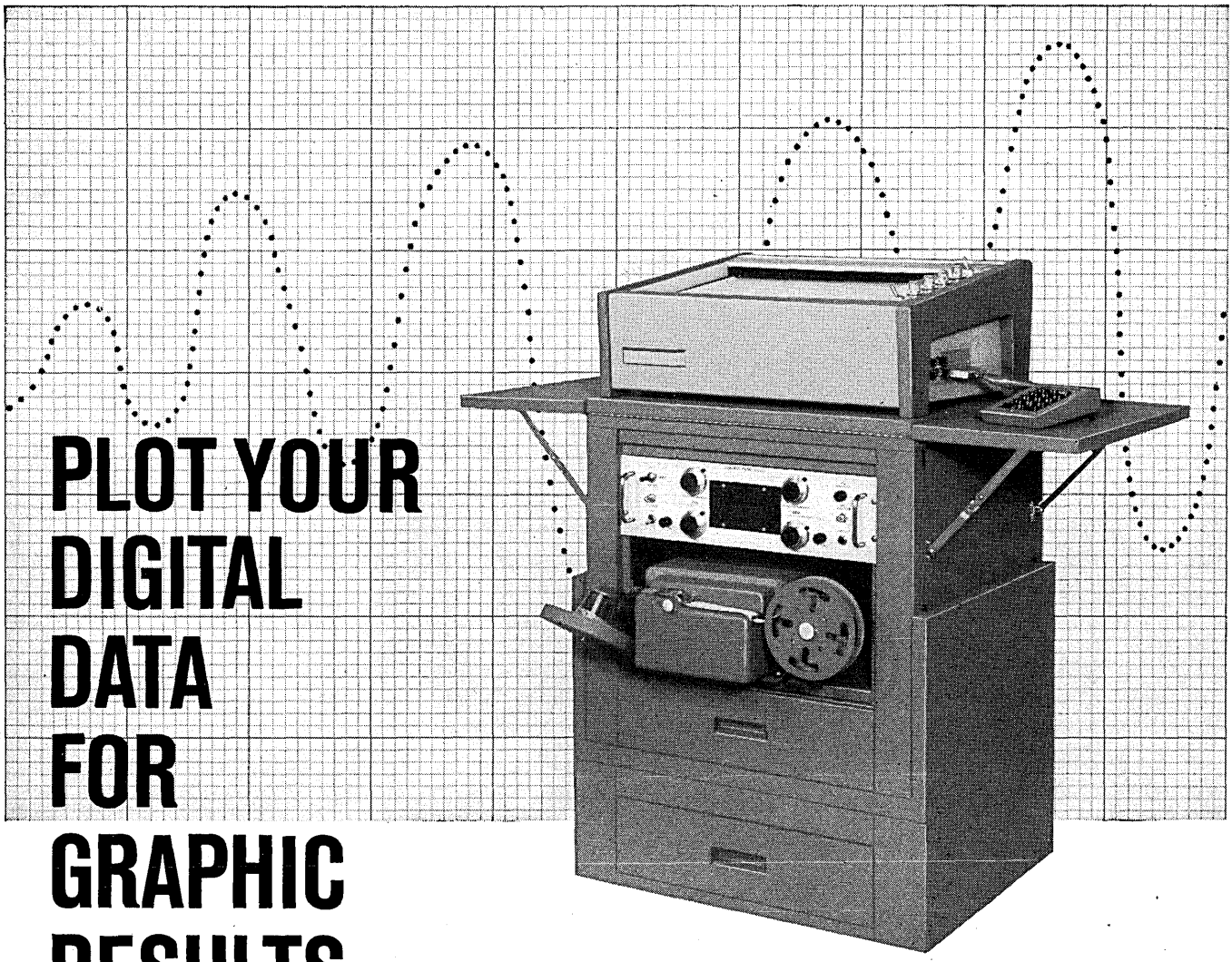
This is why, even though every Fabri-Tek employee is thoroughly convinced of the importance of maintaining quality, we constantly strive to improve end-product reliability. To this end, our "insurance men" enforce a rigorous program of vendor selection and control. They continuously monitor engineering, production and inspection methods influencing quality and reliability. They maintain an active program of customer liaison to assure the success of the program.

Of course, our product assurance group has the advantage of working with skilled production people operating in two modern, air-conditioned plants covering 50,000 square feet. They work with precision equipment, much of it developed by us as the only way to meet Fabri-Tek standards of quality.

New color brochures describe printed circuits, memory frames, memory stacks and complete memory systems. Write today for your free copies. Fabri-Tek, Inc., P.O. Box 8046, Minneapolis 16, Minn.

CIRCLE 10 ON READER CARD

FABRI-TEK®



PLOT YOUR DIGITAL DATA FOR GRAPHIC RESULTS ... *WITH ACCURATE, LOW COST EAI SERIES 3100* DATAPLOTTER

Outstanding Features of the EAI Series 3100 DATAPLOTTER include:

- System accuracy up to 0.175% of full scale.
- Punched card, tape or keyboard input.
- Plotting speeds up to 80 points per minute.
- Provisions for "off-board" origin.
- Compact, self-contained single cabinet design. Punched card reader external.
- Adaptable to any computer system.
- Accepts analog as well as digital inputs.
- Automatic off-scale point rejection.

The full potential usefulness of digital computer calculations is seldom fully realized. Because of the excessive cost of hand plotting, the benefits of graphic displays of digital data are usually sacrificed. Now, with the DATAPLOTTER 3100, this lost dividend can be recovered.

The quickest and easiest way to analyze the voluminous output of digital computers is in the form of easy-to-read x-y charts. With graphs plotted on the EAI Series 3100 [11"x 17"] DATAPLOTTER, digital information achieves new accessibility and convenience for computer data users. This new low-cost digital plotter enables project groups to set up independent data interpretation operations utilizing information obtained from central computer services. Experience shows that this equipment will deliver plots more rapidly and accurately and free valuable man-hours for engineering and management.

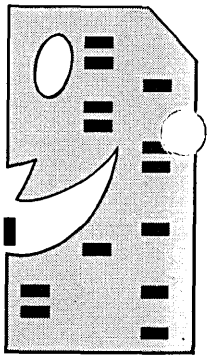
Some of the applications in which the EAI Series 3100 DATAPLOTTER is extremely valuable include Frequency Response Curves • Fluid Flow Charts • Stress Analysis • Aerodynamic Studies • Chemical Reaction Rates • Missile Trajectories and Orbits • Thrust Studies • Flight Data • Sales and Market Analyses.

EAI Series 3100 DATAPLOTTER® can save you money and improve your engineering and computer services. For information on this new equipment, write to Department D6.

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

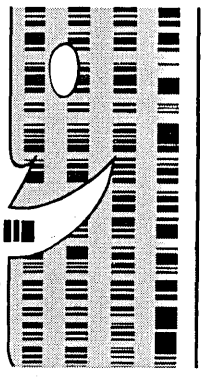
CIRCLE 15 ON READER CARD

WORLD'S FIRST!



COMPUTER TAPE CONVERSION CENTER

Now you can let your computers talk to each other fast and at low cost through a brand new mail order service. Your magnetic tapes, paper tapes, and IBM cards will reach us overnight via air mail and air express from anywhere in the country. Accepted and generated at our new center are magnetic tape formats for IBM, Burroughs, RCA, and Remington Rand computers, 5 to 8-level paper tape formats for Friden-Flexowriter, Teletype, NCR, and IBM 1620, IBM 80-column card Hollerith coding. For the first time, obtain rapid, economical direct data format conversion without leasing or purchasing costly conversion equipment.



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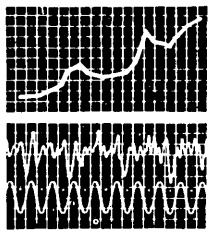
CIRCLE 36 ON READER CARD



BUSINESS & SCIENCE

THE VANISHING GLOSSARY VANISHES AGAIN

Diffused beyond clear recognition, computing's sundry glossary committees have almost but not quite produced a working, published set of terms and definitions. While the need is clearly apparent and in tidy, chopped up areas, the work continues, the present result hardly befits the effort.

Several months ago, the stage was set both with reason and political caution to publish the three-year output of a sub-committee's work on glossaries in the ACM Communications. After a date had been officially set, the efforts of our European brethren were brought to focus with the request that publication of the U.S. glossary be postponed indefinitely until the IFIP glossary was made available. The contention was that appearance of the U.S. effort would color and detract from the impact of the global work. However, no date for the IFIP glossary was fixed and while expectations are still active, the result remains consistently negative and the word "computer" sits shamefully undefined.

IBM MUDDLES THRU DESPITE 40% STOCK DIP

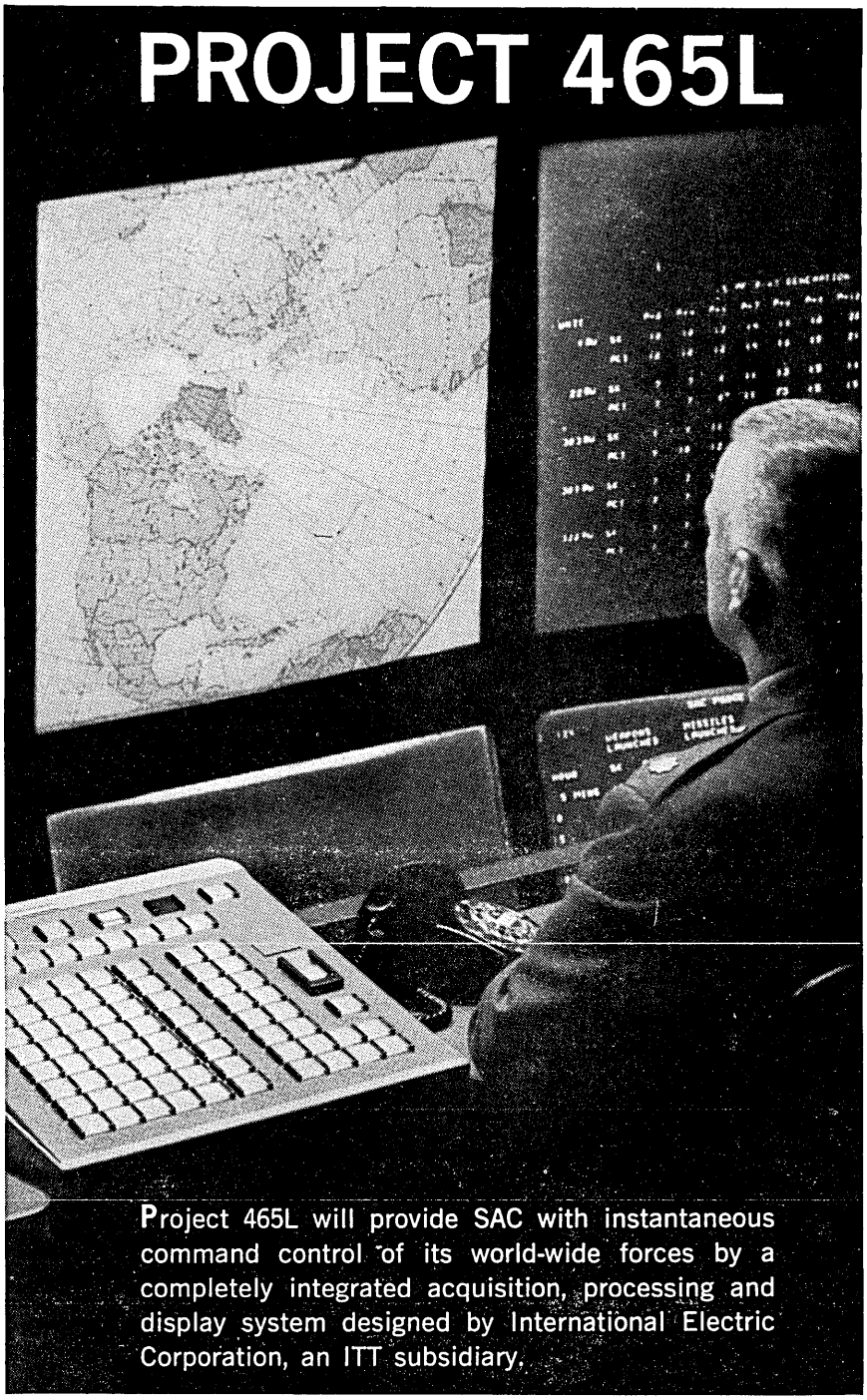
Despite a recent and comparatively rapid decline of more than 40 per cent in its stock quotation, IBM's economic condition remains healthier than ever. Speculators and green-eyed competitors may have hoped for some internal debacle as the basis for the stock dip but no such event has occurred.

Informed stock analysts can provide no single answer as to why IBM fell from a high of 607 in 1961 to 360 last month. However, the answer may lie in a shift of mutual funds to less inflated stocks followed by the smaller, easily frightened investor rescuing his profits while the deserts are still topped with whipped cream.

With over 7,000 1401's on order and installed, more than 150 7090's on the air, etc. and etc. IBM's outlook remains as plush as any ice cream sundae on the N. Y. Exchange. However, analysts expect that IBM's annual earnings growth compounded at an average of 23 per cent from 1957-1961, will stabilize at 15 per cent and result in a doubling of earnings every five years. This rate, while lower than in past years, is projected as five times the normal recorded by the general economy.

Last year about 70 per cent of IBM's gross income stemmed from computing hardware and supplies. Special

PROJECT 465L



Project 465L will provide SAC with instantaneous command control of its world-wide forces by a completely integrated acquisition, processing and display system designed by International Electric Corporation, an ITT subsidiary.

For this project, Anelex has been selected as a subcontractor to supply the Militarized High Speed Printer Systems which will make permanent records of the constant flow of information and the changing data displayed on illuminated wall maps and charts.

Whatever your data processing project, the same engineering competence and equipment reliability which earned this I.E.C. subcontract for Anelex can solve your print-out problems.

ANELEX

SYMBOL OF QUALITY

Further information available on request

ANELEX CORPORATION

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CIRCLE 16 ON READER CARD

PHILCO COMPUTER DIVISION has Immediate Openings for SCIENTISTS and ENGINEERS

IF YOU are genuinely creative and have the imagination and ability to contribute to the development of new and unusual concepts in advancing the "state of the art" you may qualify for one of a number of highly significant positions for Senior Level Engineers now being added to our Scientific Staff.

Here at PHILCO COMPUTER DIVISION *the current activities are concerned with every aspect of Computer engineering of a highly sophisticated nature.*

Information Retrieval

Experience in Data Processing Systems engineering with emphasis on data retrieval and command control. Additional experience in logic design, programming or mathematics required.

High Speed Memory

Extensive experience in magnetic memory circuit design, memory organization, high speed amplifiers and transmission line theory.

Advanced Logic

Comprehensive experience in logic design of high speed computers. Knowledge of basic logic principles extending newly-formed concepts to next generation machines. Appreciation of machine organization and adaptation of organizational concepts in terms of logic requirements.

Advanced Circuits

Comprehensive background in high-speed switching circuit design (saturating and non-saturating circuits) utilizing advanced semi-conductor techniques.

★

The above positions offer an excellent opportunity for increased professional growth. E.E., Physics and Mathematic majors with M.S. or Ph.D. degrees are invited to submit resumes in confidence to:

MR. JOHN FELOS
Professional Employment Manager

PHILCO®

A SUBSIDIARY OF Ford Motor Company

COMPUTER DIVISION, WILLOW GROVE, PA.

An Equal Opportunity Employer

CIRCLE 87 ON READER CARD

products and typewriters accounted for the balance.

IBM World Trade's gross revenues in '61 were $497.6 million. Earnings were $64.5 million of which only $18.5 million were included in the annual report. The balance was reinvested overseas. World Trade now has over 40,000 employees, 17 manufacturing plants and nearly 300 sales locations in 92 countries outside of the U. S.

One of Board Chairman Watson's publicized concerns of late has been the shift from rental to sales which could inhibit long range gains. In '61, 30 per cent of net shipments of new hardware in this country were sold outright. In the first quarter of this year, the proportion of sales to net shipments was believed to be slightly lower which could indicate that the trend may have been arrested. Perhaps an obvious although caustic observation is simply that money is still money and one should learn to receive it with far less consternation.

B5000 PROGRESS BEHIND SCHEDULE

Originally scheduled for systems testing in April or May, current expectations are for the B5000 to be running a full set of performance routines during October with August pegged as the earliest date for initial operation of the prototype.

B5000 software is presently being simulated on a large scale, competitive system as well as a B220 although due to the nature of the programming, debugging will not be completed until one to four months after the prototype is on the air. Bottlenecks at present are reported as minor yet persistent and attributable to a slowdown in main frame cabinet design and documentation for manufacturing. Plans still call for delivery of ALGOL and MCP to the first user installation.

While B5000 sales have not been overwhelming it is expected that this condition will improve once prospective users can oogle at Polish notated, flying hardware. About 12 orders are presently in the Burroughs house. The first two machines however, will be used internally: one for engineering and the other for automatic programming.

PHILCO FACES A CRITICAL TEST

Over the initial hurdle of Ford support, Philco Computer has now armed itself with the accouterments necessary for a large scale engagement. The enemy of course is hardly one of modest strength and the ground to be gained or lost is essential to Philco's future. The target is the 7090 user.

With its newly announced one microsecond memory for the 212 significantly bettering the 7094 speed; a Bryant disc file at least comparable to the 1301, and 240 KC tapes definitely in the Hypertape league, Philco has also added a new peripheral computer to combat the 1401-1410 for buffered I/O. On the surface at least, the armaments are impressive and in pricing as well, Philco may have the edge. Software is equally chaotic on both sides of the trenches except that

reprogramming from machine language may prove a formidable obstacle for the Philco sales crew.

By mid-1963, even a partial victory for Philco may be properly interpreted as one of major consequence. However, if comparatively few sales materialize, the retreat which may follow could breed a new Ford look at its computing division and perhaps a shorter tail light for the Galaxie. Assurances have been received however, that the computer division will be retained come short or long tail lights.

SEC TACKLES MIDWEST TECH "MISCONDUCT"

Encircling computing's fringe areas since 1958, Midwest Technical Development Corp., a Minneapolis investment fund, was confronted last month with an SEC civil suit in which 18 past and present officers and directors of the firm have been accused of "gross misconduct" and abuse of trust in addition to other violations of the Investment Company Act.

Twenty-four firms including Telex, Soroban Engineering, Midwestern Instruments, Electro Logic, Kauke Associates, National Semiconductor, Technical Management Service Corp. and others have been directly involved with Midwest Tech. There are over 5,000 shareholders in the company.

Specifically, the SEC suit alleges that individual defendants acquired personal investment positions in several of the firms "whose securities the fund purchased for its investment portfolio."

Officials of Midwest Tech feel that the SEC suit is an effort "to broaden heretofor undefined rules and regulations" of the Investment Company Act and "is unwarranted and without merit."

Board chairman of Midwest Tech and Telex president is Arnold J. Ryden. President of Midwest Tech is John Hawthorne. Formerly a director of the fund was Erwin Tomash, now president of Data Products, Inc., an independent, publicly owned firm recently spun off from Telex. There has been no investment by Midwest Tech in Data Products,Inc.

THE IN & OUT OF ADDRESSOGRAPH-MULTIGRAPH

Rarely considered a factor "in" the computing field, Addressograph-Multigraph has nevertheless marketed its 900 series edp system for over two years without fanfare and with relatively few sales. Three installations are presently on the air with a fourth on order. One of the three is internal at the Cleveland home office of A-M. Rental of the 900 series may range from $8-16K.

Periodically the impression has been received that A-M plans to withdraw from edp sales and concentrate on non-computer oriented systems, facsimile equipment, etc., however, most recent feedback indicates growing support for sales and technical services in edp and hopefully, another computer manufacturer may soon be born.

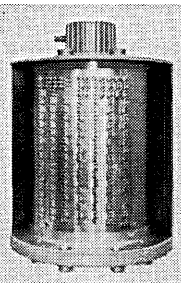
BRYANT MEMORY DRUMS FOR EVERY STORAGE APPLICATION

Whatever your immediate or long-range computer requirements, Bryant is equipped to provide "right now" response to your needs for prompt delivery of custom-designed memory drums, standard storage units, read/record heads, and other precision memory system components.

Remember—Bryant Magnetic Memory Drums offer these special features:

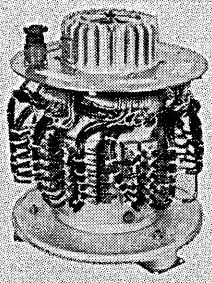
- Time-proven reliability
- Super-precise ball bearing suspension
- Dynamic runout less than .0001″
- Dynamically balanced at operating speed
- Precision integral-drive induction motors
- Exclusive tapered drum design

For more detailed information, or if you'd like to discuss your particular storage drum application problems, contact your Bryant Representative, or write direct: 852 Ladd Road, Walled Lake, Mich., MArket 4-4571.



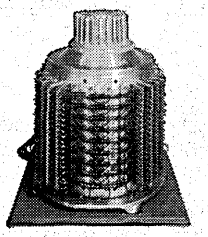
MASS DRUM MEMORY

Capacity—Up to 6,210,500 bits with fixed heads—25,000,000 bits with movable heads . . . **Tracks**—Up to 825 . . . **Speed**—900, 1800 or 3600 rpm . . . **Size**—18.5″ dia. x up to 34″ long . . . **Access time**—As low as 16.6 ms (one head per track).



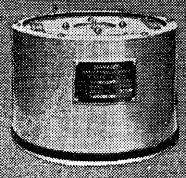
BUFFER APPLICATIONS

Capacity—Up to 225,000 bits . . . **Tracks**—Up to 150 . . . **Speed**—Up to 60,000 rpm . . . **Size**—3″ to 5″ dia. x 1″ to 8″ long . . . **Access time**—As low as 0.25 ms (4 heads per track @ 60,000 rpm).



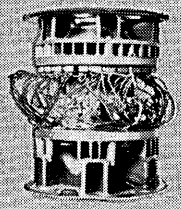
GENERAL MEMORY

Capacity—20,000 to 2,500,000 bits @ 130 bits per inch . . . **Tracks**—40 to 420 . . . **Speed**—600 to 24,000 rpm . . . **Size**—5″ dia. x 2″ long to 10″ dia. x 19″ long . . . **Access time**—As low as 2.5 ms (one head per track) . . . Aerodynamic heads optional.



SPECIAL PURPOSE MEMORIES

Analog recording . . . Multispeed operation . . . Speed—As low as 2.5 rpm . . . **Aerodynamic heads** for high density, high frequency recording . . . **Flux-sensitive heads** for low-speed playback . . . **Air bearing drums . . . Magnetic Disc Files** for mass storage up to 720,000,000 bits.



AIRBORNE SYSTEMS

Capacity—Up to 250,000 bits . . . **Tracks**—Up to 150 . . . **Speed**—Up to 18,000 rpm . . . **Size**—As small as 6″ dia. x 6″ long . . . Weight—As light as 7 lbs . . . **Access time**—As low as 3.3 ms (one head per track). Designed to meet MIL-E-5400.

62-41-CP

BRYANT

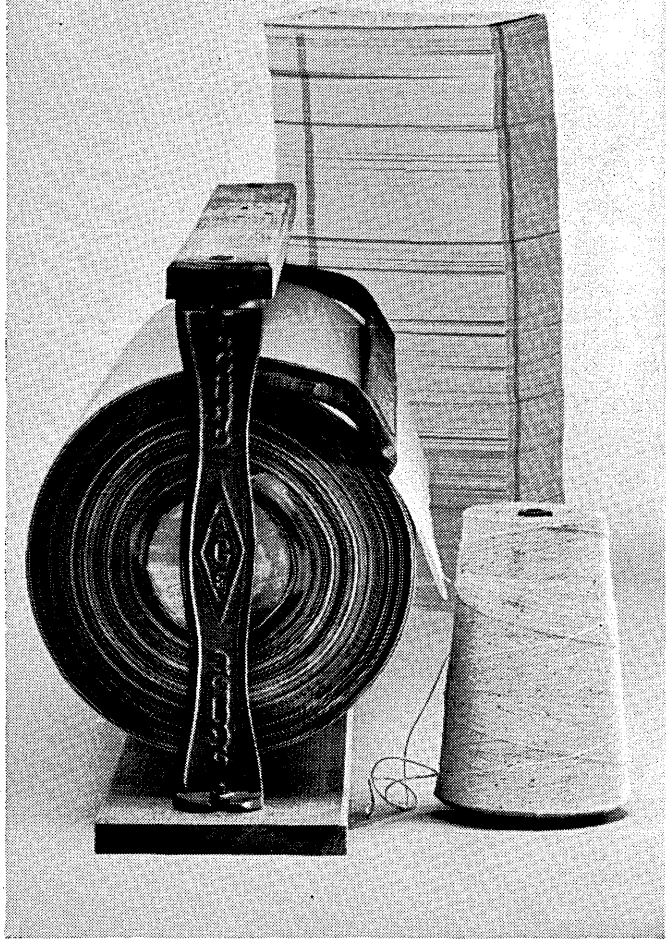
COMPUTER PRODUCTS

Disc File and Magnetic Drum Memories for Every Storage Application

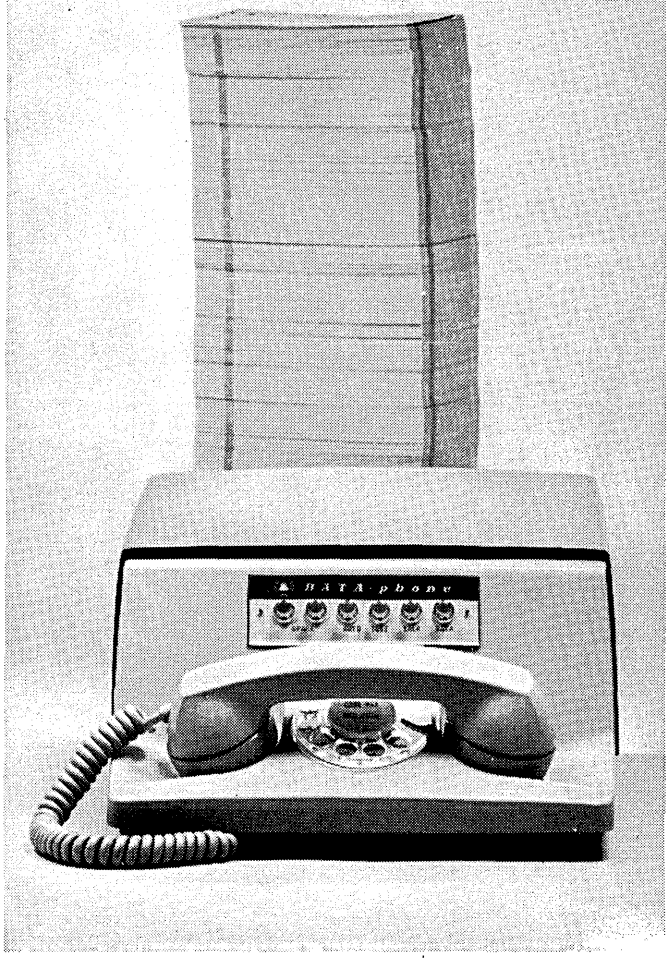
A DIVISION OF EX-CELL-O CORPORATION XLO

CIRCLE 17 ON READER CARD

IN THE TIME YOU TAKE TO WRAP IT...



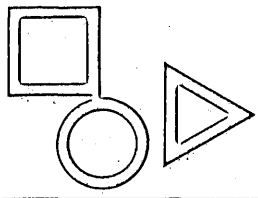
YOU COULD TELEPHONE THIS DATA!



How? With Bell System DATA-PHONE service. It lets you send business data over telephone lines at speeds up to 2500 words per minute at regular telephone rates. All kinds of data—payrolls, waybills, sales orders, inventories, even drawings. Saves time, cuts cost, speeds customer services. Questions? Just call your Bell Telephone Business Office and ask for one of our Communications Consultants. He'll gladly explain how DATA-PHONE service can extend your business machines to where they're needed, and how it broadens your control of operations for savings and profit.

BELL TELEPHONE SYSTEM

CIRCLE 18 ON READER CARD



EDITOR'S READOUT

HOW TO ANNOUNCE A FAILURE

Unlike other industries, failures in computerland are far more appetizing than successes – or so it seems to the blood shot eyes of yellow-penned journalists and especially to their readers who dance in merry approbation at the drop of the word "goof."

Whereas announcement of successes pose few problems and in fact, may conjure up a fantasy of well-healed fairies bestowing riches to smiling managements, failures result in unwieldy traumas, nervous titterings and may even be announced as successes.

Hardly an area for early standardization, failure announcements must be clearly recognized as essential to the normal maturing of computerites.

Of course, failures run the gamut from weenie goofs to grotesque stupidity, all of which may be properly rationalized as part of the learning process; in fact, the higher the tuition, the greater becomes the student's power of retention.

Despite the many virtues in the proper announcement of a failure, corporate management will most probably continue to bungle the job and whispering campaigns will perpetuate the twisting of fact and fiction. Only the truly inspired journalist may properly interpret its meaning and since all of the latter are grubby, insensitive souls, the public and professional are again left to fend for themselves.

A proper categorization of the methodology of failure announcements may provide some relief to this confusion and hopefully, may serve as a proper guide to future announcements. The failures, of course, will remain.

The following historical tracings are based almost entirely on fact and large failures. Readers may submit their requests for detailed substantiation. However, we offer no promise to reply.

1. Facing The Mob. A vogue of late has been the square shooting confrontation in which the goof is plainly exposed by the corporate prexy. Cards are laid on the proverbial table, honesty is indicated as a virtue overriding the magnitude of super-scale failure and sympathy is assumed "because we're big enough to take it . . . boys." Unfortunately, the audience has been well aware of the failure for many months prior to the announcement.

2. The Best Defense Is . . . To counteract such small embarrassments as the firing of top management, stockholders' irate complaints, and the simple failure to sell very many machines, an offensive attack is sometimes mounted even from a prone position. Public exclamation of the wonders planned for tomorrow, shouts of "let's polish off the leader" and other

non-supportable school cheers echo through the public press and elsewhere. Unfortunately, a continuing stream of new personnel announcements stirs one's curiosity as to what happened to the old personnel and why, while new installation figures remain ominously static.

3. The Mum-Up. In contrast to the offensive is a retreat into hushed silence, particularly when a product such as ultra-dandy software or super-speedy hardware appears to be extra-special late and penalties optimistically agreed to when the concept was first conceived in some heat, are now being paid with cool dispatch. The fact that ads are no longer apparent and conference papers withdrawn and exhibit space cancelled and sales pitches reversed all add up to silence, does not negate the loud reverberations which silence can produce.

4. The Grande Pre-Announcement. One of the truly monumental whoppers occurred some years ago when the better part of a computer conference afternoon was acquired solely for the announcement of a grande, new machine whose design required the physical space equivalent to an oversized ballroom and whose actual capability could be harnessed in two desk-top machines. As the announcement blazed away to the accompaniment of slides and colorful visions of rocket driven memory cores, it was unfortunately brought to the attention of the speakers that they were pre-announcing a failure and that the audience would be certain to keep running tabs on its kludge-like progress. No one was disappointed. The company left the computer field "temporarily" and has since returned with surprising timidity.

5. Who? Us? Naw! Must Be Them. Turning the other cheek may be an acceptable religious concept; however, its application in diminishing the impact of a new and unpinpointed goof generally operates by simply blaming one's neighbor. This has proven particularly true in sudden lapses of corporate support for sundry computer divisions. Unfortunately, ultimately and unmistakably, the pin does point in the right direction; in fact, it may be easily detected by the blood drawn from a competitive salesman's elongated needle.

6. The Contraction. Not uncommon today as a rationalization for failure to produce or sell a product is the belt-tightening philosophy of "We've got to make money with what we've got because what we've got is all we're going to have . . ." A press release may be published to this effect or a news story "placed" in the "right" media. Failure may also be couched in terms of success such as "This machine is such a hot number we haven't got the people to sell the whole line right now or to bring out our hidden numbers." The result is one of calling attention to poverty. If not effective, omission would be more delicate.

7. The Successful Failure. A manufacturer's statement implying phenomenal success may read as follows: "Our 804s have done so well in their military tests that we have refrained from introducing them commercially because of the impact they would have on the market." Properly translated, the same statement reads: "We've tried, but we can't sell one." Or, "It's been tested several times and if we debug it completely, that finishes our government contract."

It would be naive to assume complete honesty in the announcement of a failure, but perhaps the point of these illustrations is that honesty may not be necessary if the level of idiocy is sufficiently high. ■


ROACH


ELLESTAD


LAKE

MEDICAL DATA PROCESSING & COMPUTER AUTOMATED HOSPITALS

a clinical view of the state of the art

by CHARLES J. ROACH, MYRVIN H. ELLESTAD, M.D., and RAYMOND B. LAKE*

Judging by the number of related papers presented at technical conferences and by the articles appearing in the technical and semi-technical press, interest in applying computer techniques to medicine has increased exponentially during the past five years. Has this increased interest generated significant results—or has it merely provided a means of glamorizing results obtained in certain areas of biomedical research and a conscience salving medium for some individuals (and organizations) whose principal activity is the development of military armaments? Is smoke all that is being generated or are there some flames underneath? Answers to these questions depend largely upon what is included under "applying computer techniques to medicine" and on what one accepts as "significant results."

Almost everyone will grant that there is a need to improve information handling and processing procedures in medicine. Present methods offer little hope of dealing adequately with the accumulating mass of clinical records, the mounting volume of documentation, and the increasing weight of research data. Although electronic data processing techniques are certainly applicable to these kinds of problems, medicine as it is practiced today is not characterized by the kind of definition and explicitness generally considered to be a prerequisite for automating data processing. In spite of the number of biomedical research projects that have used computers for data analysis, it would be difficult to demonstrate that the computer has played a significant role in any important discovery. Hospitals and other medical care organizations have not used computers to any significant extent. Less than ten hospitals in the entire country have computer installations. Although we, perhaps, cannot as yet point to "significant results" in terms of computer applications to medicine, considerable progress has been made in understanding the problems faced and in developing fruitful approaches to their solution.

problem areas

Practically all current research and development activities involving the use of electronic data processing in medicine can be categorized into one of three major problem areas. These are:

(1) Development of systems for storing and retrieving medical literature.
(2) Development of techniques for recording, retrieving, and analyzing data in medical research.
(3) Development of techniques and systems for handling information in clinical medicine.

The document or literature storage and retrieval prob-

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lem is, of course, not unique to the biomedical sciences. It is a problem which pervades our entire technological society and touches each of us in a personal way as we pursue our professional and economic goals in life. Although we are not as far along toward a solution of this problem in medicine as we are in other fields, notably chemistry and metallurgy, work on both the practical and theoretical levels is being supported and guided by such organizations as the National Library of Medicine and the National Institutes of Health.

In the second problem area, the computer can be viewed as just another tool to aid the researcher in his investigations. In biological simulation studies the computer becomes the principal tool. In on-line experiments where a computer is used to monitor and analyze physiological data, the computer and instrumentation together are the main research tools. In statistical studies, the researcher uses data processing equipment for storing and retrieving data or for analyzing data. Although current data processing technology is adequate for these tasks, researchers frequently do not have convenient access to the equipment and to the technical skills required to make efficient use of the equipment.

The biomedical research support center has been proposed as a means of providing researchers in biology and medicine with competent *technical assistance* in experimental design, statistical analysis, data management, computer analysis, and electronic instrumentation and *service* in handling, storing, and analyzing data. In the current budget of the National Institutes of Health, $5,000,000 was set aside for establishing such centers. Since centers providing some of these services have been operating for a number of years at Tulane University, UCLA, New York University and elsewhere, this represents an expansion of an existing activity rather than a new approach.

applications in clinical medicine

Of the three major problem areas, the least progress has been made in the third, the development of techniques and systems for handling information in clinical medicine. Yet by almost any objective measure this area would be rated the most important. Certainly from an economic standpoint this is true. As a nation we spend in excess of $25 billion annually for health and medical care. At least $20 billion of this is for clinical medicine—payments for services of practitioners, for hospital care, and for the operation of federal, state, and municipal medical care facilities. Our expenditures for medical research amount to approximately $1 billion per year and at least one or two orders of magnitude less is spent for the publication and dissemination of medical literature.

Progress in applying electronic data processing technology to clinical medicine has been slow primarily because of the diverse nature of medical care activities and of the organizational structures within the field. Because of this diversity there is today limited understanding of the benefits that may be realized from applying this technology, little direction and guidance to those interested in applying the technology, and insufficient funds to support the necessary research and development.

Although the American Hospital Association, the Ameri-

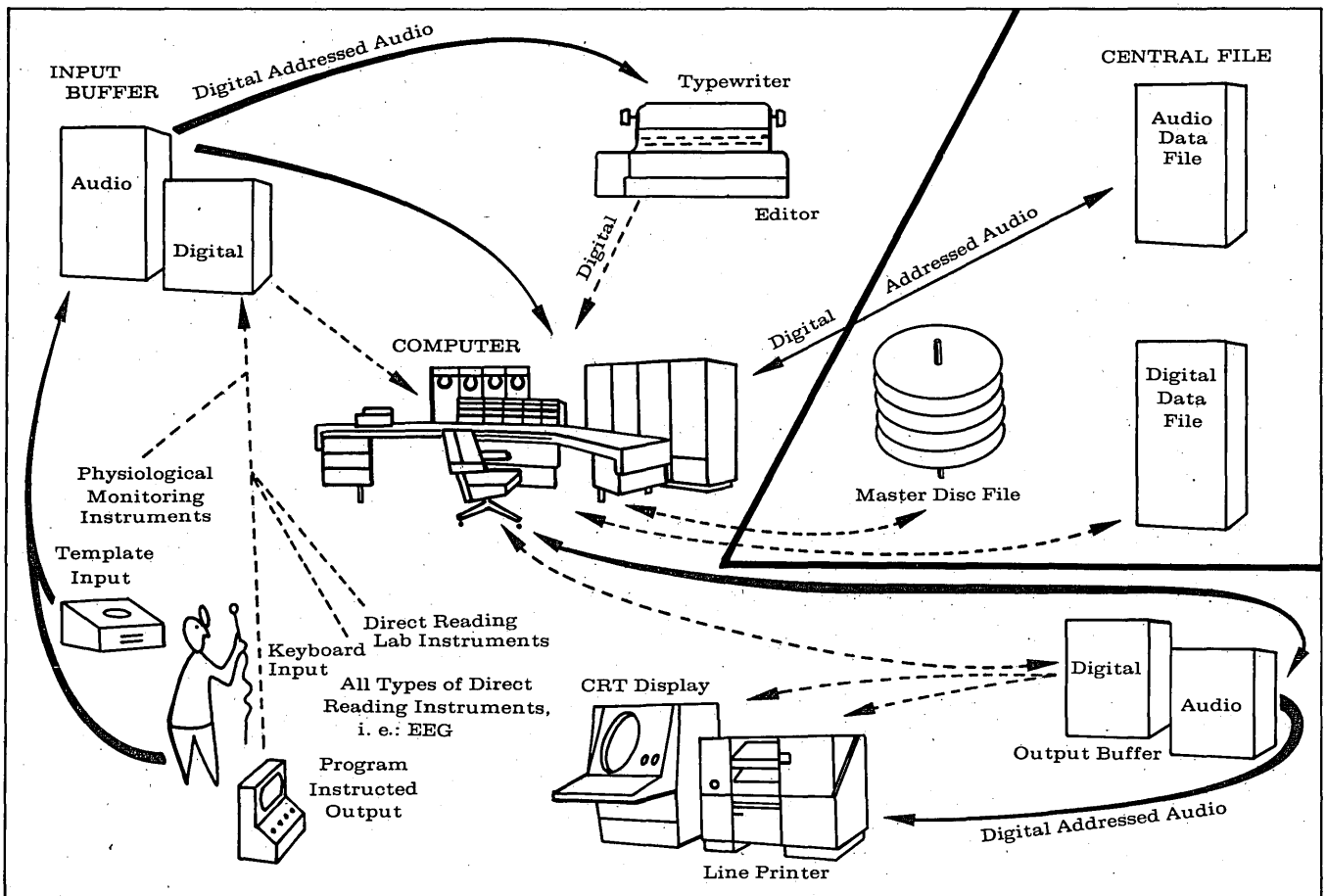


Figure 1. CONCEPTUAL MODEL

can College of Hospital Administrators, and the American Medical Association, and a number of other professional medical and paramedical societies have shown an interest in computer technology, they have provided little guidance or direction to those who are interested in applying it to clinical medicine. Since most private medical care organizations do not have the funds to support research and experimentation in this field, their interests must be served by these professional societies. The three large hospital systems (Veterans Administration, Department of Defense, and the Public Health Service) operated by the Federal Government at an annual cost of over $3 billion have the resources and have shown some interest in supporting this type of research and development. Although state, county, and municipal medical care organizations have, perhaps, the greatest need for improved information handling procedures, they cannot be looked to as a source of funds for supporting extensive research and development activities. Private foundations, universities, and industrial corporations are providing qualified technical personnel and limited funds for this work but they cannot provide the needed direction and guidance.

It would, therefore, appear that the U.S. Public Health Service through its Division of Research Grants must be looked to as the principal source of funds for development of computer applications in clinical medicine. By working together with the aforementioned professional societies and with the federal, state, and municipal hospital systems, they should be able to provide the required guidance and direction for this work. The establishment of the Advisory Committee on Computers in Research in 1960 by the Division of Research Grants was an important first step toward fulfilling this need.

Among those interested in applying computer technology to clinical medicine there has been little unanimity of thinking on what applications promise to be most fruitful, on what should be done first, or on where it should be done. Some believe that more effort should be expended in quantifying data and in establishing standard terminology before any attempt is made to automate information handling procedures. Others believe that applications to the handling of business and accounting data should be developed first. Still others think that the development of computer aids to diagnosis and therapy selection should have high priority.

A range of opinion has been voiced regarding the most suitable organization environment for initial applications. There are valid reasons for first developing computer-based systems for storing and retrieving medical records for groups of hospitals and hospital systems. Equally convincing reasons can be given for beginning with the automation of sub-systems such as the pharmacy or the clinical laboratory within a hospital or even for developing a system for providing data processing services to private practitioners. Although some work is being done in each of these application areas, the development of an integrated computer-automated information system for large and medium-sized hospitals is gradually emerging as the central problem in applying electronic data processing techniques to clinical medicine. The voluntary short-term private (non-profit) hospital, handling 67 per cent of all hospital admissions today, plays a major role in the provision of medical care. A modern, progressively managed hospital of this type can provide an excellent organizational environment for the development of such a system.

computer-automated hospitals

Memorial Hospital of Long Beach (California) is a 400-bed short-term voluntary hospital opened in June 1960. The facility was designed to be modern in every respect even to making provisions for installing a computer at a later date. Early in 1961 a study committee was organized to determine how electronic data processing should be applied to information handling and communications within the hospital. The Committee established a plan for developing an integrated computer-based system. The plan, known as Project DARE (Data Automation Research and Experimentation), emphasized the necessity of conducting research and experimentation to determine the specifications for a practical system before attempting to implement. System planning, experimenting with promising techniques in specific sub-system areas, and a planned program of education aimed at preparing hospital personnel to accept new methods were essential activities.

The objective of this project can be defined best by describing the conceptual model of the system. This model illustrated in Figure 1 employs 1) remote input-output stations, 2) a communication network, 3) a medium-scale computer, and 4) data storage media including a random access file and magnetic tape. Data generated at various locations throughout the hospital are entered directly into the system at remote input-output stations. Sensing and measuring instruments with digital output are used wherever practical to capture data as it is generated. If the data is needed at the source location, a printout or display is produced as a by-product.

With the addition of local buffer storage patient monitoring equipment such as is already being employed in the surgical, post-operative and intensive care areas of many hospitals can be used to enter vital signs data directly into the system. Many instruments in the clinical laboratory can be readily modified for direct recording. Where automatic recording is not practical either because of the type of data or because of economic considerations, manual input techniques—mark sense, punched cards, templates, keyboards, and typewriters—are employed.

In addition to these standard data recording methods, two unique techniques have been included. These are: 1) digital-addressed audio recording and retrieval, and 2) program instructed input.

The digital-addressed audio technique employs a microphone and a simple template reading device as the input mechanism. To record packets of information such as a physician's order, diagnostic summary, or progress notes, two plastic templates (cards)—one identifying the originator of the data and the other identifying the patient—are inserted into the template reader. The type of data, (medication orders, orders for laboratory tests, vital signs, progress notes, etc.), being recorded is identified by setting a dial on the template reader. This identifying data is converted into digital code and transmitted to the input buffer where it is used as the digital address for audio information which is spoken into the microphone and transmitted to the audio section of the input buffer.

The digital-addressed audio data is taken from the input buffer by the computer and stored in the audio data file portion of the central machine file where it is retrievable upon request. When the audio data is transferred to central file, the computer records each transaction in the patient's master file which is maintained in the random access master disc file.

Certain types of recorded audio data require partial transformation or summarization into digital (alphameric) form. This function is performed by a person (shown as the editor) who receives this audio data and enters a machine language summary into the system by means of a keyboard. This summary along with other types of digital data entering the system is stored by the computer in the

digital portion of the central file. Again, a record of the transaction is made in the patient's master file.

Although the editor is shown as a single individual in a central location, this function may be partially decentralized. Since the system will relieve professional personnel of many of the routine and clerical tasks they now perform, the added task of editing will not increase the needs for personnel. Chances for errors will be decreased because the communication routes are more direct. For example, physician's orders for medication may be routed to the pharmacy where the pharmacist performs the editing (data entry) function. Orders for laboratory tests may be handled similarly in the clinical laboratory. By decentralizing this operation skilled personnel can be employed on a part-time basis returning to their normal activities when they are not needed for editing. Since peak loads will occur during the morning and late-afternoon hours when physicians traditionally "make their rounds," this is a definite advantage.

The second unique technique is the program instructed input. The device used for this purpose is similar to a teaching machine in that it presents information to a person in visual form (an audio or a combined audio/visual form is also possible). Only a small amount of information is presented in each frame. The information presented may be facts, instructions, or questions. When questions are used they are formulated to permit a multiple choice answer. The operator indicates his answer by depressing one of several (perhaps four) response keys and then depressing the enter key. This action advances the film strip to the next appropriate frame. It also causes a coded signal, identifying both question and answer, to be transmitted to the input buffer or a local buffer in the machine.

The program instructed input technique should be useful in recording medical history data (either directly by the patient or through a physician intermediary), physical examination data, and certain types of data in the clinical laboratory. In recording medical history data for example it is necessary to formulate the question into a hierarchical arrangement asking general questions first. Depending upon the patient's responses, questions in greater and greater detail are presented. If, for instance, the question "Have you or any member of your immediate family ever had a cardiovascular disease?" is asked and a negative response is obtained, all further questions on this subject are omitted.

Other features of the proposed system can be illustrated best by describing how the system would operate. Before a physician made his rounds, the computer would retrieve (from the central digital data file and the master disc file) summary data for his patients. This summary data would be printed-out on a line printer at the nursing center to be used by the physician in reviewing the progress of his patients. Since the data is still retained in the machine file, the physician can use the summaries and discard them when he is finished with them. He can receive additional information about any of his patients with a keyboard request. Plots of vital signs (temperature, blood pressure, etc.) over any specified period can be obtained in this way. Any of the information in the digital-addressed audio file (nursing notes for example) can be retrieved and played back through earphones.

After the physician has seen a patient, any orders for medication and laboratory tests are entered in digital-addressed audio form. Progress notes, diagnostic summaries, and other classes of narrative data can also be recorded in this manner. Provisions for immediate playback and correction are included in the system.

We believe that physicians' orders can be processed by the editor within five minutes. Once orders have been entered in digital form, actions for carrying out these orders are initiated by the system. For example, prior to each specified medical period (one, two, four, or eight hours), the computer searches the file for all orders scheduled to be carried out within that period. A print-out of all unfilled prescriptions is produced in the pharmacy. This print-out, on perforated paper, is used by the pharmacist to label medications.

A print-out is also produced at each nursing center to inform nurses of pending medication orders. If necessary, the system can be programmed to require confirmatory data. Obviously, auxiliary functions such as drug inventory and bed census can be handled by the system. Furthermore, supplementary records like the nursing center cardex file can be eliminated since the system provides up-to-date summaries upon request. A nursing supervisor can request summary print-outs for all her patients at the beginning of a shift and discard them when finished.

When a patient is discharged from the hospital, this discharge order causes the system to print out, in the medical records department, information in both master and digital files. The audio information is assembled, read out on magnetic tape, and stored with the print-outs. Three summary levels of the case are, therefore, available for future use. Of course, the patient's bill is also prepared and waiting for him.

While the proposed system accommodates all types of alphameric data and uses audio recording for much of the information which is now being recorded in holographic and printed form, it does not handle pictorial data such as x-rays or electrocardiograms. Any type of analog data could, of course, be given a digital address and stored in the digital-addressed audio file. Most of these pictorial and analog data forms are already being abstracted. Abstracts such as the radiologist's summary of an x-ray or the cardiologist's summary of an electrocardiogram can be entered as alphameric data. Where these summaries are not adequate substitutes, the uses of the original data forms can probably be localized or made infrequent enough so that manual storage and retrieval methods will suffice. If necessary, video file equipment can be added to the system.

in conclusion

Much work remains to be done before a practical computer-automated hospital information system is developed. In particular, a fuller understanding is needed of the present system, of the hospital environment, and of the reactions physicians, nurses, and other hospital personnel have to new procedures. The proposed system model could eliminate many of the time delays, redundancies, sources of error, and other inefficiencies inherent in the present system. It could relieve hospital personnel of much of the routine associated with recording, retrieving, transmitting, and using information. It is a system which requires a minimum of data standardization or coding and hence does not require extensive retraining of personnel. And it is a system which employs existing hardware with a minimum of modifications.

How fast this work proceeds at Memorial Hospital depends on a number of factors including our success in obtaining outside funding. However, we are optimistic in our belief that a practical system can be developed using the concepts described in our model and that the system will improve the quality of medical care without increasing the cost to the patient. ■

A VIEW FROM THE BRIDGE

by Dr. H. R. J. GROSCH, Contributing Editor

I've been over here for nearly six months as I write this—"here" being Europe, with Monte Carlo as a base, and Europe meaning the Continent *and* the British Isles. Brother Bergstein has been after me to get off the diatribe kick and do a travelog: less DAMNATION and more DATAMATION, as it were. For one thing, many readers are thinking about Munich this summer, especially those with NSF or CPFF connections—U and non-U, so to speak! And there is a growing awareness throughout the profession and among our campfollowers of the sophistication, the size, and (especially) the growth rate of European information technology. So I'll try to collect and interpret a few artifacts of the current excitement.

First, though, a little disclaimer: I'm not going to be too specific. For one thing, there isn't space; more important, the real solid dope is part of my stock-in-trade, and I can't afford to give it away! Besides, the picture is changing in its details so rapidly that only fairly general syntheses are likely to have any value six months or a year from now.

One other warning: more even than in the United States, the national positions (and trends) in computation and data processing are functions of more general national parameters—economic and social parameters. Since these vary greatly from country to country, even generalizations are not usually valid all across the map. I'll try to qualify my remarks as I go along; in any event, bear in mind the admonitions of the Korzybski crew: "A tree's not a tree, except in the context of a particular quad and who's about in it."

While I'm butchering adages, I might tackle the one which above all others used to represent the conservatism of the Old World: "Le plus ça change, le plus c'est la même chose." Things are different now. The revised motto for all of Western Europe might better be "Le plus ça change—le plus ça change!" Dat ole debbil Exponential Increase is at work with a vengeance, and Même Chose is out the window. Perhaps Eire and Portugal are exceptions; I haven't been to either one since I came. But everywhere I have been—and my last swing involved almost fifty computer centers in 36 cities of eleven countries—the only constant element is Change.

Indeed, in a very real sense the United States has become the Old World, and Europe the new one. In technology, America sets the standard—and technology is THE standard nowadays, just as commerce used to be, and colonial possessions before that. In every town I visit over here, there are good bookstores—many more than in towns of comparable size in the U.S. and Canada. In every bookstore there is at least one major display of technical books. And two-thirds of the technical books are American! More, in many countries; a little less, perhaps, in England and in Germany. But remember the language barrier: except in the U. K., every scientist, every engineer, every medical man, every student studying those books has had to do so in spite of the deterrent of a foreign, and very difficult, language. Beside an indicator like that, the prevalence of Coca-Cola and Twist records is pretty small potatoes.

But there is another sense in which America has become the Old World, and this one I have to regret rather than boast of. America has it made; she wants to keep what she has, and if possible get just a little more of the same. She has an old industrial plant, an old commercial network, old diplomacy. Sure, they're exceedingly large, very well known, often rather good. But old, conservative, static; the growth rate is miniscule. Distribution techniques—advertising, for instance—are fabulous, but also fabulously expensive. Europe has a brand new set of production facilities, eager salesmen, flexible politicians and diplomats. She has seen how we used our tools, and plans to do better. From a base much lower than ours, certainly—but from a base much *higher* than the one from which we began our climb forty years ago. I predict spectacular successes. Or to be more precise, I predict spectacular *accomplishments;* I'm by no means sure two cars to every family is a success, especially over here, nor do I exult at the idea of a college degree for everybody who can tie his own shoelaces.

Because of these doubts, expressed and implied, I feel fortunate to be working in a field where I don't have to apologize or justify. The United States still leads the world in just about every form of information processing; not just in computing equipment and in applications, but in digital communications, process and other real-time control areas, operations analysis and research. Nor do I feel the lead is narrowing appreciably.

Now this is not primarily a matter of quality. The aver-

age British logical designer, the average German maintenance engineer, the average Swedish programmer is comparable to the top-level American, and far more competent than the American average. But there is such overwhelming quantity on the American scene: ten or twelve times as many machines installed (and an even greater disproportion on a transistor-count basis), more programmers per machine, more user groups, more money to go to meetings with, and more support from the manufacturers.

There is another kind of quantity advantage, too. The American educational system grinds out a fantastic number of partly-educated technical people each year, not good enough to make really novel contributions perhaps, but good enough to swarm all over a great variety of small problems or over the pieces of a large problem. Despite Parkinson—and IBM's early ventures in systems programming were just about the definitive demonstration of his aphorisms—it *is* possible to do an awful lot of work with vast masses of poorly chosen and directed bodies. You have to build pyramids and not cathedrals, of course; FORTRAN's and COBOL's hmmm? Now over here the education system has been geared to the selection and development of an intellectual elite; in several countries this is changing or has already changed, but the effects are of course minimal as yet. In France, Belgium, Italy there is no indication of any change at all, and in Britain the change is agreed on but is barely under way. It may well turn out that by the time large numbers of coders and customer engineers are coming off the educational assembly line, they will no longer be needed; I happen to think so, and would like to sharpen the American distribution accordingly. But certainly at the moment European countries are at a considerable disadvantage. There are literally *hundreds* of 1401's coming in the next two-three years. Who will operate them? These are poor countries for the buddy-system that educated California; social custom is against it in just those places where it is needed. In Sweden and Denmark, where old buddy-system (or B. S. for short) might be acceptable, it probably isn't needed; they have a reasonably broad educational policy. But Britain? France? Hardly!

And a third reason: I believe the American lead will be maintained for at least a decade by the early and vigorous acceptance of industrial R & D, and by military sponsorship of ditto. The information processing field perhaps more than any other in technology is characterized by D stepping right on the heels of R, with mass production and obsolescence not far behind. Basic research is done much farther away from the firing line in Europe, and with very much skimpier industrial support. Sure, there are substitutes: the University Grants Committee in Britain hands out an ATLAS or two, and the Deutsche forschungsgemeinschaft helps build the 2002. But the kind of direct high-power research that goes on in IBM, and to a fairly considerable extent in the laboratories of major U.S. competitors, is very scarce in Europe. Philips, perhaps, in components only; in England, the Ferranti-Manchester combination is a special case.

So I think the United States has the lead, and will keep it. But in componentry, in systems design, in programming, in operating techniques every move is watched, every paper is read, every meeting covered. Believe me, my European friends are aware: hard-aware and soft-aware, if I may be granted absolution! Hence, the *important* advances are taken up very rapidly, while lesser ones are perforce neglected or duplicated later. PERT, for instance, was picked up by Scandinavian and German shipyards long before it was used at Mare Island or Camden. But no one copied the Louisville payroll!

The most important single impression I've gathered on my rounds is this: the young people who really count in this technology are citizens of the New Europe first; of their nation or region second. They look toward their opposite numbers in adjacent or distant countries, rather than to the Adenauers and the de Gaulles. There are rivalries, as between Californians and New Yorkers, but far weaker dislikes than in the old days, and no hatreds. In my view, these are the people who count: they will manage the world of tomorrow, as they will in America. And they will be friends, or at least friendly.

My, my—a real flight of rhetoric! Well, I ought to say a few concrete things, and they won't all be so optimistic. Take Britain, for example: there appears to be a real slump in computer acceptance, and no immediate upturn in sight. There are clearly too many competing systems being designed and manufactured in the U. K. today, and a painful shakeout is not far ahead. Add to that the general smugness of user top management, and an almost complete lack of understanding—or approval—of modern technology, and the number of foreseeable novel applications dwindles painfully. And I've mentioned the narrowness of the educational distribution. When the latter broadens (five years) and the next generation of management takes over (ten years?) I look for Britain to begin remodelling herself into the large-scale Switzerland she will have to become. Meanwhile, I think Honeywell shipped that H-800 to the wrong country!

Sweden, now, and Switzerland—the other side of the coin. Many machines installed, and twice as many coming; careful but imaginative installation studies; a good balance between "scientific" and DP applications. The jobs to be done are smaller than in the U.S., so they are put on smaller machines, which by Grosch's law are less economical per unit operation. And clerical salaries, while high, are still considerably below the American level. So the crossover points are tougher, and further in the future. But those derivatives! Whew!

I've seen some beautiful shops; on my last tour, Krupp in Essen (Muster's 7070) with specially built cabinets for over a thousand tapes, and the Swiss Railway in Bern (Walter's 7070) come to mind. For contrast of old and new, the Univac SS imbedded in "a rose-red city, half as old as time" at the University of Milan is a real thrill. And to keep U.S. types on their toes, Howlett's plans for

WILLIAM D. BELL
March 30, 1962

I have asked a little space for a note about an old friend of mine. Bill Bell died in Tucson this spring, after a long painful illness he usually managed to ignore. He was one of the Founding Fathers — one of the dozen or so customers who taught IBM the computer business. He operated the first American technical service bureau; he wired the first general-purpose board; he became the first full-time consultant in our field. He wrote one of the first "management" books.

He was a photographer of considerable merit, a skindiver when the skill was uncommon, an early sports car buff. He was an ardent horseman. He had a handsome wife and sturdy kids.

He was a trendmaker, a pacesetter. He wore no man's collar. He had many friends. We miss him.

— HRJG

the Harwell ATLAS, and Corner's for the Aldermaston STRETCH, challenge our more-bucks-for-a-bang boys.

Typically, I'm asked about which American developments, hardware and software, look important. Sometimes I'm asked about European developments also, but the general assumption is that the winnowing has already occurred, over here. When I volunteer my opinions about ALGOL, for instance, which I may add parenthetically doesn't look any better to me close up and working than it did as a Diehard *vergeltungswaffe* back in the U.S. of A., they are usually politely pigeonholed with "Yes, we understood you felt that way!" If I persist, there may be fairly vigorous counterattacks like "What happened to STRETCH?" or "Who is Ike Auerbach?"

There is continuing and somewhat wistful interest in our digital data communication experiments. The telegraph and telephone systems over here are nationalized, of course, and the various PTT's are rather unconcerned about the whole thing. When somebody wants to take a few tapes through customs there are some pretty weird problems, too, so the whole question of how to get bits across the border is up in the air. In fact, 'way up; in my view, only a satellite relay station will solve the problem, and the PTT's have their fingers in that pie-in-the-sky too!

Nevertheless, I like the excitement. I like the feeling of novelty; it carries me back to the early 1950's in the United States, when there were still lots of bubbles in the champagne. Let me draw a rather curious analogy: there are two comparable engineering feats under way at the moment. In New York Harbor, Americans are building the world's greatest suspension bridge; in the Alps, Europeans are drilling the world's greatest tunnel. The Staten Island venture is a guaranteed success; under Mont Blanc, there are still dangerous difficulties. But I prefer the tunnel; the main function of the Narrows Bridge is to *detour* traffic around New York, but the Traforo di Monte Bianco is to *connect* two neighbors!

Oh, I forgot to say who was ahead over here. Guess? Yep, old Dulce Et Decorum Est, by a country kilometer.

3,500 TO ATTEND IFIP CONGRESS

Over 3,500 delegates from 21 countries will convene at Munich on August 27 for the second Congress of the International Federation for Information Processing. The six-day meeting is formed around three main areas, the Scientific Program, IFIP Interdata, and Plant Tours.

The Scientific Program will consist of three sessions on hardware development including peripheral equipment; one general, state-of-the-art session of invited papers; 20 sessions of submitted papers of broad interest, and 26 symposia of specialized interest including several panel discussions.

Included in the list of submitted papers by American authors are: *Toward Inductive Inference Automata,* L. J. Fogel, Bell Telephone Labs; *Mathematical Analysis of Merge-Sorting Techniques,* W. C. Carter, IBM; *Extending Management Capability by Electronic Computers,* A. Vazsonyi, Thompson Ramo Wooldridge; *Generalization of an Elementary Perceiving and Memorizing Machine,* E. A. Feigenbaum, Univ. of Cal. and H. A. Simon, Carnegie Tech; *An Experimental System for Logic Design-Data Accumulation and Retrieval,* R. J. Preiss, IBM; *The Multi-List System for Real-Time Storage and Retrieval,* N. S. Prywes and H. J. Gray, Univ. of Pa.; *An Algorithm for the Translation of ALGOL Statements,* W. M. Keese and H. D. Huskey, Univ. of Cal.; *Computer to Computer Communication at 2.5 Megabits/Sec.,* N. Clark and A. C. Gannet, Control Data Corp.

Invited papers include: *Automata Theory,* A. W. Burks, Univ. of Mich.; *Standardized Comparisons of Computer Performance,* R. L. Sisson and J. A. Gosden, Auerbach Electronics; *Pulse Mode and Fundamental Mode Operations of Sequential Circuits,* E. J. McCluskey, Princeton Univ.; *Problem Solving, Learning and Generality,* A. Newell, Rand Corp.; *Information Retrieval—Review and Prospectus,* A. Kent, Western Reserve Univ.; *High-Speed Memories,* W. E. Proebster.

Other invited papers will be read by Grace M. Hopper and J. P. Eckert, RemRand, and J. McCarthy, M. I. T.

Among the panel and symposia organizers are: J. Rajchman, RCA, Symposium on Fast Memory Technology; A. L. Samuel, IBM, Symposium on Pattern Recognition; M. Minsky, M.I.T., Symposium on Artificial Intelligence; R. W. Bemer, RemRand, Symposium on Programming Languages; L. Fein, Consultant, Palo Alto, Calif., Panel on University Education in Information Processing; M. L. Juncosa, Rand Corp., Symposium on Optimum Routing in Large Networks; A. S. Householder, Oak Ridge National Laboratory, Sympoisum on Matrix Computations.

IFIP Interdata, the exhibition of data processing equipment, will be held at the Munich Exhibition Ground from Sunday, August 26, to Sunday, September 2. Exhibition hours are from 9 a.m. to 6 p.m. every day, except August 28 and 30, when the exhibit will be open until 9 p.m.

During and after the Congress, five plant tours will be held for limited groups. There will be no charge for the tours, and transportation will be provided by the firms conducting the visitations. However, food and lodging will be paid by the tour participants. Applications for the plant tours must be made on the registration form for the Congress, and will be considered in order of receipt.

The scheduled tours are:

a. Munich: Siemens & Halske. One half-day during the Congress.

b. Germany: IBM Deutschland, Sindelfingen; Standard Electrik-Lorenz, Stuttgart-Zuffenhausen; Telefunken, Heilbronn. Begin at Munich on Sept. 3 and end at Heilbronn on Sept. 5.

c. England: International Computers and Tabulators Ltd.; Elliot Automation Ltd.; EMI Electronics Ltd. Begin at London on Sept. 6 and end at London on the following evening.

d. France: Cie. des Machines BULL; Cie. Industrielle des Téléphones; Cie. Européenne d'Automatisme électronique; Societé pour l'Exploitation des Procédés S. E. A. Begin at Paris on Sept. 6 and end at Paris on the following evening.

e. Italy: CEA-PEREGO Milano; Olivetti Divisione Commerciale Elettronica, Milano, Sept. 6, one day. ■

OBJECT PROGRAM EFFICIENCY

revisited

by DANIEL D. McCRACKEN, McCracken Associates, Ossining, N.Y.

"What you say about the advantages of COBOL for documentation and compatibility may be true, but I just can't afford the tremendous cost in object program efficiency." How many times have you heard *that* in a discussion of COBOL?"

An experience I had with a COBOL program recently suggests that such statements be examined carefully, to see if the whole story is being told.

I wrote two versions of a simple COBOL exercise and ran them on an Air Force Logistics Command Univac 1105. Both versions had the same procedure division and produced exactly the same output tape. The only difference between them was in their data divisions. The "sensible" version was designed taking into account some elementary facts about the 1105; the "stupid" version took no account of the machine. As a matter of fact, the only difference between the two was that the sensible version said "USAGE IS COMPUTATION, SYNCHRONIZED" in a few places and the stupid one didn't. That was literally the only difference.

What happened? The sensible version had 80 object program instructions (not counting input and output routines, of course); the stupid one had 256. An ADD verb that had created one machine instruction in the sensible program became 19 instructions, including a couple of subroutine calls; another ADD went from 2 instructions to 28; an IF went from 3 to 26; a MOVE went from 1 to 10. Most revealing, the sensible object program ran in about 8 seconds — just over tape time — while the stupid one took just *ten times as long*, 80 seconds. Mind you, both source program procedure divisions were precisely the same, and both object programs produced exactly the same output.

What does this prove? I think three pretty safe conclusions can be drawn.

1. Object program efficiency is not a function of the language only, nor of the compiler only.

2. To get a decent object program out of your compiler, you had better know something about your machine. If you blithely call for binary arithmetic on BCD fields or split a two-digit field across two words, you're going to create a mess. We will need to modify the sometimes-heard statement, "No machine knowledge is needed to code in COBOL."

3. Still, you don't have to know *everything* about the machine; I would doubt strongly that a complete machine-language programming course would be necessary for most people. In designing the two programs to demonstrate my point, I used nothing but some very elementary knowledge about how alphabetic data is stored in a binary machine and some rudimentary information about how data is manipulated. I have never programmed the 1105 nor had a programming course on it. I didn't know when I made up the demonstration, for instance, how many addresses there are in an instruction in the 1105 or how negative numbers are handled.

This obviously isn't the whole story. For one thing, the particular demonstration here would not bother a machine like the IBM 7080 very much, since my horrible example depended on the word-addressable and binary features of the 1105. Still, I have a hunch that if I knew just a little more about the 7080 I could do about the same thing there, and I already know how carelessness could bolix an object program for the non-binary 7070, about which I also know little.

The fact remains, of course, that some compilers are not as good as others. If the system basically turns out poor coding for certain types of operations, as some of them presently do, the programmer can't do much about it. Nevertheless, I suggest an eyebrow be raised the next time you hear somebody say, "Yeah, but the object programs are awful." ■

ALGOL AT DUKE

a compiler's progress for the 7070

by BRENDA BALCH and TOM GALLIE, Jr.
Duke University, Durham, N.C.

That ALGOL will soon die is an opinion which has been suggested by several experts recently on the pages of *Datamation* and elsewhere. It has also been reported that the universities are unaware that death is imminent and are busy writing ALGOL compilers instead of attending to important matters thus falling further than ever behind industry's leadership in scientific computing. We get the impression that some of these experts (whom we feel sure keep Grandad's leatherbound copy of his FORTRAN manual handy at all times) have never written an ALGOL program. One purpose of this note is to offer to process ALGOL programs for authorities who find themselves in this position. Another is to report our happy experiences with ALGOL. Of course, persons who have invented their own competing language should be encouraged to attack with no holds barred.

Duke University has just completed a compiler for the IBM 7070 with its source language a subset of ALGOL 60. This language is not a dialect of ALGOL; every correct Duke ALGOL program is a correct ALGOL 60 program, but the converse is not true. Many of the more elaborate constructions of the international language are not permitted in Duke ALGOL. Our compiler accepts real, integer, Boolean, array, and procedure declarations, block structure, conditional statements, for statements, and multiple assignments. It does not allow recursive procedures, parameters called by name, variable array bounds, switches, or own declarations.

The status of the compiler is:

1. Several hundred ALGOL programs, written by about 80 students, have been correctly processed since December. During this time major additions to the compiler were being made, but no more will be allowed. That famous last bug is still in the compiler and we're hot on his trial. Anyone want to help us look for him?

2. Documentation is in fairly good shape. The translator is based on the work of A. A. Grau, which is presented in a very clear and machine independent fashion in the Oak Ridge National Laboratory Report 3054 entitled *The Structure of an ALGOL Translator* (available, at $1.25, from the Office of Technical Services, Department of Commerce, Washington 25, D.C.) Following Dr. Grau's example, we have described our translator in something close to ALGOL. Finally, we have made some effort to make its 7070 Autocoder listing readable. Its procedure declaration mechanism is described in a Master's thesis by Thomas A. Mackey entitled *Implementation of Procedure Declarations in an ALGOL Translator*. We hope that by early this summer we can produce a mechanic's manual for those who would like to tinker with the system. Later a user's manual will follow, no doubt.

3. The character set is miserable, being limited at the

moment to the FORTRAN characters with, for example, the colon, semicolon, and left brackets represented by a dollar sign followed by a period, comma, and left parenthesis, respectively. In September we hope to have keypunches and 1401 with : , ; , [,] , <, and >, in addition to the FORTRAN characters. We are very pleased that at last IBM has standardized a set of 63 characters which seem adequate for ALGOL.

4. Operating characteristics include very fast compilation and moderate execution speeds. The system is at the moment being used on a load and go, batch processing basis, with about half of our 10K storage available to the target program, but those whose tastes differ from ours could easily change these things. An example might help here. The following nonsense FORTRAN program

```
      DIMENSION A(40,40)
1     FORMAT (E20.8)
      S=0
      DO 2 I = 1,40
      DO 2 J = 1,40
      X = I
      Y = J
      A(I,J) = .12345678 * .98765432 + SINF(X/Y)
2     S = S + A(I,J)
      PUNCH 1, S
      END
```

compiles in 7070 Basic FORTRAN, with judicious use of 729 II tapes, in 23 seconds and is executed in 29 seconds. (We have lost interest in the full FORTRAN, but suppose that it would take 3 or 4 minutes to do the job.) Written in Duke ALGOL, the same program (chosen to display that which FORTRAN does best) becomes:

```
BEGIN
      REAL I,J,S $,
      ARRAY A$(1$.40,1$.40$) $,
      S $=0 $,
      FOR I $= 1 STEP 1 UNTIL 40 DO
      FOR J $= 1 STEP 1 UNTIL 40 DO
            BEGIN
                  A$(I,J$) $= .12345678*.
                  98765432+SIN(I/J) $,
                  S $= S+A$(I,J$)
            END $,
      WRITE S
END
```

It is hoped that this choice of character representation will not reinforce the widely held opinion that Americans worship the $. Compile time is 2 seconds and execution requires 40 seconds. We have carefully avoided any effort to produce an efficient target program, but those who enjoy this part of the game might be able to get considerable improvement by instituting a few obvious changes. We are replacing the 7070 with a 7072, which has high internal speed and slow tapes. The total time (compile and execute) for the 7072 to process the above programs is estimated at 49 seconds for basic FORTRAN and 5 seconds for ALGOL.

The reasons for our compiler having the shape it has are:

1. Limitations in number of workers and time available (both time per week and total number of weeks) made a modest goal a necessity. About a year ago a sophomore, a senior, a graduate student, and a faculty member began a weekly seminar for the purpose of choosing among types of compilers and among methods for their construction. After making valuable contributions to our plans, Selden Stewart was lost to Graduate School at Berkeley. David Hayes was active in the early stages and later took charge of the subroutine package and the Boolean expressions, but has been distracted by work on his Dissertation in the theory of finite fields. In the last stages Mr. Mackey joined the group to assist in implementing procedure declarations. But, except for Miss Balch in July and August, no one has been able to work more than intermittently on the compiler. A sabbatical leave beginning this June furnished a deadline.

2. The need to instruct a large number of students dictates that the programming language must be easy to explain, to write, to punch on cards, and to read, and that the compile time (including a good number of diagnostics) must be short. We have found ALGOL no more difficult than FORTRAN to explain or write. Everyone forgets a semicolon now and then, but writing X+2 no longer sends you back to the drawing board. Reading students' ALGOL programs, for, say, Gaussian elimination with test for zero pivots or difference equation approximations to partial differential equations is much easier for us than the attempt to decipher their FORTRAN programs for these purposes. Have you tried to untangle a handful of someone else's FORTRAN IF statements? (One can not debate this point. He must try writing ALGOL and then decide one way or the other.) We are not a large University, but simple arithmetic shows that we must compile rapidly if we are to do our instructional job. It is clearly desirable for students and others to be able to make corrections to a program in source language, but it is only if translation proceeds at input speed that one can do this without paying a penalty of wasted machine time. Execution times don't matter much to us because we compile a number of times for every execution. For those who are very concerned about efficient programs, we suggest that they first solve the problem in ALGOL (this is the big job) and then rewrite the program in assembly language (a relatively easy thing.) This is in essence the way in which we wrote our compiler.

3. One of the authors is a fanatic about documentation. He believes that proper documentation is the key to planning a job, to reducing check-out time, to communication between co-workers, to continuity when a programmer drops out, and to maintenance when changes are needed. Man years of wasted labor in our Computing Laboratory due to insufficient documentation and sour experiences with undocumented programs from a computer manufacturer lie behind this opinion. (We are delighted by signs that IBM's Applied Programming people have begun placing strong emphasis on documentation in recent months.) Largely because of this prejudice, we worked hard at first on bootstrapping (i.e. using the compiler to write itself.) However, our experiences on the IBM 650 with inefficiency of a string manipulating language and later our discovery of the ease with which ALGOL is translated by hand into 7070 assembly language convinced us that it is possible to enjoy most of the benefits of bootstrapping without paying the price. The way to cheat is, as mentioned above, and well known to others before us, to write the compiler in ALGOL and translate by hand. The 7070 is a splendid machine for compiler construction, but the principle should apply to other computers as well.

4. We can see no evil in building upon the work of others. Grau's scheme, which our investigations indicated to be the most efficient yet available, was used without major change. We profited also from the ideas presented by Peter Naur in lectures at the University of North Carolina and from the continuing assistance there of John Carr III and his staff. Rainer Kogon of IBM gave generous help at the start and we have learned a great deal from the compiler writers at the University of Michigan.

Financial support was given by two grants from the National Science Foundation and one from the du Pont Corporation. ■

THE SPRING JOINT EXHUMED

by HAROLD BERGSTEIN, Editor

In 1959, last month's Spring Joint Computer Conference might have generated enough sustained excitement to warrant the label, "Best Ever." In 1962, however, an appropriate comment from a junior level programmer suggested, "Either I'm getting smarter or these conferences are getting duller."

If the technical inspiration has not improved, then at least one must credit the SJCC planners with conducting a most efficiently administered conference. Schedules were punctually observed, recruiting's sometimes criticized exhuberances were rigidly policed, the Fairmont's clerical staff functioned with polite dispatch, message reminders were viewed throughout the hotel via closed circuit TV, and while not in the purview of the planners' responsibilities, even the weather was in keeping with SF's finest.

Despite local newspaper nonsense hailing "icebox computers" (cryogenics), "decimation of the labor force" (artificial intelligence) and other witch doctor magic brewed by uninformed public relations, delegates were not markedly affected or incited to rebellion. An air of rumorless, placid contentment dominated the proceedings.

From an educational standpoint, the most effective innovation of the conference was a special program aimed at professional groups outside of the computing field. Accountants, librarians, teachers, etc., were invited to the Mark Hopkins for an efficiently run program outlining the basics of information processing . . . and relating it to their respective professions. Quite probably, the effect of these sessions will prove of far greater benefit to computing than any single effort yet conducted. It is heartily recommended that they be continued.

Registration for the Spring Joint was estimated at 2,500, no record smasher to be sure but an improvement over Bay Area representation last year. Attendance for the majority of the general sessions was almost to the capacity of the rooms in which they were held although one must hasten to add that the size of these rooms were hardly of vacuum tube proportions. In this respect as well, the planners were prudent in their selection of space for the sundry conference events.

At the opening session on May 1st, keynote speaker Dr. Edward Teller drew over 2,300 attendees, overflowing both a large room and an alternate to which his talk was piped over the speaker system. Closed-circuit television in this instance would have proven more appropriate than phone messages. Dr. Teller's reflections on thinking, however, may not have warranted the overflow attendance as some delegates expressed increasing disinterest in philosophic bantering over chess problems as opposed to recounting constructive work in artificial intelligence.

In 1959, such technical papers as those presented at the SJCC on associative memory, cryogenics, circuits for the FX-1 computer, automatic fault location techniques, retrieval of medical data, FACT compiler segmentation, etc., would have been blessed with abundant enthusiasm and perhaps an astute question or two. In 1962 however, these may have been rated among the most interesting papers but could hardly be considered exciting.

Unhampered by a general theme for the conference, the program chairman and his committee are nevertheless to be commended for selecting at least a satisfactory variety of technical papers. Several other limitations are still very much evident in the paper picking process. The publishing of hardbound proceedings, for example, necessitates an earlier submission date and with prior approvals required by individual corporations, the state-of-the-art represented is frequently pushed a year or two behind the actual date of the conference. Also, the availability of the proceedings at time of registration is hardly a boon to the speaker or the audience. Perhaps a summary of a paper's conclusions followed by questions might perk the interest factor.

The secondary factors in paper selection such as obtaining a proper balance in geography, corporate representation and variety of subject matter certainly serve to direct the judges' attentions away from the simple virtue of important and constructive content.

Finally, the selection of a program chairman is frequently based on such factors as succession to the job or the reputation and professional capability of the individual with insufficient attention given to the amount of time one may have available to devote to the job.

While almost all of the 72 exhibitors at the Spring Joint reported exceptionally heavy traffic, their offerings may be classed as the most unexciting aspect of the conference.

In terms of operating hardware, there were only six, general purpose, digital computers performing such sports as tic-tac-toe and blackjack and winning little applause as practical output from high priced, microsecond systems. The weenie-scale PDP-4 (1-4K memory) was the only spanking new computer *announced and operating* at the show. Other important announcements were made during the conference but supporting equipment was not available. Holding the paper spotlight was CDC's 3600, a 1604 successor; Collins 8400 system; Philco's battery of announcements including a 1 microsecond memory, high speed 240KC tapes, disc file and new peripheral computer, and the EPSCO 275 which overshadowed all other exhibitors as well as its own sales pitch by the construction and housing of its vigorous, blond hostess. Less animated but attractively designed were booths by Collins, Ampex, Burroughs, Packard Bell and General Dynamics.

Once again the conference featured exhibits heavy in analog and a-d conversion. PB's TRICE, Electronic Associates' newly introduced hybrid system HYDAC, Comcor, Applied Dynamics and others were present.

Notable by their absence from the exhibits were Honeywell and RCA's EDP divisions.

Viewing the exhibit area in 1959 such excitements as high density tapes, CRAM memory, a mockup of the 1107, G-20 and the 1620 "IN ACTION" may have doubled the 1,500 visitors in attendance. But even in '59, it is not likely that much interest would be evidenced by an operating teletype machine or the Service Bureau and C-E-I-R selling time.

It is of course, unreasonable to expect manufacturers to produce new operating hardware at each show as well as to perpetually be burdened by the costly tab for shipping equipment to the burgeoning number of computer shows and exhibits held each year. However, it is not unreasonable to expect exhibits which serve some function other than as a showpiece for attractive models (our objection in this respect is a mild one) and unattractive, comparatively uneducated sales personnel (our objection in this respect is far stronger). Problems can be run with some intelligent purpose such as the WIZ compiler demonstration at the GE 225 exhibit.

Undoubtedly, the most successful "gimmick" was conducted off the exhibit floor by ITT as their cable car sightseeing tour around the city captured a steady stream of happy visitors, many of whom unfortunately happened to be competitive exhibitors and a small number weren't even in attendance at the conference. ■

A BRIEF GUIDE TO HARDWARE RENTAL

look before you lease!

The accompanying information in leasing specifications was furnished, where available, by the manufacturers. These conditions should not be construed as the last word in contract terms, but rather as an unofficial guide before actual negotiations proceed.

MANUFACTURER	CONTRACT TERM	HOURS USAGE BEFORE OVERTIME	OVERTIME RATE	SPECIAL PLANS
Bendix Computer Div.	Standard GSA terms. Normally 1 year min. lease	G-15: 200 monthly G-20: 176 monthly	40% 40%	G-15: Purchase option. Credits against price from rent paid will be on all prior rent payments 50% first year, increasing 5% each year not to exceed 70% of purchase price.
				G-20: Purchase option. Credits against price from rent previously paid will be 60%, not to exceed 60% of total purchase price.
Burroughs Corp.	205, 220: 2 or 3 year lease (3 year rate is about 15% less than 2 year.)	176 monthly	40%	205: Up to 88 hours monthly at 60% of 2 or 3 year rate, with additional use at 1% of monthly rate per hour of use. 220: Up to 100 hours monthly at 70% of basic monthly rate with additional use at ½ of 1% of monthly rate per hour of use.
	B5000, B200: 2 years	176 monthly	40%	
Control Data Corp.	1 year	176 monthly	40%	Purchase option, allowing 70% of total monthly rental to be applied toward purchase price during first year of lease; 60% of rental allowed after first year. Option credits cannot exceed 75% of purchase price.
General Precision	1 year	176 monthly	50%	N. A.
General Electric	N. A.	176 monthly	N. A.	N. A.
Honeywell	1 year	1) 8 consecutive hours, 5 days weekly 2) 176 monthly	40% to 50%, depending on equipment	N. A.
IBM	N. A.	176 monthly	40%	N. A.
Packard Bell Computer	2 years	176 monthly	N. A.	N. A.
Philco Computer Div.	1 year	176 monthly	40%	GSA FY 1961-62 contract.
RCA	1 and 3 years	1) 8 hour shift, five days weekly 2) 200 hours month 3) 5 consecutive 24 hr. periods in any week 4) 5 consecutive 24 hr. periods in a given week plus 16 hr. periods each of 2 remaining days	N. A.	N. A.
	501: 1, 3, 4, 5 years			Monthly rental scaled upward from 55% of standard 200 hours per week rate for a 100 hour use rate.
UNIVAC Div.	3 years	8 consecutive hours, Monday-Friday	50%	N. A.

LET'S MEASURE OUR OWN PERFORMANCE

and discourage sloth

by ROBERT L. PATRICK,
Computer Consultant, Northridge, Calif.

The computer field is slowly maturing despite the lack of a glossary and the absence of a strong professional organization. Like the little rich boy, we also suffer from an over-indulgent papa. Papa, or in our case management, grew up in another generation. For some of us, all that is required is: ask and we shall receive. I submit that this encourages an attitude of sloth. The responsibility for arresting this trend lies with us. Even in the absence of any generally accepted yardsticks, we should establish performance measures at a local level and, through self-discipline, proceed to arrest what can be a disastrous trend.

Since the field is growing at a magnificent rate (1401 deliveries number eleven a day), we should step up our rate of training and education in order that our experience does not get diluted. Such dilution can lead to gross inefficiency.

Many installations keep only the most primitive usage figures. The figures are kept solely for the purpose of paying the manufacturer his due for good machine time realized. I submit that this is not enough. How are the good hours used? How were they used last month? Can you account for the change, if any? Is the change healthy? Is this change symptomatic of a trend? Should this trend be encouraged or discouraged? These questions and others like them require answers if you, the facility manager, are to measure your own performance. Furthermore, historical information on these and related questions will aid you immeasurably in determining if your equipment is performing well; if you are receiving value for payments made to the manufacturer for maintenance and support; and, when you choose your next machine, such information will assist you in separating the wild salesmens' claims from the important facets of the matter.

It is a fairly easy task to obtain a breakdown of the rentable hours by usage code within job number. If usage codes are assigned for Production, Maintenance, Code Preparation, Error, and Idle, then useful plots can be obtained as a by-product of your monthly job accounting and billing runs (see Figure 1). In some cases it is desirable to break Maintenance down into scheduled and unscheduled; Code Preparation into assembly, compile, and code check phases; and Error down into operator, programmer, and machine. Such figures can be aggregated over your monthly rental period and percentages computed. When these percentages are plotted against calendar time they will provide an inexpensive trend plot of the direction of growth of your facility.

Management action will stem directly from the trends shown on the plot. In a manufacturing organization the general foreman watches the scrap rate. In a computing organization the facility manager should watch the error rate.

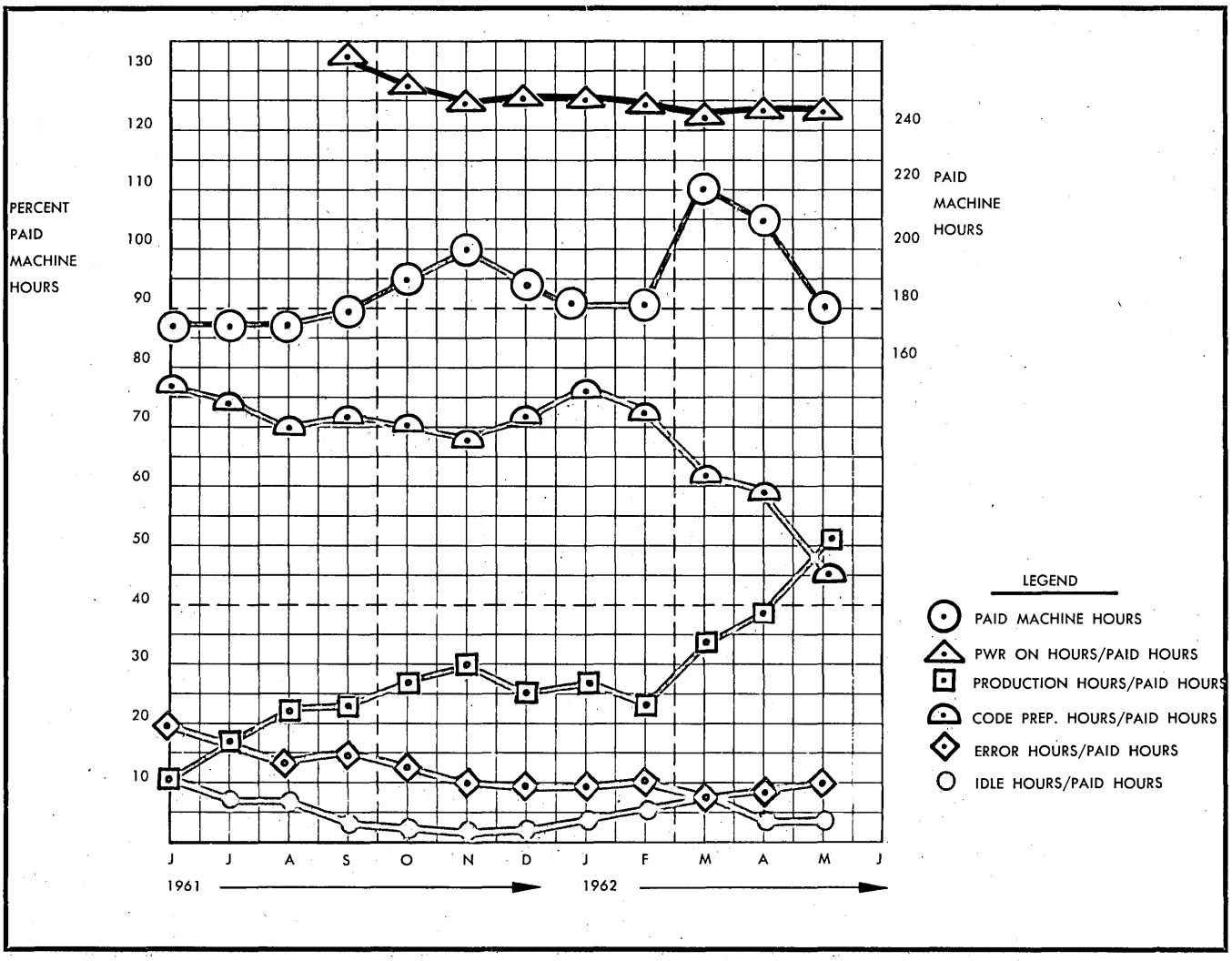
The total amount of maintenance required is an indication of how far your facility can grow before additional computer capacity is required. If the ratio of the sum of assembly plus compile time over the time spent in code checking is plotted against calendar time and an upward trend develops, the programming staff requires attention. The absolute amount of compile time used is a subject to be discussed with your salesman and your senior staff. (This is a measure of the cost of a higher level language and must be weighed against the benefits accrued from the use of this language.) In a running installation, these are measurable facts worthy of explanation.

In the absence of any generally accepted nation-wide performance measures (which in turn depend on a generally accepted glossary) the above statistics are probably not interchangeable between facilities. Nevertheless, they are very important and appropriate for a single facility. Each computer runs in its own environment; although the *magnitude* of such measures may be subject to interpretation, the *direction* of the trend is not.

While the above statistics apply predominantly to the computer room, similar measures can be concocted to measure the performance of the programming staff (not necessarily the individuals contained therein). For your facility operating in its environment, it is possible to choose some arbitrary categories of jobs. These categories can define the jobs common to your installation and your particular environment. Within these categories, it is possible to get some useful estimating parameters to help you, the facility manager, measure the performance of

your programming staff.

Usage codes can be made up for programmers. As their time is reported, it can be broken down into categories such as problem definition, programming, coding, preparation for assembly and/or compile, code check, preproduction runs, and program maintenance. If each programmer reports his time by category within a job number, then some useful statistics can be obtained from recent history. These statistics will assist you in estimating a new task which falls into one of your job categories. Programmers should also report events of significance: the day flow charting started; the day keypunching started;



MONTH	PAID MACHINE HOURS	PWR ON PD HRS	PROD. PAID	CODE PREP. PAID	ERROR PAID	IDLE PAID
J	176	1.70	.11	.77	.20	.11
J	176	1.49	.17	.75	.17	.07
A	176	1.37	.23	.70	.14	.07
S	180	1.32	.23	.72	.15	.04
O	190	1.28	.27	.70	.12	.03
N	200	1.25	.30	.68	.10	.02
D	190	1.26	.25	.71	.09	.03
J	180	1.26	.26	.76	.09	.04
F	180	1.25	.23	.72	.10	.06
M	220	1.23	.34	.62	.08	.08
A	210	1.24	.38	.59	.09	.03
M	180	1.24	.50	.47	.10	.03

the day of the first assembly or compile; the day of the first pre-production test; and the day of the first production run without error. Historical accounting records can then be reprocessed and interesting measures can be obtained for: man hours per machine hour for the programming phase (from the first customer contact up to the first production run); man hours per machine hour for the maintenance phase (production) of the job; elapsed time from first customer contact to the first pre-production run; and rate of expenditure of programmer effort by usage code within job number.

A word of caution is in order here. It is *possible* to get so interested in keeping statistical measures on the operation of a facility that the cost of the statistics exceeds the value of the measure.

If the machine time figures are aggregated across job numbers, you obtain the ratio of usage by type to total paid for machine time in the reporting period. If the people figures are aggregated across job number, you can determine the ratio of personnel activity to total reported hours. In both cases, care must be exercised that the input numbers are accurate. Care must also be exercised so that all personnel involved are aware that no disciplinary action will occur if figures are candidly reported. The purpose of such reports is so that the facility manager can measure his *own* performance.

As a manager audits these trends, actions will naturally occur to him. These actions will principally be in the form of training requirements. If his ratio of compile time to checkout time is too high, then he has a young staff and they need additional education in the art of code checking. On the other hand, if the error rate is too high, then perhaps some review or followup procedures need to be instigated.

After flow charting has begun, a computer operation is very analogous to a job shop. The general foreman of a job shop keeps careful tabs on both his scrap rate and his productivity (as measured by piece rate). When a unique job of a different category comes along, he makes allowances for the initial transient condition on the learning curve. He also expects this to settle down after a rather short period so that his production norms still apply (see Figure 2).

Although each facility will be slightly different (even though the same problem areas and computer are involved), some indicators of merit do exist. For example, plot the sum of the total years of programming experience divided by the number of programmers who are actually writing code against time. It should have a positive slope. If the problem mix does not change, total man hours divided by the total machine hours devoted to uses other than production is a measure of coding efficiency. This should tend to zero. By the same token, the ratio of total man hours to total productive machine hours is a measure of productive efficiency and should also tend to zero. The ratio of good machine time to paid machine time should tend to one, and is an important measure of the overall facility.

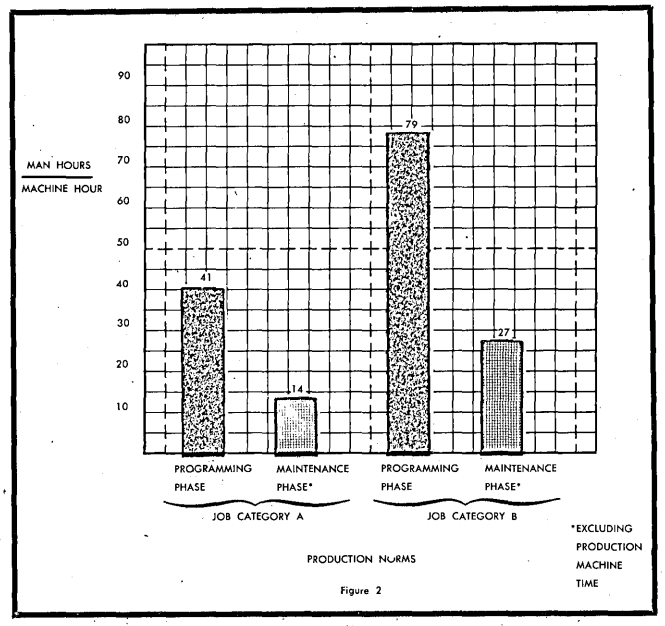


Figure 2

As in any trend plot, the slope of the trend plot is only symptomatic of your progress (or lack thereof). A trend plot does not indicate *why* the curve goes up or down, but merely indicates that the facts you've chosen to aggregate behave in a given way. If the computer load in your facility fluctuates widely, then the trend plots may appear extremely rough. Some smoothing effect can be achieved by dividing by the total machine hours used, thereby reducing all plots to a single shift basis. Other interesting statistics are the number of compiles required before production divided by the number of source statements (for a given category of jobs); or the number of code checks required before production divided by the size of the object program (for a given category). I suggest you use arbitrary categories established locally since we have no measure of problem complexity.

While some of these measures may be of dubious value in estimating new work, they do assist you in quantifying your intuition. Until we find some technique whereby we can estimate new work a priori, a posterior measure plus intuition must do. Since such measures depend on your own local environment and *your* definition of terms, they probably cannot be compared with others. Nevertheless, they are valuable for measuring your performance as a manager. There are many sophisticated techniques for fitting curves, determining means, or deviations, but a simple trend plot will tell you whether you are winning or losing.

If you have a sophisticated compiler or other complex program, you may be carrying a large portion of it as overhead. Some features were placed in your compiler for sales appeal. You are paying both training and operation costs for these features. If you have an occasion to get into such a programming system, you might add some event counters to the major forks and determine the frequency of use of the sophisticated or expensive features. Such event counters are like traffic counters. They tell you how popular a given route is. Since removing a powerful but unpopular feature is out of the question, you might see if your training is deficient. You pay for for the entire compiler anyway; you might as well train up to use these more powerful features. On the other hand, remember the features of questionable utility the next time you buy a computer and associated software system.

When the field was younger, we used measures such as these indicated above to club the manufacturers into providing us more reliable hardware. Later, similar measures were used to measure the characteristic posture of an operation. Out of these measures came peripheral equipment, monitor systems, and a professional machine operations staff. Unfortunately, some of our present programming and operating tools have never undergone such a duty cycle analysis. Even though our managements may continue to be indulgent for an extended period of time, the action of the Federal Government toward incentive contracts may cause some of us to insist on value received. If this is done, we may take an enlightened view towards huge software systems, open shop programming, and the management of our precious personnel. ■

HOW TO MAINTAIN A KLUDGE

craftily

by AUSTIN O. ARTHUR, Vice President, Maintenance,
Kludge Komputers Korporation

After proper attention has been paid to the design of the Kludge[1] and to its marketing,[2] the focus shifts to a necessary evil; namely, maintaining the thing. The customers seem to want maintenance, or at least the appearance of it, and without a large service organization, marketing the Kludge is difficult.

Of course, proper maintenance really begins with the design. The alert manufacturer carefully observes simple rules such as:

(1) Design the Kludge around fifteen basic circuit cards. Then, during production and in all subsequent field changes, modify each individual card with a resistor or condenser or such. This process soon produces a machine that really has 4200 distinct circuit cards, and *none of them is ever available in spare parts.* The maintenance man, of course, is continually gulled into thinking he has just the card he needs (and he can reassure the customer to that effect). In trying to add that one resistor, he can delay operation of the machine indefinitely.

(2) Make all checking circuits non-fail-safe. If the checking circuit ever fails, then, the customer can have his machine down for days and never even know it. When he does notice that he's in trouble, he can have lots of fun proving it to the Kludge maintainer.

(3) Be sure to avoid any mention of possible hang-up conditions in the machine's reference manual. When one of these conditions is eventually encountered and the machine hangs up with no apparent cause, it will induce much merriment between the customer and the soldering iron jockies. Each separate such condition is good for half a day of downtime.

(4) Fix up lots of indicator lights that have meaning

only to the maintenance man. *Put these lights on the console.* They amuse visitors. The maintenance man will find them. He then either has to keep running back and forth to look at them, or he'll need another man to call them out to him. Proper application of this principle can cut the effectiveness of your service crew at least in half.

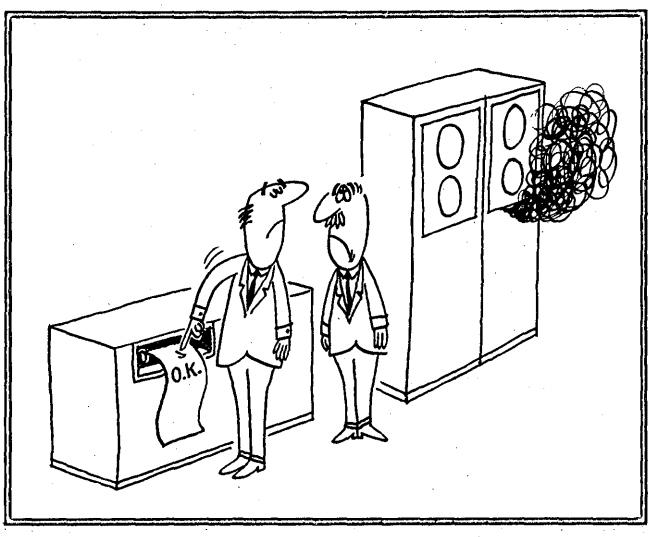
(5) Don't put all the fuses and circuit breakers in one place. Hide a few in obscure spots. Include some that give no visible indication when tripped; these are best placed *behind* something. It's an easy rule: the less chance there is for a fuse to trip, the more you hide it.

But all the above are obvious rules of design. Kludgemanship comes into its own in the field at the maintenance level. To the customer, the maintenance man (sometimes called the Kludge Fixer, or KF) is the on-the-spot representative of the vendor. The care and feeding of the KF warrants our attention. Again, experience dictates elementary, easy-to-follow rules.

(1) Don't pay them. If you did, you'd upset industry standards, for one thing. And these standards have been sensibly arrived at. After all, if you doubled their pay, you'd have the same quality of work done, wouldn't you, but costing twice as much? Of course you would! So try for high school graduates at the lowest possible salary you can get by with. (If you remind them every day of the glorious opportunities ahead, they can stay at that low level for years. And there'll be a new crop along every June.)

(2) Indoctrinate them into the proper philosophy. Assure them, for example, that when they turn a checked-out machine over to the customer, then until the next scheduled period of maintenance, all troubles described by the customer are imaginary. Or, at the very best, the troubles are intermittent and have gone away by now. Teach them to ask "are you sure it isn't programming trouble?"—this always makes for good feeling.

Point out to them that they, not the customers, are really in charge of the machine. The customers are the ones who keep the tape drives spinning in those awkward intervals between maintenance periods, but the real purpose in all this is to keep the main frame warm.



Have them also learn to instill the proper philosophy into the customer. They should encourage the customer to learn to live with a malfunction, rather than be known as a chronic complainer. Eventually the user will find a way to "program around it," since he can't afford to have it known that he tolerates a machine with less than 90% of uptime.

(3) "Trust your diagnostics"—that's the watchword. Those diagnostics were designed by better men than you, son, and if they work, the machine works. If any part of the system could fail, the all-wise diagnostics would surely have revealed it. So in the final analysis, the job is simple: ignore what the customer is yapping about and run the diagnostics. Then if no errors are reported, the customer was obviously dreaming and can safely be ignored.

Be sure, of course, not to let the KF know anything *about* the diagnostics. If you do, you'll soon have some smart-aleck KF poking into one of them and trying to improve it.

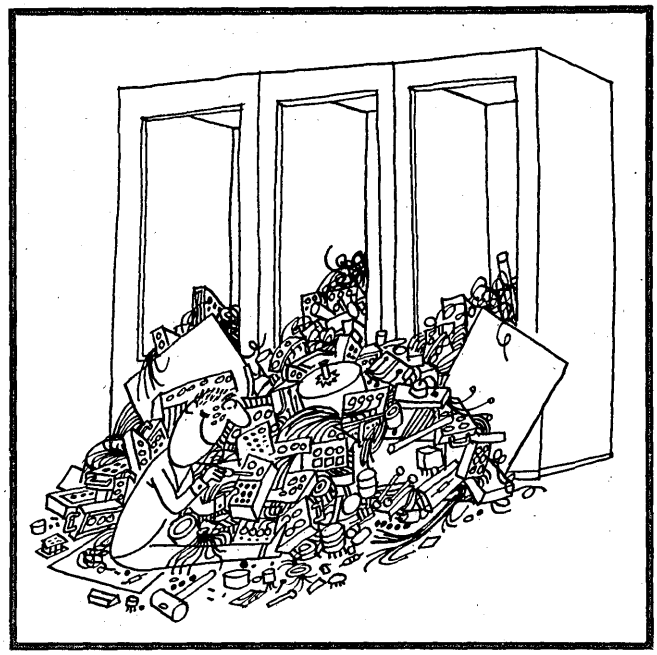
(4) Teach them to take first things first. If the customer reports more than one trouble at a time, then one of the troubles has higher priority than the others. It is only good sense, and good customer relations, to do that one first, right? But now notice that if you play your cards just right, some of the low priority troubles can slide along for weeks. A top notch man can sometimes stall one until his successor (some naive youngster) takes over. One of the all-time great KF's, Herman Schmelzer, managed to ignore a broken start key throughout the entire life of a machine.

(5) Operate on the symptoms, not the disease. This one is so obvious, it's almost not worth listing. Just as an example, suppose a tape drive won't read successive rec-

ords at high speed. The solution is to lengthen the inter-record gaps. That'll fix it.

Notice how nicely things begin to compound now? If a good solid glitch is designed into the machine, and the KF is carefully trained to operate only on its symptoms (all the while telling the customer that he's imagining his troubles), the Kludge may not function properly for years. And there is never any worry about competition, since all the other manufacturers know all these rules, too.

(6) Introduce your boys at an early age to the telephone. Point out to them that a good man can spend six out of every eight hours talking to other KF's at other installations (not to mention talking to wifey and all the other members of the bowling league). The customers at



both installations may believe that their troubles are being fixed.

(7) From time to time, circuit changes will have to be made on the machines in the field. Get several of your best factory KF's to make the change and time them. Pick the shortest of these times. Then when the change is sent out to the field, quote this time as the estimate. The KF in the field can now play a real fun game with his installation managers. "Give me your machine for three hours to make this improvement," he says. It'll really take 53 man-hours, counting the shocking effect of rule (6). For best results, schedule these changes around month-end report time.

(8) In spite of all these eminently sensible rules, one of your boys may draw one of those oddball customers who insist that the whole Kludge work properly, even to the op-codes that are never used. There is one in every territory. Then the watchword is "If you can't fix it—inspect it." A thorough inspection requires that every part be disassembled, cleaned, oiled, and reassembled. And no customer has the gall to point out, after this lengthy process, that the thing still doesn't work. He's honor bound to prove it to himself all over, and the alert KF can apply rule (2) again. Incidentally, caution the KF's to dispose of the leftover parts after reassembly.

In spite of your good intentions, some of your men will wind up fixing machines. Pretty soon the customers notice this and get spoiled rotten. When this happens, your only recourse is rule 9:

(9) Transfer them. ■

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ABOUT OUR AUTHOR:

AUSTIN O. ARTHUR entered the computing field when it was young and he wasn't. He has spent roughly equal amounts of time with the U.S. Army, a major university, a large industrial organization, and a research group. He drives a VW.

The latter is not irrelevant. This article was originally prepared to describe maintenance procedures on American automobiles. It has been pointed out that it is only in the automotive and computing industries that members can get a big yak out of reading manufacturers' news releases verbatim at conventions.

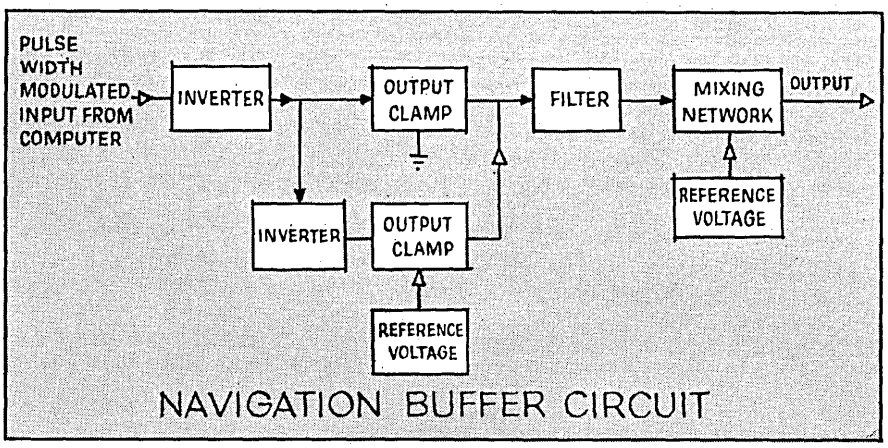
Mr. Arthur is a member of ACM. He heads the Subcommittee on Monitor Systems for the 026.

NOTES:

(1) See *How To Design a Kludge* by Jackson Granholm, *Datamation*, February, 1962.

(2) See *How To Market a Kludge* by Oswald I. Orthmut, *Datamation*, May, 1962.

SKIRMISH OVER A COMPUTER-TO-INERTIAL-PLATFORM INTERPRETER



NAVIGATION BUFFER CIRCUIT

What is the best way to implement the digital-to-analog conversion circuitry required to convert binary incremental signals from a digital computer to precise d.c. voltages for gyro torquing in an airborne tactical data system? This was a problem faced by Litton data systems engineers.

Several engineers who had participated in the development of an earlier navigation buffer employing the digital servo technique were strongly inclined towards playing it safe by adopting an identical approach. To permit the navigation system to sustain the longer flights required under the new program, they proposed engineering greater accuracy into the existing buffer. Somehow, they felt, the additional requirements for lesser weight and volume could also be met. Preliminary investigation revealed that this scheme would require at least 20 pounds of hardware.

Feeling that a better way could be found, other engineers studied alternate approaches and finally proposed a scheme for generating d.c. gyro torquing voltages scaled according to width-modulated pulses linearly related to computer word length. This approach appeared to hold promise of an accuracy of at least 1 part in 4000 (0.025%), which was specified for two of the required eight signals (six for the inertial subsystem; two for the cockpit display system). The pulse width modulation/demodulation method also appeared to require far less hardware than would the digital servo technique because of the elimination of heavy electromechanical components.

Skeptics were quick to point out that the specified precision would be impossible to obtain in view of errors inherent in pulse-width modulation, delays and rise times in the precision switch, switch offset voltage, reference supply voltage, filter capacitor leakage and stability, filter lags, drum speed variation, and signal line ground currents.

Undaunted, the advocates of the new method pressed ahead, conducted detailed studies and laboratory investigations to nullify all objections and verified the complete feasibility of their proposed scheme.

Now functioning as part of a tactical data system installed in a carrier-based aircraft, this eight-signal navigation buffer is packaged on five 3″ x 3″ cards and two small assemblies. Weight and volume are about one-fifth of that required for a digital servo type of buffer. More recently, new packaging techniques have enabled reduction of the buffer unit by an additional 40% to two cards and two assemblies without degrading accuracy.

Litton management recognizes the value of results stimulated by healthy controversy. Security and proprietary restrictions preclude our discussing current activities, but new programs offering many new technical challenges are now being conducted. And Litton continues to encourage an environment in which engineers can propose and pursue other than safe approaches to problems. If you've been frustrated in your attempts to follow through on new approaches to digital data handling and display functions, write Harry D. Laur, Litton Systems, Inc., Data Systems Division, 6700 Eton Avenue, Canoga Park, California; or telephone DIamond 6-4040.

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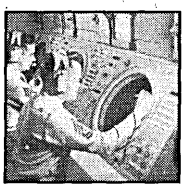
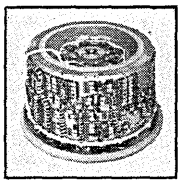
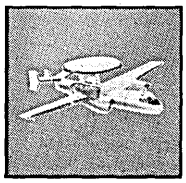


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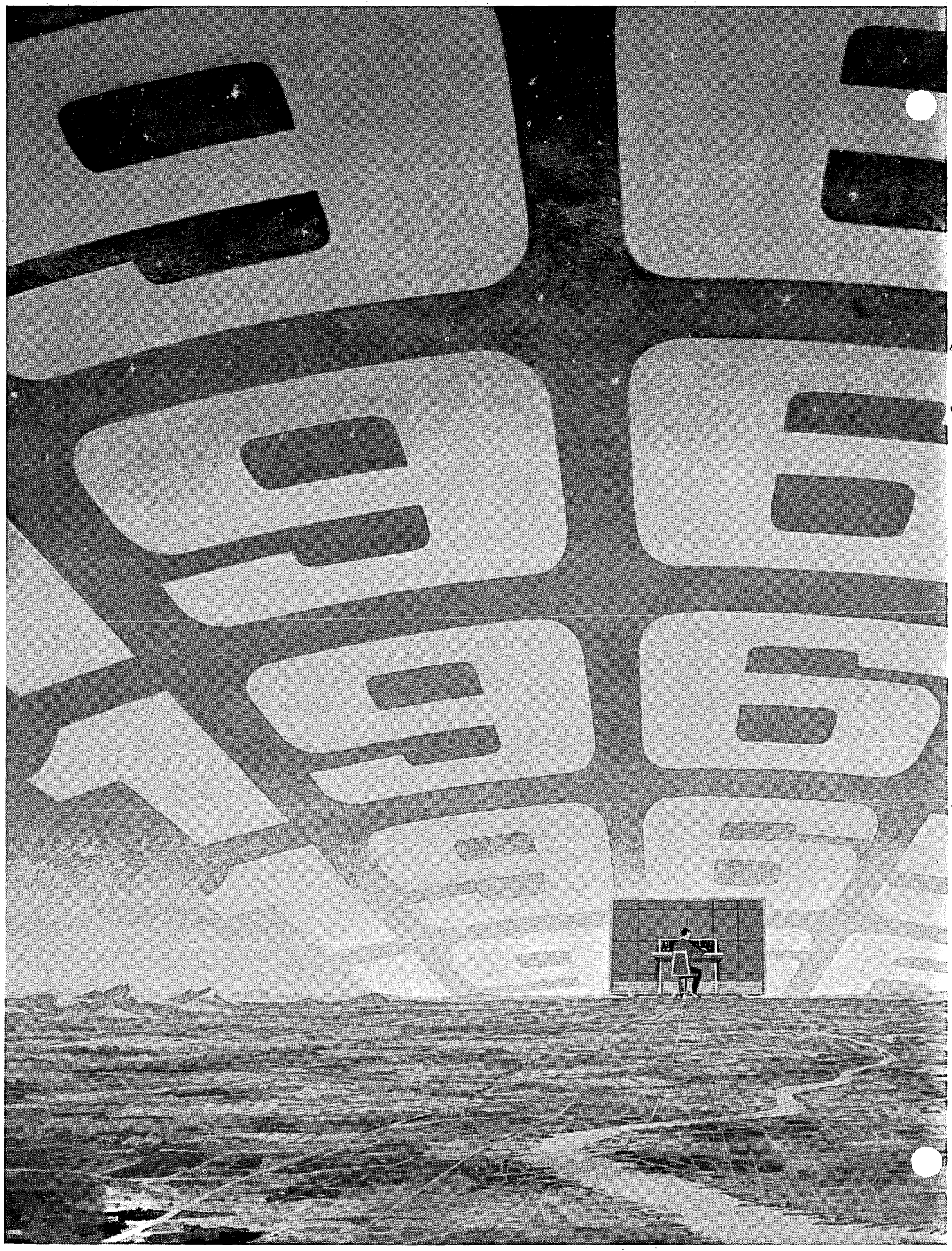

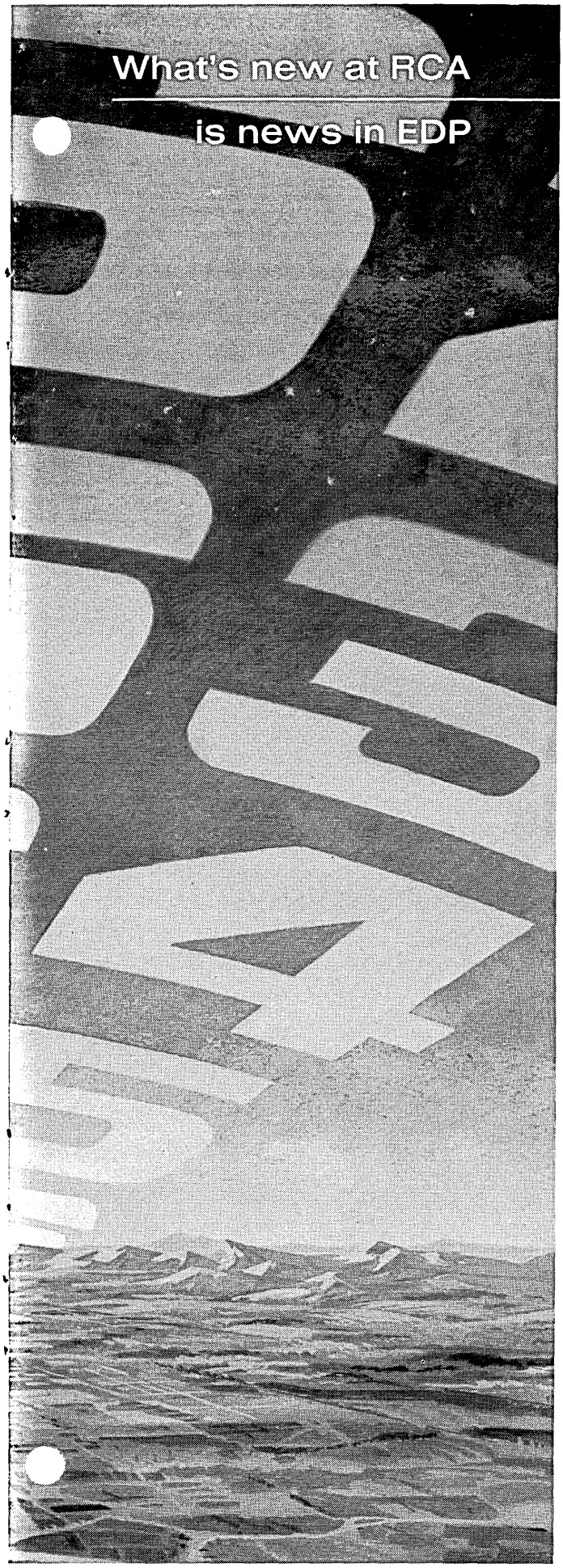

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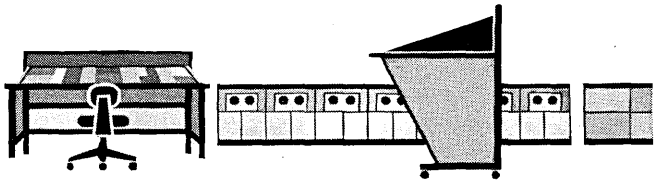

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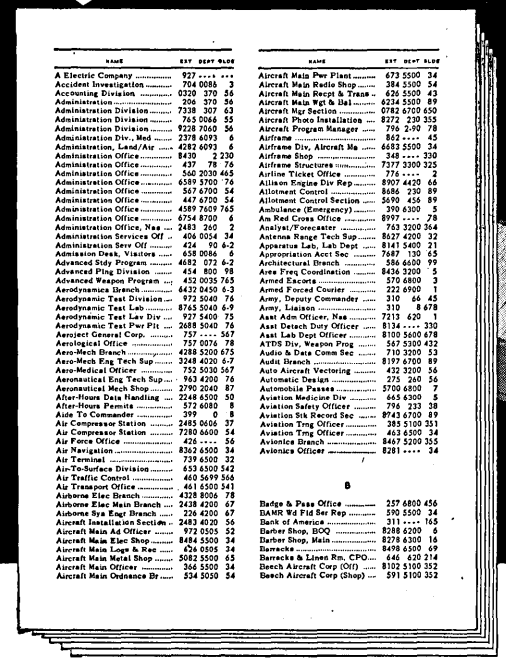
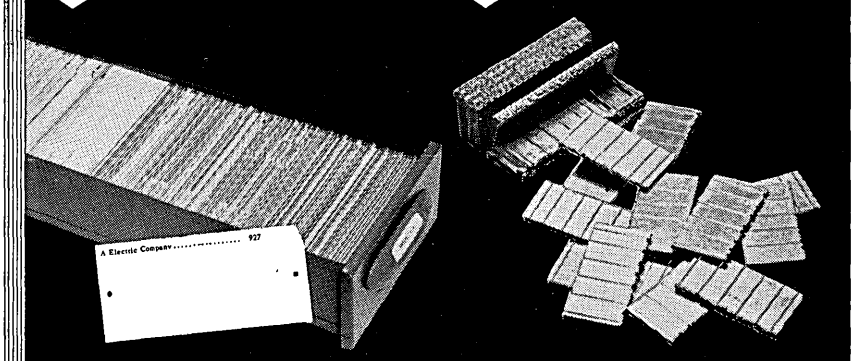


NAME	EXT	DEPT	BLDG
A Electric Company	927	----	---
Accident Investigation	704	0086	3
Accounting Division	0320	370	56
Administration	206	370	56
Administration Division	7338	307	63
Administration Division	765	0066	55
Administration Division	9228	7060	56
Administration Div., Med	2378	6093	6
Administration, Land/Air	4282	6093	6
Administration Office	8430	2	230
Administration Office	437	78	76
Administration Office	560	2030	465
Administration Office	6589	5700	76
Administration Office	567	6700	54
Administration Office	447	6700	54
Administration Office	4589	7609	765
Administration Office	6754	8700	6
Administration Office, Nas	2483	260	2
Administration Services Off	406	0054	34
Administration Serv Off	424	90	6-2
Admission Desk, Visitors	658	0086	6
Advanced Stdy Program	4682	072	6-2
Advanced Ptng Division	454	800	98
Advanced Weapon Program	452	0035	765
Aerodynamics Branch	6432	0450	6-3
Aerodynamic Test Division	972	5040	76
Aerodynamic Test Lab	8765	5040	6-9
Aerodynamic Test Lab Div	927	5400	75
Aerodynamic Test Pwr Plt	2688	5040	76
Aeroject General Corp.	757	----	567
Aerological Office	757	0076	78
Aero-Mech Branch	4288	5200	675
Aero-Mech Eng Tech Sup	3248	4020	6-7
Aero-Medical Officer	752	5030	567
Aeronautical Eng Tech Sup	963	4200	76
Aeronautical Mech Shop	2790	2040	87
After-Hours Data Handling	2248	6500	50
After-Hours Permits	572	6080	8
Aide To Commander	399	0	8
Air Compressor Station	2485	0606	37
Air Compressor Station	7280	6600	54
Air Force Office	426	----	56
Air Navigation	8362	6500	34
Air Terminal	739	6500	32
Air-To-Surface Division	652	6500	542
Air Traffic Control	460	5699	566
Air Transport Office	461	6500	541
Airborne Elec Branch	4328	8006	78
Airborne Elec Main Branch	2438	4200	67
Airborne Sys Engr Branch	226	4200	67
Aircraft Installation Section	2482	4020	56
Aircraft Main Ad Officer	972	0505	52
Aircraft Main Elec Shop	8484	5500	34
Aircraft Main Loge & Rec	426	0505	34
Aircraft Main Metal Shop	5082	5500	65
Aircraft Main Officer	366	5500	34
Aircraft Main Ordnance Br	534	5050	54
Aircraft Main Pwr Plant	673	5500	34
Aircraft Main Radio Shop	384	5500	54
Aircraft Main Recpt & Trans	626	5500	43
Aircraft Main Wpt & Bal	6234	5500	89
Aircraft Mgr Section	0782	6700	650
Aircraft Photo Installation	8272	230	355
Aircraft Program Manager	796	2-90	78
Airframe	862	----	45
Airframe Div, Aircraft Ma	6683	5500	34
Airframe Shop	348	----	330
Airframe Structures	7377	3300	325
Airline Ticket Office	776	----	2
Allison Engine Div Rep	8907	4420	66
Allotment Control	8686	230	89
Allotment Control Section	5690	456	89
Ambulance (Emergency)	390	6300	5
Am Red Cross Office	8997	----	78
Analyst/Forecaster	763	3200	364
Antenna Range Tech Sup	8627	4200	32
Apparatus Lab, Lab Dept	8141	5400	21
Appropriation Acct Sec	7687	130	65
Architectural Branch	586	6600	99
Area Freq Coordination	8436	3200	5
Armed Escorts	570	6800	3
Armed Forced Courier	222	6900	1
Army, Deputy Commander	310	66	45
Army, Liaison	310	8	678
Asst Adm Officer, Nas	7213	620	1
Asst Detach Duty Officer	8134	----	330
Asst Lab Dept Officer	8100	5600	678
ASTDS Div, Weapon Ptng	567	5500	432
Audio & Data Comm Sec	710	3200	53
Audit Branch	8197	6700	89
Auto Aircraft Vectoring	432	3200	56
Automatic Design	275	260	56
Automobile Passes	5700	6800	7
Aviation Medicine Div	665	6300	5
Aviation Safety Officer	796	233	38
Aviation Stk Record Sec	8913	6700	89
Aviation Trng Officer	383	5100	351
Aviation Trng Officer	463	6500	34
Avionics Branch	8467	5200	355
Avionics Officer	8281	----	34
B			
Badge & Pass Office	257	6800	456
BAMR Wd Fld Ser Rep	590	5500	34
Bank of America	311	----	165
Barber Shop, BOQ	8288	6200	6
Barber Shop, Main	8278	6300	16
Barracks	8498	6500	69
Barracks & Linen Rm, CPO	646	620	214
Beech Aircraft Corp (Off)	8102	5100	352
Beech Aircraft Corp (Shop)	591	5100	352



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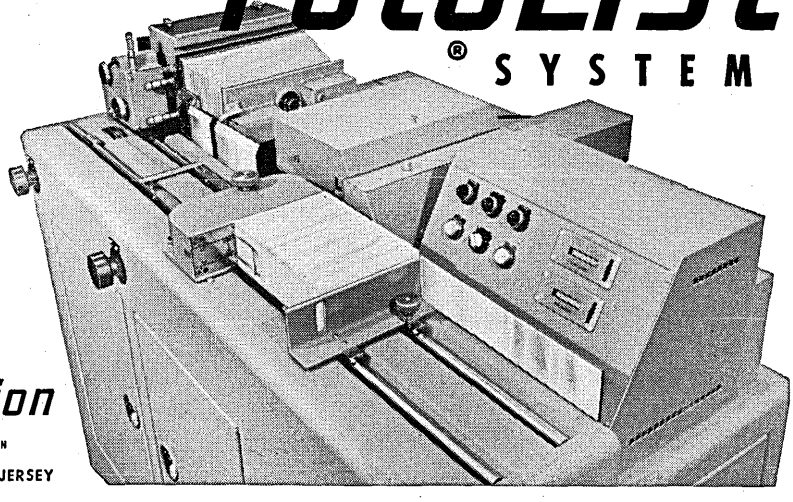

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CIRCLE 20 ON READER CARD

SHOEBOX - A VOICE RESPONSIVE MACHINE

widening the doorway to the open shop

by W. C. DERSCH, IBM Advanced Systems Development Lab, San Jose, Calif.

An experimental device in voice recognition which responds to spoken commands holds promise of widening the open shop by providing a direct link from the user to the main frame.

Known as SHOEBOX, the device has been developed by IBM in San Jose, and presently recognizes and responds to 16 words (including 10 digits). Individuals active in the field of voice recognition frequently ask whether we are limited to 16 words. The answer is an emphatic "no!" We believe that with improvement in measurements and logic, a device can be produced to identify and respond to perhaps as many as 10,000 word patterns.*

The technology of this device may ultimately result in direct vocal input to a translation machine which now must depend on a keyboard operator.

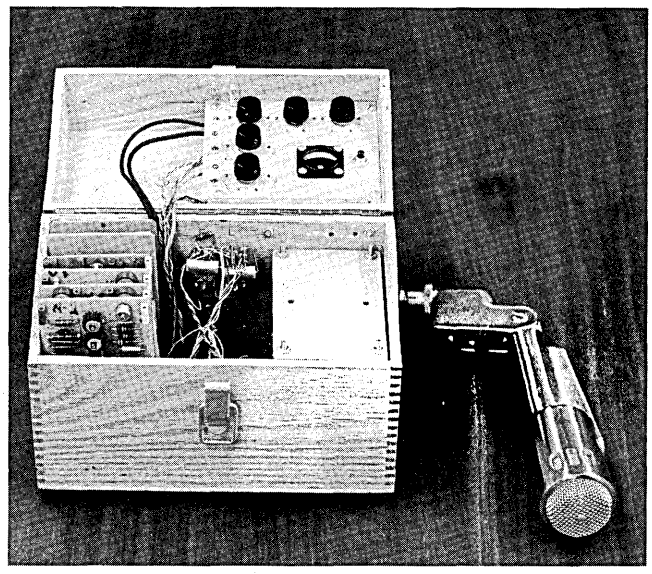
Since the logical output elements of SHOEBOX are relay points, the choice of a readout mechanism is virtually unlimited. Instead of being harnessed to the arithmetic element of a calculator, for example, a SHOEBOX type of device could operate a computer program interrupt cycle, or it could enter a variety of information at the operator's convenience.

And since there would be no need in certain applications to punch cards or key the data, voice could be used to introduce human decision directly into program steps.

When words are spoken into a microphone, the device in its present application, instructs a standard desk adding machine to print what was said. The correct answers to arithmetical problems can also be obtained because SHOEBOX recognizes six command words: "plus," "minus," "subtotal," "total," "false" and "off." Most ordinary variations in speech rates and differences in pitch and inflection do not affect the machine's recognition ability—in fact, SHOEBOX will respond almost as well to singing as to normal speaking tones, though it is baffled by whispering or shouting. The device operates in the presence of considerable ambient noise, thus making it usable not only in an office, but also in airfield towers and in other establishments with noisy backgrounds.

The SHOEBOX device (see fig. 1) is based on the discovery that speech sounds can be identified mechanically by a unique feature of the speech wave which arises from its phase structure. This phase-dependent asymmetry

Fig. 1. Closeup of SHOEBOX (calculator is not shown).



*A word pattern is the minimum meaningful unit of language recognized by the machine. It usually consists of a group of syllables and/or words.

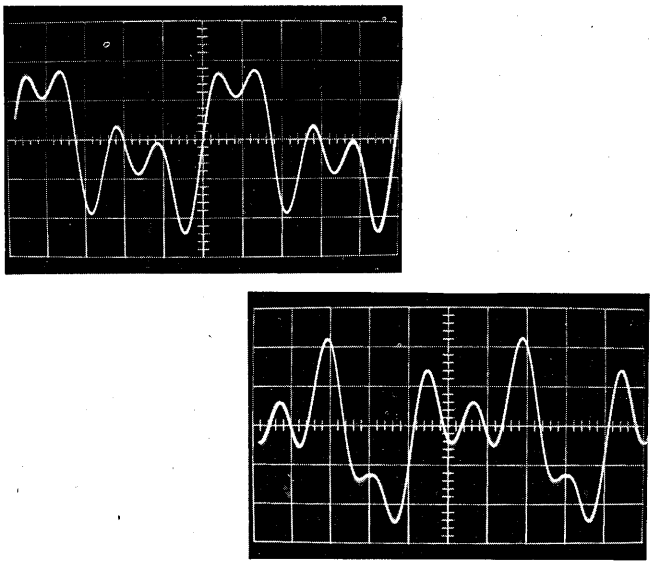


Fig. 2A. Phase Effects — Three given frequencies with phase as variable. The three wave shapes are not perceptibly different to the human ear. Time base is identical to photos in Fig. 2B.

Fig. 2B. Phase Effects — Only the third harmonic is changed. All three wave shapes sound perceptibly different.

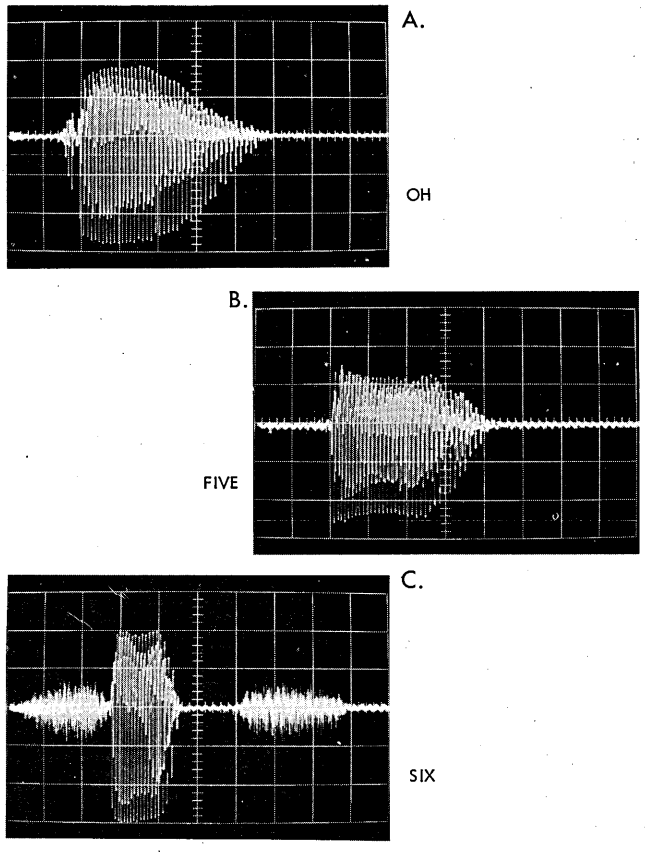
property in the wave is not recognizable by the human ear, but experimenters have found that by making use of it, voice recognition machines could be made simpler and more reliable than in the past.

This usage of phase structure upsets some long held ideas in the field of speech recognition by machine. For years experiments in this field used the human being as a criterion for speech analysis and in judgments as to the design of a machine. This was the result of the path pursued by numerous investigations into human perception.

Over 100 years ago, for instance, G. S. Ohm suggested that the ear possesses uniquely the ability to resolve a complex wave into a series of pure harmonics. Using tuning forks and strings, Helmholtz confirmed this work and more specifically stated that the ear is insensitive to the phase relationships of the pure harmonic frequencies. Although the oscilloscope shows the phase difference in these shapes quite clearly (see fig. 2A), the human ear makes no such discrimination between the three waves, and in each case hears the same sound. In figure 2B each sound wave pattern is perceptibly different from the other two.

Although contributing considerably to voice recognition, early research schemes suffered from a number of limitations. Some used magnetic tape recordings of spoken words and required manual pre-editing of these tapes to determine word boundaries before the tapes are fed to the voice recognition device. This is time consuming. Soundproof booths and lengthy programs on large-scale computers are often adjuncts of these devices. Often the operations do not take place in "real time;" that is, recognition is not simultaneous with the speaker's pronunciation. Some of these devices are highly sensitive to noise and demand considerable stylized speech by trained speakers.

Fig. 3. Electrical Analog of Some Sound Pressure Waves of Three Digits Spoken in a Quiet Office.



In 1959 at San Jose, IBM undertook a voice recognition project. We assumed, as in other schemes, that recognition of speech events can best be made by dividing the speech into segments. Since speech is time-dependent, like a moving train, we knew first that we would have to locate a word with respect to a time base. So like previous researchers we looked for a method of determining the beginning of a word.

Like many other experimenters, we thought the acoustic level of the voice command might provide the key to the beginning of the word. But this approach led into a blind alley. Due to the transient beginnings of many sounds, it was not possible to determine the threshold level for triggering which would consistently signal the beginning of a word. The sound "a" as in eight, or "o" as in "oh" (see fig. 3a), frequently appears to be preceded by an "h". The "o" in "oh" (fig. 3b) is as much as 100 times stronger than the "f" in "five;" in fact, the "f" sometimes does not even register. But if the acoustic level is raised to register the "f," then one cannot be sure where the "oh" begins. Similar problems are encountered with strong sounds, such as the "s" in "six" (fig. 3c) which has a long shallow build-up into the opening sound. The speech sounds themselves, not ambient and circuit noise, limit the operation.

If we could not use the acoustic energy level, what other course was left? We tried other techniques to establish the beginning of a word but over the next 1½ years we met with no success. Then one day serendipity occurred. Asymmetry, we noted, was always present in the wave shape on the oscilloscope (fig. 3c). Why not use it? We found that when you numerically subtract the negative and positive envelopes of the asymmetric peaks a unique signal is observed which specifically corresponds to the sounds produced by the vocal cords. The onset of this signal became what we were looking for, a registration point. We found that we didn't have to use the beginning of the word as we perceive it, but only the point where the machine begins its own unique response to the word. To handle words that do not start with sounds produced by the vocal cords—such as the word, "six"—we were able to "look back" through 200 milliseconds or so in time for a signal which identifies these unvoiced sounds.

For the machine to distinguish reliably among words we combined a number of measurements and established a code. We chose as the base of the code, voicing and friction, the two most general characteristics of spoken sounds. Voiced sounds are the speech sounds made by the action of the vocal cords. In our program, these sounds are known as machine vowels. They include the familiar vowels such as a, e, i, o, u, along with such consonants as l, m, n, r, w, and z, all of which are produced wholly or partially by the vocal cords.

The machine consonants are sounds produced only by air escaping through a constriction, such as the throat or teeth. Examples are the "s" as the beginning of the word "six," the "f" in the word "form" and the terminal "ve" in the word, "five." The "z" sound in "zero" is classified as a machine vowel even though it contains strong frictional components because it also contains voicing.

These definitions are also used in determining the boundaries of each word segment composed exclusively of a vowel or a consonant. For example, let us consider a portion of our SHOEBOX vocabulary, e.g., the ten digits, from 0 to 9, using the word oh for zero. If we classify these words according to their content of machine vowels and machine consonants, we can set up a "gross word code" as shown in fig. 4. Ambiguities that might occur in recognition due to the same code word standing for two different speech words are resolved by specially designed sampling circuits which are uniquely responsive to certain sounds.

The pressure waves generated when one of the ten digits is spoken are converted by the device into signals which are broken up and assigned to three time segments as shown in fig. 5. The first time segment is designated "early" and accepts either no speech sounds or only those speech sounds that are frictional (machine consonants). Time segment 2 contains only those sounds produced by the vocal cords, namely the machine vowels. Time segment 3 is assigned the same sounds as time segment 1, but is designated late because it follows the registration point. All naturally-spoken words contain voice sounds, even though they may not have consonants. In SHOEBOX, the machine vowel always is assigned to the middle segment. Nonvoiced sounds and silence do not fall into this segment. If the machine vocabulary is to contain polyvoiced words—for example, the word San Francisco—

SPOKEN WORD	CODE*
1, 9, OH	V
2, 3, 4, 7	CV
5, 6	CVC
8	VC

* V = Vowel
C = Consonant

Fig. 4. Gross Word-Code of Machine Consonants and Vowels.

Fig. 5. Final Word-Code, Showing Segmentation — One machine syllable is a combination of a machine vowel and consonants containing only one onset of voicing. ("Plus," "minus" and "total" are not included in this table.)

	MACHINE SYLLABLE		
SPOKEN DIGIT	TIME SEGMENT 1 (Machine Consonants)	TIME SEGMENT 2 (Machine Vowels)	TIME SEGMENT 3 (Machine Consonants)
1		ONE	
2	T	WO	
3	TH	REE	
4	F	OUR	
5	F	I	VE
6	S	I	X
7	S	EVEN	
8		EIGH	T
9		NINE	
0		OH	

REGISTRATION POINT

the machine time base and logic will have to be extended as described above.

To explore the various aspects of this approach, we built several different voice recognition models at IBM.* SHOEBOX is shown in block diagram in fig. 6A. The system consists basically of five parts: a microphone and amplifier, a measurement block (sampling circuits), time base circuit, logic block of circuits, and an output device such as a printer, a meter, or tape unit.

Suppose one speaks the digit, "six" into the microphone. The word, acccording to our classification scheme, has three parts: "s," "ih," and "ks." The sibilant speech sound is converted into its electrical analog in the microphone. The signal follows a circuit which is connected to the time base and is parallel to a block of sampling circuits, some of which are exclusively responsive to nonvoiced speech sounds and others to voiced speech sounds. Since "s" is nonvoiced, the nonvoiced responsive circuit responds to the "s" sound by energizing in the meaurement block a storage relay which corresponds to this sound. The signal is effectively stored. At the onset of voicing, that is, as the "ih" sound comes through the circuit, the voice sampling circuit responds, establishing the registration point by energizing a voicing relay. At this moment, the initial "s" sound is transferred to a relay assigned to the early segment of the time base.

At the termination of voicing the "ks" signal of the "x" in "six" energizes the nonvoiced circuit and causes the signal to be stored in a relay in time segment 3, which can now be called friction-late, since it follows voicing. The sampling circuits in the measurement block additionally classify the signal into friction-strong and friction-weak, as illustrated by such sounds as "s" and "f," respectively.

Three of the final decision relays in the logic block are labeled F_{se} (friction strong early), voicing and F_{sl} (friction strong late), corresponding to the segments of the word, "six." This three-relay arrangement of stored measurements is in sequence. Since we have the registration point, we can position it on our logic matrix. The ordered sequence relates the measurements to each other and thus effects recognition of the word, "six."

The time base in our machine has several interesting properties. The key property is that it is not affected by the speaking rate. In practice the time base functions well when one speaks rapidly or when a word is dragged out, as in singing. Mispronunciation of a word, or omission of some sounds, do not affect the remainder of the word on the time base. For example, the word "three" is sometimes pronounced "dree," with the "th" omitted. The machine vowel, "ree," still is assigned to the center segment of the time base and there is no shift in position of the remaining elements.

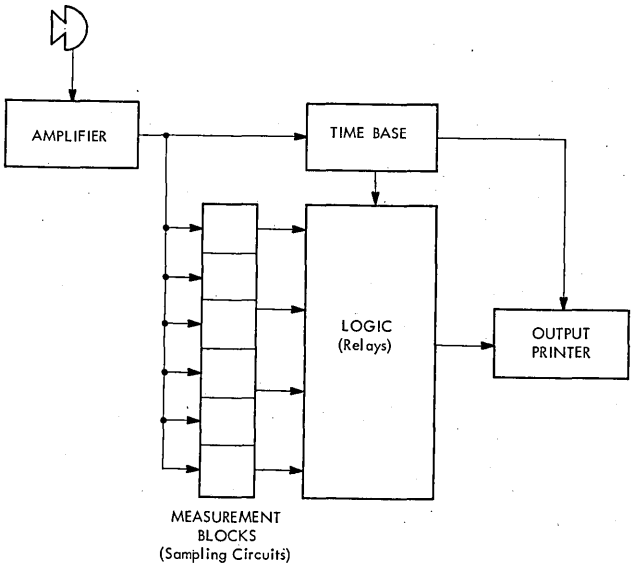
The time base (fig. 6B) is completely independent of word beginnings or endings. When one pronounces "six," recognition of the beginning of the initial "s" sound is very uncertain. The sound resembles a "th" sound or an "f" sound—or an "h" sound mixed with ambient noise—until it finally builds up to the strong frictional sound characteristic of the "s." None of the word-beginning acoustic elements has any effect on the proper registration of the true "s" sound or on the rest of the word.

Auxiliary timing circuits are used to control the output printer. These circuits, in effect, indicate when the word is finished, thereupon transferring the information stored in the logic relays to the solenoids which energize the printer.

In addition to its implementation of a computer open shop, voice recognition devices have possible uses in many other fields. Jet fighter pilots could use voice control and voice verification to replace many complex manually operated instruments in already highly complex instrument panels. A small vocabulary machine, perhaps similar to SHOEBOX, might be used to enter data suitable for automatic industrial processing. Utility meter readers, operators of automatic equipment, and cash register operators are among those who would benefit from the development of voice-controlled devices.

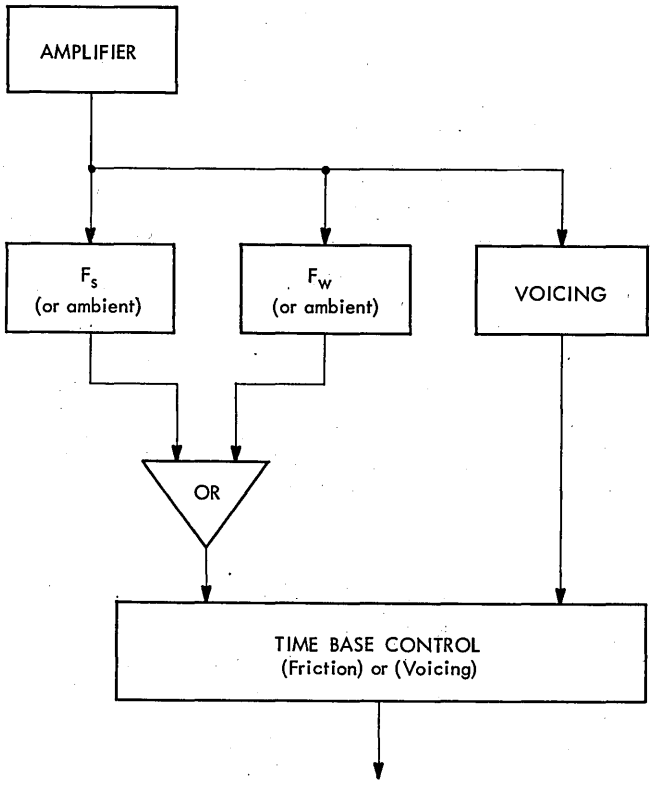
A noteworthy side benefit could be that speakers would generally be obliged to improve their pronunciation, since the machine hears not what the speaker meant to say but what he actually said. ■

Fig. 6A. Block Diagram of Voice Recognizer.



*The generic predecessor of SHOEBOX was housed in a suitcase. It recognized 10 spoken digits. Indicator lights were used on the output side.

Fig. 6B. Detail of Time Base Block.



FOR GENERAL DYNAMICS CIRCLE 21 ON READER CARD →

A SURVEY OF AIRLINE RESERVATION SYSTEMS

11 reported; 7 on the air

The need for a highly-sophisticated computer-based airline reservation system, capable of performing a myriad of functions in addition to the basic need for real-time seat availability and inventory, has resulted in the design of four such systems: American's SABRE (IBM); Pan American's PANAMAC (IBM); Delta's 9074 SABRE (IBM); and United Instamatic (Teleregister).

To date, only Instamatic is on the air, and was announced as operational on October 29, 1961.

Development of these systems has been over a span of almost ten years. Work on American's SABRE began in 1953; PANAMAC was conceived in 1956; 9074 SABRE in 1959, and Instamatic in 1958.

Airlines requiring only seat availability and inventory information utilize first-generation, special-purpose equipment (some of fairly recent vintage, i.e., Teleregister's Resitron and Reservisor) and relatively new solid-state general-purpose systems, such as Univac's 490 Real Time. (Northwest will soon replace its Univac File Computer with newer RemRand equipment.)

Eastern's 490 Real-Time System is capable of handling a minimum of 46 different types of operations; completing at least 30K transactions per hour, with a potential for expansion to 90K; and transmitting data to 876 agent desk sets located in 42 cities.

The SABRE system, the most ambitious and complex of the various systems, has been faced with overcoming a host of obstacles, both in hardware and programming. Due to the amount of ground it is expected to cover when fully operational, the testing and debugging of the system has been considerable.

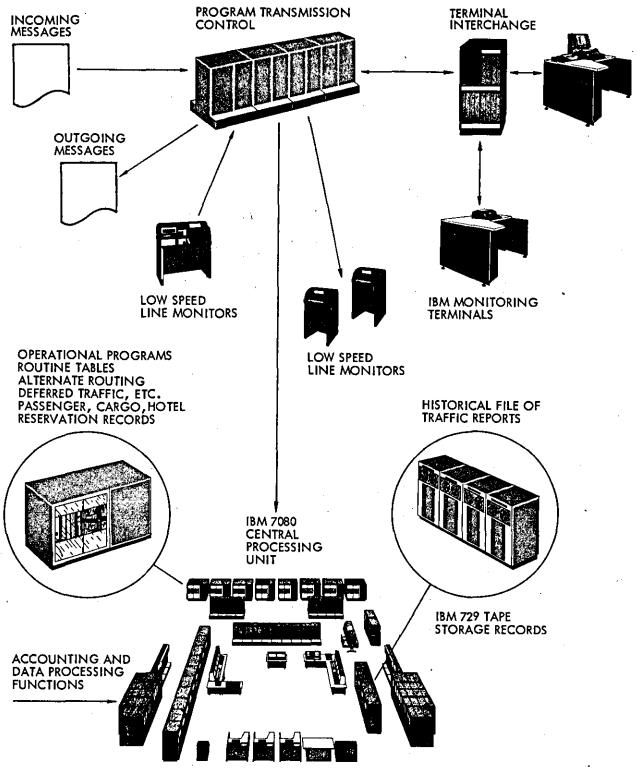
Some of the reasons for the delay may be attributed to shortcomings in system design and sub-programming; coordination breakdown between programmers and specification writers; and the failure to deliver hardware scheduled for installation in the first quarter of this year.

It was reported in the trade press in March that regional, on-the-air status for SABRE was imminent. However, W. R. Plugge, director of technical reservations systems for American, told DATAMATION recently:

"Contrary to what you may have read . . . American Airlines' SABRE system will not be ready for cutover in New England in May. It is true that Hartford is a test city and we will begin to do some testing in April and May, but at present it is impossible for us to pinpoint

United Instamatic: Reservations agent uses agent set to check space availability. The set is also used to make or cancel reservations.

United Instamatic: Denver control center. At left are two of three computer control consoles; the third is at right. Console for overall system control is at far right.



Pan American PANAMAC: Messages and inquiries from reservation sets (upper right) will be transmitted to the center via terminal interchanges and voice-grade data channels. At the dp center, three IBM 7750 Programmed Transmission Controls will translate incoming messages into computer language which are input to the central processor. Outgoing messages will pass through the 7750 onto the proper communication line and then to the interchanges, which automatically select the terminals.

any target date. We are hopeful that the system test period which began this month (March) will not take too long; however, we do not intend to install the system until it has been completely checked out." (IBM reports that initial hook-up between cities has been forecast during 1962-1963.)

In light of American's difficulties, DATAMATION queried Delta and PanAm as to when their systems would be implemented. These replies were forthcoming:

"... Delta has not established as yet the programming of the system into the major cities. It will also require further analysis as to the additional computer utilization that may be scheduled. The initial installation is scheduled to begin in April, 1963, with the computer center located in Atlanta."

PanAm would go no further than reiterate their original announcement made in March of this year that PANAMAC would go into operation during "the fourth quarter of 1963."

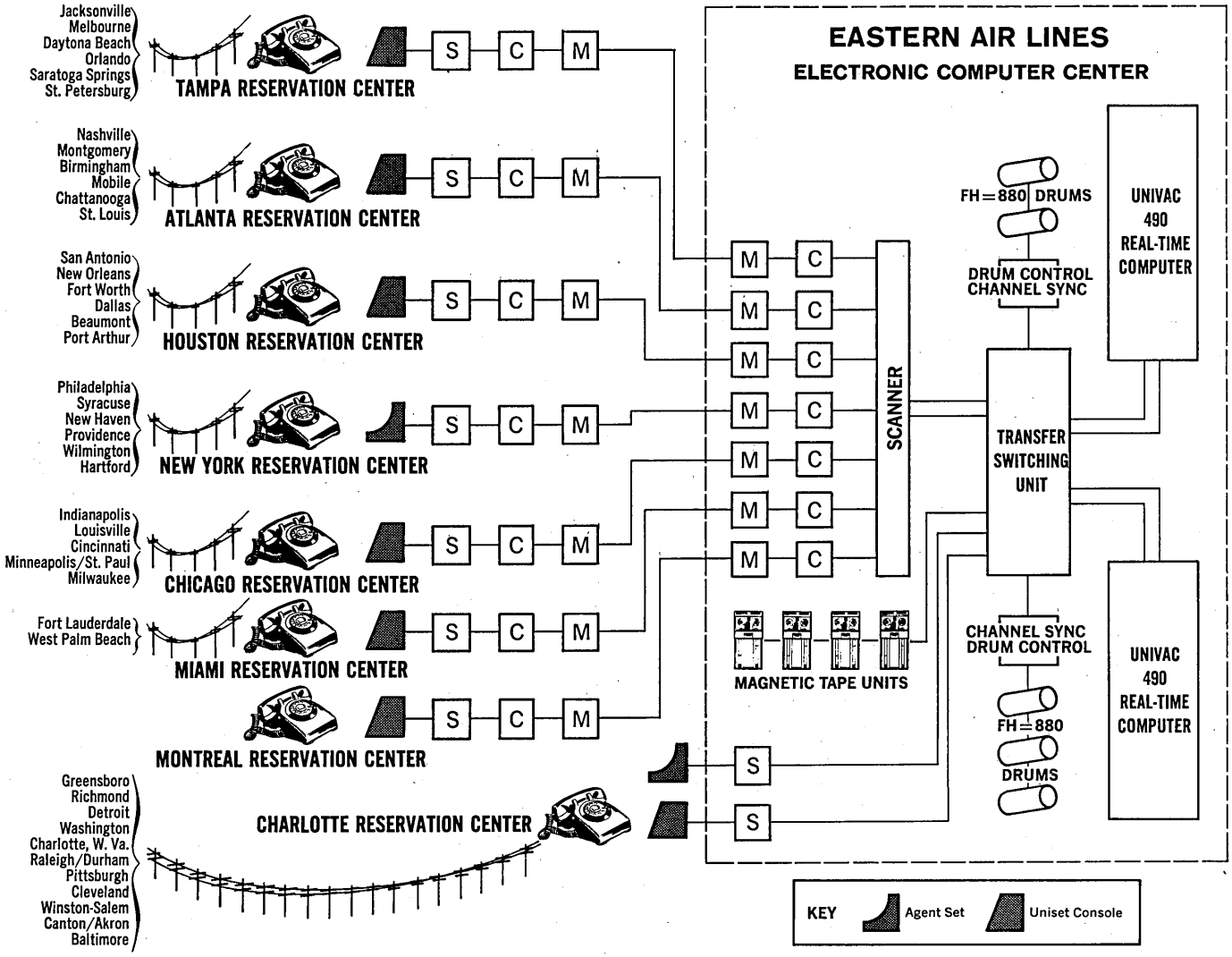
The Instamatic system, which was not designed with as many refinements as SABRE (and consequently has not received as much notice) links more than 800 agent sets to three general-purpose, solid-state Teleflite computers. In addition to furnishing a constant summary of seat availability, Instamatic provides statistical summaries for management control and analysis.

The importance of an accurate seat inventory may be emphasized in the following, verified account: about a year ago, a flight operated by Airline X, departed for Chicago from Los Angeles with exactly four passengers on board (who all happened to be in the computer business and were enroute to a computer users conference.)

A few minutes later, Airline Y's flight, also on a Los Angeles-Chicago schedule, departed with a full load of passengers, many of whom were, as fate would have it, also computer-types, going to the same meeting. It was believed that a misplaced parity bit was to blame for the abundance of seats in the earlier flight. ■

A SYSTEM SUMMARY

AIRLINE	SYSTEM	OPERATIONAL DATE	MANUFACTURER	CENTRAL PROCESSOR	INTERNAL STORAGE	OFF-LINE STORAGE
American	SABRE	not available	IBM	2-7090's	64K total	drum: 7.2 million char. disk: 500 million char.
Braniff	Reservisor	Nov. 25, 1957	Teleregister	Unified Airline System	——	drum (capacity n.a.)
Delta	9074 SABRE	April, 1963	IBM	2-7074's	200K total	disk: 400 million char.
Eastern	490 Real Time	Mar. 1, 1962	Univac	2-490's	64K total	drum: 4 million words
National	Teleregister	Feb. 18, 1962	Teleregister	Unified Airline System	——	drum (capacity n.a.)
Northeast	Reservisor	Mar. 1, 1959	Teleregister	Unified Airline System	——	drum (capacity n.a.)
Northwest	File Computer	Oct., 1957	Univac	Univac File Computer	n. a.	n.a.
Pan American	PANAMAC	4th Qtr., 1963	IBM	2-7080's	320K total	disk: 400 million char.
TWA	Teleflite	1st Qtr., 1963	Teleregister	2-Teleflite Computers	32K total	drum: 4 million char.
United	Instamatic	Oct. 29, 1961	Teleregister	3-Teleflite Computers	30K total	drum: 5.2 million char.
Western	Resetron	Dec. 15, 1959	Teleregister	Unified Airline System	——	drum: (capacity n.a.)



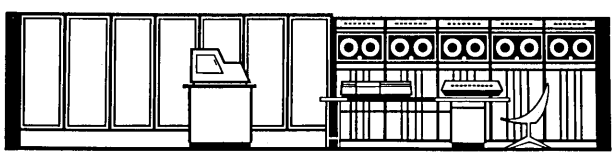
Eastern 490 Real-Time: Forty-two cities are connected with a reservation agent equipped with an agent set in six reservation centers, linked directly with the EAL Computer Center in Charlotte, N. C. Components represented are Scanner (S); Communications Control Unit (C); and Modulator-Demodulator (M).

AGENT SETS	CHARACTERISTICS
1100	General purpose. Seat inventory and availability. Record passenger's name, telephone number and special requirements; provide passenger waitlist; flight forecasts; ticketing arrangements; manifests and passenger lists; schedule changes and extra sections; historical records; management and operations reports.
2	Special purpose. Seat inventory and availability.
300	General purpose. Seat inventory and availability. Record passenger's name, telephone number and special requirements; provide passenger waitlist; manifests and passenger lists; management and operations reports.
876	General purpose. Seat inventory and availability.
171	Special purpose. Seat inventory and availability.
84	Special purpose. Seat inventory and availability.
n.a.	General purpose. Seat inventory and availability.
600	General purpose. Seat inventory and availability. Record passenger's name, telephone number and special requirements; provide passenger waitlist; manifests and passenger lists; schedule changes; management and operations reports.
250	General purpose. Seat inventory and availability. Record passenger's name, telephone number and special requirements. Provision for management and operations reports.
827	General purpose. Seat inventory and availability. Record passenger's name, teelphone number and special requirements. Provision for off-line reports.
150	Special purpose. Seat inventory and availability.

Honeywell Computers Tackle Higher Mathematics with AUTOMATH

Higher education, in the form of assemblers and compilers, gives computers the ability to accept and act upon instructions phrased in other than a basic machine-language vocabulary. FACT, and COBOL, for example, are business-oriented compilers that enable Honeywell computers to handle business problems couched in business terms.

Now, Honeywell announces an equally powerful family of engineering and scientific programming aids, called AUTOMATH, for its full line-up of computers. AUTOMATH, which is completely compatible with FORTRAN, is designed to take full advantage of the many exclusive features of Honeywell systems. The AUTOMATH family includes algebraic compilers for the Honeywell 400 and 1800 computers and embraces an advanced version of the existing Honeywell 800 algebraic compiler. Engineers and scientists can learn to use AUTOMATH in less than a week's time. AUTOMATH greatly reduces the time and cost of preparing programs, improves accuracy, and increases computer productivity by minimizing human intervention.



Small users get big benefits

The Honeywell 400 is a powerful business data processing system which also has scientific capabilities that rival or exceed those of many larger, more expensive machines. AUTOMATH 400 capitalizes on this ability, and includes the following major characteristics:

1. AUTOMATH 400 is designed for use on a system that has 2000 or more words of memory, four or more magnetic tape units, a printer, a punch and a card reader.
2. A monitor feature provides Load-and-Go operation whereby one, or a series of programs can be compiled and executed without interruption.
3. An elaborate diagnostic system enables the programmer to remove rapidly any errors that he may have introduced.
4. Fixed-point constants and variables may have values ranging up to nine significant digits.
5. Programs too large to be contained in memory may be executed by bringing portions into memory only as needed, and by permitting areas of memory to be shared by various portions of the program.
6. The ability to insert hand-code permits the employment of other peripheral equipment, such as paper tape units, as well as the insertion of special program checkout statements.

How to move medium-size mountains

AUTOMATH 800 is an advanced version of the Honeywell 800 Algebraic Compiler which incorporates a basic scientific language and takes advantage of the high-speed capabilities of the computer. Additional power has been provided by modifications which speed up the compiling process and permit more efficient use of available memory. AUTOMATH 800 includes the following features:

1. Batch compiling of programs onto a tape in such a way that they can be immediately executed.
2. Fixed-point variables provide accuracy ranging up to 14 significant digits. Floating-point values may range from 10^{-65} to 10^{+63} in decimal, or from 16^{-65} to 16^{+63} in binary form.
3. Provision for buffering tape input and output operations can be used to increase program execution speed.
4. Problem data and parameters can be included with the program being compiled, making it available for immediate use.
5. AUTOMATH 800 is designed for use on a machine with 4000 or more words of memory and for four or more magnetic tape units.

The bigger the job, the harder it works

The Honeywell 1800, newest and fastest of all Honeywell computers, has a particularly broad and powerful scientific capability. AUTOMATH 1800 has been developed to gain maximum efficiency from this capability. AUTOMATH 1800 can compile source programs written for 400 and 800 systems, and can be used on Honeywell 800 computers that have sufficiently large equipment configurations. Major characteristics of AUTOMATH 1800 include the following:

1. AUTOMATH 1800 is designed for use on a Honeywell 1800 with 16,000 or more words of memory and seven or more magnetic tape units. This provides extremely fast, efficient compilation.
2. Load-and-Go operation takes a series of programs through compilation and execution at extremely high speeds.
3. Memory utilization is automatically and dynamically optimized by a compiler monitor system throughout execution of the generated program. This greatly increases the maximum size of programs that can be handled.
4. Input-output operations are automatically buffered, substantially speeding their execution.
5. A full set of logical decision statements and relational operations are provided; adjustable dimension statements and complex and double-precision arithmetic are permitted. This enables the programmer to create a much more flexible program with greater ease.

Basic benefits go across the board

All three Honeywell AUTOMATH compilers are compatible to the extent that you can start small and grow through the ranks without reprogramming. Programs created for a Honeywell 400 can be used immediately by the more powerful compilers. A full library of mathematical and scientific routines is available to all three compilers and optimum use is made of hardware features such as automatic error correction and simultaneous operations.

If your interest in computers lies strongly in their scientific or engineering capabilities, you will want all the facts on Honeywell AUTOMATH. Write to Honeywell EDP Division, Wellesley Hills 81, Mass. In Canada, Honeywell Controls Limited, Toronto 17, Ontario.

Honeywell

H HONEYWELL *Electronic Data Processing*

CIRCLE 22 ON READER CARD

While the function of information processing in command and control may prove only of indirect concern to the majority of DATAMATION readers, the effect of current thought in this area does bear heavily on the ultimate directions of edp in business and scientific applications.

Publication of the following recommendations does not represent DATAMATION editorial policy but may be regarded as part of a continuing effort at informing our readers of peripheral as well as primary news in the broad spectrum of automatic information processing.

INFORMATION PROCESSING FOR MILITARY COMMAND

compatibility & flexibility advised

by LEE S. CHRISTIE, System Development Corp., Santa Monica, Calif. and MARLIN G. KROGER, Motorola, Inc., Riverside, California

In systems for the direction of armed forces, information processing is currently a serious issue. Where should computers be used in command and control systems? How should a military command analyze its information processing needs? What part can computers play in decision making? Where should we direct R&D efforts related to automated command and control systems? Should DOD standardize computer programming languages?

Such questions as these have been explored in recent Department of Defense studies. This article summarizes the answers to these questions elaborated in two reports: an Institute for Defense Analyses study on "Computers in Command and Control," and a System Development Corporation report on "Computer Programming Standards in Command and Control."

The authors of this article were the "chairmen and chief editors" of the two studies; however, we wish to emphasize that we are greatly indebted to the other members of our study teams for their contributions although they should not be held responsible for the present rendering.

The phrase "command and control" is used to describe a general capability for directing armed forces. Computers are now thought of as integral parts of modern command and control information systems. However, the uses to which computers can be put vary considerably with the type of command and control problem.

Even though not all systems can be neatly categorized as either command-type or control-type (because most systems have elements of both) it is helpful to differentiate between the command functions and control functions.

Command functions involve broad problems of planning, assessing the capabilities of the command's forces and those of the enemy, allocating resources, alerting, and committing the command's forces. These functions require the gathering of large amounts and many classes of information, aggregating the information, and processing it to enable a commander to make knowledgeable, deliberate decisions in a context of changing objectives.

Control functions, on the other hand, characteristically involve direct control of weapons in situations where, although the volume is large, the information can be categorized into relatively few classes, and since the objectives are definite and fixed, the problem is one of directing action toward the objectives through error detection and correction.

There is a shift in emphasis from control functions to command functions at some level of command. At lower levels, for example a SAGE air defense direction center, the control function is the dominant factor. On the other hand, at higher levels, the command function dominates. The cross-over point occurs at different echelons depending on mission characteristics—at Division level in the Field Army case, at Specified Command level in the SAC case.

Experience shows that systems dominated by the command function have quite different automation problems

from systems dominated by the control function. Characteristically, control and sensor systems are firmly embedded in the physical aspects of surveillance and weapons hardware, and, in consequence, much of their computer processing involves such matters as the numerical solution of equations of motion on a real-time basis. In command systems, computers are primarily useful for logical operations that support evaluation of plans and assessment of force capability, operations such as information storage, retrieval and display.

evolutionary design

The DOD studies recommend that the using operational command be given early the computer capability to automate at least one phase of its command functions and thus allow the command to gain experience with computer hardware and techniques. Then, additional functions can be automated in time-sequence steps as the necessary analysis is completed. However, care should be taken that the introduction of automated capability does not, even for short periods, cause dangerous decreases in the command's reaction-capability due to transients in the overall system.

Procurement practices should recognize that an evolutionary system has no "operational cutover date" when the system phases from development to use and no "complete operational date," beyond which it ceases to evolve. An evolving system must, at all stages of development, have either unused capacity or quickly expandable capability to allow for a smooth pattern of planned growth.

The user of the system should participate in every step of the evolution. He is a vital part of the system and if he delegates his responsibility to an agency outside his organization, there is danger that the user will depend on automated decision aids without realizing the extent to which human judgment of operational parameters has been built into such aids by an outside developer. Also, an outside development agency lacks the intimate understanding that the using command has of its functions and problems, which themselves are often changing rapidly and unpredictably.

Such involvement of the actual user in the system design will require a sharp increase in the number of technically competent user-command personnel. Necessary outside technical help must have a close, two-way working relationship with the using command at all levels, particularly at the top.

compatibility and flexibility

At the present time, there are few commands that depend extensively on computer assistance for command information processing. The majority of the commands to which automation may be applied are using interim data processing capabilities, or are operating manually and planning to obtain automated capability in the near future. Because these systems are still in the early stages of implementation, compatibility can be attained without excessive modification of schedules or designs if action is taken soon.

Technical compatibility is a matter of the compatibility of the language and equipment used for information exchange by a system or a complex of systems. Although the specific functional organization and the operation of a command and control system is a responsibility of the using operational command and higher command authority, the equipment and the formal languages that such systems use are subject to broader standardization. Language must be standardized and made compatible to some degree or chaos will result when different commands operate jointly.

The separate efforts of the individual services can accomplish important compatibility improvements within their own areas, but the trend toward Unified Commands and Joint Task Forces emphasizes the need for compatible inter-service information systems. The DDR&E and the JCS have the responsibility, and must provide the leadership, to ensure that commands and services have adequate guidance in matters of compatibility and that standards are established sensibly, interpreted correctly, and followed.

Interrelated with the need for compatibility is the need for flexibility in information processing hardware. Such flexibility is a prerequisite for evolutionary system growth because of the changes in hardware requirements that are to be expected as the system evolves. A command should be given some computer capability early—without waiting for a complete definition of needs. As the system design progresses and ideas are developed for new methods of executing functional responsibilities, it is desirable that the initial equipment configuration be able to grow and adapt accordingly. Also, future changes must be anticipated, both in new functional responsibilities and in new hardware capabilities.

Modular design is the current trend in equipment development for computer-based systems. This trend can be an important factor in attaining flexibility. However, equipment modules, generally, are now standard only within a particular manufacturer's line—and, while buying equipment from only one source might be a "solution," it is an unacceptable constraint. A family of modular, compatible, general purpose equipments that can be configured for a wide range of system capacities should be developed, improved as the state-of-the-art advances, and made available for off-the-shelf procurement. This family should contain a wide variety of types of modules, such as drums, tapes, disk files, displays, printers, arithmetic units and control units. Within each particular type there should be a variety of modules of different speeds, volumes, and the like.

the importance of a standard programming language for command and control

Compatibility and growth flexibility have meaning only from a complete system point of view. Having modular, compatible hardware is one part of the problem. Having a modular, compatible language is a related but quite different problem.

An important part of the military command and control language problem can be attacked through computer programming languages. It seems feasible to develop and phase into use a standard Procedure Oriented programming Language (POL) specially tailored to command and control application that would complement modular equipment and make possible a facile exchange of data and procedures among the diverse DOD command systems. Study may show that there should be a nested set of at least two languages (the smaller a subset of the larger), since a single language is unlikely to be completely suitable for the full range of systems and computers.

Modular structure makes a system flexible only if changes to various kinds of individual modules (hardware *or* software) do not cause disruption and a consequent necessity for major revision elsewhere in the system. A standard POL will provide its required contribution to system flexibility in proportion to the degree of machine independence it attains.

Effective machine independence through POL standardization will permit programming for a new or restructured command and control system to start without the system's computer being immediately available. When initial information processing requirements have

been determined, a set of equipment modules tailored to these requirements can be chosen; then, as new requirements become apparent, new equipment modules well suited to the user's need can be added.

Moreover, during operations, programming changes can keep pace with data processing equipment changes easily, often needing to be made only in the compiler part of the programming system. New programs that reflect changed operational specifications can be prepared rapidly once the compiler has been thus modified. Finally, the working out of changes in one system can be reflected in other systems through the use of the POL standard.

The introduction of a POL standard can reduce programming costs appreciably, since without a standard, unnecessarily complete development efforts—to provide specifically oriented compilers and supporting utility systems —must be carried out for each command and control system. Also, personnel will need little programming retraining in transferring from one system to another.

Before data can flow between systems, it is imperative that agreement be reached on formats and encodings, as well as on isolation of the most effective points in the systems to perform translations from one form of data representation to another. Without a mutually understood language for data description, it is quite difficult to make such agreements explicit, an exercise that is essential prior to the design of system interfaces.

The problem of data description has been treated in individual command and control program systems through the use of a data dictionary, a central communication pool containing data descriptions and relevant storage allocation information. This technique is easily adaptable to a standardized multi-machine, intersystem POL. A standard POL with broad data description features will not in itself solve all the problems associated with such information interchange, but such a broad data description capability is a prerequisite for any solution.

The desirability of a capability for procedure interchange, as distinct from data interchange, is found at two levels. The simpler case is the wholesale shift of a program from one machine to another, either to permit the introduction of a new and superior machine into a system or to handle computational overloads by borrowing facilities from another installation. To accomplish this type of shift is not trivial in the present state of the programming art, but it is demonstrably easier if a standard POL is in common use.

A more difficult problem, but one of potentially vast importance for command and control systems, is the dynamic exchange of program segments between operating systems. The value of facilitiating the interchange of procedures is exemplified by the fact that the operational functions of one command, e.g., warning in NORAD, must be represented in the simulations and models of other commands, e.g., SAC. NORAD operational programs embody the facts of NORAD operations; SAC's models embody their understanding of those NORAD operations relevant to SAC. If these warning procedures and models both exist in standard POL form, automated methods to analyze their consistency can be developed by either command. When disparities are found, either the models can be corrected or operational changes can be coordinated on an accurate basis.

implementing a standard POL system

The basis in technical experience prerequisite to establishing a standard command and control POL system exists today. It is generally neither systematized nor well documented. Further, some of the experience shows that systems dominated by the command function have somewhat different programming requirements from systems dominated by the control function. Finally, some system varieties, such as some sensor and intelligence systems, have peculiar requirements that may be difficult to encompass efficiently in a standard POL system. Therefore, to establish such a standard as a practical system requires a substantial developmental effort and a considerable amount of applied research directed to the selection and consolidation of POL techniques.

Two examples will illustrate:

1) A single language is unlikely to be completely suitable for the full range of systems and computers. There may have to be a compatible set of at least two nested languages (i.e., the smaller of the two is a subset of the larger) to accommodate the range of sizes of applicable computers.
2) Continuity of operation is usually of high importance in a command and control system; yet, revisions and maintenance must be accomplished. These facts may require a common executive control of operational and utility functions. The presence of the programs necessary to perform executive control is reflected in constraints in the design of a POL system, particularly in the area of the compiler and supporting utility system.

The primary motivation for the development of POL's is increasing the efficiency of program preparation. Currently, this gain in programmer effectiveness is commonly purchased at the expense of more storage or longer running time for the programs compiled. However, there is good reason to believe that given the necessary research effort, compilers can be improved to the point that the operating efficiency of their products rivals, or even exceeds, that of hand-coded programs.

Economy of computer time concerns not only reduction of the time required to execute the object program but also the computer time required for initial compilation and for recompilation. The recompilation factor arises during checkout and when the operating program is modified. In many cases, good techniques to improve performance in one area lead to a loss of efficiency in other areas. Investigation is needed to determine those techniques that have the best trade-off characteristics.

A problem of considerable importance that has been given very little study is that of data organization in the object programs and the associated question of providing a capability to describe such data organization in POL's. Proper design of data description techniques has a bearing on the recompilation problem and is critical for source language debugging. Alternate methods for data dictionaries can be tested through a technique of experimental compilers.

The effectiveness of a standard POL will be dependent on factors concerning both the programming process and the utilization of machines by programs. In arriving at performance criteria for a standard POL system, both of these types of factors must be considered in terms of the operational constraints of various systems. A criterion that is appropriate for one system may be inappropriate to apply across the field.

The primary performance factor is the efficiency with which the system produces its product. Efficiency may be measured on scales stated in terms of economy of human effort, computer running time, required storage, initial dollar investment, sustaining cost, and various functions of these variables. The inter-relationships among these variables are involved and little understood. A systematic study of existing languages and their compilers should lead to means by which efficiency can be approached rationally. In addition, experiments with actual programming systems can provide the data necessary to develop

empirical measures of programming efficiency.

Among the language factors for which criteira and scale should be established are:

a) applicability—facility of expression of processing procedures for the range of information processing problems encountered in command and control systems;
b) clarity—familiarity of symbols and forms, notational consistency and freedom from ambiguity.

A major factor for the compiler and supporting utility system is machine independence—the fraction of each that is transferable from one machine to another.

Additional factors, primarily referable to the supporting utility system, that require criteria and scales for measurement include:

a) debugging capability—ease of testing for, and isolating, errors in program logic and arithmetic;
b) modification capability—degree to which there is efficiency in program revision.

The establishment of a standard command and control POL will be successful only if its development, implementation, and maintenance are well managed. The following specific recommendations have been made in this regard.

A decision to define and adopt a standard POL in a definite time period—such as two years—should be made and announced. A time-phased plan for incorporating the standard POL system into the various DOD command and control systems should be established.

While the overall management of a standard POL System, developmentally and operationally, might take one of several courses, the smoothest sailing is likely to result from setting up a central organization with responsibility and authority: a) to manage a language-integrating activity somewhat similar to CODASYL and, b) to carry out supporting functions and developmental tasks. Direction would be exercised by this organization over the applied research necessary to establish a practical standard and to maintain it dynamically. Specification, conformity tests, and official documentation, as well as central monitoring of implementation, revisions, and maintenance, would radiate from this organization.

advanced research needed for command and control

The state-of-the-art in information techniques, such as problem formulation, analysis, modeling, and design and command languages, is the primary technical factor limiting our capability to apply automation to command systems. Research to provide the knowledge and techniques needed to exploit computers more fully in our evolving command systems should be expanded in the following areas.

1. Development of improved techniques in formulation, analysis and programming.
2. Development of improved procedures and languages for communication between machines and their users.
3. Basic research directed toward increasing our understanding of such complex processes as pattern perception, concept formation and recognition, problem-solving, learning, and decision-making.
4. Research directed toward improving the flexible modularity and dependability of computers and their associated hardware. ■

NEW FIRMS & mergers in DP

■ A new firm, Teleplex Corp., has been formed in Princeton, N.J., to develop equipment in electronic data handling. President is Ayhan Hakimoglu, formerly director of engineering, electronics, General Devices, Inc., Princeton.

■ Standard Register Co., Dayton, Ohio, is now the sales and service organization for data communications equipment manufactured by Raytheon's Equipment Div. The first product to be handled will be the DataRay 401 System.

■ ComputerMat II, a second self-serve computer center operated by ComputerMat, Inc., has opened at 14827 Ventura Blvd., L. A. The new center includes an IBM 1620, and is patterned after the Wilshire Blvd. center in Los Angeles.

■ Full ownership of the Information Retrieval Corp. has been acquired by Information For Industry, Inc., Washington, D.C., and will be operated as a wholly-owned IFI subsidiary. IRC has developed, and will market nationally this fall, a Command Retrieval Information System.

■ General Precision, Inc., and the Mitsubishi Electric Manufacturing Co., Ltd., Japan, have formed a new firm to be known as Mitsubishi Precision, Inc. Among the products which will be manufactured and sold throughout Asia are General Precision computers, avionic systems and components, air traffic control equipment, and medical electronic equipment.

■ Booz, Allen Applied Research Inc., has acquired Designers for Industry, Inc., Cleveland, and will become the DFI—Cleveland Operations of the parent firm. DFI specializes in product, process, and manufacturing equipment in R & D.

■ Moore Associates, Inc., San Carlos, Calif., has acquired a "substantial interest" in Communicom, Inc., Palo Alto, Calif. The latter will be engaged in the field of multi-channel communications switching, auto-programming, networks, and analog and digital communications systems.

■ A new company to develop and produce peripheral equipment has been formed by Control Data Corp. and Holley Carburetor Co., Warren, Michigan. The new firm will be called the Holley Computer Products Co. and will be jointly directed with equal interest by CDC and Holley.

Officials named for top posts include W. C. Norris, president of CDC, who will serve as board chairman; board members selected were G. S. Hanson, marketing division's general manager; T. G. Kamp, general manager of the Peripheral Equipment Div.; and R. L. Perkins, special consultant on peripheral products with Control Data.

■ A new firm, Management Technology Inc., has been created by five former officers recently resigned from Operations Research Inc. The firm, to be located in Los Angeles and Washington, D.C., will develop new computer-oriented decision-making techniques beyond current PERT methodology. MTI is headed by Donald G. Malcolm, president; Herbert Millstien, vice president, plans & programs; John Diesel, vice president, operations; Wilbur Crater, vice president, engineering, and Robert Bicknell, vice president, Washington office.

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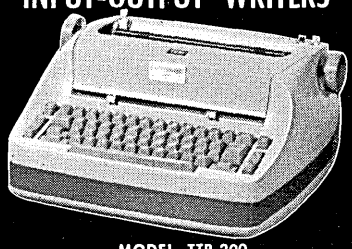

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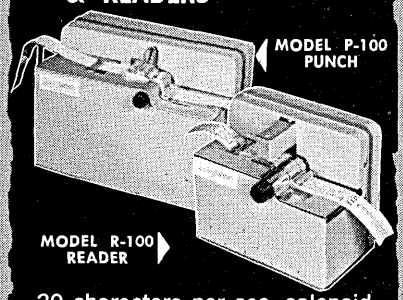

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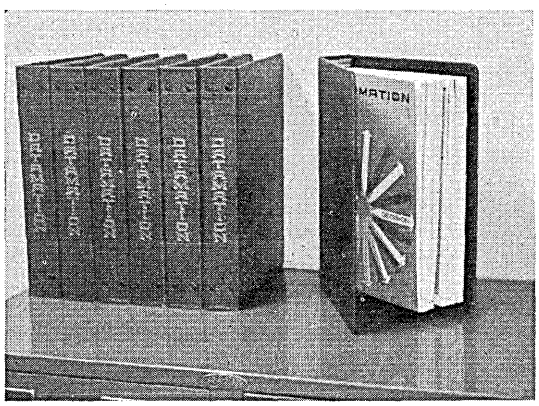

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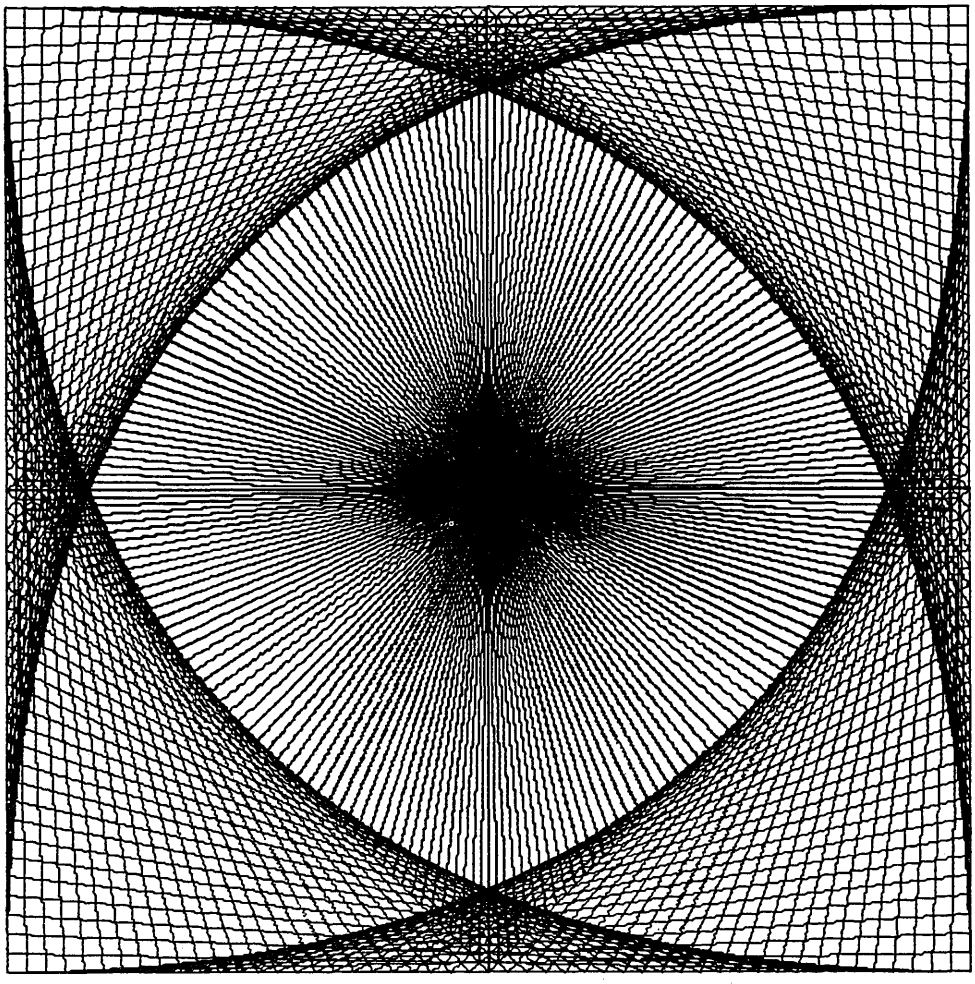
What is going to happen next? To further the development of operational control systems which require communications, IBM is investigating new techniques in the fields of microwaves, lasers, fiber optics and ferroelectrics.

One group is studying electronically self-modulated antennae arrays in connection with the processing of satellite data. To assure survival of our national communications system, another group is working on the development of stored program techniques that will permit automatic reconfiguration of military networks in the event of nuclear attacks. Out of their research may come advanced control systems to work in connection with communications linkages of tomorrow.

If you have been searching for an opportunity to make important contributions in control or data processing systems using advanced communications techniques, or any of the other fields in which IBM scientists and engineers are finding answers to basic questions, please contact us. IBM is an Equal Opportunity Employer. Write to: Manager of Professional Employment, IBM Corp., Dept. 701S, 590 Madison Avenue, New York 22, N. Y.



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COORDINATE CONVERSION TRACKING AT GOLDSTONE

To meet the tracking requirements of NASA's Project Echo, the Coordinate Conversion Computer, produced by Computer Control Co., was used to provide pointing control of the Mojave Desert tracking station's two 85-feet microwave transmitting and receiving antennas. The two antennas, their servo-drive systems, tracking optics, microwave data link, and the computer form a closed loop tracking system.

The computer, installed at Jet Propulsion Laboratory's Deep Space Instrumentation Facility, Goldstone, Calif., will also be used in NASA's Mariner, Surveyor, and Ranger projects.

In the Echo project, the computer accepted precomputed orbital data or on-line computations via teletype from Goddard Space Flight Center. It performed arithmetic operations required to correct and convert the data to real time pointing commands for the two antennas.

The basic transformation and computations performed were: 1) Transformation of receiving antenna. Hour Angle (HA) and Declination (Dec.) to Earth-fixed, center-of-the-earth Cartesian coordinates. (COE). 2) Transformation of COE to HA and Dec. 3) Transformation of transmitting antenna Az and El to COE. 4) Transformation of COE to Az and El. 5) Transformation of orbital parameters to COE.

Machine computation is accomplished serially, in binary, in accordance with an internally stored program on punched paper tape. The memory section consists of magnetostrictive delay lines. Three types are used: eight one-word quick-access lines; eight 20-word data lines, and eight 40-word order lines. Word size is 25 bits.

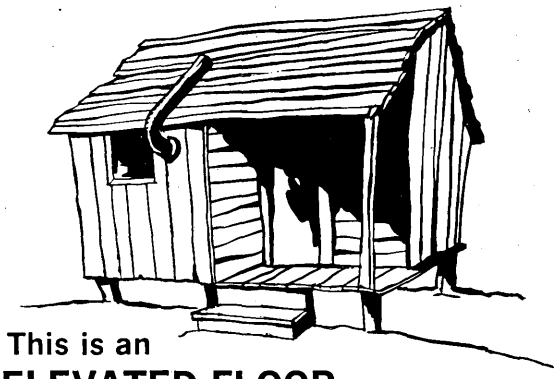
Control unit operations occur serially and synchronously under control of signals from the timing unit. The basic clock is a 1-mc oscillator which is synchronized to the Goldstone 1-mc timing reference signal. Other timing signals for recognition of the beginning words and the start of data in the memory units are provided to the computer.

Tracking data generated for Goldstone by off-site computing facilities (i.e., Goddard Computing Center, etc.) are transmitted in standard 60 wpm teletype code. The teletype data, consisting of hour angle, declination, range, and universal time, are punched on paper tape and fed into the code converter from a tape reader.

The data associated with each time tag are converted from teletype code to binary-coded decimal and stored in registers, and the time tag compared with time generated at Goldstone. When coincidence is obtained between time on the tape and local Goldstone time, the hour angle, declination and range information is converted to serial binary and provided to the computer for processing.

The time-comparison logic circuitry also provides signals to the paper-tape reader to permit bidirectional positioning of the data tape. Manual over-ride and rejection of poor teletype data by visual and/or automatic recognition of illegal characters on the tape is provided.

Digital commands from punched paper tape or the computer can be used to automatically position the antennas. The necessary analog input to the servo drive units of each antenna axis is derived from the following equipment: digital comparitor; digital predictor; search-pattern generator (receiver antenna only); offset generator, and a d-a converter—all a portion of the computer.



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ONCE UPON A TIME

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NEWS BRIEFS

FALL JOINT C.C. ISSUES CALL FOR PAPERS

June 30th has been set as the deadline for papers to be submitted to the Fall Joint Computer Conference, which will be held in Philadelphia, December 4-6, at the Sheraton Hotel.

Along with a complete draft of the paper, authors should send a 35 word abstract and a 500 word summary, to: E. Gary Clark, Chairman, Program Committee, Burroughs Corporation, Research Center, Box 843, Paoli, Pa.

Theme of the conference will be "Computers in the Space Age," and will include such areas as Information Processing in Space Technology; Advanced System Organizations; Hardware/Software Relations; New Applications of Information Processing; Information Processing as a National Resource; Information Communication and Display.

IFIP CONGRESS 65 TO BE HELD IN N.Y.C.

The first International Federation for Information Processing Congress to be held in the United States has been scheduled for New York City in May, 1965. The IFIP Council has accepted the invitation from AFIPS (American Federation of Information Processing Societies) extended by Dr. Willis H. Ware, chairman of the board of governors of AFIPS, to hold the conference in the U.S.

RCA DP ORDERS SHOW FIRST QTR. INCREASE

Domestic orders for RCA data processing systems were said to be twice the number ordered in the same period last year, a stockholder's meeting was told recently. Approximately 280 301's have been sold since its introduction two years ago.

Foreign orders for 110 dp systems will be delivered in 1962 and 1963, with export sales of between $50 million and $100 million expected in the next three years.

Also reported was that the West Palm Beach, Fla., plant, opened eleven months ago, has produced its 100th 301. The 601, RCA's largest system, is scheduled for delivery this fall.

ARTIFICIAL INTELLIGENCE THEME OF AIEE FORUM

Prospective authors have been invited to submit papers on artificial intelligence which will be read at sessions during the 1963 AIEE Winter General Meeting in N.Y.C., January 27-February 1, 1963.

Deadline for a 100-word abstract and 500-word informal summary has been set for July 1st. October 29th is the deadline for full text for publication in "Transaction Papers."

Papers may discuss any aspect of artificial intelligence, but possible specific aspects of interest are: 1. What is "Artificial Intelligence?" (Definitions, state of the art reviews, possible applications.) 2. The role of network models—can Artificial Intelligence be implemented by Neural Nets or Neuron Analogs? 3. The utilization of analytic processes. Can we find the attributes of Artificial Intelligence by developing analytic processes? 4. Trends in the augmentation of Man's Intelligence by Machine—what are the probable trends in future applications?

Correspondence regarding the artificial intelligence sessions should be directed to B. W. Pollard, Papers Chairman, Artificial Intelligence Sessions, Burroughs Corp., 6071 Second Ave., Detroit 32, Mich.

WIZ ALGEBRAIC COMPILER ANNOUNCED FOR GE-225

A new compiler, WIZ, has been announced by General Electric Computer Department, for use with the GE-225. The compiler is designed to translate algebraic expressions into computer language, with little knowledge of computer operation needed by the user.

The four-step compiler is used in this manner: a series of algebraic statements are written in WIZ sentence form; the statements are keypunched, fed into a card-reader which transfers the instructions to the central processor, where the WIZ instructions are translated into machine language. Finally, the results are delivered on punched cards.

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IBJOB SYSTEM SET FOR 7090, 7094 USERS

IBM has announced the IBJOB Processor, a single programming system that permits IBM 7090 and 7094 users to process several source languages as part of a single job. The software, to be available in the fourth quarter of 1962, will incorporate the following:

The Monitor (IBJOB); The Loader (IBLDR); Macro Assembly Program (IBMAP); FORTRAN IV Compiler (IBFTC); COBOL 61 Compiler (IBCBC); The Library (IBLIB).

IBJOB can be stored either on 1301 disk files or 729 mag tape, and will be capable of being handled on Hy-

FIRST COMPUTER PERIQUIP USERS MEETING HELD

Nearly 100 users and prospective users of the S-C 4020 Computer Recorder attended a two-day conference recently at General Dynamics/Electronics, San Diego. The meeting was said to be the first in the computing field to be held by a users' group of peripheral equipment.

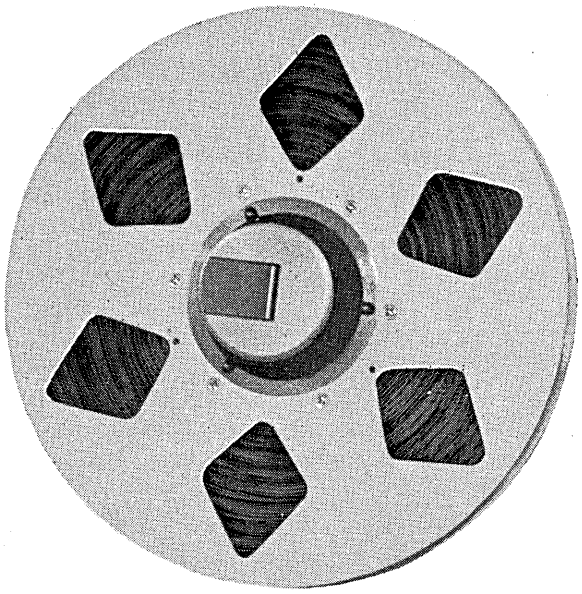
GD's Charles McGehee told the meeting that S-C 4020 performance levels have been running between 85% and 99%, with an average of 95%.

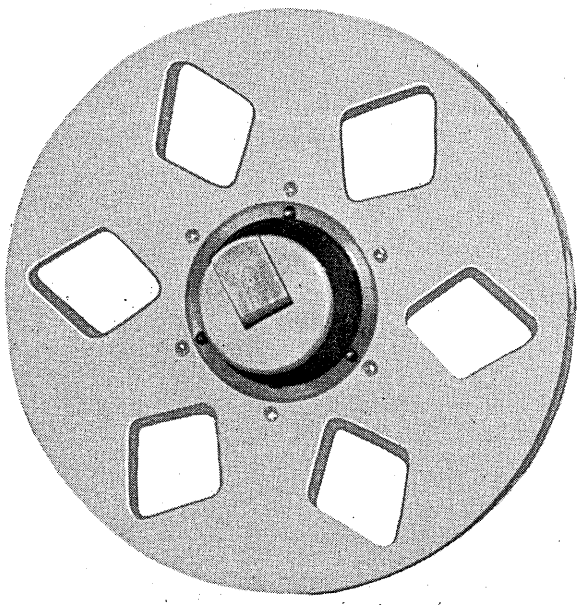
A series of lectures presented by GD/E personnel covered "Automatic Film Processor and Hard Copy Producer;" "Economic Evaluation of the S-C 4020 as a Printer;" "High Density Capability with IBM 7030;" and "Software Library."

During the first day of the conference, users described their respective applications of the 4020. Speakers were Kedar Pyatt and William Lindley, General Atomic; Harold Pietsch, General Dynamics/Astronautics; and Leonard Yarbrough, Space and Information Div. of North American Aviation.

Users making presentations during the second day were Frank Wagner, NAA; Ruck Byrne, Astronautics; George Gianopulos, Jet Propulsion Lab; Edward Voorhees, Los Alamos Scientific Laboratory, and Clement Pease, Bell Telephone Labs.

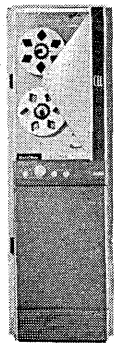
The next users conference will be held in Chicago in September.





Speeds to 150 ips

EVERY SECOND REALLY COUNTS when you employ CEC's unique DR-2700 Vacuum-Buffered Digital Tape Transport—an instrument that has proven its exceptional reliability in shipboard, field-van, and



computer environment applications. And the CEC DR-2700 is functionally designed to perform to its maximum capabilities at temperatures anywhere within 0° to 40°C and 10 to 90% relative humidity.

CEC

Data Recorders Division

CONSOLIDATED ELECTRODYNAMICS

PASADENA, CALIFORNIA • A SUBSIDIARY OF BELL & HOWELL

CIRCLE 26 ON READER CARD

NEWS BRIEFS . . .

pertape units, to include: IOCS)Input/Output Control System); Sort (fixed and variable length version); Utilities; FORTRAN IV Compiler; and COBOL 61 Compiler.

TRW AWARDED $450,000 FOR DAMAGE ASSESSMENT

The Department of Defense has awarded Thompson Ramo Wooldridge, Inc., a $450,000 contract to assist in the design of an advanced computer-supported damage assessment center. To be known as the Department of Defense Damage Assessment Center (DODDAC), the system will, in peacetime, analyze hazards and vulnerabilities of worldwide military forces and economic resources. Under wartime conditions, the system will assess and report the damage to these forces.

The design effort will include requirements, specifications and procedures for data processing, data display and data communication subsystems as necessary to refine DODDAC operations at several installations.

CLINICAL DECISION MAKING STUDY GRANT TO CARNEGIE

A grant of $18,000 has been awarded to Dr. B. Kleinmuntz, assistant professor of psychology at Carnegie Tech, from the National Institute of Mental Health, for research on "Computer Simulation of Clinical Decision Making."

One of the aims of the research project is to explore how some interpreters of objective personality tests think during the process of clinical decision making. Dr. Kleinmuntz hopes to tape-record their decisions and then program Carnegie's G-20 so that it reacts as well as some of the experts.

The ultimate goal of the study is to instruct the computer to become a more accurate decision maker than the experts who were originally programmed. Once the computer is properly programmed, Dr. Kleinmuntz believes that it will not make the types of careless mistakes to which humans are frequently prone. It is also expected that the computer can be used as a tool for high-speed mass processing of thousands of personality tests.

FIRST COMPUTER FOR INDIA TO BE BUILT BY EAI

Electronic Associates, Inc., Long Branch, N.J., will furnish a PACE 231R general purpose analog system

to the Indian Ministry of Defense in New Delhi, it was reported recently.

The computer, believed to be the first to be installed in India, will be used by companies and organizations engaged in scientific research projects for the government. Contract for the $58K unit was awarded by the India Supply Mission.

FALLOUT PREDICTOR DEVELOPED BY NBS

The National Bureau of Standards, Washington, has announced development of an improved analog fallout predictor, which computes the expected total radioactivity of fallout at points and times selected by the operator.

Input data are set into the predictor directly on panel dials. The point for which fallout is predicted is identified by a spot of light projected through the glass of a map table. The operator selects the point by placing an appropriate map on the glass top with the burst point at the table's center and operates the map table handwheels to move the light spot to the map point desired.

Computations are made by integrating the fallout, at each point selected, of radioactive particles of various sizes which originate at various parts of the cloud produced at the burst.

SBC'S 7090 TO EASE TRADEMARK SEARCHING

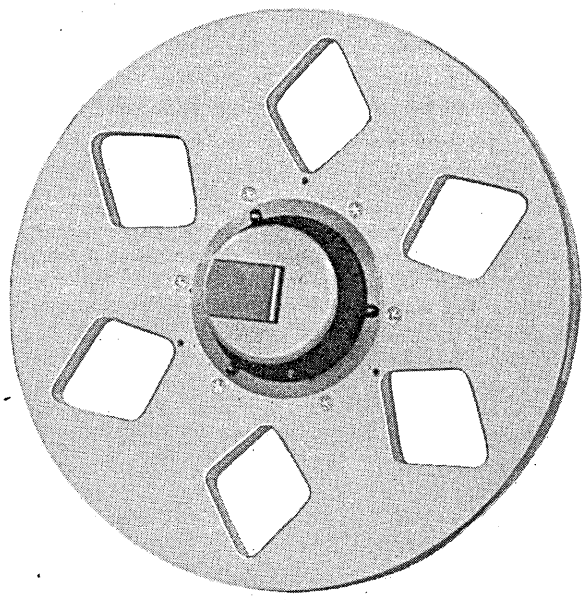
The Service Bureau Corp. will record on mag tape more than one million different trademarks in 22 countries, including the United States, to aid companies in searching trademarks. The service, to be offered in September by Trade Mark International, Detroit, will utilize SBC's IBM 7090/1401 equipment in New York and Detroit.

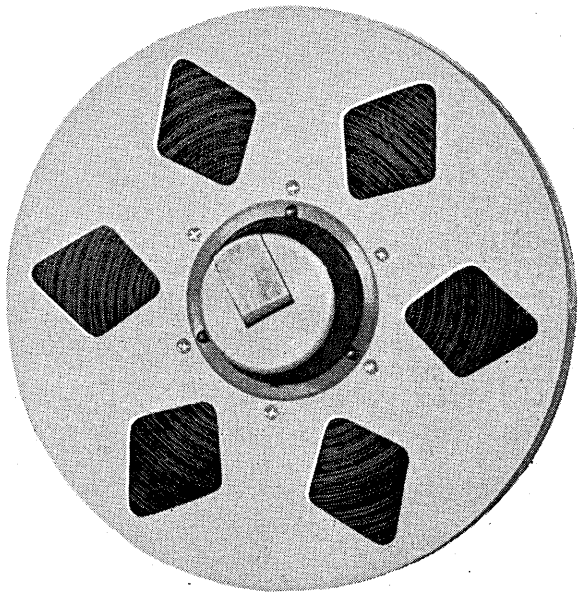
In operation, a proposed trademark will be compared to a master file to find words that are spelled the same, sound the same, or are closely related. Also to be compared will be foreign equivalents and coined words.

When the comparison is complete, a print out will report on the marks found in these categories showing the country or countries in which it is registered, the expiration or reference dates, the owner or mark number, and the classification.

CIRCLE 101 ON READER CARD

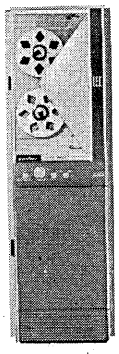
● A conference to deal with engineering aspects of spaceborne computers and dp systems for missiles and spacecraft will be held at the Disneyland Hotel, Anaheim, Calif., Oct. 30-31. Sponsored by the Professional Group on Electronic Com-





Densities to 555.5 bpi

EVERY SQUARE INCH REALLY ADDS UP when you employ CEC's DR-2700 Tape Transport. Start and stop distances are predictable and repeatable within ±.03 inch. Furthermore, it's *fully transistorized,* has all-metal heads, is IBM-compatible and exhibits no programming restrictions up to 200 commands per second. Want complete data? Call your nearest CEC office or write for Bulletin CEC 2700-X1.



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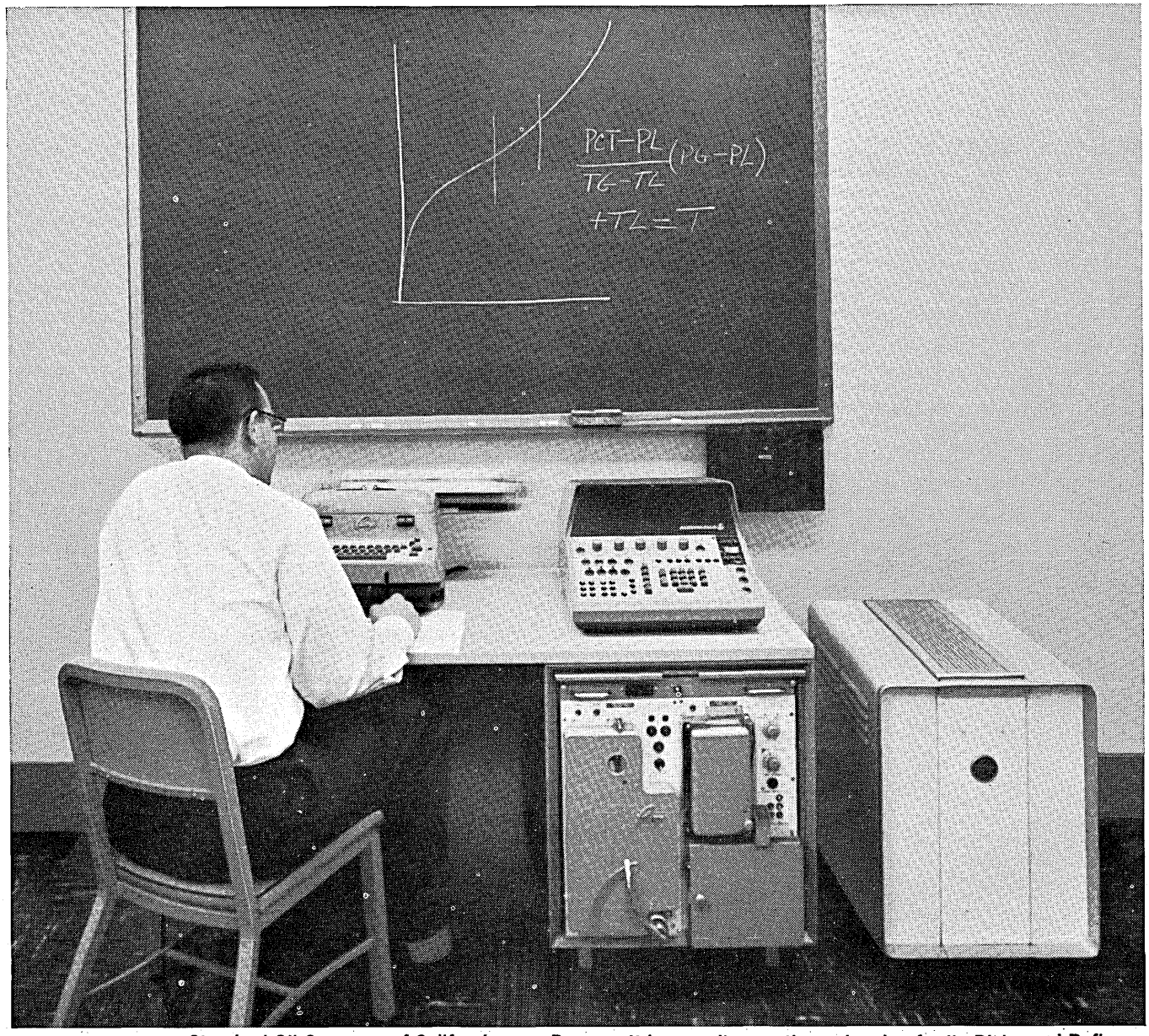


Standard Oil Company of California uses Recomp II in overall operations planning for its Richmond Refinery.

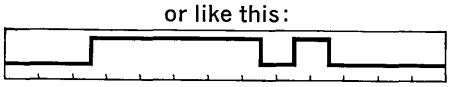
This computer speaks English.

Some computers act as though they're trying to hide the facts. Not Recomp.®

Recomp II has a built-in direct numerical display of any memory word. When it wants to show you a number like 1000., it shows just that: 1000. And it can carry it out to 12 digits. To show you 1000., other computers may display something like this:

●●○○○○○○●○●●●

or like this:



Recomp II automatically checks every program, bit by bit, against the original tape. And built-in echo checking of typewriter or punch output assures accuracy.

Recomp II abounds in other built-ins (floating-point, square root command, and conversion from decimal to binary, to name a few). It has two high speed memory loops (each containing 16 instructions). It has a large word length (40 bits). And a large memory (8160 instructions).

Recomp II is ideal for medium-scale needs; Recomp III is perfect for small-scale needs. You can lease a Recomp III for $1,495 (complete with no accessories required), or a Recomp II (with a complete line of peripheral equipment) for up to $4,500 a month.

There are many small and medium scale computers on the market today. Only a few are really outstanding. Recomp is one of them.* For the full Recomp story, write:

AUTONETICS Industrial Products
Department 66, 3400 E. 70th Street, Long Beach, California.
Autonetics is a Division of North American Aviation.

Recomp

*No computer feasibility study is complete without Recomp.

CIRCLE 28 ON READER CARD

puters of the IRE, papers on existing equipment and on new techniques and future trends will be presented.

Engineers interested in presenting papers should submit 1000 word summaries, by June 15, to Dr. R. A. Kudlich, AC Spark Plug Div., General Motors Corp., 950 Sepulveda Blvd., El Segundo, Calif.

● A GE 312 process computer system will be used by Union Electric Co., St. Louis, to check the performance of boiler-turbine units. Known as GARDE, the system utilizes sensitive sensing devices installed on equipment throughout the plant, and will transmit to the computer temperatures, pressures, electrical loads, etc.

● A CDC 160-1604 system will be installed at the University of Minnesota early this summer, it was announced recently. The system will be operated in the numerical analysis center of the university's Institute of Technology, and will be available for use in research and training programs by all university departments.

● The GE Information Processing Center in Chicago will use a GE-225 for demand-deposit accounting and payroll processing for the Cosmopolitan National Bank, Chicago. The system will enable "One Check Payroll" services to be available, which allows a firm to write one check to the bank to cover its total payroll for the current pay period. The computer then processes all employee data and credits wages directly to the respective employee-selected savings, checking, or other accounts in the bank.

CIRCLE 102 ON READER CARD

NEWS BRIEFS . . .

● Day-by-day standings of over 11,000 bowlers at the Woman's International Bowling Congress being held in Phoenix are being prepared by the Phoenix office of The Service Bureau Corp. Leader listings of the top 50 to 100 entrants during the six-week tournament are prepared daily and weekly by SBC. At the end of the tournament SBC will prepare the prize checks, totaling $143,000.

● The Pacific Coast Stock Exchange will soon convert its San Francisco clearing house functions to an RCA 301, which will enable the Exchange to complete necessary reports within 1½ hours after the market closes each day.

● Cornell University, Ithaca, N.Y., has ordered a 1604/160A system from Control Data. Delivery is scheduled for late summer 1962. The system will be used mainly as a research and graduate academic tool for all departments of the university.

● The world's first cement plant designed and built around a computer control system has been announced by Thompson Ramo Wooldridge. An RW-300 will be the heart of a closed-loop system for integrated control of wet blending and clinker burning operations in the Chichibu Cement Co.'s new plant near Tokyo.

● The General Atomic Division of General Dynamics Corp., San Diego, is operating an IBM 7090 and 1401 in its new computing facility at John Jay Hopkins Laboratory. A second 1401 is scheduled to be installed by June.

● Among the courses being offered at the Engineering Summer Conference, to be held at the University of Michigan, are: Introduction to Digital Computer Engineering; Theory of Codes; Parallel Computers, Automata and Adaptive Systems; Foundations and Tools for Operations Research

COMPUTER ENGINEERS
LOGIC DESIGNERS
CORE MEMORY SPECIALISTS

Collins Radio Company has immediate openings for experienced digital computer design engineers at its plant in Cedar Rapids, Iowa. New programs in digital data systems offer outstanding opportunities for growth and development with a leader in the electronics field.

Recently announced development plans call for graduate engineers experienced in

Computer Systems — Memory Systems
Logic Design — Magnetic Tape Handlers

Qualified applicants interested in a career with a future, send your resume to:

L. R. Nuss, Manager
Professional Employment

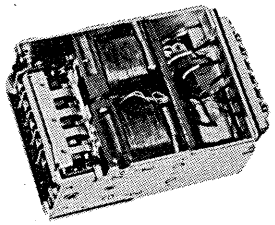
COLLINS RADIO COMPANY
Cedar Rapids, Iowa

COLLINS

An equal opportunity employer

CIRCLE 76 ON READER CARD

RELIABLE
High-speed Electromechanical *Neuron*® COUNTER



Lasts 300 Million cps
Lubricated for Life
Rated for Continuous Duty
No Half-count Ambiguity

Neuron bi-directional counter, highly reliable electromechanical digital indicator, provides outstanding performance in a variety of counting functions—mass production, shaft-position increments, bi-directional flow, liquid quantity, batch tabulation, time intervals, drive line printers, tool sequence, parking lots, etc. With minor changes, it adapts readily to many other applications. Options include: mechanical or electrical reset; visual and/or switch readout; 12, 24, 48 or 90 vdc, and 110 vac; and, hermetically sealed models.

Priced from $135 — Literature Available

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DATA INSTRUMENTS DIVISION
TELECOMPUTING CORPORATION
12838 Saticoy Street • North Hollywood, Calif.

CIRCLE 29 ON READER CARD

Programmers

What do you know about the H1800?

If your answer is "Nothing", you're probably wrong. This newest member of Honeywell's growing line of digital computer systems will seem quite familiar to many business and scientific programmers.

The H1800 is a powerful extension of Honeywell's other computer systems, the H800, and its medium-scale counterpart, the H400.

All three systems utilize the unique and proven software packages that have made Honeywell's EDP systems one of the most competent and versatile in the industry. The H1800 now makes them one of the most powerful.

Honeywell's growing line of automatic programming aids, including FACT, EASY, COBOL, ARGUS, ALGOL-type Compilers, etc., can handle a broad variety of computer applications. The addition of the new H1800, with its great central processor and magnetic tape speeds, now permits Honeywell programmers to engage in larger business data processing jobs, more complex scientific computations and real-time applications. These broadening horizons of work at Honeywell have created unique opportunities for professional growth and personal advancement to those Programmers who join us now. Immediate opportunities exist in the following areas:

Automatic Programming

Compiler Development

Systems Analysis

In addition to the usual professional employee benefits, Honeywell offers a unique educational-support program:

Address your resume to:
Mr. John L. Ritchie
Personnel Manager
Programming Systems Division
60 Walnut Street
Dept. 616,
Wellesley Hills, Mass.

Honeywell

H Electronic Data Processing

Opportunities also exist in other Honeywell divisions coast to coast. Send resume to H. E. Eckstrom, Minneapolis-Honeywell, Minneapolis 8, Minnesota

"An equal opportunity employer"

CIRCLE 77 ON READER CARD

NCR

ADVANCED PROGRAMMING RESEARCH

The expanding utilization of NCR's computer systems has created new opportunities for experienced programmers familiar with automatic programming techniques. College education, plus 2-5 years experience with large scale magnetic tape systems can qualify you for a rewarding career with NCR, one of the world's leading business machine manufacturers. Recognized and respected wherever men trade, NCR stands alone for its creative and flexible approach to business system development.

Aside from the opportunities present in Programming Research, other openings in our expanding operation include:

- Installation Representative: experience required, covers magnetic tape system programming, knowledge of complete business systems, and ability to work effectively as a representative of NCR.
- Programmer: for small systems work which requires good background in data processing as related to normal business functions and some knowledge of programming of magnetic tape systems. Intermittent customer contact.
- Instructor: experience and education should be such that the person employed can effectively train program personnel. Familiarity with math and business systems is desirable. Programming of magnetic tape systems necessary.

Other opportunities may more nearly meet your particular experience and aspirations. To investigate, you need only write, sending complete resume to:

T. F. Wade, Technical Placement
The National Cash Register Company, Main & K Streets, Dayton 9, Ohio

An Equal Opportunity Employer

CIRCLE 78 ON READER CARD

and the Management Sciences; Recent Mathematical Advances in Operations Research; Systems Engineering; and Data Processing in Sensor Systems. For detailed information, write to the office of the Engineering Summer Conferences, Univ. of Michigan, Ann Arbor.

● McDonnell & Co., Inc., N.Y.C. stock brokerage firm, will install an NCR 315 to confirm transactions, record the number of shares bought or sold, compute the dollar value, and handle all internal record-keeping. Other tasks which are planned include figuring taxes and commissions and preparing monthly customer statements.

● A computer technique to predict family income from life insurance and other assets has been introduced by a Chicago life insurance agency. Called "Tron-A-Cast," the system uses information, furnished by the client, which is processed by an IBM 1401. The technique was designed by the Service Bureau Corp.

● The Houston branch of C-E-I-R, Inc., will provide computer and programming services to NASA's Manned Spacecraft Center until the latter's relocation to Houston from Langley

NEWS BRIEFS . . .

AFB, Va., is completed. Both utilize an IBM 7090 and 1401.

● Weather bureau meteorologists at the National Hurricane Research Project, Miami, Fla., are using a GE 225 to analyze storm data collected by reconnaissance aircraft, which fly through live hurricanes and record the data on mag tape. Goal of the project is to build a mathematical model of a hurricane to permit more rapid forecasting.

● The Armour Research Foundation of Illinois Institute of Technology will add an IBM 7090 and 1401 which will also be used by the Service Bureau Corporation. Under an agreement with the Foundation, SBC will purchase time on the 7090. Installation is expected in October. In the spring of 1963, the 7090 will be converted to an IBM 7094.

● The Los Angeles sections of the American Institute of Electrical Engineers and the Institute of Radio Engineers are sponsoring a Workshop on Ultra-high Speed Digital Comsize problems currently faced in the puters in Los Angeles, to be held in August. The workshop will emphadevelopment of digital systems operating in the kilomegacycle range. Persons wishing to participate in the workshop are invited to send summaries of their contribution to Dr. E. J. Schubert, Beckman System Div., 2400 Harbor Blvd., Fullerton, Calif.

● System Training Centers of Operations Research Inc. will offer 37 management seminars and training courses to representatives of government and industry during 1962. Among the subjects to be taught are: basic PERT system; advanced PERT systems; PERT analyst's course; PERT for military personnel; management games design. Training centers are located in Santa Monica, Calif., and Silver Springs, Md. Some courses will also be presented in Los Angeles, New York City, San Francisco, Miami, and Boston.

● Three major programming packages for the Bendix G-20 has been distributed to users during the past month, bringing major systems for the machine to a total of nine. The most recent trio include ALCOM, EXECUTIVE, and PERT. Work is proceeding for an additional 25 programs to be released within the next three months, according to O. Paul Staderman, director of marketing for Bendix Computer.

MANAGER OF MARKETING
for
INTERNATIONAL DIVISION
COMPUTER PRODUCTS

To organize and supervise all marketing activities of a new international division of leading computer manufacturer. Position requires extensive knowledge of computers or related fields. Applicants must have extensive line management experience in all phases of marketing activities. Temporary residence abroad for 1-2 years will be required. Our company employees know of this ad.

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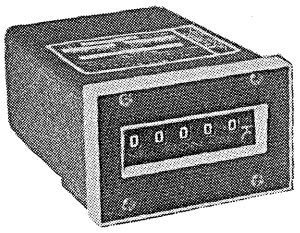
ELECTRICAL READOUT

High-speed Electromechanical *Neuron*® COUNTER



Positive Switch-closure Action
Individual Decimal Readout
Visual Readout
Bi-directional
100-ma Resistive Switching

Neuron bi-directional counter, highly reliable electromechanical digital indicator, provides outstanding performance in a variety of counting functions—mass production, shaft-position increments, bi-directional flow, liquid quantity, batch tabulation, time intervals, drive line printers, tool sequence, parking lots, etc. With minor changes, it adapts readily to many other applications. Options include: mechanical or electrical reset; visual and/or switch readout; 12, 24, 48 or 90 vdc, and 110 vac; and, hermetically sealed models.

Priced from $135 Literature Available

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CIRCLE 30 ON READER CARD

If you do care about money— the RPC-4000 beats all other computers in its class

$

If you don't care about money— the RPC-4000 beats all other computers in its class

"THE COLD COMPETITIVE FACTS ARE EMBARRASSING— TO THE COMPETITION."

8008 word memory—over 4000 more than any other computer in its class. Computing speeds of up to 230,000 operations per minute. Desk-size, and completely transistorized. 30,000 characters per minute input—18,000 characters per minute output. □ Easiest operation and programming. Its automatic routines let you learn to program the RPC-4000 in hours instead of days. (More than 3000 students were taught programming in less than one day with PINT, an interpretive routine developed especially for the RPC-4000 by Purdue University. A film of this training will be shown on request). You'll never have to be dependent upon programming specialists. Even non-technical personnel can master it. □ All of this adds up to the largest memory, greatest problem solving capacity and flexibility in the low- or medium-priced field. A desk-size computer—but with room-size computer capacity. □ Cost? The RPC-4000 talks the way money does. The least expensive computer with equal capacity costs twice as much. Then there's the chunk of cash you may save on programming—thanks to the RPC-4000 ready-prepared Program Library—the most extensive in its class.

Where can you get comparable computer value per dollar? Only one place—General Precision. The LGP-30—little brother (or sister) to the RPC-4000 is the most powerful and has the biggest memory of any complete computer system in its class. And it rents at the astonishing low cost of $1100 per month. For more information about rental or purchase, write Commercial Computer Division.

GENERAL PRECISION

COMMERCIAL COMPUTER DIVISION / GENERAL PRECISION, INC. / BURBANK, CALIFORNIA

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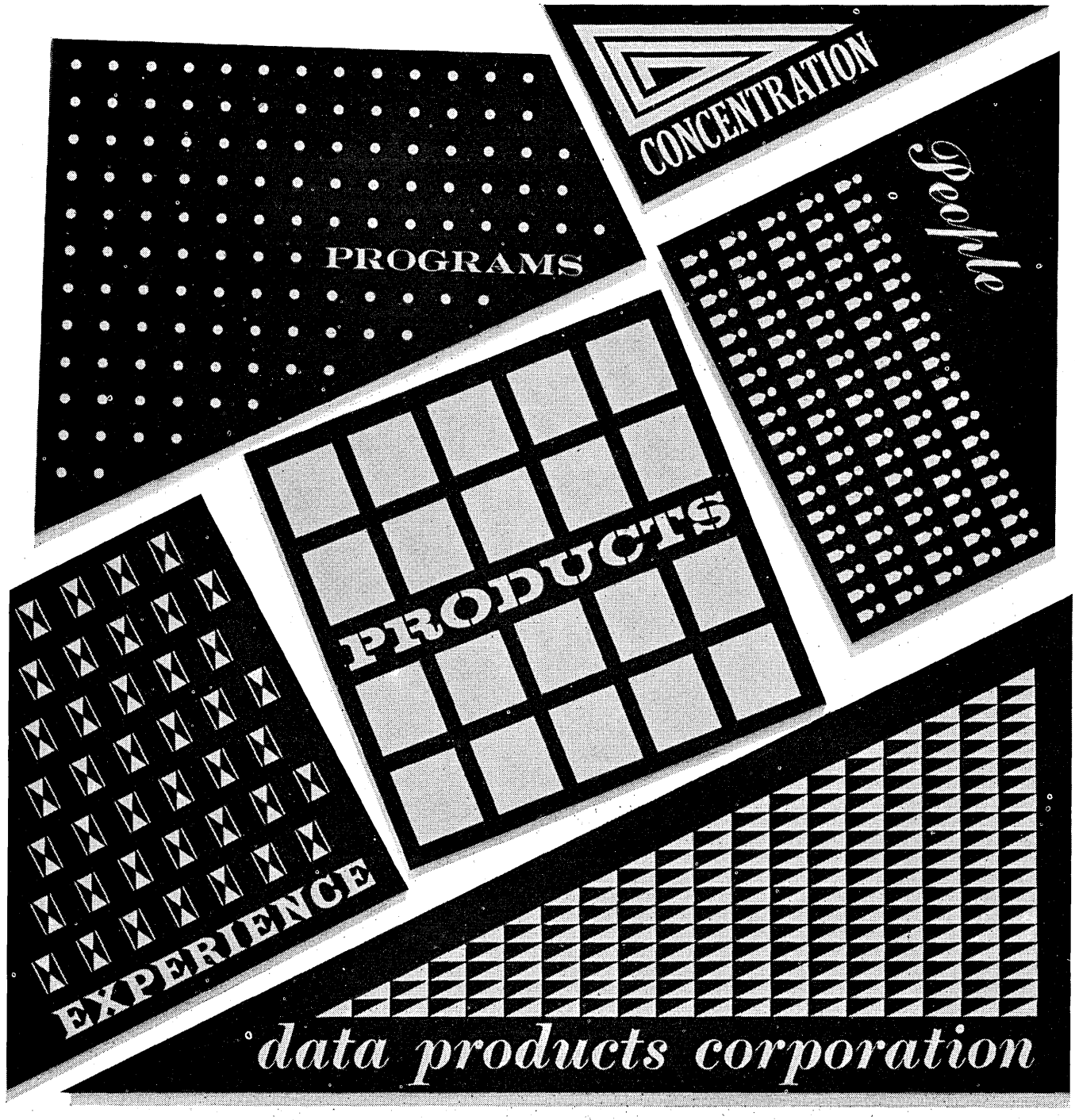

Puzzling over data input data output data storage?

Puzzle no more.

data products corporation is a new company . . . a carefully constructed composite of: PEOPLE — a long-together, smooth-functioning team of data systems specialists; EXPERIENCE — totalling 289 years in a 23-man management/technical/marketing staff specializing within a field only 10 years old; CONCENTRATION — exclusive on equipment and services for the data industries; PRODUCTS — a unified line of technologically advanced equipments in the fields of data storage, data input and data output; PROGRAMS — customer oriented design, development, manufacture and marketing directed toward timely and economic solutions to data industry problems. This is: *data products corporation*/8535 Warner Drive/Culver City/California/Phones: 837-4491 and 870-2161.

A puzzle for you. The one above. Using its six elements, you can make five other shapes. Or, can you? Write for one and see. On your letterhead, please, to Room 611.

There's something magnetic about you, Computape.

My special oxide coating, Penelope. It's revolutionary. Specially designed for high density, high resolution data recording. Helps me guarantee *556 or* 800 bits per inch with no dropouts for severest computer applications.

P. S. Computape doesn't really talk, of course. But in a computer, Computape *reliability* will deliver its own message. New COMPUTAPE, the premium quality computer and instrumentation tape, is the product of the only company devoted exclusively to the manufacture of quality tapes for data processing and instrumentation. *Investigate new Computape today. Better still, immediately.*

COMPUTRON INC.
122 Calvary Street, Waltham, Massachusetts

CIRCLE 33 ON READER CARD

NEW PRODUCTS

high speed printer
Model LP-1200 is able to print up to 1200 lines per minute with numeric copy and 1000 lines per minute with alphanumeric copy. The LP-1200 provides 64 characters as standard and a maximum of 160 columns and can be operated either on-line or off-line. POTTER INSTRUMENT CO., Sunnyside Blvd., Plainview, N.Y. For information:
CIRCLE 200 ON READER CARD

perforated tape reader
Designed for slower speed digital instrumentation, the Model 2500, photoelectric tape reader is priced at $745. The device, uni-directional and utilizing silicon photo-diodes, features single speed units at 100 to 300 cps, and asynchronous stepping at speeds to 60 cps. DIGITRONICS CORP., Albertson, N.Y. For information:
CIRCLE 201 ON READER CARD

high speed plotter
Model 565 digital incremental plotter is capable of plotting output in 1/100 inch increments at 300 steps per second. The 565 operates on-line with most medium-scale digital computers, and off-line with large-scale digital computers. The plotter is priced at $4,550. CALIFORNIA COMPUTER PRODUCTS, INC., 8714 E. Cleta St., Downey, Calif. For information:
CIRCLE 202 ON READER CARD

relay buffer unit
This buffer unit, interposed between a computer, tape reader or other serial output device and a summary card punch, is able to provide serial to parallel conversion, temporary storage, and high current output circuits. The unit can be randomly accessed on input and on specific orders can be arranged to release in predetermined sections or blocks. NORTH ELECTRIC CO., 533 S. Market St., Galion, Ohio. For information:
CIRCLE 203 ON READER CARD

computer simulator
The Minivac 6010 is a miniature device able to simulate programs and circuits of advanced dp equipment. The device is said to be able to perform arithmetical tasks and also demonstrates how a large computer performs logical operations. The unit is powered by a self-contained 12 volt DC power supply. Price is $155. CENTRAL SCIENTIFIC CO., 1700 W. Irving Park Rd., Chicago 13, Ill. For information:
CIRCLE 204 ON READER CARD

punched tape reader
The single-line TP-523 has been designed for applications where economy and a slower speed are required and reads standard one inch 8-level tape. The price of this reader is $395.00. ELECTRONIC ENGINEERING CO. OF CALIF., 1601 E. Chestnut Ave., Santa Ana, Calif. For information:
CIRCLE 205 ON READER CARD

buffer storage unit
The R/SA-VB-INT is available in two series, 100 and 300, each of which has models with storage capacities of 256, 512, 1024, 2048 and 4096 characters of up to 40 bits per character. The buffer features six operating modes, random interlacing of addressing methods and operating modes and a built-in test program. DI/AN CONTROLS, INC., 944 Dorchester Ave., Boston 25, Mass. For information:
CIRCLE 206 ON READER CARD

nor-nand circuit
This universal circuit contains four inputs and four outputs and has been designed specifically for digital circuitry applications. The unit can operate with pulse widths of one microsecond, with a maximum full load delay of 0.1 microsecond. INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa. For information:
CIRCLE 207 ON READER CARD

versalogic
These two megacycle digital modules have a propogation time through one flip flop and two gate amplifiers of 0.25 usec or less under maximum logic and stray capacitive load. Versalogic sys-

MARKETING REPRESENTATIVE

OPPORTUNITY—Join a young, aggressive management team building a technical service organization—now 120 strong—in the Information Technology Field:

- Integrated Electronic Systems Engineering • Programmed Teaching
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RESPONSIBILITIES—Initiate, plan, develop and execute aggressive and imaginative marketing and sales program. Develop marketing opportunities and sales promotions for company services, software products and new fields of endeavor.

REQUIREMENTS—BS degree with 7 years' experience in selling to industry, 3 in the field of computer technology. Prefer experience with consulting firm as principal in management services group, and experience in selling technical services or complex electronics systems.

PLUS FACTORS—A liberal and long-range all-inclusive-benefit program including profit sharing.

For interview consideration send complete resume to:
Isaac L. Auerbach
President
1634 Arch St., Philadelphia 3, Pa.

AUERBACH corporation

A Total Capability In INFORMATION SCIENCES & TECHNOLOGY
An Equal Opportunity Employer

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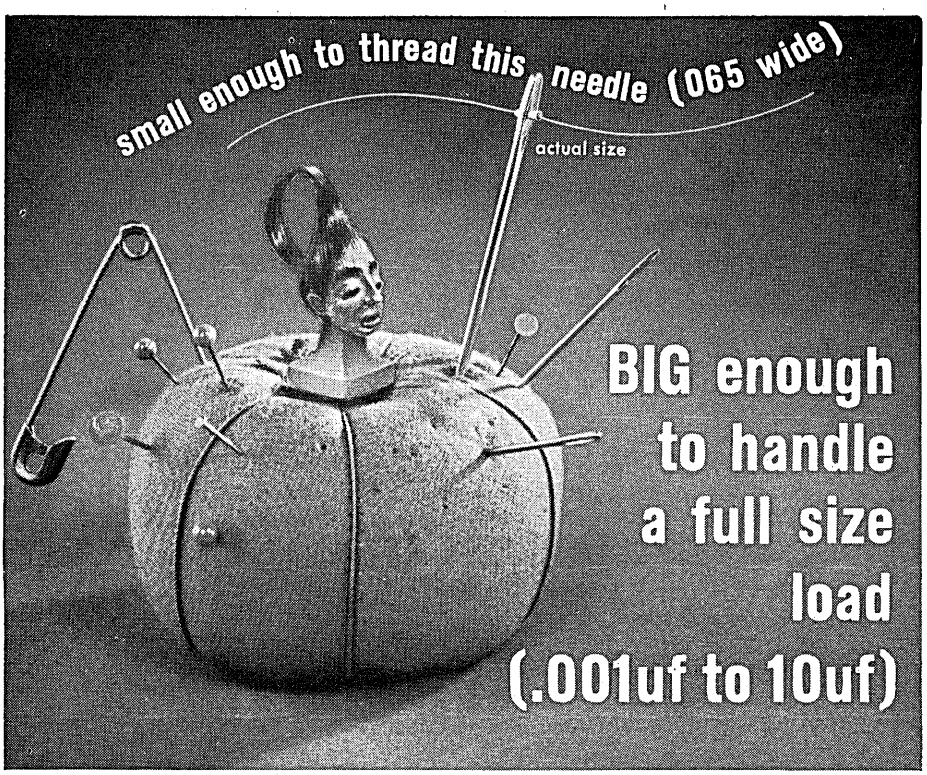
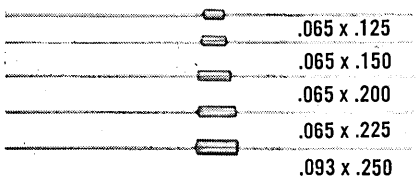
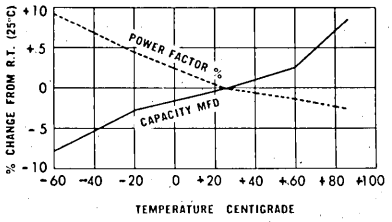


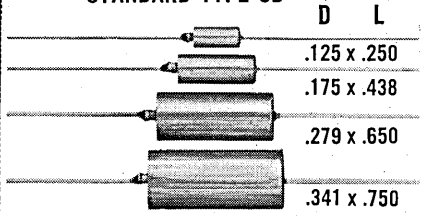
NEW MICRO MINIATURE TYPE MM — SIZE D L



TYPICAL CHARACTERISTIC CURVES



STANDARD TYPE SD — SIZE D L



CAPACITY .0047uf TO 330uf

VOLTAGE 1 VDC TO 50 VDC

TEMPERATURE −80°C TO +125°C

Burnell introduces its new GLP micro-miniature solid tantalum capacitor line

SPECIFICATIONS

- TEMPERATURE RANGE . . . −55°C to 85°C. (125°C with derating)
- TOLERANCE . . . −20% +50%. (closer tolerance available on special request)
- VOLTAGE CHARACTERISTICS . . . D.C. voltage ratings from 1VDC to 30VDC. Maximum operating voltage at any temperature range of −55°C to +85°C.

LIFE TEST . . . Capable of withstanding a 1000 hour life test at maximum temperature with rated voltage applied.

Burnell & Company, through its new capacitor division **GLP ELECTRONICS**, has added a new micro-microminiature dimension to the solid tantalum capacitor field, by designing and building the broadest miniaturized line of capacitors, measuring only .0650D x .125 Lg. Also available is GLP's standard line of aluminum and tantalum capacitors, as shown here, in polar and non-polar types with weldable leads . . . Non-Standards, to your specs . . . available on request.

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CIRCLE 34 ON READER CARD

NEW PRODUCTS . . .

tems have simple basic logic rules and a minimum of package types. DECISIONAL CONTROL ASSOC., INC., 644 Terminal Way, Costa Mesa, Calif. For information:

CIRCLE 208 ON READER CARD

milliwatt modules

Series 60 low-power, miniaturized, encapsulated digital modules are designed for operation at frequencies up to two megacycles. The average circuit dissipation is 25 milliwatts. COMPUTER CONTROL CO., INC., 983 Concord St., Framingham, Mass. For information:

CIRCLE 209 ON READER CARD

low-cost digital clock

The Model 1200 solid-state digital clock is designed for laboratory and systems applications, and is priced at $1500. Time information is presented on a front-panel, in-line, 6-digit projection display. A maximum of 23 hours 59 minutes 59 seconds is displayed in the standard version. WYLE LABORATORIES, El Segundo, Calif. For information:

CIRCLE 210 ON READER CARD

analog computer

The TDA-2 analog computer has been designed for the solution of complex two-dimensional flow problems and has an accuracy of within 1%. Applications include temperature distribution, stress analysis, fluid flow, heat transfer and electrical or magnetic flow. CARLSON COMPUTER CO., Poway, Calif. For information:

CIRCLE 211 ON READER CARD

transistor heat dissipator

Greater surface area and position of the angled fan segments of the new Fan-Top TXBF-032-025B increases transistor switching speed and beta, induces turbulence and increases convection efficiency in forced air. INTERNATIONAL ELECTRONIC RESEARCH CORP., 135 W. Magnolia Boulevard, Burbank, Calif. For information:

CIRCLE 212 ON READER CARD

photogrammetric readout

Model 3900 scaler is an automatic readout device for photogrammetric work which can be adapted to stereoplotting equipment in producing cross-sectional survey data from dp systems. The scaler is priced at $5,900. AUTOTROL, 1359 Harlan St., Denver, Colo. For information:

CIRCLE 213 ON READER CARD

delay line

A new standard 1000-ohm delay line features modular construction which allows 24-hour delivery on an "off the shelf" basis. Each module of the

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RELIABILITY
ACCURACY

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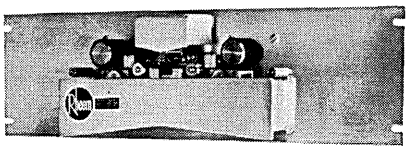


Economically Priced

HIGH SPEED Photocell READER

500-1000 Characters/Second!

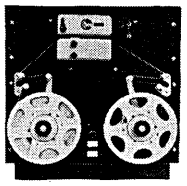
Latest addition to our line...new 2-speed Model RR-1000 Reader handles 500-1000 characters per second...unidirectional and bi-directional...transistorized ...rugged construction...desk or rack mounts...for 5-, 7-, 8-channel punched tapes. Supplements standard Rheem Readers Models RR-20, RR-100, and RR-300 handling 20, 100, or 300 lines per second. Error rates less than 1 in 10^8 characters.

Priced at approximately 50% the usual price of such equipment!

NEW!!!

Tape SPOOLERS

For use with all Reader Models. For 5-, 7-, 8-channel tape. Bi-directional with high speed forward and rewind.



New Spooler with Standard Reader

Write for full information TODAY!

Rheem electronics

Designers and Builders of Complete Numerical Positioning Control Systems

A Division of Rheem Manufacturing Company

5200 West 104th Street, Los Angeles 45, California, SPring 6-1800

CIRCLE 35 ON READER CARD

NEW PRODUCTS . . .

"Wee Line" component is an encapsulated LC circuit which provides specific delay increments. NYTRONICS, INC., 550 Springfield Ave., Berkeley Heights, N. J. For information:

CIRCLE 214 ON READER CARD

storage register

Read and write gating are included in the model 234 ten line input decimal storage register. The 234 is to be used with electronic counters in applications that require a buffer storage to readout while the counter system is operating without interruption during the readout period. ADVANCED RESEARCH ASSOC., INC., 4130 Howard Avenue, Kensington, Md. For information:

CIRCLE 215 ON READER CARD

i/o equipment

A new high speed x-y plotter and paper tape reader have been developed for use with the SPEC computer. The plotter is a two-axis recorder which enables output of any two integrators to be plotted one against the other. The paper tape input reads up to 60 characters per second using any standard perforated tape. COMPUTER CONTROL CO., 2251 Barry Ave., Los Angeles 64, California. For information:

CIRCLE 216 ON READER CARD

isodrive core memory

Development of a compact, welded module, miniaturized, and extremely flexible coincident current memory system called the Isodrive Memory, Model SE1440Z1 was announced at EJCC.

Primarily designed for airborne applications in satellites or missile systems, the Isodrive Memory can also be used in small mobile military ground systems. It has a capacity of 1440 bits, and can be used as a standard memory, buffer unit or shift register. As a buffer, the unit provides a 100 KC reading or writing rate. As a standard memory a 50 KC rate is obtainable. Measuring only 2″ x 3″ x 5″ (30 cu. in.), the Model SE1440Z1 is built around an "Isodrive" core array which has an operating temperature range of −55° C to +100° C. The unit requires only 300 mw at 1 KC bit range. Standby power of only 2 to 3 mw is required. ELECTRONIC MEMORIES, 9430 Bellanca Ave., L.A. 45, California. For information:

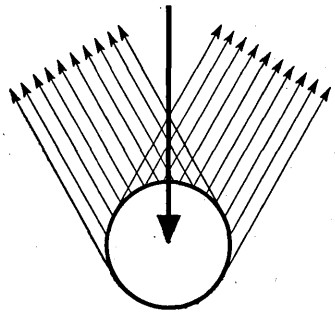
CIRCLE 217 ON READER CARD

medium power driver

The MPD-541 is a medium power driver module for use in digital systems, and consists of four independent medium power transistor dc amplifier

INFORMATION RETRIEVAL
APPLIED TO

INTELLIGENCE DATA PROCESSING SYSTEMS



REQUIRING

DATA SYSTEM ANALYSTS
SENIOR
COMPUTER PROGRAMMERS

MITRE's expanding role in systems engineering for the Air Force Electronic Systems Division has led to an increased effort in the design and development of intelligence data processing systems. There are new opportunities for creative work in automatic indexing and retrieval, systems analysis and synthesis.

MITRE is engaged in the analysis of intelligence operations at several Air Force Commands. Command requirements for accurate and timely intelligence support is leading to the use of automatic data processing systems. MITRE is assisting the Air Force in determining the extent and means of applying automatic data processing to the intelligence problems. This work is supported by experimental activities at our Bedford operation in pleasant suburban Boston. Positions are also available in Colorado Springs, Colo., Omaha, Neb., and Washington, D. C.

Write in confidence to Vice President — Technical Operations, The MITRE Corporation, P. O. Box 208, Dept.MF9, Bedford, Mass.

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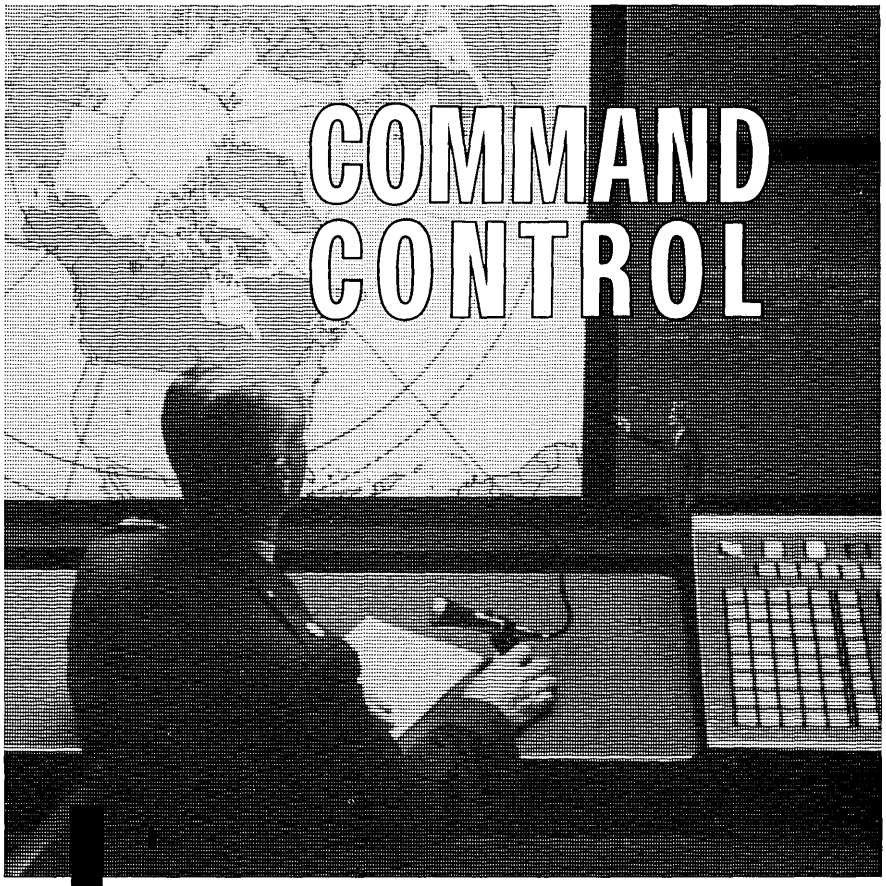
CIRCLE 81 ON READER CARD



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We are active today in: digital communications, data display, satellite control, oceanic systems, military command/control systems, ballistic missile command/control systems, computer programming, artificial intelligence, commercial data processing and human factors engineering.

We offer positions in these areas:

INFORMATION SYSTEMS ENGINEERS — For design of command/control and advanced communication systems. Experience in traffic, antenna and propagation theory, and mathematics as applied to communications and space technology.

OPERATIONS ANALYSTS — To establish systems requirements in satellite control, air traffic control, ASW and command/control. Also, assignments in man/machine communications and information retrieval.

AEROSPACE ENGINEERS — For integration of digital command/control systems with complex weapons systems.

DIGITAL SYSTEMS ENGINEERS — Engineers with management ability to direct sub-systems engineering effort on a global command/control system. Experience is desired in message traffic control, data processing systems, data display and multi-sequencing techniques.

COMPUTER PROGRAMMERS — For real time programming analysis and development. To develop compilers, problem-oriented computer language and advanced programming systems.

For consideration, write to Manager, Professional Staffing, Dept. DA, enclosing resume.

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CIRCLE 82 ON READER CARD

NEW PRODUCTS . . .

circuits intended for switching service. Flip-flops and one-shots, etc., may be used to directly drive the MPD-541. CONTROL EQUIPMENT CORP., 19 Kearney Rd., Needham Heights 94, Mass. For information:

CIRCLE 218 ON READER CARD

readout unit

The electro-mechanically operated SDR II self-decoding alphanumeric digital readout unit decodes binary information directly, displays it in any of 10 alphanumeric characters per second, and accepts voltage signals from a digital computer or similar equipment. Both readout and counter versions can be ganged to provide any number of digits. KAUKE & CO., 1632 Euclid St., Santa Monica, Calif. For information:

CIRCLE 219 ON READER CARD

five-trace oscilloscope

The model 237 includes input gain control, five-beam oscilloscope, five independent vertical amplifiers, five independent horizontal sweep amplifiers and several power supplies. The 237 can be used in comparison and analysis of telemetry data, missile tracking information and intelligence data. SYSTEM RESEARCH LABORATORIES, INC., 500 Woods Drive, Dayton 32, Ohio. For information:

CIRCLE 220 ON READER CARD

computer link

The DEXTER data system, which links a given computer to any number of remote test laboratories or process stations, is based on a network of portable input modules that accept both analog and digital information. Input may be presented by paper tape, magnetic tape, punched card, typewritten log or fed directly to the computer. BECKMAN INSTRUMENTS, INC., 2400 Harbor Blvd., Fullerton, Calif. For information:

CIRCLE 221 ON READER CARD

standard modular packages

Circupaks are standard modular packages for miniature electronic circuits which are machine-molded from epoxy compounds. They feature standardization of components, elimination of molds, improved product appearance and full circuit protection during and after encapsulation. I. S. DIELECTRIC, INC., 181 Greenwood Street, Worcester, Mass. For information:

CIRCLE 222 ON READER CARD

long-length delay line

The 197 magnetostrictive delay line provides a five millisecond delay with a pulse repetition rate of one MC/S with a return-to-zero operation. The delay line operates on an input voltage

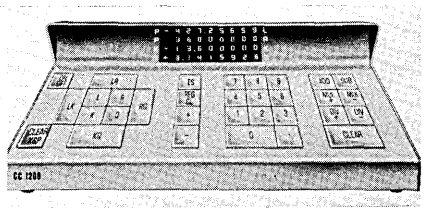
NEW PRODUCTS . . .

of 16 volts @ 80 ma maximum with an input pulse width at the 10% point which is .4 to .5 usec. maximum. DELTIME INC., 608 Fayette Ave., Mamaroneck, N. Y. For information:

CIRCLE 223 ON READER CARD

computer-calculator

The CC 1200 is able to transmit all information from a conventional keyboard by means of electronic circuits.



Two problems can be performed simultaneously in less than one second. COMPUTRON CORP., 12740 San Fernando Rd. North, Sylmar, Calif. For information:

CIRCLE 224 ON READER CARD

rolling tapes

A Mobile Space Saving System has been designed to nearly double the storage capacity of a designated area for computer tapes and tabulating cards which roll on flush floor tracks. An open access area is provided in each of the mobile rows so that any mobile unit can roll aside for immediate reference to any rear unit. DOLIN METAL PRODUCTS, INC., 315 Lexington Ave., Brooklyn 16, N. Y. For information:

CIRCLE 225 ON READER CARD

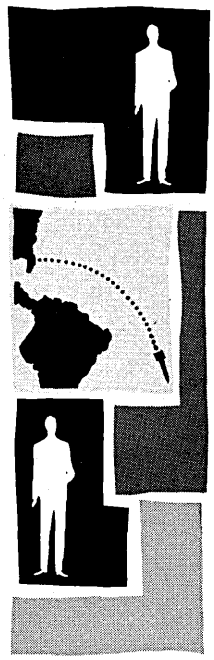
mass memory

New mass memory systems, series I, II, and 31 are disc file memories which can store 154 million bits, 617 million bits and 9 million bits, (per disc) respectively. The systems feature serial or parallel data transmission, precision magnetic field head positioner, separate head positioner for each disc and automatic sequencing of addresses. TELEX, INC., DATA SYSTEMS DIV., Telex Park, St. Paul 1, Minn. For information:

CIRCLE 226 ON READER CARD

converter and comparator

Two new peripheral units for data handling, a card-to-tape converter, the DC-3000, and the DC-3500, a converter-comparator, have a processing rate of 45 cards per minute and 60 characters per second. The DC-3000 is a punched card to punched tape converter and the DC-3500 is a basic DC-3000 with an adjunct tape reading unit for comparison of the information punched on tape with the



DATA HANDLING ENGINEERS ARE NEEDED AT CAPE CANAVERAL

Guided Missiles Range Division of Pan American World Airways, Inc. has the total planning, development, operational and maintenance responsibility for the Atlantic Missile Range.

Unique career opportunities now exist in the fields of Digital/Analog Data Handling Techniques. Data Handling Engineers are needed to prepare specifications for Digital/Analog Data Systems including large scale digital computers and high speed data transmission systems. BS, MS or PhD degree in EE or Physics and two to five years experience in any of the above fields is required.

Send complete resume in confidence to:

D. E. Bruner, Personnel Manager
Department D-2

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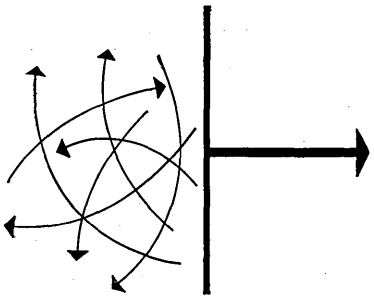
PATRICK AIR FORCE BASE, FLORIDA

CIRCLE 88 ON READER CARD

OPENINGS IN AIR TRAFFIC CONTROL



The Federal Aviation Agency has selected MITRE to establish an experimental air traffic control "system test bed." Operations, equipment, and computer program techniques will be designed, implemented, tested, and evaluated in the "system test bed" prior to incorporation in a new national air traffic control system.

Challenging assignments are now available for individuals with demonstrated ability in any of the following areas:

- **Operations Research or Operations Analysis related to real time control systems**
- **Large-scale system design, test, or evaluation**
- **Computer program design for real time systems**

Scientists and engineers are needed immediately for this important job and thereafter for MITRE's expanding role in the design and development of real time computer-based systems.

Recent college graduates with high scholastic achievements and an interest in these fields are also invited to apply. MITRE is located in pleasant suburban Boston.

Write in confidence to Vice President — Technical Operations, The MITRE Corporation, P.O. Box 208, Dept. MF9 Bedford, Mass.

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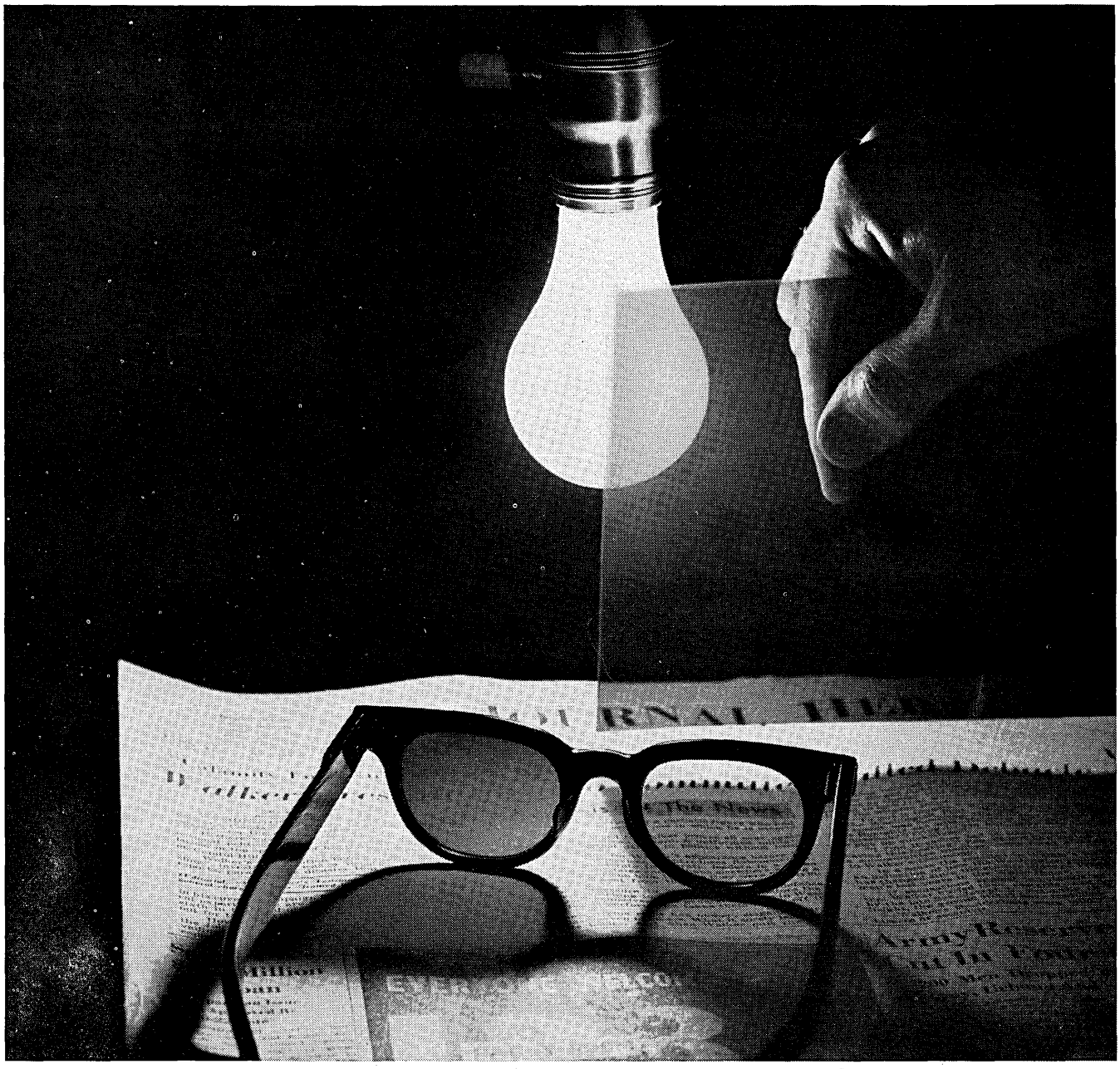
CIRCLE 83 ON READER CARD



Wouldn't it be wonderful if someone invented... sun glasses that grow darker as the sun gets brighter?

As a matter of fact, the chemists, physicists and engineers who work at research for NCR have come up with a development that makes just such glasses possible.

But you won't be able to buy sun glasses labeled NCR for some time . . . if ever.

For, you see, the glass that changes with the light was developed for quite another use. It is among the many new and important projects currently in process by NCR's two thousand research and development workers. And, like all the others, it has as its central focus the objective of improving the capacity and efficiency of computers, calculators and other machines in modern business systems.

The secret of the glass that changes color is being explored to enhance the speed and flexibility of data processing systems. The use of photochromism is an extremely advanced method of increasing the utility of electronic computers. The operating principle is based on color changes which occur under varying wave lengths of light.

Obviously, this principle has application to other complex commercial and military devices which we can't discuss here.

It's another reason why we say. Look to NCR for the forward developments dedicated to providing the finest in total systems . . . from original entry to final report — through NCR accounting machines, cash registers, adding machines and electronic data processing.

NCR

New sign of The National Cash Register Company, Dayton 9, Ohio—1,133 offices in 120 countries—78 years of helping business save money

CIRCLE 51 ON READER CARD

COMPUTER RESEARCH ENGINEERS & LOGICAL DESIGNERS

Rapid expansion of the Computer Laboratory at Hughes-Fullerton has created several attractive professional opportunities for qualified Computer Research Engineers and Logical Designers. These positions require active participation in broad computer R & D activities in connection with Army/Navy computer systems and *new* large-scale, general-purpose computers. These multiple processor computers utilize advanced solid-state circuitry, gating and resolution times in the millimicrosecond regions; combine synchronous and asynchronous techniques for maximum speed and reliability.

These professional assignments involve broad areas of logical design, programming and system conception. Fields of interest include:

▪ Distributed computers ▪ Advanced arithmetic processing techniques ▪ Mechanized design ▪ Asynchronous design techniques ▪ Utilization of parametrons in computers ▪ Studies in the utilization of multiple processor computers.

These professional assignments involve such R & D areas as:

▪ Solid state digital circuitry involving millimicrosecond logic ▪ Microwave carrier digital circuits ▪ Sub-microsecond core memory ▪ Thin film storage techniques ▪ Functional circuit concepts ▪ Micro-miniaturization concepts ▪ Tunnel diodes ▪ Microwave parametrons ▪ Circuit organization for maximal-speed computing.

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CIRCLE 84 ON READER CARD

NEW PRODUCTS . . .

original data from the punched card. 5, 6, 7 and 8 channel tape code may be used. ELECTRONIC DATACOUPLETS, INC., 3655 Lenawee Ave., Los Angeles 16, Calif. For information:

CIRCLE 227 ON READER CARD

micrologic elements

Three additional integrated functional digital logic circuits called Micrologic elements are available including the half-adder, buffer and counter adapter. These elements will enable the computer design engineer to build a digital logic section able to operate at bit rates in excess of 1MC. FAIRCHILD SEMICONDCTOR, 545 Wishman Rd., Mountain View, Calif. For information:

CIRCLE 228 ON READER CARD

clock track writer

Model CT-1000 is a solid state digital device that can be used for writing indexes and clock tracks on most magnetic drum or disc memories. A special coherent oscillator is used to eliminate the need for high frequency basic oscillators. Price of the unit is $3,100. HARVEY-WELLS ELECTRONICS, INC., 14 Huron Drive, Natick, Mass. For information:

CIRCLE 229 ON READER CARD

memory core

The Isodrive memory core has been designed for use in adverse environment computers and does not require drive current compensation over a temperature range of −55 C to +100 C. It is available in 40 or 50 mil OD sizes. ELECTRONIC MEMORIES, INC., 9430 Bellanca Avenue, Los Angeles 45, Calif. For information:

CIRCLE 230 ON READER CARD

coincident current memory

The CCM coincident current memory systems offer cycle times to 3.5 microseconds and are available with word sizes to 4096 and bit lengths to 64. The circuitry is of solid state design and power supplies are self-contained and transistor-regulated. DAYSTROM, INC., MILITARY ELECTRONICS DIV., Archbald, Pa. For information:

CIRCLE 231 ON READER CARD

digicard

Model DCFF1026 counter/shift register flip flop is a silicon digital card module which is applicable in data processing, automatic control and computation. The circuit features set-reset inputs which are isolated from the trigger input network. SOLID STATE ELECTRONICS CORP., 15321 Rayen St., Sepulveda, Calif. For information:

CIRCLE 232 ON READER CARD

COMPUTER PROGRAMMERS

7030 (STRETCH), 7090, AN/FSQ-7 (SAGE)

COMPUTER PROGRAMMERS

MITRE is expanding its effort on the design and development of computer programs for critical experiments in the area of large-scale computer-based command and control systems. Test facilities are now equipped with 7090, 1401, and AN/FSQ-7 (SAGE) computers. These facilities will soon be expanded to include a 7030 STRETCH computer.

Experienced Programmers interested in important assignments can find professional fulfillment in these areas:

- **Problem-Oriented Languages**
- **Computer Applications**
- **Programming Research**
- **Numerical Analysis**
- **Real Time System Design**
- **Utility Program Design**
- **System Programming Techniques**
- **Information Storage and Retrieval**
- **Facility Operations**
- **Computer System Evaluation**

Recent college graduates with high scholastic achievements and an interest in helping us develop these fields are also invited to apply.

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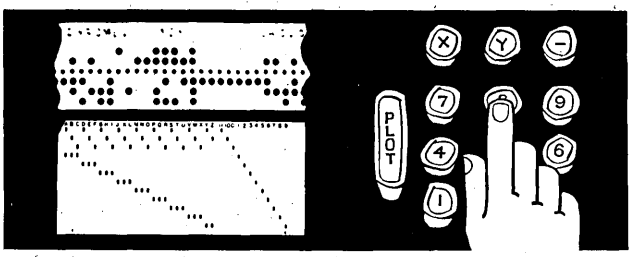
CIRCLE 85 ON READER CARD

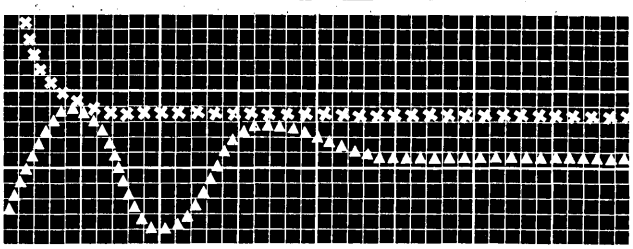
PLOT FOR ECONOMY

SAVE TIME... SAVE MONEY...

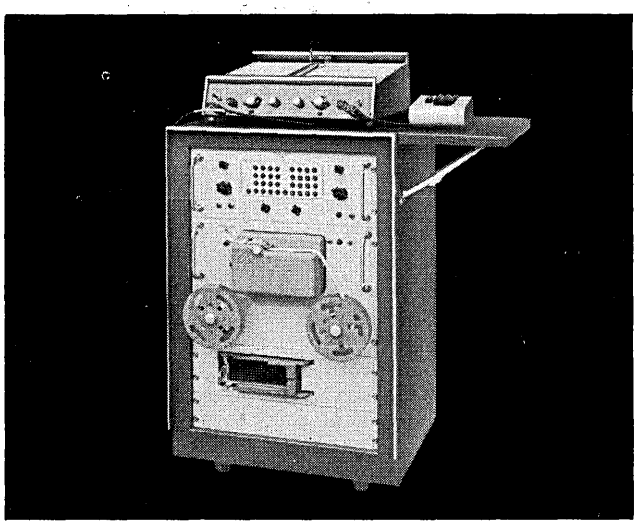
CONVERT THIS



TO THIS



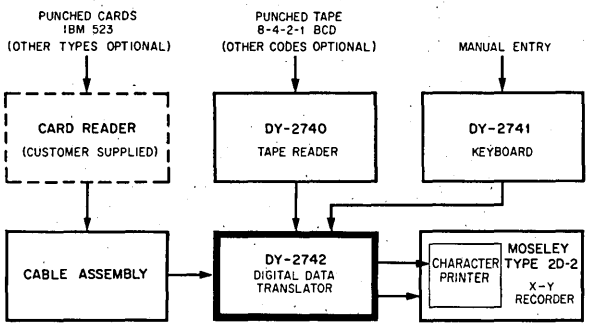
WITH THIS



Here's rapid, economical, time-saving conversion of digital data to easy-to-read X-Y charts. Data stored on punched tape or punched cards or tabular data entered manually on a keyboard is quickly plotted with Dymec DY-6242 Digital Data Plotting System. DY-6242 system ability to accept most standard format computer tapes minimizes the need for special computer programming.

The Dymec system is ideal for rapid translation conversion and graphical presentation of data in such areas as stress analysis—verification of numerically controlled machine tool program tapes—pulse height analyzer display—business situations, profit-loss and trend data—thrust analysis—fluid flow and aerodynamic studies—space vehicle trajectory and orbit information—real-time analog parameters acquired digitally, frequency, voltage, current, transients—in any application where large amounts of digital data are more easily understood in graphical form.

Here's the DY-6242 System:



Here's what it offers: Card, perforated tape or keyboard input • Up to 50 points/min. plotted with cards • Up to 80 points/min. with tape • Plot accuracy better than 0.15% • Resolution: 4 digits and sign accepted for both X-Y axes • Zero suppression up to 10,000 counts for convenient placement of plot • All for $8,700.00

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CIRCLE 38 ON READER CARD

NEW LITERATURE

3600 COMPUTER: This 11-page booklet lists the characteristics, features, software circuitry and peripheral equipment of the CDC 3600. A complete description of the three functional modules as well as the expansibility of the computer is also presented. CONTROL DATA CORP., 8100 34th Ave. So., Minneapolis 20, Minn. For copy:
CIRCLE 130 ON READER CARD

XY PLOTTING BOARDS: Descriptions, features, optional equipment, digital accessories and specifications of the 3305 single-arm and 3306 dual-arm xy plotting boards are presented in this brochure. COMPUTER SYSTEMS, INC., Monmouth Junction, N. J. For copy:
CIRCLE 131 ON READER CARD

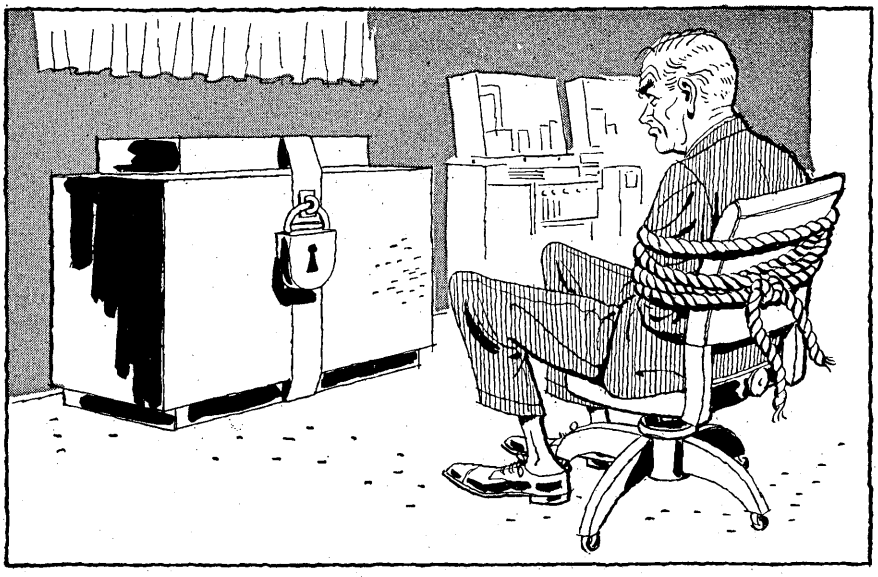
AUTOMATIC PROGRAMMING AIDS: This brochure describes the Computer Optimization Package (COP), programming aids to maximize the operating efficiency of Honeywell computers. COP includes monitoring systems, program test systems, library and scientific routines, sorting and collating routines, tape handling routines and simulator systems. MINNEAPOLIS-HONEYWELL, EDP DIV., 60 Walnut St., Wellesley Hills 81, Mass. For copy:
CIRCLE 133 ON READER CARD

MICROLOGIC ELEMENTS: This 12-page booklet presents an outline of the manufacturing process of a half-shift register, from crystal to final inspection. Each production step is described and illustrated. FAIRCHILD SEMICONDUCTOR, 545 Whisman Rd., Mountain View, Calif. For copy:
CIRCLE 134 ON READER CARD

MAGNETIC TAPE TRANSPORT: This illustrated brochure presents specifications, and a general description of the CDC 606. This new unit features complete pneumatic control of the tape and includes complete read/write circuits, skew control and local motion control. CONTROL DATA CORP., 7801 Computer Avenue, Minneapolis 24, Minnesota. For copy:
CIRCLE 132 ON READER CARD

SILICON LOGIC MODULES: This eight-page brochure describes a new line of silicon logic modules, and covers thirteen circuit modules. Presented are general descriptions and operating characteristics of the modules, which operate over a temperature range from -55 degrees to 100 degrees C. at a frequency of one megacycle/sec. PACKARD BELL COMPUTER, 1905 Armacost Ave., Los Angeles 25, Calif. For copy:
CIRCLE 135 ON READER CARD

WIZ COMPILER: This illustrated booklet presents information on the WIZ



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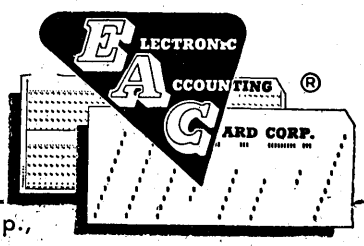

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CONTROL DATA ANNOUNCES 3600 COMPUTER SYSTEM

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The Control Data 3600 brings to the industry a new order of speed, capacity, computing power, and machine sophistication for solving large-scale scientific problems and for handling large-volume data processing.

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COMPARE THESE ADVANCED FEATURES:

- Storage Module of 32,768 48-bit words—expansible in 32,768-word modules up to 262,144 48-bit words:
  1.5 microseconds—memory cycle time
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- Execution times, including access:
  4 microseconds—Floating Point Add
  1-6 microseconds—Floating Point Multiply
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  2-26 microseconds—Double Precision Floating Point Multiply
- Programming Systems operating under control of Master Control System will include: Monitor System, Compass, Fortran, Cobol, and 1604 Compatibility Package.
- Communication Module with 4 bi-directional data channels—expansible up to 8 bi-directional data channels. (Up to 8 control and/or peripheral devices can be attached to each bi-directional data channel.)
- Up to 3 additional Communication Modules may be added, with from 1 to 8 bi-directional data channels each.
- Code compatible with the Control Data 1604 Computer except for three 1604 I/O instructions.
- Various special, high-speed circuits employing tunnel diodes—operating at 4 nanoseconds per stage.
- Parallel binary mode of operation:
  2^{48-1} for single precision fixed point
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- 48-bit word length plus 3 bits for parity checking.
- Byte-scan operation in which: 1) data of variable length within a word can be operated on by one operation or 2) high-speed scanning can be performed on computer storage in byte-size pieces.
- Results of all arithmetic operations normalized or unnormalized, rounded or unrounded . . . at programmer's option.
- Inter-register instruction.
- Two-way search instructions.
- Data transmission control performed by high-speed registers located in Communication Module—permitting I/O activity to proceed independent and asynchronous of main computer program.
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- 48-bit sense light register.
- Universal bit-sensing instructions.
- Shifting time constant—regardless of number of positions shifted.
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- Auto-load buttons for card and magnetic tape equipment.
- Direct card reader entry into Accumulator.
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For further information on the new, advanced large-scale Control Data 3600 Computer, see the Control Data representative in your area . . . or write for Publication No. B-4B-62.

CONTROL DATA CORPORATION
8100 34th Avenue South
Minneapolis 20, Minnesota

NEW LITERATURE . . .

compiler, designed for use with the GE-225. Features and a description of WIZ language and programs are given. GENERAL ELECTRIC CO., COMPUTER DEPT., 13430 N. Black Canyon Highway, Phoenix, Ariz. For copy:

CIRCLE 136 ON READER CARD

X-Y RECORDER: An illustrated folder describes transistorized x-y recorders including the model 500, 11" x 17" recorder. Specific design features are detailed. ELECTRO INSTRUMENTS, INC., 8611 Balboa Ave., San Diego 11, Calif. For copy:

CIRCLE 137 ON READER CARD

G-15: This new brochure presents the features, applications and specifications of the G-15. Components of the system are illustrated. BENDIX COMPUTER DIV., 5630 Arbor Vitae St., Los Angeles 45, Calif. For copy:

CIRCLE 138 ON READER CARD

340 CONTROL COMPUTER SYSTEM: This leaflet highlights the 340, a 330 with the addition of a core processor. A generalized command list, with operating time, is given as well as a description of characteristics including core memory, drum memory, access time, instruction format and power consumption. TRW COMPUTERS CO., 8433 Fallbrook Ave., Canoga Park, Calif. For copy:

CIRCLE 139 ON READER CARD

PROGRAMMED DATA PROCESSOR: The PDP-4 single address, 18-bit, parallel machine is highlighted in this pamphlet and includes the programming of and instructions for the PDP-4 as well as information on a typical installation, standard machines and optional equipment. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:

CIRCLE 140 ON READER CARD

DIGITAL COMPUTERS: This bulletin highlights the new 900 series which is a solid state, single address, ferrite core memory machine for general-purpose scientific computation and special-purpose systems integration. General characteristics, operating speeds, and programming systems are included. SCIENTIFIC DATA SYSTEMS, INC., 1542 15th St., Santa Monica, Calif. For copy:

CIRCLE 141 ON READER CARD

DP PLANNING KIT: This guide offers information on the ordering and planning the use of Able-stik pressure sensitive pin feed labels for data processing shops. The kit includes actual size illustrations and price lists for the 26 available sizes. ALLEN HOLLANDER CO., INC., 385 Gerard Ave., New York 51, N. Y. For copy:

CIRCLE 142 ON READER CARD

COMPUTER APPLICATION REPORT: This 12-page booklet, "Analog Component Requirements for Solving the Six-Degree-of-Freedom Orbital Flight Equations," details the program for an analog computer. APPLIED DYNAMICS, INC., 2275 Platt Road, Ann Arbor, Mich., For copy:

CIRCLE 143 ON READER CARD

MAGNETIC CORE MEMORIES: This brochure gives information on the company's line of core memory planes, core memory stacks, temperature controlled stacks and complete memory systems. FABRI-TEK, INC., P. O. Box 8046, Minneapolis 16, Minn. For copy:

CIRCLE 144 ON READER CARD

PERT FAMILIARIZATION: This manual includes topics on PERT network development, critical and subcritical path development, the PERT bar chart as well as examples of the network and bar chart. THE BOEING CO., NEWS BUREAU, Seattle 24, Wash. For copy:

CIRCLE 145 ON READER CARD

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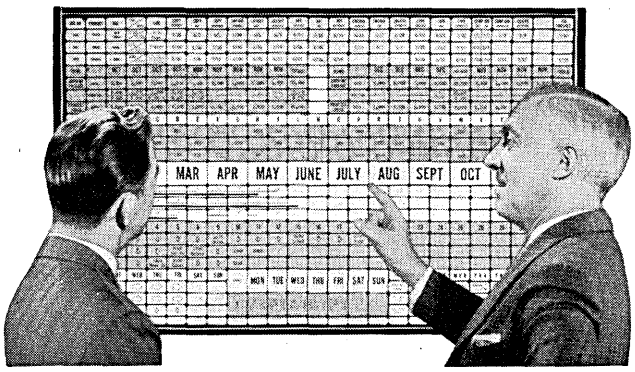

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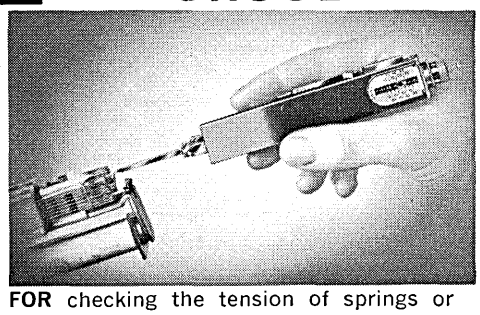

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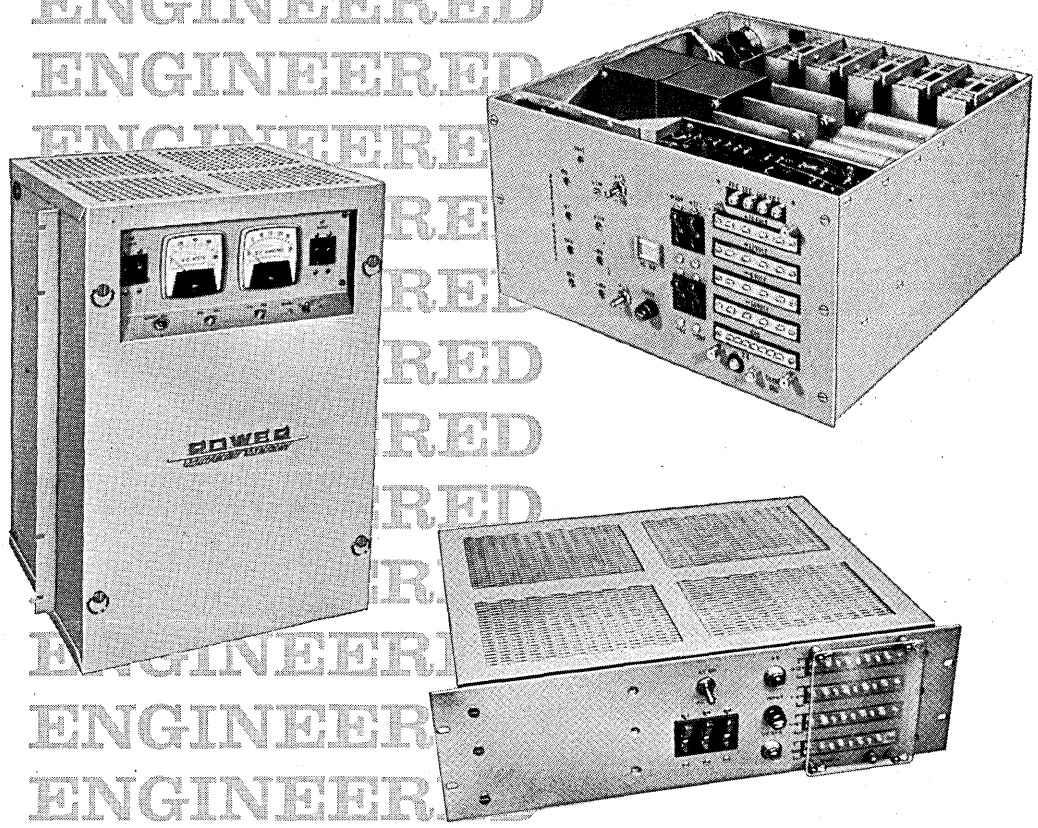

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PECO, a Division of North Electric, also manufactures highly reliable standard and special battery chargers. These units range from fully transistorized 6 amp size up to unusually high current capacity magnetic amplifier-transistor regulated units for military, industrial and utility applications.

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4000 EXPECTED AT NMAA CONFERENCE

An attendance of better than 4,000 has been forecast for the 1962 International Data Processing Conference and Business Exposition, which will be held at the Statler Hilton Hotel, NYC, June 19-22. The Conference, sponsored by the National Machine Accountants Association, has selected the theme "Key to Efficiency."

More than 80 manufacturers will participate in the Business Exposition, which will be open during all four days of the conference. Exposition hours are 1 p.m. to 8 p.m. on June 19; 9 a.m. to 6 p.m., June 20 and 21; and 9 a.m. to noon, June 22.

Thirty seminars will be held during the conference, and have been scheduled so that each seminar will be presented twice, to allow for possible conflict of subject matter presented simultaneously. Six subject areas of discussion will be offered: Management, Machines, Industry Sessions, Systems Development, Applications, and Other Subjects.

The Conference's keynote speaker will be Dr. Kenneth McFarland, educational consultant, General Motors Corp. Guest speaker at the farewell luncheon on June 22 will be Warren Hume, president, Data Processing Division, IBM.

NEXT MONTH IN DATAMATION

The Law And The Computer will be the subject of our cover feature scheduled for DATAMATION's heated, mid-summer number. For third generation prognosticators, an analysis of nanosecond hardware coupled to a survey of logic systems will also be featured. A graphic study of cost vs. memory speeds will invite the attentions of computerland historians and for the shop manager, a trio of how to select, train and evaluate programmers may prove inviting. Not to be forgotten however, is an indelicate but accurate view of The Operating System For A Kludge.

Two tapes are better than one!

automation from one tape / addition from the other!

This is the Friden Add-Punch®, Model ACPT. Like any conventional adding machine, it produces a conventional paper tape establishing control totals.

But there on the left of the machine it also records complete or selected data on a punched paper tape: the extra tape that turns addition into automation.

Why? So you can automate your data work right where a great deal of data work starts—at the adding machine level.

If yours is a *large* company, use the tape for automatic conversion to punched cards. (No key punching or verifying is necessary.) Or you can use it for direct input into your computer.

If yours is a *small* company, call in a service bureau to process the tape and prepare reports. It's usually a low-cost service.

The Friden Add-Punch is simple to use, and yet handles a wide variety of statistical and accounting jobs. It is built to take the constant use of a busy staff, year after year.

Call in a Friden Systems man. He will show you how to reap the benefits of Add-Punch automation. Or write: Friden, Inc., San Leandro, California.

THIS IS PRACTIMATION: automation so hand-in-hand with practicality there can be no other word for it.

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Sales, Service and Instruction Throughout the U.S. and World

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Said J. Stefan and L. Boltzmann: *"The total radiation from a black body is proportional to the fourth power of the absolute temperature of the black body."*

Radiation is usually associated with high temperatures. Yet very cold bodies emit a radiation which can be highly significant in missile and space applications. The problem faced by infrared scientists, trying to detect variations in radiation from low temperature atmospheres, can be likened to detecting a one-foot cube of ice from a distance of five miles.

Lockheed Missiles & Space Company scientists are deeply engaged in studying the problems of infrared emission from the earth and its atmosphere, as seen from orbital altitudes. Although the earth resembles a black body at 300° Kelvin, the emission from its atmosphere, under some circumstances, is much colder. To make measurements under these circumstances, Lockheed has evolved radiometric equipment with one of the most sensitive detection systems yet conceived.

Scientists and engineers must also take careful measurements of a potential employer. Lockheed Missiles & Space Company in Sunnyvale and Palo Alto, California, on the beautiful San Francisco Peninsula, invites this close scrutiny. As Systems Manager for the AGENA Satellite series and the POLARIS FBM, Lockheed preeminence in Missiles and Space creates positions in many disciplines for outstanding engineers and scientists.

Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-13A, 599 North Mathilda Ave., Sunnyvale, Calif. U.S. citizenship or existing Department of Defense industrial security clearance required. An Equal Opportunity Employer.

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Systems Manager for the Navy POLARIS FBM and the AGENA vehicle in various Air Force Satellite programs. Other current projects include such NASA programs as the OGO, ECHO, and NIMBUS.

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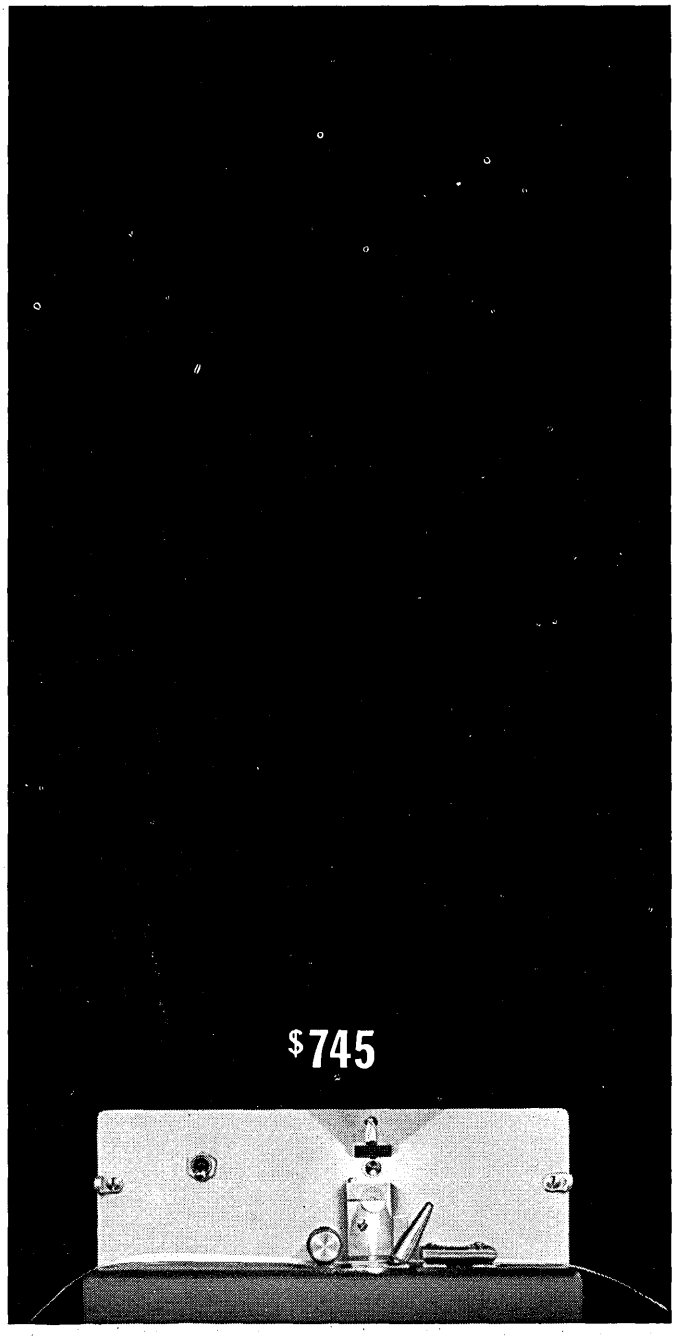
How much does it cost to get Digitronics photo-electric reliability in your tape reader?



It used to cost over $2000—if you installed a Digitronics high speed photo-electric unit. So, with regret, many designers remained wedded to electro-mechanical readers. Now, however, at speeds to 300 cps, stepping at 100 cps, you can design-in a Model 2500 Digitronics photo-electric perforated tape reader for only $745.

Best of all, the Digitronics quality is still here—right down to the finely machined parts, stainless steel corrosion-resisting parts, self-adjusting brake, solid state circuitry, and other important design features.

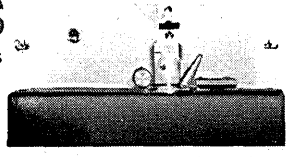
True, this is a simpler reader, with fewer sophisticated functions and capabilities. But for lower speed applications, long the domain of electro-mechanical readers, there's nothing finer than this new product. Find out about the Model 2500 today.

Should you have more sophisticated requirements, Digitronics can provide you with readers capable of accommodating 5 to 8 level tape interchangeably at 60 to 5000 cps. Tape handlers are also available for 5 to 8 level tape up to 1000 cps.

For more information, write Digitronics Corporation, Albertson, New York.

DIGITRONICS PERFORATED TAPE READERS

Where every bit counts



Information from countless sources, staggering amounts of it. New information that changes from moment to moment, old information that must be retrieved from storage in seconds. Information of world importance. This is what command decisions are based on: This is what a new science-technology must cope with to help make command decisions possible. The science-technology of which we speak involves the development of far-reaching man-machine systems to provide information processing assistance for military and government leaders. The needs of this field have created a number of new positions at System Development Corporation. Our scientists, engineers and computer programmers applied this science-technology to help develop SAGE. We now apply it to our work on the SAC Control System and other command and control systems being developed. At SDC, our staff participates in key phases of system development; analysis, synthesis, computer instruction, system training and evaluation. If you are a Computer Programmer seeking the work we describe, please contact Mr. A. C. Granville, Jr., SDC, 2401 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D.C.; Lexington, Massachusetts; and Paramus, New Jersey. "An equal opportunity employer."

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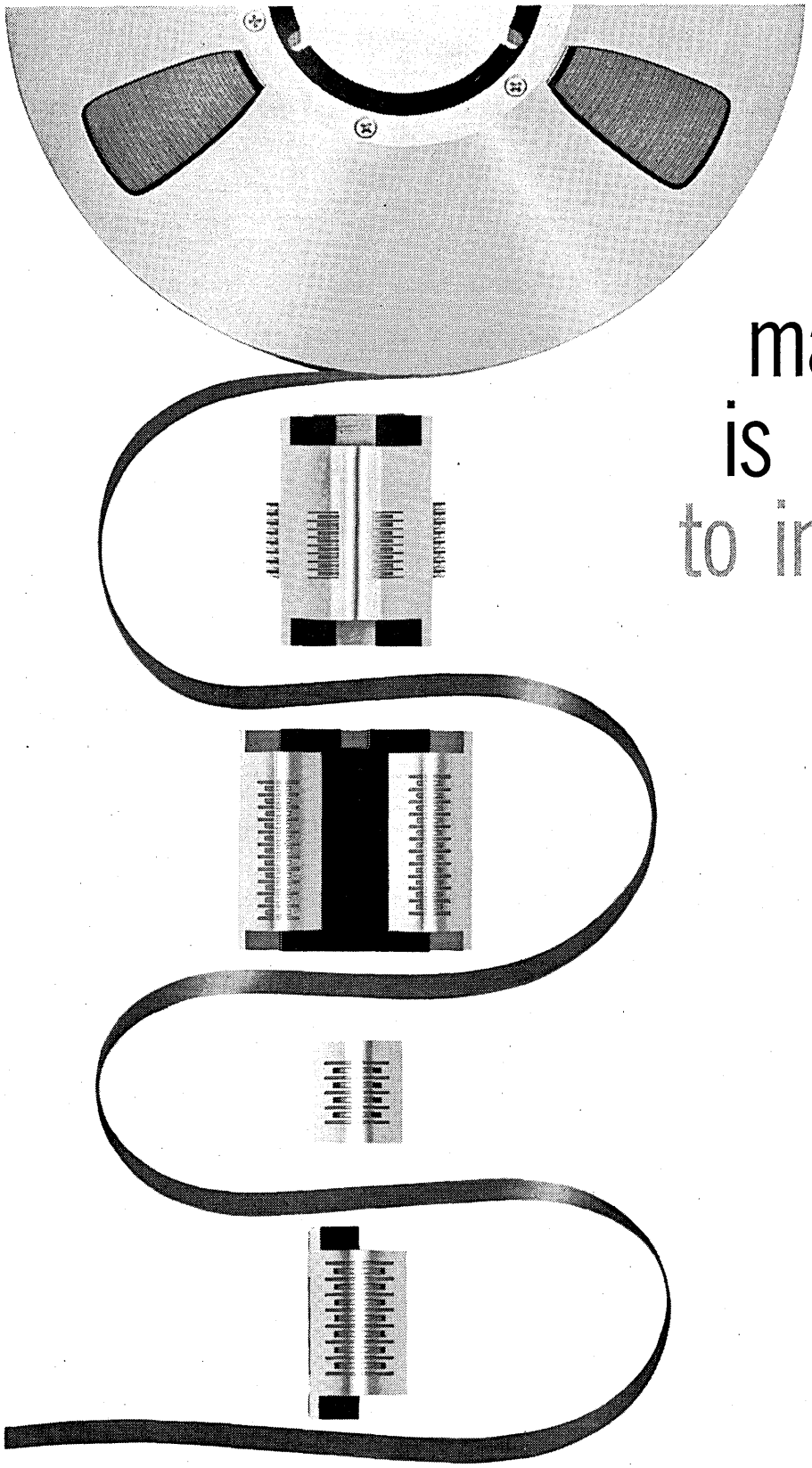

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- 5 PROGRAMMERS
- 1 CONTRACTS ADMINISTRATOR
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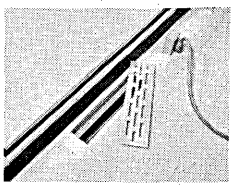

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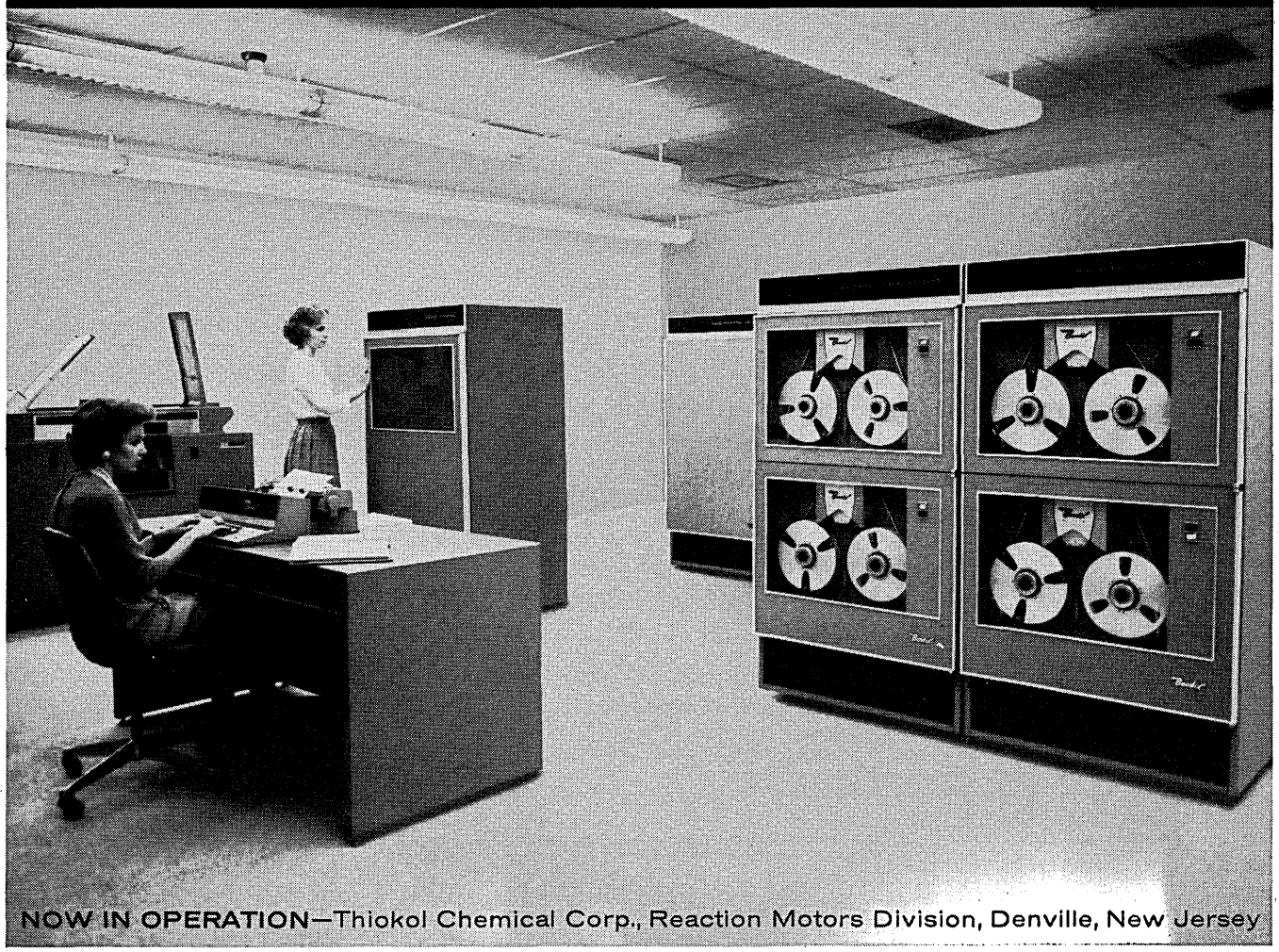
THE BENDIX G-20 COMPUTING SYSTEM



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TPM systems from GKI will solve this problem for your EDP facility. Call or write us for more details on TPM . . . the modern tape approach to computer profits.

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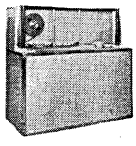

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M3000

. . . a new design principle

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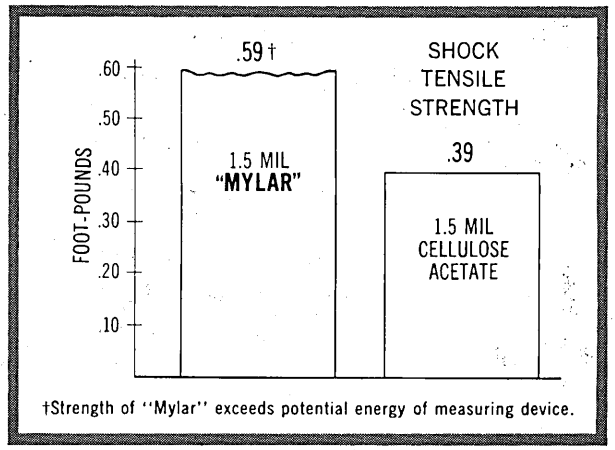
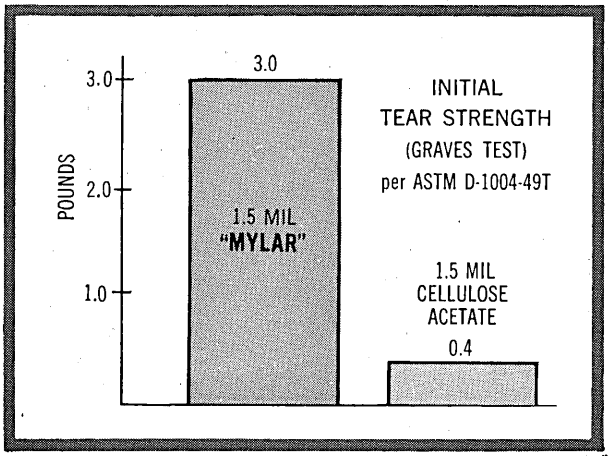


†Strength of "Mylar" exceeds potential energy of measuring device.

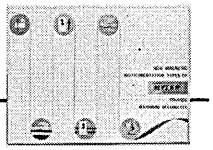


Every minute of downtime costs you dollars. That's why the reliability of your magnetic tape is so important. Tapes of Mylar*, resist breaking from sudden starts and stops since they have high shock-tensile strength . . . and they have 7 times the initial tear strength of acetate tapes.

"Mylar" adds to the reliability of playback. It resists the cupping, swelling and shrinking which can reduce intimate head contact and cause read/write errors. Age, storage conditions and repeated playbacks won't affect "Mylar" either.

The cost of the data . . . the cost of the equipment . . . the cost of time *all* demand reliability. Get it with tapes of "Mylar". Send coupon for free booklet of comparative test data and judge for yourself. Du Pont Company, Film Department, Wilmington 98, Delaware.

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



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customized to your

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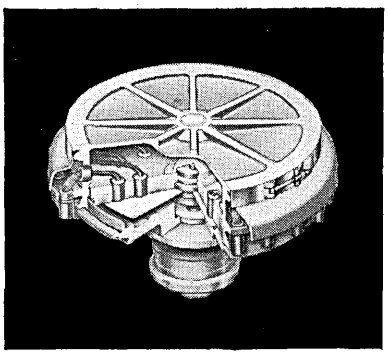

. . . or anything in between: that's the straight off-the-shelf story from LFE today. Ready-made complete memory packs now available in capacities from 10,000 to 777,200 bits.

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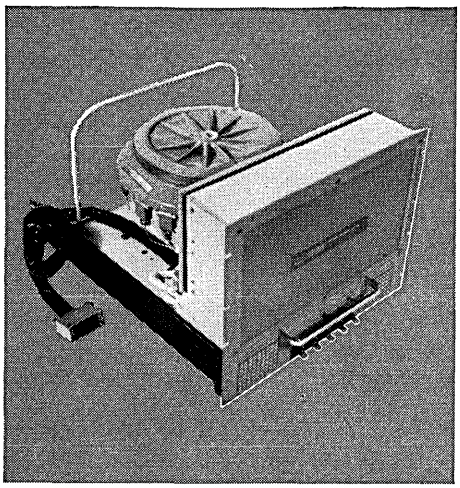

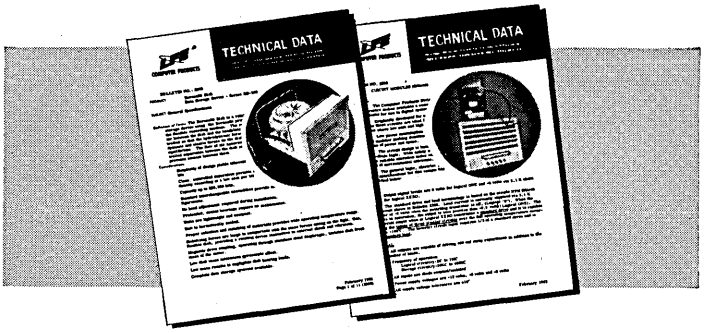

Technical Data Bulletin 2203
BERNOULLI DISK — Series BD-200

Technical Data Bulletin 2350
CIRCUIT MODULES (Silicon)

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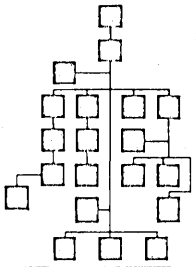


people IN DATAMATION

■ Robert W. Bemer has been named Director of Systems Programming for the UNIVAC Division of Sperry Rand, and will be responsible for the development of major programming packages for all UNIVAC systems. Previously, he had been with IBM as Manager of Programming Systems Development; Manager of Corporate Logical Systems Standards; and Director of Programming Standards, his most recent position before joining UNIVAC. Prior to his affiliation with IBM, he was Manager of Mathematical Analysis for the Missile and Space Division of Lockheed. He had also been associated with the RAND Corp. and Marquardt Aircraft Co. Bemer represents the U.S. on the Terminology Committee of the International Federation for Information Processing (IFIP).

■ Jack Strong of C-E-I-R, Los Angeles, and formerly of North American Aviation has resigned to join Computer Sciences Corp. as assistant to the president. Prior to C-E-I-R's recent cancellation of STRETCH, Strong was director of this project and instrumental in encouraging the cancellation.

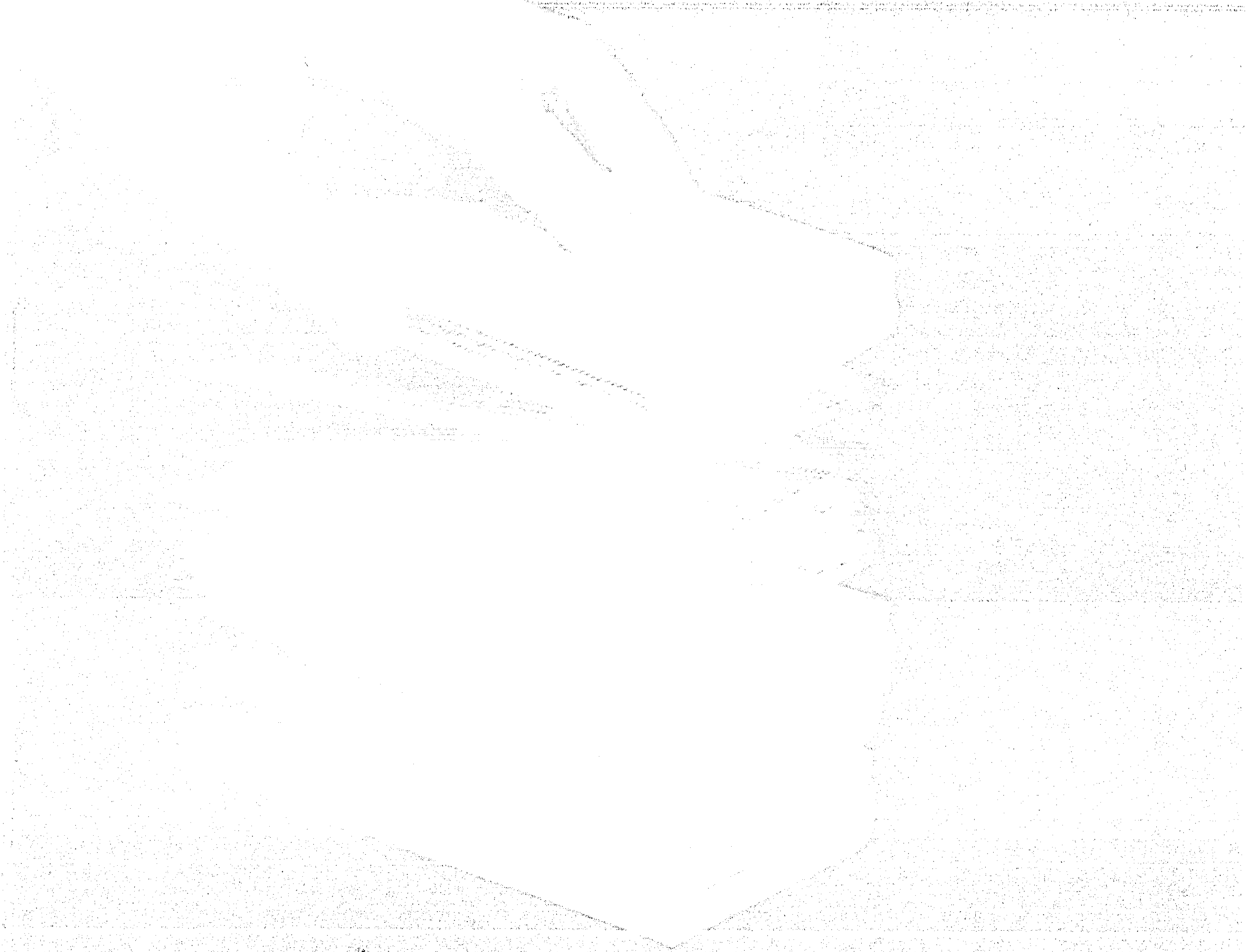
■ Dr. Louis Robinson has been named manager of the IBM Data Processing Division's Application and Systems Programming Department, White Plains, N.Y. He will be responsible for coordinating development and marketing of computer languages and applications programs.

■ R. J. Mindlin, director of the Banks and Financial Systems Section of National Cash Register's Product Planning Department, has been named chairman of the International Standard Committee for Character Recognition.

Apologies!

In DATAMATION's April Business & Science column, it was incorrectly reported that Charles M. Edwards had departed as Bendix Computer's general manager. A correct report appeared in the March issue (page 119) in which Edwards was listed as having been promoted to general manager while Charles W. Horrell resigned from Bendix to join UNIVAC.

FOR GENERAL ELECTRIC CIRCLE 5 ON READER CARD →



AT THE DROP OF A DECK...

$$f = 3wb^2/4t^2(1+1.61b/w^2)$$

WIZ and the GE-225 computer solve this problem less than [illegible] after the data is read in.

The program reads WIZ language statement cards and data cards, then immediately and continuously produces a compiled GE-225 program. It compiles 500 to 1000 machine instructions per minute in one pass, requires no magnetic tape and as little as 8000 words of memory.

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To see WIZ in action, contact your nearest General Electric Computer Department office. Or write for Bulletin CPB 217, General Electric Computer Department, Section 1205, Phoenix, Arizona.

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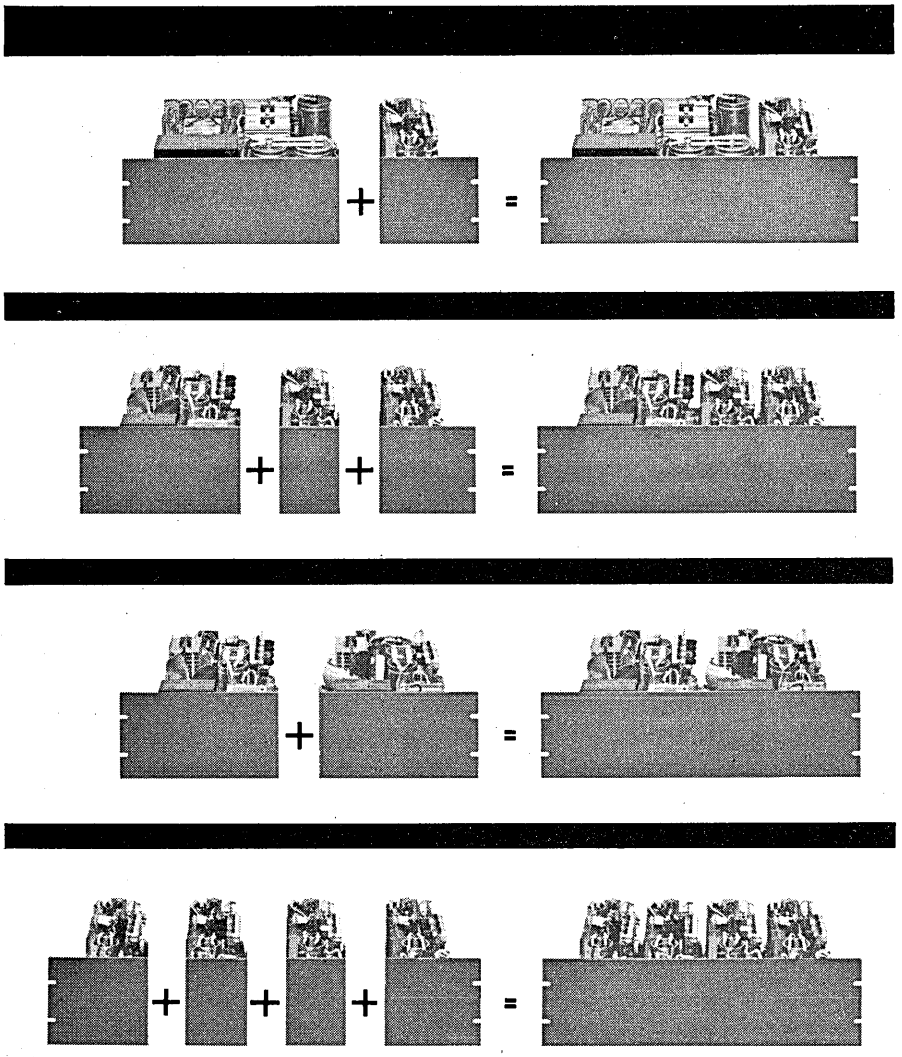

■ Fifty-four transistorized dc power supplies are available in modular units with nine voltage ranges from 1 to 37 volts and six power sizes, with current ranges from .7 to 25 amperes. They provide almost unlimited versatility in the design of electronic equipment.

■ The units are made in ¼, ½, ¾ and full rack widths and are 5¼ inches in height, permitting use in any combination. They may be employed for laboratory development work or as highly stable components in data processing and ground support equipment.

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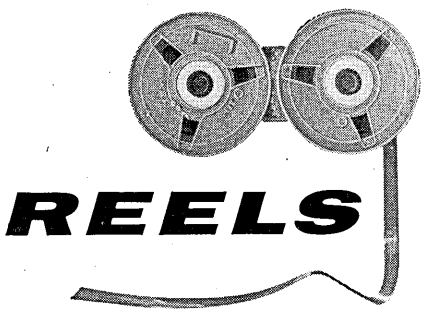

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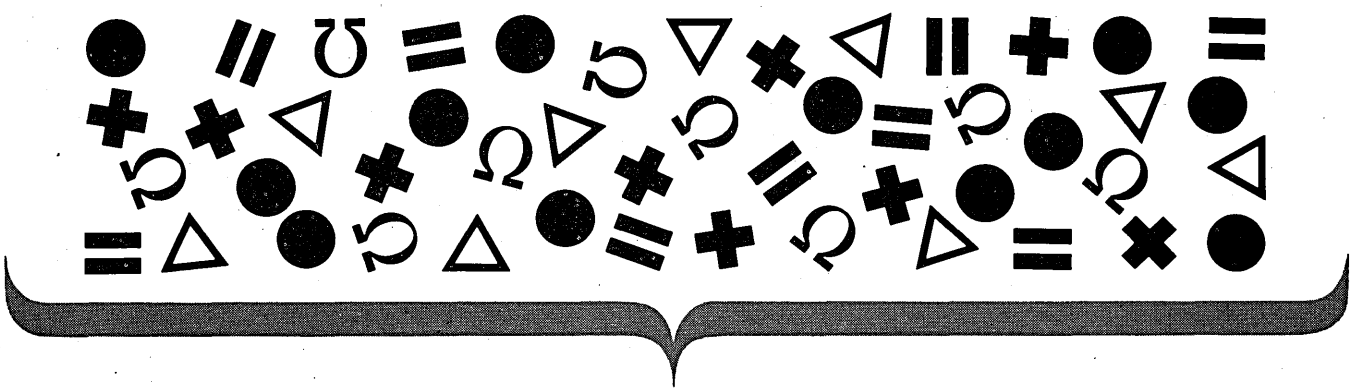
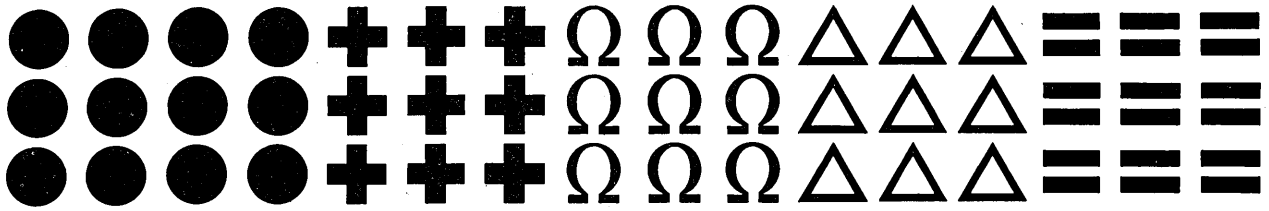
CIRCLE 54 ON READER CARD

NEW COMPUTATION OPPORTUNITIES

AT AEROSPACE CORPORATION



The rapidly increasing workload in the recently activated computation center at Aerospace Corporation has resulted in the need for additional top level staff members. □ Established six months ago, the center is already well equipped, having two IBM 7090's, five 1401's and considerable related equipment. □ This facility in El Segundo near Los Angeles provides the computation capability necessary to support the Aerospace Corporation mission of systems research, planning, and engineering, technical direction, and operational design and development on a wide variety of ballistic missile, space and re-entry programs. □ Urgent requirements exist for highly qualified engineers, physicists and mathematicians in the following areas: **COMPUTER PROGRAMMERS** / Emphasis will be placed on scientific programming in one or more of these areas: orbital mechanics and trajectory analysis, aerodynamics, thermodynamics, missile dynamics, control systems and structures, simulation of guidance systems and computers. Degrees in Engineering, Physics, or Mathematics with programming experience for the IBM 7090 are desirable for these applications. Other areas include management data processing, compiler and monitor design and development. **NUMERICAL ANALYSTS** / Individuals with advanced degrees in Mathematics are desired for both basic research and application to machine computation of new numerical methods for the solution of non-linear equations, two-point boundary value problems, partial difference equations, and matrix eigenvalue problems. **APPLIED MATHEMATICIANS** / Advanced degrees in Mathematics or Mathematical Physics are desirable in conjunction with some industrial experience. The tasks here are the formulation and analysis of physical problems and mathematical models originating in missile and space technology. Specific areas are astrodynamics, elasticity, thermodynamics, fluid flow, and control theory. **BAY AREA ASSIGNMENTS** / In addition to the El Segundo activity, Aerospace Corporation has assignments for qualified personnel to perform computing functions in the San Francisco area. Opportunities here involve systems engineering for programming real time satellite control, and various phases of high speed computing. For these positions a degree in Mathematics, Physics or Electrical Engineering is required together with at least four years experience in technical computer programming. □ Qualified applicants are invited to contact Aerospace Corporation, an equal opportunity employer. □ To arrange convenient interviews applicants should write to Mr. Charles Lodwick, Room 208, Aerospace Corporation, Los Angeles 45, California.



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CIRCLE 91 ON READER CARD

DERIVING
majority logic
NETWORKS

FUND THM:

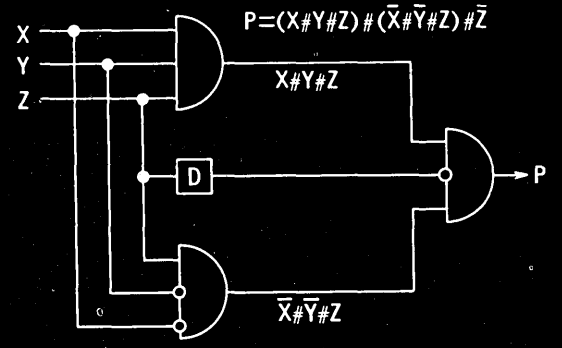
$f(X,Y,Z) \equiv (X\#Y\#f_{x\bar{y}})\#(\bar{X}\#\bar{Y}\#f_{x\bar{y}})\#f_{xy}$

DEFINITIONS:

$X\#Y\#Z \equiv Maj(X,Y,Z);\ f_{xy} \equiv f(X,X,Z);\ f_{x\bar{y}} \equiv f(X,\bar{X},Z)$

DERIVATION:

Let f(X,Y,Z) be even-parity function P.
Then $f_{xy} \equiv \bar{Z}$ and $f_{x\bar{y}} \equiv Z$ so



The fundamental theorem of majority-decision logic, a typical product of Univac's Mathematics and Logic Research Department, has practical as well as theoretical interest. The even-parity checker derived above from the fundamental theorem can be treed to determine the parity of 3^n bits in 2_n logic levels using only $\frac{3}{2}(3^n - 1)$ three-input majority gates.

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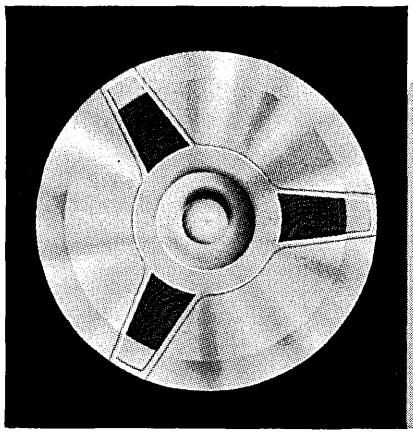

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The book assumes no knowledge of punched card methods, no mathematics, and no knowledge of business operations beyond the bare minimum. It is assumed that the procedure to be followed has already been set up and that the reader's responsibility is to implement this procedure. Because the IBM 1401 is in such wide use and even greater demand, this book is centered around it. Examples and exercises are based on the 1401, but the general principles apply to any computer.

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Lafuze: MAGNETIC AMPLIFIER ANALYSIS

A systematic procedure is given here for analyzing magnetic amplifier circuits *in general*—using equivalent circuits to represent the magnetic core and the block diagram of basic servo theory. 1962. 252 pages. $9.75

Coulson (Editor): PROGRAMMED LEARNING AND COMPUTER BASED INSTRUCTION

This book presents a rounded attempt at cross-fertilizing many different skill and interest areas, in order to produce more integrated communications and a truly unified attack on educational problems. 1962. Approx. 304 pages. $6.75

Margulies-Eigen (Editors): APPLIED PROGRAMED INSTRUCTION

Intensive coverage of all areas both present and projected, estimates of economic feasibility, data on uses, and students' reactions. In short, everything that is known about the subject is included here. 1962. Approx. 360 pages. Prob. $6.95

Tomovic-Karplus: HIGH-SPEED ANALOG COMPUTERS

A detailed treatment of high-speed repetitive computation. It covers the theory, design and applications of high-speed computers as well as the theory of both types of analog computation. Includes European, American, and Russian sources of material. 1962. Approx. 272 pages. Prob. $9.95

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BOOK capsules

A METHODOLOGY FOR SYSTEMS ENGINEERING, by Arthur D. Hall, 1962, D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J., 478 pp., $12.

This four-part text aims to increase awareness and understanding of systems engineering as a process. The author sets forth definitions and approaches to the main recurring problems of the process 1-M problem definition, goal setting, systems synthesis, systems analysis, choosing alternate systems, and planning.

COMPUTER BASICS, by Technical Education and Management, Inc., 1961, Howard W. Sams & Co., Inc., 1720 E. 38th St., Indianapolis 6, Indiana, five volumes, $4.65 ea.

This five-volume set was originally prepared for the U. S. Navy to train electronics technicians in computer technology. Volume titles are: Introduction to Analog Computers; Analog Computers—Mathematics & Circuitry; Digital Computers—Mathematics & Circuitry; Digital Computers—Storage & Logic Circuitry; and Computers—Organization, Programming and Maintenance.

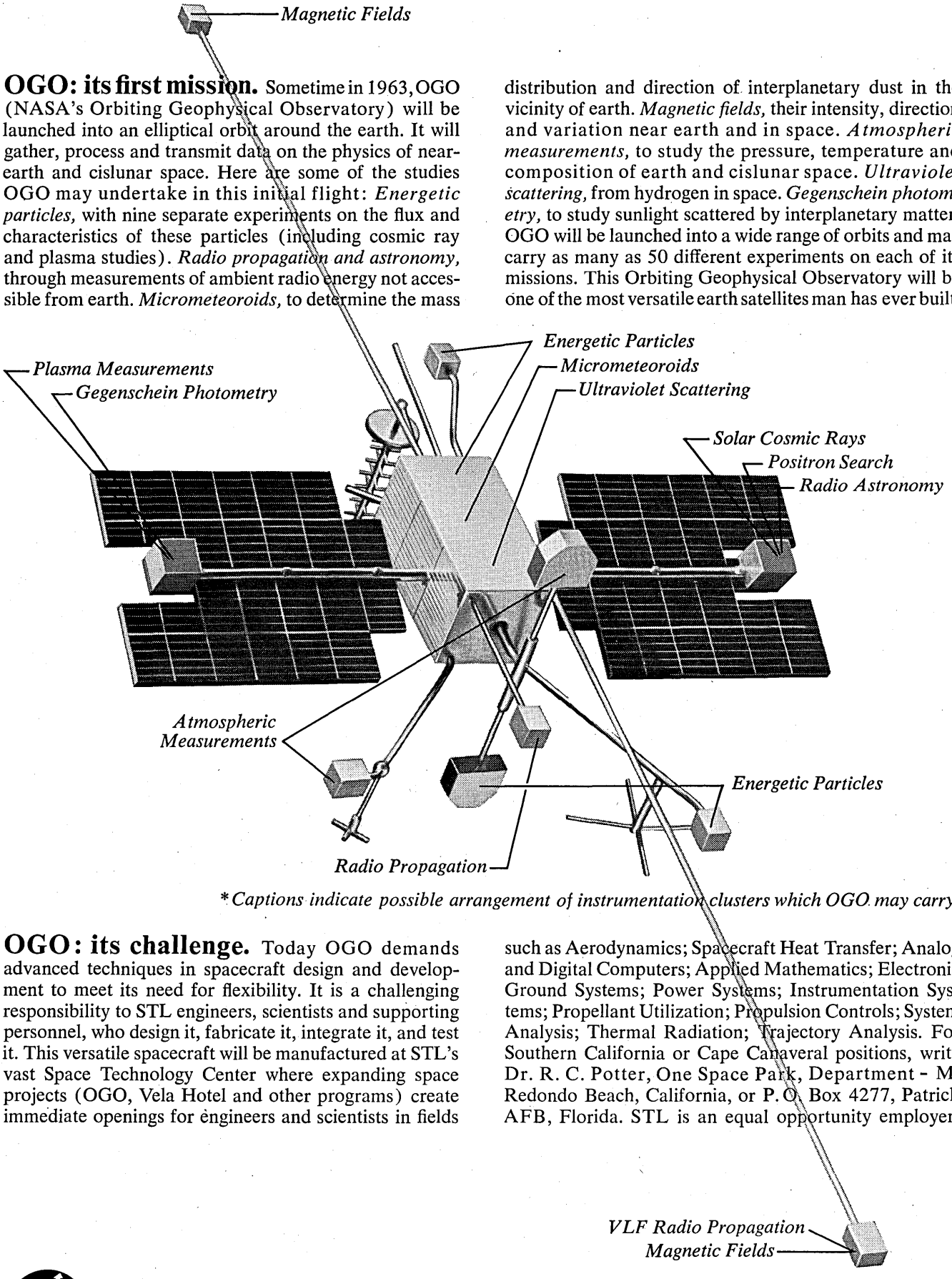
ELECTRONIC COMPUTERS: FUNDAMENTALS, SYSTEMS, AND APPLICATIONS, edited by Paul von Handel, 1961, Prentice-Hall, Inc., Englewood Cliffs, N. J., 236 pp., $13.50.

This volume, written for those with a scientific background but no previous knowledge of computers, analyzes the inherent properties of digital and analog computers, and the digital differential analyzer. Emphasis is placed on underlying principles rather than specific machines or applications.

DATA PROCESSING, VOLUME IV, proceedings of the 1961 International Conference of the National Machine Accountants Association, 1961, 524 Busse Highway, Park Ridge, Ill., 388 pp., $5.

Papers read at the annual meeting of the NMA held in 1961 are published according to broad topics. Included are: Management: Does a Computer Pay Off? Management of Data Processing Department; Machines: Computer Comparisons; New Concepts – New Horizons; Systems Development; Organizing for Effective Data Processing. Other subjects included are Automatic Coding; Applications; and a Computer Course.

OGO: its first mission. Sometime in 1963, OGO (NASA's Orbiting Geophysical Observatory) will be launched into an elliptical orbit around the earth. It will gather, process and transmit data on the physics of near-earth and cislunar space. Here are some of the studies OGO may undertake in this initial flight: *Energetic particles,* with nine separate experiments on the flux and characteristics of these particles (including cosmic ray and plasma studies). *Radio propagation and astronomy,* through measurements of ambient radio energy not accessible from earth. *Micrometeoroids,* to determine the mass distribution and direction of interplanetary dust in the vicinity of earth. *Magnetic fields,* their intensity, direction and variation near earth and in space. *Atmospheric measurements,* to study the pressure, temperature and composition of earth and cislunar space. *Ultraviolet scattering,* from hydrogen in space. *Gegenschein photometry,* to study sunlight scattered by interplanetary matter. OGO will be launched into a wide range of orbits and may carry as many as 50 different experiments on each of its missions. This Orbiting Geophysical Observatory will be one of the most versatile earth satellites man has ever built.



**Captions indicate possible arrangement of instrumentation clusters which OGO may carry.*

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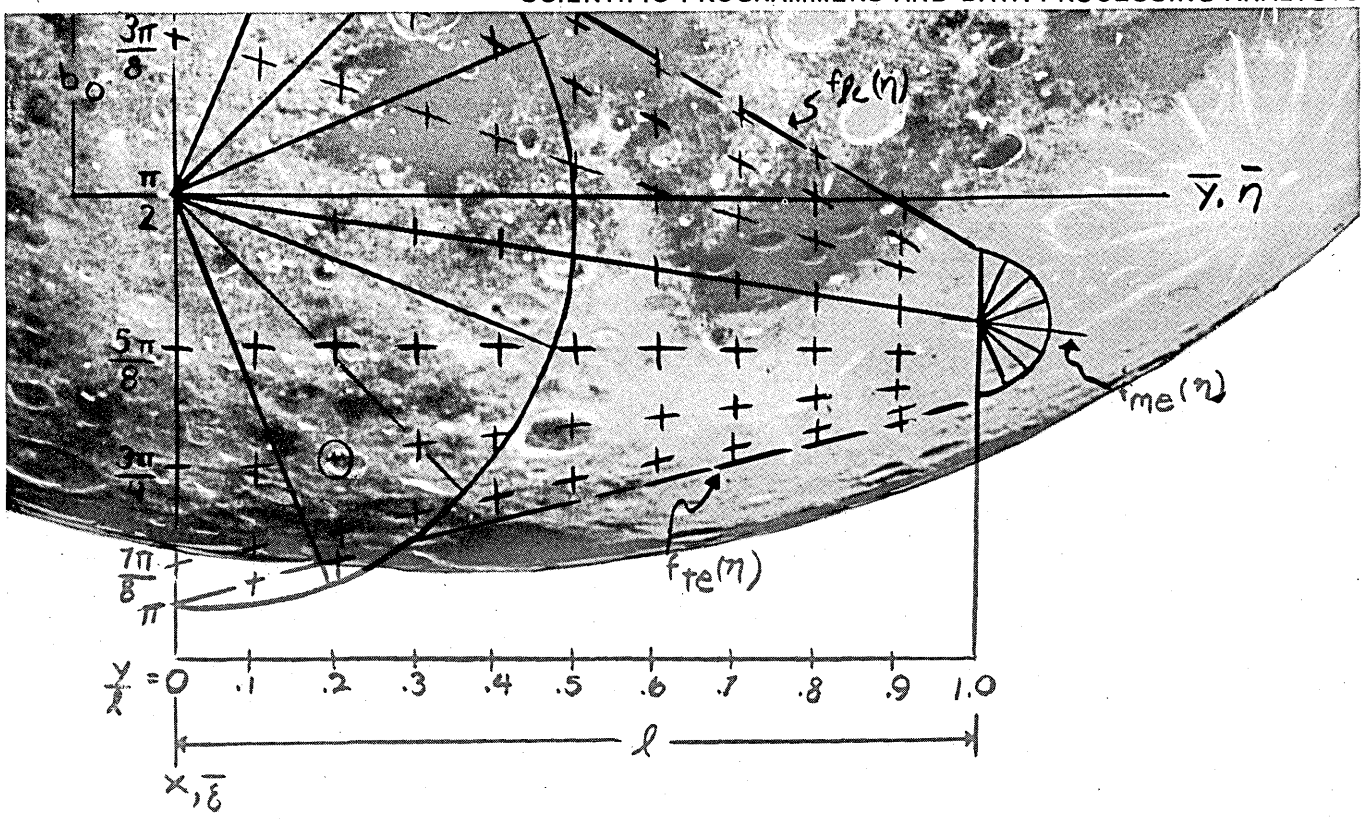

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These positions are with the Huntsville Operation* managed by General Electric for the GEORGE C. MARSHALL SPACE FLIGHT CENTER. Marshall is directed by Dr. Wernher von Braun for NASA and charged with the responsibility of developing, building and launching giant space vehicles for space exploration and conducting related research.

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... Meteorological analysis relative to space vehicle design requirements, optimum weather conditions for launching, and analysis of acoustical shock effects on populated areas from static firings and launchings.

... Determination of fuel reserve which must be carried aboard a rendezvous vehicle to achieve coplanar orbit.

... Design, programming and installation of data processing systems on large-scale computers to initiate development cycles of specific vehicles: i.e. design engineering, fabrication, assembly, quality assurance, static test firing, launching, flight evaluation.

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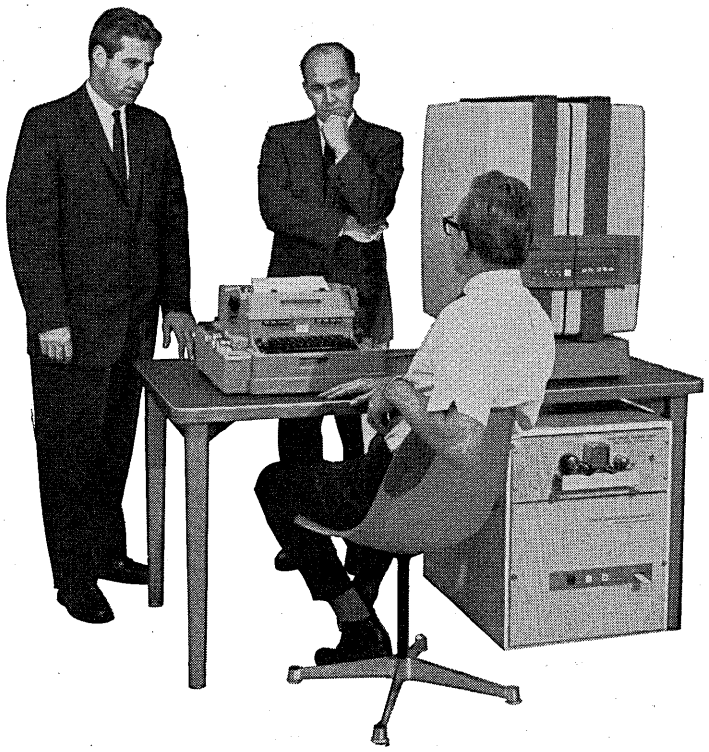

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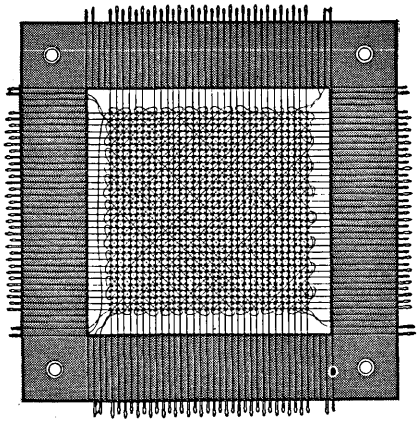

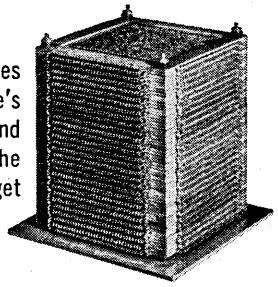

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